# QUASARS IN GALAXY CLUSTER ENVIRONMENTS 

by<br>Erica Ellingson

# A Dissertation Submitted to the Faculty of the DEPARTMENT OF ASTRONOMY <br> In Partial Fulfillment of the Requirements For the Degree of DOCTOR OF PHILOSOPHY <br> In the Graduate College <br> THE UNIVERSITY OF ARIZONA 

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# Quasars in galaxy cluster environments 

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#### Abstract

The evolution of radio loud quasars is found to be strongly dependent upon their galaxy cluster environment. Previous studies (Yee and Green 1987) have shown that bright quasars at $z \sim 0.6$ are found in clusters as rich as Abell richness class 1 , while high luminosity quasars at lower redshifts are found only in poorer environments. An observational study of the environments of 66 low luminosity quasars with $0.3<z<0.6$ yields several objects in rich clusters of galaxies. This result implies that radio loud quasars in these environments have faded approximately 3 magnitudes in the interval between redshifts 0.6 and 0.4 , corresponding to a luminosity e-folding fading time of 900 million years, similar to the dynamical timescale of these environments. The analysis of low luminosity radio quiet quasars indicate that they are never found in rich environments, suggesting that they are a physically different class of objects.

Properties of the quasar environment are investigated to determine constraints on the physical mechanisms of quasar formation and evolution. The optical cluster morphology indicates that the cluster cores have smaller radii and higher galaxy densities than are typical for low redshift clusters of similar richness. Radio morphologies may indicate that the formation of a dense intracluster medium is associated with the quasars' fading at these epochs. Galaxy colors appear to be normal, but there may be a tendency for clusters associated with high luminosity quasars to contain a higher fraction of gas-rich galaxies than those associated with low luminosity quasars, a result consistent with the formation of an ICM.


Multislit spectroscopic observations of galaxies associated with high luminosity quasars indicate that quasars are preferentially located in regions of low relative velocity dispersion, either in rich clusters of abnormally low velocity dispersion, or in poor groups which are dynamically normal. This suggests that galaxy-galaxy interactions may play a role in quasar formation and sustenance. Virialization of rich clusters and the subsequent increase in galaxy velocities may therefore be responsible for the fading of quasars in rich environments.

## Section 1: Introduction

The evidence that quasars are often associated with galaxies or clusters of galaxies not only supports the cosmological interpretation of the quasar redshift, but also suggests that the nature of the quasar activity is at least partially linked to the quasar environment. A number of investigators (e.g. Stockton 1982, Gehren et al. 1984, Hutchings et al. 1984, Yee and Green 1984, Yee 1987, Yee and Green 1987) have found that quasars show a strong tendency to have close galaxy neighbors, or to be situated in regions of higher-than-average galaxy density. This trend predicts that some property of dense galaxy environments is conducive to the quasar phenomenon.

A popular interpretation of this result is that galaxy-galaxy interactions between the quasar host galaxy and a nearby neighbor play an important role in the triggering of the quasar. Hutchings et al. (1984) found that a significant fraction of a sample of optically-selected quasars are located in groups of galaxies, and that many show isophotal distortions which may be indications of galaxy-quasar interactions. Stockton and MacKenty (1987) also found that about a third of their sample of quasars contained extra-nuclear ionized gas, which might be interpreted as indicative of tidal distortions caused by interactions. In a spectroscopic survey of galaxies situated within 100 kpc projected distance from a sample of bright quasars, Heckman et al. (1984) found that $95 \%$ of them had velocities within $1000 \mathrm{~km} / \mathrm{sec}$ of the quasar, hence confirming that the association was not coincidental alignments of galaxies and quasars. Yee (1987) showed that for a sample of radio-quiet quasars, $40 \%$ of them had a galaxy neighbor brighter than -19 mag within 100 kpc , and that the data were
consistent with every quasar having a companion galaxy with optical magnitude brighter than -16.5 .

Several theoretical models have been suggested in support of the interaction model. Roos $(1981,1985)$ and DeRobertis (1985) present models in which gaseous fuel can be supplied to the quasar nuclear engine from the quasar host galaxy or from an interacting, gas-rich companion. Hernquist (1989) has demonstrated using numerical models that sufficient amounts of gas can be desposited in the host galaxy nucleus as the result of a galaxy merger. Carlberg (1989) has determined as well that the decrease with recent epochs of the galaxy merging rate is consistent with mergers being the cause of the evolution in the luminosity function of quasars.

The interaction model for the triggering of quasars seems plausible both theoretically and observationally, and the environment of quasars on scales less than 100 kpc clearly plays a role in their activity. There remains, however, the question of whether the properties of some quasars might also be linked to more global properties of their environments; i.e. the environment on scales of 100 kpc to 1 Mpc. Fabian et al. (1986) have suggested that the large amounts of gas associated with cooling flows sinking to the center of the cluster potential may be used to fuel an AGN in this position. Hintzen and Romanishin (1986) have suggested that this is the case for at least one well-studied radio-loud quasar. Stocke and Perrenod (1981) have suggested that quasar evolution might be intimately tied to the evolution of a dense intra-cluster medium in galaxy clusters. In their scenario, the formation of a dense (greater than $10^{-4} \mathrm{~cm}^{-3}$ )

ICM is presumed to strip gaseous fuel from the quasar host galaxies and other galaxies in the cluster core, resulting in a lack of fuel for the AGN.

The environments of quasars on galaxy-cluster scales has been studied by several investigators. Yee and Green (1984) imaged a large sample of bright quasars with $0.05<z<2.0$ and found that, on average, quasars reside in environments with galaxy densities 2 to 3 times larger than environments of normal galaxies. They also noted that bright quasars were not observed to be in rich clusters of galaxies. The sampling depth of their data, however, was such that associated galaxies at $z>0.4$ would be too poorly detected to allow an accurate quantification of the environment. Yee and Green (1987), in a deeper CCD imaging survey of bright quasars, discovered that bright radio-loud quasars at redshifts greater than 0.5 are often situated in the centers of rich clusters of galaxies. Several other radio-loud quasars have also been found to be surrounded by rich clusters (Wyckoff et al. 1980, Hintzen, Boeshaar and Scott 1981, Stockton 1980). In these environments, there is not only a larger supply of possible galaxies with which to interact, but also the possibility that the cluster core provides a uniquely favorable environment for the existence of such objects. The properties of these environments may be special in that they provide a high probability of an effective galaxy-galaxy interaction, may have properties conducive to the sustained fueling of the quasar, or may be linked, directly or indirectly, to the formation of a radio-prwerful object.

It is clear that the study of the environments of quasars, both at distances corresponding to galaxy-galaxy interaction and to their global environment, provides us with valuable clues about the processes that trigger and sustain the
nuclear activity. This thesis addresses the subject by presenting the statistical properties of quasar environments. Chapter 2 of this thesis presents a survey of the environments of a sample of optically faint quasars. These results, in combination with earlier surveys of the environments of optically bright quasars (Yee and Green 1984; 1987), indicate that the optical evolution of radio loud quasars is strongly influenced by their galaxy cluster environment. Chapter 3 discusses the observed properties of these quasar environments and attempts to identify which conditions might be favorable for quasar activity. Cluster radial profiles, quasar morphologies, galaxy colors and associated galaxy velocities are presented. Results for clusters associated with optically luminous and less luminous are also compared in order to identify differences in cluster properties which might be responsible for the evolution in quasar luminosity identified in Chapter.2. In Chapter 4, these results are discussed in terms of physical models of quasar formation and maintenance, and the environments of quasars are compared with previous results for other active galactic nuclei. Finally, further work in the investigation of the galaxy cluster environments of quasars is suggested.

## Section 2: The Evolution of Quasars in Galaxy Cluster Environments

### 2.1 Introduction

One of the strongest indications that the processes governing quasar evolution are dependent at least in part upon the global quasar environment comes from an observed change in the richness of the galaxy environments of quasars at moderate redshifts. Yee and Green (1987, hereafter YG87), in a deep CCD imaging survey of bright quasars, found that the preferred site of bright, radioloud quasars has evolved in recent epochs. Quasars with $z<0.5$, although situated in regions of enhanced galaxy density, are rarely found in rich clusters of galaxies (Figure 2.1). Their counterparts at $z \sim 0.6$, however, are often found in galaxy environments as rich as Abell richness class 1 clusters (Abell 1958). Clusters of galaxies in a magnitude-limited survey cannot possibly evolve so as to become less frequent over this short a time period; therefore the observed lack of association between clusters and luminous quasars must imply that the quasars have dimmed. Quasars in poor environments, on the other hand, are found at both high and low redshift. One interpretation of this observation is that quasars situated in rich environments naturally fade more quickly than those in poor environments. A second is that the rich galaxy cluster environments tend to become inconducive to either the birth or the sustenance of luminous, radio-loud quasars with cosmic time, at least over the redshift interval of 0.6 to 0.4 . This second interpretation implies not only evidence for the evolution of quasars as a function of environment, but also evidence for evolution in the properties of rich galaxy clusters as well.


Figure 2.1 Galaxy-quasar spatial covariance amplitude. $B_{j q}$, versus redshift for a sample of radio-loud quasars with $r<17.5$, from Yee and Green (1984, 1987). The spatial covariance amplitude is a measure of the galaxy density in the quasar environment. The average galaxy-galaxy spatial covariance amplitude is approximately $67 \mathrm{Mpc}^{1.77}$ (solid line), whereas Abell richness class 0 and 1 clusters have values of 360 and 645 , respectively (dashed lines). This figure shows that bright quasars are often found in rich clusters of galaxies at $z \sim 0.6$, but not at lower redshifts.

The quasars observed in YG87 were the brightest objects at those redshifts. If this evolution in quasar optical luminosity for radio-loud quasars in rich environments is correct, one would expect to be able to find fainter quasars in rich environments at lower redshifts. Studying the environments of faint quasars at $z<0.6$, therefore, would allow us to confirm the evolutionary explanation of the YG87 result, as well as characterize the timescale of this observed evolution.

This timescale has two interpretations, depending on the nature of quasar activity in these environments. If quasars are long-lived, ( $>1 \mathrm{Gyr}$ ) less luminous quasars at a given redshift might be the direct counterparts of more luminous objects at higher redshifts. Lower luminosity quasars found in rich environments, then, would provide us with a statistical quasar fading timescale, due either to the internal properties of quasars found in these environments, or driven by changes in the quasar environment.

Alternatively, if quasars are short-lived, a change in the properties of cluster environment which decreases the frequency of the triggering of nuclear activity, the efficiency with which quasars are fueled or the amount of fuel which is available for consumption would also result in a decrease in the number of luminous quasars. In that case, fainter quasars may still thrive in these rich environments at more recent epochs. A measure of how severely the luminosities of quasars in the richest environments are diminished as a function of redshift therefore yields a timescale for the change of the environmental properties which cause the evolution in the quasars. This timescale can then be compared to timescales of change in rich galaxy cluster environments in order to evaluate the mechanisms which might be responsible for the quasars' fading.

In either case, it is clear that a study of the environments of faint quasars at intermediate redshifts will yield valuable clues as to the dependence of quasar activity on environment.

### 2.2 Observations and Data Reduction

To investigate the environments of lower luminosity quasars, a sample of 66 quasars with $17.5<m_{r}<20, \mathrm{~b}>20$, and $0.3<z<0.6$ taken from the Hewitt-Burbidge Catalog (1987) has been observed. Thirty-two of these quasars are known radio sources $\left(\log \left(\mathrm{P}_{\text {rad }}\right) \geq 25\right.$ Watts $/ \mathrm{Hz}$ at 20 cm$)$ and the remainder are radio quiet. This sample was chosen to extend and complement the YG87 sample, which consisted of 21 radio loud and 10 radio quiet quasars with $m_{r}<17.5$ mag and $0.3<z<0.65$. Deep CCD images were obtained of each field using the Steward Observatory $2.3-\mathrm{m}$ telescope and the KPNO 2.1m telescope and several different CCD chips. Table 2.1 synopsizes the dates and instruments used during each of the observing runs. Two exposures of typically 900 seconds were taken with the Gunn $r$ filter $(6500 \pm 500 \AA$, Thuan and Gunn 1976) for each field, and for approximately half of the fields (those with clearly visible companions to the quasar) one exposure of 1200 seconds with the Gunn $g$ filter ( $4960 \pm 400 \AA$ ) was also taken. Twenty-four of the fields were observed during non-photometric conditions. For these fields, additional 300 second frames were taken through each filter on subsequent photometric nights for calibration purposes. Finally, several control fields were observed in both filters in order to verify consistency of the galaxy background count from YG87. These fields were chosen to be approximately 1 degree from a quasar field and to avoid bright stars.

The preliminary data reduction was performed at NOAO using IRAF. The frames were debiased and corrected for non-uniform response in standard fashion using dome flats. In many cases, a significant ( $2-5 \%$ ) residual nonflatness

Table 2.1. Observations: Photometry

| UT Date | Telescope | CCD | Comments |
| :--- | :---: | :---: | :---: |
| 7-9 Sept. 1986 | SO 2.3-m | TI-1 $800 \times 800$ | UV-flooded |
| 30 Nov. 1986 |  |  |  |
| 1-3 Dec. 1986 | KPNO 2.1-m | TEK-1 $512 \times 512$ |  |
| 7-9 Jan. 1987 | SO 2.3-m | MMT TI $800 \times 800$ | UV-flooded |
| 6 Mar. 1987 | SO 2.3-m | TI-1 $800 \times 800$ | damaged CCD; <br> data discarded |
| 26-28 May 1987 | SO 2.3-m | TI-1 $800 \times 800$ | damaged CCD; <br> data discarded |
| 1-3 June 1987 | KPNO 2.1-m | TEK-1 $512 \times 512$ |  |
| 25-27 Sept. 1987 | SO 2.3-m | RCA $340 \times 512$ |  |
| 17-19 Feb. 1988 | SO 2.3-m | TI-2 $800 \times 800$ | UV-flooded |
| 16 Aug. 1988 | SO 2.3-m | TI-2 $800 \times 800$ | UV-flooded |
| 17-18 Oct. 1988 | SO 2.3-m | TI-2 $800 \times 800$ | UV-flooded |

remained because of large scale differences between the sky and dome illumination. A sky flat was therefore created by calculating a scaled median frame of every long exposure for a given night and filter, and smoothing heavily. The unsmoothed median frame was also used to subtract night sky fringes in the Gunn $r$ frames where necessary. Overall, the resultant data was flat to approximately $1 \%$ and had residual sky fringes with amplitudes less than $2 \%$ of the sky background.

Subsequent data reduction was performed using the PPP data analysis package (Yee, Green and Stockman 1986, hereafter YGS86; Yee 1990), kindly provided by H. Yee. CCD cosmetic defects were removed by interpolating across the offending areas of the chip, and the frames were shifted and trimmed so that the images of each field were aligned to within one pixel. Object-finding, photometry, and classification were performed using techniques essentially identical to those used in YGS86. This ensures that the data are wholly consistent with those in earlier work with respect to possible biases caused by the details of classification and the photometry of faint, extended objects.

Object finding was performed by identifying flux enhancements of at least $1-\sigma$ above the sky background of two similar exposures, and then cross-correlating their positions. The telescope was moved a distance of typically 5 arcseconds between successive exposures, so this technique removes both cosmic rays and remaining chip defects from the object list. Finally, each field was blinked and inspected by eye in order to add double objects and objects near bright stars which may have been missed, and to delete false detections caused by diffraction spikes and charge bleeding from bright objects.

Total magnitudes were then calculated for each object. The technique used is an improved version of that used in YGS86 and is discussed in depth in Yee (1990). The algorithm utilizes partial pixel apertures to deal with poorly sampled images, and has a more complex treatment of crowded fields. If an object has a neighbor within 24 arcseconds, a circular "mask" is calculated for each neighbor. This mask is centered on the neighbor, and has a radius equal to the distance between the neighbor and the position of minimum signal on the line connecting the object and the neighbor. Pixels inside the mask are not used; instead the flux from the unobscured part of the aperture is scaled to correct for the area lost. In this way, systematic brightening of objects due to their proximity to a brighter object is minimized.

A maximum aperture of 12 arcseconds was used but the aperture was decreased if the integrated profile reached an inflection point or varied more than is statistically predicted for background fluctuations. In this case, the object's magnitude was then corrected by a scaled mean profile determined from the profiles of bright stars in the field. This may result in a very slight underestimation of galaxy magnitudes, although simulations (Yee 1990) suggest that this is negligible.

Objects were classified as stars or galaxies using a classification criterion, C 2 , which is defined by

$$
\begin{equation*}
C 2=\frac{1}{(N-2)} \sum_{i=3}^{N}\left(m_{i}^{*}-m_{i}\right)-C_{0} \tag{2.1}
\end{equation*}
$$

where $m_{i}$ and $m_{i}^{*}$ are the instrumental magnitudes, within an aperture of diameter $2 i+1$, for the object in question, and a reference stellar object, and $N$ denotes the last accepted aperture for the object as discussed above. The constant $C_{0}$ is formed by the difference between the magnitudes in the 5 pixel diameter aperture for the object and the reference. Stellar objects on a given frame will have similar values of C2 close to zero, while extended objects will tend to have smaller values. The typical variance of the classifier for reasonably bright stars is about 0.075 . Objects within this range are classified as stars (class 3 ), and objects above this range are considered cosmic ray or noise events (class 0 ). Those objects which are between -0.075 and -0.150 are labeled class 2 , and are considered likely to be galaxies. In high-latitude fields, most faint objects are indeed galaxies, and so class 2 objects are treated as such in subsequent analysis. Objects with C2 less than $\mathbf{- 0 . 1 7 5}$ are almost certainly galaxies, or very bright saturated stars. If the value of the central pixel of the object is at the CCD saturation level, then the object is considered a saturated star (class 4), otherwise it is labeled class 1, a galaxy. The classification of these bright objects were also carefully checked by eye. Figure 2.2 shows a plot of the classifier C2 as a function of instrumental magnitude for a typical quasar field. It is interesting to note that the quasar itself, $0911+402$, is found to have a C2 somewhat less than the nominal value for stars, indicating the presence of underlying "fuzz." This small effect is noticeable in quasars of redshifts up to about 0.5 for typical seeing conditions.

Observations of Gunn standards (Thuan and Gunn 1976, Kent 1985) were used to calibrate the instrumental magnitudes. For the photometric nights,

r

Figure 2.2 Classification criterion, C2, versus $r$ magnitude for objects in the field of the quasar $0911+402$. The dotted lines mark the limits for classification of an object as star, the solid bar marks the boundary between classes 2 and 1 (see text). Arrows mark reference stars and circled objects are fainter than the $5-\sigma$ detection limit. The quasar is marked by a solid dot.
photometric zero points, and extinction terms were derived for each night, and average $g-r$ color terms were calculated for each instrument. Typical residuals from the fits were about 0.03 magnitudes in each filter. Colors for those objects which were observed through both the $r$ and $g$ filters were calculated using only the innermost parts of the object profile in order to decrease the uncertainty in the color determination caused by noise in the profile wings. To prevent errors caused by differences in seeing and guiding errors between exposures in the two filters, normalized profiles of several bright objects were compared in each color. A color aperture was then chosen such that the difference in the normalized flux of the two profiles within this aperture was less than $1 \%$. This radius was typically 2-4 arcseconds in size. The $g-r$ color of the object was then calculated from the flux within this aperture, and the magnitude corresponding to the filter of poorer signal-to-noise ratio (usually $g$ ) was calculated using this color and the other magnitude. An average background galaxy color of 0.8 was determined from the control frames, and this value was used in the calibration of objects which were observed only with the $r$ filter. This value is also a reasonable choice for early-type galaxies at moderate redshifts and, combined with the small color terms determined for the instruments, would contribute an error of less than 0.03 mag for most other objects.

Non-photometric data were calibrated using a "bootstrap" process. First, the short frames taken under photometric conditions were calibrated using the method described above. Objects with good signal-to-noise ratios on both the short photometric and the deep non-photometric frames were identified, and these objects were used to determine the combined photometric zero point and
extinction correction for each of the non-photometric frames. Color terms from photometric observations using the same instrument were used. In most cases, between five and ten of these intermediate objects were used in determining the photometric zero-point and residuals of 0.1 mag were typical. Where possible, an attempt was made to include both stars and galaxies in the calibration process. For a given filter, the zero points varied less than about 0.4 mag in a given nonphotometric night, and had values consistent with not more than about 0.5 magnitude of extinction for the worst data.

Corrections for galactic latitude were performed following the model by Sandage (1973) with coefficents to $\operatorname{cosec}(b)$ of 0.08 and 0.11 mag for $r$ and $g$, respectively. For $\mathrm{b}>60^{\circ}$, no correction was made.

The interpretation of faint galaxy counts is highly dependent upon the choice of completeness magnitudes for these objects. Much care was given to the determination of this quantity. First, a limiting magnitude for a five-sigma detection of a star, $m_{\text {lim }}$, was defined using the noise in the CCD signal from the background determination for each frame. The difference between this limiting magnitude and the completeness magnitude for a galaxy detection, $m_{l i m}-m_{c o m}$, should be constant for all fields observed under reasonable seeing conditions ( $<2$ arcseconds), since it is a function of the mean galaxian light profile. This difference was determined by summing the galaxy counts in all of the quasar fields. The number of galaxies expected is a steeply rising function of magnitude, since both the background counts as well as any galaxy cluster counts increase with fainter magnitudes. Choosing a completeness magnitude which is too faint (i.e. $m_{l i m}-m_{\text {com }}$ is too small) will result in a turnover, or a drop in the galaxy
counts at magnitudes brighter than the hypothesized completeness magnitude, whereas choosing too bright a limit will have no effect on the shape of the number counts at faint magnitudes. Galaxy counts for the fields were examined using several values for the difference between the limiting and completeness magnitudes (Figure 2.3), and completeness limits 1.0 mag brighter than the 5 -sigma limiting magnitudes were chosen. For the quasar fields, the limiting magnitudes were typically about 23.5 in $r$ and 24.0 in $g$, with a scatter in each of approximately 0.5 mag due to the nonuniformity of the observing conditions.

Galaxy counts at faint magnitudes are also compromised by the difficulties of object classification. As shown in Fig 2.2, the expected value of C2 for galaxies and stars merges together for very faint objects, causing some galaxies to be classified as stars at these magnitudes. This also will result in a drop in galaxy counts at faint magnitudes, accompanied by a rise in star counts. As galaxy background counts rise more quickly than the star counts at these magnitudes, errors due to misclassification are easily recognized. The method discussed above for determining the galaxy completeness magnitude demonstrates that the former effect is not evident with a careful choice of completeness magnitude. A similar analysis of the star counts indicated that for $m_{l i m}-m_{\text {com }}<1.0$, the star count turns upwards at fainter magnitudes (Figure 2.4). This is a further indication that the completeness magnitude has been properly determined and that misclassification does not strongly affect the galaxy counts at faint magnitudes. These difficulties in classifying faint objects definitely limit the determination of galaxy counts at faint magnitudes. In this case, the penalty was not large,


Figure 2.3 Galaxy counts versus $r$ magnitude for $m_{\text {lim }}-m_{\text {com }}$ of 0.8 (solid dots and solid line) and 1.0 (open squares and dashed line). The decrease in galaxy counts at faint magnitudes in the former implies that the latter provides the better determination of the completeness magnitude.
but deeper observation will necessitate more complex means of classifying faint objects (see e.g. Yee 1990).

The final catalogs of objects in 66 quasar fields are listed in Appendix A. For each detected object, the following information is tabulated: column (1): object number, in order of increasing right ascension; columns (2) and (3) position, given as offset from the quasar in seconds of arc (positive represents north and east); columns (4) and (5): $r$ and $g$ magnitudes; column (6): $g-r$ color calculated as discussed above; column (7) classification as defined above. Approximate uncertainties for the magnitudes of objects observed under photometric conditions range from about 0.1 for objects with $r<22.5$ to 0.2 mag for fainter objects. Objects whose magnitudes were calculated using the "bootstrap" technique have uncertainties ranging from approximately 0.14 to 0.22 mag. The $g-r$ colors are accurate to approximately 0.1 mag .


Figure 2.4 Star counts versus $r$ magnitude for $m_{\text {lim }}-m_{\text {com }}$ of 0.8 (solid dots and solid line) and 1.0 (open squares and dashed line). The increase in star counts at faint magnitudes in the former implies that the latter provides the better determination of the completeness magnitude.

### 2.3 Quantification of Quasar Environments

Quantification of the richness of the galaxy environments of quasars is obtained by calculating the quasar-galaxy spatial covariance amplitude ( $B_{g q}$ ) for each field (Longair and Seldner 1979). This quantity scales the number of excess galaxies counted in the vicinity of the quasar for the expected spatial and luminosity distributions of associated galaxies at that redshift, yielding a measure which is consistent with the assumed models of cosmology and the evolution of the galaxy luminosity function. This method was used in quantifying the environments of quasars by YG87, and radio galaxies by Yates et al. (1989). Detailed discussions of the derivation of $B_{g q}$ are given by Longair and Seldner (1979). Following is a brief outline of the derivation.

The apparent distribution of galaxies around the quasar can be described by the angular covariance function, $w(\theta)$, defined by

$$
\begin{equation*}
n(\theta) d \Omega=N_{b}[1+w(\theta)] d \Omega \tag{2.2}
\end{equation*}
$$

where $n(\theta) d \Omega$ is the number of galaxies in an angular area $d \Omega$ at an angular distance $\theta$ from the quasar, and $N_{b}$ is the average background count. A powerlaw form is usually ascribed to $w(\theta)$ :

$$
\begin{equation*}
w(\theta)=A \theta^{1-\gamma} \tag{2.3}
\end{equation*}
$$

where $\gamma$ has a canonical value of 1.77 (Seldner and Peebles 1978), and $A$ is referred to as the angular covariance amplitude, a measurable quantity which
reflects the overdensity of galaxies in angular area. Integrating equation 3.2 within a circle with radius $\theta$ yields:

$$
\begin{equation*}
A=\frac{N_{t o t}-N_{b}}{N_{b}} \frac{(3-\gamma)}{2} \theta^{\gamma-1} \tag{2.4}
\end{equation*}
$$

where $N_{\text {tot }}$ is the total number of galaxies within an angular radius of $\theta$. These quantities can be determinined observationally from the data.

To obtain a quantity which reflects the spatial and luminosity distributions of galaxies associated with the quasar, the spatial covariance function, analogous to the angular covariance function above, is defined:

$$
\begin{equation*}
n(r) d V=\rho[1+\xi(r)] d V \tag{2.5}
\end{equation*}
$$

where $n(r) d V$ is the number of galaxies in volume $d V$ at a distance $r$ from the quasar, and $\rho$ is the average spatial density of galaxies. By assuming spherical symmetry around the quasar, it can be shown by deprojection of (2.3) that

$$
\begin{equation*}
\xi(r)=B r^{-\gamma} \tag{2.6}
\end{equation*}
$$

where $\gamma$ has the same value as in equation 2.3 , and $B$ is the spatial covariance amplitude, the chosen measure of the richness of galaxy environment.

Finally, the spatial covariance amplitude, $B$, can be determined from the the observed angular covariance amplitude $A$ :

$$
\begin{equation*}
B=\frac{A N_{b}(m)}{3.78} \frac{D^{3-\gamma}}{\Phi(m, z)} \tag{2.7}
\end{equation*}
$$

where $N_{b}(m)$ is the expected background galaxy counts brighter than apparent magnitude $m, D$ is the luminosity distance to the quasar at redshift $z$, and $\Phi(m, z)$ is the normalized integrated LF of galaxies to apparent magnitude $m$, at redshift $z$. The factor of 3.78 is an integration constant for $\gamma=1.77$ (YG87).

Determining $B$, the spatial covariance amplitude, from $A$, the angular covariance amplitude requires several assumptions. First, the distribution of galaxies is assumed to be spherically symmetric about the quasar. A second assumption is that the power law index of galaxy clustering, $\gamma$, must be constant for the redshifts of the quasars observed. YG87, in investigating the environments of bright quasars at $z<0.6$ found that $\gamma$ has the same value as for the low-redshift galaxy-galaxy covariance function (Seldner and Peebles 1978). Finally, the luminosity function of galaxies must be universal for all galaxies at a given redshift and must be determined in a way which is self-consistent with the observed background counts, since $B_{g q}$ is defined in comparison with the background.

The determination of such a luminosity function requires care, since the observed excess galaxies are assumed to be at the quasar redshift; at high redshifts, both evolution in the galaxies' luminosities and the effects of cosmology must be considered. A large value of the deceleration parameter, $q_{0}$, will tend to make the galaxies appear brighter at high redshift than will a low value. Luminosity evolution of the galaxies will, of course, have the same effect. Observations of the excess galaxies associated with quasars at a known redshift provide a method by which these two effects can be decoupled. Observed luminosity distributions for the excess galaxies associated with quasars may be calculated and compared with present-day luminosity functions. The amount of brightening seen in the
high-redshift galaxies in excess of the assumed K-correction can then be used to determine possible combinations of the amount of evolution in the luminosities of the associated galaxies and the deceleration parameter, $q_{0}$, for a given choice of zero-redshift galaxy luminosity function.

These models may then be compared with the observed field counts in order to determine which is most consistent. To do this, two assumptions must then be made. First, it is assumed that the space density of field galaxies does not change. This may be erroneous if galaxy merging in the field is significant, but is probably a reasonable assumption in this case. The second is that the luminosity function of field galaxies at each redshift is the same as for the excess galaxies associated with quasars. This assumption could potentially be problematic because of the observed differences in relative abundances of different morphological types of galaxies found in different environments (Dressler 1980). Since these observations are made with a red filter, however, the light observed comes primarily from early-type (E/S0 and early spiral) galaxies, and the results are not overly sensitive to variations in morphological mix (YG87). Using these assumptions and each of the evolution/cosmology combinations determined by the LFs of the excess galaxies, the number of field galaxies expected at a given apparent magnitude may be calculated for each choice of local LF and $q_{0}$, and fit to the observed background counts. The best fit model is the most self-consistent combination of evolution and $q_{0}$.

This method was used in YG87 to determine a self-consistent world-model based on the luminosities of galaxies associated with bright radio-loud quasars. One of the best-fitting models, (the KE1 model) was based on the present-day
luminosity functions of King and Ellis (1985), and implied an evolution of 0.9 mag since $z \sim 0.6$ and a $q_{0}$ of 0.02 . It is this model, which has a relatively flat faint-end slope of the galaxy LF ( $\alpha=-1.0$ ), which is here referred to as the YG87 model.

Although the necessisy of determining both the evolution in the luminosity function and the background counts appears to introduce large errors in the determiniation of $B_{g q}$, the choice of a self-consistent model actually minimizes the error. Yates et al. (1989), using data from imaging surveys of radio galaxies with $z<0.8$, have tested a number of self-consistent models with differing Kcorrections and parameterizations of the evolution in the luminosity function. They argue that the error in $B_{g q}$ due to model dependences is less than $20 \%$. In fact, because of this result, they also adopt the YG87 model for their subsequent analysis.

In the study of the environments of faint quasars presented here, the number of excess galaxies is sufficient only to test for consistency with the YG87 results. Luminosity functions were fit to the excess galaxies in the fields of radio-loud quasars binned into two groups, with $0.3<z<0.45$ and $0.45<z<0.6$. Fields with both high and low numbers of excess galaxies were used, since there might be a tendency for the fields with many excess galaxies actually to be contaminated by foreground galaxies. This would erroneously brighten the luminosity functions for the excess galaxies, implying more evolution than is actually there. Including fields with few excess galaxies increases the noise in the galaxy counts, but decreases the chance of such systematic errors.

The absolute $r$ magnitudes for excess galaxies were calculated using a $q_{0}$ of 0.02 and $H_{0}$ of $50 \mathrm{~km} / \mathrm{sec} / \mathrm{Mpc}$. Unless otherwise specified, these values will be used throughout this thesis. The galaxies in the low redshift bin were then Kcorrected to a median redshift of 0.38 , and the galaxies in the high redshift bin to 0.53 , using values from Sebok (1986). K-correcting over such small redshifts minimizes problems caused by the different corrections needed for galaxies of different morphologies and the undetermined morphological mix of the observed galaxies. The zero-redshift luminosity function was K -corrected to the higher redshifts for direct comparison, assuming a morphological mix of $50 \% \mathrm{E}$ and S0, $25 \% \mathrm{Sab}$, and $25 \% \mathrm{Sbc}$ galaxies. The luminosity functions are therefore calculated and compared in the observed waveband.

For each redshift sample, an average luminosity function was calculated using the method described by Schechter (1976) for deriving an average LF for galaxies from several clusters. The fractional errors in the data points were calculated using

$$
\begin{equation*}
\frac{\sqrt{N_{t o t}}}{\left(N_{t o t}-N_{b}\right)} \tag{2.8}
\end{equation*}
$$

where $N_{t o t}$ is the total number of counts in the magnitude bin, and $N_{b}$ is the background count determined from observations of control fields. The luminosity functions were fitted by a Schechter function,

$$
\begin{equation*}
\Phi(M) d M=0.4(\ln 10)\left[\operatorname{dex} 0.4\left(M^{*}-M\right)\right]^{\alpha+1} \exp \left[-\operatorname{dex} 0.4\left(M^{*}-M\right)\right] d M \tag{2.9}
\end{equation*}
$$

using least squares techniques with $\Phi^{*}$ and $M^{*}$ as free parameters. The slope of the faint end of the LF, $\alpha$, was assumed to be -1.0 , in accordance with the KE1 model of YG87. Figures 2.5 and 2.6 show the luminosity functions for the two redshift bins and the best fit. For the low-redshift bin, the LF is adequately fit by a Schechter function with a characteristic magnitude $M_{r}^{*}$ of $-22.48 \pm 38$. The high redshift bin is poorly fit because of inadequacy of the data; its best fit $M_{r}^{*}$ of $\mathbf{- 2 3 . 5 4}$ has an error of 1.7 mag .

A higher signal-to-noise ratio $L F$ of excess galaxies in the quasar fields can, of course, be constructed using those fields with the largest number of excess galaxies. As discussed before, this may introduce an erroneous brightening of the LF due to foreground galany contamination, but with this warning in mind, another estimate of $M_{r}^{*}$ at higher redshifts can be obtained. The four richest fields 3C 215, 5C 02.10, 4C 47.15 and 3C 275.1, were selected and a LF calculated from the excess galxies in the fields. The galaxies were K-corrected to a median redshift of 0.46 . The LF is best fit by a Schechter-function with an $M_{r}^{*}$ of $\mathbf{- 2 2 . 3 6}$ $\pm 0.28$ (Figure 2.7). The consistent value of the characteristic magnitude and the small number of galaxies in the highest luminosity bin suggests that there is an insignificant amount of contamination in these fields.

Figure 2.8 shows a comparison of the observed $M_{r}^{*}$ for the LFs determined above, from YG87, and curves calculated from a no-evolution model of the KE LFs and the YG87 model of galaxy evolution. The YG87 model implies an evolution in galaxy magnitudes of about 0.9 mag since $z=0.6$. This amount is consistent with the amount of evolution inferred from optical and infrared colors


Figure 2.5 Luminosity function for excess galaxies associated with radio loud quasars with $0.3<z<0.45$. The solid line represents the best fit Schechter function with $\alpha$ equal to -1.0 .


Figure 2.6 Luminosity function for excess galaxies associated with radio loud quasars with $0.45<z<0.6$. The solid line represents the best fit Schechter function with $\alpha$ equal to -1.0.


Figure 2.7 Luminosity function for excess galaxies associated with the four radio loud quasars with the largest values of $B_{g q}$. The solid line represents the best fit Schechter function with $\alpha$ equal to -1.0 .
of elliptical and radio galaxies by Eisenhardt and Lebofsky (1987), whose results indicate a brightening of about 1 mag since $z \sim 1$.

The LFs obtained here, although the data points are wholly consistent with the data from YG87, suggesi slightly more evolution than is used in the YG87 model. The YG87 evolution model, also shown, is adopted, however, in order to retain consistency with the YG87 data. This decision will not greatly affect the results as the calculated values of $B_{g q}$ are relatively insensitive to changes in the assumed evolution; a very large increase of 0.6 mag in the assumed evolution at $z=0.5$ results in a lowering of $B_{g q}$ at that redshift of only $10 \%$, and less at lower redshifts. It should be noted that using a model with less evolution will only increase the $B_{g q}$ for the high redshift fields, and so any observed increase of $B_{g g}$ at higher redshifts is not from erroneously assuming this evolution in the LFs.

The background distribution of galaxies in $r$ was measured from counts taken from the control fields. The number of these fields and the area subtended by these fields, however, was small compared to those observed by YGS86 using an identical method. Figure 2.9 shows the background counts for YGS86 and this survey, showing them in very good agreement, and allowing us to adopt their values. Since these background counts were the counts used in YG87 to determine which evolution/cosmology model to use, the world-model used is therefore the same self-consistent one used in YG87.

The quasar-galaxy spatial covariance amplitude, $B_{g q}$, was calculated for each of the quasar fields using the method and parameters described above. A metric radius of 0.5 Mpc was used for each field, corresponding to radii of 72


Figure 2.8 Characteristic galaxy absolute magnitude in the observed waveband, $M_{r}^{*}$, versus redshift for excess galaxies associated with quasars. Open dots represent the luminosity functions discussed in the text, closed dots are the results of YG87. The solid line represents an unevolving KE1 model with K-corrections from Sebok (1986) (see text) and the dashed line represents the evolution in galaxy magnitudes derived by YG7 and used in calculating $B_{g q}$.


Figure 2.9 Background galaxy counts as a function of $r$ magnitude. The solid dots represent the data from YGS86 and the open dots counts derived from the control fields discussed in the text.
arcseconds at $z=0.38$ and 65 arcseconds at $z=0.46$. For fields where the quasar was not well-centered on the CCD, parts of this area fell beyond the field of view. For those fields, corrections to the counts proportional to the area truncated by the frame were made. To decrease the effects of noise caused by the rapidly rising background galaxy counts at faint magnitudes, galaxies were counted to magnitudes only 2.5 mag deeper than $M_{r}^{*}$, for fields where the completeness limit was fainter than this. Errors in $B_{g q}$ were calculated from:

$$
\begin{equation*}
\frac{\sqrt{N_{t o t}}}{\left(N_{t o t}-N_{b}\right)} \tag{2.10}
\end{equation*}
$$

Table 2.2 presents the results for each of the quasar fields.
Prestage and Peacock $(1988,1989)$ have calculated $B_{g g}$ for a sample of Abell clusters which is useful for calibrating the richnesses of environments observed at higher redshifts. Their values of $B_{g g}$ of Abell richness class 0,1 and 2 are 360, 645 and 945 , respectively.

## Table 2.2. Environments of Faint Quasars

| QSO | $z$ | $r_{\text {com }}$ | $\begin{gathered} B_{g q} \\ \left(\mathrm{Mpc}^{1.77}\right) \end{gathered}$ | $M_{r}$ | $\begin{gathered} \log \left(\mathrm{P}_{\text {rad }}\right) \text { at } 20 \mathrm{~cm} \\ \text { Watts } / \mathrm{Hz} \\ \text { (Radio loud only) } \\ \hline \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 0007-114 | 0.456 | 22.93 | $-108 . \pm 141$. | -23.14 |  |
| $0100+020$ | 0.390 | 22.68 | 77. $\pm 132$. | -24.63 |  |
| $0121+108$ | 0.510 | 22.52 | 116. $\pm 210$. | -23.53 | 25.19 |
| 0124-02 | 0.510 | 21.90 | 544. $\pm 202$. | -23.92 |  |
| $0130+000$ | 0.400 | 21.98 | 31. $\pm 164$. | -25.20 |  |
| $0131+015$ | 0.410 | 22.44 | 15. $\pm 155$. | -25.00 |  |
| 0135-057 | 0.400 | 22.35 | $-30 . \pm 146$. | -23.75 | 25.52 |
| 0136+060 | 0.450 | 22.55 | 50. $\pm 172$. | -24.16 | 24.91 |
| 0208-018 | 0.560 | 22.99 | $-218 . \pm 70$. | -24.35 | 26.34 |
| 0215-16 | 0.516 | 22.28 | $-81 . \pm 217$. | -24.71 | 26.34 |
| $0222+000$ | 0.520 | 23.38 | 138. $\pm 153$. | -23.70 | 26.50 |
| $0248+020$ | 0.489 | 22.96 | $-176 . \pm 138$. | -23.19 |  |
| 0249+15 | 0.489 | 22.25 | 416. $\pm 236$. | -25.39 | 25.81 |
| 0438-165 | 0.500 | 22.36 | -197. $\pm 161$. | -23.63 | 23.85 |
| 0449-183 | 0.338 | 22.20 | 242. $\pm 166$. | -23.47 | 24.89 |
| 3 C 147 | 0.545 | 22.48 | $-59 . \pm 283$. | -25.29 | 27.81 |
| 4C57.15 | 0.438 | 22.25 | 557. $\pm 270$. | -23.03 | 26.30 |
| 0844+377 | 0.451 | 22.61 | $353 . \pm 183$. | -22.89 |  |
| 4C09.31 | 0.366 | 22.67 | 113. $\pm 144$. | -24.19 | 25.86 |
| 0856+156 | 0.424 | 22.70 | $-89 . \pm 140$. | -24.04 |  |
| 3C215 | 0.411 | 22.90 | 995. $\pm 223$. | -23.82 | 26.23 |
| $0911+402$ | 0.323 | 22.43 | $-129 . \pm 105$. | -23.22 |  |
| $0928+00$ | 0.505 | 22.09 | -209. $\pm 194$. | -23.52 | 26.34 |
| $0941+441$ | 0.579 | 22.55 | -505. $\pm 174$. | -25.39 |  |
| 0947+433 | 0.363 | 22.34 | $351 . \pm 191$. | -23.27 |  |
| $0956+225$ | 0.485 | 22.39 | $-369 . \pm 99$. | -24.19 |  |
| 4C23.24 | 0.565 | 22.99 | 221. $\pm 175$. | -25.84 | 26.44 |
| 4C48.28 | 0.385 | 21.96 | 120. $\pm 180$. | -23.46 | 25.36 |
| $1015+38$ | 0.380 | 21.28 | 74. $\pm 163$. | -25.20 | 25.55 |
| 1045-188 | 0.595 | 21.39 | -315. $\pm 268$. | -24.50 | 27.03 |
| 5C 02.10 | 0.478 | 21.38 | 967. $\pm 293$. | -26.64 | 24.94 |
| 1137+659 | 0.317 | 21.82 | 178. $\pm 107$. | -22.15 |  |
| 1200-051 | 0.381 | 21.74 | 215. $\pm 176$. | -25.59 | 26.20 |

Table 2.2. Environments of Faint Quasars


### 2.4 Results

The primary purpose of this experiment is to determine whether radio-loud quasars of low luminosity at $z \sim 0.4$ are found in rich environments similar to those associated with more luminous quasars at higher redshift. Figure 2.10 shows $B_{g q}$ as a function of redshift for radio-loud quasars in the the YG87 sample, this faint quasar sample with $0.3<z<0.6$, and for bright quasars with $z<0.3$ from Yee and Green (1984; hereafter YG84). At $z<0.4$, the bright and the faint quasars appear to have similar galaxy environments. The faint quasars in the redshift range $0.3<z<0.4$ have an average $B_{g q}$ of 150 . If an average galaxy-galaxy spatial covariance amplitude of 67.5 (Davis and Peebles 1973) is adopted, quasars are found on average to be situated in environments approximately 2.3 times denser than the average galaxy. This value is identical to that of the bright quasar sample. At $z<0.4$, only one quasar is found to have a $B_{g q}$ greater than about $500 \mathrm{Mpc}^{1.77}$ (3C206 from the bright quasar survey; see Ellingson et al., 1989 for a detailed study of this field.) The dispersion in $B_{g q}$ is 118 , which is similar to the observational errors. At $0.4<z<0.6$, however, the bright and faint samples show marked differences. The environments of the bright YG87 sample are similar to those of the lower redshift objects, but the low-luminosity quasar sample includes four clusters of Abell richness class $>1$. Images of these fields are also shown in Figure 2.11(a-d). This difference in observed environment can be interpreted as the ability of low-luminosity quasars to exist in rich environments at more recent epochs than their high-luminosity counterparts.


Figure 2.10 Spatial covariance amplitude, $B_{g q}$, versus redshift for bright radio loud quasars from YG87 and YG84 (solid circles), and faint radio loud quasars from this survey (open circles). The solid line marks the average galaxygalaxy spatial covariance amplitude $\left(\mathrm{B}_{g g}\right)$, and a dashed line is drawn at a $B_{g q}$ of $500 \mathrm{Mpc}^{1.77}$.


Figure 2.11a CCD $r$ image of the quasar 3C 215 at $z=0.411$.


Figure 2.11b CCD $r$ image of the quasar 3C 275.1 at $z=0.557$.


Figure 2.11c CCD $r$ image of the quasar 4C 57.15 at $z=0.438$.


Figure 2.11d CCD $r$ image of the quasar 5C 02.10 at $z=.478$.

Statistical fluctuations in the background counts, of course, will be responsible for some fraction of high $B_{g q}$ fields, rather than a true associated cluster of galaxies. This fraction can be estimated by examining fluctuations in the control fields used to determine the background counts for YG87. The change in $B_{g q}$ due to variations in galaxy counts is a strong function of the redshift assumed for the excess galaxies. At high redshift, small fluctuations can cause large changes in $B_{g q}$, since the LF of galaxies is not deeply sampled (1.4 mag past the characteristic magnitude $M_{r}^{*}$ at $z=0.6$, compared with 2.2 mag at $z=0.4$ ). However, less than one field with $B_{g q}$ greater than 500 is expected for $z \sim 0.42$ in these samples. (Yee, private communication), in comparison with the four actually found.

While the directly observable phenomenon is a difference in the change in observed environments for high and low luminosity quasars, a likely interpretation of this result is that the observed luminosity of quasars in rich environments has decreased between $z=0.6$ and 0.4. To illustrate this, Figure 2.12 shows absolute magnitude of the two radio-loud samples plotted against redshift. Quasars in Abell richness class 1 environments or greater ( $B_{g q}>500$ ) are represented as solid dots. The observational limits of the two surveys are marked. The significance of the difference in the distributions of the quasars on the $M-z$ plane in rich and poor environments was tested using a Kolmogorov-Smirnov test for two-dimensional data (Press and Teukolsky 1989). Results indicate that the distribution in luminosity-redshift space for quasars in rich environments differs from that of quasars in poor environments at the $95 \%$ confidence level. Quasars in rich clusters of galaxies, therefore, have a different distribution of luminosities
at a given redshift than do those in poorer environment; this is equivalent to saying that their luminosity function evolves in a different fashion. Quasars in these rich environments are observed to be fainter at more recent epochs, fading approximately 3 magnitudes between $z=0.6$ and $z=0.4$. A straight line fit to the magnitudes of quasars in rich environments versus lookback time indicates an e-folding time of 880 million years for these objects. Again, it is clear from this illustration that more luminous quasars in rich environments with $z \sim 0.4$ could have been detected, but were not.

As there are strong correlations between redshift and other properties of quasars, it is extremely important to evaluate whether a correlation between environment and some intrinsic property of the quasar is responsible for this behavior. In particular, both optical and radio luminosities of quasars are prone to strong selection effects varying with redshift, with the most luminous objects being more prevalent at high redshift than at low redshift. Figure 2.13 shows $B_{g q}$ plotted versus the optical luminosity, $M_{r}$, for radio-loud quasars in the redshift range $0.3<z<0.6$ for both the bright and faint quasar samples. The optical magnitudes are taken from the CCD photometry discussed in section 2.2, and from YG87. As the difference in K-corrections expected for $r$ magnitudes of quasars between redshifts of 0.4 and 0.6 is small (less than 0.16 mag, e.g. Weedman 1986), no K-corrections are made. There is no correlation between optical brightness and richness of environment for radio-loud quasars; quasars in rich clusters of galaxies exhibit absolute $M_{r}$ magnitudes ranging from - 23 to -28 . This implies that the observed change in environment is not due to selection effects in the optical luminosities of quasars observed. Indeed, Figure


Figure 2.12 Absolute quasar $r$ magnitude versus redshift for radio loud quasars. Solid circles represent quasars in rich clusters of galaxies ( $B_{g q}>500$ $\mathrm{Mpc}^{1.77}$ ) and open circles represent quasars in poorer environments. The solid lines indicate sample limits for the bright and faint quasar samples. The dashed line is the best straight line fit to the magnitudes of quasars in rich environments with $z>0.3$, corresponding to an e -folding fading time of 880 million years.
2.12 illustrates this result; a correlation with optical luminosity cannot explain why the brightest quasars at $z=0.6$ and the faintest at $z=0.4$ are located in the richest environments.

It is also necessary to examine the radio properties of quasars in different environments to evaluate selection effects arising from the choice of radio-loud objects. The $20-\mathrm{cm}$ radio power of quasars with $0.3<z<0.6$ is shown plotted versus $B_{g q}$ in Figure 2.14. There is no strong correlation between radio power and environment for this sample, which indicates that environment is not fundamentally tied to radio power or vice-versa. The strong radio-power-redshift selection effect caused by the flux limited radio surveys from which these samples were drawn, however, limits the strength of this conclusion. Figure 2.15, a plot of radio power versus redshift for quasars of varying environments, illustrates this problem. This plot is analogous to Figure 2.12, but concerns radio luminosity instead of optical luminosity. Since there are few quasars with radio powers greater than about $10^{26}$ Watts $/ \mathrm{Hz}$ at redshifts less than 0.4 , the properties of this sample are not inconsistent with a trend for the richest environments to host radio-powerful quasars. Both the average radio and the optical luminosites of the quasars in these samples change by about 0.5 dex between $z \sim 0.6$ and $z \sim 0.3$. The decrease of 3 mag in optical luminosity for quasars in rich environments, therefore, indicates that the ratio of optical to radio luminosities in this sample decreases drastically for quasars in rich environments between redshifts of 0.6 and 0.3 .

This possibility, however, would not affect the correlation between environment, optical luminosity and redshift. A slight (1.7- $\sigma$ ) correlation is seen


Figure 2.13 Spatial covariance amplitude, $B_{g q}$, versus quasar absolute $r$ magnitude for radio loud quasars with $0.3<z<0.6$.


Figure 2.14 Spatial covariance amplitude, $B_{g q}$, versus quasar radio power at 20 cm for radio loud quasars with $0.3<z<0.6$.


Figure 2.15 Quasar radio power at 20 cm versus redshift for radio loud quasars. Solid circles represent quasars in rich environments ( $B_{g q}>500 \mathrm{Mpc}^{1.77}$. and open circles quasars in poorer environments.
between radio power and optical luminosity for these objects, in the sense that more powerful radio sources are generally brighter in the optical. This may be merely due to a coupling of the luminosity-redshift selection effect in both optical and radio properties, rather than a true physical correlation, as this correlation is statistically weaker than both the optical luminosity-redshift, and radio power-redshift correlation. Because of this "positive or non-existent" correlation between optical and radio luminosity, the possibility that the most powerful radio sources are likely to be found in rich clusters cannot explain the tendency for the faintest optical quasars at $z<0.5$ to have a similar environment. The only effect that a tendency for rich environments to be associated with very powerful radio sources would have on this sample would be an observed decrease at more recent epochs in the fraction of rich clusters found associated with quasars for all optical luminosities. The large number of rich environments found at $z \sim 0.6$ relative to the total number found at lower redshifts may indicate just this; the luminosity-redshift plane has not yet been sufficiently sampled to provide strong confirmation, however.

A relationship between environment and radio morphology may also exist, although this sample is not sufficient to test it definitely. Longair and Seldner (1979) and Prestage and Peacock (1988) observed samples of radio galaxies of varying radio morphologies, and concluded that FR (Fanaroff-Riley 1973) type I galaxies (those with distorted or relaxed radio structures) are more likely to be found in rich environments than FR II (classical double lobed and triple) radio sources. This can be interpreted as the combined effect of a high-density ICM associated with galaxy clusters surrounding the FR I galaxies and the
weaker radio power of the FR I sources. In the YG87 sample of bright quasars, however, six of the seven quasars in environments with $B_{g q}$ greater than 500 were associated with FR II radio sources, in a sample consisting of 17 FR II sources and two single sources. In the faint quasar survey, radio morphology was available for 14 of the radio-loud quasars, 12 of which were double or triple sources and the rest single sources. All of these quasars associated with rich clusters are also double or triple sources; two of the three for which we have detailed radio maps, however, have bent or distorted lobes (3C 275.1 and 3C 215) and the third (4C57.15) shows signs of being confined by an external medium. The average radio powers of these three objects is similar to the average radio powers of the optically more luminous sources in rich environments at higher redshift. This leads to the intriguing suggestion that these radio sources may be affected by an ICM which is absent from the environments of the brighter quasars, and that the formation of a high-density ICM may be an important element in the rapid evolution of the optical luminosities of quasars in rich environments. More definite conclusions, however, cannot be made without a survey of the radio properties of a uniform sample of quasars. Further discussion of the size and morphology of the radio sources associated with these quasars is presented in Section 3.

The results described above indicate that while optically luminous radioloud quasars at $z \sim 0.6$ can be found in galaxy clusters of Abell richness class 1 or richer, only less luminous quasars are found in these environments at $z \sim 0.4$. This result is not likely to be due to selection effects in the sample of optical or radio luminosities of the quasar, but is a true evolutionary effect. The observed
difference in optical luminosity is approximately 3 mag between redshifts 0.6 and 0.4 , which corresponds to an e-folding time of approximately 0.9 Gyrs.

This result requires cautious interpretation, however. The observed "fading" of quasars is actually only the exclusion of the most optically luminous quasars from rich clusters at $z<0.6$, not necessarily a true fading for individual quasars, or of the quasar luminosity function as a whole. At most, it may be assumed that the quasars observed to be in rich environments at $z \sim 0.4$ correspond to a "knee" or a cutoff in the luminosity function of quasars in those environments, brighter than which the density of quasars falls sharply. The absolute magnitude of the observed quasars in rich environments is about -25 at $z \sim 0.5$, which does not seem inconsistent with the position of the break in the luminosity functions compiled by Green (1989) for optically-selected quasars, although the the position of this feature is not well-determined for low redshift quasars. Alternatively, if the quasar luminosity function is a featureless power law at these luminosities, these quasars may correspond to the luminosity at which the density of quasars is high enough so that they are likely to be observed in these samples. In either case, it must be remembered that the properties of the observed quasars are assumed to be characteristic of some such luminosity function, and that although the differences in the distribution of quasars in rich and poor environments are seen to be statistically significant, the small number of objects leave strong uncertainties in the details of its evolution.

In particular, it is necessary to address the possible uncertainties which might arise from the sample limits of the quasars which were used in this study.

Figure 2.12 is helpful in illustrating these points. The absolute optical magnitudes of quasars that were included were mostly severely restricted at $z>0.6$ and $z<0.3$, where only the YG87 and YG84 objects are available. In the higher redshift range, the existence of fainter quasars in rich environments is to be expected and in even greater numbers than is seen for the brighter objects (given a sample with similar radio properties). In the lower redshift range, finding quasars in rich clusters in the regions excluded by this study might increase the quasar fading time to as much as 1.8 Gyrs. At optical magnitudes fainter than about -23, however, galactic light starts to dominate the optical emission from AGNs. Radio-loud objects which have such optically faint nuclei are likely to be classified as N -galaxies or radio galaxies, and decomposition of the nuclear light from the host galaxy is necessary to trace the optical evolution of the nuclear source.

DeRobertis and Yee (1989) have found low-level AGN-like emission lines in the spectra of the nuclei of several radio galaxies at $z \sim 0.05$ found in rich clusters of galaxies. Decomposition of the nuclear light from the host galaxy yields optical absolute magnitudes of approximately -18. Extrapolating an exponential fading curve from the faint quasar data yields an expected optical nuclear magnitude of about - 17 (with large errors, of course). These radio galaxies in rich clusters may therefore be the very low redshift counterparts of the quasars in this study. These objects illustrate the strength of using galaxy cluster environment, rather than the (possibly more transient) properties of the object itself, to trace the evolution of AGNs over large timescales.

In order to interpret the evolution of radio-loud quasars in rich clusters of galaxies, it is also necessary to compare their evolution to the observed evolution of quasars in general. Radio-loud quasars comprise a small fraction (about 10\%) of all quasars, and the number of these situated in rich environments, although not well-determined, is a fraction of that. They must therefore be treated as a small, very special sample of objects, whose evolution does not necessarily reflect that of quasars in general. For comparison, Boyle et al. (1988) report a redshift dependence of luminosity of $(1+z)^{3.2}$ for their sample of opticallyselected quasars at $z \sim 1$, which corresponds to a e-folding fading time of about 4 Gyr , or a decrease of less than 0.5 mag between redshifts 0.6 and 0.4. Radioloud quasars in rich environments, however, fade with an exponential timescale of 900 Myrs, about 4 times as fast. This implies that although we cannot supply any information concerning the shape of the luminosity function of radio-loud quasars in rich clusters of galaxies, it evolves much more quickly than that of quasars in general as well as radio-loud quasars in poor environments. This in turn indicates that the optical evolution of radio-loud quasars is strongly dependent on environment.

Finally, the environments of radio-loud and radio-quiet quasars are compared. The bright YG87 quasar sample consists of only 10 radio quiet objects and does not include any with $z>0.55$, which precluded them from drawing any strong conclusions about the environments of radio-quiet quasars. The addition of 36 faint radio-quiet quasars, however, yields a significant difference in the environments of radio-loud and radio-quiet quasars.

The radio-quiet quasars in both the bright and faint quasar surveys have an average $B_{g q}$ of 85 , which does not seem to change with redshift, although the scatter increases at higher redshift since the luminosity function of associated galaxies is sampled less deeply. This average value is lower than that of the radio-loud quasars, even for $z<0.4$, but only at the 1.2 -sigma level. A larger difference is that radio-quiet quasars show no evidence of ever being located in rich clusters of galaxies, at least for redshifts less than 0.7 . It should be noted that the only environment of a radio-quiet quasar with a $B_{g q}$ greater than $500,0124-02$, is suspected of having a contaminating foreground cluster because of several very luminous galaxies visible in the field. No fields associated with radio-quiet environment of a quasars have values as high as the 800 or 900 seen for some radio-loud quasars; most fields have $B_{g q}$ of less than about 300, corresponding to Abell richness class 0 or poorer environments. A twodimensional Kolmogorov-Smirnov test (Press and Teukolsky 1989) indicates at the $98 \%$ confidence level that radio-loud and radio-quiet quasars with $0.3<z<$ 0.6 are not drawn from the same distribution in the $B_{g q}-z$ plane (Figure 2.16). Radio loud and radio quiet quasars, therefore, are observed to prefer significantly different environments at $0.3<z<0.6$.

This result is important in that it clearly indicates that radio loud and radio quiet quasars are physically distinct objects, and not the same object at different viewing angles or stages in their evolution. In particular, it implies that while radio quiet objects may evolve into radio loud objects in poor environments, radio loud quasars do not evolve into radio quiet quasars. Another phrasing of this result is that the lifetimes of the radio sources in AGNs are at least as long,


Figure 2.16 Spatial covariance amplitude, $B_{g q}$, versus redshift for radio loud quasars (solid circles) and radio quiet quasars (open circles).
or longer, than the optical sources. This implies that radio galaxies and radioloud quasars may be the same object at different evolutionary stages, a result also implied by the low redshift radio galaxies studied by Yee and DeRobertis, discussed above.

The observed environments of radio loud vs. radio quiet quasars are consistent with scenarios linking radio-loud quasars with elliptical host galaxies and radio-quiet quasars with spiral host galaxies. The fact that spiral galaxies are less likely to be found in the centers of rich clusters of galaxies (see Section 3.3, however, for a discussion of the galactic content of these clusters) is consistent with the observations that radio quiet quasars are never found in rich environments. Likewise, elliptical galaxies are located both in the field and in rich environments- the same is found for radio-loud quasars.

In summary, the richness of the environments of faint quasars at $0.3<z<$ 0.6 has been determined to test whether it is similar to that of environments associated with bright radio-loud quasars at $z>0.6$. A number of low luminosity radio-loud quasars were found to reside in galaxy clusters as rich as Abell class 1 or richer, implying that while bright quasars are no longer found in these rich environments at $z \sim 0.4$, fainter quasars are still evident. This evolution in the luminosity of radio-loud quasars situated in rich environments is not due to selection effects caused by either optical or radio luminosities of the quasars. This sample, however, is not inconsistent with quasars in rich environnments having radio powers generally greater than about $10^{-26}$ Watts/Hz. Comparison with the evolution of radio-loud quasars in poor environments and with quasars in general indicates that radio-loud quasars in these rich environments fade in
the optical more than six times more rapidly- on timescales of less than 1 Gyr. The evolution of radio loud quasars, therefore, is shown to be strongly dependent on the richness of their galaxy cluster environment.

The environments of radio quiet quasars are found to be significantly different from those of radio loud quasars in that the former are never found in rich galaxy clusters. This implies that these two types of objects are physically distinct and that radio loud quasars in rich environments cannot evolve into radio quiet quasars.

## Section 3: Properties of Clusters of Galaxies Associated with Quasars

In the previous section it was shown that the evolution of radio-loud quasars is strongly influenced by their environment. In this section, the morphological and dynamical properties of clusters of galaxies associated with quasars are investigated, in the hopes of identifying those conditions under which quasar activity is favored. These clues can then be used in evaluating different models of the triggering and sustenance of the quasar phenomenon. In addition, changes in the environments associated with bright and faint quasars can be used to suggest physical mechanisms for the observed evolution.

### 3.1 Cluster Radial Profiles

Information concerning the optical morphologies of galaxy clusters associated with quasars was obtained from the sample of faint quasars discussed in Section 2. Because of the small number of excess galaxies in each field, data from all of the fields were combined in order to construct a composite galaxy density profile. A higher signal-to-noise ratio profile may be constructed using only those fields with large numbers of excess counts, but these fields are also those most likely to be contaminated by foreground or background galaxies. Three separate profiles were therefore calculated- one for the entire faint, radio-loud sample, one from the 12 fields which have $B_{g q}$ greater than 300 , and one from the four fields with $B_{g q}$ greater than 500.

A method outlined by Merrifield and Kent (1989) was used, where the individual clusters are assumed to have the same radial profile, but can have
different total richnesses and redshifts. First the galaxies brighter than the completeness magnitude are counted in rings of width 100 kpc centered on the quasar, and corrected for the expacted background galaxy counts. Because the clusters are assumed to be at differing redshifts, and the quasars are not always centered exactly in the center of the CCD field, the galaxy counts for each field will be complete to differing metric radii. The maximum radii were extended slightly by assuming that the distributions of excess galaxies were spherically symmetric. If $r_{1}$ is the distance between the quasar and the nearest edge of the field, and $r_{2}$ is the distance to the second-closest edge, the galaxy counts from the annulus between $r_{1}$ and $r_{2}$ are scaled to correct for the obscured area in this annulus. In this way, galaxy counts were determined for each of the quasar fields, to radii ranging from 300 to 800 kpc .

For the first few rings, where each of the clusters can contribute, the composite profile is determined by

$$
\begin{equation*}
\mu(R)=\frac{1}{N} \sum_{j=1}^{N} \frac{n_{j}(R)}{A_{j}} \tag{3.1}
\end{equation*}
$$

where $R$ is the metric radius from the quasar, and $A$ is the area from which the galaxy counts are determined, and errors are calculated from Poisson statistics.

When the radius is large enough that it reaches the edge of one of the fields, that cluster is, of course, dropped from the composite. Because the individual clusters are assumed to have differing richnesses, however, the composite cluster profile at larger radii must be renormalized to include what that particular cluster would have contributed if the data were available. This normalization
assumes that the missing cluster has the same profile shape as the composite does at larger radii, and has the same relative richness as it displayed at smaller radii. The composite cluster profile at larger radii is thus determined by

$$
\begin{equation*}
\mu(R)=\chi_{R} \frac{1}{N} \sum_{j=1}^{N} \frac{n_{j}(R)}{A_{j}} \tag{3.2}
\end{equation*}
$$

where

$$
\begin{equation*}
\chi_{R}=\frac{\sum_{j \in J} \frac{n_{j}(R-1)}{A_{j}}}{\sum_{j \in K} \frac{n_{j}(R-1)}{A_{j}}} \tag{3.3}
\end{equation*}
$$

and $R$ is the radius interval under consideration, $R-1$ is the interval immediately inside of $\mathrm{R}, \mathrm{J}$ respresents those clusters which contribute to the composite cluster profile at radius $\mathrm{R}-1$, and K represents those clusters which contribute at radius R.

The composite galaxy density profile was fit by least squares methods to an empirical King model. The results of the fits illustrated in Figure 3.1(a-c). The fit to the data for all of the fields is poor because of noise in the profile, and does not yield an accurate measure of the core radius. The fit to the data from fields with $B_{g q}$ greater than 300 yields a core radius of $160 \pm 60 \mathrm{kpc}$. This value, however, may be affected by contamination in a few of the high $B_{g q}$ fields. The effect of such contamination would be to add a constant term to the King profile, causing the fit to measure too large a core radius. The fit for the four richest clusters yields a core radius of $200 \pm 50$. These data might also suffer from similar contamination from foreground and background galaxies. The luminosity functions of these clusters, however, were calculated in

Section 2.3, and show no signs of significant contamination, and the calculated core radius is cosistent with the value from the larger sample. These two values, therefore, probably represent the true core radius from the composite of the radial profile of rich clusters associated with quasars.

The core radii of clusters associated with faint quasars are about half of other determinations of the core radii of clusters of similar richnesses (Colless 1988, Dressler 1980). The effects of background contamination, or of the quasars not being in the exact centers of the clusters would only make the observed value an overestimate of the true core radius. The core radii, therefore, are probably truly smaller than for low-redshift Abell clusters of the same richness class. They are, however, similar to the results from determining the profiles of individual rich clusters from much deeper CCD images of fields associated with bright quasars. Yee et al. (1989) report that three of the clusters associated with quasars in the YG87 sample at $z \sim 0.6$ show extremely rich cluster cores with radii of less than 200 kpc . Likewise, Ellingson et al. (1989) found that the cluster associated with 3C206 at $z=0.2$ had a (poorly fit) core radius of only 37 kpc . This cluster is also highly flattened, suggesting that the cluster is far from being virialized and may be undergoing a collapse or or "bounce" stage of its evolution.

The composite central galaxy surface densities of the fields with $B_{g q}>500$ was found to be $330 \pm 50 \mathrm{gal} / \mathrm{Mpc}^{2}$. This value is several times the typical central galaxy density of normal Abell class 1 and 2 clusters of galaxies at low redshift, which is typically around $100 \mathrm{gal} / \mathrm{Mpc}^{2}$ (Colless 1988). This result, however, is wholly consistent with the observation that the core radii are on


Figure 3.1a Radial galaxy density profile for the environments of optically faint, radio quasars. The solid line represents the best-fit empirical King profile.


Figure 3.1b Radial galaxy density profile for the environments of optically faint, radio quasars with $B_{g q}>300$. The solid line represents the best-fit empirical King profile.


Figure 3.1c Radial galaxy density profile for the environments of optically faint, radio quasars with $B_{g q}>500$. The solid line represents the best-fit empirical King profile.
average a factor of two smaller than those of low redshift Abell clusters of similar richness. The Abell richness class, which is similar for both the low redshift Abell clusters and the clusters associated with quasars, is based on galaxy counts within several core radii from the cluster center, and hence is a measure of the number of galaxies in the cluster at larger scales than the cluster core. The central densities can therefore be quite different for clusters of the same Abell richness class but different core radii. It should be remembered, therefore, that $B_{g q}$, the quantity from which the Abell richness is inferred, is a measure of the average environment over 500 kpc , and quasars with similar $B_{g q}$ can actually be located in very different environments on smaller scales.

Because of the small number of objects in each individual field, the data were unfortunately not sufficient to determine either the nature of the galaxy density profile at very small radii ( $r<200 \mathrm{kpc}$ ), or to address the question of whether the quasars are truly found at the exact centers of these galaxy clusters. Both of these questions are of great interest in evaluating the importance of mergers as a triggering mechanism for quasar activity, and will be addressed with the availability of deeper data from the richer clusters associated with quasars. In this analysis, it was assumed that the quasars are located at the center of the clusters; Merrifield and Kent have reviewed evidence in support of this assumption with respect to cD galaxies. If the quasars in rich clusters reside in host galaxies which are the counterparts of giant ellipticals or cD galaxies, this assumption should be valid for quasars as well. Indeed, one of the quasars in this survey, 3C 275.1, was shown by Hintzen et al. (1981) to be surrounded by a cD-like nebulous envelope.

### 3.2 Quasar Radio Morphologies

The radio morphology of quasars, although discussed briefly in Section 2, is included in this section because of evidence that the morphology of the extended radio emission is directly tied to properties of the quasar environment. Prestage and Peacock (1988) noted that FR II morphology radio galaxies (classical double lobe sources) are less likely to be associated with rich environments than the more distorted FR I morphology galalaxies. This can be interpreted as evidence of interaction between the material causing the radio lobe and a dense intracluster medium (ICM). The largest linear size (LLS) of extended radio sources may therefore be correlated with the density of the ICM associated with the cluster surrounding a quasar of a given radio power. Table 3.1 lists the LLS (lobe-to-lobe) of most of the radio-loud quasars in the YG87 and faint quasar surveys which were obtained from Hintzen et al. (1983) and references therein. Figure 3.2 is a plot of radio power at 20 cm versus the largest metric size of the extended source, with different symbols marking optically luminous and less-luminous quasars, and quasars in rich and poor environments. The sizes range from zero, for single-component radio sources up to 1 Mpc for the most extended double and triple sources. There does not seem to be a strong correlation with environment as measured by the spatial covariance amplitude. An intriguing observation, however, is that the three low luminosity quasars in rich environments have an average linear extent of only 200 kpc . (No radio morphological data was available for 5C 02.10, the fourth quasar in that category.) In comparison, the average size of the steep-spectrum luminous quasars in rich environments was found to be 560 kpc . The only luminous quasar with $B_{g q}>500$ and a size of less
than 300 kpc from the YG87 survey is 3C345, a flat-spectrum compact source with superluminal motion. The three optically less luminous quasars in rich environments for which radio morphologies are available have an average radio power similar to that of the optically luminous sample in rich environments. This suggests that the more relaxed radio morphology of the less luminous quasars is due to their environment, rather than lower radio power, as suggested by Prestage and Peacock (1988).

In addition, two of these three small radio sources asociated with rich clusters, 3C275.1 and 3C215, have bent or distorted morphologies (Hintzen et al., 1983, Riley et al, 1978), indicating substantial interaction of the radio lobes with an ICM. The third source from the faint quasar survey, 4C 57.15, may show signs of confinement from an external medium (Hintzen et al. 1983). The quasar 3C 275.1 is also associated with an X-ray source which, although only partially resolved, suggests the presence of an ICM density greater than about $10 \mathrm{~cm}^{-3}$, (Crawford 1988) consistent with an interpretation that the radio morphology is associated with dense intra-cluster gas.

The trend for the quasars in rich environments at lower redshift to have smaller and more distorted radio morphologies suggests that their environments are forming increasingly dense ICMs at these redshifts. This possibility, however, is not consistent with the observations of Barthel and Miley (1986), who found that the incidence of bent radio sources increases suddenly at $z>1.5$, implying denser ICMs in the past. Stocke and Perrenod (1981) suggest, however, that ICM densities in rich clusters are initially high, but decrease rapidly due to expansion, reaching a minimum at redshifts of about 2 . The densities
then increase again as the cluster core collapses and the central potential deepens. This relatively recent increase in ICM density may be linked to the optial evolution of radio loud quasars in rich environments.

Table 3.1a. Radio Morphologies: Faint Quasars

| QSO | z | $\begin{gathered} \log \left(\mathrm{P}_{\mathrm{rad}}\right) \\ (\mathrm{Watts} / \mathrm{Hz}) \end{gathered}$ | $\begin{gathered} \text { Morphology } \\ \mathrm{D}=\text { double } \\ \mathrm{T}=\text { triple } \\ \mathrm{S}=\text { single } \\ \hline \end{gathered}$ | Largest Linear Size (kpc) | Ref. |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 0121+020 | 0.510 | 25.19 | D | 775. | 1 |
| 0135-057 | 0.400 | 25.52 | D | 288. | 1 |
| 0222+000 | 0.523 | 26.50 | S | - | 2 |
| 0249+15 | 0.489 | 25.81 | T | 279. | 1 |
| 4C57.15 | 0.438 | 26.30 | T | 195. | 1 |
| 4C09.31 | 0.366 | 25.86 | T | 364. | 3 |
| 3 C 215 | 0.411 | 26.23 | D | 290. | 1 |
| 4C23.24 | 0.565 | 26.44 | D | 100. | 1 |
| 4C48.28 | 0.385 | 25.36 | D | 752. | 1 |
| 3C275.1 | 0.557 | 26.58 | D | 125. | 4 |
| $1522+113$ | 0.331 | 25.66 | S | - | 1 |
| $1608+113$ | 0.457 | 25.88 | T | 69. | 1 |
| $2209+080$ | 0.484 | 26.65 | T | 83. | 1 |
| 3CR455 | 0.543 | 26.95 | D | 27. | 5 |

## References

1. Hintzen, Ulvestad and Owen (1983)
2. Potash and Wardle (1979)
3. Hutchings et al. (1976)
4. Elsmore and Ryle (1976)
5. Miley and Hartsuijker (1978)
6. Owen, Porcas and Neff (1978)
7. Riley and Pooley (1978)

Table 3.1b. Radio Morphologies: Bright Quasars

| QSO | z | $\log \left(\mathrm{P}_{\text {rad }}\right)$ <br> (Watts/Hz) | Morphology <br> $\mathrm{D=} \mathrm{double}$ <br> $\mathrm{T}=$ triple <br> $\mathrm{S}=$ single | Largest Linear Size <br> $(\mathrm{kpc})$ | Ref. |
| :--- | :---: | :---: | :---: | :---: | :---: |
| PHL 658 | 0.450 | 25.53 | T |  |  |
| 0044+03 | 0.624 | 25.53 | T | 236. | 3 |
| 4C 24.02 | 0.457 | 26.00 | T | 72. | 1 |
| 3C 48 | 0.367 | 27.25 | S | 422. | 5 |
| 3C 95 | 0.614 | 26.79 | T | 13. | 6 |
| 4C 31.30 | 0.462 | 26.15 | T | 1020. | 3 |
| 3C 206 | 0.200 | 25.75 | T | 889. | 1 |
| 3C 246 | 0.344 | 26.33 | T | 750. | 3 |
| 4C 41.21 | 0.611 | 26.83 | T | 103. | 5 |
| 4C 61.20 | 0.422 | 26.22 | T | 279. | 7 |
| 4C 10.30 | 0.420 | 25.86 | T | 602. | 3 |
| 4C -00.43 | 0.422 | 26.71 | T | 227. | 3 |
| 4C 16.30 | 0.634 | 26.52 | T | 190. | 1 |
| 4C 63.15 | 0.594 | 26.32 | T | 363. | 1 |
| 3C 263 | 0.652 | 27.12 | T | 511. | 7 |
| 3C 281 | 0.599 | 26.49 | D | 416. | 7 |
| 4C 11.50 | 0.436 | 25.89 | T | 309. | 3 |
| 3C 334 | 0.555 | 26.85 | T | 344. | 1 |
| 3C 345 | 0.590 | 26.98 | S | 391. | 1 |

## References

1. Hintzen, Ulvestad and Owen (1983)
2. Potash and Wardle (1979)
3. Hutchings et al. (1976)
4. Elsmore and Ryle (1976)
5. Miley and Hartsuijker (1978)
6. Owen, Porcas and Neff (1978)
7. Riley and Pooley (1978)


Figure 3.2 Quasar radio power at 20 cm versus the largest linear size of radio lobes for radio-loud quasars. Circles represent optically less luminous quasars, and squares the more luminous YG87 objects. Solid symbols represent quasars in rich environments $\left(B_{g q}>500\right)$ and open symbols objects in poorer environments.

### 3.3 Properties of Galaxies in the Quasar Field

Photometry of the galaxies associated with quasars yields two valuable results in the study of quasar environments. First, knowledge of the luminosity function of excess galaxies is necessary to determine the spatial covariance amplitude in a self-consistent manner, simultaneously testing for evolution in the luminosity functions at higher redshifts. Second, multi-color photometry yields information about the stellar content of the cluster galaxies, and thus about the star formation rates and activity in the cluster.

The luminosity functions of excess galaxies in the quasar fields were calculated and discussed in Section 2.3. The LFs were found to be generally consistent with the results of YG87, indicating that there has been approximately 0.9 mag of evolution at $\lambda_{0} \sim 4000 \AA$ since $z \sim 0.6$. This result may be a property of galaxies in general (indeed, that is assumed in the derivation of $B_{g q}$ ), or may be a phenomenon linked specifically to the clusters associated with quasars. As there seems to be no plausible reason why the existence of a quasar would change the LF of galaxies associated with it, the latter correlation would be have to be a by-product of the same conditions which make the cluster favorable for quasar activity. Until it can be shown that the LF of these galaxies is different from that of field galaxies at the same redshift, however, this possibility must remain unexplored.

The $g-r$ colors for galaxies in 29 fields surrounding quasars and 4 control fields were determined. These fields included those with $B_{g q}$ greater than 300, and also a number of fields surrounding radio quiet and low $B_{g g}$ quasars. Examples of color-magnitude diagrams for several of the rich fields are shown in

Figure 3.3(a-d). Model colors as a function of redshift were created by convolving the galaxy energy distributions of Coleman, Wu and Weedman (1980) with Gunn filter responses at different redshifts. The expected color and magnitude for a first-ranked galaxy of each type is marked. These figures illustrate that galaxies in clusters associated with quasars have colors consistent with normal galaxy spectra situated at the redshift of the quasar.

The fraction of blue galaxies, $f_{B}$, was calculated for each field with $B_{g q}$ greater than 100. The blue fraction is defined as the fraction of galaxies which have colors bluer than a critical color, $(g-r)_{\text {crit }}$, and are brighter in $r$ than a color completeness magnitude, $r_{c o l}$. The critical color was defined as 0.1 magnitude redder than the expected color of an Sbc galaxy at the quasar redshift, consistent with that used by Butcher and Oemler (1984). For these fields, the critical color ranged from 0.76 at $z=0.3$ to 1.28 at $z=0.6$. The color completeness magnitude $r_{c o l}$, is dependent on the completeness magnitudes of the $r$ filter, $r_{\text {com }}$, and the five-sigma limiting magnitude of the $g$ filter, $g_{\text {lim }}$. At any given $r$ magnitude, the accurate determination of the color of objects is limited to objects bluer than $g_{l i m}-r$. Objects redder than this limit have undetermined $g$ magnitudes and are hence considered arbitrarily red objects. This will not affect the blue fraction as long as all such objects are truly redder than the critical color. The color completeness limit, therefore, is the same as $r_{\text {com }}$ as long as $g_{l i m}-r_{\text {com }}$ is greater than the critical color $(g-r)_{\text {crit }}$. For fields where this is not the case, the color completeness magnitude is brightened until $g_{l i m}-r_{c o l}$ is equal to the critical color.


Figure 3.3a Color-magnitude diagram, $g-r$ versus $r$, for galaxies in the field of 3C 215 at $z=0.411$. The vertical line on the lower axis denotes the limiting $r$ magnitude, $m_{\text {lim }}$ for the field. Galaxy color models (see text) are indicated, showing the expected color and magnitudes of normal galaxies of different morphologial types. From top to bottom: E and S0, Sbc, Scd and Irr. Tic marks on these curves represent redshift intervals of 0.2 . vertical lines under the curves mark the expected color of galaxies of a given morphology at the quasar redshift.


Figure 3.3b Color-magnitude diagram, $g-r$ versus $r$, for galaxies in the field of 3 C 275.1 at $z=0.557$. The vertical line on the lower axis denotes the limiting $r$ magnitude, $m_{l i m}$ for the field. Galaxy color models (see text) are indicated, showing the expected color and magnitudes of normal galaxies of different morphologial types. From top to bottom: E and S0, Sbc, Scd and Irr. Tic marks on these curves represent redshift intervals of 0.2 . vertical lines under the curves mark the expected color of galaxies of a given morphology at the quasar redshift.


Figure 3.3c Color-magnitude diagram, $g-r$ versus $r$, for galaxies in the field of 4C $57.15 \mathrm{z}=0.438$. The vertical line on the lower axis denotes the limiting $r$ magnitude, $m_{l i m}$ for the field. Galaxy color models (see text) are indicated, showing the expected color and magnitudes of normal galaxies of different morphologial types. From top to bottom: E and S0, Sbc, Scd and Irr. Tic marks on these curves represent redshift intervals of 0.2 . vertical lines under the curves mark the expected color of galaxies of a given morphology at the quasar redshift.


Figure 3.3d Color-magnitude diagram, $g-r$ versus $r$, for galaxies in the field of 5C 02.10 at $z=0.478$. The vertical line on the lower axis denotes the limiting $r$ magnitude, $m_{\text {lim }}$ for the field. Galaxy color models (see text) are indicated, showing the expected color and magnitudes of normal galaxies of different morphologial types. From top to bottom: E and S0, Sbc, Scd and Irr. Tic marks on these curves represent redshift intervals of 0.2 . vertical lines under the curves mark the expected color of galaxies of a given morphology at the quasar redshift.

The total background galaxy counts were determined as described in Section 2.3, and the background blue fractions were determined from the colors of galaxies in the control fields and in the fields with $B_{g q}$ less than 100. Galaxies in these fields can be expected to be relatively uncontaminated by galaxies truly associated with the quasar; a $B_{g q}$ of 100 at a redshift of 0.4 implies an excess of 1 galaxy in a typical field. The blue fraction was calculated for critical colors between 0.8 to 1.2 in increments of 0.1 mag , and ranged from $0.47 \pm 0.04$ for the bluest critical color, to $0.69 \pm 0.04$ for the reddest. Within the uncertainties, no magnitude dependence was found in these background fractions for color completeness magnitudes between 21.0 and 22.5 ; color fractions from different fields were therefore combined and compared despite different limits. Errors in the background color fraction were calculated using Poisson statistics. The blue fraction was then calculated for each of the quasar fields with $B_{g q}>100$ using the critical color and background blue fraction appropriate to the quasar redshift:

$$
\begin{equation*}
f_{B}=\frac{B-f_{B b} N_{b}}{T-N_{b}} . \tag{3.4}
\end{equation*}
$$

In this equation, $B$ is the observed number of blue galaxies, $T$ is the total number of galaxies in the field, $N_{b}$ is the number of background counts expected, and $f_{B b}$ is the background blue fraction of galaxies. The error was calculated using

$$
\begin{equation*}
\sigma=\sqrt{\frac{T}{\left(T-N_{b}\right)^{2}}+e r r_{b}^{2}} \tag{3.5}
\end{equation*}
$$

where $\operatorname{err}_{b}$ is the error in the background blue fraction, as calculated above.
The blue fraction, $f_{B}$, is tabulated in Table 3.2 for galaxies within 500 kpc of the quasar. Several objects have blue fractions greater than 1 or less than zero. These values occur when the observed number of red galaxies or blue galaxies is less than the number expected from the background contribution to the counts. Because the total number of excess galaxies observed in each individual field was small, the average blue fraction as a function of environment was also calculated. The data were combined into three bins with $B_{g q}$ of 100-$300,300-500$, and $>500$, with average $B_{g q}$ of 176,378 and 781 . The objects in these bins were were determined to have blue fractions of $0.55 \pm 0.31,0.57$ $\pm 0.20$ and $0.15 \pm 0.13$, respectively.

As discussed above, there is always a danger of preferentially including objects with foreground contamination when choosing fields on the basis of $B_{g q}$, increasing the blue fraction. In this case, the four richest clusters are probably not contaminated in this way, as their LFs are wholly consistent with galaxies associated with the quasars, and their radial profiles reach the background level near the edge of the CCD field. Because of this, the blue fraction determined for these fields is probably a reflection of the galaxies associated with the quasars, and not contamination. The fact that they are redder than the low $B_{g q}$ objects implies the difference in galaxy colors cannot be explained by foreground contamination in any case. The colors of objects with $B_{g q}$ between 300 and 500 have colors indistinguishable from the field, which might indicate some contamination is present, or that the underlying galaxy colors are bluer than for the very rich environments.

Table 3.2. Fraction of Blue Galaxies

| QSO | z | $r_{\text {col }}$ | $(g-r)_{\text {crit }}$ | $f_{B}$ |
| :--- | :---: | :---: | :---: | :---: |
| $0249+15$ | 0.49 | 22.15 | 1.17 | $0.29 \pm 0.30$ |
| $0449-183$ | 0.34 | 22.31 | 0.84 | $0.05 \pm 0.33$ |
| 4 C57.15 | 0.44 | 22.20 | 1.06 | $0.03 \pm 0.26$ |
| $0844+377$ | 0.45 | 22.61 | 1.10 | $0.58 \pm 0.23$ |
| 4 C09.31 | 0.37 | 22.67 | 0.91 | $0.44 \pm 0.27$ |
| 3C215 | 0.41 | 22.82 | 1.02 | $0.08 \pm 0.19$ |
| 4C23.24 | 0.57 | 22.61 | 1.25 | $0.30 \pm 0.28$ |
| 5C02.10 | 0.48 | 22.55 | 1.14 | $0.29 \pm 0.20$ |
| $1137+659$ | 0.32 | 21.82 | 0.79 | $0.62 \pm 0.47$ |
| $1200-051$ | 0.38 | 21.75 | 0.95 | $<0$ |
| $1234+152$ | 0.40 | 22.36 | 0.97 | $0.47 \pm 0.44$ |
| 3 C275.1 | 0.56 | 21.84 | 1.24 | $0.59 \pm 0.35$ |
| $1352-104$ | 0.33 | 22.13 | 0.83 | $>1.0$ |
| $1608+396$ | 0.46 | 22.47 | 1.11 | $<0$ |
| 4 C61.34 | 0.52 | 22.50 | 1.21 | $0.97 \pm 0.24$ |
| $2140-048$ | 0.34 | 22.41 | 0.84 | $0.73 \pm 0.44$ |
| $2141+040$ | 0.41 | 22.00 | 1.01 | $0.65 \pm 0.38$ |
| $2209+080$ | 0.48 | 22.66 | 1.16 | $>1$ |

These results are not inconsistent with observations of low-redshift environments. Dressler (1980) showed that spiral galaxies avoid the centers of rich clusters of galaxies, but are found in increasing numbers in poorer environments. Our result shows that for poor environments, the blue fraction of excess galaxies is similar to that of the field, while in rich environments there is a deficit of gas-rich galaxies.

The data, however, are marginally inconsistent with the blue fractions observed for other clusters of galaxies at $z \sim 0.4$. Butcher and Oemler (1984) found that even rich clusters of galaxies at redshifts $\sim 0.4$ had significant blue fractions, indicating strong evolution in the colors of galaxies in these environments. While the data from the environments of faint quasars do not agree with this result, a study of several rich clusters associated with bright quasars (Yee et al. 1990) found that their blue fraction was consistent with or even exceeded the values predicted by the "Butcher-Oemler" relationship (Figure 3.4). Although based on a very small number of fields, this difference in blue fraction between the bright and faint quasar surveys is suggestive of differences in the environments of the two samples in the sense that bright radio-loud quasars are somewhat more likely to be surrounded by gas-rich galaxies than are the fainter quasars at more recent epochs.

Although the background fraction of blue galaxies was seen to be relatively stable with respect to small changes in completeness magnitudes, the blue fraction of galaxies in clusters is actually dependent on the completeness magnitude in absolute terms, since the characteristic magnitudes of different galaxy morphological types is different. Sampling the luminosity function of galaxies at a


Figure 3.4 Blue fraction of excess galaxies (see text) versus redshift for (solid circles) several optically luminous quasars from the YG87 and YG84 samples, and from the faint quasar sample (open circles). All quasars have $B_{g q}$ greater than 500, implying environments at least as rich as Abell richness class 1 clusters. The solid line indicates the relationship between blue fraction and redshift found by Butcher and Oemler (1984).
given redshift less deeply will yield a lower blue fraction, since fewer late-type galaxies will be included in the study. The typical depth of sampling of the galaxy LF must be therefore addressed when comparing different measurements of the blue fraction. The average completeness magnitude from the faint quasar sample was -20.1 which is similar to the value of -20.0 obtained by Butcher and Oemler (1984) for their sample. The same background counts were used for the faint quasar sample, and the deeper multicolor observations of objects in the YG87 sample (Yee et al. 1990); the color determination for galaxies associated with the high luminosity quasars at $z \sim 0.6$, therefore was limited to a value of approximately -20.4. The cluster galaxies, therefore, were sampled to similar absolute magnitudes for all of the fields. As the characteristic magnitude of the galaxy LFs in the observed band becomes slowly fainter with redshift (see Figure 2.8) this implies a tendency for the higher redshift fields to be sampled somewhai less deeply. As described above, this cannot account for the observed trend of the YG87 clusters at $z \sim 0.6$ having higher blue fractions than the lower redshift samples.

### 3.4 Dynamics

### 3.4.1 Observations and Data Reduction

Information about the dynamics of the environments of bright quasars in the YG84 and YG87 samples was forcibly extracted from multi-slit spectroscopy of galaxies in the quasar fields. The data were taken using the KPNO 4-m telescope and Cryogenic Camera during a number of observing runs between 1984 and 1988. Table 3.3 details this information. In addition, emission-line redshifts of several of the quasars, 3C 263, 3C 345, and 4C 31.30, were obtained with the Steward Observatory $2.3-\mathrm{m}$ telescope and B+C spectrograph on 9 March 1988. The 19 fields chosen were primarily associated with bright radio-loud quasars with $B_{g q}>300$, although several poorer fields and fields associated with radio-quiet quasars were also included. Redshifts of the targeted quasars and associated galaxies ranged from less than 0.2 to 0.6 . In addition, the spectroscopic data described in Ellingson et al. (1989) from the 3C206 field are also included. Unfortunately, imaging data from the faint quasar survey were unavailable at the time most of these observations were made, and so none of the faint quasar fields were observed spectroscopically.

The galaxies targeted in each field were chosen to have $r$ magnitudes brighter than 22, and distances of less than 1.5 arcminutes from the quasar at the field center. Preference was given to galaxies not more than 2 magnitudes fainter than the expected magnitude for a first-ranked elliptical galaxy at the quasar redshift, and to objects close to the quasar, although crowding naturally limits the number of objects on one aperture plate for which spectra may be obtained. Where multicolor data were available, preference was given to objects with the

## Table 3.3. Observations: Spectroscopy

| UT Date | QSO | Mask ID | \# Objects | Integration (sec) |
| :---: | :---: | :---: | :---: | :---: |
| 1-4 Mar. 1984 |  |  |  |  |
|  | 1146-03 | 55 | 10 | 7200 |
|  | 4C11.50 | 47 | 6 | 3000 |
|  | 0953+41 | 49 | 8 | 10800 |
|  | $1116+21$ | 51 | 11 | 7200 |
|  |  | 52 | 9 | 7200 |
|  | $1309+35$ | 53 | 11 | 7200 |
|  | 0923+20 | 45 | 9 | 7200 |
|  | $1217+02$ | 56 | 10 | 5750 |
| 25-27 Aug. 1984 |  |  |  |  |
|  | $0044+03$ | 84 | 11 | 7500 |
|  |  | 85 | 12 | 9000 |
| 18-20 Mar. 1985 |  |  |  |  |
|  | 3 C 206 | 175 | 12 | 7200 |
|  | 1103-00 | 154 | 10 | 7200 |
|  | 1302-10 | 160 | 6 | 3600 |
| $\begin{aligned} & 28 \text { Feb., } \\ & \text { 1-2 Mar. } 1987 \end{aligned}$ |  |  |  |  |
|  | 3 C 246 | 343 | 11 | 12000 |
|  | $1427+48$ | 161 | 5 | 6000 |
|  | $0812+02$ | 340 | 16 | 8500 |
|  |  | 341 | 10 | 15800 |
|  | 3C281 | 338 | 15 | 9000 |
| 16-18 Mar. 1988 |  |  |  |  |
|  | 3C281 | 339 | 17 | 12000 |
|  | 0931+43 | 484 | 6 | 6000 |
|  | 4C31.30 | 470 | 14 | 9000 |
|  | 3C345 | 471 | 9 | 9000 |
|  |  | 472 | 10 | 8000 |
|  | 4C19.44 | 476 | 7 | 12000 |

colors of early-type galaxies at the quasar redshift. Positional data from Green and Yee (1984), YGS86 and unpublished images from Yee were used.

Aperture masks were created for each field which included between 5 and 15 small slits with minimum lengths of 10 acrseconds, and widths of 2.5 arcseconds. The Cryocam detector is a TI CCD with $800 \times 80015 \mu \mathrm{~m}$ pixels and a read noise of 8-10 $e^{-}$. The dispersing element was a grism with a dispersion of $4.3 \AA /$ pixel. The spectral range of each spectrum is dependent on the position of the object in the field, but was generally shortened to approximately $4500-6000 \AA$ due to defocusing of the spectrum at the edges of the CCD. Each mask was used for a total integration time of between 3000 and 16,000 seconds, depending on the redshift of the quasar and the observing conditions.

Data were reduced at NOAO using IRAF. For a detailed discussion of the data reductions process for multislit spectroscopy, see Ellingson (1989). In short, the data were debiased, flat-fielded and corrected for S-curvature in the dispersion direction using exposures of quartz lamps interspersed between data exposures, and extracted using "profile" weighting. The subtraction of the sky background was done by fitting pixels adjacent to the object spectrum for each line of the spectrum and subtracting the fit. The small slit size and faintness of the objects made this difficult, especially in areas of the spectrum where defocusing was evident. This was the limiting factor in the interpretation of most of the spectra of faint galaxies, especially those at high redshift where spectral features were difficult to disentangle from residual background sky emission at red wavelengths. Wavelength solutions were calculated for $\mathrm{He}-\mathrm{Ne}-\mathrm{Ar}$ arc lamp exposures and applied to the galaxy spectra. Spectra from individual exposures
were then rebinned to the same starting wavelengths and dispersions and combined. Figure $3.5(\mathrm{a}-\mathrm{h})$ shows the reduced spectra for objects associated with quasars.

While emission lines and strong absorption features (notably the H and K lines of Ca II) enabled us to determine the redshift of many galaxies immediately, poor sky subtraction and poor signal-to-noise ratios made many of the absorption spectra difficult to interpret by eye. Cross correlation with stellar templates allows a more objective and accurate determination of the redshift of obects with low signal-to-noise ratios.

To prepare the extracted, wavelength corrected spectra for cross-correlation, the spectra are first binned logarithmically, all residual night-sky emission lines are excised, and the spectra are trimmed to exclude regions of extremely poor signal. The spectral continua are then fitted with a fourth-order spline curve and the fit is subtracted in order to leave only the spectral line features. This discards information concerning the spectral shape, but is necessary for the cross-correlation process. The calculated redshift, however, is carefully checked by eye using the unsubtracted spectrum, confirming that the spectral continuum is consistent with the resultant redshift. The same continuum subtraction is also performed on templates formed from combinations of high-quality spectra of $F$, G and K stars. The stellar data were obtained from Jacoby, Christiansen and Hunter's (1984) library of stellar spectra. The stellar and galaxy spectra have approximately the same resolution and were binned to have the same logarithmic dispersion. The cross correlation algorithm is a simple "shift, multiply and add"

Figure 3.5a.


Figure 3.5b.


Figure 3.5c.


Figure 3.5d.


Figure 3.5e.


Figure 3.5f.


Figure 3.5g.


Figure 3.5h.

function, and galaxy redshifts were determined by fitting a parabola to the crosscorrelation peak.

The cross correlation procedure also allows the derivation of a formal error in the galaxy redshift, which is difficult to estimate by other methods and is important in the interpretation of low signal-to-noise ratio data. Sources of error in the determination of the galaxy redshift include: (1) errors from the wavelength calibration, (2) errors due to discrete binning of the spectra, (3) errors inherent in the correlation technique, which stem from noise in the object spectrum, noise in the template spectrum, imperfect matching between object and template spectra, and differences in the intrinsic width of galactic and stellar absorption lines (i.e. determining the systemic velocity from a broadened line profile).

The uncertainty in the calculated redshift due to errors in the wavelength solution were estimated to be $15 \mathrm{~km} / \mathrm{sec}$. The error due to the discrete binning of the galaxy and template binning can be estimated by rebinning the template spectra with a one-half bin shift and recalculating the correlation functions and redshifts. The mean error in velocity was found to be $50 \mathrm{~km} / \mathrm{sec}$, and can be considered to be an upper limit, since the error is maximized by a shift of one-half bin.

The uncertainty in the redshift from the cross-correlation itself can be determined from the error in the derivation of the position of the correlation peak. The center 5-10 points of the peak are fitted to a parabola using conventional least-squares methods. The uncertainty in this determined redshift can be computed from the error in the fit. These errors are on the order of $50-200 \mathrm{~km} / \mathrm{s}$.

The total error in the galaxy redshifts derived from our spectra varies between 70 and $300 \mathrm{~km} / \mathrm{sec}$. Table 3.4 lists the fields by quasar and redshift, the objects in each field whose spectra were identified, their positions relative to the quasar in the field, their $r$ magnitudes, and their redshifts.

Table 3.4. Spectral Identifications


Table 3.4. Spectral Identifications -cont.-


Table 3.4. Spectral Identifications -cont.-

|  | $\Delta \alpha\left({ }^{\prime \prime}\right)$ | $\Delta \delta\left({ }^{\prime \prime}\right)$ | $r$ | z | Associated? |
| :---: | :---: | :---: | :---: | :---: | :---: |
| QSO: $0923+20$ |  | $z=0$. |  | Mask \#45 |  |
| 1 | -68 | -108 | 00.00 | $0.1910 \pm 0.0004$ | * |
| 2 | -68 | 39 | 00.00 | - |  |
| 3 | -42 | 1 | 19.02 | star |  |
| 4 | 6 | 32 | 20.22 | $0.1890 \pm 0.0003$ | * |
| 5 | 5 | -10 | 17.80 | - |  |
| 6 | 17 | 2 | 20.95 | $0.1907 \pm 0.0002$ | * |
| 7 | 36 | -10 | 21.60 | - |  |
| 8 | 116 | -3 | 00.00 | $0.1899 \pm 0.0003$ | * |
| 9 | 157 | 9 | 00.00 | $0.2328 \pm 0.0004$ |  |
| QSO: 1103-00 |  | $z=0.4232^{3}$ |  | Mask \#154 |  |
| 1 | -88 | 35 | 20.60 | - |  |
| 2 | -87 | -7 | 19.38 | star |  |
| 3 | -64 | 22 | 19.41 | - |  |
| 4 | -53 | 14 | 19.97 | - |  |
| 5 | -29 | 29 | 20.26 | star |  |
| 6 | -15 | -4 | 19.91 | - |  |
| 7 | 10 | -29 | 19.90 | - |  |
| 8 | 21 | -39 | 20.10 | star |  |
| 9 | 71 | -39 | 19.50 | $0.4252 \pm 0.0005$ | * |
| 10 | 51 | -39 | 20.95 | star |  |
|  | 1146- | $z=0$ | $1^{1} \quad \mathrm{M}$ | Mask \#55 |  |
| 1 | -66 | -73 | 20.60 | - |  |
| 2 | -72 | 5 | 20.95 | $0.443 \pm 0.0015$ |  |
| 3 | -3 | -15 | 20.90 | - |  |
| 4 | -59 | 50 | 20.01 | - |  |
| 5 | 6 | -35 | 20.37 | $0.3377 \pm 0.0008$ | * |
| 6 | 41 | -50 | 20.65 | $0.3015 \pm 0.0005$ |  |
| 7 | 32 | -10 | 19.60 | - |  |
| 8 | 70 | -26 | 20.08 | - |  |
| 9 | 79 | -26 | 19.90 | - |  |
| 10 | 72 | 76 | 19.98 | $0.4403 \pm 0.0005$ |  |

Table 3.4. Spectral Identifications -cont.-


Table 3.4. Spectral Identifications -cont.-

|  | $\Delta \alpha\left({ }^{\prime \prime}\right)$ | $\Delta \delta\left({ }^{\prime \prime}\right)$ | $r$ | 2 | Associated? |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | : 3C 246 | $z=0.3444^{1} \quad$ Mask \#343 |  |  |  |
| 1 | -130 | -80 | 22.67 | - |  |
| 2 | 80 | -76 | 21.75 | $0.3444 \pm 0.0003$ | * |
| 3 | -43 | -47 | 21.76 | $0.3080 \pm 0.0020$ |  |
| 4 | 15 | -33 | 20.65 | $0.1473 \pm 0.0003$ |  |
| 5 | 17 | -20 | 20.54 | $0.3309 \pm 0.0003$ | * |
| 6 | -4 | -1 | 21.50 | $0.3449 \pm 0.0005$ | * |
| 7 | -44 | 24 | 21.67 | - |  |
| 8 | 24 | 34 | 21.98 | $0.3366 \pm 0.0020$ | * |
| 9 | 42 | 51 | 21.35 | - |  |
| 10 | 16 | 74 | 20.65 | star |  |
| 11 | -42 | 90 | 20.76 | star |  |
| QSO: $0812+02$ |  | $z=0.403{ }^{1} \quad$ Mask \#340 |  |  |  |
| 3 | -106 | 50 | 19.93 | - |  |
| 4 | -91 | 59 | 19.52 | $0.2736 \pm 0.0003$ |  |
| 6 | -52 | 32 | 18.99 | star |  |
| 7 | -49 | -9 | 18.45 | $0.3478 \pm 0.0010$ |  |
| 8 | -40 | -28 | 20.00 | star |  |
| 9 | -28 | -28 | 19.97 | $0.30 \pm 0.01$ |  |
| 10 | -20 | -17 | 21.30 | $0.3592 \pm 0.0008$ |  |
| 11 | -21 | -64 | 20.50 | $0.3601 \pm 0.0005$ |  |
| 12 | -3 | 9 | 20.27 | - |  |
| 13 | 0 | -9 | 20.19 | $\overline{\text { un }} .4030 \pm 0.0018$ | * |
| 14 | 0 | -61 | 19.22 | star |  |
| 15 | 19 | 52 | 20.04 | $0.4038 \pm 0.0008$ | * |
| 16 | 21 | -33 | 21.87 | - |  |
| 17 | 35 | 28 | 19.74 | star |  |
| 18 | 41 | 0 | 20.22 | $0.3599 \pm 0.0006$ |  |
| QSO: 0812+02 |  | $z=0.403^{1} \quad$ M |  | Mask \#341 |  |
| 1 | -91 | 59 | 19.52 | $0.2729 \pm 0.0006$ |  |
| 2 | -60 | 51 | 22.00 | star |  |
| 3 | -52 | 32 | 18.99 | star |  |
| 4 | -49 | -9 | 19.45 | $0.3481 \pm 0.0005$ |  |

Table 3.4. Spectral Identifications -cont.-

|  | $\Delta \alpha\left({ }^{\prime \prime}\right)$ | $\Delta \delta\left(^{\prime \prime}\right)$ | $r$ | z | Associated? |
| :--- | :---: | :---: | :---: | :---: | :---: |
| 5 | -1 | 55 | 21.77 | star |  |
| 6 | -28 | -28 | 19.97 | $0.343 \pm 0.002$ |  |
| 7 | -3 | -14 | 20.58 | $0.4030 \pm 0.0008$ | $*$ |
| 8 | 35 | 23 | 19.74 | star |  |
| 9 | 41 | 6 | 20.22 | $0.3614 \pm 0.0004$ |  |
| 10 | 87 | 34 | 21.55 | - |  |
|  |  |  |  |  |  |
| QSO: | $0044+03$ | $z=0.624^{3}$ | Mask \#84 |  |  |
| 1 | -94 | 59 | 19.02 | $0.1317 \pm 0.0005$ |  |
| 2 | -71 | 60 | 22.50 | - |  |
| 3 | -96 | 8 | 21.41 | $0.3786 \pm 0.0006$ |  |
| 4 | -65 | 8 | 21.83 | - |  |
| 5 | -4 | 63 | 20.49 | $0.3142 \pm 0.0005$ |  |
| 6 | -55 | -51 | 21.12 | - |  |
| 7 | 8 | 3 | 22.16 | - |  |
| 8 | 61 | 71 | 18.72 | $0.3133 \pm 0.0004$ | - |
| 9 | 62 | -19 | 21.61 |  |  |
| 10 | 59 | -55 | 21.62 | $0.4489 \pm 0.0006$ |  |
| 11 | 75 | -60 | 23.12 | - |  |


| QSO: |  | $0044+03$ | $z=0.624^{3}$ |  |
| :--- | :---: | :---: | :---: | :---: |
| 1 | -96 | -29 | 22.20 | - |
| 2 | -66 | -44 | 22.50 | - |
| 3 | -49 | -40 | 20.64 | $\sim 0.3$ |
| 4 | -80 | 46 | 23.15 | - |
| 5 | -76 | 69 | 21.90 | - |
| 6 | -17 | 18 | 21.91 | - |
| 7 | -26 | 69 | 22.11 | $0.2077 \pm 0.0003$ |
| 8 | 26 | 75 | 23.06 | $0.42 \pm 0.01$ |
| 9 | 33 | 41 | 21.72 | $0.381 \pm 0.0010$ |
| 10 | 56 | 39 | 22.69 | $0.313 \pm 0.0015$ |
| 11 | 75 | 48 | 22.47 | - |
| 12 | 89 | 50 | 22.20 | $\sim 0.4$ |

Table 3.4. Spectral Identifications -cont.$\Delta \alpha\left({ }^{\prime \prime}\right) \quad \Delta \delta\left({ }^{\prime \prime}\right) \quad r \quad z \quad$ Associated?

| QSO: 3C 345 |  |  |  | $z=0.5928^{3}$ | Mask \#471 |  |
| :--- | :--- | :---: | :---: | :---: | :---: | :---: |
| 1 | -107 | 9 | 21.44 | $0.2847 \pm 0.0007$ |  |  |
| 2 | -80 | -10 | 21.20 | $0.5648 \pm 0.0016$ |  |  |
| 3 | -44 | 32 | 21.29 | $0.6749 \pm 0.0004$ |  |  |
| 4 | -17 | -16 | 21.81 | - |  |  |
| 5 | -11 | 28 | 21.62 | - | $*$ |  |
| 6 | 7 | -1 | 21.08 | $0.5910 \pm 0.0003$ | $*$ |  |
| 7 | 29 | -37 | 21.44 | $0.5938 \pm 0.0006$ | $*$ |  |
| 8 | 31 | 39 | 20.50 | $\operatorname{star}$ |  |  |
| 9 | 80 | 28 | 21.18 | $0.3496 \pm 0.0020$ |  |  |


| QSO: 3C 345 |  |  |  |  | $z=0.5928^{3}$ |
| :--- | :--- | :---: | :---: | :---: | :---: |
| 1 | -104 | 33 | 21.36 | $0.3352 \pm 0.0010$ |  |
| 2 | -104 | 1 | 22.41 | - |  |
| 3 | -36 | 60 | 21.70 | $0.4146 \pm 0.0008$ |  |
| 4 | -37 | 36 | 21.78 | $0.5941 \pm 0.0005$ | $*$ |
| 5 | -21 | 11 | 22.24 | $0.5852 \pm 0.0010$ | $?$ |
| 6 | 23 | 43 | 22.38 | - |  |
| 7 | -1 | -5 | 22.23 | - |  |
| 8 | 20 | -11 | 21.01 | $0.5822 \pm 0.0010$ | $?$ |
| 9 | 41 | -38 | 22.86 | - |  |
| 10 | 66 | -57 | 22.18 | - |  |


| QSO: 3C 281 |  |  |  |  |  |  | $z=0.602^{5}$ | Mask \#338 |  |  |  |
| :--- | :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 2 | -112 | 77 | 23.00 | - |  |  |  |  |  |  |  |
| 3 | -79 | 97 | 21.80 | - | $*$ |  |  |  |  |  |  |
| 4 | -98 | 25 | 21.43 | $0.6090 \pm 0.0008$ | $*$ |  |  |  |  |  |  |
| 5 | -44 | 90 | 21.60 | $\sim$ |  |  |  |  |  |  |  |
| 6 | -78 | -2 | 21.35 | $\sim 0.46$ | $*$ |  |  |  |  |  |  |
| 7 | -20 | 50 | 21.23 | $0.6067 \pm 0.0006$ | $*$ |  |  |  |  |  |  |
| 8 | -7 | 15 | 20.64 | $0.5037 \pm 0.0004$ | $*$ |  |  |  |  |  |  |
| 9 | -1 | -5 | 21.05 | $0.6053 \pm 0.0004$ | $*$ |  |  |  |  |  |  |
| 10 | 14 | -23 | 21.48 | $0.3266 \pm 0.0005$ |  |  |  |  |  |  |  |
| 11 | 41 | -17 | 21.41 | $0.5513 \pm 0.0008$ | $*$ |  |  |  |  |  |  |
| 12 | 29 | -73 | 21.15 | $0.6025 \pm 0.0008$ | $*$ |  |  |  |  |  |  |
| 13 | 44 | -77 | 21.06 | star |  |  |  |  |  |  |  |
| 14 | 46 | -116 | 21.73 | - | $*$ |  |  |  |  |  |  |
| 15 | 94 | -86 | 20.89 | $0.5951 \pm 0.0003$ | $*$ |  |  |  |  |  |  |

Table 3.4. Spectral Identifications -cont.-

|  | $\Delta \alpha\left({ }^{\prime \prime}\right)$ | $\Delta \delta\left({ }^{\prime \prime}\right)$ | $r$ | z | Associated? |
| :---: | :---: | :---: | :---: | :---: | :---: |
| QSO: 3C 281 |  | $z=0.60$ | Ma | \#339 |  |
| 1 |  |  | 21.93 | - |  |
| 2 | -112 | 77 | 23.00 | - |  |
| 3 | -64 | 100 | 21.36 | - |  |
| 4 | -17 | 112 | 21.25 | $0.5807 \pm$ |  |
| 5 | -60 | 33 | 21.60 | - |  |
| 6 | -8 | 71 | 20.81 | $0.5668 \pm$ |  |
| 7 | -46 | -15 | 20.67 | - |  |
| 8 | 3 | 21 | 21.30 | $0.5024 \pm$ |  |
| 9 | 22 | 16 | 21.86 | - |  |
| 10 | -7 | -39 | 21.56 | - |  |
| 11 | 41 | -6 | 20.96 | - |  |
| 12 | 99 | 29 | 22.92 | - |  |
| 13 | 1 | -101 | 21.54 | $0.4349 \pm$ |  |
| 14 | 91 | -24 | 21.63 | - |  |
| 15 | 104 | -33 | 22.56 | - |  |
| 16 | 106 | -53 | 21.90 | - |  |
| 17 | 102 | -86 | 22.32 | - |  |
| QSO: 4C 19.4 |  | $z=0.720^{6} \quad \mathrm{~N}$ |  | Mask \#476 |  |
| 1 | -14 | -48 | 21.86 | $0.5293 \pm$ |  |
| 2 | -22 | -12 | 21.49 | $0.4406 \pm$ |  |
| 3 | 3 | -7 | 21.91 | - |  |
| 4 | 1 | 8 | 21.46 | $0.4592 \pm$ |  |
| 5 | -2 | 31 | 22.86 | - |  |
| 6 | 21 | 43 | 22.45 | - |  |
| 7 | 66 | 51 | 21.74 | $0.3509 \pm$ |  |

1 Heckman, Miley and Green (1984).
2 Schmidt and Green (1983).
3 this thesis.
4 Bergeron and Knuth (1984).
5 Wills and Lynds (1978).
6 Burbidge and Kinman (1966).

### 3.4.2 Results

In a sample of 267 spectra in 19 fields centered on bright quasars, 127 redshifts of galaxies were determined, 41 of which are considered to be associated with the quasars. The remaining objects were either unidentifiable because of poor signal, or were classified as either faint stars, or foreground or background galaxies. There are probably some selection effects in the identification process; galaxies with strong H and K breaks were more likely to be identified, as were galaxies with strong emission. Galaxies with redshifts greater than about 0.6 were difficult to identify, since the H and K absorption (the strongest absorption feature in most of these spectra) was then shifted into spectral regions where defocusing of the chip made night sky emission lines difficult to subtract. Likewise, galaxies where strong spectral features coincided with the $5577 \AA$ night sky emission line, and other bright sky emission features were difficult to identify. In general, however, redshifts were determined for most galaxies with $r$ brighter than about 21.5 , and for a few objects as faint as 22.

In addition to the data described above, relative velocities of 45 additional galaxies associated with quasars were taken from the literature (Heckman et al. 1984, and references therein). These velocities correspond to galaxies within 500 kpc of the quasar, and have errors comparable to those of the multispec data. The sample of quasars which were included in these surveys had a considerable overlap with those in the YG87 and YG84 surveys, and there were several galaxies whose redshifts were confirmed by both the published and these new observations. In addition, the richness of the global environments, as measured by $B_{g q}$, was also available for most of the fields from YG84 and YG87.

The total number of associated galaxies for which we have velocity data is now 86 , allowing the determination of a composite velocity distribution with respect to the quasars. The relative velocities of galaxies with respect to the quasars were calculated using the following formula:

$$
\begin{equation*}
v_{i}=c \frac{z_{g a l}-z_{g s o}}{\left(1+z_{q s o}\right)} \tag{3.6}
\end{equation*}
$$

where $z_{g a l}$ is the observed galaxy redshift and $z_{g s o}$ is the quasar redshift. Quasar redshifts were obtained from several sources described in Table 3.4. For all but one quasar, the $5007 \AA$ [OIII] emission line was used in determining the quasar redshift. One quasar, 3C 281, has extremely weak forbidden line emission, and for this quasar, the Mg II redshift was used. Quasar redshifts were generally accurate to $150 \mathrm{~km} / \mathrm{sec}$ or better. The relative velocities of the galaxies from all of the fields were combined to create the velocity distribution shown in Figure 3.6.

Mean velocities and line-of-sight velocity dispersions were calculated from

$$
\begin{gather*}
v_{a v e}=\frac{1}{N} \sum_{i=1}^{N} v_{i}  \tag{3.7}\\
\sigma=\left[\frac{\sum_{i=1}^{N} v_{i}^{2}}{N-1}-\frac{\left\langle\Delta v^{2}\right\rangle}{\left(1+z_{q s o}^{2}\right)}\right]^{1 / 2} \tag{3.8}
\end{gather*}
$$

and

$$
\begin{equation*}
\left\langle\Delta v^{2}\right\rangle=\frac{\sum_{i=1}^{N} e r r_{i}}{N-1} \tag{3.9}
\end{equation*}
$$



Figure 3.6 Relative velocities of galaxies associated with luminous quasars.
where $v_{i}$ is the relative line-of-sight velocity of the galaxies, and $e r r_{i}$ is the observational error in the determination of the velocity. The rms error in the multislit velocities was typically $150 \mathrm{~km} / \mathrm{sec}$. Errors ranging from $100 \mathrm{~km} / \mathrm{sec}$ to $200 \mathrm{~km} / \mathrm{sec}$ were assumed for the data taken from the literature, where observational errors were not supplied by the authors. Only galaxies within 500 kpc of the quasars were used. In choosing which galaxies are considered cluster members, an iterative three- $\sigma$ clipping algorithm was used to discard foreground and background galaxies. In this method, the galaxy with the most deviant relative velocity is discarded and the process iterated until all galaxies have velocities less than three times the calculated velocity dispersion. In most cases, only one or two objects with relative velocities less than $3000 \mathrm{~km} / \mathrm{sec}$ were discarded, indicating that this process did not artificially lower the velocity dispersions.

Velocity dispersions were calculated for the entire sample of galaxies, for galaxies associated with radio-loud and radio-quiet quasars, for galaxies in environments with low and high $B_{g q}$ (less than and greater than 500 ), and separately for the multislit data and data from the literature. The results are tabulated in Table 3.5.

There is some evidence (Heckman et al. 1984, see, however, Vrtilek 1987) that the [OIII] emission from quasars and Seyfert galaxies is systematically blueshifted with respect to the underlying galaxy light. The magnitude of the shift is on the order of $100 \mathrm{~km} / \mathrm{sec}$, although there is a distribution of values. This effect is thought to be evidence that the mechanism by which the radio lobes are created is linked somehow with the kinematics of the narrow-line region. If the quasar host galaxies are not preferentially red or blue shifted with

Table 3.5. Mean Relative Velocities and Dispersions

| Data | N | Mean Velocity <br> $(\mathrm{km} / \mathrm{sec})$ | Velocity Dispersion <br> $(\mathrm{km} / \mathrm{sec})$ |
| :--- | :---: | :---: | :---: |
| ALL | 86 | $32 \pm 45$ | $416 \pm 31$ |
| Multislit <br> Only | 41 | $19 \pm 75$ | $484 \pm 65$ |
| Literature <br> Only | 45 | $30 \pm 48$ | $404 \pm 44$ |
| Radio Loud | 49 | $-41 \pm 65$ | $458 \pm 45$ |
| Radio Quiet | 37 | $107 \pm 77$ | $444 \pm 58$ |
| Rich | 37 | $1 \pm 73$ | $447 \pm 59$ |
| Poor | 29 | $80 \pm 84$ | $450 \pm 68$ |
| C88 | 108 | $-43 \pm 85$ | $887 \pm 58$ |

respect to the cluster center (and there is no plausible reason for this to be so), this effect should be observable in our data as a systematic redshift of galaxy velocities with respect to the quasars' [OIII] emission line velocity. The redshifts used in determining the relative velocities of the quasars are, however, drawn from a number of sources, including Heckman et al. (1984). Differences in the method used to determine these redshifts (i.e. are only the line centers used, or is the entire line used to determine the published quasar redshift) are likely to dilute this effect.

The weighted-average velocity of the composite velocity distribution for all the galaxies associated with quasars is $32 \pm 45 \mathrm{~km} / \mathrm{sec}$, indicating that no such effect is found in our data for quasars in general. Limiting the data to only those galaxies assciated with radio-quiet quasars yields a central velocity of $107 \pm 77$ $\mathrm{km} / \mathrm{sec}$, suggesting that there might be a tendency for there to be a blue shift in the [ 0 III] line profile. This result, however, is only significant at the $84 \%$ confidence level. No shift is seen in this sample of radio-loud quasars.

The complete composite velocity distribution and each of the subsamples have similar velocity dispersions of about $400-450 \mathrm{~km} / \mathrm{sec}$. No statistically significant differences were found in the properties of the velocity distributions of any of the subsamples based on the radio power of the quasar or richness of the cluster environment. The velocity dispersion for the cluster of galaxies associated with 3C 206, which supplies the largest number of cluster members which are available for an individual cluster is $550 \pm 110$, also consistent with the overall distribution. The largest possible difference in the subsamples exists in comparing the velocity dispersions of the multislit data and the data from the
literature, with dispersions of $484 \pm 55$ and $404 \pm 44$, respectively. This already unalarming result can be further explained by an overestimation in the errors assumed for the velocities taken from the literature (see e.g. Eq. 3.8).

This, however, does suggest the possibility that the velocity dispersions listed in Table 3.5 are affected by inaccuracies in the estimation of the observational errors. If the errors are estimated to be too large, the velocity dispersion will be artificially lowered; if they are underestimated, the dispersions will be too high. Because the errors contribute only in quadrature, however, their effect is relatively small as long as they are less than the velocity dispersions themselves. In this case, the errors would have had to be underestimated by about a factor of 2 in order to erroneously raise the velocity dispersions by $100 \mathrm{~km} / \mathrm{sec}$. This large an error seems unlikely with the use of cross-correlation techniques in the determination of galaxy velocities. Ignoring the observational errors altogether (a gross underestimation of them) only raises the velocity dispersions by about 5 percent. The velocity dispersions therefore, are likely to be unaffected by errors in the velocity measurements.

Since the galaxy velocities are all measured relative to the quasars, the dynamics of the quasars with respect to the cluster center are important in the interpretation of these data. There is some empirical and theoretical support to the argument that quasars are at the dynamical centers of their associated rich clusters. Velocities of ten galaxies associated with the quasar 3C 206 indicate that the quasar velocity is indistinguishable from the dynamical center of the cluster. Velocities of cD galaxies are also often found to be indistinguishable from the central velocity of the cluster galaxies. (Colless 1988; see however Hill
et al. 1988 , for examples of cDs with high peculiar motions) If the quasars are not located in the dynamical centers of the clusters, the composite velocity distribution will be broadened to have a width corresponding to the widths of the galaxy distribution and the width of the distribution of quasar velocities with respect to the dynamical centers of the individual clusters, summed in quadrature. As the velocity dispersion calculated from the composite velocity distribution is already low, it would be difficult to absorb a quasar velocity dispersion of greater than about $100 \mathrm{~km} / \mathrm{sec}$ without lowering the galaxy velocity dispersions to very low values for rich clusters of galaxies.

In order to compare the dynamics of galaxies associated with quasars to the dynamics of other high-density systems, the velocity dispersions were compared to velocity data from a sample of normal Abell class 1 clusters at low redshift. Velocity data was taken from Colless (1988; hereafter C88) for 108 galaxies within 500 kpc of the cluster core of nine Abell clusters. The individual clusters were of Abell richness class 1, or poor examples of richness class 2, and had velocity dispersions ranging from 550 to $1100 \mathrm{~km} / \mathrm{sec}$. The slightly richer clusters were included since their core densities are more likely to reflect the same physical conditions as the extremely dense cores of the clusters associated with quasars (see section 3.1) The average velocity dispersion for these clusters was $890 \mathrm{~km} / \mathrm{sec}$, which is consistent with other determinations of the velocity dispersions of Abell class 1 clusters (i.e. Dressler and Shechtman 1988).

A Kolmogorov-Smirnov test determined that this sample of C 88 galaxies has a velocity distribution significantly different ( $99 \%$ confidence level) from both the total composite velocity distribution, and from the distribution assembled from
galaxies in environments with $B_{g q}$ greater than 500 (corresponding to Abell class 1 or richer) In addition, an F-test of the distributions found it unlikely (greater than $99 \%$ confidence) that the velocities from the low-redshift Abell clusters and the quasar clusters were drawn from parent distributions with the same standard deviation. Bright quasars therefore, seem likely to exist preferentially in environments with velocity dispersions significantly less than are typical for the centers of rich clusters at low redshifts.

Two selection effects in these samples of galaxy velocities must be evaluated. First, since there are unknown selection effects in the distribution of the observed galaxies at different distances from the cluster core, (i.e. only one object very near the quasar was observable per multislit mask, but that object was carefully chosen to be most likely to yield a redshift) any gradients in the velocity dispersion over these scales will result in a systematic difference in velocity dispersion for the two samples. This possibility, however, should be negligible; only galaxies with distances from the quasar or cluster core of less than 500 kpc were used. Gradients in galaxy velocities have been observed (Kent and Gunn 1982), but are generally observable only on much larger scales. Colless tested the C88 galaxy velocities for such gradients and found none.

A second selection effect might come from differences between the C88 and multislit samples in the absolute magnitudes of the galaxies for which velocity determinations were possible. If there is dynamical segregation of galaxies of different luminosities, sampling deeper into the galaxy luminosity function for the Abell cluster galaxies would yield a higher velocity dispersion. The lowredshift C88 sample includes galaxies with absolute magnitude 3 magnitudes
fainter than the multislit data for $z \sim 0.6$. No evidence for such segregation was found in the C88 sample, however, except for the tendency for the brightest (often cD ) galaxy to have a very low velocity relative to the dynamical center; otherwise the brightest galaxies have velocities consistent with the cluster as a whole. For the multislit data, the quasars correspond to the brightest cluster members, and indeed may have lower velocities than the other cluster galaxies. Their velocities, however, are not used in the calculation of the velocity dispersion, and hence cannot be responsible for lowering the observed velocity dispersions in the associated clusters. A very strong dynamical segregation of galaxies present only in the galaxies associated with quasars might account for the different velocity dispersion in the two samples. Since only the brightest cluster galaxies are observed with the multislits, a tendency for these galaxies to have smaller relative velocities might cause the observed low dispersion, even if fainter galaxies had dispersions which were similar to the C88 data. This possibility cannot be ruled out because of the relatively small range of galaxy luminosities for which we have redshifts. However, this would still indicate that the dynamics of the two samples are extremely different in this regard.

The velocity distribution of galaxies associated with quasars was also compared to a series of statistical models, in order to test for the effects of the cluster membership criteria, and of creating a composite velocity distribution from several different clusters. The models of the velocity dispersion used were based on the probability of observing a galaxy velocity given a sample of clusters with a gaussian distribution of velocity dispersions. The probability of sampling a given relative velocity is then proportional to:

$$
\begin{equation*}
\int_{0}^{\infty} e^{-v^{2} / 2 \sigma^{2}} e^{-\left(\sigma-\sigma_{a v e}\right)^{2} / 2 \sigma_{\text {range }}^{2}} d \sigma \tag{3.10}
\end{equation*}
$$

where $\sigma_{\text {ave }}$ is the mean velocity dispersion of the clusters and $\sigma_{\text {range }}$ is the deviation of velocity dispersions. The inclusion of a range of possible velocity dispersions will tend to narrow the shape of the velocity distribution somewhat at low velocities, and broaden it at high velocities.

The data were compared to six different models, summarized in Table 3.6. The first three all use a mean velocity dispersion of 850 to correspond to the expected mean dispersion of low-redshift Abell richness class 1 clusters. In model 850 , the range of dispersions was taken to be $300 \mathrm{~km} / \mathrm{sec}$, consistent with the observations of the C88 sample. Velocities greater than $3 \times 850 \mathrm{~km} / \mathrm{sec}$ are excluded, in accordance with the criteria used to define cluster members. Model 850a is for a single gaussian velocity distribution with a dispersion of $850 \mathrm{~km} / \mathrm{sec}$. Model 850 c uses the same mean and range of velocity dispersions as 850 , but excludes any galaxies with velocities greater than $1350 \mathrm{~km} / \mathrm{sec}$. This model represents a distribution in which a broad velocity dispersion was erroneously truncated at $3 \times 450 \mathrm{~km} / \mathrm{sec}$, the maximum velocity used for the real data, and thereby artificially narrowed. Model 450 and 450a have mean velocity dispersions of $450 \mathrm{~km} / \mathrm{sec}$; model 450 includes a range of dispersions of $200 \mathrm{~km} / \mathrm{sec}$, while 450a is for a single gaussian distrubution. Finally, model 250 represents a distribution of clusters with mean velocity dispersion of $250 \mathrm{~km} / \mathrm{sec}$ and a range of $200 \mathrm{~km} / \mathrm{sec}$. This model is based on the observations of Ramella et al (1989) of a statistical sample of small groups of galaxies.

Table 3.6. Velocity Distribution Models

| Model | $\sigma_{a v e}$ <br> $(\mathrm{~km} / \mathrm{sec})$ | $\sigma_{\text {range }}$ <br> $\mathrm{km} / \mathrm{sec}$ | Comment |
| :---: | :---: | :---: | :---: |
| 850 | 850 | 300 |  |
| 850 a | 850 | single <br> gaussian |  |
| 850 c | 850 | 300 | truncated at <br>  <br> 450 |
| 450 a | 450 | 200 |  |
|  | 450 | single |  |
| 250 | 250 | 200 |  |

The data and models were compared using a Kolmogorov-Smirnov D statistic. Table 3.7 lists the results for the C88 sample, for the entire sample of galaxies associated with quasars, for galaxy velocities of objects in rich clusters associated with quasars ( $B_{g q}>500$ ), and for the galaxies in poorer environments. Also listed are the $95 \%$ and $99 \%$ confidence limits for these samples.

The results for the C88 sample of galaxies in low-redshift Abell clusters show that the data are not inconsistent with the 850 and 850a models, although they may be inconsistent with the 850 c truncated model. This lends credibilty to these models as reasonable representations of the velocities found in normal Abell cluster environments. The data are highly inconsistent with models of smaller mean velocity dispersion.

The composite distribution of velocities for all of the galaxies associated with quasars is shown to be inconsistent at the $99 \%$ confidence level with all of the models with mean velocity dispersion of $850 \mathrm{~km} / \mathrm{sec}$. This indicates that the observed velocity distribution is not likely to be caused by a distribution in velocity dispersions of the cluster samples, or by an overly-restrictive application of the cluster member criterion. The data are also found to be inconsistent at the $95 \%$ confidence level with model 250 , suggesting that the observed velocity distribution is also inconsistent with a sample of clusters with very small velocity dispersions. Figures 3.7 and 3.8 show cumulative velocity distributions of the data and the models for comparison.

The data were also compared to two models with mean velocity dispersion of $450 \mathrm{~km} / \mathrm{sec}$, approximately the same value dispersion as calculated for the data itself. As expected, the data is shown to be not inconsistent with both

Table 3.7. Results of Kolmogorov-Smirnov Tests

| Model: | 850 | 850 a | 850 c | 450 | 450 a | 250 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| Data |  |  |  |  |  |  |
| C 88 | 0.08 | 0.09 | $\underline{0.20}$ | $\underline{0.33}$ | $\underline{0.31}$ | $\underline{0.47}$ |
| $\mathrm{~N}=108$ |  |  |  |  |  |  |
| $95 \%=0.13$ |  |  |  |  |  |  |
| $99 \%=0.15$ |  |  |  |  |  |  |
| ALL | $\underline{0.32}$ | $\underline{0.34}$ | $\underline{0.27}$ | 0.13 | 0.12 | $\underline{0.15}$ |
| $\mathrm{~N}=86$ |  |  |  |  |  |  |
| $95 \%=0.15$ |  |  |  |  |  |  |
| $99 \%=0.18$ |  |  |  |  |  |  |
| Rich | $\underline{0.32}$ | $\underline{0.34}$ | $\underline{0.34}$ | 0.11 | 0.12 | 0.20 |
| $\mathrm{~N}=37$ |  |  |  |  |  |  |
| $95 \%=0.23$ |  |  |  |  |  |  |
| $99 \%=0.25$ |  |  |  |  |  |  |
| Poor | $\underline{0.29}$ | $\underline{0.30}$ | 0.22 | 0.11 | 0.11 | $\underline{0.28}$ |
| $\mathrm{~N}=29$ |  |  |  |  |  |  |
| $95 \%=0.24$ |  |  |  |  |  |  |
| $99 \%=0.29$ |  |  |  |  |  |  |



Figure 3.7 Cumulative relative velocity distributions. The bold-faced line represents the data from galaxies associated with bright quasars, and the solid line represents model 850 c (see text and Table 3.6). Dashed and dotted lines represent models 850 and 850 a, respectively. The data are shown to be inconsistent with all of these models.


Figure 3.8 Cumulative relative velocity distributions. The bold-faced line represents the data from galaxies associated with bright quasars, and the solid line represents model 250 (see text and Table 3.6). The data are shown to be inconsistent with this model.


Figure 3.9 Cumulative relative velocity distributions. The bold-faced line represents the data from galaxies associated with bright quasars, and the solid line represents model 450 (see text and Table 3.6). The dashed line represents model 450a. The data are shown to be not inconsistent with these models.
the single gaussian model, and with a broadened distribution of cluster velocity dispersions. Figure 3.9, however, illustrates that the latter is more likely to accurately describe the data, although the departures from a single gaussian model are not statistically significant.

Velocities of galaxies in rich clusters and poor environments are also compared separately to each of the models. Though the rich and poor environment samples are found to be not inconsistent with each other, they may show tendencies to be more or less consistent with different models. The sample is now roughly divided in two, however, so that the results are much weakened. For both samples of galaxies, the data is found again to be inconsistent with the models with high velocity dispersions and with the 250 model. The sample of galaxies in poor environments, in particular, is shown to be inconsistent with the 250 model at the $98 \%$ confidence level. Figure 3.10 shows the cumulative distributions.

As the 250 model is based on observations of poor clusters, finding a larger dispersion for galaxies in groups of similar richness associated with quasars than for "normal" groups is interesting. In judging the compatibility of the data with model 250 , however, it must be remembered that all velocities are measured with respect to the quasar, and that the quasar is assumed to be at rest with respect to the cluster center. If quasars have measureable velocity with repect to the cluster dynamical center, the composite velocity dispersion calculated for the galaxies will be broadened. Colless (1988) suggests that cD galaxies in rich clusters have velocities of about $.25 \sigma$. which would mean a dispersion of approximately $100 \mathrm{~km} / \mathrm{sec}$ and account for only a $11 \%$ difference between the


Figure 3.10 Cumulative relative velocity distributions. The bold-faced line represents the data from galaxies in poor groups ( $B_{g q}$ less than 500 ) associated with bright quasars, and the solid line represents model 250 (see text and Table 3.6). The data is shown to be inconsistent with this model.
observed and real velocity dispersions. If, however, the distribution of quasar velocities were similar to that of the rest of the galaxies in the cluster, the velocity dispersion would be decreased by a factor of root 2 , bringing it down to approximately $300 \mathrm{~km} / \mathrm{sec}$.

As mentioned above, the velocity dispersion for quasars in rich clusters of galaxies is low compared to that of Abell clusters at low redshift, and that decreasing the dispersion further by postulating that quasars are not at rest in the centers of these clusters would lower the dispersion to uncomfortably low values for rich clusters. In addition, there is evidence that the quasars in these rich environments are indeed in the dynamical center, or at least have velocity dispersions much lower than those of the other cluster galaxies. Quasars in poor groups, however, probably do not share this characteristic, and are more likely to have similar velocities to the other galaxies in the group. Assuming this, the velocity dispersion for those galaxies in poor environments must be corrected for the relative motion of the quasars, suggesting that a value of closer to $300 \mathrm{~km} / \mathrm{sec}$ is appropriate. This value is also consistent with the values used in model 250, which were taken from observations of similar poor groups. It seems, therefore, that while quasars in rich clusters of galaxies probably reside in the dynamical center of environments with anomalously low velocity dispersions, quasars in poorer groups reside in dynamically normal environments.

It might be suggested that the difference in velocity dispersion seen between clusters associated with bright quasars at $z>0.3$ and low-redshift Abell clusters comes primarily from evolution in the properties of normal clusters, rather than that abnormal clusters are associated with quasars. Gunn (1988) has synopsized
data from eight rich clusters of galaxies at $z \sim 0.45$. The velocity dispersions of all of the individual clusters are greater than $500 \mathrm{~km} / \mathrm{sec}$, and the avarage dispersion is consistent with values for low-redshift clusters. There may still be systematic differences in the clusters chosen in Gunn's sample (which were identified primarily from their high density contrast against the background galaxy distribution) and the clusters detected near quasars, however, and this possibility cannot be evaluated until more complete spectroscopic observations of high redshift clusters are obtained.

In summary, the dynamics of galaxies in rich clusters associated with bright quasars are found to differ from those of low-redshift environments of similar richness, whereas galaxies in poor groups associated with the quasars may be dynamically normal. In all subsamples of the data based on richness of environment and radio properties of the quasar, the relative velocity distributions are found to be statistically indistinguishable, characterized by a gaussian (or slightly broadened gaussian) distribution with a dispersion of about $450 \mathrm{~km} / \mathrm{sec}$. There is no tendency for radio-loud quasars to exhibit systematic red or blueshifts, but radio-quiet quasars may show a weak tendency to have blueshifted [O III] velocities with respect to the galaxy velocity distribution.

### 3.5 Summary of the Properties of Quasar Environments

The properties of clusters of galaxies associated with quasars have been studied using optical and radio imaging data of both optically bright and faint quasars, and optical spectroscopy of the galaxies associated with the bright quasars. These studies attempt to determine which properties of these environments are conducive to quasar activity and, if possible, to ascertain whether changes in the cluster environments might be responsible for the rapid optical evolution of quasars discussed in Section 2. The cluster properties for both the bright YG87 and new faint samples, therefore, are first compared with the properties of low-redshift cluster environments, and then the two samples are compared.

The rich galaxy environments associated with quasars may be different from low-redshift Abell clusters of the same richness in several ways. First, optical imaging of the cluster cores indicates that the galaxies are more tightly clustered around the quasar than are Abell cluster galaxies around their cluster center. The core radii of quasar clusters is less than 200 kpc - a factor of 2 smaller than for normal low-redshift clusters. This result seems to apply to both the rich clusters around bright quasars at $z \sim 0.6$ and composite galaxy density distributions for rich clusters around faint quasars at $z \sim 0.4$.

The calculated radial distributions, of course, depend on the assumption that the quasar is in the cluster core. This seems to be the case for several of the clusters for which very deep photometry is available (Ellingson et al. 1989; Yee et al. 1990), although there is some evidence that some quasars are situated in smaller condensations of galaxies on the outskirts of the rich
clusters (Yee et al. 1990), or large-scale structures. As a specific example, the quasar 3C 345 is located in a dense subcluster, but may be also embedded in a very large supercluster spanning many Mpc (Crampton and Rensing 1982). Indirect evidence of this may be seen in the velocities of galaxies in the 3C345 field- Table 3.6 lists a number of objects which, although not associated with the quasar by the membership criteria used here, have redshifts within a few thousand $\mathrm{km} / \mathrm{sec}$ of the quasar.

As most of the imaging of the quasars is confined to radii less than 1 Mpc from the quasar (and less in the case of the YG87 and faint quasar survey), the larger-scale environment of the quasars is relatively unknown. While the spatial covariance amplitudes of the quasars may indicate that they exist in environments similar to Abell class 1 clusters, this measure is an average over typically 500 kpc to 1 Mpc . The possibility therefore exists that quasars may be found in the centers of small subcondensations or knots of very high galaxy density and sizes of $100-200 \mathrm{kpc}$, located in larger regions of enhanced galaxy density, as well as in the cores of rich clusters.

The colors and spectra of the galaxies associated with quasars seem consistent with those of normal galaxies. Yee et al. (1988) and Ellingson et al. (1989) find that the rich environments immediately surrounding bright quasars may contain larger fractions of blue galaxies than predicted even by the ButcherOemler effect (Butcher and Oemler 1984). Error bars for the blue fraction of galaxies in individual clusters are large, however, and this effect is not clearly supported by the colors of galaxies surrounding fainter quasars. The galaxies in rich clusters associated with low luminosity quasars are redder than predicted
by the Butcher-Oemler relationship, and instead seem more consistent with lowredshift clusters. The difference between the bright and faint quasar samples in the colors of associated galaxies, however, may be used as a weak indication of differences in the environments associated with optically bright and faint quasars. If gas-rich galaxies are no longer found in the cluster cores, either through gas-stripping of the galaxies by their passage through a dense ICM, or through some other process, it might be postulated that gaseous fuel available for consumption by the quasar may be lacking as well. This might then cause a dimming of the quasars, or a shortening of their lifetimes. A possible flaw in this scenario, however, is if quasar host galaxies have small velocities with respect to the dynamical center of the cluster, they are not likely to be stripped due to their movement through the ICM. A scarcity of gas in the quasar host galaxy, in that case, cannot be inferred from a similar lack in companion galaxies which have higher velocities relative to the cluster center.

A more intriguing (although still statistically insignificant) difference may be seen in the radio morphologies of the two samples. The bright quasars in rich environments mostly have FR II classical double and triple morphologies with diameters greater than about 200 kpc . The three faint quasars in rich clusters for which detailed radio maps were available showed bent or distorted radio lobes or signs of containment from an external medium and are on average smaller than the double-lobed structures of optically luminous quasars of similar radio power. This suggests that one possible difference in the two samples is the existence of a dense intra-cluster medium associated with the faint quasar environments. As
discussed above, gas stripping of cluster galaxies may be indicative of a lack of fuel for the quasar.

Gas in the cluster core can also be interpretated as evidence for cooling flows in the quasar vicinity. It has been suggested that cooling flows could supply a mechanism for fueling quasars over long lifetimes (Fabian et al. 1986), and that a decrease in the cooling flows may be responsible for the evolution of quasars, especially those in cluster environments. The evidence here suggests, however, that the fainter quasars are associated with dense gas environments. This implies that a dense ICM in the vicinity of the quasar impedes the optical emission from the nucleus, rather than fuels it. This might be understood if large amounts of cooling gas in the nucleus tended to fragment and form stars rather than remain available for quasar consumption. Another possibility might be that dust formed in the cooling flows might obscure the optical quasar light. Another problem with the cooling flow mechanism is that lifetimes of cooling flows are generally believed to be on the order of 5-10 Gyr (e.g. Arnaud 1988), much longer than the observed quasar fading time. The optical evolution of radio galaxies is therefore probably not linked in any direct way to changes in cooling flows in these environments.

The most significant difference found between clusters of galaxies associated with quasars and normal rich clusters is that the dynamics of the galaxies associated with quasars indicate that bright quasars are found preferentially in environments with small relative velocities. This may be understood using models of quasar activity in which the triggering by galaxy-galaxy interactions is important. Fast encounters between the quasar host galaxy and a neighboring
galaxy are much less effective at wreaking the necessary havoc than are slow encounters (Toomre and Toomre 1972, Aarseth and Fall 1980, DeRobertis 1985), and radial galaxy orbits are more efficient than tangential. The increase in velocity dispersion and the decrease in the fraction of highly radial orbits which accompany virialization, therefore, might have a strong effect on the evolution of quasars situated in rich clusters of galaxies, with quasars in these environments tending to disappear as the cluster virializes. Quasars in poorer environments, where dynamical evolution is slow, would not show as dramatic a change. Poor groups of galaxies at recent epochs have velocity dispersions as low as those seen for galaxies associated with quasars, and hence may be considered suitable environments for quasar activity, even at recent epochs. This model is consistent with observations of the existence of quasars in poor environments at both high and low redshifts.

To complement the statistical nature of these results, it is interesting to summarize and contrast results from the extensive studies of two particular quasars, 3C 206 in the bright quasar survey, and 3C 275.1 in the faint quasar survey. These quasars are two of the first discovered to reside in very rich clusters of galaxies and hence have been the target of extensive observations. The quasars and their environments, however, do have several characteristics which separate them from the population of what might be called "normal" quasars in rich cluster environments. Therefore, instead of considering these objects typical of bright and fading quasars in rich environments, it might be better to study the most extreme of their anomalies and postulate that these properties play a
role (or, at least, are consistent with) their places in the evolution of radio-loud quasars in rich environments.

It must be noted first that the choice of 3C 206 to represent a bright (that is, unfaded) quasar is somewhat suspect; although it was included in the bright quasar surveys of Yee and Green, comparison of its absolute $r$ magnitude with that of 3C 275.1 indicates that they have very similar optical luminosities. It is, however, situated in a very rich cluster environment at a redshift of only 0.2. If the quasar fading relation is indeed much faster for radio-loud objects in rich environments, 3C 206 stands out as an anomalously bright quasar for its rich environment and redshift, and hence may exhibit (in excess?) the same properties of the "unfaded" objects at high redshift. On the other hand, it may only represent a random object from the bright end of the luminosity function at low redshift and therefore have properties very typical of the faint quasars. This object, however, does seem to share the same properties as have been observed in the bulk of the bright quasars, and so it does not seem unwise to associate it cautiously with these objects.

The quasar and cluster of galaxies surrounding 3C 206 have been studied by a number of investigators. Wyckoff et al. (1980) first resolved the quasar and determined that at least one of the associated galaxies was located at the same redshift of the quasar. Ellingson et al. (1989) concluded from decomposition and variability data, however, that the host galaxy was at least a magnitude fainter than expected for a normal first-ranked elliptical galaxy, and had colors 0.25 mag bluer in $B-V$. Velocities of associated galaxies yielded a velocity dispersion for the cluster core of about $500 \pm 100 \mathrm{~km} / \mathrm{sec}$, which is typical of the
sample of bright quasars discussed here (note that the 3C 206 cluster is included in this sample, contributing approximately $15 \%$ of the velocities). The cluster of galaxies seems to be strongly flattened, but shows no evidence of rotation, and has an extremely compact cluster core centered on the quasar. The cluster, therefore appears to be in a state far from virialization, perhaps in a collapse or "bounce" stage. There are several blue galaxies in this small core area, although projection effects may be responsible for their apparent existence in this very rich environment. The quasar is an X-ray source, but it is not known whether it is resolved. Finally, the quasar is a steep-spectrum double-lobed radio source with a relatively large linear size of about 750 kpc , aligned approximately with the flattened cluster morphology (Wyckoff et al. 1980), indicating that an ICM in the vicinity of the quasar is not dense enough to retard the radio lobes. Little extended [OIII] emission was found by Stockton and MacKenty (1987) in a search for direct evidence of extranuclear gas in the quasar vicinity.

The quasar 3C 275.1, on the other hand, shows much evidence of large quantities of gas near the quasar. This object has been extensively studied by Hintzen and collaborators. They found (Hintzen and Romanishin 1988) that the quasar host galaxy properties are consistent with a very bright giant elliptical galaxy, although the colors were again found to be somewhat bluer than normal. The quasar is embedded in a 100 kpc elliptical cloud of ionized gas which seems to be rotating as a solid body (Hintzen and Stocke 1988). The quasar shows a bent-lobe radio morphology, and a rather small linear size of 125 kpc , also suggestive of a surrounding dense ICM. The quasar is a strong, marginallyresolved X-ray source, implying that the X-ray flux could come from either the
quasar or an ICM surrounding it. Hintzen and Romanishin suggest that this gas is evidence for a cooling flow centered on the quasar, and that the quasar might also be considered a "proto-cD galaxy." This quasar is also embedded in a very compact knot of galaxies (although not as dense as the cluster associated with 3C 206), which has a relatively large blue fraction of galaxies. The velocities of the associated galaxies are not known.

The primary difference observed so far between these two quasars is in the amount of material which seems to be associated with them at distances of about 100 kpc from the nucleus. 3C 275.1 shows evidence for a large amount of hot, high-density gas in its vicinity, while 3C 206 shows no sign of a similar gas-rich environment. The origin and nature of this gas is still unclear. It may be residual gas from disruptive interactions between the quasar host galaxy and cluster galaxies (cf. Stockton and MacKenty 1987), or evidence of a rich ICM and/or cooling flows in the cluster of galaxies.

An untested difference between these two objects is the dynamical state of the clusters of galaxies associated with them. The cluster associated with 3C 206 may be an unvirialized cluster with a low velocity dispersion. The cluster surrounding 3 C 275.1 appears to be more regular and may be more advanced in its dynamical evolution, despite its higher redshift. There is evidence, therefore, that either the gaseous content of the quasar environment or the dynamical state of the cluster core, or both, may affect the quasar luminosities, and may be linked to the evolution of quasars as a function of environment.

## Section 4: Discussion

### 4.1 Summary of Results

In section 2, observations of the environments of a sample of faint quasars at $0.3<z<0.6$ were used to show that the evolution of radio loud quasars is dependent upon the richness of their environment. This evolution is characterized by a rapid fading of the observed optical luminosities of quasars in environments as rich as Abell class 1 galaxy clusters, with little or no fading apparent for radio loud quasars in poorer environments. The magnitude of this fading is approximately 3 magnitudes between redshifts 0.6 and 0.4 . A fit to the observed luminosities of quasars in rich clusters yields an fading e-folding time of about 0.9 Gyr 3-4 times faster than has been observed for optically selected quasars in general (i.e. Boyle et al. 1988).

No correlation was found between the optical luminosity of the quasars and environment, indicating that selection effects in the optical magnitudes of the quasars in the sample are not responsible for the observed evolution. Likewise, no strong correlation between radio power and environment was found. This sample, however, was not chosen on the basis of uniform radio properties, and quasars at higher redshift in this sample have larger radio powers on average. The results are therefore not inconsistent with quasars in rich environments generally having radio powers greater than $10^{26}$ Watts $/ \mathrm{Hz}$. This possibility, however, does not affect the interpretation of evolution in the quasars' optical luminosities. Radio power and optical luminosity in this sample are positively correlated; a radio power-environment correlation or threshhold, therefore, cannot explain the tendency for the most luminous quasars observed at $z \sim 0.6$
and the least luminous at $z=0.4$ to be found in similarly rich environments. The observed decrease in luminosity of radio loud quasars in rich environments is therefore likely to be true evolution in the typical optical luminosities of the quasars.

In addition, observations of radio quiet quasars showed that their environments are different from those of radio loud quasars in that they are never found in these rich environments for $z<0.7$. This result implies that radio loud and radio quiet quasars at these redshifts are physically distinct objects, rather than the same object at different viewing angles or stages of evolution.

In section 3, properties of the galaxy cluster environments of radio loud quasars were investigated in order to determine physical conditions which are favorable for quasar activity. Where possible, results from fields in the YG87 bright quasar survey and the faint quasar survey were compared in order to determine changes in the quasar environment which might be responsible for the observed decrease in optical luminosities of the quasars.

Observations of the cluster environments of faint radio-loud quasars indicate that the excess galaxies in these fields are reasonably well-fit by an empirical King model with core radius of about 200 kpc . This core radius is consistent with that derived for clusters associated with bright quasars (Yee et al. 1989), but is a factor of 2 smaller than is observed for low-redshift clusters of galaxies of Abell richness class 1 (Colless 1988, Dressler 1980) and corresponds to an environment with several times greater central density than a "normal" cluster of the same Abell class. The data so far are insufficient to determine whether quasars in rich clusters are situated exactly in the local position of highest galaxy
density, although studies of several individual objects (i.e. Ellingson et al 1989, Yee et al. 1990) indicate this is so. The limited field available for these imaging studies, however, does not rule out the possibility that quasars are situated in small, very dense knots of galaxies embedded in larger structures, as well as in rich cluster cores. Velocity data from galaxies in the 3C 345 field may support this possibility.

The radio morphologies for quasars in both the bright and faint quasar samples were compared. Although the number of objects is small, these two samples may show differences, in that the radio morphologies for the optically faint quasars in rich clusters tend to be of smaller extent and more distorted than for optically more luminous quasars in environments of similar richness. This may indicate that the clusters of galaxies associated with the faint quasars may contain larger amounts of gas in the quasar vicinity. Because the average radio power is similar for the optically faint quasars in rich clusters and the optically bright quasars in similar environments, this difference is probably not due to evolution in the radio power of these objects.

The luminosities and colors of the excess galaxies in the faint quasar fields were found to be consistent with those expected for normal galaxies at the quasar redshift. The fraction of excess galaxies with blue colors was determined and found to be consistent with values for clusters at low redshifts. Although the uncertainties in this fraction are large, this may be inconsistent with the blue fractions of clusters at $z \sim 0.6$ associated with bright quasars, which are found to be as large or larger than those found for high redshift clusters by Butcher and Oemler (1984). This difference in the environments of bright and faint quasars
might imply a decrease in the amount of gas found in cluster galaxies, perhaps due to stripping from their motion through a developing ICM.

Finally, velocities of galaxies associated with bright quasars indicate that relative velocity dispersions in the environments of these objects is typically $450 \mathrm{~km} / \mathrm{sec}$ or less. This value is significantly smaller than the dispersions of low redshift rich clusters, suggesting that the dynamics of these clusters is very different from "normal" clusters. Velocity dispersions of $450 \mathrm{~km} / \mathrm{sec}$, however, might be somewhat larger than "normal" for some of the poor groups observed to harbor quasars. In these instances, however, non-zero motion of the quasar host galaxy relative to the dynamical center of the group would raise the relative velocities observed in a dynamically normal environment. Luminous quasars are therefore shown to be preferentially situated in environments with small relative velocities, whether in normal small groups of galaxies, or rich clusters with abnormally small velocity dispersions. The dynamics of galaxies associated with less luminous quasars have not yet been investigated for comparison.

### 4.2 Physical Models

The influence of environment on the optical evolution of radio-loud quasars is clear, as are several characteristics of clusters which may be conducive towards quasar activity, including high galaxy densities, low relative velocity dispersions and possibly a lack of a dense ICM. Differences in the properties of cluster associated with luminous and less luminous quasars suggest weakly that they differ in the amount of intra cluster gas in the cluster core, with the fainter objects having more gas-rich environments. The cause of the observed evolution of radio loud quasars in rich environments cannot be determined without extensive additional observation, but several physical explanations of this evolution can be suggested based on simple models of quasar activity and the evolution of cluster environments.

The necessary ingredients for creating a quasar are a supermassive black hole lodged in the center of a host galaxy, a fuel supply, and a transport mechanism to supply fuel to this central engine (Gunn 1979). Of these three ingredients, environmental change is likely to affect only the latter two. In fact, since black holes, once created, only grow in size, the disappearance of luminous quasars in rich environments must be related to decreases in the amount of fuel available to the black hole, and its supply rate for objects in rich environments.

The primary observation in this study of quasars in rich environments is that there are fewer luminous quasars at $z \sim 0.4$ in these environments than at $z \sim 0.6$. The amplitude of the quasar luminosity function for radio loud objects in rich environments, therefore, has decreased for the most luminous quasars. It should be emphasized that it is not known whether it decreases
similarly for quasars of all luminosities, or whether the evolution is only evident for luminous quasars, leaving the densities relatively constant for fainter objects. The discussion of physical models for this evolution, therefore, must be limited to the evolution of luminous radio loud quasars in rich clusters of galaxies between redshifts of approximately 0.7 and 0.3 .

The luminosity function of these objects can be shown to depend on three properties of the quasars: their luminosities as a function of age, their birthrate (as a function of luminosity, epoch, and now environment), and their lifetimes (also a function of luminosity, epoch and environment). Decreases in any one (or more) of these three quantities will decrease the observed luminsity function. Current results are not sufficient to determine which of these three properties cause the observed evolution. Clues from the physical conditions shown favorable to quasar activity, however, allow the discussion of physical mechanisms relating to fuel supply and transport to the quasar central engine which might be responsible for each of the three properties.

First, a decrease in the luminosity of either the brightest quasars or all quasars in rich clusters of galaxies can lead directly to the observed fading of quasars in these environments. In this case, the faint quasars seen at $z \sim 0.4$ are the direct counterparts of the brighter quasars at $z \sim 0.6$. The observed evolution corresponds to the pure luminosity evolution proposed for quasars in general (i.e. Boyle et al. 1988), but here would apply only to the very small subset of radio loud quasars in clusters of galaxies.

In this scenario, the quasars are assumed to be long lived (lifetimes greater than 1 Gyr ) and the e-folding timescale for this direct fading of optical emission
from quasars is the observed statistical fading time of 900 Myrs . This timescale is probably best interpreted as the timescale of change in some crucial property or properties of the quasar environment, since radio loud quasars in poor environments clearly have much longer fading timescales. This timescale is also typical of dynamical timescales in cluster environments of this type. For a "typical" quasar environment with core radius of 200 kpc and velocity dispersion of $450 \mathrm{~km} / \mathrm{sec}$, the crossing time is approximately 500 Myrs and the relaxation time for the cluster core is 1.5-2 times greater (e.g. White 1982). This is in good agreement with the observed fading time. It is therefore possible that the fading of quasars is due either directly to dynamical changes due to the relaxation of the cluster, or to other changes in the cluster driven by the same dynamical evolution.

One such mechanism might be that small, low relative velocity encounters between the quasar host galaxy and a companion galaxy are necessary to continually disturb gas or star orbits to fuel the central engine. An increase in the core velocity dispersion might then decrease the effectiveness of these small perturbations, leading to a fairly gradual decrease in the fuelling rate for the quasar. The observed low velocity dispersion of galaxies associated with bright quasars strongly suggests that environments with higher velocities are not suitable for quasar activity. This is also in agreement with the models of Toomre and Toomre (1972), and more recently, Carlberg (1989), where efficiency of galaxygalaxy encounters in triggering nuclear activity is expected to be greater for low relative velocities. Hence, if virialization in the quasar environment raises the velocity dispersion to higher values, the probability of an effective encounter
is lowered. Another important influence on the rate of effective interactions is the possibility that the extended halos of the cluster galaxies might become tidally stripped, decreasing the frequency of efficient interactions over a similar timescale.

A second mechanism might be related to the evolution of a hot ICM, or possibly to cooling flows in the cluster core. As discussed in Section 3.5, however, a mechanism whereby the existence of an ICM would cause a gradual fading of quasar luminosities is elusive, since if quasars have small velocities relative to the dynamical center of the clusters, stripping would be ineffective in removing gas from the quasar host galaxy. Cooling flows are also problematic, since the existence of intracluster material seems to be related to a fading of the quasar luminosities, rather than a possible fuel supply.

A second scenario for the evolution of radio loud quasars in rich environments is linked to a decrease in the birthrate of these objects. To cause the observed evolution, quasar lifetimes in this scenario must be shorter than the observed fading time of $\sim 1$ Gyr. The luminosity function evolves, therefore, because quasars die and are no longer replaced by new objects of the same luminosity. Again, it should be noted that in this scenario, it is not known whether only the brightest quasars are no longer created, or whether quasars of all optical luminosities are similarly affected.

The primary physical mechanism implied by this scenario is a decrease in the birthrate of quasars due to a decrease in the triggering of nuclear activity by mergers or strong galaxy-galaxy encounters. The difference between this scenario and the luminosity evolution scenario discussed above is in the nature
of the triggering process. In the previous case, ongoing small perturbations fuel the quasar at decreasing but continuous rates. In this scenario, mergers and more violent encounters are used to trigger the quasar "event" whose lifetime is shorter than the period between subsequent mergers. Aarseth and Fall (1980) have shown that merging requires that the encounter velocity not significantly exceed the internal velocity dispersion of the galaxies, approximately $200 \mathrm{~km} / \mathrm{sec}$. The fraction of galaxies with relative velocities less than $200 \mathrm{~km} / \mathrm{sec}$ is lower by a factor of 4 for a gaussian distribution of galaxy velocities with dispersion of $850 \mathrm{~km} / \mathrm{sec}$ than for one with dispersion $450 \mathrm{~km} / \mathrm{sec}$. Virialization of cluster galaxies, therefore, decreases this merger rate on dynamical timescales, causing a decline in the birth of new quasars.

The third scenario is that the lifetimes of bright quasars have decreased, causing a decrease in their duty cycle. As in the scenario based on decreasing birthrates, this requires that the lifetimes of the quasars are shorter than the observed fading timescale. The decrease in the number of bright quasars seen in rich clusters at low redshifts is simply a reflection of how long they are visible at high luminosities.

Quasar lifetimes are dependent upon the amount of fuel available for the quasar, and the rate at which it is consumed. For a sample of quasars with a certain distribution of black hole masses and luminosities, their lifetimes are dependent only upon the total amount of gas available in a given quasar event. This quantity could possibly be dependent on the galaxy cluster environment in several ways. First, a change in the effectiveness of galaxy interactions might on average decrease the amount of gas dumped into the interior parts of the quasar
host galaxy. Dynamical evolution, as discussed above, would therefore decrease the fuel supply of quasars in rich environments, and hence their lifetimes. Second, gas stripping might deplete the amount of gas available in the quasar host galaxy, though as mentioned earlier, stripping may not be efficient in the quasar host galaxy. It may, however, be sufficient to strip gas from other cluster galaxies. If the quasar's central engine is dependent upon gas supplied by a merging galaxy, gas stripping of cluster galaxies may remove a necessary source of fuel. A third possibility is inspired by the large body of evidence suggesting that the amount of gas available in most galaxies has decreased since $z \sim 0.5$, best illustrated in the "Butcher-Oemler" effect (1984). the dependency of this effect on environment, however, is not clear, as it may be equally present in the field (Koo 1986). In this case, however, a general trend cannot be responsible for the difference in evolution of quasars in rich and poor environments. Gas must be diminished preferentially in galaxies in the centers of rich clusters in order to produce the observed evolution. A final simple explanation is that quasars in rich clusters undergo multiple active stages, and that the time necessary to replenish the host galaxy's internal fuel supply is longer than the time between quasar "triggers." In this case, the quasars will have decreasing lifetimes as the available gas in the host galaxy is depleted faster than it can be supplied. Quasars in poorer environments may be triggered less frequently, and therefore have more time to replenish the internal fuel supply.

These three scenarios are sufficient to describe the observed evolution of bright radio quasars in rich clusters of galaxies, but currently cannot be distinguished by the available observations. There is an interesting difference in the
details of these models which might be tested with more complete samples of quasars. A change in slope of the high-luminosity end of the luminosity function of quasars indicates the relative amount of evolution suffered by luminous and less luminous quasars. If this slope could be measured, it might provide an indication as to which of these three scenarios is most likely.

In the first scenario, the gradually decreasing luminosity of quasars is caused by declining fueling rates. There is no clear reason why the decline in these rates might be dependent upon the luminosity of the quasar, and hence faint quasars should be affected similarly to bright ones. The result is that the highend slope of the luminosity function remains constant. In the second scenario, there is a weak tendency for more massive galaxies to capture other galaxies at somewhat higher relative velocities (Pierce and Tully 1988). If the quasar luminosity is linked to the host galaxy mass in some fashion (as proposed by Carlberg 1989), the most luminous quasars would be more likely to capture other cluster galaxies and trigger AGN activity. The effect on the luminosity function, therefore, would be a net decrease in the number of all quasars but a flattening of the bright end slope, as faint quasars are affected more than bright quasars. The third scenario would cause the opposite effect; declining fuel supplies would affect the most luminous quasars before the fainter ones, hence steepening the quasar luminosity function.

A difficult, but possible, test of these scenarios involves calculating the ratio of the quasar luminosity to the Eddington luminosity. The Eddington luminosity is the maximum luminosity a black hole of a given mass can produce before outwards radiation pressure overcomes the gravitational attraction which
fuels it. Whether quasars shine at the Eddington Luminosity or some fixed fraction of it is not well-determined, as black hole masses are undetermined. Wandel and Yahil (1984) estimated the masses of the black holes associated with luminous quasars by studying the dynamics of emission in the broad line region. Their results indicate that the quasars in their sample shine at a relatively fixed fraction (approximately 1\%) of the Eddington luminosity. The first scenario described above, luminosity evolution, predicts that the average $L / L_{E d d}$ will be larger for the high redshift quasars than for the low redshift quasars. The second scenario predicts only a change in birthrate, and not in the quasar luminosities as a function of age or their lifetimes. The ratio $L / L_{E d d}$, therefore, will remain the same for high and low redshift objects. The third scanario, a decrease in the quasar lifetimes, does not predict a single result; $L / L_{E d d}$ will depend on the details of the quasar luminosity as a function of its age.

### 4.3 Comparison with Other Active Galactic Nuclei

It must be rememberd that radio loud quasars comprise only about $10 \%$ of all quasars, and that those in rich clusters are an even smaller fraction. It is therefore useful and necessary to compare the properties and environments of these special objects with other types of active galactic nuclei.

The environments of radio quiet quasars are found in this study to be significantly different from radio loud quasars in that there is no evidence that they are ever found in rich clusters of galaxies. As discussed earlier, this implies that these objects are physically different, and certainly implies that they are not merely the same object seen at different orientations of in different stages of evolution. The difference in environments, instead, is suggestive of the difference between the enviroments of spiral and elliptical galaxies. Several investigators (e.g. Hutchings et al. 1987) in studies of quasar host galaxies, have suggested that this is the case. Seyfert galaxies, AGNs whose host galaxies have the properties of spirals, are also found in environments which are slightly richer than average, though never in rich clusters of galaxies (Dahari 1984, MacKenty 1989; see, however, Fuentes-Williams and Stocke 1988).

The environments of radio galaxies are extremely similar to those of radio loud quasars, and their optical identification as elliptical galaxies also supports the interpretation that host galaxy type is the key to radio loud/quiet differentiation. Studies of the environments of radio galaxies (Prestage and Peacock 1988, Yates 1989, Hill 1989) show that radio galaxies are also found in rich cluster environments.

The fact that radio loud quasars cannot evolve into radio quiet quasars implies that the lifetimes of the radio emission must be as long or longer than the optical lifetimes. Some fraction of radio galaxies, therefore, could be radio quasars in which the optical light has faded, is quiescent or obscured. This interpretation is also suggested in recent work by Hill (1989), who showed that radio galaxies are more likely to be found in rich clusters of galaxies at $z \sim 0.5$ than at lower redshifts. This effect was shown to be strongest for FR II radio galaxies, which might imply that their disappearance from clusters may be due to a change at lower redshift into FR I morphology sources, a change which might also be evident in radio quasars. The objects studied by DeRobertis and Yee (1989) also suggest that some radio galaxies are the end or quiescent evolutionary stages of radio loud quasars.

### 4.4 Future Work

The environments of quasars and other AGNs have recently been found to be a fruitful target of investigation. In this study, the environments of radio loud quasars were found to have a strong effect on their optical evolution, and several mechanisms based on observed properties of quasar environments were suggested to explain this dependence. Several additional projects are clearly needed in order to confirm and clarify this evolution and its interpretation.

First, a glance at Figure 2.12 indicates immediately that further imaging of the environments of both faint quasars at $z \sim 0.6$ and quasars/radio galaxies at $z \sim 0.2$ is necessary to better derive the optical fading curve of quasars. A sample of faint quasars at high redshifts are also very likely to yield large numbers of new clusters, to further study the properties of quasar environments. Detailed studies of low redshift clusters of galaxies associated with radio galaxies may also yield very important results concerning the possible end states of quasar evolution, and complete the study of the effects of environment on radio loud AGN from $z \sim 0.7$ to present epochs.

The relationship between radio power, radio morphology and the evolution of radio loud quasars in rich environments is still unclear. Environments for a sample of quasars chosen to have similar radio powers and morphologies at all redshifts must be examined in order to determine possible correlations of environment with radio properties. These observations can then be compared directly with studies of the environments of radio galaxies.

Differences in the dynamics and the properties of the ICM between the bright and faint quasar samples may help determine which physical mechanism
is responsible for the decline in quasar luminosity for quasars in rich environments. Velocities of galaxies associated with the bright quasar sample have been obtained; multi-object spectroscopy of the galaxies associated with faint quasars at $z \sim 0.4$ is still necessary. Likewise, X-ray observations of these clusters may help answer the question of whether intra cluster gas content plays a role in quasar evolution.

A final project which involves the study of quasar environments uses $C$ IV absorption at $z_{a b s} \sim z_{e m}$ found in the wings of C IV emission lines from radio loud quasars with $z \sim 1.5$. These absorptions, studied by Foltz et al. (1986), may be due to the halos of galaxies in cluster environments at the quasar redshift. A search for correlations between quasar environment and incidence of C IV absorptions at $z \sim 0.6$ are underway, but are difficult to find due to poor resolution in existing IUE spectra; HST observations may allow confirmation of this interpretation and allow the study of quasar environments to arbitrarily large redshifts.

## APPENDIX: Photometry

This appendix presents photometry of objects in the fields of faint quasars, as described in Section 2.2. The fields are ordered by increasing right ascension, and include the quasar identification, redshift and coordinates, and the $r$ limiting magnitude (RL) and, where available, the $G$ limiting magnitude (GL). The columns contain the following information for each object: 1) Object number; 2) and 3) offset position from the quasar in arcseconds (positive is to the north and east); 4) $r$ total magnitude; 5) $g$ total magnitude where available; 6) $g-r$ color where available; 7) object classification where 1 and 2 denote galaxies, 3 denotes stars, and 0 denotes probable cosmic ray or noise events; 8) identification of the quasar in the field.


| 1 | -54.6 | -9.5 | 22.14 | 23.80 | 1.65 | 1 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| 2 | -54.3 | -16.3 | 20.79 | 22.07 | 1.28 | 1 |
| 3 | -54.0 | 20.0 | 22.84 | 22.85 | 0.01 | 1 |
| 4 | -51.5 | 16.6 | 22.55 | 24.26 | 1.71 | 1 |
| 5 | -45.7 | -19.1 | 17.88 | 19.30 | 1.42 | 1 |
| 6 | -42.4 | -3.8 | 22.45 | 23.25 | 0.80 | 2 |
| 7 | -36.5 | 43.3 | 22.58 | 23.19 | 0.60 | 3 |
| 8 | -35.7 | 14.1 | 23.47 | 22.96 | -0.51 | 3 |
| 9 | -32.6 | -9.8 | 22.21 | 23.64 | 1.43 | 2 |
| 10 | -30.9 | -65.6 | 23.10 | -- | -- | 3 |
| 11 | -27.1 | -51.9 | 22.37 | 24.02 | 1.65 | 1 |
| 12 | -26.3 | 2.7 | 22.38 | 23.54 | 1.16 | 1 |
| 13 | -25.4 | -78.3 | 20.42 | 21.67 | 1.25 | 1 |
| 14 | -22.1 | -13.9 | 23.03 | -- | -- | 2 |
| 15 | -20.5 | 30.2 | 20.94 | 21.57 | 0.64 | 1 |
| 16 | -17.8 | -48.7 | 22.11 | -- | -- | 3 |
| 17 | -13.4 | -73.4 | 23.17 | -- | -- | 3 |
| 18 | -5.7 | -40.8 | 19.09 | 20.51 | 1.42 | 3 |
| 19 | -4.4 | -74.7 | 21.73 | 22.89 | 1.16 | 1 |
| 20 | 0.0 | 0.0 | 17.62 | 17.38 | -0.25 | 3 |
| 21 | 7.5 | -74.6 | 21.71 | 23.15 | 1.44 | 1 |
| 22 | 7.7 | 20.1 | 22.26 | 24.27 | 2.01 | 2 |
| 23 | 10.7 | -70.9 | 21.97 | 22.56 | 0.59 | 3 |


| RA: Obj | 0121+108 |  | ---- | $z=0.510$ |  |  | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1215 | 2.58 | Dec:+10 50 | 4.8 | RL=23 | 41 |  |
|  | \# RA | \# Dec | R | G | G-R | Class |  |
| 1 | 130.5 | 39.8 | 23.35 | -- | -- | 3 |  |
| 2 | 130.3 | -27.0 | 22.06 | -- | -- | 1 |  |
| 3 | 129.2 | 31.2 | 21.11 | -- | -- | 1 |  |
| 4 | 127.5 | -43.6 | 20.07 | -- | -- | 1 |  |
| 5 | 127.2 | 35.0 | 21.67 | -- | -- | 2 |  |
| 6 | 127.1 | 8.0 | 22.09 | -- | -- | 3 |  |
| 7 | 126.8 | -13.0 | 21.52 | -- | -- | 1 |  |
| 8 | 123.6 | 59.4 | 20.43 | -- | -- | 3 |  |
| 9 | 122.5 | 19.5 | 22.60 | -- | -- | 1 |  |
| 10 | 122.0 | 40.0 | 21.49 | -- | -- | 1 |  |
| 11 | 118.9 | -47.4 | 22.55 | -- | -- | 3 |  |
| 12 | 113.4 | -45.7 | 23.13 | -- | -- | 3 |  |
| 13 | 108.2 | -63.1 | 21.86 | -- | -- | 1 |  |
| 14 | 107.8 | 51.5 | 19.73 | -- | -- | 3 |  |
| 15 | 107.8 | -2.2 | 21.87 | -- | -- | 1 |  |
| 16 | 105.7 | -72.9 | 19.74 | -- | -- | 2 |  |
| 17 | 102.0 | -4.8 | 20.70 | -- | -- |  |  |


| 18 | -96.7 | -10.9 | 23.08 | -- | -- | 2 |
| ---: | ---: | ---: | ---: | :--- | :--- | :--- |
| 19 | -96.1 | -8.4 | 23.21 | -- | -- | 3 |
| 20 | -89.2 | 27.9 | 22.41 | -- | -- | 2 |
| 21 | -78.9 | 27.8 | 22.60 | -- | -- | 1 |
| 23 | -73.9 | -95.9 | 22.91 | -- | -- | 2 |
| 24 | -71.1 | -16.0 | 22.51 | -- | -- | 1 |
| 25 | -63.7 | 18.4 | 17.81 | -- | -- | 1 |
| 26 | -59.4 | 29.3 | 21.21 | -- | -- | 1 |
| 27 | -58.5 | -48.9 | 22.70 | -- | -- | 1 |
| 28 | -55.3 | 12.8. | 23.26 | -- | -- | 2 |
| 29 | -50.3 | -72.8 | 22.96 | -- | -- | 3 |
| 31 | -47.6 | -87.4 | 23.17 | -- | -- | 1 |
| 32 | -40.4 | 35.8 | 20.64 | -- | -- | 2 |
| 33 | -38.8 | -57.2 | 20.81 | -- | -- | 1 |
| 34 | -35.5 | -80.5 | 22.44 | -- | -- | 2 |
| 35 | -31.9 | -54.2 | 21.01 | -- | -- | 1 |
| 36 | -25.0 | 26.7 | 22.09 | -- | -- | 2 |
| 37 | -24.4 | 102.7 | 21.76 | -- | -- | 1 |
| 38 | -17.8 | 51.2 | 23.07 | -- | -- | 3 |
| 39 | -17.4 | 9.6 | 23.27 | -- | -- | 0 |
| 40 | -15.7 | -86.4 | 23.02 | -- | -- | 1 |
| 41 | -13.6 | 29.9 | 19.58 | -- | -- | 1 |
| 42 | -8.6 | 6.9 | 22.71 | -- | -- | 1 |
| 43 | -5.8 | 17.9 | 21.77 | -- | -- | 1 |
| 44 | -5.4 | 12.7 | 22.31 | -- | -- | 1 |
| 45 | -3.1 | 6.4 | 22.98 | -- | -- | 1 |
| 46 | 0.0 | 0.0 | 19.27 | -- | -- | 1 |
| 47 | -0.1 | -65.8 | 23.16 | -- | -- | 3 |
| 48 | 0.4 | -7.0 | 21.12 | -- | -- | 1 |
| 49 | 0.7 | -8.7 | 20.47 | -- | -- | 1 |
| 50 | 1.3 | -12.3 | 21.91 | -- | -- | 1 |
| 51 | 5.0 | -35.4 | 22.78 | -- | -- | 1 |
| 52 | 8.0 | -68.9 | 21.56 | -- | -- | 1 |
| 53 | 8.3 | 48.2 | 21.53 | -- | -- | 3 |
| 54 | 11.1 | -45.2 | 21.00 | -- | -- | 1 |
| 55 | 11.3 | -36.9 | 21.91 | -- | -- | 1 |
| 56 | 16.5 | 56.2 | 22.05 | -- | -- | 1 |
| 57 | 17.0 | -84.0 | 23.27 | -- | -- | 1 |
| 59 | 22.6 | -67.3 | 21.68 | -- | -- | 1 |
| 60 | 32.6 | 11.5 | 22.73 | -- | -- | 1 |
| 61 | 36.5 | 4.9 | 17.40 | -- | -- | 3 |
| 62 | 36.3 | -8.5 | 17.30 | -- | -- | 0 |
|  |  |  |  |  |  |  |


| -~-- | 0124-02 |  |  | $z=0.350$ |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: | 12435 | 80 | Dec:- 211 | 9.0 | RL=22 | 90 |  |
| Obj | \#RA | \#Dec | R | G | G-R | Class | Comments |
| 1 | -72.7 | 22.3 | 20.89 | -- | -- | 0 |  |
| 3 | -68.2 | 59.5 | 20.63 | -- | -- | 1 |  |

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| -67.9 | 21.4 | 21.89 | -- | -- | 1 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| -67.9 | -2.2 | 22.28 | -- | -- | 1 |
| -66.1 | 40.0 | 21.70 | -- | -- | 3 |
| -63.3 | 5.2 | 21.54 | -- | -- | 1 |
| -62.0 | 24.0 | 22.03 | -- | -- | 3 |
| -44.8 | 60.3 | 20.09 | -- | -- | 0 |
| -37.6 | -28.8 | 22.73 | -- | -- | 3 |
| -35.5 | -42.9 | 22.78 | -- | -- | 3 |
| -32.0 | -58.1 | 21.68 | -- | -- | 1 |
| -28.5 | -41.4 | 22.34 | -- | -- | 3 |
| -26.2 | -12.2 | 21.35 | -- | -- | 2 |
| -24.1 | -14.4 | 22.22 | -- | -- | 1 |
| -22.4 | -28.7 | 20.30 | -- | -- | 1 |
| -22.0 | 58.3 | 20.10 | -- | -- | 1 |
| -18.7 | -22.9 | 21.84 | -- | -- | 1 |
| -15.8 | -59.7 | 22.54 | -- | -- | 0 |
| -11.5 | -37.0 | 22.19 | -- | -- | 0 |
| -11.0 | 69.5 | 21.87 | -- | -- | 3 |
| -7.7 | 59.7 | 22.65 | -- | -- | 3 |
| -5.4 | 10.1 | 20.60 | -- | -- | 3 |
| -4.2 | -60.9 | 19.71 | -- | -- | 1 |
| -3.0 | -17.1 | 20.00 | -- | -- | 1 |
| 0.0 | 0.0 | 17.88 | -- | -- | 3 |
| 0.3 | 22.3 | 22.22 | -- | -- | 1 |
| 0.4 | -47.9 | 21.63 | -- | -- | 1 |
| 3.3 | -54.0 | 22.16 | -- | -- | 2 |
| 10.5 | 59.4 | 22.41 | -- | -- | 3 |
| 10.4 | 21.7 | 18.33 | -- | -- | 1 |
| 10.9 | -15.1 | 19.80 | -- | -- | 1 |
| 12.4 | -15.7 | 19.61 | -- | -- | 1 |
| 13.4 | -33.8 | 21.28 | -- | -- | 2 |
| 13.9 | -62.5 | 21.31 | -- | -- | 3 |
| 14.1 | 73.7 | 22.74 | -- | -- | 3 |
| 15.3 | 19.5 | 20.99 | -- | -- | 1 |
| 15.3 | -63.7 | 20.50 | -- | -- | 3 |
| 17.0 | 23.2 | 21.12 | -- | -- | 1 |
| 21.3 | -40.7 | 21.11 | -- | -- | 1 |
| 25.7 | -7.4 | 20.94 | -- | -- | 1 |
| 29.7 | 9.5 | 22.45 | -- | -- | 3 |
| 39.1 | 76.4 | 22.53 | -- | -- | 3 |
| 42.5 | -22.8 | 20.91 | -- | -- | 1 |
| 43.0 | -53.1 | 22.85 | -- | -- | 3 |
| 42.8 | 2.9 | 21.86 | -- | -- | 3 |
| 42.9 | -60.9 | 22.18 | -- | -- | 0 |
| 43.3 | 38.8 | 17.70 | -- | -- | 1 |
| 45.6 | -11.7 | 21.43 | -- | -- | 1 |
| 50.1 | 38.1 | 19.23 | -- | -- | 1 |
| 56.6 | 41.9 | 19.69 | -- | -- | 1 |
| 61.8 | 78.2 | 20.84 | -- | -- | 3 |
| 68.8 | 57.4 | 21.45 | -- | -- | 1 |
| 70.2 | 64.3 | 22.64 | -- | -- | 3 |


| 58 | 70.2 | -46.8 | 22.21 | -- | -- | 1 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 69 | 75.1 | -33.8 | 21.54 | -- | -- | 1 |



| RA: <br> Obj | 0131+015 |  |  | z=0.400 |  |  |  | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1 | 3144 | 4.40 | Dec:+ 0 | 016.0 | RL=23 | . 44 |  |
|  |  | \#RA | \#Dec | R | G | G-R | Class |  |
| 1 |  | -23.0 | -61.6 | 21.36 | -- | -- | 0 |  |
| 2 |  | -7.4 | 38.7 | 22.78 | -- | -- | 2 |  |
| 3 |  | -5.5 | 8.2 | 20.37 | -- | -- | 1 |  |
| 4 |  | -2.1 | -26.4 | 21.30 | -- | -- | 1 |  |
| 5 |  | 0.0 | 0.0 | 17.29 | -- | -- | 3 | QSO |
| 6 |  | 12.6 | -65.8 | 20.14 | -- | -- | 2 |  |
| 7 |  | 14.5 | -37.6 | 22.10 | -- | -- | 1 |  |
| 8 |  | 16.2 | 42.8 | 22.89 | -- | -- | 3 |  |
| 9 |  | 24.6 | -60.1 | 22.13 | -- | -- | 3 |  |
| 10 |  | 29.6 | -60.0 | 23.27 | -- | -- | 3 |  |
| 12 |  | 32.2 | -38.8 | 22.60 | -- | -- | 3 |  |
| 13 |  | 32.4 | 11.8 | 20.71 | -- | -- | 1 |  |
| 14 |  | 34.3 | -9.4 | 23.08 | -- | -- | 3 |  |
| 15 |  | 35.2 | 12.5 | 21.52 | -- | -- | 1 |  |
| 16 |  | 35.5 | -55.2 | 21.33 | -- | -- | 1 |  |
| 17 |  | 39.3 | -56.0 | 22.28 | -- | -- | 1 |  |
| 18 |  | 40.3 | -58.8 | 20.54 | -- | -- | 1 |  |
| 20 |  | 43.7 | -49.8 | 22.11 | -- | -- | 1 |  |
| 21 |  | 45.1 | -42.9 | 22.34 | -- | -- | 2 |  |
| 22 |  | 48.0 | -31.6 | 22.14 | -- | -- | 1 |  |
| 24 |  | 68.3 | -26.9 | 22.35 | -- | -- | 1 |  |


|  | 0135-057 |  | $z=0.400$ |  |  |  | $\mathrm{L}=24.01$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: | 13529 | 9.10 | Dec:- 5 | 26.0 | RL=23. | 41 G |  |
| Obj | \#RA | *Dec | R | G | G-R | Class | Comments |
| 1 | -42.4 | 72.3 | 20.03 | 21.49 | 1.46 | 1 |  |
| 2 | -38.2 | -28.7 | 23.02 | -- | -- | 1 |  |
| 3 | -36.1 | 33.0 | 21.79 | 23.26 | 1.47 | 2 |  |
| 4 | -34.0 | 58.3 | 21.92 | 23.72 | 1.80 | 2 |  |
| 5 | -31.4 | 50.6 | 22.14 | -- | -- | 2 |  |
| 7 | -28.4 | 0.2 | 22.16 | 23.65 | 1.49 | 1 |  |
| 8 | -27.2 | -34.1 | 22.86 | -- | -- | 1 |  |
| 9 | -25.7 | -1.6 | 21.07 | 22.36 | 1.29 | 1 |  |
| 10 | -22.7 | 58.3 | 20.97 | 23.15 | 2.19 | 1 |  |
| 11 | -18.5 | -2.8 | 21.53 | 21.67 | 0.14 | 3 |  |
| 12 | -18.1 | -22.3 | 22.31 | 23.78 | 1.47 | 2 |  |
| 13 | -11.4 | -16.5 | 22.45 | 23.73 | 1.28 | 3 |  |
| 14 | -9.6 | 47.0 | 21.21 | 23.85 | 2.64 | 1 |  |
| 15 | 0.0 | 0.0 | 18.46 | 18.87 | 0.41 | 2 | Qso |
| 16 | 4.5 | -46.8 | 22.80 | 23.20 | 0.40 | 1 |  |
| 17 | 4.7 | 32.4 | 22.86 | 23.27 | 0.41 | 1 |  |
| 18 | 7.4 | 55.6 | 22.02 | 22.92 | 0.90 | 1 |  |
| 19 | 8.6 | -29.6 | 21.05 | 21.70 | 0.64 | 1 |  |
| 20 | 10.1 | -49.0 | 20.29 | 21.99 | 1.70 | 1 |  |
| 21 | 10.6 | 66.8 | 22.53 | 23.08 | 0.55 | 3 |  |


| 22 | 14.6 | -32.6 | 21.67 | 21.93 | 0.26 | 1 |
| ---: | ---: | ---: | :---: | :---: | :---: | :---: |
| 23 | 14.9 | 29.4 | -- | 23.84 | -- | 1 |
| 24 | 19.9 | -7.9 | 20.49 | 21.35 | 0.86 | 1 |
| 25 | 21.0 | -53.5 | 22.32 | 23.41 | 1.09 | 1 |
| 26 | 24.4 | -39.3 | 22.91 | 23.53 | 0.62 | 2 |
| 27 | 28.7 | 57.1 | 23.38 | $-\ldots$ | -- | 2 |
| 28 | 31.1 | -41.0 | 23.01 | 22.55 | -0.46 | 2 |
| 29 | 32.1 | 13.0 | 22.46 | 23.24 | 0.79 | 1 |
| 30 | 32.4 | -4.3 | -- | 22.23 | -- | 0 |
| 31 | 34.2 | -52.0 | 21.28 | 21.90 | 0.61 | 1 |
| 32 | 35.5 | 27.9 | -- | 23.41 | -- | 1 |
| 33 | 39.1 | 47.2 | 21.53 | 22.38 | 0.85 | 1 |


| RA: Obj | 0136+060 |  | $z=0.450$ |  |  |  | $\mathrm{GL}=23.83$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 13620 | . 20 | Dec:+ 6 | 550.1 | RL=23. | 62 G |  |
|  | \#RA | \# Dec | R | G | G-R | Class | 3 Comments |
| 1 | -46.2 | 34.7 | 22.74 | 23.59 | 0.85 | 3 |  |
| 2 | -46.2 | -30.9 | 21.16 | 23.51 | 2.35 | 3 |  |
| 3 | -44.8 | 16.2 | 22.88 | 23.79 | 0.91 | 3 |  |
| 4 | -43.8 | 40.7 | 21.01 | 22.06 | 1.05 | 1 |  |
| 5 | -43.7 | -57.0 | 21.49 | 22.77 | 1.29 | 3 |  |
| 6 | -41.9 | -36.0 | 22.32 | -- | -- | 3 |  |
| 7 | -38.2 | 35.6 | 23.37 | -- | -- | 1 |  |
| 8 | -37.9 | 27.5 | 22.25 | 22.33 | 0.09 | 1 |  |
| 9 | -37.0 | 9.9 | 21.46 | 22.19 | 0.73 | 1 |  |
| 10 | -36.6 | -7.8 | 22.94 | -- | -- | 3 |  |
| 11 | -28.7 | -16.6 | 22.89 | -- | -- | 3 |  |
| 12 | -27.9 | -12.8 | 20.75 | 22.87 | 2.12 | 1 |  |
| 13 | -27.8 | -2.0 | 22.31 | 23.04 | 0.73 | 1 |  |
| 15 | -23.6 | 5.6 | 23.46 | 23.65 | 0.19 | 1 |  |
| 16 | -21.5 | 53.5 | 20.72 | 21.67 | 0.95 | 1 |  |
| 17 | -21.3 | -29.6 | 18.94 | 20.54 | 1.60 | 3 |  |
| 18 | -20.7 | -21.4 | 18.90 | 20.49 | 1.60 | 3 |  |
| 19 | -19.7 | -56.9 | 22.43 | 22.25 | -0.18 | 3 |  |
| 20 | -19.1 | 20.8 | 22.08 | -- | -- | 2 |  |
| 22 | -5.4 | 5.6 | 22.20 | 23.17 | 0.97 | 1 |  |
| 23 | -2.3 | 72.6 | 22.66 | 22.77 | 0.11 | 1 |  |
| 24 | 0.0 | 0.0 | 18.59 | 18.49 | -0.10 | 2 | QSo |
| 25 | 1.9 | -25.6 | 23.41 | -- | -- | 2 |  |
| 26 | 2.3 | 39.1 | -- | 23.42 | -- | 2 |  |
| 27 | 4.9 | -44.5 | 23.03 | -- | -- | 2 |  |
| 29 | 8.1 | -27.0 | 23.55 | -- | -- | 3 |  |
| 31 | 10.7 | 45.5 | 20.30 | 21.42 | 1.12 | 3 |  |
| 32 | 11.4 | -5.7 | 7 -- | 23.75 | -- | 2 |  |
| 33 | 13.6 | 1.0 | 23.29 | 23.35 | 0.06 | 1 |  |
| 34 | 14.7 | -60.0 | 21.47 | 22.09 | 1.62 | 3 |  |
| 35 | 20.3 | -21.3 | 21.71 | 22.55 | 0.83 | 1 |  |
| 36 | 21.6 | -14.8 | -- | 23.64 | -- | 0 |  |


| 37 | 22.2 | -6.8 | 20.02 | 21.79 | 1.76 | 1 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| 38 | 25.0 | -53.8 | 23.30 | 23.30 | -0.01 | 1 |
| 39 | 26.8 | -2.6 | 22.85 | 23.07 | 0.22 | 1 |
| 40 | 28.3 | 45.0 | 21.94 | 22.28 | 0.34 | 1 |
| 41 | 30.5 | 19.0 | 23.41 | -- | -- | 2 |
| 42 | 32.3 | 31.8 | 22.67 | 23.21 | 0.54 | 3 |
| 43 | 32.1 | -57.7 | 20.75 | 22.37 | 1.63 | 1 |
| 44 | 34.2 | -60.7 | 21.23 | 22.15 | 0.92 | 1 |
| 45 | 36.9 | -7.3 | 23.11 | 23.76 | 0.65 | 2 |
| 46 | 41.1 | 56.1 | 18.79 | 19.66 | 0.37 | 1 |
| 47 | 40.8 | 50.8 | 23.19 | 23.67 | 0.48 | 3 |


| ---- |  | 208-01 |  |  |  | z=0. |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA : | 2 | 837 | 7.00 | Dec:-1 | 48 | 48.0 | RL= 23 | . 89 |  |
| Obj |  | \#RA | \#Dec | R |  | G | G-R | Class | Comments |
| 1 |  | -48.6 | -21.7 | 21.73 |  | -- | -- | 1 |  |
| 2 |  | -47.7 | -42.9 | 23.09 |  | -- | -- | 1 |  |
| 3 |  | -45.8 | 37.7 | 22.66 |  | -- | -- | 1 |  |
| 4 |  | -42.1 | 33.4 | 23.79 |  | -- | -- | 2 |  |
| 5 |  | -38.2 | -8.6 | 19.69 |  | -- | -- | 3 |  |
| 6 |  | -35.2 | 30.0 | 19.56 |  | -- | -- | 3 |  |
| 7 |  | -28.1 | 24.2 | 23.52 |  | -- | -- | 3 |  |
| 8 |  | -24.2 | 32.2 | 22.73 |  | -- | -- | 1 |  |
| 9 |  | -17.4 | -18.9 | 20.00 |  | -- | -- | 1 |  |
| 10 |  | -13.2 | -25.6 | 15.89 |  | -- | -- | 3 |  |
| 11 |  | -6.5 | 19.8 | 22.70 |  | -- | -- | 2 |  |
| 12 |  | -6.3 | -43.2 | 20.06 |  | -- | -- | 1 |  |
| 13 |  | 0.0 | 0.0 | 18.73 |  | -- | -- | 3 | qSo |
| 14 |  | 3.5 | -40.2 | 23.48 |  | -- | -- | 1 |  |
| 15 |  | 3.2 | -49.7 | 19.26 |  | -- | -- | 3 |  |
| 16 |  | 9.4 | -18.8 | 23.59 |  | -- | -- | 3 |  |
| 17 |  | 11.9 | 40.9 | 22.99 |  | -- | -- | 1 |  |
| 18 |  | 18.2 | -15.7 | 22.22 |  | -- | -- | 3 |  |
| 19 |  | 21.0 | 20.6 | 21.96 |  | -- | -- | 1 |  |
| 20 |  | 22.9 | -48.5 | 14.88 |  | -- | -- | 3 |  |
| 21 |  | 24.5 | 15.6 | 21.61 |  | -- | -- | 1 |  |
| 23 |  | 27.1 | -37.2 | 22.92 |  | -- | -- | 1 |  |
| 24 |  | 29.6 | -51.9 | 21.46 |  | -- | -- | 1 |  |
| 25 |  | 47.5 | -6.9 | 22.55 |  | -- | -- | 1 |  |
| 26 |  | 57.5 | -27.0 | 23.73 |  | -- | -- | 3 |  |
| 27 |  | 60.1 | 3.8 | 22.24 |  | -- | -- | 1 |  |
| 28 |  | 64.0 | -25.9 | 22.59 |  | -- | -- | 1 |  |
| 29 |  | 65.8 | 46.9 | 19.06 |  | -- | -- | 1 |  |


| RA: | 21534 | 4.70 | Dec:-16 | 4459.3 | RL=23 | 28 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Obj | \#RA | \#Dec | R | G | G-R | Class | Comments |
| 1 | -21.7 | 41.0 | 21.71 | -- | -- | 1 |  |
| 2 | -20.2 | -13.8 | 21.21 | -- | -- | 1 |  |
| 3 | -17.2 | -28.1 | 21.53 | -- | -- | 1 |  |
| 4 | -1.1 | -52.5 | 19.27 | -- | -- | 1 |  |
| 5 | 0.0 | 0.0 | 18.24 | -- | -- | 3 | QSO |
| 6 | 4.6 | -8.0 | 19.91 | -- | -- | 1 |  |
| 8 | 13.9 | -7.3 | 22.16 | -- | -- | 3 |  |
| 10 | 17.1 | -9.6 | 22.45 | -- | -- | 1 |  |
| 11 | 18.6 | 6.5 | 21.14 | -- | -- | 1 |  |
| 12 | 24.5 | -40.3 | 21.92 | -- | -- | 3 |  |
| 13 | 31.3 | -19.5 | 22.14 | -- | -- | 3 |  |
| 14 | 31.2 | -22.1 | 22.78 | -- | -- | 3 |  |
| 15 | 33.8 | -31.4 | 22.35 | -- | -- | 0 |  |
| 16 | 37.0 | -40.6 | 22.19 | -- | -- | 1 |  |
| 17 | 38.1 | -25.5 | 19.21 | -- | -- | 1 |  |
| 18 | 41.7 | -32.3 | 22.88 | -- | -- | 0 |  |
| 19 | 42.0 | 33.1 | 21.19 | -- | -- | 1 |  |
| 20 | 47.7 | -12.3 | 23.04 | -- | -- | 0 |  |
| 21 | 53.1 | 13.0 | 22.48 | -- | -- | 0 |  |
| 22 | 57.9 | -45.7 | 21.84 | -- | -- | 1 |  |
| 23 | 62.7 | 32.1 | 22.13 | -- | -- | 3 |  |
| 25 | 68.9 | -1.3 | 21.75 | -- | -- | 1 |  |


| ---- | 0222+000 |  |  | $z=0.523$ |  |  |  |  | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: | 2 | 2234 | 4.30 | Dec:+ 0 | 3 | 38.0 | RL=24 | 38 |  |
| Obj |  | \#RA | \#Dec | R |  | G | G-R | Class |  |
| 1 |  | -48.0 | 24.0 | 23.36 |  | -- | -- | 2 |  |
| 2 |  | -47.6 | 49.3 | 23.24 |  | -- | -- | 3 |  |
| 3 |  | -44.9 | 26.1 | 19.99 |  | -- | -- | 3 |  |
| 4 |  | -42.3 | -42.8 | 23.91 |  | -- | -- | 1 |  |
| 5 |  | -35.1 | -6.8 | 22.30 |  | -- | -- | 1 |  |
| 6 |  | -30.0 | -21.0 | 23.23 |  | -- | -- | 3 |  |
| 7 |  | -26.5 | 25.8 | 16.85 |  | -- | -- | 3 |  |
| 8 |  | -26.5 | 22.5 | 17.35 |  | -- | -- | 3 |  |
| 9 |  | -25.0 | -8.6 | 23.08 |  | -- | -- | 3 |  |
| 10 |  | -23.2 | -3.4 | 23.99 |  | -- | -- | 3 |  |
| 11 |  | -21.3 | -29.9 | 17.61 |  | -- | -- | 3 |  |
| 12 |  | -17.8 | 4.3 | 23.08 |  | -- | -- | 1 |  |
| 13 |  | -13.0 | -22.8 | 23.50 |  | -- | -- | 1 |  |
| 14 |  | -11.2 | -54.5 | 23.94 |  | -- | -- | 3 |  |
| 15 |  | -2.0 | 5.5 | 21.61 |  | -- | -- | 1 |  |
| 16 |  | -1.7 | -42.8 | 22.79 |  | -- | -- | 1 |  |
| 17 |  | 0.0 | 0.0 | 19.27 |  | -- | -- | 2 | qso |
| 18 |  | 1.3 | -41.9 | 23.57 |  | -- | -- | 1 |  |
| 19 |  | 3.7 | 14.6 | 22.44 |  | -- | -- | 1 |  |
| 20 |  | 3.3 | -10.0 | 24.33 |  | -- | -- | 2 |  |


| 21 | 3.8 | -51.5 | 23.67 | - | -- | 1 |
| :--- | ---: | ---: | :--- | :--- | :--- | :--- |
| 22 | 9.1 | 21.1 | 22.70 | -- | -- | 1 |
| 23 | 10.1 | 47.3 | 21.81 | -- | -- | 1 |
| 24 | 10.8 | 19.1 | 24.05 | -- | -- | 3 |
| 25 | 11.8 | -38.0 | 22.47 | -- | -- | 1 |
| 26 | 14.2 | -28.7 | 22.82 | -- | -- | 1 |
| 27 | 16.3 | 25.9 | 20.20 | -- | -- | 1 |
| 28 | 16.8 | -32.6 | 23.18 | -- | -- | 1 |
| 29 | 20.6 | 34.5 | 23.32 | -- | -- | 1 |
| 30 | 27.0 | 9.0 | 23.43 | -- | -- | 1 |
| 31 | 28.9 | 2.4 | 21.31 | -- | -- | 1 |
| 32 | 30.1 | -43.6 | 23.77 | -- | -- | 1 |
| 33 | 30.6 | -50.3 | 21.69 | -- | -- | 1 |
| 35 | 33.7 | 20.8 | 23.26 | -- | -- | 3 |
| 36 | 41.1 | -41.0 | 22.41 | -- | -- | 3 |
| 37 | 45.8 | -13.6 | 20.98 | -- | -- | 1 |
| 38 | 50.6 | 33.2 | 22.49 | -- | -- | 1 |
| 39 | 56.2 | -54.2 | 20.38 | -- | -- | 3 |
| 40 | 56.7 | 21.2 | 24.32 | -- | -- | 2 |
| 41 | 60.5 | 43.2 | 21.19 | -- | -- | 3 |
| 42 | 64.6 | 31.5 | 20.78 | -- | -- | 3 |
| 43 | 65.9 | -52.9 | 23.53 | -- | -- | 2 |



| 28 | 22.5 | 53.0 | 22.76 | -- | -- | 1 |
| ---: | ---: | ---: | ---: | :--- | :--- | :--- |
| 29 | 30.8 | 67.8 | 22.27 | -- | -- | 1 |
| 30 | 38.1 | -15.2 | 22.33 | -- | -- | 1 |
| 31 | 39.9 | 14.6 | 22.86 | -- | -- | 1 |
| 32 | 41.1 | -49.2 | 21.03 | -- | -- | 1 |
| 33 | 42.2 | 6.2 | 23.52 | -- | -- | 1 |


| RA: Obj | 0249+15 |  | $z=0.489$ |  |  |  | GL=23.69 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 249 | 0.30 | Dec:+15 | 3754.9 | $\mathrm{RL}=23$ |  |  |
|  | \#RA | \#Dec | C $\quad \mathrm{R}$ | G | G-R | Class | Comments |
| 1 | -82.7 | -45.5 | - 21.14 | 21.80 | 0.66 | 1 |  |
| 2 | -81.0 | 39.1 | 18.92 | 19.70. | 0.77 | 1 |  |
| 3 | -78.6 | 21.8 | 32.60 | -- | -- | 1 |  |
| 4 | -72.8 | -71.3 | 32.74 | 23.60 | 0.86 | 1 |  |
| 5 | -71.0 | -3.8 | 21.41 | 22.59 | 1.18 | 1 |  |
| 6 | -67.3 | 29.9 | 9 19.19 | 20.72 | 1.53 | 3 |  |
| 7 | -63.8 | 81.9 | 21.98 | 22.88 | 0.91 | 1 |  |
| 8 | -58.5 | 33.8 | - 21.99 | 22.72 | 0.73 | 2 |  |
| 9 | -57.7 | -22.9 | 22.31 | 23.03 | 0.72 | 1 |  |
| 10 | -50.2 | -26.1 | 123.04 | -- | -- | 3 |  |
| 11 | -48.4 | 7.2 | 22.54 | -- | -- | 1 |  |
| 12 | -46.3 | 64.6 | -18.33 | 19.83 | 1.49 | 3 |  |
| 13 | -44.5 | -36.0 | - 21.67 | 23.37 | 1.70 | 1 |  |
| 14 | -44.1 | -67.8 | 21.06 | 21.97 | 0.91 | 1 |  |
| 16 | -41.7 | 20.6 | 6 21.07 | 21.82 | 0.75 | 1 |  |
| 17 | -39.2 | -15.6 | 6 21.08 | 22.41 | 1.33 | 1 |  |
| 18 | -35.1 | 40.9 | 92.35 | 23.66 | 1.31 | 1 |  |
| 19 | -33.6 | -67.4 | 422.35 | -- | -- | 1 |  |
| 20 | -33.2 | 2-18.7 | 21.22 | 23.54 | 2.33 | 1 |  |
| 21 | -28.4 | 42.2 | 21.82 | 22.62 | 0.80 | 1 |  |
| 22 | -25.3 | -57.1 | 120.60 | 22.43 | 1.83 | 1 |  |
| 23 | -23.3 | -65.1 | 121.83 | 22.80 | 0.97 | 1 |  |
| 24 | -21.9 | -23.4 | 420.05 | 21.22 | 1.18 | 3 |  |
| 25 | -17.1 | -18.2 | 21.83 | 23.60 | 1.76 | 1 |  |
| 26 | -14.5 | 50.5 | 22.57 | -- | -- | 1 |  |
| 27 | -9.4 | 49.6 | - 22.15 | 23.26 | 1.11 | 1 |  |
| 28 | -7.6 | -32.4 | 421.10 | 22.85 | 1.75 | 1 |  |
| 30 | -4.3 | 68.7 | 19.67 | 19.95 | 0.38 | 3 |  |
| 31 | 0.0 | 0.0 | 17.42 | 17.83 | 0.41 | 3 | QSo |
| 32 | 2.4 | -73.1 | 121.20 | 23.09 | 1.90 | 1 |  |
| 33 | 4.3 | 14.7 | 720.82 | 21.48 | 0.66 | 1 |  |
| 34 | 4.8 | -39.7 | 721.72 | 23.63 | 1.91 | 2 |  |
| 35 | 6.2 | 28.6 | - 22.28 | -- | -- | 3 |  |
| 36 | 7.7 | 61.1 | 21.71 | -- | -- | 3 |  |
| 37 | 10.2 | 21.7 | 20.69 | 21.05 | 0.36 | 1 |  |
| 38 | 13.1 | 26.3 | 22.91 | -- | -- | 2 |  |
| 39 | 15.1 | 89.9 | 22.74 | -- | -- | 2 |  |
| 40 | 15.4 | 8.8 | 23.08 | 23.30 | 0.23 | 1 |  |


| 41 | 16.8 | -44.4 | 20.42 | 21.99 | 1.57 | 1 |
| ---: | ---: | ---: | :--- | :--- | :--- | :--- |
| 42 | 17.2 | -61.0 | 20.28 | 22.22 | 1.94 | 1 |
| 43 | 17.9 | -1.6 | 22.51 | -- | -- | 1 |
| 44 | 18.9 | 78.2 | 21.02 | 22.64 | 1.62 | 1 |
| 45 | 22.2 | -56.3 | 20.33 | 22.02 | 1.69 | 3 |
| 47 | 30.8 | -33.5 | 21.75 | 22.73 | 0.98 | 1 |
| 48 | 31.8 | 44.3 | 20.80 | 21.94 | 1.13 | 1 |
| 49 | 33.2 | 46.0 | 19.05 | 20.02 | 0.97 | 1 |
| 50 | 34.0 | -26.2 | 21.91 | 23.22 | 1.31 | 3 |
| 51 | 34.9 | -8.6 | 22.08 | -- | -- | 1 |
| 52 | 36.6 | 15.1 | 16.06 | 17.36 | 1.30 | 3 |
| 54 | 43.4 | -67.3 | 18.67 | 19.94 | 1.27 | 3 |
| 55 | 45.1 | -64.6 | 22.08 | 22.97 | 0.89 | 3 |
| 56 | 45.8 | 90.8 | 20.81 | 21.98 | 1.16 | 1 |
| 57 | 46.3 | -73.8 | 22.07 | 22.48 | 0.41 | 1 |
| 58 | 47.8 | 16.1 | 22.67 | 23.16 | 0.49 | 3 |
| 59 | 49.5 | 57.2 | 22.28 | -- | -- | 1 |
| 60 | 56.3 | 16.0 | 21.22 | 23.07 | 1.85 | 3 |
| 62 | 61.4 | 63.4 | 22.97 | -- | -- | 1 |
| 63 | 64.2 | 5.3 | 22.93 | 23.60 | 0.67 | 1 |
| 64 | 64.8 | 38.7 | 21.39 | -- | -- | 1 |
| 65 | 65.9 | -4.4 | 22.18 | 23.59 | 1.41 | 3 |
| 66 | 66.2 | -53.8 | 22.37 | 23.68 | 1.31 | 2 |
| 67 | 68.3 | 12.8 | 22.76 | -- | -- | 2 |
| 68 | 69.4 | 68.6 | 22.82 | 23.09 | 0.27 | 3 |
| 69 | 71.3 | -54.8 | 22.39 | -- | -- | 3 |
| 70 | 72.2 | -79.6 | 19.45 | 20.07 | 0.62 | 1 |
| 71 | 73.2 | 32.3 | 22.14 | -- | -- | 3 |
| 72 | 74.8 | 8.6 | 21.98 | -- | -- | 3 |
| 74 | 79.3 | 69.1 | 21.76 | 23.09 | 1.33 | 3 |
| 75 | 81.7 | -55.7 | 22.62 | -- | -- | 2 |
| 76 | 85.7 | -48.3 | -- | 22.58 | -- | 1 |
| 77 | 86.5 | -38.1 | 22.79 | -- | -- | 2 |


| ---- | 0438-165 |  | $z=0.500$ |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: | 4382 | 26.00 | Dec:-16 | 3536.0 | RL=23 | . 36 |  |
| Obj | \#RA | \# Dec | R | G | G-R | Class | Comments |
| 1 | -81.6 | [ 34.7 | 22.41 | -- | -- | 0 |  |
| 3 | -79.2 | 74.0 | 21.72 | -- | -- | 1 |  |
| 4 | -79.0 | -60.6 | 18.67 | -- | -- | 3 |  |
| 5 | -77.7 | -13.5 | 22.41 | -- | -- | 2 |  |
| 6 | -76.1 | 71.4 | 17.86 | -- | -- | 3 |  |
| 7 | -76.3 | 60.6 | 18.05 | -- | -- | 3 |  |
| 9 | -75.0 | -11.3 | 22.52 | -- | -- | 2 |  |
| 10 | -74.3 | -29.7 | 20.14 | -- | -- | 2 |  |
| 11 | -71.4 | 63.5 | 23.34 | -- | -- | 0 |  |
| 12 | -70.1 | 48.8 | 22.42 | -- | -- | 3 |  |
| 13 | -67.8 | -32.4 | 22.55 | -- | -- | 3 |  |


| 14 | -66.4 | 33.3 | 20.13 | -- | -- | 3 |
| ---: | ---: | ---: | ---: | :--- | :--- | :--- |
| 15 | -61.6 | 54.0 | 22.10 | -- | -- | 1 |
| 16 | -59.8 | 58.3 | 21.47 | -- | -- | 1 |
| 18 | -51.9 | 8.7 | 22.91 | -- | -- | 2 |
| 19 | -50.5 | -59.3 | 21.69 | -- | -- | 1 |
| 20 | -49.3 | 0.6 | 21.28 | -- | -- | 1 |
| 21 | -48.5 | -1.4 | 22.44 | -- | -- | 3 |
| 22 | -46.4 | 44.0 | 22.88 | -- | -- | 3 |
| 23 | -46.2 | 72.1 | 22.60 | -- | -- | 3 |
| 24 | -45.4 | 9.5 | 21.56 | -- | -- | 1 |
| 25 | -45.5 | -6.8 | 22.95 | -- | -- | 1 |
| 26 | -43.1 | 35.8 | 22.42 | -- | -- | 1 |
| 27 | -42.9 | 13.3 | 23.25 | -- | -- | 2 |
| 28 | -31.3 | 48.5 | 21.69 | -- | -- | 1 |
| 29 | -30.9 | 3.3 | 22.60 | -- | -- | 1 |
| 30 | -30.4 | -40.2 | 20.97 | -- | -- | 3 |
| 31 | -26.5 | 24.2 | 22.66 | -- | -- | 3 |
| 32 | -22.8 | -0.8 | 22.71 | -- | -- | 1 |
| 33 | -22.3 | 39.8 | 22.60 | -- | -- | 1 |
| 34 | -21.8 | -41.4 | 21.97 | -- | -- | 3 |
| 35 | -20.7 | 70.7 | 22.14 | -- | -- | 1 |
| 36 | -18.1 | -24.1 | 23.29 | -- | -- | 1 |
| 37 | -13.0 | -40.1 | 22.56 | -- | -- | 1 |
| 38 | -6.7 | 74.6 | 23.11 | -- | -- | 0 |
| 39 | -6.7 | 43.4 | 20.96 | -- | -- | 3 |
| 41 | 0.0 | 0.0 | 19.24 | -- | -- | 2 |
| 42 | 1.3 | -15.9 | 22.37 | -- | -- | 3 |
| 43 | 2.6 | 76.5 | 23.02 | -- | -- | 3 |
| 44 | 3.3 | -25.1 | 23.24 | -- | -- | 0 |
| 45 | 3.8 | -42.4 | 20.59 | -- | -- | 1 |
| 46 | 9.1 | 53.4 | 23.25 | -- | -- | 3 |
| 47 | 13.3 | 8.7 | 20.30 | -- | -- | 1 |
| 48 | 13.9 | 5.3 | 17.44 | -- | -- | 3 |
| 49 | 16.1 | 64.9 | 22.25 | -- | -- | 1 |
| 50 | 18.6 | 80.8 | 22.22 | -- | -- | 1 |
| 52 | 19.6 | 55.0 | 21.78 | -- | -- | 3 |
| 53 | 19.7 | -28.8 | 22.08 | -- | -- | 3 |
| 54 | 21.1 | 57.2 | 21.17 | -- | -- | 1 |
| 65 | 21.8 | -4.4 | 19.56 | -- | -- | 3 |
| 56 | 24.4 | 50.4 | 22.37 | -- | -- | 0 |
| 57 | 24.6 | 43.3 | 20.72 | -- | -- | 3 |
| 58 | 25.0 | 64.0 | 22.59 | -- | -- | 3 |
| 59 | 29.0 | 6.9 | 22.14 | -- | -- | 1 |
| 60 | 32.8 | -60.5 | 17.40 | -- | -- | 3 |
| 61 | 37.0 | 33.9 | 21.69 | -- | -- | 3 |
| 62 | 37.7 | -48.8 | 22.24 | -- | -- | 1 |
| 63 | 39.3 | 10.6 | 17.98 | -- | -- | 3 |
| 65 | 56.4 | 54.0 | 21.95 | -- | -- | 1 |
| 66 | 58.4 | 70.2 | 23.28 | -- | -- | 2 |
| 67 | 62.0 | -22.0 | 19.04 | -- | -- | 3 |
|  |  |  |  |  |  |  |


|  | 0449-183 |  | 200.338 |  |  |  | $\mathrm{GL}=24.13$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: | 44926 | 6.30 | Dec:-18 | 2355.0 | RL=23 |  |  |
| Obj | \#RA | \#Dec | R | G | G-R | Class | Comments |
| 1 | -69.7 | -33.8 | 20.63 | 21.45 | 0.81 | 1 |  |
| 3 | -66.0 | -20.3 | 21.98 | 23.16 | 1.18 | 2 |  |
| 4 | -65.6 | 56.6 | 22.73 | 23.41 | 0.68 | 3 |  |
| 5 | -65.1 | 23.7 | 19.08 | 19.51 | 0.43 | 1 |  |
| 6 | -63.9 | 64.6 | - 22.33 | 23.39 | 1.06 | 3 |  |
| 7 | -63.7 | 54.3 | 21.57 | 22.44 | 0.88 | 1 |  |
| 8 | -61.7 | 17.0 | 21.30 | 22.93 | 1.63 | 1 |  |
| 9 | -62.3 | 7.8 | 22.07 | 23.96 | 1.89 | 1 |  |
| 10 | -62.1 | 29.6 | 21.69 | 23.49 | 1.80 | 1 |  |
| 12 | -56.8 | -34.5 | 22.03 | 23.00 | 0.97 | 1 |  |
| 13 | -56.6 | 64.9 | 22.63 | 24.00 | 1.37 | 2 |  |
| 14 | -50.9 | 97.2 | 22.48 | -- | -- | 2 |  |
| 15 | -50.0 | -73.3 | 21.69 | 22.96 | 1.27 | 2 |  |
| 16 | -48.5 | -64.3 | 19.20 | 20.29 | 1.09 | 1 |  |
| 17 | -46.1 | 6.8 | 21.22 | 21.97 | 0.75 | 1 |  |
| 18 | -42.7 | 52.7 | 22.42 | -- | -- | 1 |  |
| 19 | -41.5 | -54.3 | 22.37 | 23.53 | 1.15 | 1 |  |
| 20 | -36.4 | -13.1 | 20.22 | 21.18 | 0.96 | 1 |  |
| 21 | -35.0 | -66.2 | 22.36 | 23.25 | 0.89 | 1 |  |
| 22 | -30.3 | 1.9 | 20.89 | 22.42 | 1.53 | 3 |  |
| 23 | -29.8 | -69.7 | 21.41 | 22.00 | 0.59 | 1 |  |
| 25 | -24.7 | 17.3 | 22.09 | 23.24 | 1.15 | 1 |  |
| 26 | -22.4 | 23.6 | 21.99 | 22.27 | 0.27 | 2 |  |
| 27 | -21.8 | -2.2 | 19.95 | 21.12 | 1.17 | 1 |  |
| 28 | -21.2 | 54.7 | 19.81 | 21.15 | 1.34 | 1 |  |
| 29 | -17.3 | -35.9 | 23.32 | 22.23 | -1.09 | 1 |  |
| 30 | -11.6 | 56.0 | 20.36 | 22.01 | 1.65 | 3 |  |
| 31 | -11.4 | 43.0 | 21.35 | 22.91 | 1.56 | 3 |  |
| 32 | -8.8 | 7.5 | 21.21 | 23.06 | 1.86 | 1 |  |
| 33 | -6.5 | -46.6 | 17.46 | 18.93 | 1.46 | 3 |  |
| 34 | -5.2 | 18.4 | 21.83 | 23.57 | 1.74 | 1 |  |
| 35 | -4.7 | 31.5 | 18.03 | 18.31 | 0.27 | 3 |  |
| 36 | 0.0 | 0.0 | 18.50 | 19.67 | 1.17 | 1 | QSo |
| 37 | 1.5 | 23.5 | 21.77 | 23.27 | 1.50 | 1 |  |
| 38 | 2.0 | -49.2 | 21.39 | 22.35 | 0.96 | 1 |  |
| 39 | 4.1 | 3.5 | 21.02 | 22.51 | 1.48 | 2 |  |
| 40 | 5.1 | -55.3 | 21.78 | 23.44 | 1.66 | 3 |  |
| 41 | 9.3 | 16.8 | 21.27 | 22.79 | 1.53 | 3 |  |
| 42 | 10.5 | -9.5 | 21.75 | 22.48 | 0.73 | 1 |  |
| 43 | 10.5 | -12.4 | 21.31 | 22.21 | 0.90 | 1 |  |
| 44 | 11.7 | -68.0 | 21.96 | 22.36 | 0.40 | 2 |  |
| 45 | 13.3 | 85.8 | 22.03 | 23.89 | 1.86 | 2 |  |
| 46 | 20.1 | -65.1 | 21.56 | 22.04 | 0.48 | 1 |  |
| 47 | 27.8 | 33.6 | 20.03 | 21.65 | 1.62 | 1 |  |
| 48 | 27.2 | -34.2 | 21.98 | 22.79 | 0.80 | 1 |  |
| 49 | 34.0 | 91.3 | 20.90 | 22.35 | 1.44 | 3 |  |
| 50 | 35.4 | -12.4 | 22.18 | 23.43 | 1.25 | 2 |  |
| 52 | 39.2 | -55.7 | 22.61 | 23.35 | 0.74 | 1 |  |


| 53 | 41.3 | 17.7 | 23.23 | -- | -- | 1 |
| :--- | ---: | ---: | ---: | :---: | :---: | :---: |
| 55 | 48.3 | -15.1 | 22.63 | 23.91 | 1.28 | 1 |
| 56 | 48.8 | 19.1 | 22.85 | 23.20 | 0.35 | 3 |
| 57 | 50.0 | 61.3 | 22.95 | 23.37 | 0.41 | 2 |
| 58 | 51.3 | -39.5 | 20.57 | 22.15 | 1.58 | 3 |
| 59 | 71.9 | -50.0 | 22.50 | 23.88 | 1.37 | 3 |
| 60 | 74.8 | 21.6 | 22.75 | -- | -- | 1 |
| 61 | 75.5 | 59.0 | 22.68 | 23.88 | 1.20 | 2 |
| 62 | 78.5 | -12.4 | 21.44 | 23.57 | 2.13 | 1 |
| 63 | 84.0 | 53.8 | 22.20 | 23.73 | 1.53 | 3 |
| 64 | 85.3 | -6.7 | 20.77 | 21.32 | 0.55 | 1 |
| 65 | 85.5 | 21.7 | 23.13 | 22.91 | -0.23 | 1 |
| 66 | 87.4 | 10.5 | 22.35 | 23.79 | 1.44 | 1 |
| 67 | 91.1 | 89.9 | 22.37 | 22.93 | 0.56 | 1 |
| 68 | 94.7 | 73.9 | 19.92 | 20.17 | 0.25 | 1 |


| RA: <br> Obj | 3C 147 |  | z=0.545 |  |  |  |  | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 53843 | 3.55 | Dec: +49 | 49 | 42.8 | RL=23 | 48 |  |
|  | \#RA | \#Dec | R |  | G | G-R | Class |  |
| 1 | -46.9 | 74.9 | 19.68 |  | -- | -- | 3 |  |
| 2 | -46.0 | 63.9 | 17.85 |  | -- | -- | 3 |  |
| 3 | -44.1 | -29.0 | 22.46 |  | -- | -- | 3 |  |
| 4 | -44.0 | -7.6 | 21.82 |  | -- | -- | 3 |  |
| 5 | -42.7 | 113.6 | 20.18 |  | -- | -- | 3 |  |
| 6 | -42.1 | -13.6 | 22.05 |  | -- | -- | 3 |  |
| 7 | -40.8 | -47.7 | 19.83 |  | -- | -- | 1 |  |
| 8 | -40.6 | -41.8 | 19.40 |  | -- | -- | 3 |  |
| 9 | -40.0 | -2.5 | 20.00 |  | -- | -- | 3 |  |
| 11 | -37.9 | -45.2 | 19.18 |  | -- | -- | 2 |  |
| 12 | -37.5 | 10.8 | 19.50 |  | -- | -- | 3 |  |
| 13 | -37.2 | 92.5 | 21.98 |  | -- | -- | 3 |  |
| 15 | -33.9 | 68.9 | 23.05 |  | -- | -- | 0 |  |
| 16 | -32.7 | -18.8 | 19.65 |  | -- | -- | 1 |  |
| 17 | -32.0 | 17.4 | 19.01 |  | -- | -- | 3 |  |
| 18 | -31.5 | -19.4 | 18.84 |  | -- | -- | 3 |  |
| 19 | -31.7 | -22.6 | 19.24 |  | -- | -- | 3 |  |
| 20 | -29.5 | 23.6 | 21.83 |  | -- | -- | 2 |  |
| 21 | -29.2 | -31.1 | 22.60 |  | -- | -- | 1 |  |
| 22 | -27.5 | 76.2 | 23.37 |  | -- | -- | 0 |  |
| 23 | -26.4 | 14.8 | 23.16 |  | -- | -- | 3 |  |
| 24 | -26.3 | 105.4 | 22.37 |  | -- | -- | 3 |  |
| 25 | -26.8 | 99.2 | 23.08 |  | -- | -- | 2 |  |
| 26 | -21.7 | -30.4 | 18.17 |  | -- | -- | 3 |  |
| 27 | -20.5 | 15.8 | 23.12 |  | -- | -- | 1 |  |
| 28 | -18.7 | 65.0 | 21.33 |  | -- | -- | 2 |  |
| 29 | -18.1 | 116.2 | 23.22 |  | -- | -- | 3 |  |
| 31 | -17.5 | -30.5 | 19.61 |  | -- | -- | 3 |  |
| 32 | -16.9 | 112.0 | 22.03 |  | -- | -- | 3 |  |


| 33 | -16.5 | 39.4 | 21.38 | -- | -- | 3 |
| ---: | ---: | ---: | ---: | :--- | :--- | :--- |
| 34 | -16.2 | 45.5 | 22.37 | -- | -- | 3 |
| 35 | -15.2 | -12.1 | 21.49 | -- | -- | 3 |
| 36 | -13.6 | -19.9 | 21.49 | -- | -- | 1 |
| 37 | -11.6 | 113.7 | 17.91 | -- | -- | 3 |
| 38 | -10.8 | 93.2 | 21.28 | -- | -- | 1 |
| 39 | -10.3 | 10.4 | 20.46 | -- | -- | 3 |
| 40 | -8.3 | 24.1 | 20.78 | -- | -- | 3 |
| 41 | -5.6 | 64.3 | 22.70 | -- | -- | 3 |
| 42 | -5.7 | 6.2 | 19.39 | -- | -- | 3 |
| 43 | -5.5 | -12.0 | 23.18 | -- | -- | 2 |
| 44 | -4.0 | -7.0 | 21.70 | -- | -- | 0 |
| 45 | -3.8 | 78.7 | 22.27 | -- | -- | 1 |
| 46 | -2.3 | 24.9 | 19.06 | -- | -- | 3 |
| 47 | -1.0 | 32.8 | 17.20 | -- | -- | 3 |
| 48 | 0.0 | 0.0 | 17.80 | -- | -- | 3 |
| 49 | 2.5 | 8.2 | 22.13 | -- | -- | 0 |
| 51 | 7.8 | 37.8 | 18.11 | -- | -- | 3 |
| 52 | 8.3 | 52.6 | 19.95 | -- | -- | 1 |
| 53 | 9.5 | 63.2 | 20.62 | -- | -- | 3 |
| 54 | 10.1 | 88.7 | 22.71 | -- | -- | 3 |
| 57 | 15.1 | 60.1 | 23.02 | -- | -- | 0 |
| 58 | 17.7 | 8.9 | 20.11 | -- | -- | 1 |
| 59 | 18.1 | 87.2 | 18.88 | -- | -- | 3 |
| 60 | 19.3 | 113.0 | 21.79 | -- | -- | 3 |
| 62 | 20.6 | 25.3 | 22.74 | -- | -- | 3 |
| 63 | 24.4 | 99.8 | 20.63 | -- | -- | 1 |
| 64 | 24.3 | 4.5 | 21.82 | -- | -- | 3 |
| 65 | 24.6 | 80.6 | 19.33 | -- | -- | 3 |
| 67 | 26.4 | 63.4 | 19.28 | -- | -- | 3 |
| 68 | 27.4 | 42.8 | 22.58 | -- | -- | 3 |
| 69 | 30.5 | 118.5 | 22.41 | -- | -- | 1 |
| 70 | 30.4 | 106.7 | 22.37 | -- | -- | 3 |
| 71 | 30.5 | 88.1 | 21.41 | -- | -- | 1 |
| 72 | 30.5 | 56.8 | 21.84 | -- | -- | 3 |
| 73 | 30.4 | 36.5 | 20.08 | -- | -- | 3 |
| 74 | 30.7 | -14.6 | 19.68 | -- | -- | 3 |
| 75 | 31.6 | -10.9 | 18.06 | -- | -- | 3 |
| 76 | 31.8 | 19.5 | 22.57 | -- | -- | 3 |
| 78 | 33.0 | 67.4 | 16.94 | -- | -- | 3 |
| 79 | 35.0 | -10.7 | 18.25 | -- | -- | 3 |
| 80 | 35.3 | -20.5 | 22.46 | -- | -- | 1 |
| 81 | 36.1 | -36.8 | 20.82 | -- | -- | 3 |
| 82 | 36.2 | 83.9 | 17.83 | -- | -- | 3 |
| 83 | 36.2 | -29.8 | 21.75 | -- | -- | 3 |
| 84 | 37.5 | 55.6 | 18.44 | -- | -- | 3 |
| 85 | 39.5 | 41.9 | 16.89 | -- | -- | 3 |
| 86 | 39.5 | 22.0 | 22.41 | -- | -- | 3 |
| 87 | 40.5 | -48.0 | 21.23 | -- | -- | 2 |
| 88 | 42.6 | 69.8 | 20.84 | -- | -- | 3 |
| 89 | 43.7 | -7.4 | 22.95 | -- | -- | 3 |
|  |  |  |  |  |  |  |


| 90 | 49.5 | -46.6 | 23.46 | -- | -- | 3 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 91 | 50.9 | 46.7 | 21.18 | -- |  | 3 |
| 92 | 51.1 | 102.7 | 18.53 | -- | -- | 3 |
| 93 | 53.0 | 30.3 | 21.92 | -- | -- | 3 |
| 95 | 55.1 | 39.3 | 22.36 | -- |  | 1 |
| 97 | 56.2 | 54.4 | 21.02 | -- | -- | 3 |
| 98 | 56.0 | -37.7 | 22.73 | -- | -- | 3 |
| 99 | 57.6 | 82.9 | 23.09 | -- | -- | 0 |
| 101 | 60.2 | 32.8 | 22.71 | -- | -- | 3 |
| 103 | 60.9 | 85.7 | 21.27 | -- | -- | 3 |
| 104 | 62.2 | 84.4 | 21.72 | -- | -- | 3 |
| 105 | 64.4 | 95.9 | 20.14 | -- | -- | 3 |
| 106 | 65.3 | 35.3 | 19.23 | -- | -- | 2 |
| 107 | 65.7 | 80.2 | 19.08 | -- | -- | 3 |
| 108 | 66.1 | -23.0 | 20.57 | -- | -- | 1 |
| 109 | 65.9 | 39.5 | 15.91 | -- | -- | 3 |
| 110 | 66.3 | -27.5 | 18.31 | -- | -- | 3 |
| 112 | 66.8 | -39.4 | 21.69 | -- | -- | 3 |
| 113 | 68.4 | 58.2 | 21.14 | -- | -- | 1 |
| 114 | 71.7 | 106.1 | 20.70 | -- | -- | 3 |
| 115 | 72.2 | 61.3 | 20.16 | -- | -- | 3 |
| 116 | 74.8 | 50.7 | 22.20 | -- | -- | 3 |
| 117 | 75.8 | 72.8 | 19.87 | -- | -- | 3 |
| 118 | 75.7 | -23.8 | 19.40 | -- | -- | 3 |
| 119 | 77.3 | -2.3 | 18.94 | -- | -- | 3 |
| 120 | 77.6 | 39.8 | 16.84 | -- | -- | 3 |
| 121 | 78.0 | 61.5 | 19.92 | -- | -- | 1 |
| 124 | 80.8 | 44.7 | 22.38 | -- | -- | 1 |
| 125 | 81.2 | 58.8 | 17.93 | -- | -- | 3 |
| 126 | 81.8 | 8.8 | 22.31 | -- | -- | 2 |
| 127 | 82.4 | -47.2 | 17.36 | -- | -- | 3 |
| 128 | 83.4 | 76.8 | 18.87 | -- | -- | 3 |
| 129 | 83.7 | 26.2 | 22.65 | -- | -- | 1 |
| 130 | 84.8 | 0.2 | 21.54 | -- | -- | 1 |
| 131 | 84.8 | 25.3 | 23.11 | -- | -- | 0 |
| 132 | 86.6 | 36.1 | 21.14 | -- |  | 3 |
| 133 | 89.4 | 59.6 | 20.97 | -- | -- | 3 |
| 134 | 93.6 | 73.8 | 21.27 | -- | -- | 3 |
| 135 | 95.3 | -35.3 | 20.13 | -- | -- | 3 |
| 136 | 97.1 | 37.9 | 20.64 | -- | -- | 3 |
| 137 | 97.3 | -6.7 | 20.84 | -- |  | 3 |
| 138 | 98.9 | 50.5 | 22.21 | -- | -- | 1 |
| 140 | 103.4 | 11.8 | 16.78 | -- | -- | 3 |
| 141 | 105.2 | 86.8 | 22.34 | -- | -- | 3 |
| 142 | 105.0 | -30.2 | 22.79 | -- | -- | 3 |
| 144 | 106.4 | 60.0 | 21.75 | -- | -- | 1 |
| 145 | 106.8 | 88.1 | 22.54 | -- | -- | 3 |
| 146 | 106.9 | 37.2 | 20.96 | -- | -- | 2 |
| 147 | 107.7 | 99.9 | 21.21 | -- |  | 3 |
| 148 | 108.1 | 8.4 | 15.88 | -- | -- | 3 |
| 149 | 108.5 | 94.2 | 21.19 | -- | -- |  |


| 150 | 109.2 | 61.9 | 17.35 | -- | -- | 3 |
| ---: | ---: | ---: | ---: | :--- | :--- | :--- |
| 151 | 110.5 | 68.7 | 17.59 | -- | -- | 3 |
| 152 | 110.5 | 21.1 | 16.66 | -- | -- | 3 |
| 153 | 110.9 | -22.4 | 20.62 | -- | -- | 1 |
| 154 | 112.2 | 48.1 | 22.57 | -- | -- | 2 |
| 155 | 113.0 | 84.2 | 18.96 | -- | -- | 3 |
| 156 | 113.5 | 54.8 | 17.90 | -- | -- | 3 |
| 157 | 115.7 | 105.8 | 16.44 | -- | -- | 3 |
| 158 | 116.0 | 102.4 | 16.58 | -- | -- | 3 |
| 159 | 116.3 | 31.3 | 16.75 | -- | -- | 3 |
| 160 | 119.2 | 78.0 | 22.92 | -- | -- | 0 |
| 161 | 119.6 | 90.9 | 23.26 | -- | -- | 0 |
| 162 | 123.0 | 57.0 | 22.73 | -- | -- | 2 |
| 163 | 122.8 | 23.5 | 17.12 | -- | -- | 3 |
| 164 | 123.1 | 6.4 | 18.63 | -- | -- | 2 |



| 34 | 14.6 | 58.4 | 23.04 | 23.59 | 0.55 | 2 |
| :--- | ---: | ---: | ---: | :---: | :---: | :---: |
| 35 | 15.6 | 25.3 | 21.11 | 21.50 | 0.39 | 2 |
| 36 | 15.4 | -21.0 | 23.18 | 23.02 | -0.16 | 1 |
| 37 | 20.3 | -13.1 | 16.80 | 17.20 | 0.40 | 4 |
| 38 | 21.0 | 43.4 | 22.82 | 23.09 | 0.27 | 1 |
| 39 | 22.4 | 8.1 | 21.09 | 22.49 | 1.40 | 1 |
| 40 | 22.0 | 65.2 | 22.31 | -- | -- | 3 |
| 41 | 23.8 | -15.5 | 21.61 | 22.13 | 0.62 | 1 |
| 42 | 23.8 | -1.2 | 20.37 | 22.61 | 2.24 | 1 |
| 43 | 25.3 | 18.5 | 21.14 | 22.28 | 1.14 | 1 |
| 44 | 26.5 | -44.6 | 21.75 | 23.62 | 1.87 | 1 |
| 45 | 29.2 | -2.3 | 23.06 | -- | -- | 1 |
| 46 | 29.5 | -53.3 | 22.87 | -- | -- | 1 |
| 47 | 31.3 | -76.0 | 21.66 | -- | -- | 2 |
| 48 | 33.0 | 18.0 | 21.54 | 23.35 | 1.81 | 2 |
| 49 | 34.6 | -29.8 | 22.35 | 23.64 | 1.29 | 1 |
| 50 | 36.4 | 0.0 | 21.15 | 22.22 | 1.07 | 1 |
| 51 | 38.8 | 53.2 | 21.56 | 22.92 | 1.36 | 2 |
| 52 | 38.8 | -72.9 | 21.01 | 22.28 | 1.27 | 1 |
| 53 | 39.3 | -71.4 | 21.88 | -- | -- | 0 |
| 54 | 40.5 | -48.3 | 20.11 | 22.75 | 2.64 | 1 |
| 55 | 41.2 | -8.1 | 22.25 | 22.52 | 0.27 | 1 |
| 56 | 43.5 | 26.8 | 22.35 | -- | -- | 1 |
| 57 | 48.6 | -9.7 | 21.69 | 22.24 | 0.55 | 3 |


| ---- | 0844+377 |  | $z=0.451$ |  |  |  | GL=24.18 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: | 844 | 1.00 | Dec: +37 | 4354.0 | $\mathrm{RL}=23$ |  |  |
| Obj | \# BA | \# Dec | R | G | G-R | Class | Comments |
| 1 | 103.2 | 29.7 | 23.34 | -- | -- | 3 |  |
| 2 | 103.5 | -30.6 | 6 -- | 23.61 | -- | 3 |  |
| 3 | -99.6 | -41.1 | 23.08 | 22.85 | -0.23 | 1 |  |
| 4 | -99.3 | 1.2 | 22.82 | 23.58 | 0.77 | 1 |  |
| 6 | -95.3 | 96.2 | 22.11 | 23.59 | 1.48 | 1 |  |
| 7 | -95.1 | -27.4 | 22.69 | 23.58 | 0.89 | 3 |  |
| 8 | -93.4 | 88.6 | 23.07 | -- | -- | 3 |  |
| 9 | -91.9 | -58.1 | 20.73 | 21.67 | 0.95 | 1 |  |
| 10 | -90.2 | 94.8 | 22.70 | 23.18 | 0.48 | 1 |  |
| 11 | -88.6 | 79.9 | 21.57 | 22.41 | 0.85 | 1 |  |
| 12 | -88.1 | -34.2 | 23.34 | -- | -- | 1 |  |
| 13 | -88.2 | 80.5 | 21.42 | 21.88 | 0.46 | 1 |  |
| 14 | -83.3 | 2.3 | 20.66 | 21.97 | 1.31 | 1 |  |
| 15 | -81.5 | -39.9 | 19.05 | 20.51 | 1.46 | 1 |  |
| 16 | -81.4 | -49.4 | 21.67 | 23.30 | 1.63 | 1 |  |
| 17 | -79.9 | 16.9 | 18.63 | 20.21 | 1.59 | 3 |  |
| 18 | -79.6 | 86.0 | 22.43 | 22.99 | 0.56 | 1 |  |
| 19 | -79.4 | -42.7 | 22.58 | -- | -- | 1 |  |
| 20 | -77.6 | 48.9 | 23.23 | -- | -- | 1 |  |
| 23 | -74.2 | 19.3 | 20.85 | 21.70 | 0.86 | 1 |  |


| 24 | -72.1 | 5.8 | 22.24 | 22.70 | 0.46 | 1 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 25 | -71.5 | 45.8 | 23.35 | 23.47 | 0.11 | 2 |
| 27 | -70.5 | -61.6 | 19.98 | 20.16 | 0.18 | 1 |
| 29 | -62.8 | 5.7 | -- | 24.12 | -- | 3 |
| 31 | -63.2 | -21.9 | 22.68 | 23.26 | 0.58 | 1 |
| 32 | -62.4 | -26.7 | 19.50 | 20.28 | 0.77 | 1 |
| 33 | -62.3 | -33.4 | 23.41 | 23.83 | 0.43 | 1 |
| 34 | -57.7 | 88.9 | 22.93 | 23.42 | 0.49 | 3 |
| 36 | -51.8 | 5.4 | 18.83 | 20.16 | 1.33 | 1 |
| 37 | -50.7 | -30.5 | 20.53 | 22.10 | 1.58 | 3 |
| 38 | -49.7 | 94.0 | 20.70 | 21.62 | 0.92 | 1 |
| 40 | -44.2 | -51.4 | 23.38 | 24.10 | 0.72 | 0 |
| 41 | -44.4 | 52.1 | -- | 24.07 | -- | 3 |
| 42 | -44.1 | -2.6 | 22.55 | 23.67 | 1.12 | 1 |
| 43 | -43.0 | -1.1 | 23.49 | 23.82 | 0.33 | 2 |
| 44 | -41.7 | 34.4 | 20.43 | 22.19 | 1.76 | 1 |
| 45 | -41.6 | 93.4 | 22.16 | 22.80 | 0.64 | 1 |
| 46 | -39.9 | 72.0 | 21.89 | 22.28 | 0.39 | 1 |
| 47 | -39.4 | 95.3 | 18.47 | 19.96 | 1.49 | 3 |
| 48 | -37.5 | -65.0 | 23.42 | -- |  | 1 |
| 50 | -36.7 | -22.2 | -- | 23.42 | -- | 3 |
| 51 | -36.0 | 76.7 | 22.20 | 22.65 | 0.44 | 3 |
| 52 | -35.0 | 11.0 | 20.26 | 21.17 | 0.91 | 1 |
| 53 | -34.1 | -56.5 | 23.48 | 23.31 | -0.17 | 1 |
| 56 | -32.2 | 38.5 | 21.89 | 23.82 | 1.93 |  |
| 57 | -30.9 | -71.3 | 22.95 | 23.37 | 0.42 | 2 |
| 59 | -27.3 | -48.7 | 22.58 | -- |  | 1 |
| 60 | -24.5 | 10.7 | 22.04 | 23.17 | 1.13 |  |
| 61 | -24.6 | -25.9 | 23.39 | -- |  | 1 |
| 63 | -22.3 | 2.4 | 17.88 | 17.73 | -0.15 | 3 |
| 64 | -21.9 | 48.2 | 22.68 | 23.72 | 1.04 |  |
| 65 | -21.7 | -2.3 | 21.36 | 22.19 | 0.84 | 1 |
| 66 | -20.5 | 43.1 | 21.52 | 22.68 | 1.16 |  |
| 68 | -19.0 | 0.0 | 21.03 | 21.97 | 0.94 | 1 |
| 70 | -17.1 | 42.1 | 21.68 | 22.78 | 1.10 | 1 |
| 71 | -16.2 | -70.1 | 23.36 | -- | -- | 1 |
| 72 | -15.3 | 36.4 | 23.16 | 23.80 | 0.63 | 3 |
| 73 | -13.6 | -16.8 | 23.38 | 23.73 | 0.35 | 3 |
| 74 | -12.5 | -14.2 | 21.94 | 22.81 | 0.88 | 1 |
| 75 | -11.8 | -39.0 | 23.45 | 23.53 | 0.08 | 1 |
| 76 | -11.6 | 11.3 | 20.83 | 22.52 | 1.69 | 1 |
| 77 | -11.3 | 42.8 | 22.77 | 23.96 | 1.19 | 1 |
| 78 | -11.0 | 58.1 | 22.84 | 23.63 | 0.79 | 2 |
| 79 | -9.9 | 30.3 | -- | 24.10 | -- | 1 |
| 80 | -9.6 | 63.0 | 22.46 | 23.03 | 0.58 | 2 |
| 81 | -8.5 | 95.7 | 22.35 | 23.34 | 0.99 | 1 |
| 82 | -8.7 | 21.8 | 20.62 | 21.14 | 0.52 | 1 |
| 83 | -8.2 | -66.8 | 20.60 | 21.55 | 0.95 | 3 |
| 84 | -8.1 | -6.7 | 22.20 | -- | -- | 2 |
| 85 | -6.9 | -48.5 | 22.78 | 23.23 | 0.44 | 1 |
| 86 | -4.3 | 4.9 | 22.02 | 22.97 | 0.95 | 1 |


| 89 | -1.0 | -13.7 | 22.57 | 23.91 | 1.34 | 1 |
| ---: | ---: | ---: | :---: | :---: | :---: | :---: |
| 90 | -0.6 | 64.4 | 23.35 | 24.11 | 0.76 | 1 |
| 91 | 0.0 | 0.0 | 19.70 | 20.67 | 0.97 | 1 |
| 92 | 0.8 | 77.3 | 23.37 | 23.81 | 0.44 | 3 |
| 93 | 0.8 | -9.6 | 23.18 | -- | .- | 2 |
| 95 | 3.2 | 54.8 | 22.93 | 23.31 | 0.38 | 2 |
| 97 | 4.0 | -63.2 | -- | 24.09 | -- | 3 |
| 98 | 4.8 | 83.6 | 20.36 | 21.86 | 1.50 | 1 |
| 99 | 8.3 | -44.2 | 23.40 | 24.06 | 0.66 | 1 |
| 100 | 9.0 | 89.1 | 23.47 | -- | -- | 3 |
| 101 | 12.1 | -12.5 | 23.57 | -- | -- | 0 |
| 104 | 14.7 | 92.0 | 22.79 | -- | -- | 1 |
| 105 | 14.4 | 66.4 | 22.19 | 23.01 | 0.81 | 1 |
| 106 | 15.4 | 23.3 | 19.57 | 20.92 | 1.35 | 3 |
| 107 | 16.9 | 79.8 | 23.22 | -- | -- | 1 |
| 109 | 18.9 | -53.5 | 23.36 | -- | -- | 2 |
| 112 | 22.7 | 29.5 | 23.42 | -- | -- | 2 |
| 113 | 23.9 | -68.2 | 22.41 | 22.88 | 0.46 | 2 |
| 114 | 26.1 | -31.6 | 18.20 | 19.14 | 0.94 | 3 |
| 115 | 29.8 | 80.5 | -- | 23.87 | -- | 1 |
| 116 | 31.2 | 81.9 | 22.89 | 23.44 | 0.56 | 1 |
| 117 | 31.7 | -42.3 | 23.53 | 23.98 | 0.45 | 3 |
| 118 | 32.2 | -35.7 | 22.66 | 23.75 | 1.09 | 1 |
| 120 | 33.6 | -38.3 | 23.47 | 23.28 | -0.19 | 3 |
| 121 | 33.4 | -74.2 | 23.44 | -- | -- | 3 |
| 122 | 34.1 | -53.5 | 23.27 | -- | -- | 2 |
| 123 | 34.2 | 41.4 | -- | 23.39 | -- | 2 |
| 124 | 35.1 | 82.4 | 22.20 | 23.61 | 1.41 | 1 |
| 125 | 36.5 | -50.9 | 21.63 | 22.56 | 0.93 | 1 |
| 127 | 38.4 | -42.0 | 20.73 | 21.95 | 1.22 | 1 |
| 130 | 42.6 | 16.7 | 23.46 | -- | -- | 2 |
| 131 | 43.1 | 7.2 | 21.63 | 23.22 | 1.60 | 1 |
| 132 | 45.8 | 3.0 | 22.60 | 23.18 | 0.58 | 1 |
| 133 | 45.7 | -41.0 | 22.12 | 22.32 | 0.21 | 1 |
| 134 | 48.3 | -62.5 | 21.59 | -- | -- | 1 |
| 135 | 52.6 | 24.4 | 22.97 | 22.83 | -0.14 | 3 |
| 137 | 54.6 | 45.6 | 23.09 | 23.72 | 0.63 | 2 |
| 138 | 54.8 | -39.4 | -- | 22.62 | -- | 2 |
| 139 | 54.5 | -67.6 | 23.23 | 23.61 | 0.38 | 1 |
| 140 | 55.4 | 31.5 | 23.18 | 23.68 | 0.50 | 2 |
| 141 | 58.0 | -42.2 | 23.57 | -- | -- | 1 |
| 142 | 59.0 | -31.4 | 23.57 | -- | -- | 3 |
| 143 | 59.4 | -16.4 | 16.93 | 18.14 | 1.22 | 3 |
| 144 | 59.7 | 75.1 | -- | 23.88 | -- | 2 |
| 145 | 60.6 | -50.9 | 21.07 | 21.81 | 0.74 | 1 |
| 146 | 60.9 | 5.7 | 21.72 | 22.28 | 0.57 | 2 |
| 147 | 61.4 | -18.8 | 21.49 | 22.26 | 0.77 | 1 |
|  |  |  |  |  |  |  |


| RA : | 8465 | 57.30 | Dec: +10 | 042.0 | $\mathrm{RL}=23$ |  | $\mathrm{GL}=24.15$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Obj | \#RA | \#Dec | R | G | G-R | Class | $s$ Comments |
| 1 | -82.1 | 79.8 | 21.30 | 22.07 | 0.77 | 2 |  |
| 2 | -82.1 | 17.0 | 18.69 | 19.31 | 0.62 | 1 |  |
| 3 | -77.4 | 420.8 | 21.69 | 22.46 | 0.78 | 1 |  |
| 4 | -77.0 | -53.8 | 22.20 | 23.79 | 1.59 | 1 |  |
| 5 | -76.3 | 32.1 | 22.46 | 22.92 | 0.45 | 1 |  |
| 6 | -76.4 | 425.8 | 21.42 | 22.07 | 0.65 | 1 |  |
| 7 | -75.7 | 728.7 | 22.49 | 23.56 | 1.06 | 1 |  |
| 8 | -73.6 | 666.3 | 21.97 | 22.80 | 0.83 | 2 |  |
| 9 | -73.6 | 6 43.4 | 19.80 | 20.40 | 0.60 | 3 |  |
| 10 | -72.5 | 566.9 | 23.16 | 23.16 | 0.00 | 1 |  |
| 11 | -72.3 | -69.2 | 21.04 | 22.22 | 1.18 | 1 |  |
| 12 | -71.7 | 792.4 | 18.91 | 19.67 | 0.76 | 1 |  |
| 14 | -64.9 | -41.7 | 23.08 | -- | -- | 1 |  |
| 15 | -64.2 | -53.3 | 22.98 | -- | -- | 1 |  |
| 16 | -62.9 | -21.6 | 22.64 | 23.28 | 0.64 | 1 |  |
| 17 | -60.6 | 67.9 | 21.27 | 22.43 | 1.16 | 3 |  |
| 18 | -58.6 | 61.6 | 22.30 | 23.60 | 1.30 | 1 |  |
| 19 | -55.1 | 170.8 | 18.96 | 20.27 | 1.31 | 3 |  |
| 20 | -53.5 | 55.0 | 23.09 | -- | -- | 1 |  |
| 22 | -50.2 | 21.9 | 22.62 | 23.62 | 1.00 | 1 |  |
| 23 | -48.9 | -18.3 | 23.17 | -- | -- | 1 |  |
| 24 | -49.1 | -7.0 | 19.15 | 19.76 | 0.61 | 1 |  |
| 25 | -46.6 | - 7.4 | 22.53 | 23.72 | 1.19 | 1 |  |
| 26 | -45.0 | -4.6 | 19.35 | 20.79 | 1.45 | 1 |  |
| 27 | -40.2 | 33.3 | 22.97 | 24.06 | 1.09 | 3 |  |
| 28 | -39.1 | -15.7 | 21.92 | 23.55 | 1.63 | 1 |  |
| 29 | -34.5 | 520.3 | 21.67 | 22.15 | 0.48 | 1 |  |
| 30 | -32.9 | 58.2 | 22.88 | 24.01 | 1.14 | 3 |  |
| 31 | -32.3 | 17.8 | 19.02 | 20.30 | 1.28 | 3 |  |
| 32 | -31.8 | -56.3 | 21.45 | 22.63 | 1.19 | 1 |  |
| 33 | -30.4 | 41.0 | 21.34 | 22.22 | 0.89 | 1 |  |
| 34 | -30.5 | 545.7 | 21.42 | 20.93 | -0.48 | 3 |  |
| 35 | -29.3 | 35.6 | 19.68 | 21.12 | 1.43 | 3 |  |
| 36 | -26.5 | -14.5 | 22.26 | 23.33 | 1.06 | 1 |  |
| 37 | -21.9 | -1.5 | 22.40 | 22.37 | -0.03 | 1 |  |
| 38 | -21.1 | 1-16.9 | 22.64 | -- | -- | 2 |  |
| 39 | -15.2 | 26.3 | 20.93 | 22.32 | 1.38 | 3 |  |
| 40 | -12.3 | 39.3 | 21.92 | 22.36 | 0.45 |  |  |
| 41 | -7.8 | -28.0 | 23.17 | -- | -- | 2 |  |
| 42 | -7.8 | 86.6 | 20.18 | 21.91 | 1.73 | 1 |  |
| 43 | -4.8 | 87.9 | 20.11 | 21.11 | 1.00 | 3 |  |
| 44 | -4.8 | 8 13.2 | 20.77 | 22.23 | 1.46 | 1 |  |
| 45 | -4.8 | 89.8 | 22.23 | 22.63 | 0.40 | 1 |  |
| 46 | -3.2 | -7.1 | 23.30 | -- | -- | 2 |  |
| 47 | -2.4 | 31.0 | 22.89 | 24.14 | 1.25 | 3 |  |
| 48 | -1.7 | 726.3 | 21.52 | 22.08 | 0.56 | 1 |  |
| 49 | -1.6 | -47.7 | 21.92 | 23.31 | 1.38 | 1 |  |
| 50 | 0.0 | 0.0 | 17.89 | 17.88 | -0.01 | 3 | QSo |
| 51 | 0.3 | -16.3 | 21.75 | 23.40 | 1.65 | 1 |  |


| 52 | 1.2 | 82.8 | 17.09 | 18.27 | 1.18 | 3 |
| ---: | ---: | ---: | :--- | :--- | :--- | :--- |
| 53 | 1.1 | 43.8 | 23.03 | 23.98 | 0.95 | 3 |
| 54 | 1.1 | -24.5 | 22.94 | 23.61 | 0.66 | 1 |
| 55 | 2.1 | 30.8 | 23.13 | -- | -- | 2 |
| 56 | 7.4 | -2.5 | 21.87 | 22.69 | 0.82 | 1 |
| 57 | 12.2 | 30.1 | 22.49 | 22.97 | 0.48 | 1 |
| 58 | 13.2 | 54.8 | 21.71 | 21.84 | 0.13 | 3 |
| 59 | 16.6 | 16.8 | 22.67 | 23.35 | 0.67 | 1 |
| 60 | 17.9 | -17.4 | 23.63 | -- | -- | 3 |
| 61 | 18.0 | 50.8 | 21.60 | 22.47 | 0.87 | 1 |
| 62 | 20.5 | -17.9 | 20.11 | 21.68 | 1.57 | 1 |
| 63 | 30.1 | -31.2 | 22.40 | -- | -- | 1 |
| 64 | 31.3 | 13.7 | 23.38 | -- | -- | 1 |
| 65 | 38.6 | 59.0 | 21.71 | 23.31 | 1.60 | 3 |
| 66 | 40.9 | -4.7 | 21.82 | 23.02 | 1.20 | 1 |
| 67 | 48.1 | 85.1 | 23.30 | -- | -- | 3 |
| 68 | 52.5 | 76.8 | 19.36 | 20.58 | 1.22 | 3 |
| 69 | 57.5 | 63.0 | 21.09 | 22.52 | 1.43 | 3 |
| 70 | 60.2 | 1.4 | 20.32 | 21.60 | 1.28 | 3 |
| 71 | 60.6 | -48.9 | 22.66 | -- | -- | 1 |
| 72 | 73.7 | 11.5 | 22.47 | 23.65 | 1.18 | 1 |
| 73 | 77.6 | 43.3 | 23.04 | -- | -- | 2 |
| 74 | 81.3 | -17.9 | 22.45 | 22.76 | 0.31 | 3 |
| 75 | 81.8 | -8.7 | 22.64 | 23.89 | 1.25 | 3 |
| 76 | 83.3 | 87.9 | 17.95 | 19.02 | 1.07 | 3 |
| 78 | 88.1 | 30.0 | 23.23 | 23.97 | 0.74 | 3 |
| 79 | 89.2 | 3.5 | 21.72 | 22.32 | 0.60 | 2 |
| 80 | 89.6 | -28.6 | 20.12 | 20.33 | 0.21 | 1 |


| RA: Obj | 0856+156 |  |  | ---- |  | $z=0.424$ |  |  | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 8 | 5623 | . 89 | Dec:+15 | 39 | 21.0 | RL= 23 | . 68 |  |
|  |  | \#RA | \# Dec | R |  | G | G-R | Class |  |
| 1 |  | -34.6 | 5.4 | 18.56 |  | -- | -- | 3 |  |
| 2 |  | -30.6 | -32.1 | 22.98 |  | -- | -- | 1 |  |
| 3 |  | -28.5 | -81.1 | 18.96 |  | -- | -- | 3 |  |
| 4 |  | -24.6 | -66.3 | 22.76 |  | -- | -- | 3 |  |
| 5 |  | -21.8 | 17.0 | 22.66 |  | -- | -- | 1 |  |
| 6 |  | -21.8 | -25.3 | 19.26 |  | -- | -- | 3 |  |
| 7 |  | -21.5 | -68.5 | 23.24 |  | -- | -- | 3 |  |
| 8 |  | -21.2 | -37.1 | 22.47 |  | -- | -- | 3 |  |
| 9 |  | -17.4 | -74.6 | 21.01 |  | -- | -- | 3 |  |
| 10 |  | -16.3 | -22.8 | 18.31 |  | -- | -- | 3 |  |
| 11 |  | -15.9 | -40.4 | 23.00 |  | -- | -- | 2 |  |
| 12 |  | -11.0 | -87.0 | 22.70 |  | -- | -- | 3 |  |
| 13 |  | -9.2 | -22.6 | 21.66 |  | -- | -- | 1 |  |
| 14 |  | -6.4 | -68.7 | 22.09 |  | -- | -- | 1 |  |
| 15 |  | -4.9 | -33.2 | 18.22 |  | -- | -- | 3 |  |
| 16 |  | -0.4 | -21.8 | 22.62 |  | -- | -- | 2 |  |


| 17 | -0.7 | 18.7 | 22.39 | -- | -- | 1 |
| ---: | ---: | ---: | ---: | :--- | :--- | :--- |
| 18 | 0.0 | 0.0 | 19.55 | -- | -- | 3 |
| 19 | 0.1 | -30.8 | 21.81 | -- | -- | 3 |
| 21 | 2.7 | -67.7 | 23.37 | -- | -- | 3 |
| 22 | 4.2 | -51.8 | 19.56 | -- | -- | 1 |
| 23 | 6.4 | -26.2 | 23.34 | -- | -- | 3 |
| 24 | 12.1 | 10.3 | 22.17 | -- | -- | 1 |
| 25 | 13.7 | -86.4 | 19.69 | -- | -- | 3 |
| 26 | 25.4 | -60.1 | 23.31 | -- | -- | 0 |
| 27 | 26.1 | -17.3 | 23.38 | -- | -- | 3 |
| 28 | 26.6 | -81.4 | 20.75 | -- | -- | 3 |
| 29 | 35.3 | 16.2 | 23.25 | -- | -- | 3 |
| 30 | 37.3 | -7.8 | 21.10 | -- | -- | 2 |
| 31 | 40.1 | -70.7 | 23.01 | -- | -- | 1 |
| 32 | 40.5 | -6.0 | 20.48 | -- | -- | 1 |
| 33 | 43.2 | -17.9 | 18.75 | -- | -- | 3 |
| 34 | 43.8 | 1.5 | 20.11 | -- | -- | 1 |
| 35 | 44.6 | -54.2 | 18.60 | -- | -- | 3 |
| 36 | 46.0 | 16.5 | 22.12 | -- | -- | 1 |
| 37 | 46.8 | 5.1 | 21.06 | -- | -- | 1 |
| 38 | 47.9 | -50.3 | 22.56 | -- | -- | 1 |
| 39 | 49.8 | -78.7 | 23.62 | -- | -- | 3 |
| 40 | 50.3 | -51.7 | 23.50 | -- | -- | 1 |
| 41 | 54.2 | -58.7 | 23.52 | -- | -- | 3 |
| 42 | 56.0 | -6.1 | 21.04 | -- | -- | 3 |
| 43 | 57.3 | 20.8 | 22.03 | -- | -- | 1 |
| 44 | 59.2 | -17.7 | 21.61 | -- | -- | 2 |
| 45 | 60.5 | -43.5 | 21.28 | -- | -- | 1 |
| 46 | 61.7 | -66.2 | 22.89 | -- | -- | 1 |
| 47 | 64.5 | 8.8 | 23.21 | -- | -- | 0 |
| 48 | 66.1 | -59.1 | 21.18 | -- | -- | 3 |
| 49 | 66.4 | -68.8 | 23.64 | -- | -- | 2 |
| 50 | 68.5 | -6.8 | 22.70 | -- | -- | 2 |

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| 16 | -58.2 | -45.7 | 23.21 | -- | - - | 3 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 17 | -58.5 | -63.5 | 23.35 | -- | -- | 3 |
| 18 | -58.4 | 16.8 | 23.36 | -- | -- | 3 |
| 19 | -58.5 | -10.4 | 23.42 | -- | -- | 3 |
| 20 | -57.0 | 23.6 | 19.61 | 21.38 | 1.76 | 1 |
| 21 | -56.8 | -69.8 | 23.85 | -- | -- | 2 |
| 22 | -55.5 | -53.7 | 23.08 | 22.92 | -0.15 | 2 |
| 23 | -55.2 | -58.7 | 20.28 | 21.47 | 1.20 | 3 |
| 25 | -53.3 | -40.8 | 21.73 | -- | -- | 2 |
| 26 | -50.6 | -12.6 | 21.22 | 21.68 | 0.45 | 1 |
| 27 | -50.0 | 15.6 | 22.84 | -- | -- | 3 |
| 28 | -48.5 | 49.7 | 21.56 | 23.15 | 1.59 | 1 |
| 30 | -45.7 | -18.1 | 23.22 | -- | -- | 1 |
| 31 | -45.8 | -43.4 | 22.46 | -- | -- | 1 |
| 32 | -46.1 | $-44.5$ | 22.50 | 22.56 | 0.06 | 2 |
| 35 | -41.8 | -74.6 | 22.29 | -- | -- | 2 |
| 36 | -40.1 | -65.8 | 21.53 | 22.64 | 1.11 | 1 |
| 37 | -39.3 | -14.0 | 21.57 | 22.66 | 1.09 | 1 |
| 38 | -38.6 | -49.7 | 20.94 | 22.23 | 1.29 | 1 |
| 39 | -38.4 | 34.3 | 20.93 | 21.98 | 1.05 | 1 |
| 40 | -36.3 | -5.8 | 21.50 | 22.13 | 0.63 | 1 |
| 41 | -35.7 | 16.5 | 23.59 | -- | -- | 2 |
| 42 | -36.0 | -11.2 | 18.38 | 19.98 | 1.60 | 1 |
| 43 | -33.8 | -11.3 | 19.29 | 20.97 | 1.68 | 1 |
| 44 | -33.3 | -75.6 | 22.91 | -- | -- | 1 |
| 45 | -30.6 | -39.5 | 23.27 | -- | -- | 1 |
| 46 | -27.4 | -77.3 | 23.62 | -- | -- | 3 |
| 47 | -27.2 | 53.8 | 19.50 | 20.61 | 1.11 | 1 |
| 48 | -26.6 | 51.6 | 20.37 | 21.37 | 1.00 | 1 |
| 49 | -26.9 | 35.3 | 22.37 | -- | -- | 2 |
| 50 | -25.8 | -5.3 | 20.04 | 21.76 | 1.72 | 1 |
| 51 | -25.0 | -36.0 | 23.81 | -- | -- | 3 |
| 52 | -23.0 | -61.1 | 21.41 | -- | -- | 2 |
| 53 | -21.7 | 66.1 | 21.31 | 22.71 | 1.40 | 1 |
| 54 | -21.7 | -63.8 | 21.84 | 22.94 | 1.10 | 1 |
| 55 | -20.0 | 17.6 | 22.11 | 23.15 | 1.04 | 1 |
| 56 | -20.8 | 3.6 | 22.48 | 23.21 | 0.73 | 2 |
| 57 | -19.3 | -61.5 | 23.46 | -- | -- | 1 |
| 58 | -18.0 | -67.1 | 18.28 | 18.77 | 0.49 | 3 |
| 59 | -17.6 | -73.6 | 22.80 | -- | -- | 3 |
| 60 | -16.4 | 47.1 | 19.95 | 21.29 | 1.34 | 1 |
| 61 | -14.5 | -41.9 | 22.76 | -- | -- | 1 |
| 62 | -14.1 | -58.9 | 23.20 | - - | -- | 1 |
| 63 | -12.7 | -48.5 | 19.57 | 21.11 | 1.55 | 1 |
| 64 | -9.1 | 16.0 | 23.49 | -- | -- | 3 |
| 65 | -8.0 | -64.8 | 23.81 | - | -- | 3 |
| 66 | -7.5 | -16.5 | 21.86 | -- | - - | 1 |
| 67 | -7.6 | -36.9 | 23.32 | -- | -- | 1 |
| 68 | -6.6 | -45.6 | 22.45 | 23.04 | 0.60 | 1 |
| 69 | -5.0 | 43.8 | 22.74 | -- | -- | 1 |
| 70 | -3.6 | -33.6 | 22.43 | -- | -- | 3 |


| 71 | -4.0 | -62.9 | 22.75 | -- | -- | 2 |
| ---: | ---: | ---: | :--- | :---: | :---: | :---: |
| 72 | -3.7 | -23.6 | 19.88 | 20.90 | 1.02 | 1 |
| 73 | -3.4 | -79.5 | 19.78 | 21.74 | 1.96 | 0 |
| 74 | -0.9 | -47.0 | 23.57 | -- | -- | 1 |
| 76 | -0.3 | 74.0 | 22.25 | -- | -- | 1 |
| 77 | 0.0 | 0.0 | 18.55 | 19.15 | 0.60 | 1 |
| 78 | 0.6 | -11.1 | 21.32 | 22.17 | 0.85 | 3 |
| 79 | 1.9 | 36.0 | 23.87 | -- | -- | 1 |
| 80 | 2.7 | -64.6 | 19.45 | 20.68 | 1.24 | 1 |
| 81 | 3.6 | -17.7 | 22.39 | -- | -- | 1 |
| 82 | 4.2 | 36.0 | 20.15 | 20.60 | 0.44 | 3 |
| 83 | 4.1 | 17.9 | 22.67 | -- | -- | 3 |
| 84 | 4.5 | -7.1 | 21.55 | 22.96 | 1.41 | 2 |
| 85 | 6.2 | -12.2 | 20.08 | 21.74 | 1.66 | 1 |
| 86 | 6.9 | 4.9 | 23.31 | -- | -- | 2 |
| 87 | 7.7 | 34.4 | 20.71 | 21.89 | 1.18 | 1 |
| 88 | 7.7 | -45.8 | 22.93 | -- | -- | 2 |
| 89 | 7.8 | 78.3 | 21.00 | 22.32 | 1.32 | 1 |
| 90 | 9.1 | -77.4 | 19.58 | 21.02 | 1.43 | 3 |
| 91 | 9.2 | -6.4 | 17.27 | 17.77 | 0.51 | 3 |
| 92 | 11.5 | -58.8 | 22.73 | -- | -- | 1 |
| 94 | 12.3 | -0.5 | 22.45 | 23.15 | 0.70 | 1 |
| 95 | 13.7 | -12.5 | 23.30 | -- | -- | 2 |
| 96 | 14.6 | 75.0 | 22.96 | -- | -- | 2 |
| 97 | 15.9 | -59.5 | 20.90 | 22.07 | 1.16 | 3 |
| 98 | 17.6 | 20.0 | 23.74 | -- | -- | 2 |
| 100 | 20.3 | -45.1 | 23.49 | -- | -- | 3 |
| 101 | 20.1 | 11.4 | 22.54 | -- | -- | 1 |
| 102 | 24.4 | -19.8 | 23.62 | -- | -- | 1 |
| 103 | 25.1 | -61.5 | 22.72 | -- | -- | 2 |
| 104 | 25.3 | 32.0 | 21.60 | 23.28 | 1.67 | 1 |
| 105 | 25.0 | -54.6 | 22.35 | -- | -- | 3 |
| 106 | 26.0 | -46.5 | 21.71 | 22.90 | 1.20 | 2 |
| 107 | 26.5 | 29.5 | 22.99 | -- | -- | 1 |
| 109 | 27.9 | 79.6 | 21.85 | 22.54 | 0.69 | 2 |
| 110 | 32.3 | -11.0 | 20.86 | 21.45 | 0.60 | 1 |
| 111 | 32.3 | -55.3 | 23.13 | -- | -- | 2 |
| 112 | 33.0 | 86.9 | 20.72 | 22.72 | 2.00 | 3 |
| 113 | 33.6 | -22.6 | 23.65 | -- | -- | 3 |
| 114 | 34.9 | -70.3 | 22.48 | -- | -- | 1 |
| 115 | 36.5 | 58.5 | 20.16 | 21.55 | 1.39 | 1 |
| 116 | 37.2 | 23.9 | 20.87 | 22.83 | 1.96 | 1 |
| 117 | 37.4 | -50.1 | 21.99 | 22.60 | 0.61 | 2 |
| 118 | 38.1 | -63.2 | 21.45 | 23.27 | 1.82 | 1 |
| 119 | 38.2 | -39.0 | 20.49 | 21.26 | 0.76 | 1 |
| 121 | 39.2 | -10.6 | 22.06 | 22.99 | 0.93 | 2 |
| 122 | 39.8 | 70.6 | 23.71 | -- | -- | 3 |
| 123 | 40.6 | 19.2 | 21.76 | -- | -- | 1 |
| 124 | 41.3 | 87.0 | 23.11 | -- | -- | 3 |
| 125 | 43.0 | -11.1 | 21.29 | 22.76 | 1.46 | 3 |
| 126 | 43.6 | -54.9 | 22.26 | -- | -- | 1 |
|  |  |  |  |  |  |  |


| 127 | 44.9 | -26.9 | 20.63 | 21.99 | 1.36 | 3 |
| ---: | ---: | ---: | :--- | :---: | :---: | ---: |
| 128 | 44.9 | 77.9 | 23.91 | -- | -- | 3 |
| 129 | 47.3 | -17.9 | 21.19 | 22.48 | 1.29 | 1 |
| 130 | 49.2 | 49.2 | 23.54 | -- | - | 1 |
| 131 | 50.3 | -46.7 | 20.27 | 20.92 | 0.65 | 1 |
| 132 | 50.3 | -72.0 | 21.48 | 22.76 | 1.28 | 3 |
| 133 | 52.0 | 7.9 | 22.48 | -- | -- | 3 |
| 134 | 53.1 | 54.9 | 23.08 | -- | -- | 1 |
| 135 | 53.8 | 72.8 | 23.69 | -- | -- | 3 |
| 136 | 58.1 | -75.3 | 19.99 | 22.24 | 2.26 | 1 |
| 137 | 58.4 | 52.3 | 22.99 | -- | -- | 1 |
| 138 | 59.8 | 17.5 | 23.25 | -- | -- | 2 |
| 139 | 60.3 | 43.5 | 23.13 | -- | -- | 2 |
| 140 | 60.5 | -79.2 | 18.19 | 19.36 | 1.16 | 1 |
| 141 | 61.1 | -0.8 | 21.83 | -- | -- | 3 |
| 142 | 61.7 | -2.2 | 21.91 | -- | -- | 1 |
| 143 | 65.0 | 33.0 | 21.85 | -- | -- | 1 |
| 144 | 66.1 | 21.4 | 21.78 | -- | -- | 2 |
| 145 | 66.2 | -53.2 | 20.08 | 21.98 | 1.91 | 1 |
| 146 | 68.5 | -64.7 | 21.52 | -- | -- | 1 |
| 147 | 68.6 | 22.6 | 22.43 | -- | -- | 1 |
| 148 | 68.7 | 31.6 | 19.64 | 21.47 | 1.83 | 1 |
| 149 | 73.7 | -78.5 | 22.79 | 23.15 | 0.36 | 1 |
| 150 | 74.6 | -52.4 | 21.65 | 23.27 | 1.62 | 1 |
| 151 | 77.0 | -79.6 | 22.73 | -- | -- | 1 |
| 152 | 77.7 | -15.0 | 21.66 | 23.22 | 1.57 | 1 |
| 154 | 81.0 | -24.8 | 21.59 | 22.52 | 0.94 | 2 |
| 155 | 81.9 | 9.3 | 22.06 | -- | -- | 1 |
| 156 | 82.8 | 80.9 | 16.75 | 17.85 | 1.10 | 3 |
| 157 | 84.1 | 44.3 | 23.44 | -- | -- | 1 |
| 158 | 85.2 | 3.3 | 22.48 | -- | -- | 1 |
| 159 | 85.9 | -51.5 | 20.53 | 21.22 | 0.69 | 2 |
| 160 | 87.7 | -52.7 | 21.34 | 21.91 | 0.58 | 1 |
| 161 | 88.2 | 40.4 | 20.57 | 21.29 | 0.72 | 1 |
| 162 | 89.4 | 0.3 | 22.32 | -- | -- | 1 |


| RA: <br> Obj | 0911+402 |  |  | $z=0.323$ |  |  | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 91134 | .90 D | c:+40 15 | 34.0 | RL=23 | 43 |  |
|  | \#RA | \#Dec | R | G | G-R | Class |  |
| 2 | 109.4 | 40.5 | 22.66 | -- | -- | 3 |  |
| 3 | 108.5 | -30.8 | 17.89 | -- | -- | 3 |  |
| 4 | 108.5 | -75.4 | 19.26 | -- | -- | 3 |  |
| 5 | 105.9 | -37.2 | 22.20 | -- | -- | 0 |  |
| 6 | 101.5 | 14.0 | 23.16 | -- | -- | 3 |  |
| 7 | 100.7 | -56.7 | 21.69 | -- | -- | 1 |  |
| 8 | -99.4 | -45.1 | 23.28 | -- | -- | 0 |  |
| 9 | -98.6 | 57.3 | 23.43 | -- | -- | 0 |  |
| 11 | -94.2 | 64.5 | 23.13 | -- | -- | 0 |  |


| 12 | -92.0 | -71.2 | 20.82 | -- | -- | 1 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 15 | -89.6 | -2.8 | 22.08 | -- | -- | 1 |
| 16 | -89.0 | -77.3 | 18.77 | -- | -- | 0 |
| 18 | -87.8 | -23.5 | 21.75 | -- | -- | 2 |
| 19 | -85.6 | -45.5 | 22.27 | -- | -- | 2 |
| 20 | -84.6 | -36.8 | 22.85 | -- | -- | 2 |
| 22 | -77.2 | -3.0 | 21.35 | -- | -- | 1 |
| 23 | -68.8 | 52.5 | 22.87 | -- | -- | 1 |
| 24 | -68.9 | -30.4 | 20.86 | -- | -- | 1 |
| 25 | -65.8 | -34.6 | 18.46 | -- | -- | 1 |
| 26 | -65.8 | -11.0 | 23.24 | -- | -- | 1 |
| 27 | -64.1 | 15.6 | 23.28 | -- | -- | 0 |
| 29 | -61.8 | 29.0 | 20.43 | -- | -- | 3 |
| 31 | -60.3 | -35.9 | 23.37 | -- | -- | 0 |
| 32 | -59.8 | 58.0 | 21.76 | -- | -- | 3 |
| 33 | -56.5 | -73.3 | 22.88 | -- | -- | 3 |
| 34 | -55.7 | -12.0 | 19.95 | -- | -- | 1 |
| 35 | -53.8 | 46.4 | 22.74 | -- | -- | 3 |
| 36 | -53.8 | -31.3 | 22.29 | -- | -- | 2 |
| 37 | -52.0 | -68.8 | 22.69 | -- | -- | 0 |
| 38 | -51.3 | -42.2 | 21.34 | -- | -- | 1 |
| 39 | -50.0 | 59.7 | 23.18 | -- | -- | 2 |
| 40 | -47.7 | -45.8 | 17.10 | -- | -- | 3 |
| 42 | -39.1 | 41.2 | 20.08 | -- | -- | 3 |
| 43 | -37.5 | -33.5 | 23.27 | -- | -- | 1 |
| 45 | -24.9 | 31.0 | 22.54 | -- | -- | 3 |
| 46 | -22.6 | -12.9 | 23.36 | -- | -- | 3 |
| 47 | -21.8 | 21.8 | 23.33 | -- | -- | 3 |
| 49 | -19.2 | 53.2 | 21.36 | -- | -- | 1 |
| 50 | -9.7 | 68.0 | 23.17 | -- | -- | 3 |
| 51 | -6.4 | -74.4 | 22.73 | -- | -- | 1 |
| 52 | -5.4 | 65.3 | 23.30 | -- | -- | 1 |
| 53 | -4.2 | 12.5 | 23.29 | -- | -- | 0 |
| 54 | -1.1 | -35.4 | 21.56 | -- | -- | 1 |
| 55 | 0.0 | 0.0 | 18.13 | -- | -- | 3 |
| 57 | 7.8 | 54.7 | 15.66 | -- | -- | 4 |
| 61 | 22.6 | -39.1 | 21.99 | -- | -- | 1 |


| 0928+00 ---- z=0.505 |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: | 92818 | 8.08 | Dec:+ 0 | 4813.5 | RL= 23 | . 09 |  |
| Obj | \# RA | \# Dec | R | G | G-R | Class | Comments |
| 1 | -54.0 | 17.8 | 20.82 | -- | -- | 1 |  |
| 2 | -48.9 | -19.7 | 22.64 | -- | -. | 3 |  |
| 3 | -44.0 | -47.1 | 20.86 | -- | -- | 3 |  |
| 4 | -40.0 | 9.6 | 21.00 | -- | -- | 3 |  |
| 5 | -33.3 | -13.1 | 23.07 | -- | -- | 0 |  |
| 6 | -32.1 | -46.0 | 20.32 | -- | -- | 3 |  |
| 7 | -30.9 | 47.1 | 19.94 | -- | -- | 3 |  |


| 8 | -31.1 | -38.2 | 22.91 | -- | -- | 3 |  |
| ---: | ---: | ---: | ---: | :--- | :--- | :--- | :--- |
| 9 | -21.6 | 8.9 | 21.51 | -- | -- | 3 |  |
| 10 | -3.0 | 9.3 | 20.81 | -- | -- | 1 |  |
| 11 | 0.0 | 0.0 | 19.35 | -- | -- | 3 | QSO |
| 12 | 4.8 | 36.6 | 21.05 | -- | -- | 3 |  |
| 13 | 17.9 | 52.9 | 20.71 | -- | -- | 3 |  |
| 14 | 28.5 | 29.2 | 21.54 | -- | -- | 1 |  |
| 15 | 32.0 | -7.9 | 22.66 | -- | -- | 3 |  |
| 16 | 39.2 | -7.3 | 22.90 | -- | -- | 1 |  |
| 17 | 40.9 | -10.3 | 22.72 | -- | -- | 3 |  |
| 18 | 41.9 | -1.2 | 22.16 | -- | -- | 1 |  |
| 19 | 46.2 | 21.3 | 21.64 | -- | -- | 1 |  |
| 20 | 50.5 | -9.0 | 21.35 | -- | -- | 1 |  |


|  | 0941+441 |  | $z=0.579$ |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA : | 9412 | 20.70 | Dec:+44 | 810.0 | RL=23 |  |  |
| Obj | \#RA | \#Dec | - $\quad$ R | G | G-R | Class | Comments |
| 1 | 101.5 | -20.1 | 22.58 | -- | -- | 3 |  |
| 2 | 101.5 | 64.7 | 22.63 | -- | -- | 1 |  |
| 4 | 100.2 | 13.9 | 22.73 | -- | -- | 1 |  |
| 5 | -99.1 | 179.5 | - 22.72 | -- | -- | 1 |  |
| 6 | -98.2 | -10.6 | - 21.47 | -- | -- | 1 |  |
| 8 | -95.6 | -48.8 | 21.65 | -- | -- | 1 |  |
| 9 | -93.9 | 52.9 | 23.38 | -- | -- | 3 |  |
| 10 | -92.3 | -59.5 | 19.34 | -- | -- | 1 |  |
| 12 | -89.6 | 69.5 | 21.81 | -- | -- | 3 |  |
| 13 | -88.8 | -38.8 | 30.54 | -- | -- | 1 |  |
| 14 | -87.4 | 4-18.4 | 421.41 | -- | -- | 1 |  |
| 15 | -87.2 | -64.3 | 32.63 | -- | -- | 1 |  |
| 16 | -86.9 | -26.8 | - 22.93 | -- | -- | 2 |  |
| 18 | -85.5 | -32.3 | 32.97 | -- | -- | 2 |  |
| 19 | -83.2 | - -52.4 | 422.84 | -- | -- | 1 |  |
| 20 | -80.2 | -40.0 | 22.61 | -- | -- | 1 |  |
| 22 | -78.4 | 49.2 | 23.25 | -- | -- | 3 |  |
| 23 | -75.6 | 62.0 | 23.10 | -- | -- | 1 |  |
| 24 | -74.3 | 34.7 | 73.39 | -- | -- | 3 |  |
| 25 | -73.9 | -31.5 | - 21.09 | -- | -- | 3 |  |
| 26 | -73.3 | 32.5 | - 23.37 | -- | -- | 2 |  |
| 27 | -71.3 | 3.9 | - 22.51 | -- | -- | 1 |  |
| 29 | -63.6 | - 37.2 | 22.60 | -- | -- | 0 |  |
| 30 | -58.9 | 92.2 | 22.13 | -- | -- | 1 |  |
| 31 | -54.8 | -67.8 | - 21.71 | -- | -- | 1 |  |
| 33 | -53.0 | -25.6 | - 23.25 | -- | -- | 0 |  |
| 34 | -53.0 | -43.5 | - 22.79 | -- | -- | 3 |  |
| 36 | -48.9 | 86.5 | - 21.76 | -- | -- | 1 |  |
| 37 | -48.1 | -36.9 | 22.87 | -- | -- | 2 |  |
| 38 | -47.2 | 66.6 | 21.99 | -- | -- | 0 |  |
| 40 | -45.3 | 1.3 | 23.49 | -- | -- | 2 |  |


| 41 | -44.2 | 28.9 | 19.16 | -- | -- | 3 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 42 | -36.8 | -11.3 | 22.23 | -- | -- | 2 |  |
| 44 | -32.2 | -59.5 | 22.46 | -- | -- | 1 |  |
| 45 | -29.0 | 30.4 | 23.14 | -- | -- | 1 |  |
| 48 | -25.7 | 65.1 | 22.89 | -- | -- | 2 |  |
| 49 | -25.9 | -53.2 | 23.29 | -- | -- | 3 |  |
| 51 | -25.3 | -60.1 | 23.04 | -- | -- | 2 |  |
| 52 | -22.0 | 78.5 | 23.22 | -- | -- | 1 |  |
| 54 | -7.6 | -5.8 | 22.58 | -- | -- | 1 |  |
| 55 | -7.2 | -26.4 | 23.16 | -- | -- | 3 |  |
| 56 | -7.3 | -72.1 | 18.41 | -- | -- | 3 |  |
| 57 | -5.4 | -16.3 | 19.11 | -- | -- | 1 |  |
| 58 | -1.8 | -36.3 | 22.16 | -- | -- | 3 |  |
| 59 | -0.8 | 82.7 | 19.58 | -- | -- | 3 |  |
| 60 | 0.0 | 0.0 | 17.86 | -- | -- | 3 | QSO |
| 61 | 3.0 | 25.4 | 19.99 | -- | -- | 2 |  |
| 62 | 2.8 | 23.2 | 21.31 | -- | -- | 3 |  |
| 63 | 8.0 | -69.8 | 22.67 | -- | -- | 1 |  |
| 64 | 8.8 | -74.3 | 22.66 | -- | -- | 1 |  |
| 65 | 8.4 | 13.7 | 23.30 | -- | -- | 1 |  |
| 66 | 10.0 | 58.5 | 23.18 | -- | -- | 2 |  |
| 67 | 10.3 | 77.6 | 23.04 | -- | -- | 0 |  |
| 68 | 11.6 | 29.6 | 22.51 | -- | -- | 1 |  |
| 70 | 13.2 | 82.1 | 22.47 | -- | -- | 1 |  |
| 71 | 13.5 | 25.0 | 23.18 | -- | -- | 1 |  |
| 72 | 16.1 | 43.1 | 22.72 | -- | -- | 0 |  |
| 73 | 16.4 | -29.4 | 21.73 | -- | -- | 3 |  |
| 75 | 20.6 | -52.6 | 22.80 | -- | -- | 1 |  |
| 76 | 24.1 | 75.5 | 15.51 | -- | -- | 4 |  |
| 77 | 26.1 | -48.6 | 23.31 | -- | -- | 2 |  |
| 79 | 41.4 | 30.3 | 22.41 | -- | -- | 1 |  |
| 80 | 43.1 | -62.5 | 22.60 | -- | -- | 1 |  |
| 81 | 44.5 | -32.8 | 22.69 | -- | -- | 1 |  |
| 82 | 45.0 | -3.9 | 22.44 | -- | -- | 2 |  |
| 83 | 53.0 | 67.5 | 23.19 | -- | -- | 3 |  |
| 84 | 54.0 | 60.0 | 23.50 | -- | -- | 1 |  |
| 85 | 55.0 | -54.7 | 21.82 | -- | -- | 1 |  |
| 88 | 59.5 | -13.5 | 23.42 | -- | -- | 1 |  |
| 90 | 61.7 | 52.7 | 23.35 | -- | -- | 2 |  |
| 91 | 70.2 | -18.0 | 22.48 | -- | -- | 2 |  |


| ---- | 0947+433 |  |  | $z=0.363$ |  |  | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: | 947 | 7.10 | Dec:+43 23 | 8.0 | $\mathrm{RL}=23$ |  |  |
| Obj | \#RA | \#Dec | R | G | G-R | Class |  |
| 1 | -97.8 | 7.2 | 20.17 | -- | -- | 1 |  |
| 2 | -87.8 | -12.2 | 19.47 | -- | -- | 1 |  |
| 3 | -85.5 | -11.5 | 21.60 | -- | -- | 3 |  |
| 4 | -80.4 | -62.2 | 19.33 | -- | -- | 1 |  |


| 5 | -79.4 | 33.8 | 22.78 | -- | -- | 0 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 6 | -79.1 | -30.5 | 22.04 | -- | -- | 1 |  |
| 7 | -75.0 | -23.8 | 22.62 | -- | -- | 1 |  |
| 8 | -75.4 | 13.8 | 21.75 | -- | -- | 3 |  |
| 9 | -71.8 | 21.6 | 20.91 | -- | -- | 2 |  |
| 10 | -66.7 | 46.1 | 20.51 | -- | -- | 1 |  |
| 11 | -61.2 | -26.2 | 20.26 | -- | -- | 1 |  |
| 12 | -60.4 | 63.0 | 21.06 | -- | -- | 1 |  |
| 13 | -51.5 | 29.8 | 18.99 | -- | -- | 1 |  |
| 14 | -50.7 | -20.1 | 19.49 | -- | -- | 1 |  |
| 15 | -50.9 | 51.2 | 21.34 | -- | -- | 3 |  |
| 16 | -49.0 | -22.6 | 21.19 | -- | -- | 1 |  |
| 17 | -48.8 | -12.2 | 20.86 | -- | -- | 1 |  |
| 18 | -48.6 | 36.2 | 22.63 | -- | -- | 0 |  |
| 19 | -43.4 | -16.6 | 19.05 | -- | -- | 1 |  |
| 20 | -35.9 | -41.8 | 21.90 | -- | -- | 1 |  |
| 21 | -29.9 | -36.4 | 20.78 | -- | -- | 3 |  |
| 22 | -27.8 | 16.4 | 20.52 | -- | -- | 1 |  |
| 23 | -27.4 | 95.3 | 20.73 | -- | -- | 1 |  |
| 24 | -26.8 | -26.7 | 21.32 | -- | -- | 3 |  |
| 25 | -25.6 | 0.5 | 21.72 | -- | -- | 3 |  |
| 26 | -24.8 | 83.9 | 21.67 | -- | -- | 1 |  |
| 27 | -19.6 | 87.1 | 22.07 | -- | -- | 1 |  |
| 28 | -18.7 | -63.5 | 16.29 | -- | -- | 3 |  |
| 29 | -18.1 | 92.7 | 20.23 | -- | -- | 1 |  |
| 30 | -16.5 | 22.5 | 21.02 | -- | -- | 1 |  |
| 31 | -15.5 | 79.9 | 20.10 | -- | -- | 1 |  |
| 32 | -13.4 | -64.2 | 20.78 | -- | -- | 1 |  |
| 33 | -13.8 | 70.8 | 22.25 | -- | -- | 1 |  |
| 34 | -11.8 | 76.4 | 19.49 | -- | -- | 1 |  |
| 35 | -11.3 | 36.3 | 21.72 | -- | -- | 1 |  |
| 36 | -10.1 | 21.0 | 21.91 | -- | -- | 2 |  |
| 38 | -7.4 | 58.3 | 21.62 | -- | -- | 3 |  |
| 39 | -6.0 | 16.7 | 22.48 | -- | -- | 1 |  |
| 40 | -4.6 | 22.8 | 23.17 | -- | -- | 3 |  |
| 41 | -4.8 | 30.3 | 21.21 | -- | -- | 1 |  |
| 42 | -2.4 | 24.1 | 20.28 | -- | -- | 1 |  |
| 43 | -2.8 | 20.3 | 21.41 | -- | -- | 1 |  |
| 44 | 0.0 | 0.0 | 18.77 | -- | -- | 2 | qso |
| 45 | 1.0 | 81.1 | 20.66 | -- | -- | 1 |  |
| 46 | 5.1 | 69.9 | 22.28 | -- | -- | 3 |  |
| 47 | 6.3 | 22.3 | 22.90 | -- | -- | 0 |  |
| 48 | 8.0 | 90.6 | 21.02 | -- | -- | 1 |  |
| 49 | 12.3 | 6.3 | 17.96 | -- | -- | 3 |  |
| 50 | 19.4 | 38.3 | 22.03 | -- | -- | 1 |  |
| 51 | 21.2 | -40.0 | 19.09 | -- | -- | 1 |  |
| 52 | 22.8 | 46.0 | 21.59 | -- | -- | 0 |  |
| 53 | 24.7 | 30.3 | 22.42 | -- | -- | 2 |  |
| 54 | 30.8 | -49.6 | 21.78 | -- | -- | 1 |  |
| 55 | 37.4 | -13.4 | 20.94 | -- | -- | 1 |  |
| 56 | 40.1 | -2.2 | 22.02 | -- | -- | 1 |  |


| 57 | 47.2 | -59.7 | 20.34 | -- | -- | 1 |
| ---: | ---: | ---: | ---: | :--- | :--- | :--- |
| 58 | 48.8 | -55.4 | 19.55 | -- | -- | 1 |
| 59 | 50.5 | 72.1 | 21.21 | -- | -- | 1 |
| 60 | 52.8 | -62.0 | 21.12 | -- | -- | 1 |
| 61 | 57.8 | -8.3 | 19.78 | -- | -- | 1 |
| 64 | 61.3 | -23.8 | 17.26 | -- | -- | 1 |
| 65 | 61.5 | -48.5 | 22.04 | -- | -- | 1 |
| 66 | 63.5 | -43.8 | 20.82 | -- | -- | 1 |
| 67 | 66.2 | -58.0 | 22.15 | -- | -- | 1 |
| 68 | 66.6 | -38.7 | 19.43 | - | -- | 1 |
| 69 | 65.9 | 23.4 | 22.37 | -- | -- | 1 |


|  | 0956+225 |  | z=0.485 |  |  |  | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA : | 95622 | 2.00 | Dec:+22 | 3232.0 | RL= 23 | . 39 |  |
| Obj | \#RA | \#Dec | R | G | G-R | Class |  |
| 1 | -59.2 | -27.3 | 19.65 | 5 | -- | 1 |  |
| 2 | -56.0 | 40.3 | 23.21 | 1 | -- | 3 |  |
| 3 | -16.0 | 45.0 | 19.19 | -- | -- | 3 |  |
| 4 | -14.0 | -17.1 | 21.60 | -- | -- | 3 |  |
| 5 | -12.1 | 45.2 | 16.73 | - | -- | 3 |  |
| 6 | 0.0 | 0.0 | 18.60 | - | -- | 2 | QSo |
| 7 | 3.6 | 38.2 | 17.73 |  | -- | 3 |  |
| 8 | 12.5 | 41.5 | 21.84 | + | -- | 1 |  |
| 9 | 14.3 | 6.5 | 20.84 | -- | -- | 2 |  |
| 10 | 14.6 | -37.2 | 22.47 | -- | -- | 3 |  |
| 11 | 16.0 | 19.3 | 22.44 |  | -- | 1 |  |
| 12 | 38.2 | 4.4 | 22.86 | -- | -- | 3 |  |
| 13 | 38.3 | -29.2 | 22.26 |  | -- | 3 |  |
| 14 | 51.0 | 19.6 | 20.43 | -- | -- | 1 |  |


| 4 | 4 C 23.2 |  |  | $z=0$ |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 10 | 12 | 0.50 | Dec:+23 | 1611.4 | RL=23 |  | 23.86 |
| Obj | \#RA | \# Dec | R | G | G-R | Class | Comments |
| 1 | -73.6 | 51.0 | 22.41 | 23.79 | 1.38 | 1 |  |
| 2 | -72.4 | 33.9 | 22.72 | 23.41 | 0.69 | 3 |  |
| 3 | -71.8 | 29.8 | 22.02 | 23.54 | 1.52 | 1 |  |
| 4 | -67.3 | 122.7 | 71.87 | -- | -- | 1 |  |
| 5 | -67.2 | 38.4 | 21.82 | 22.52 | 0.69 | 1 |  |
| 6 | -66.0 | 60.3 | 19.02 | 20.31 | 1.29 | 3 |  |
| 7 | -65.3 | -16.0 | 23.21 | -- | -- | 2 |  |
| 8 | -58.5 | -10.8 | 23.04 | 23.33 | 0.29 | 1 |  |
| 9 | -56.8 | 82.6 | 20.98 | 22.67 | 1.69 | 1 |  |
| 10 | -51.6 | 70.4 | 19.21 | 20.36 | 1.15 | 3 |  |
| 11 | -50.6 | 96.6 | 22.69 | 23.58 | 0.90 | 1 |  |
| 12 | -46.8 | 15.5 | 21.46 | 22.87 | 1.41 | 1 |  |


|  | -46.6 | 74.9 | 22.76 | -- | -- | 3 |
| ---: | ---: | ---: | ---: | :---: | :---: | :---: |
| 14 | -46.2 | 67.0 | 23.26 | -- | -- | 1 |
| 15 | -36.5 | 64.8 | 23.74 | -- | -- | 3 |
| 16 | -35.4 | 75.8 | 23.64 | -- | -- | 1 |
| 17 | -30.4 | 102.8 | 23.50 | -- | -- | 3 |
| 18 | -28.4 | 111.0 | 22.96 | 22.55 | -0.42 | 1 |
| 19 | -27.5 | 59.5 | 22.20 | 23.02 | 0.82 | 1 |
| 20 | -22.1 | 26.8 | 23.37 | -- | -- | 2 |
| 21 | -17.8 | -8.2 | 17.51 | 18.10 | 0.60 | 1 |
| 22 | -17.3 | 111.7 | 23.40 | 23.67 | 0.27 | 2 |
| 23 | -13.9 | 53.2 | 23.79 | -- | -- | 3 |
| 24 | -11.2 | 29.5 | 21.94 | 23.73 | 1.78 | 1 |
| 25 | -10.8 | 4.6 | 22.53 | 23.47 | 0.95 | 1 |
| 26 | -7.0 | 109.9 | 22.35 | 23.68 | 1.33 | 1 |
| 27 | -5.4 | 101.9 | 21.89 | 23.15 | 1.27 | 1 |
| 28 | -5.3 | 56.6 | 22.85 | -- | -- | 1 |
| 29 | -4.8 | 19.2 | 20.53 | 22.23 | 1.70 | 1 |
| 30 | -4.6 | 66.1 | 23.39 | 23.80 | 0.41 | 3 |
| 31 | -1.4 | 45.9 | 21.31 | 22.29 | 0.98 | 1 |
| 32 | 0.0 | 0.0 | 16.89 | 17.16 | 0.27 | 3 |
| 33 | 1.8 | 49.4 | 22.23 | 23.01 | 0.77 | 1 |
| 34 | 2.7 | 104.7 | 15.89 | 16.11 | 0.22 | 4 |
| 35 | 5.1 | 9.4 | -- | 16.42 | -- | 1 |
| 36 | 7.1 | 102.3 | 22.03 | 23.78 | 1.75 | 1 |
| 38 | 10.1 | 85.9 | 21.92 | 22.41 | 0.48 | 2 |
| 39 | 10.0 | 61.9 | 23.74 | -- | -- | 0 |
| 40 | 12.4 | -10.4 | 23.77 | 23.41 | -0.36 | 2 |
| 41 | 14.8 | 30.7 | 20.13 | 21.11 | 0.98 | 3 |
| 42 | 17.4 | 44.5 | 21.51 | 22.66 | 1.15 | 1 |
| 43 | 16.9 | -2.9 | 23.11 | -- | -- | 1 |
| 44 | 17.5 | 9.0 | 19.58 | 20.27 | 0.69 | 1 |
| 45 | 18.0 | -7.2 | 21.69 | 22.77 | 1.07 | 2 |
| 46 | 18.6 | 55.2 | 21.94 | 22.25 | 0.31 | 3 |
| 47 | 22.3 | -15.0 | 18.72 | 20.15 | 1.43 | 3 |
| 48 | 22.6 | 40.1 | 22.68 | 23.14 | 0.56 | 2 |
| 51 | 27.0 | -1.2 | 22.30 | 23.29 | 0.99 | 2 |
| 52 | 28.9 | 26.1 | 22.75 | 23.26 | 0.51 | 1 |
| 53 | 29.9 | 42.7 | 23.72 | -- | -- | 3 |
| 54 | 31.1 | 83.8 | 14.69 | 14.55 | -0.14 | 4 |
| 55 | 38.7 | 10.3 | 22.23 | 21.14 | -1.10 | 2 |
| 56 | 40.2 | 49.9 | 22.74 | 22.59 | -0.15 | 1 |
| 57 | 41.8 | -13.8 | 18.97 | 19.37 | 0.40 | 3 |
| 58 | 43.5 | 18.3 | 22.58 | 23.74 | 1.17 | 1 |
| 60 | 52.0 | 46.0 | 21.99 | 22.41 | 0.42 | 3 |
| 66 | 55.7 | 68.3 | 23.29 | -- | -- | 2 |
| 63 | 58.1 | 71.2 | 23.54 | -- | -- | 3 |
| 64 | 59.8 | -16.0 | 22.75 | -- | -- | 2 |
| 65 | 64.3 | 83.7 | 21.64 | 20.71 | -0.93 | 1 |
| 68 | 64.9 | -9.6 | 22.91 | 23.25 | 0.34 | 1 |
| 68 | 66.5 | 36.0 | 21.20 | 22.64 | 1.44 | 3 |
|  | 71.3 | 19.3 | 22.24 | 23.79 | 1.56 | 1 |
| 15 |  |  |  |  |  |  |


| 69 | 72.9 | 69.5 | 23.17 | 23.56 | 0.39 | 1 |
| ---: | ---: | ---: | ---: | :--- | :--- | :--- |
| 70 | 74.2 | 101.2 | 21.29 | 23.20 | 1.91 | 1 |
| 71 | 76.3 | 39.8 | 22.37 | 22.70 | 0.33 | 1 |
| 72 | 79.0 | 100.4 | 20.14 | 20.68 | 0.54 | 1 |
| 74 | 80.9 | 119.9 | 21.66 | 22.11 | 0.45 | 1 |
| 75 | 80.9 | 58.4 | 21.51 | 22.10 | 0.59 | 1 |
| 76 | 80.9 | 23.4 | 23.50 | -- | -- | 1 |
| 77 | 81.1 | -5.8 | 23.17 | 23.31 | 0.14 | 0 |
| 78 | 82.5 | 11.4 | 22.59 | -- | -- | 1 |
| 79 | 84.0 | 74.0 | 21.04 | 21.14 | 0.10 | 3 |
| 80 | 84.8 | 119.2 | 21.78 | 22.92 | 1.14 | 3 |
| 81 | 85.3 | -9.6 | 22.60 | 23.19 | 0.59 | 3 |
| 82 | 86.5 | 70.5 | 22.88 | 22.90 | 0.02 | 3 |
| 83 | 87.9 | 44.3 | 18.29 | 18.98 | 0.69 | 1 |
| 84 | 95.0 | 60.4 | 23.04 | -- | -- | 2 |


| ---- 4C 48.28 |  |  | $z=0.385$ |  |  |  |  | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 10 | 1250 | . 00 | Dec:+48 | 52 | 57.0 | RL=22 | . 96 |  |
| Obj | \#RA | \#Dec | R |  | G | G-R | Class |  |
| 1 | -44.3 | -25.5 | 22.56 |  | -- | -- | 0 |  |
| 2 | -38.2 | -5.9 | 22.45 |  | -- | -- | 0 |  |
| 3 | -28.4 | -18.4 | 22.11 |  | -- | -- | 1 |  |
| 4 | -24.7 | 1.7 | 19.97 |  | -- | -- | 1 |  |
| 5 | -22.1 | 39.9 | 21.54 |  | -- | -- | 2 |  |
| 6 | -20.4 | 35.5 | 21.02 |  | -- | -- | 1 |  |
| 7 | -20.4 | -28.0 | 22.39 |  | -- | -- | 3 |  |
| 8 | -15.0 | -5.9 | 22.15 |  | -- | -- | 2 |  |
| 9 | 0.0 | 0.0 | 18.72 |  | -- | -- | 3 | qSo |
| 10 | 7.3 | 35.5 | 21.94 |  | -- | -- | 2 |  |
| 11 | 11.9 | -39.3 | 22.15 |  | -- | -- | 2 |  |
| 12 | 13.7 | -33.2 | 21.89 |  | -- | -- | 2 |  |
| 13 | 25.9 | 42.5 | 19.00 |  | -- | -- | 1 |  |
| 14 | 26.8 | 3.2 | 20.26 |  | -- | -- | 1 |  |
| 15 | 37.9 | -30.3 | 22.92 |  | -- | -- | 0 |  |
| 17 | 49.0 | 16.9 | 20.98 |  | -- | -- | 3 |  |


| ---- 1015+38 |  |  | z=0.380 |  |  |  | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 10 | 1528 | 40 | Dec:+38 | 2025.0 | $\mathrm{RL}=23$ |  |  |
| Obj | \# A A | \% Dec | R | G | G-R | Class |  |
| 1 | -41.8 | 10.0 | 21.39 | -- | -- | 2 |  |
| 2 | -22.0 | 45.6 | 22.12 | -- | -- | 1 |  |
| 3 | -20.0 | -7.8 | 22.07 | -- | -- | 2 |  |
| 4 | -12.7 | -8.6 | 21.90 | -- | -- | 1 |  |
| 5 | -6.9 | 46.7 | 20.96 | -- | -- | 1 |  |
| 6 | -4.8 | 12.9 | 22.23 | -- | -- | 2 |  |


| 7 | -4.0 | 46.2 | 21.59 | - | - | - | 2 |
| ---: | ---: | ---: | ---: | :--- | :--- | :--- | :--- |
| 8 | -1.3 | 37.4 | 22.37 | -- | -- | 1 |  |
| 9 | -1.3 | 25.8 | 22.51 | -- | -- | 1 |  |
| 10 | 0.0 | 0.0 | 18.23 | -- | -- | 3 | QSO |
| 11 | 2.1 | -10.7 | 21.19 | -- | -- | 2 |  |
| 12 | 3.9 | 33.3 | 19.83 | -- | -- | 3 |  |
| 13 | 4.5 | 31.6 | 20.82 | -- | -- | 3 |  |
| 14 | 7.1 | -10.8 | 21.86 | -- | -- | 3 |  |
| 15 | 11.8 | -41.8 | 20.66 | -- | -- | 1 |  |
| 16 | 26.6 | -15.9 | 17.72 | -- | -- | 3 |  |
| 18 | 46.2 | 38.9 | 22.27 | -- | -- | 1 |  |


| ---- 1045-188 |  |  | z=0.595 |  |  |  | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 10 | 454 | . 08 | Dec:-18 | 5344.1 | RL= 23 | . 39 |  |
| Obj | \#RA | \#Dec | R | G | G-R | Class |  |
| 1 | -55.3 | 18.5 | 21.18 | -- | -- | 3 |  |
| 2 | -48.6 | -17.3 | 22.67 | -- | -- | 3 |  |
| 3 | -44.8 | -37.0 | 23.22 | -- | -- | 0 |  |
| 4 | -43.2 | 3.1 | 21.09 | -- | -- | 3 |  |
| 5 | -43.4 | -25.5 | 18.94 | -- | -- | 3 |  |
| 6 | -41.1 | -32.3 | 22.79 | -- | -- | 2 |  |
| 7 | -39.1 | 17.8 | 20.52. | -- | -- | 3 |  |
| 8 | -22.1 | 52.3 | 22.16 | -- | -- | 1 |  |
| 9 | -20.6 | -26.0 | 21.86 | -- | -- | 2 |  |
| 10 | -19.2 | 8.0 | 22.66 | -- | -- | 1 |  |
| 12 | -15.4 | 52.9 | 23.22 | -- | -- | 3 |  |
| 13 | -13.6 | -30.7 | 22.61 | -- | -- | 1 |  |
| 14 | -12.6 | 10.1 | 20.21 | -- | -- | 3 |  |
| 15 | 0.0 | 0.0 | 18.83 | -- | -- | 3 | QSO |
| 16 | 4.3 | -21.4 | 22.68 | -- | -- | 0 |  |
| 17 | 5.0 | 39.2 | 22.19 | -- | -- | 1 |  |
| 18 | 6.3 | 55.9 | 21.14 | -- | -- | 3 |  |
| 20 | 9.5 | -24.6 | 22.33 | -- | -- | 1 |  |
| 21 | 9.4 | -35.7 | 21.52 | -- | -- | 1 |  |
| 22 | 14.7 | 35.0 | 23.09 | -- | -- | 1 |  |
| 24 | 22.2 | 3.3 | 22.21 | -- | -- | 1 |  |
| 25 | 32.6 | -43.5 | 20.49 | -- | -- | 3 |  |
| 26 | 34.7 | -32.5 | 20.17 | -- | -- | 3 |  |
| 27 | 37.1 | 45.3 | 22.18 | -- | -- | 1 |  |
| 28 | 37.3 | 3.2 | 21.35 | -- | -- | 3 |  |
| 29 | 45.8 | 50.0 | 22.45 | -- | -- | 3 |  |
| 30 | 46.5 | 7.5 | 23.03 | -- | -- | 3 |  |
| 31 | 46.7 | 59.3 | 21.88 | -- | -- | 0 |  |
| 32 | 51.7 | -7.7 | 23.02 | -- | -- | 3 |  |


| RA: 10 | 4941 | . 00 | Dec: +48 | 5553.0 | RL=23. | 55 G | L=23.89 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Obj | \#RA | \#Dec | R | G | G-R | Class | Comments |
| 1 | -19.3 | -6.4 | 21.89 | 22.28 | 0.39 | 1 |  |
| 3 | -17.7 | -50.4 | 22.07 | -- | -- | 1 |  |
| 4 | -16.6 | 18.4 | 22.56 | -- | -- | 1 |  |
| 5 | -14.6 | 13.5 | 21.37 | 23.05 | 1.67 | 1 |  |
| 6 | -14.4 | -13.1 | 22.30 | 23.31 | 1.01 | 1 |  |
| 7 | -12.7 | -5.0 | 22.41 | 22.74 | 0.33 | 1 |  |
| 8 | -12.4 | 13.3 | 23.00 | -- | -- | 1 |  |
| 9 | -8.3 | -7.0 | 22.06 | 22.55 | 0.49 | 1 |  |
| 10 | -8.3 | -60.0 | 22.15 | 23.65 | 1.50 | 1 |  |
| 11 | -7.6 | 14.3 | 22.70 | 23.41 | 0.71 | 1 |  |
| 12 | -6.2 | 9.9 | 23.00 | 23.18 | 0.18 | 3 |  |
| 13 | -5.0 | -27.8 | 22.34 | -- | -- | 1 |  |
| 14 | -4.9 | -58.3 | 22.05 | 23.85 | 1.80 | 2 |  |
| 15 | -3.9 | 17.3 | 21.13 | 22.63 | 1.50 | 1 |  |
| 16 | -3.1 | -28.9 | 22.03 | 23.53 | 1.50 | 2 |  |
| 17 | -2.6 | -23.4 | 19.86 | 22.10 | 2.23 | 1 |  |
| 18 | -2.3 | -67.2 | 21.58 | 22.90 | 1.32 | 1 |  |
| 19 | 0.0 | 0.0 | 18.16 | 18.19 | 0.03 | 2 | qSo |
| 21 | 2.5 | -69.6 | 20.72 | 21.08 | 0.36 | 3 |  |
| 22 | 4.1 | -0.4 | 22.02 | -- | -- | 2 |  |
| 24 | 5.3 | 9.3 | 21.28 | 22.79 | 1.51 | 1 |  |
| 25 | 6.9 | -23.1 | 22.46 | 22.60 | 0.13 | 1 |  |
| 26 | 7.5 | -5.2 | 19.96 | 21.89 | 1.93 | 1 |  |
| 27 | 8.6 | 30.2 | 22.56 | 22.81 | 0.26 | 3 |  |
| 28 | 9.2 | -67.1 | 23.33 | -- | -- | 1 |  |
| 29 | 9.6 | -36.9 | 20.65 | 22.51 | 1.86 | 1 |  |
| 30 | 10.9 | 13.8 | 21.96 | 22.83 | 0.87 | 2 |  |
| 31 | 10.6 | -9.6 | 22.01 | 23.89 | 1.88 | 3 |  |
| 33 | 11.3 | 6.9 | 21.51 | 22.89 | 1.38 | 2 |  |
| 34 | 14.4 | 35.1 | 22.54 | -- | -- | 2 |  |
| 35 | 14.7 | 0.9 | 22.77 | -- | -- | 3 |  |
| 36 | 15.2 | 38.3 | 22.44 | 23.89 | 1.45 | 2 |  |
| 37 | 15.6 | -4.6 | 21.01 | 22.66 | 1.65 | 1 |  |
| 39 | 17.2 | -8.6 | 23.53 | -- | -- | 3 |  |
| 41 | 20.1 | -1.8 | 20.56 | 22.18 | 1.63 | 1 |  |
| 42 | 20.9 | -55.6 | 22.69 | -- | -- | 1 |  |
| 43 | 20.8 | -6.3 | 20.93 | 22.12 | 1.19 | 3 |  |
| 44 | 21.2 | -42.2 | 20.71 | 20.73 | 0.03 | 2 |  |
| 45 | 22.3 | -68.2 | 22.05 | 23.13 | 1.08 | 1 |  |
| 46 | 22.7 | 26.9 | 20.80 | 22.48 | 1.68 | 2 |  |
| 47 | 25.1 | 31.9 | 22.08 | -- | -- | 1 |  |
| 48 | 25.3 | 12.2 | 20.22 | 22.14 | 1.92 | 1 |  |
| 49 | 25.4 | 17.5 | 22.05 | -- | -- | 1 |  |
| 50 | 26.9 | -5.2 | 21.61 | 22.47 | 0.85 | 1 |  |
| 52 | 29.9 | -42.1 | 22.49 | 23.61 | 1.12 | 1 |  |
| 53 | 31.7 | -3.1 | 22.39 | 23.27 | 0.89 | 1 |  |
| 54 | 32.0 | 0.1 | 22.94 | -- | -- | 2 |  |
| 56 | 36.7 | -65.1 | 22.10 | 23.59 | 1.49 | 1 |  |
| 57 | 37.9 | -31.4 | 22.35 | 22.84 | 0.49 | 3 |  |


|  |  |  |  |  | - | 0 |
| ---: | ---: | ---: | :--- | :--- | :--- | :--- |
| 58 | 39.2 | -2.2 | 23.37 | - | -- | 1 |
| 59 | 41.2 | 34.4 | 22.68 | - | - | -- |
| 60 | 40.2 | -10.2 | 23.45 | - | 3 |  |
| 61 | 40.6 | 5.8 | 22.38 | 23.83 | 1.45 | 1 |
| 62 | 41.8 | 31.0 | 21.31 | 22.35 | 1.04 | 1 |
| 63 | 42.4 | 18.1 | 22.68 | 23.67 | 0.99 | 3 |
| 65 | 42.8 | -47.7 | 23.21 | 23.73 | 0.52 | 2 |
| 67 | 45.7 | 24.7 | 21.56 | 23.06 | 1.50 | 1 |
| 68 | 45.4 | -69.6 | 23.44 | -- | -- | 3 |
| 69 | 46.6 | 8.8 | 23.39 | -- | -- | 1 |
| 70 | 49.1 | -14.6 | 20.39 | 20.92 | 0.53 | 1 |
| 71 | 49.6 | 0.2 | 23.06 | -- | -- | 1 |
| 72 | 52.8 | -44.8 | 21.90 | 23.13 | 1.23 | 1 |
| 74 | 54.6 | -22.2 | 22.42 | 22.81 | 0.39 | 1 |
| 75 | 54.7 | -10.7 | 23.08 | -- | -- | 3 |
| 76 | 55.1 | -64.0 | 22.54 | 23.52 | 0.98 | 1 |
| 77 | 59.8 | 14.6 | 23.53 | -- | -- | 1 |
| 78 | 61.3 | 11.4 | 21.50 | 23.04 | 1.54 | 1 |
| 79 | 67.0 | -3.0 | 21.01 | 22.44 | 1.44 | 1 |
| 80 | 66.2 | -15.1 | 22.92 | 22.86 | -0.06 | 1 |
| 81 | 72.4 | -11.5 | 22.26 | 22.77 | 0.51 | 2 |
| 82 | 73.8 | -39.5 | 22.28 | 23.63 | 1.35 | 1 |
| 84 | 75.2 | -14.7 | 22.35 | 23.25 | 0.90 | 1 |
| 85 | 75.8 | -64.9 | 22.41 | 22.76 | 0.35 | 2 |
| 86 | 76.6 | 15.3 | 21.98 | 23.84 | 1.86 | 1 |
| 87 | 79.0 | 44.6 | 23.10 | -- | -- | 1 |
| 88 | 79.3 | 25.8 | 22.99 | -- | -- | 1 |



| 19 | 4.4 | -9.4 | 22.62 | -- | -- | 0 |
| ---: | ---: | ---: | :---: | :---: | :---: | :---: |
| 20 | 5.8 | -4.9 | -- | 23.42 | -- | 2 |
| 21 | 7.9 | -1.2 | 22.60 | -- | -- | 1 |
| 22 | 9.0 | 51.6 | -- | 23.50 | -- | 2 |
| 23 | 12.5 | -15.4 | 20.09 | 21.58 | 1.49 | 1 |
| 24 | 13.9 | -33.7 | 17.72 | 18.18 | 0.46 | 1 |
| 25 | 16.4 | -60.8 | 22.67 | 23.39 | 0.72 | 3 |
| 26 | 18.6 | 23.9 | 22.68 | 23.65 | 0.97 | 1 |
| 27 | 33.8 | 42.2 | 20.14 | 20.41 | 0.27 | 1 |
| 28 | 34.7 | -24.5 | 21.73 | 22.61 | 0.88 | 1 |
| 29 | 39.6 | -51.6 | 21.39 | 21.51 | 0.12 | 2 |
| 30 | 43.1 | -48.4 | 22.21 | 22.62 | 0.41 | 3 |
| 31 | 44.9 | -36.7 | 22.16 | -- | -- | 1 |


| ---- 1200-051 |  |  | $z=0.381$ |  |  |  | $\mathrm{GL}=23.60$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 12 | 0 | 0.63 | Dec:- 5 | 1124.1 | RL=22. |  |  |
| Obj | \#RA | \#Dec | R | G | G-R | Class | B Comments |
| 1 | -70.3 | -81.1 | 21.52 | 21.97 | 0.44 | 2 |  |
| 2 | -57.3 | -5.7 | 19.76 | 20.88 | 1.13 | 1 |  |
| 3 | -55.0 | 3.8 | 8 -- | 23.58 | -- | 0 |  |
| 4 | -53.9 | -5.4 | 21.00 | 22.11 | 1.12 | 1 |  |
| 5 | -51.9 | -56.9 | 21.06 | 21.59 | 0.53 | 3 |  |
| 6 | -46.3 | 6.4 | 42.35 | 23.11 | 0.76 | 1 |  |
| 7 | -45.5 | 58.3 | 21.44 | 22.41 | 0.97 | 1 |  |
| 8 | -44.5 | 29.9 | 21.04 | 22.59 | 1.56 | 2 |  |
| 9 | -44.1 | -38.0 | 21.40 | 22.88 | 1.49 | 1 |  |
| 10 | -41.7 | 70.1 | 19.32 | 19.67 | 0.35 | 3 |  |
| 11 | -41.7 | -50.4 | 419.78 | 21.57 | 1.80 | 3 |  |
| 12 | -40.3 | 11.9 | 21.00 | 21.99 | 0.99 | 1 |  |
| 13 | -39.3 | -43.8 | 82.11 | 22.88 | 0.77 | 1 |  |
| 14 | -39.0 | -60.8 | 21.76 | 23.38 | 1.62 | 1 |  |
| 15 | -36.4 | 18.5 | - 21.69 | 22.37 | 0.68 | 1 |  |
| 16 | -35.6 | -79.5 | 21.51 | -- | -- | 2 |  |
| 19 | -28.8 | -55.5 | 19.52 | 21.29 | 1.77 | 1 |  |
| 20 | -27.4 | -67.2 | 21.95 | 23.18 | 1.23 | 1 |  |
| 21 | -24.6 | 9.9 | 22.03 | 23.24 | 1.21 | 3 |  |
| 23 | -23.1 | -11.0 | 21.56 | 23.02 | 1.46 | 3 |  |
| 24 | -18.7 | 10.7 | 22.62 | 23.05 | 0.43 | 3 |  |
| 25 | -18.5 | -14.5 | 22.38 | 23.52 | 1.15 | 1 |  |
| 26 | -18.8 | 35.3 | 3 -- | 23.29 | -- | 3 |  |
| 27 | -15.9 | -18.6 | 22.64 | -- | -- | 3 |  |
| 28 | -12.8 | -0.3 | 22.02 | -- | -- | 1 |  |
| 29 | -10.4 | 76.2 | 21.68 | 23.25 | 1.57 | 1 |  |
| 30 | -9.4 | 72.9 | 19.93 | 20.31 | 0.38 | 1 |  |
| 31 | -3.9 | 20.0 | 20.52 | 21.92 | 1.40 | 1 |  |
| 32 | -1.4 | -45.8 | 18.25 | 18.70 | 0.45 | 3 |  |
| 33 | 0.0 | 0.0 | 16.39 | 16.56 | 0.17 | 3 | QSO |
| 34 | 1.5 | -48.6 | 20.08 | 21.61 | 1.53 | 1 |  |


| 35 | 3.3 | -27.7 | 22.72 | 23.34 | 0.62 | 3 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| 37 | 6.6 | 41.2 | 21.42 | 22.59 | 1.18 | 1 |
| 38 | 6.9 | -5.3 | 22.00 | 23.02 | 1.02 | 2 |
| 39 | 11.4 | 12.0 | 21.08 | 21.50 | 0.41 | 2 |
| 40 | 12.7 | -67.6 | 21.24 | 21.92 | 0.68 | 2 |
| 41 | 13.9 | 52.6 | 21.74 | 23.19 | 1.45 | 2 |
| 43 | 31.2 | 82.4 | 21.69 | 22.27 | 0.58 | 2 |
| 44 | 37.8 | 50.0 | 21.55 | 22.28 | 0.72 | 3 |
| 45 | 38.2 | 44.9 | 22.69 | 22.47 | -0.22 | 1 |
| 46 | 41.3 | -1.0 | 21.79 | 22.97 | 1.18 | 2 |
| 48 | 54.1 | 41.5 | 21.49 | 21.83 | 0.35 | 2 |
| 49 | 66.0 | 18.4 | 19.18 | 20.70 | 1.53 | 3 |
| 50 | 65.7 | 40.7 | 20.74 | 21.20 | 0.46 | 3 |
| 51 | 70.8 | -71.2 | 21.78 | 22.33 | 0.56 | 2 |
| 52 | 73.3 | -77.2 | 21.01 | 21.94 | 0.93 | 1 |
| 53 | 89.3 | -4.2 | 17.74 | 18.14 | 0.40 | 3 |
| 54 | 93.2 | 79.1 | -- | 22.70 | -- | 2 |
| 55 | 94.2 | 66.7 | 21.93 | 22.81 | 0.88 | 2 |


| ---- 1222+125 |  |  | $z=0.415$ |  |  |  | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 12 | 2240 | 0.90 | Dec:+12 | 3510.0 | RL=23 | 47 |  |
| Obj | \# RA | \#Dec | R | G | G-R | class |  |
| 1 | -69.1 | -17.8 | 21.34 | -- | -- | 1 |  |
| 2 | -64.3 | -22.2 | 22.33 | -- | -- | 1 |  |
| 3 | -50.9 | 68.7 | 20.81 | -- | -- | 1 |  |
| 4 | -40.3 | 12.1 | 22.74 | -- | -- | 3 |  |
| 5 | -38.2 | -3.7 | 20.53 | -- | -- | 3 |  |
| 6 | -37.3 | 58.0 | 22.89 | -- | -- | 3 |  |
| 7 | -35.9 | -35.9 | 16.11 | -- | -- | 3 |  |
| 8 | -33.6 | 65.6 | 21.16 | -- | -- | 1 |  |
| 9 | -28.5 | -18.6 | 21.89 | -- | -- | 3 |  |
| 10 | -27.5 | -9.1 | 22.46 | -- | -- | 3 |  |
| 11 | -19.1 | 54.1 | 19.14 | -- | -- | 1 |  |
| 12 | -8.4 | 62.5 | 22.91 | -- | -- | 0 |  |
| 13 | -6.2 | -3.8 | 21.97 | -- | -- | 1 |  |
| 14 | 0.0 | 0.0 | 17.49 | -- | -- | 2 | Qso |
| 15 | 2.0 | -21.6 | 22.74 | -- | -- | 1 |  |
| 16 | 3.3 | 20.3 | 22.33 | -- | -- | 1 |  |
| 18 | 15.2 | 5.0 | 20.69 | -- | -- | 1 |  |
| 20 | 16.9 | -72.2 | 22.51 | -- | -- | 1 |  |
| 21 | 17.5 | 40.2 | 22.95 | -- | -- | 3 |  |
| 22 | 20.7 | -67.4 | 20.59 | -- | -- | 1 |  |
| 23 | 26.1 | -10.3 | 21.93 | -- | -- | 1 |  |
| 24 | 28.1 | 49.0 | 20.80 | -- | -- | 1 |  |
| 25 | 30.3 | 26.0 | 22.25 | -- | -- | 1 |  |
| 26 | 33.2 | -44.6 | 20.93 | -- | -- | 1 |  |
| 27 | 38.5 | 57.9 | 19.79 | -- | -- | 1 |  |
| 28 | 41.4 | -58.2 | 22.14 | -- | -- | 1 |  |


| 29 | 43.5 | 38.0 | 22.16 | -- | -- | 1 |
| ---: | ---: | ---: | ---: | :--- | :--- | :--- |
| 30 | 43.0 | 11.2 | 21.98 | -- | -- | 2 |
| 31 | 50.0 | -6.7 | 22.14 | -- | -- | 1 |
| 32 | 50.8 | -56.0 | 20.76 | -- | -- | 1 |
| 33 | 53.4 | -42.7 | 18.75 | -- | -- | 3 |
| 34 | 56.6 | -45.9 | 18.78 | -- | -- | 1 |
| 35 | 58.1 | 78.5 | 21.23 | -- | -- | 1 |
| 36 | 59.6 | -56.0 | 22.84 | -- | -- | 3 |
| 37 | 60.1 | -48.0 | 20.69 | -- | -- | 1 |
| 38 | 72.3 | 40.7 | 21.65 | -- | -- | 1 |
| 39 | 79.8 | -56.0 | 22.72 | -- | -- | 2 |
| 40 | 84.6 | 29.2 | 22.39 | -- | -- | 1 |
| 41 | 84.9 | -76.5 | 20.93 | -- | -- | 3 |
| 42 | 87.6 | 25.6 | 22.97 | -- | -- | 3 |
| 43 | 90.0 | -63.0 | 22.57 | -- | -- | 1 |
| 44 | 93.0 | 26.0 | 20.84 | -- | -- | 1 |
| 45 | 92.7 | 10.8 | 22.79 | -- | -- | 1 |
| 46 | 92.6 | -38.4 | 23.30 | -- | -- | 0 |
| 47 | 94.5 | -49.8 | 20.05 | -- | -- | 1 |
| 48 | 98.1 | -21.4 | 20.49 | -- | -- | 1 |
| 49 | 101.4 | 57.9 | 22.10 | -- | -- | 3 |


| - 1 | 1234+15 |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 12 | 3456 | . 60 | Dec:+15 | 1347.0 | RL=23. |  | $\mathrm{L}=24.40$ |
| Obj | \#Ra | \#Dec | R | G | G-R | Class | Comments |
| 1 | -48.0 | 45.0 | 22.66 | 23.52 | 0.86 | 3 |  |
| 2 | -47.6 | -35.5 | 23.12 | -- | -- | 3 |  |
| 3 | -46.3 | -45.3 | 21.82 | 23.44 | 1.62 | 2 |  |
| 4 | -44.5 | 33.1 | 22.21 | 22.46 | 0.25 | 2 |  |
| 5 | -42.8 | -27.8 | 21.80 | 22.64 | 0.84 | 1 |  |
| 6 | -41.0 | 44.7 | 22.65 | 23.80 | 1.15 | 3 |  |
| 7 | -39.9 | 17.0 | 21.09 | 22.43 | 1.34 | 1 |  |
| 8 | -37.7 | -18.3 | 21.89 | 22.57 | 0.68 | 3 |  |
| 9 | -34.0 | 22.0 |  | 23.93 | -- | 3 |  |
| 10 | -32.8 | 26.5 | 23.13 | 24.00 | 0.87 | 0 |  |
| 11 | -27.0 | -49.2 | 22.27 | 24.09 | 1.82 | 2 |  |
| 12 | -25.0 | 33.1 | 20.85 | 21.63 | 0.68 | 1 |  |
| 13 | -24.4 | -17.1 | 21.83 | 23.22 | 1.39 | 1 |  |
| 14 | -22.0 | -40.2 | 22.49 | 23.51 | 1.02 | 3 |  |
| 15 | -17.1 | 6.4 | 23.35 | 23.70 | 0.36 | 1 |  |
| 16 | -15.1 | -12.1 | 22.97 | 23.17 | 0.21 | 1 |  |
| 17 | -9.8 | -28.8 | 23.03 | 24.32 | 1.28 | 3 |  |
| 18 | -1.1 | -18.5 | 22.63 | 23.42 | 0.89 | 1 |  |
| 19 | -0.5 | -23.5 | 21.02 | 22.29 | 1.27 | 1 |  |
| 20 | 0.0 | 0.0 | 18.56 | 18.31 | -0.25 | 3 | QSo |
| 21 | 2.7 | 13.0 | 23.06 | 23.84 | 0.78 | 1 |  |
| 22 | 4.2 | 48.0 | 22.06 | 23.13 | 1.06 | 3 |  |
| 24 | 8.2 | 3.9 | 20.52 | 22.01 | 1.49 | 1 |  |


| 25 | 8.2 | -45.0 | -- | 23.35 | -- | 2 |
| ---: | ---: | ---: | :---: | :---: | :---: | :---: |
| 26 | 9.3 | -1.9 | 21.38 | 22.58 | 1.20 | 3 |
| 27 | 9.5 | -24.7 | 22.64 | 22.05 | -0.59 | 3 |
| 28 | 18.1 | -35.0 | -- | 23.34 | -- | 3 |
| 29 | 21.9 | 6.8 | -- | 23.74 | -- | 3 |
| 30 | 25.4 | 1.9 | 21.04 | 22.02 | 0.98 | 1 |
| 31 | 26.3 | -10.6 | 19.84 | 20.30 | 0.46 | 1 |
| 32 | 28.0 | 13.1 | 17.46 | 17.88 | 0.42 | 3 |
| 33 | 29.5 | 50.3 | 21.88 | 22.08 | 0.20 | 2 |
| 34 | 30.6 | 47.0 | 22.92 | 23.20 | 0.28 | 1 |
| 35 | 35.0 | 16.5 | 22.19 | 22.45 | 0.26 | 3 |
| 36 | 34.0 | 10.9 | 22.78 | -- | -- | 2 |
| 37 | 36.8 | -31.0 | -- | 23.74 | -- | 3 |
| 38 | 38.3 | 31.8 | -- | 23.74 | -- | 3 |
| 39 | 39.7 | -24.0 | -- | 23.83 | -- | 2 |
| 40 | 42.9 | -12.4 | 20.32 | 21.20 | 0.88 | 1 |
| 41 | 44.2 | -16.0 | 19.60 | 20.84 | 1.25 | 3 |
| 42 | 44.3 | 11.8 | -- | 23.92 | -- | 3 |
| 43 | 47.4 | 28.6 | 21.64 | 22.10 | 0.46 | 2 |
| 44 | 47.7 | -8.3 | 21.33 | 22.23 | 0.89 | 2 |


| ---- 1238006 |  |  | $z=0.310$ |  |  |  | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 12 | 3834 | 4.73 | Dec:+ 0 | 23.0 | RL=22 | . 60 |  |
| Obj | \%RA | \# Dec | R | G | G-R | Class |  |
| 1 | -71.5 | 76.0 | 19.82 | -- | -- | 0 |  |
| 2 | -68.3 | 58.8 | 20.41 | -- | -- | 0 |  |
| 3 | -55.4 | 50.7 | 16.45 | -- | -- | 3 |  |
| 4 | -50.3 | -45.6 | 22.08 | -- | -- | 1 |  |
| 5 | -44.9 | -24.5 | 21.73 | -- | -- | 1 |  |
| 6 | -42.5 | -75.5 | 22.50 | -- | -- | 0 |  |
| 7 | -42.2 | 25.2 | 20.63 | -- | -- | 2 |  |
| 9 | -35.7 | -85.1 | 21.60 | -- | -- | 1 |  |
| 10 | -25.8 | -70.7 | 20.26 | -- | -- | 1 |  |
| 11 | -20.7 | -24.1 | 21.43 | -- | -- | 1 |  |
| 12 | -20.2 | -29.5 | 21.16 | -- | -- | 1 |  |
| 13 | -17.9 | -77.9 | 21.73 | -- | -- | 1 |  |
| 14 | -5.2 | -78.7 | 21.06 | -- | -- | 1 |  |
| 15 | 0.0 | 0.0 | 17.93 | -- | -- | 3 | QSO |
| 16 | 0.7 | -35.0 | 19.32 | -- | -- | 2 |  |
| 17 | 0.7 | -33.3 | 19.92 | -- | -- | 1 |  |
| 18 | 3.1 | -19.4 | 22.35 | -- | -- | 1 |  |
| 19 | 4.4 | 65.3 | 21.26 | -- | -- | 3 |  |
| 20 | 5.4 | -23.0 | 21.61 | -- | -- | 2 |  |
| 21 | 12.5 | -33.2 | 21.08 | -- | -- | 3 |  |
| 22 | 14.5 | 30.0 | 20.09 | -- | -- | 1 |  |
| 23 | 22.1 | 23.1 | 21.34 | -- | -- | 1 |  |
| 24 | 28.9 | -49.0 | 21.22 | -- | -- | 3 |  |
| 26 | 34.3 | -36.7 | 20.19 | -- | -- | 1 |  |


| 27 | 36.6 | -52.5 | 18.69 | -- | -- | 3 |
| :--- | ---: | ---: | :--- | :--- | :--- | :--- |
| 28 | 42.3 | 61.3 | 21.49 | -- | -- | 0 |
| 29 | 50.0 | -54.7 | 22.31 | -- | -- | 1 |
| 30 | 69.3 | -89.8 | 21.63 | -- | -- | 0 |
| 31 | 59.5 | 4.1 | 20.58 | -- | -- | 3 |
| 32 | 70.3 | -29.8 | 18.70 | -- | -- | 3 |
| 33 | 71.4 | 73.1 | 21.82 | -- | -- | 0 |
| 34 | 72.6 | -74.3 | 21.83 | -- | -- | 1 |
| 35 | 75.5 | 56.1 | 20.19 | -- | -- | 1 |
| 36 | 76.8 | -52.7 | 19.41 | -- | -- | 1 |
| 37 | 77.2 | -18.0 | 21.28 | -- | -- | 2 |
| 38 | 77.6 | 63.5 | 17.68 | -- | -- | 3 |
| 39 | 81.4 | -39.1 | 20.43 | -- | -- | 1 |
| 42 | 95.3 | 75.4 | 20.73 | -- | -- | 3 |
| 43 | 97.8 | -73.8 | 20.53 | -- | -- | 0 |


| ---- |  | C 275. |  |  | $\mathbf{z = 0}$ |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: | 12 | 4127 | . 50 | Dec:+16 | 3918.0 | RL=23. | 48 G | 23.08 |
| Obj |  | \#RA | \# Dec | R | G | G-R | Class | Comments |
| 1 |  | -64.9 | 3.7 | 23.46 | -- | -- | 2 |  |
| 2 |  | -63.9 | -22.2 | 22.93 | -- | -- | 3 |  |
| 3 |  | -61.8 | -17.5 | 22.96 | -- | -- | 3 |  |
| 5 |  | -47.9 | -56.6 | 20.28 | 21.73 | 1.45 | 1 |  |
| 6 |  | -47.3 | 52.1 | 22.94 | -- | -- | 3 |  |
| 7 |  | -45.7 | -60.1 | 21.92 | -- | -- | 1 |  |
| 8 |  | -44.5 | -20.2 | 22.17 | 22.71 | 0.54 | 1 |  |
| 9 |  | -42.8 | 82.7 | 22.33 | 22.82 | 0.49 | 2 |  |
| 10 |  | -39.9 | 0.8 | 22.73 | -- | -- | 2 |  |
| 11 |  | -33.9 | 4.4 | 22.81 | -- | -- | 2 |  |
| 12 |  | -31.6 | 42.2 | 22.12 | 22.50 | 0.38 | 2 |  |
| 13 |  | -31.6 | -28.9 | 21.67 | 22.35 | 0.68 | 1 |  |
| 14 |  | -30.9 | -15.7 | 22.73 | -- | -- | 1 |  |
| 15 |  | -29.9 | 59.2 | 22.79 | -- | -- | 2 |  |
| 16 |  | -25.1 | -85.1 | 16.33 | 15.57 | -0.76 | 3 |  |
| 17 |  | -24.8 | -58.0 | 22.08 | 22.40 | 0.33 | 1 |  |
| 18 |  | -24.0 | 6.1 | 23.41 | -- | -- | 3 |  |
| 19 |  | -22.2 | 42.3 | 22.17 | 22.44 | 0.27 | 1 |  |
| 20 |  | -21.4 | 1.3 | 22.12 | --- | -- | 1 |  |
| 21 |  | -20.1 | -6.3 | 22.14 | -- | -- | 1 |  |
| 22 |  | -18.9 | -66.6 | 20.07 | 20.36 | 0.29 | 3 |  |
| 23 |  | -16.5 | 18.9 | 23.34 | -- | -- | 2 |  |
| 24 |  | -15.6 | -24.7 | 20.37 | 21.98 | 1.61 | 1 |  |
| 25 |  | -14.4 | 51.1 | 20.36 | 21.54 | 1.18 | 1 |  |
| 26 |  | -5.1 | 4.3 | 20.56 | 21.13 | 0.57 | 1 |  |
| 27 |  | -4.4 | -9.6 | 23.32 | -- | -- | 3 |  |
| 28 |  | -1.3 | 33.1 | 21.49 | 21.96 | 0.47 | 1 |  |
| 29 |  | -1.3 | 16.4 | 22.46 | -- | -- | 1 |  |
| 30 |  | -1.3 | -29.5 | 22.09 | 22.36 | 0.28 | 1 |  |

$0.2 \quad 19.3 \quad 22.68$


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$\begin{array}{lllllll}79 & 88.9 & 78.2 & 22.05 & 22.19 & 0.14 & 1 \\ 80 & 90.8 & 42.4 & 22.48 & 22.97 & 0.49 & \end{array}$
$\begin{array}{lllllll}80 & 90.8 & -42.4 & 22.48 & 22.97 & 0.49 & 3\end{array}$


| 1 | $1257+27$ |  |  | z=0 |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 12 | 125751 | 1.20 De | :+27 41 | 42.0 | RL=23 | 70 |  |
| Obj | \#RA | \#Dec | R | G | G-R | Class | Comments |
| 2 | -75.7 | -2.2 | 20.90 | -- | -- | 1 |  |
| 3 | -71.7 | 69.8 | 22.60 | -- | -- | 1 |  |
| 4 | -71.5 | 6.5 | 21.54 | -- | -- | 1 |  |
| 5 | -70.3 | 54.4 | 22.78 | -- | -- | 2 |  |
| 6 | -68.9 | 24.4 | 19.99 | -- | -- | 3 |  |
| 7 | -69.0 | 7.4 | 22.67 | -- | -- | 1 |  |
| 8 | -64.0 | -6.8 | 22.43 | -- | -- | 2 |  |
| 9 | -61.5 | 75.2 | 21.62 | -- | -- | 1 |  |
| 10 | -56.8 | 45.2 | 22.14 | -- | -- | 3 |  |
| 11 | -50.5 | 74.6 | 22.62 | -- | -- | 1 |  |
| 12 | -45.2 | 35.1 | 19.16 | -- | -- | 3 |  |
| 13 | -44.7 | -50.0 | 18.11 | -- | -- | 3 |  |
| 14 | -42.4 | 51.8 | 22.05 | -- | -- | 1 |  |
| 15 | -39.0 | -52.5 | 23.17 | -- | -- | 3 |  |
| 16 | -37.8 | -21.7 | 22.08 | -- | -- | 1 |  |
| 17 | -36.9 | -26.4 | 22.16 | -- | -- | 1 |  |
| 18 | -35.8 | -24.2 | 21.63 | -- | -- | 1 |  |
| 19 | -36.7 | -71.1 | 22.95 | -- | -- | 1 |  |
| 20 | -35.4 | 46.2 | 23.05 | -- | -- | 2 |  |
| 21 | -34.4 | -6.7 | 21.70 | -- | -- | 1 |  |
| 22 | -33.5 | 50.6 | 22.01 | -- | -- | 2 |  |
| 23 | -32.2 | -9.3 | 23.38 | -- | -- | 3 |  |
| 25 | -26.9 | 80.1 | 20.58 | -- | -- | 1 |  |
| 26 | -25.4 | 63.1 | 22.83 | -- | -- | 1 |  |


| 27 | -25.2 | -54.2 | 21.89 | -- | -- | 1 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 28 | -21.5 | -9.1 | 22.76 | -- | -- | 1 |  |
| 29 | -16.7 | 23.0 | 23.51 | -- | -- | 3 |  |
| 30 | -13.0 | 75.3 | 22.16 | -- | -- | 1 |  |
| 31 | -1.9 | 82.3 | 17.60 | -- | -- | 3 |  |
| 32 | 0.0 | 0.0 | 20.19 | -- | -- | 3 | QSo |
| 33 | 0.0 | -72.1 | 23.02 | -- | -- | 3 |  |
| 34 | 8.4 | 71.4 | 21.61 | -- | -- | 3 |  |
| 35 | 8.9 | -25.1 | 18.10 | -- | -- | 1 |  |
| 36 | 16.9 | 36.0 | 22.30 | -- | -- | 2 |  |
| 37 | 17.0 | -50.1 | 21.85 | -- | -- | 1 |  |
| 38 | 17.5 | 48.1 | 22.02 | -- | -- | 1 |  |
| 39 | 25.2 | 24.7 | 22.15 | -- | -- | 1 |  |
| 40 | 28.3 | 14.3 | 23.28 | -- | -- | 3 |  |
| 41 | 33.8 | 41.4 | 21.59 | -- | -- | 1 |  |
| 42 | 34.8 | 7.8 | 22.88 | -- | -- | 2 |  |
| 43 | 34.7 | -33.4 | 23.38 | -- | -- | 3 |  |
| 44 | 35.4 | 1.0 | 21.85 | -- | -- | 1 |  |
| 45 | 37.1 | 47.9 | 23.11 | -- | -- | 1 |  |
| 46 | 37.7 | 22.0 | 22.52 | -- | -- | 2 |  |
| 47 | 42.0 | 51.2 | 22.99 | -- | -- | 1 |  |
| 48 | 44.2 | -70.9 | 22.65 | -- | -- | 1 |  |
| 49 | 44.5 | 60.1 | 23.40 | -- | -- | 3 |  |
| 50 | 46.6 | -70.8 | 22.80 | -- | -- | 2 |  |
| 51 | 47.0 | -63.6 | 23.69 | -- | -- | 0 |  |
| 52 | 48.7 | 45.6 | 23.60 | -- | -- | 2 |  |
| 53 | 52.0 | -74.6 | 21.70 | -- | -- | 3 |  |
| 54 | 53.7 | 55.0 | 22.51 | -- | -- | 1 |  |
| 55 | 58.9 | -36.9 | 21.71 | -- | -- | 1 |  |
| 56 | 63.2 | -47.6 | 22.43 | -- | -- | 1 |  |
| 57 | 66.7 | -47.3 | 22.72 | -- | -- | 2 |  |
| 58 | 70.2 | 79.0 | 20.19 | -- | -- | 1 |  |
| 60 | 71.8 | -16.1 | 21.99 | -- | -- | 1 |  |
| 61 | 74.9 | 21.2 | 23.32 | -- | -- | 2 |  |
| 62 | 80.0 | -74.3 | 23.53 | -- | -- | 2 |  |
| 63 | 84.1 | -77.4 | 22.87 | -- | -- | 2 |  |
| 64 | 84.8 | 69.2 | 20.61 | -- | -- | 1 |  |


| ---- | 1258+3 |  | ---- | $z=0$. |  |  | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 12 | 584 | 1.74 |  |  |  |  |  |
| Obj | \#RA | \#Dec | R | G | G-R | Class |  |
| 1 | -67.7 | -49.7 | 17.99 | -- | -- | 3 |  |
| 2 | -67.0 | -53.4 | 22.09 | -- | -- | 3 |  |
| 3 | -59.4 | -8.8 | 13.68 | -- | -- | 4 |  |
| 4 | -54.9 | 37.5 | 19.98 | -- | -- | 1 |  |
| 5 | -54.8 | -44.3 | 22.26 | -- | -- | 2 |  |
| 6 | -51.7 | -1.5 | 19.26 | -- | -- | 1 |  |
| 7 | -44.9 | -36.0 | 22.62 | -- | -- | 2 |  |


| 10 | -31.8 | -68.2 | 19.23 | -- | -- | 3 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 11 | -30.9 | 2.7 | 21.81 | -- | -- | 3 |  |
| 12 | -28.6 | -71.6 | 22.23 | -- | -- | 1 |  |
| 13 | -22.0 | -91.4 | 22.31 | -- | -- | 2 |  |
| 14 | -19.8 | 33.6 | 21.38 | -- | -- | 1 |  |
| 16 | -18.0 | -26.5 | 20.99 | -- | -- | 3 |  |
| 17 | -16.8 | -84.9 | 22.03 | -- | -- | 1 |  |
| 18 | -10.7 | -39.9 | 21.74 | -- | -- | 1 |  |
| 19 | -8.4 | 117.9 | 23.24 | -- | -- | 2 |  |
| 20 | -5.6 | -39.5 | 22.69 | -- | -- | 2 |  |
| 22 | -1.0 | -32.7 | 14.60 | -- | -- | 4 |  |
| 23 | 0.0 | 0.0 | 18.66 | -- | -- | 1 | QSO |
| 24 | 6.3 | 44.0 | 19.98 | -- | -- | 1 |  |
| 26 | 14.9 | 36.0 | 22.03 | -- | -- | 1 |  |
| 27 | 20.5 | 107.4 | 21.90 | -- | -- | 1 |  |
| 28 | 22.2 | 18.8 | 19.02 | -- | -- | 3 |  |
| 29 | 27.6 | 32.7 | 22.23 | -- | -- | 1 |  |
| 30 | 27.4 | 118.9 | 23.14 | -- | -- | 3 |  |
| 31 | 29.0 | 11.3 | 21.16 | -- | -- | 1 |  |
| 33 | 35.8 | 116.9 | 22.83 | -- | -- | 1 |  |
| 34 | 37.5 | -37.3 | 22.91 | -- | -- | 1 |  |
| 35 | 39.8 | -98.5 | 22.21 | -- | -- | 1 |  |
| 36 | 41.5 | 104.3 | 21.75 | -- | -- | 1 |  |
| 37 | 46.0 | -59.5 | 21.82 | -- | -- | 1 |  |
| 39 | 52.2 | 118.4 | 22.08 | -- | -- | 1 |  |
| 40 | 55.6 | 108.0 | 23.13 | -- | -- | 0 |  |
| 42 | 56.7 | 106.1 | 22.51 | -- | -- | 1 |  |
| 43 | 58.8 | -44.0 | 22.24 | -- | -- | 1 |  |
| 44 | 62.0 | -43.0 | 23.00 | -- | -- | 2 |  |
| 46 | 67.1 | -78.5 | 23.02 | -- | -- | 1 |  |
| 47 | 67.4 | 3.8 | 20.09 | -- | -- | 1 |  |
| 48 | 75.8 | 10.8 | 20.96 | -- | -- | 1 |  |
| 49 | 76.9 | 30.5 | 22.38 | -- | -- | 1 |  |
| 50 | 78.3 | -45.5 | 22.94 | -- | -- | 1 |  |
| 53 | 90.8 | -83.9 | 22.72 | -- | -- | 1 |  |
| 54 | 91.0 | -42.6 | 22.49 | -- | -- | 2 |  |
| 55 | 91.7 | -65.7 | 21.63 | -- | -- | 1 |  |
| 56 | 92.9 | -96.2 | 22.28 | -- | -- | 2 |  |
| 57 | 98.8 | -87.4 | 22.63 | -- | -- | 1 |  |


| 1 | 303+3 |  | $z=0.470$ |  |  |  | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 13 | 32 | 1.61 | Dec:+33 | 5145.7 | RL=23.20 |  |  |
| Obj | \#RA | \#Dec | R | G | G-R | Class |  |
| 1 | -73.3 | 24.4 | 21.60 | -- | -- | 1 |  |
| 3 | -68.5 | 36.7 | 18.99 | -- | -- | 3 |  |
| 4 | -68.6 | -43.1 | 21.01 | -- | -- | 3 |  |
| 5 | -64.1 | 20.7 | 20.42 | -- | -- | 1 |  |
| 6 | -59.5 | -35.0 | 22.05 | -- | -- | 1 |  |


| 7 | -59.1 | -39.0 | 21.16 | - | -- | 2 |
| ---: | ---: | ---: | ---: | :--- | :--- | :--- |
| 8 | -52.5 | -36.5 | 23.15 | - | -- | 2 |
| 9 | -50.1 | -32.2 | 21.90 | -- | -- | 2 |
| 10 | -47.9 | 38.2 | 18.89 | -- | -- | 3 |
| 11 | -48.1 | 30.0 | 20.48 | -- | -- | 3 |
| 13 | -32.4 | -6.2 | 17.68 | -- | -- | 3 |
| 14 | -31.9 | -56.0 | 22.81 | -- | -- | 3 |
| 16 | -19.2 | 1.5 | 22.17 | - | -- | 2 |
| 17 | -12.8 | -53.6 | 21.28 | -- | -- | 1 |
| 18 | 0.0 | 0.0 | 18.30 | -- | -- | 2 |
| 19 | 8.8 | -20.0 | 22.08 | -- | -- | 1 |
| 20 | 19.9 | -52.6 | 21.10 | - | -- | 3 |
| 22 | 26.0 | -19.3 | 21.43 | -- | -- | 3 |


| ---- 1306277 |  |  | $z=0.462$ |  |  |  | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 13 | 624 | 4.00 | Dec:+27 39 | 59.0 | RL=23 |  |  |
| Obj | \#RA | \#Dec | R | G | G-R | Class |  |
| 1 | -90.6 | -53.6 | 23.40 | -- | -- | 3 |  |
| 3 | -81.8 | 30.5 | 21.89 | -- | -- | 1 |  |
| 4 | -82.2 | 21.0 | 23.42 | -- | -- | 1 |  |
| 5 | -81.1 | 52.0 | 22.68 | -- | -- | 2 |  |
| 6 | -80.4 | 5.7 | 23.67 | -- | -- | 2 |  |
| 7 | -79.2 | 23.7 | 23.51 | -- | -- | 1 |  |
| 8 | -78.4 | -71.8 | 21.95 | -- | -- | 1 |  |
| 9 | -72.3 | -53.0 | 19.39 | -- | -- | 3 |  |
| 10 | -71.2 | 54.0 | 23.11 | -- | -- | 2 |  |
| 11 | -70.0 | 60.7 | 21.77 | -- | -- | 1 |  |
| 12 | -68.8 | 56.3 | 21.04 | -- | -- | 1 |  |
| 13 | -68.6 | 64.7 | 23.44 | -- | -- | 0 |  |
| 14 | -68.2 | -24.4 | 23.33 | -- | -- | 2 |  |
| 15 | -64.9 | 44.3 | 22.15 | -- | -- | 1 |  |
| 16 | -61.0 | 60.0 | 23.34 | -- | -- | 2 |  |
| 17 | -60.6 | -25.2 | 19.59 | -- | -- | 1 |  |
| 18 | -57.4 | 37.8 | 22.38 | -- | -- | 1 |  |
| 19 | -56.0 | -27.6 | 22.39 | -- | -- | 1 |  |
| 20 | -55.8 | -92.1 | 22.85 | -- | -- | 3 |  |
| 21 | -53.6 | -19.1 | 22.55 | -- | -- | 3 |  |
| 22 | -53.4 | 22.2 | 22.56 | -- | -- | 1 |  |
| 23 | -44.0 | -5.3 | 16.82 | -- | -- | 3 |  |
| 24 | -40.0 | -51.5 | 19.50 | -- | -- | 1 |  |
| 25 | -35.9 | 17.0 | 22.27 | -- | -- | 1 |  |
| 26 | -31.2 | 1.7 | 23.53 | -- | -- | 3 |  |
| 27 | -21.9 | -47.6 | 20.12 | -- | -- | 1 |  |
| 28 | -15.7 | -88.9 | 22.83 | -- | -- | 0 |  |
| 29 | -11.2 | 36.6 | 22.90 | -- | -- | 1 |  |
| 30 | 0.0 | 0.0 | 19.07 | -- | -- | 2 | QSo |
| 31 | 3.9 | -47.7 | 23.01 | -- | -- | 3 |  |
| 32 | 13.6 | 0.6 | 20.88 | -- | -- | 1 |  |


| 33 | 34.5 | 46.4 | 22.46 | -- | -- | 1 |
| ---: | ---: | ---: | ---: | :--- | :--- | :--- |
| 34 | 34.4 | 43.0 | 22.82 | -- | -- | 1 |
| 35 | 37.5 | 4.6 | 23.15 | -- | -- | 0 |
| 37 | 41.0 | -31.2 | 22.71 | -- | -- | 0 |
| 38 | 42.0 | -89.1 | 23.50 | -- | -- | 2 |
| 39 | 42.8 | 39.5 | 21.75 | -- | -- | 1 |
| 40 | 42.8 | -41.0 | 23.20 | -- | -- | 3 |
| 41 | 44.4 | 33.1 | 22.81 | -- | -- | 1 |
| 42 | 56.7 | -29.8 | 22.31 | -- | -- | 1 |
| 43 | 60.4 | -24.6 | 22.83 | -- | -- | 3 |
| 44 | 60.8 | -57.3 | 22.96 | -- | -- | 1 |
| 45 | 65.7 | 50.7 | 20.91 | - | -- | 3 |
| 46 | 68.8 | -38.5 | 22.80 | -- | -- | 3 |
| 47 | 70.4 | 11.4 | 23.02 | -- | -- | 1 |


| ---- 1332+375 |  |  | $z=0.438$ |  |  |  | $\mathrm{GL}=24.24$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 13 | 32 | 4.00 | Dec:+37 | 3051.0 | RL $=23$ |  |  |
| Obj | \#RA | \#Dec | R | G | G-R | Class | Comments |
| 1 | -74.5 | -59.3 | 23.48 | -- | -- | 2 |  |
| 2 | -74.0 | 66.0 | 22.76 | 23.48 | 0.72 | 1 |  |
| 3 | -69.6 | 66.6 | 23.12 | 23.69 | 0.57 | 3 |  |
| 4 | -69.1 | -48.8 | 23.63 | 23.34 | -0.29 | 1 |  |
| 5 | -68.6 | 45.3 | 23.18 | 23.97 | 0.79 | 3 |  |
| 6 | -68.1 | 37.5 | 22.79 | 23.99 | 1.21 | 2 |  |
| 7 | -66.9 | 1.5 | 21.56 | 22.07 | 0.50 | 1 |  |
| 8 | -66.3 | 38.9 | 23.45 | -- | -- | 2 |  |
| 9 | -61.7 | -22.5 | 23.23 | 23.63 | 0.40 | 1 |  |
| 10 | -60.6 | 29.6 | -- | 24.01 | -- | 3 |  |
| 11 | -59.1 | 22.2 | 22.83 | 24.22 | 1.39 | 1 |  |
| 12 | -50.0 | 49.7 | 22.87 | -- | -- | 2 |  |
| 13 | -49.1 | 16.5 | 22.40 | 23.45 | 1.05 | 1 |  |
| 14 | -49.5 | -81.8 | 21.50 | 21.58 | 0.07 | 3 |  |
| 15 | -48.5 | -19.4 | 20.42 | 22.17 | 1.75 | 1 |  |
| 16 | -45.9 | 31.6 | 21.87 | 23.18 | 1.31 | 1 |  |
| 17 | -43.1 | 74.9 | 18.91 | 20.05 | 1.14 | 3 |  |
| 18 | -41.5 | -66.1 | 23.06 | 23.79 | 0.72 | 1 |  |
| 19 | -40.7 | -21.5 | 23.11 | 24.23 | 1.12 | 3 |  |
| 20 | -39.6 | -42.9 | 22.16 | 22.40 | 0.25 | 1 |  |
| 21 | -38.8 | 43.1 | 23.48 | -- | -- | 1 |  |
| 22 | -30.7 | -65.1 | 22.47 | 23.21 | 0.74 | 1 |  |
| 25 | -26.6 | 73.3 | 21.64 | 23.37 | 1.73 | 1 |  |
| 26 | -26.0 | 9.5 | 21.79 | 22.73 | 0.94 | 1 |  |
| 27 | -25.7 | -23.2 | 22.02 | 23.46 | 1.43 | 1 |  |
| 28 | -23.6 | -33.3 | 21.45 | 22.24 | 0.79 | 1 |  |
| 29 | -21.6 | 34.8 | 22.39 | 23.58 | 1.20 | 1 |  |
| 30 | -13.6 | -65.6 | 22.43 | 23.51 | 1.08 | 2 |  |
| 32 | -8.2 | -54.5 | 21.53 | 23.07 | 1.55 | 1 |  |
| 33 | -7.8 | 29.9 | 22.00 | 22.87 | 0.87 | 1 |  |


| 34 | -5.3 | -7.8 | 21.46 | 22.51 | 1.05 | 2 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 35 | -3.4 | -26.4 | 23.14 | 23.70 | 0.56 | 1 |
| 36 | 0.0 | 0.0 | 18.25 | 18.34 | 0.09 | 3 |
| 37 | -0.5 | -5.3 | -- | 24.16 | -- | 3 |
| 38 | 0.6 | -62.5 | 22.79 | -- | -- | 3 |
| 39 | 2.3 | -11.2 | 23.56 | 24.09 | 0.64 | 3 |
| 40 | 5.0 | 17.5 | 22.90 | -- | -- | 1 |
| 41 | 6.6 | 1.3 | 21.32 | 23.25 | 1.93 | 3 |
| 42 | 8.8 | 21.6 | 21.81 | 22.73 | 0.92 | 1 |
| 43 | 10.6 | -28.3 | 22.89 | 23.65 | 0.76 | 1 |
| 44 | 17.3 | 74.6 | 23.11 | -- | -- | 3 |
| 45 | 19.1 | -18.7 | 22.33 | -- | -- | 1 |
| 46 | 20.5 | -65.8 | 23.17 | -- | -- | 3 |
| 47 | 24.4 | -1.1 | 23.04 | -- | -- | 1 |
| 48 | 24.7 | 63.2 | 20.53 | 22.28 | 1.74 | 1 |
| 49 | 26.4 | -76.4 | 23.22 | 23.47 | 0.26 | 3 |
| 50 | 32.1 | 56.4 | 22.67 | 24.07 | 1.40 | 2 |
| 51 | 34.7 | -0.2 | 22.92 | 23.62 | 0.69 | 3 |
| 52 | 36.3 | -8.3 | 22.36 | 23.13 | 0.77 | 3 |
| 53 | 38.1 | -47.2 | 20.75 | 21.81 | 1.06 | 1 |
| 54 | 40.7 | 13.8 | 22.57 | 23.23 | 0.66 | 1 |
| 55 | 40.4 | -35.2 | 22.41 | 24.15 | 1.74 | 1 |
| 56 | 43.9 | -50.9 | 23.09 | 24.23 | 1.13 | 2 |
| 57 | 44.7 | -80.8 | 21.88 | 22.12 | 0.24 | 1 |
| 58 | 45.0 | -67.4 | 20.71 | 22.43 | 1.72 | 1 |
| 59 | 45.5 | -22.5 | 23.49 | -- | -- | 3 |
| 60 | 53.2 | 74.3 | 21.53 | 22.05 | 0.51 | 1 |
| 61 | 57.4 | 57.0 | 23.17 | -- | -- | 1 |
| 62 | 59.4 | -79.7 | 22.72 | 23.77 | 1.05 | 1 |
| 63 | 61.3 | -43.9 | 21.93 | 23.36 | 1.43 | 3 |
| 65 | 66.4 | 29.9 | 21.43 | 22.92 | 1.49 | 1 |
| 66 | 69.3 | -13.7 | 22.04 | 23.28 | 1.24 | 1 |
| 67 | 70.5 | -22.5 | 22.29 | -- | -- | 1 |
| 68 | 72.1 | -46.6 | 21.53 | 22.32 | 0.79 | 3 |
| 69 | 72.7 | 42.4 | 23.20 | 24.14 | 0.94 | 2 |
| 70 | 76.6 | 56.2 | 23.35 | 23.92 | 0.57 | 2 |
| 71 | 77.1 | 67.7 | 22.28 | 24.06 | 1.77 | 1 |
| 72 | 77.3 | -20.6 | 21.71 | 22.89 | 1.17 | 1 |
| 73 | 80.3 | 62.4 | 21.08 | 22.18 | 1.10 | 1 |
| 74 | 80.6 | -34.7 | 22.06 | 23.08 | 1.02 | 2 |
| 75 | 83.8 | 15.7 | 21.59 | 22.52 | 0.93 | 1 |
| 76 | 83.8 | -39.1 | 22.53 | -- | -- | 1 |
| 77 | 85.0 | -58.4 | 21.93 | 23.17 | 1.25 | 1 |
| 78 | 85.9 | -2.8 | 22.28 | 23.31 | 1.03 | 1 |
| 79 | 85.9 | -54.7 | 21.12 | 23.11 | 1.99 | 1 |
| 80 | 86.6 | -27.1 | 21.66 | 23.22 | 1.56 | 1 |
| 81 | 86.8 | -82.1 | 22.01 | 23.09 | 1.07 | 1 |
| 82 | 88.4 | 50.2 | 23.17 | -- | -- | 1 |
| 83 | 90.9 | -67.3 | 23.06 | -- | -- | 3 |


| ---- 1 | 336+26 |  | ---- | $z=0$ |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 13 | 36 | 2.98 | Dec:+26 29 | 5.5 | RL= 23 | . 57 |  |
| Obj | \#RA | \#Dec | R | G | G-R | Class | Comments |
| 1 | 122.1 | 29.8 | 20.20 | -- | -- | 3 |  |
| 2 | 118.8 | 30.2 | 21.94 | -- | -- | 1 |  |
| 3 | 113.4 | -31.0 | 22.76 | -- | -- | 2 |  |
| 4 | 109.6 | -16.3 | 23.24 | -- | -- | 0 |  |
| 5 | 105.2 | 61.1 | 23.18 | -- | -- | 3 |  |
| 6 | -96.6 | -61.5 | 20.82 | -- | -- | 1 |  |
| 7 | -93.7 | 54.5 | 22.51 | -- | -- | 1 |  |
| 8 | -87.2 | -32.0 | 19.62 | -- | -- | 1 |  |
| 9 | -84.8 | 76.8 | 21.09 | -- | -- | 1 |  |
| 10 | -85.2 | -26.2 | 23.22 | -- | -- | 3 |  |
| 11 | -83.3 | -19.6 | 21.09 | -- | -- | 1 |  |
| 12 | -70.7 | 6.2 | 22.44 | -- | -- | 0 |  |
| 13 | -63.0 | 70.3 | 21.66 | -- | -- | 1 |  |
| 14 | -62.9 | 56.1 | 20.81 | -- | -- | 1 |  |
| 15 | -58.4 | -50.1 | 21.88 | -- | -- | 2 |  |
| 16 | -57.0 | -1.1 | 19.97 | -- | -- | 3 |  |
| 17 | -51.0 | -67.5 | 20.30 | -- | -- | 1 |  |
| 18 | -48.8 | -42.6 | - 21.79 | -- | -- | 1 |  |
| 19 | -43.9 | 24.5 | - 20.68 | -- | -- | 3 |  |
| 20 | -43.5 | 27.1 | 19.27 | -- | -- | 3 |  |
| 21 | -43.0 | -2.5 | 23.03 | -- | -- | 3 |  |
| 22 | -41.3 | 70.0 | 23.04 | -- | -- | 2 |  |
| 23 | -41.1 | 2.7 | 721.49 | -- | -- | 1 |  |
| 24 | -39.7 | -3.5 | $5 \quad 23.26$ | -- | -- | 3 |  |
| 25 | -39.0 | 65.9 | 22.33 | -- | -- | 3 |  |
| 26 | -34.7 | -49.6 | - 20.04 | -- | -- | 1 |  |
| 27 | -33.4 | -72.2 | 22.78 | -- | -- | 3 |  |
| 28 | -30.1 | -59.0 | 21.33 | -- | -- | 1 |  |
| 29 | -27.9 | -12.4 | 419.45 | -- | -- | 3 |  |
| 30 | -26.1 | 3.7 | 20.15 | -- | -- | 1 |  |
| 31 | -19.9 | 44.3 | 30.64 | -- | -- | 1 |  |
| 32 | -19.3 | -54.9 | 22.77 | -- | -- | 1 |  |
| 33 | -18.3 | 37.5 | - 23.44 | -- | -- | 0 |  |
| 34 | -17.2 | 30.8 | 22.44 | -- | -- | 2 |  |
| 35 | -16.5 | -80.0 | 20.73 | -- | -- | 1 |  |
| 36 | -15.3 | -73.3 | 322.40 | -- | -- | 2 |  |
| 37 | -11.9 | 41.8 | 18.93 | -- | -- | 1 |  |
| 38 | -4.4 | -48.1 | 22.66 | -- | -- | 1 |  |
| 39 | -3.9 | 9.1 | 22.78 | -- | -- | 1 |  |
| 40 | 0.0 | 0.0 | 18.26 | -- | -- | 3 | QSO |
| 41 | -0.6 | -55.7 | 22.71 | -- | -- | 3 |  |
| 42 | 2.2 | 15.5 | 23.55 | -- | -- | 3 |  |
| 43 | 1.8 | -73.3 | 22.79 | -- | -- | 3 |  |
| 44 | 2.7 | 65.7 | 19.22 | -- | -- | 1 |  |
| 45 | 3.7 | 78.1 | 22.30 | -- | -- | 3 |  |
| 46 | 7.8 | 79.8 | - 20.49 | -- | -- | 1 |  |
| 47 | 11.1 | 71.2 | 21.69 | -- | -- | 2 |  |
| 48 | 11.0 | -12.6 | 23.49 | -- | -- | 0 |  |


| 49 | 12.0 | -71.3 | 20.62 | -- | -- | 1 |
| ---: | ---: | ---: | ---: | :--- | :--- | :--- |
| 50 | 18.0 | 28.2 | 22.76 | -- | -- | 1 |
| 51 | 18.4 | -21.4 | 22.38 | -- | -- | 1 |
| 53 | 24.7 | 51.9 | 23.31 | -- | -- | 2 |
| 54 | 24.6 | 23.6 | 23.00 | -- | -- | 2 |
| 55 | 25.8 | -31.3 | 22.27 | -- | -- | 3 |
| 56 | 27.3 | 64.0 | 23.01 | -- | -- | 3 |
| 58 | 31.0 | 4.5 | 20.70 | -- | -- | 1 |
| 59 | 31.6 | -8.0 | 21.74 | -- | -- | 1 |
| 60 | 32.0 | -75.6 | 21.43 | -- | -- | 1 |
| 61 | 33.8 | 72.4 | 23.18 | -- | -- | 1 |
| 62 | 34.3 | -32.3 | 21.61 | -- | -- | 1 |
| 63 | 36.0 | -75.5 | 22.85 | -- | -- | 2 |
| 64 | 40.3 | -40.5 | 22.29 | -- | -- | 1 |
| 65 | 41.1 | 54.9 | 20.66 | -- | -- | 1 |
| 66 | 44.0 | 57.4 | 22.83 | -- | -- | 3 |
| 67 | 45.5 | 39.2 | 22.12 | -- | -- | 3 |


| ---- 1352-104 |  |  | $z=0.332$ |  |  |  | $\mathrm{GL}=23.05$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 13 | 527 | 7.80 D | Dec:-10 26 | 26.0 | RL=23. | 14 G |  |
| Obj | \#RA | \#Dec | R | G | G-R | Class | Comments |
| 2 | -65.1 | 171.2 | 221.25 | 22.45 | 1.20 | - 2 |  |
| 3 | -58.1 | -86.0 | 20.86 | 20.72 | -0.14 | 3 |  |
| 4 | -56.1 | 73.8 | 21.65 | 22.96 | 1.30 | 1 |  |
| 5 | -55.8 | 0.8 | 21.33 | 22.37 | 1.04 | 1 |  |
| 6 | -55.1 | -35.4 | 22.75 | -- | -- | 2 |  |
| 7 | -53.7 | -35.0 | 22.14 | -- | -- | 1 |  |
| 8 | -53.4 | -20.5 | 22.46 | -- | -- | 3 |  |
| 9 | -44.3 | 57.9 | 21.01 | 22.13 | 1.13 | 3 |  |
| 10 | -40.9 | -43.0 | 20.65 | 21.28 | 0.63 | 3 |  |
| 11 | -35.9 | 6.7 | 21.20 | 21.53 | 0.34 | 1 |  |
| 12 | -35.4 | -49.8 | 20.44 | 20.53 | 0.09 | 1 |  |
| 13 | -35.4 | -59.2 | 20.93 | -- | -- | 1 |  |
| 14 | -30.4 | 54.5 | 21.86 | 22.70 | 0.84 | 1 |  |
| 17 | -23.2 | 26.8 | 21.74 | 22.41 | 0.67 | 2 |  |
| 18 | -22.5 | 35.4 | 20.02 | 21.05 | 1.03 | 3 |  |
| 19 | -20.7 | 9.9 | 22.48 | -- | -- | 3 |  |
| 20 | -19.1 | -11.6 | 22.03 | 22.10 | 0.07 | 3 |  |
| 22 | -17.7 | -40.1 | 19.20 | 19.33 | 0.13 | 1 |  |
| 23 | -17.0 | 11.6 | 21.41 | 22.18 | 0.77 | 1 |  |
| 24 | -16.7 | -16.7 | 20.46 | 21.09 | 0.62 | 1 |  |
| 25 | -16.6 | 2.2 | 22.31 | -- | -- | 3 |  |
| 26 | -13.3 | 26.7 | 21.45 | 21.44 | 0.00 | 0 |  |
| 27 | -12.1 | 4.4 | 22.30 | 22.76 | 0.46 | 2 |  |
| 28 | -10.2 | -81.3 | 20.15 | 21.74 | 1.58 | 1 |  |
| 29 | -9.5 | -17.6 | 22.28 | -- | -- | 3 |  |
| 30 | -8.8 | 25.5 | 20.36 | 21.39 | 1.04 | 3 |  |
| 31 | -6.5 | 50.0 | 22.43 | 22.55 | 0.12 | 3 |  |


| 32 | -2.0 | -38.1 | 21.56 | 21.84 | 0.28 | 1 |  |
| :--- | ---: | ---: | :--- | :---: | :---: | :--- | :--- |
| 34 | -0.1 | 9.4 | 20.55 | 21.32 | 0.77 | 3 |  |
| 35 | 0.0 | 0.0 | 17.60 | 17.60 | 0.01 | 3 | QSO |
| 36 | 0.3 | -64.2 | 18.93 | 19.52 | 0.59 | 1 |  |
| 37 | 0.9 | 35.8 | 20.20 | 20.98 | 0.78 | 1 |  |
| 38 | 2.9 | 67.7 | 22.17 | -- | -- | 2 |  |
| 39 | 3.2 | 7.9 | 20.37 | 20.92 | 0.55 | 3 | -- |
| 40 | 3.5 | -86.5 | 22.67 | -- | 3 |  |  |
| 41 | 7.1 | 38.8 | 21.88 | 22.28 | 0.40 | 0 |  |
| 42 | 8.5 | 14.3 | -- | 22.82 | -- | 1 |  |
| 45 | 14.5 | -87.5 | 21.84 | 21.36 | -0.49 | 2 |  |
| 46 | 15.2 | 3.5 | 21.34 | 22.71 | 1.38 | 1 | -- |
| 47 | 15.6 | -68.0 | 22.76 | -- | 1 |  |  |
| 48 | 19.9 | -47.3 | 20.45 | 21.65 | 1.20 | 3 |  |
| 50 | 27.9 | -4.1 | 23.09 | -- | -- | 3 |  |
| 51 | 36.0 | 50.3 | 21.62 | 22.32 | 0.70 | 1 |  |
| 52 | 36.4 | -70.7 | 20.54 | 20.92 | 0.38 | 1 |  |
| 53 | 44.9 | -73.4 | 21.77 | 23.01 | 1.23 | 1 |  |
| 54 | 46.4 | -6.3 | 22.14 | 22.67 | 0.52 | 2 |  |
| 56 | 49.4 | 64.5 | 22.42 | -- | -- | 3 |  |
| 57 | 50.1 | -24.8 | 21.86 | 22.00 | 0.14 | 3 |  |
| 58 | 53.4 | -75.7 | 21.68 | -- | -- | 1 |  |
| 59 | 57.1 | -81.4 | 21.75 | -- | -- | 1 |  |
| 60 | 66.1 | 77.4 | 19.58 | 20.78 | 1.20 | 3 |  |
| 61 | 68.1 | -82.5 | 22.76 | -- | -- | 3 |  |
| 62 | 68.0 | -14.2 | 20.64 | 20.78 | 0.14 | 3 |  |
| 63 | 70.7 | -55.1 | 22.27 | 22.62 | 0.36 | 1 | -- |
| 64 | 73.7 | -41.8 | 21.71 | -- | 0 |  |  |
| 65 | 76.6 | 54.4 | 21.53 | 21.57 | 0.04 | 1 |  |
| 66 | 76.5 | 80.4 | 22.41 | 22.00 | -0.41 | 3 | -- |
| 67 | 77.2 | -60.2 | 22.22 | -- | 2 |  |  |
| 68 | 80.6 | 55.1 | 19.23 | 19.17 | -0.06 | 1 |  |
| 71 | 85.7 | -83.0 | 20.78 | 21.12 | 0.34 | 1 | 1.14 |
| 72 | 87.7 | 0.3 | 20.80 | 21.94 | 3 |  |  |
| 73 | 88.9 | 40.6 | 22.61 | 22.35 | -0.26 | 3 |  |
| 74 | 91.3 | -26.0 | 22.99 | -- | -- | 0 |  |
| 75 | 91.7 | -80.4 | 17.85 | 17.73 | -0.12 | 3 |  |
| 76 | 93.5 | -57.8 | 20.97 | 20.64 | -0.33 | 1 |  |
|  |  |  |  |  |  |  |  |


| ---- 1415+254 |  |  | $z=0.560$ |  |  |  |  | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 14 | 15 | 6.60 | Dec:+25 | 27 | 26.3 | RL=23 | 40 |  |
| Obj | \# RA | \#Dec | R |  | G | G-R | Class |  |
| 1 | -88.4 | -66.3 | 20.70 |  | -- | -- | 1 |  |
| 2 | -83.8 | 5.0 | 18.89 |  | -- | -- | 3 |  |
| 5 | -81.9 | -85.8 | 22.54 |  | -- | -- | 1 |  |
| 7 | -75.5 | 10.1 | 22.54 |  | -- | -- | 1 |  |
| 8 | -74.6 | -58.6 | 19.90 |  | -- | -- | 3 |  |
| 9 | -73.9 | -33.3 | 23.22 |  | -- | -- | 0 |  |


| 10 | -72.5 | -44.9 | 23.36 | -- | -- |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 11 | -68.0 | -48.3 | 22.45 | -- | -- |
| 12 | -67.9 | 6.0 | 15.06 | -- | -- |
| 13 | -67.3 | 36.4 | 20.32 | -- | -- |
| 14 | -61.1 | -49.7 | 22.49 | -- | -- |
| 15 | -59.3 | -90.0 | 21.89 | -- | -- |
| 16 | -53.7 | 67.3 | 23.01 | -- | -- |
| 17 | -53.4 | -28.4 | 23.35 | -- | -- |
| 18 | -51.1 | -12.4 | 19.94 | -- | -- |
| 19 | -50.4 | 60.0 | 21.55 | -- | -- |
| 21 | -45.9 | -46.9 | 22.12 | -- | -- |
| 22 | -45.8 | -3.8 | 21.39 | -- | -- |
| 24 | -44.0 | -30.4 | 20.14 | -- | -- |
| 25 | -36.3 | 74.2 | 19.94 | -- | -- |
| 26 | -34.4 | -59.0 | 19.40 | -- | -- |
| 27 | -33.7 | -4.3 | 19.73 | -- | -- |
| 28 | -28.4 | -93.7 | 20.12 | -- | -- |
| 29 | -29.0 | 52.6 | 21.62 | -- | -- |
| 30 | -28.2 | 49.1 | 20.36 | -- | -- |
| 31 | -27.9 | -2.8 | 21.06 | -- | -- |
| 32 | -26.9 | 3.8 | 21.56 | -- | -- |
| 34 | -25.0 | -47.5 | 22.45 | -- | -- |
| 35 | -24.8 | 23.9 | 22.58 | -- | -- |
| 36 | -24.2 | 35.3 | 23.31 | -- | -- |
| 37 | -23.6 | -80.1 | 22.85 | -- | -- |
| 39 | -16.0 | -53.0 | 19.81 | -- | -- |
| 40 | -15.2 | 22.4 | 22.43 | -- | -- |
| 41 | -13.8 | -48.0 | 18.82 | -- | -- |
| 42 | -12.4 | -10.5 | 23.29 | -- | -- |
| 43 | -11.0 | -55.5 | 18.39 | -- | -- |
| 44 | -8.6 | 71.3 | 19.75 | -- | -- |
| 46 | -4.9 | -33.5 | 22.04 | -- | -- |
| 47 | -3.4 | -71.1 | 23.25 | -- | -- |
| 48 | -1.4 | 5.8 | 23.38 | -- | -- |
| 50 | -1.4 | -62.7 | 23.01 | -- | -- |
| 51 | 0.0 | 0.0 | 20.22 | -- | -- |
| 52 | 0.6 | -72.0 | 23.04 | -- | -- |
| 53 | 2.5 | 35.9 | 21.90 | -- | -- |
| 54 | 3.2 | 17.1 | 23.06 | -- | -- |
| 55 | 4.5 | 38.5 | 22.75 | -- | -- |
| 56 | 6.8 | -16.2 | 22.83 | -- | -- |
| 59 | 23.8 | 49.1 | 22.70 | -- | -- |
| 61 | 34.8 | 32.0 | 23.05 | -- | -- |
| 62 | 39.8 | 66.8 | 23.22 | -- | -- |
| 63 | 41.1 | -39.1 | 22.84 | -- | -- |
| 66 | 44.1 | -61.7 | 17.75 | -- | -- |
| 67 | 45.6 | -15.3 | 23.03 | -- | -- |
| 70 | 50.3 | -65.3 | 20.97 | -- | -- |
| 71 | 52.4 | 70.0 | 20.25 | -- | -- |
| 73 | 53.9 | -68.1 | 21.37 | -- | -- |
| 74 | 55.9 | 63.7 | 23.00 | -- | -- |


| 76 | 62.0 | 11.6 | 22.42 | -- | -- | 1 |
| ---: | ---: | ---: | ---: | :--- | :--- | :--- |
| 78 | 67.7 | -16.1 | 22.60 | -- | -- | 1 |
| 79 | 67.7 | 37.4 | 22.62 | -- | -- | 1 |
| 80 | 68.1 | 19.5 | 21.72 | -- | -- | 1 |
| 81 | 68.8 | -61.3 | 22.67 | -- | -- | 2 |
| 82 | 69.1 | -48.2 | 18.77 | -- | -- | 1 |
| 84 | 74.0 | 15.7 | 22.58 | -- | -- | 3 |
| 85 | 75.7 | -74.6 | 23.01 | -- | -- | 2 |
| 86 | 76.5 | 1.5 | 21.72 | -- | -- | 1 |
| 87 | 78.1 | 23.7 | 22.26 | -- | -- | 1 |
| 88 | 83.2 | 43.3 | 18.71 | -- | -- | 1 |


| ---- 1452+301 |  |  | $z=0.580$ |  |  |  |  | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 14 | 45225 | . 23 | Dec: +30 | 8 | 6.9 | RL=23 | . 51 |  |
| Obj | \#RA | \#Dec | R |  | G | G-R | Class |  |
| 1 | -74.2 | -77.3 | 15.03 |  | -- | -- | 3 |  |
| 2 | -70.3 | 72.4 | 23.29 |  | -- | -- | 3 |  |
| 4 | -67.3 | -1.2 | 22.89 |  | -- | -- | 2 |  |
| 5 | -66.1 | -27. 5 | 21.36 |  | -- | -- | 1 |  |
| 6 | -63.4 | -63.0 | 18.15 |  | -- | -- | 3 |  |
| 7 | -63.5 | -4.0 | 22.37 |  | -- | -- | 1 |  |
| 8 | -62.6 | -7.8 | 22.07 |  | -- | -- | 2 |  |
| 9 | -60.3 | 75.7 | 22.68 |  | -- | -- | 1 |  |
| 10 | -56.9 | 47.5 | 22.78 |  | -- | -- | 1 |  |
| 11 | -55.6 | 7.5 | 21.63 |  | -- | -- | 3 |  |
| 14 | -49.2 | 52.1 | 23.39 |  | -- | -- | 2 |  |
| 15 | -47.6 | 58.5 | 21.69 |  | -- | -- | 1 |  |
| 17 | -44.2 | -37.4 | 20.31 |  | -- | -- | 1 |  |
| 18 | -43.7 | 18.6 | 21.48 |  | -- | -- | 1 |  |
| 19 | -43.3 | 52.8 | 22.57 |  | -- | -- | 2 |  |
| 20 | -42.7 | -3.6 | 22.25 |  | -- | -- | 1 |  |
| 21 | -42.3 | 31.8 | 21.52 |  | -- | -- | 1 |  |
| 22 | -40.7 | -38.1 | 22.00 |  | -- | -- | 1 |  |
| 23 | -34.7 | -70.8 | 21.54 |  | -- | -- | 1 |  |
| 24 | -28.8 | -19.3 | 19.91 |  | -- | -- | 1 |  |
| 25 | -27.0 | 53.6 | 23.05 |  | -- | -- | 1 |  |
| 26 | -26.2 | 37.0 | 22.05 |  | -- | -- | 1 |  |
| 27 | -26.0 | -28.0 | 23.05 |  | -- | -- | 1 |  |
| 28 | -19.7 | 19.0 | 18.86 |  | -- | -- | 1 |  |
| 29 | -18.3 | 57.9 | 20.60 |  | -- | -- | 1 |  |
| 30 | -17.6 | 72.2 | 21.01 |  | -- | -- | 0 |  |
| 31 | -4.5 | 1.2 | 22.72 |  | -- | -- | 1 |  |
| 33 | -3.4 | 17.9 | 22.45 |  | -- | -- | 1 |  |
| 34 | -2.5 | -50.8 | 21.11 |  | -- | -- | 1 |  |
| 36 | -2.1 | 2.8 | 22.57 |  | -- | -- | 3 |  |
| 37 | -1.6 | 52.4 | 17.92 |  | -- | -- | 3 |  |
| 39 | -0.8 | 3.5 | 23.28 |  | -- | -- | 2 |  |
| 40 | 0.0 | 0.0 | 18.49 |  | -- | -- | 3 | QSo |


| 42 | 15.0 | -9.9 | 20.15 | -- | -- | 1 |
| ---: | ---: | ---: | ---: | :--- | :--- | :--- |
| 44 | 17.6 | 8.2 | 22.96 | -- | -- | 2 |
| 45 | 20.9 | -19.6 | 21.89 | -- | -- | 1 |
| 46 | 21.9 | -73.2 | 22.68 | -- | -- | 2 |
| 47 | 24.0 | 3.7 | 20.49 | -- | -- | 1 |
| 48 | 27.8 | -11.2 | 23.36 | -- | -- | 2 |
| 50 | 31.2 | -0.5 | 23.17 | -- | -- | 0 |
| 52 | 31.6 | 39.2 | 18.25 | -- | -- | 3 |
| 63 | 32.9 | -49.8 | 21.25 | -- | -- | 1 |
| 54 | 36.4 | 9.3 | 22.40 | -- | -- | 3 |
| 55 | 37.6 | 65.6 | 21.36 | -- | -- | 1 |
| 66 | 44.1 | 52.2 | 22.15 | -- | -- | 1 |
| 67 | 46.0 | -72.5 | 21.80 | -- | -- | 1 |
| 58 | 46.1 | -21.6 | 22.38 | -- | -- | 1 |
| 69 | 46.5 | -3.9 | 21.85 | -- | -- | 1 |
| 60 | 49.7 | 19.1 | 21.25 | -- | -- | 1 |
| 61 | 55.4 | 47.0 | 22.52 | -- | -- | 1 |
| 62 | 59.0 | 39.3 | 23.30 | -- | -- | 1 |
| 63 | 60.1 | 68.7 | 22.04 | -- | -- | 3 |
| 64 | 64.0 | 81.2 | 23.28 | -- | -- | 3 |
| 65 | 68.9 | 70.9 | 22.70 | -- | -- | 1 |
| 66 | 71.2 | -69.0 | 20.80 | -- | -- | 1 |
| 67 | 75.0 | 82.5 | 20.74 | -- | -- | 1 |
| 68 | 76.8 | 80.2 | 22.49 | -- | -- | 1 |
| 69 | 78.8 | 21.3 | 20.34 | -- | -- | 1 |
| 70 | 79.1 | -7.0 | 22.01 | -- | -- | 3 |
| 71 | 79.3 | 72.2 | 23.20 | -- | -- | 3 |
| 72 | 81.9 | 23.6 | 23.19 | -- | -- | 3 |
| 73 | 86.4 | -45.2 | 22.32 | -- | -- | 2 |
| 75 | 89.2 | -82.5 | 21.51 | -- | -- | 3 |
| 76 | 89.8 | -51.0 | 21.58 | -- | -- | 1 |
| 77 | 89.4 | 72.5 | 21.67 | -- | -- | 1 |
| 78 | 89.6 | 82.1 | 23.40 | -- | -- | 0 |
| 80 | 91.2 | -3.7 | 22.01 | -- | -- | 1 |
| 81 | 92.4 | -43.2 | 22.47 | -- | -- | 2 |
| 82 | 93.6 | 39.0 | 19.43 | -- | -- | 3 |
| 83 | 93.7 | -34.5 | 23.02 | -- | -- | 1 |
| 84 | 95.4 | -39.1 | 23.13 | -- | -- | 0 |
| 85 | 96.4 | 56.2 | 22.77 | -- | -- | 2 |
|  |  |  |  |  |  |  |



| -65.8 | -33.9 | 21.38 | - | - | 1 |
| ---: | ---: | ---: | :--- | :--- | :--- |
| -65.9 | -52.8 | 20.13 | -- | -- | 1 |
| -65.5 | 0.9 | 22.57 | -- | -- | 1 |
| -65.0 | -22.6 | 21.78 | - | -- | 3 |
| -64.0 | 62.4 | 23.56 | -- | -- | 0 |
| -63.5 | 32.2 | 22.31 | -- | -- | 1 |
| -63.0 | -60.8 | 23.20 | -- | - | 0 |
| -62.7 | 27.3 | 23.06 | -- | -- | 1 |
| -62.0 | 34.7 | 19.04 | -- | -- | 3 |
| -59.7 | -81.7 | 22.52 | -- | -- | 1 |
| -59.0 | -76.3 | 19.89 | -- | -- | 1 |
| -58.5 | -69.1 | 22.51 | -- | -- | 3 |
| -55.0 | -71.5 | 20.54 | -- | -- | 1 |
| -52.6 | -58.9 | 22.25 | - | -- | 1 |
| -61.4 | 73.9 | 23.59 | -- | -- | 0 |
| -46.7 | -21.9 | 21.08 | -- | -- | 1 |
| -46.7 | -78.1 | 20.99 | -- | -- | 1 |
| -45.4 | -75.0 | 21.59 | -- | -- | 3 |
| -43.9 | 13.1 | 23.32 | -- | -- | 2 |
| -42.9 | 38.8 | 22.45 | -- | -- | 0 |
| -42.9 | -17.8 | 22.45 | -- | -- | 1 |
| -42.0 | 56.0 | 21.62 | -- | -- | 1 |
| -35.0 | 54.9 | 23.49 | -- | -- | 3 |
| -31.7 | -17.9 | 22.29 | -- | -- | 3 |
| -31.8 | -74.1 | 16.18 | -- | -- | 3 |
| -30.2 | -85.6 | 19.65 | -- | -- | 3 |
| -29.1 | 28.8 | 23.20 | -- | -- | 1 |
| -25.9 | -46.2 | 21.49 | -- | -- | 3 |
| -24.5 | 62.8 | 22.21 | -- | -- | 2 |
| -22.4 | -39.1 | 20.43 | -- | -- | 1 |
| -20.5 | -86.3 | 20.11 | -- | -- | 3 |
| -20.3 | -66.7 | 22.62 | -- | -- | 1 |
| -18.5 | 78.3 | 23.15 | -- | -- | 2 |
| -18.7 | 57.3 | 23.13 | -- | -- | 0 |
| -17.8 | -25.8 | 22.15 | -- | -- | 1 |
| -16.6 | 22.6 | 21.73 | -- | -- | 2 |
| -13.9 | -81.8 | 22.77 | -- | -- | 2 |
| -12.8 | 17.3 | 22.96 | -- | -- | 3 |
| -12.1 | -57.0 | 21.54 | -- | -- | 3 |
| -9.2 | 28.4 | 22.97 | -- | -- | 1 |
| -8.9 | -44.5 | 18.85 | -- | -- | 1 |
| -8.5 | 52.1 | 21.12 | -- | -- | 3 |
| -6.7 | -32.4 | 21.20 | -- | -- | 1 |
| -5.7 | 60.5 | 20.42 | -- | -- | 3 |
| -3.2 | -45.8 | 23.44 | -- | -- | 3 |
| -2.4 | 34.7 | 22.80 | -- | -- | 2 |
| -1.7 | -16.8 | 23.35 | -- | -- | 1 |
| 0.0 | 0.0 | 18.42 | -- | -- | 1 |
| 0.6 | 11.7 | 21.35 | -- | -- | 1 |
| 0.6 | -63.9 | 22.79 | -- | -- | 2 |
| 3.3 | -55.7 | 23.69 | -- | -- | 2 |
|  |  |  |  |  |  |


| 62 | 4.3 | -44.2 | 20.96 | -- | -- | 1 |
| ---: | ---: | ---: | ---: | :--- | :--- | :--- |
| 63 | 4.8 | 76.9 | 17.52 | -- | -- | 3 |
| 64 | 6.2 | -57.4 | 22.54 | -- | -- | 3 |
| 65 | 7.2 | 36.3 | 22.77 | -- | -- | 3 |
| 66 | 8.0 | 34.0 | 22.85 | -- | -- | 1 |
| 67 | 10.0 | 79.8 | 21.87 | -- | -- | 0 |
| 68 | 10.6 | 3.3 | 19.94 | -- | -- | 3 |
| 69 | 12.8 | -2.5 | 22.50 | -- | -- | 3 |
| 70 | 13.3 | 27.7 | 23.47 | -- | -- | 3 |
| 71 | 14.8 | 54.7 | 21.66 | -- | -- | 3 |
| 72 | 15.1 | -25.3 | 22.14 | -- | -- | 1 |
| 73 | 15.5 | 35.3 | 19.82 | -- | -- | 3 |
| 74 | 18.0 | -78.3 | 17.16 | -- | -- | 3 |
| 75 | 19.4 | -86.9 | 21.11 | -- | -- | 1 |
| 76 | 20.4 | -11.7 | 22.70 | -- | -- | 3 |
| 77 | 21.3 | -37.9 | 20.00 | -- | -- | 3 |
| 78 | 23.0 | 57.8 | 23.21 | -- | -- | 1 |
| 79 | 24.1 | -83.5 | 22.14 | -- | -- | 1 |
| 80 | 25.0 | 56.3 | 21.83 | -- | -- | 3 |
| 81 | 25.1 | -29.9 | 21.47 | -- | -- | 1 |
| 82 | 26.3 | 25.4 | 22.06 | -- | -- | 1 |
| 83 | 27.2 | -38.7 | 22.31 | -- | -- | 2 |
| 84 | 35.1 | -84.4 | 20.80 | -- | -- | 3 |
| 85 | 36.2 | 12.8 | 21.14 | -- | -- | 1 |
| 86 | 37.8 | -57.0 | 22.85 | -- | -- | 1 |
| 87 | 40.2 | 78.7 | 20.19 | -- | -- | 1 |
| 88 | 39.8 | -14.9 | 22.68 | -- | -- | 2 |
| 89 | 40.4 | -74.1 | 21.35 | -- | -- | 1 |
| 90 | 42.1 | -26.3 | 22.28 | -- | -- | 1 |
| 91 | 44.4 | 38.1 | 21.96 | -- | -- | 1 |
| 92 | 44.4 | -43.1 | 23.58 | -- | -- | 2 |
| 93 | 47.8 | 17.9 | 21.57 | -- | -- | 3 |
| 94 | 49.5 | -30.9 | 21.03 | -- | -- | 1 |
| 95 | 49.8 | -82.9 | 23.76 | -- | -- | 3 |
| 96 | 51.6 | 56.6 | 20.96 | -- | -- | 1 |
| 97 | 51.8 | 5.2 | 22.38 | -- | -- | 1 |
| 98 | 51.6 | -45.3 | 22.31 | -- | -- | 2 |
| 99 | 55.5 | -42.2 | 22.91 | -- | -- | 2 |
| 100 | 56.2 | -75.8 | 23.56 | -- | -- | 0 |
| 101 | 58.1 | -76.2 | 23.03 | -- | -- | 3 |
| 102 | 58.5 | 76.3 | 22.23 | -- | -- | 2 |
| 103 | 64.6 | -16.0 | 21.53 | -- | -- | 2 |
| 104 | 66.1 | -67.8 | 16.33 | -- | -- | 3 |
| 105 | 70.1 | 62.0 | 22.64 | -- | -- | 1 |
| 106 | 70.0 | -49.3 | 21.40 | -- | -- | 1 |
| 107 | 72.3 | -32.1 | 22.97 | -- | -- | 3 |
| 108 | 79.5 | -45.3 | 20.49 | -- | -- | 1 |
|  |  |  |  |  |  |  |


| RA: 1 | 53346 | . 20 | Dec:+ 1 | 3513.0 | $\mathrm{RL}=23$. | . $81 \mathrm{GL}=23.82$ |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Obj | \#RA | \#Dec | R | G | G-R | Class | Comments |
| 1 | -85.5 | 49.0 | 19.77 | 19.92 | 0.15 | 1 |  |
| 2 | -83.6 | 62.8 | 23.27 | -- | -- | 2 |  |
| 3 | -83.3 | -6.9 | 22.58 | 23.53 | 0.95 | 3 |  |
| 4 | -80.8 | -8.5 | 21.28 | 22.17 | 0.88 | 1 |  |
| 5 | -80.9 | -40.9 | 21.93 | 21.60 | -0.33 | 1 |  |
| 6 | -79.0 | -60.1 | 19.22 | 19.21 | -0.01 | 3 |  |
| 7 | -75.7 | 17.3 | 23.27 | -- | -- | 1 |  |
| 8 | -72.6 | 65.6 | 23.28 | -- | -- | 2 |  |
| 9 | -70.2 | 4.4 | 20.73 | 22.28 | 1.54 | 1 |  |
| 10 | -68.3 | 2.6 | 16.79 | 17.46 | 0.67 | 3 |  |
| 11 | -64.3 | 59.1 | 23.39 | -- | -- | 3 |  |
| 12 | -63.1 | -15.3 | 23.09 | -- | -- | 1 |  |
| 14 | -57.0 | 51.3 | 19.81 | 20.35 | 0.54 | 1 |  |
| 16 | -52.5 | 76.0 | 23.07 | -- | -- | 2 |  |
| 17 | -49.1 | -19.0 | 22.90 | -- | -- | 1 |  |
| 18 | -47.0 | -34.6 | 22.42 | -- | -- | 3 |  |
| 19 | -45.9 | 74.8 | 22.88 | 23.21 | 0.33 | 3 |  |
| 20 | -45.8 | 41.5 | 23.32 | -- | -- | 3 |  |
| 21 | -45.8 | -60.2 | 21.35 | 22.08 | 0.73 | 1 |  |
| 22 | -45.2 | -63.7 | 21.54 | 21.99 | 0.45 | 1 |  |
| 23 | -45.4 | -65.6 | 23.38 | 23.67 | 0.29 | 2 |  |
| 25 | -43.3 | 48.4 | 22.07 | 22.88 | 0.81 | 1 |  |
| 26 | -43.3 | 3.2 | 22.87 | 23.22 | 0.36 | 1 |  |
| 27 | -39.8 | 30.1 | 23.38 | -- | -- | 1 |  |
| 28 | -38.7 | 82.9 | 23.47 | -- | -- | 1 |  |
| 29 | -37.8 | -45.4 | 23.68 | -- | -- | 3 |  |
| 30 | -37.4 | 10.1 | 18.51 | 19.28 | 0.77 | 1 |  |
| 31 | -30.1 | -5.4 | 21.38 | 21.94 | 0.55 | 1 |  |
| 32 | -28.0 | 35.7 | 22.96 | 23.27 | 0.32 | 1 |  |
| 33 | -25.2 | -17.8 | 20.51 | 21.97 | 1.47 | 1 |  |
| 34 | -24.4 | 74.3 | 19.53 | 20.21 | 0.68 | 3 |  |
| 35 | -22.8 | 0.2 | 22.69 | -- | -- | 1 |  |
| 36 | -20.5 | 41.3 | 23.03 | -- | -- | 3 |  |
| 37 | -20.7 | 30.7 | 22.69 | 22.85 | 0.25 | 3 |  |
| 38 | -18.4 | -26.7 | 22.63 | -- | -- | 3 |  |
| 39 | -15.5 | 48.1 | 20.61 | 21.59 | 0.98 | 1 |  |
| 40 | -13.3 | 21.2 | 21.66 | 22.84 | 1.27 | 3 |  |
| 41 | -12.4 | 80.7 | 20.05 | 21.25 | 1.19 | 3 |  |
| 42 | -11.6 | -52.4 | 17.00 | 17.35 | 0.35 | 3 |  |
| 43 | -8.4 | -29.4 | 23.41 | -- | -- | 0 |  |
| 44 | -8.1 | -77.3 | 23.34 | -- | -- | 3 |  |
| 45 | -6.7 | 25.2 | 22.63 | 22.97 | 0.34 | 1 |  |
| 46 | -5.4 | -9.7 | 20.65 | 22.02 | 1.38 | 1 |  |
| 47 | -1.1 | 49.5 | 21.12 | 21.39 | 0.27 | 1 |  |
| 48 | 0.0 | 0.0 | 19.57 | 19.65 | 0.08 | 3 | QSo |
| 49 | 0.9 | 82.1 | 23.35 | -- | -- | 3 |  |
| 50 | 1.7 | 76.6 | 19.54 | 20.72 | 1.18 | 3 |  |
| 51 | 1.1 | 11.4 | 16.88 | 17.11 | 0.22 | 3 |  |
| 52 | 2.3 | 39.0 | 23.26 | -- | -- | 0 |  |


| 63 | 2.7 | 62.6 | 23.24 | 23.54 | 0.29 | 1 |
| ---: | ---: | ---: | :--- | :---: | :---: | :---: |
| 54 | 2.5 | 34.1 | 21.67 | 22.15 | 0.48 | 1 |
| 55 | 3.2 | 23.3 | 22.36 | -- | -- | 3 |
| 56 | 4.8 | 87.6 | 22.35 | 23.38 | 1.03 | 1 |
| 67 | 6.5 | -56.3 | 22.84 | 23.44 | 0.59 | 1 |
| 58 | 7.0 | 89.3 | 23.44 | -- | -- | 1 |
| 59 | 6.7 | -35.8 | 20.24 | 21.06 | 0.82 | 3 |
| 60 | 7.4 | -18.2 | 23.39 | -- | -- | 1 |
| 61 | 8.3 | 17.2 | 19.07 | 19.18 | 0.11 | 3 |
| 62 | 10.2 | -10.5 | 23.72 | -- | -- | 1 |
| 64 | 11.2 | -0.2 | 23.23 | -- | -- | 1 |
| 65 | 14.7 | -56.9 | 23.17 | -- | -- | 1 |
| 66 | 15.6 | -63.7 | 22.75 | 23.12 | 0.38 | 3 |
| 68 | 17.0 | -22.1 | 21.70 | 23.16 | 1.47 | 1 |
| 69 | 18.1 | 80.6 | 20.79 | 21.88 | 1.09 | 3 |
| 70 | 19.8 | 45.5 | 23.54 | -- | -- | 2 |
| 71 | 20.7 | -13.8 | 23.05 | -- | -- | 3 |
| 72 | 20.4 | -27.5 | 16.24 | 16.31 | 0.07 | 3 |
| 73 | 24.2 | -26.4 | 20.56 | 21.37 | 0.81 | 1 |
| 75 | 25.3 | 69.2 | 22.39 | 22.94 | 0.55 | 1 |
| 76 | 28.0 | -8.4 | 21.11 | 22.49 | 1.38 | 3 |
| 77 | 30.5 | 85.1 | 23.61 | -- | -- | 2 |
| 79 | 35.0 | -24.6 | 22.13 | 23.46 | 1.34 | 2 |
| 80 | 35.2 | -33.5 | 23.65 | -- | -- | 2 |
| 81 | 39.0 | 19.8 | 23.60 | -- | -- | 3 |
| 82 | 40.3 | 16.2 | 20.70 | 20.77 | 0.08 | 3 |
| 83 | 42.2 | -26.0 | 23.44 | -- | -- | 1 |
| 84 | 43.1 | 67.4 | 22.29 | 23.42 | 1.13 | 1 |
| 85 | 43.4 | -16.9 | 15.95 | 16.41 | 0.46 | 3 |
| 87 | 46.8 | 82.2 | 22.94 | 23.39 | 0.45 | 2 |
| 88 | 48.4 | -43.9 | 21.12 | 21.10 | -0.03 | 1 |
| 90 | 50.1 | -39.6 | 19.20 | 20.02 | 0.82 | 3 |
| 91 | 51.8 | -13.3 | 22.99 | -- | -- | 3 |
| 92 | 55.2 | 31.6 | 23.78 | -- | -- | 3 |
| 94 | 58.2 | 17.3 | 21.87 | 21.67 | -0.20 | 3 |
| 95 | 58.4 | -18.6 | 23.25 | 23.60 | 0.36 | 3 |
| 96 | 58.3 | -42.2 | 22.68 | 22.25 | -0.44 | 1 |
| 98 | 64.8 | 54.0 | 22.71 | -- | -- | 3 |
| 99 | 71.2 | 38.4 | 22.91 | -- | -- | 3 |
|  |  |  |  |  |  |  |


| ---- 1546+027 |  |  | $z=0.413$ |  |  |  | $\mathrm{GL}=23.84$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 15 | 465 | . 31 | Dec:+ 2 | 6.4 | RL=23 |  |  |
| Obj | \#RA | \#Dec | R | G | G-R | Class | Comments |
| 1 | -76.3 | 39.6 | 22.94 | 22.66 | -0.27 | 3 |  |
| 2 | -76.0 | -32.2 | 22.46 | 23.81 | 1.35 | 3 |  |
| 3 | -67.3 | 51.6 | 20.83 | 21.61 | 0.78 | 3 |  |
| 4 | -56.8 | 5.1 | 20.37 | 21.83 | 1.47 | 2 |  |
| 5 | -55.3 | -62.5 | 22.25 | 23.11 | 0.86 | 3 |  |


| 6 | -53.9 | 73.8 | 21.48 | 22.75 | 1.27 | 3 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 7 | -53.2 | -16.9 | 16.24 | 16.31 | 0.06 | 3 |  |
| 8 | -49.6 | -55.4 | 16.58 | 17.11 | 0.53 | 3 |  |
| 9 | -44.8 | -26.0 | 23.18 | -- | -- | 2 |  |
| 10 | -44.7 | -10.7 | 18.91 | 19.00 | 0.09 | 3 |  |
| 11 | -41.8 | -51.3 | 20.06 | 21.20 | 1.15 | 3 |  |
| 12 | -38.3 | 46.2 | 18.96 | 19.77 | 0.81 | 1 |  |
| 13 | -35.8 | 28.2 | 21.37 | 21.57 | 0.21 | 3 |  |
| 14 | -34.5 | -5.1 | 17.54 | 17.76 | 0.21 | 3 |  |
| 15 | -32.4 | -84.3 | 21.64 | 21.28 | -0.36 | 3 |  |
| 16 | -27.2 | 53.8 | 20.48 | 21.38 | 0.90 | 1 |  |
| 17 | -21.4 | 45.0 | 22.21 | 22.70 | 0.49 | 1 |  |
| 18 | -20.8 | -72.3 | 19.45 | 19.45 | 0.00 | 3 |  |
| 19 | -17.4 | 33.1 | 20.89 | 22.50 | 1.61 | 1 |  |
| 20 | -13.9 | -77.2 | 20.21 | 21.11 | 0.90 | 1 |  |
| 21 | -12.2 | 25.6 | 20.78 | 22.32 | 1.55 | 1 |  |
| 22 | -10.1 | -22.6 | 20.55 | 22.04 | 1.50 | 1 |  |
| 23 | -9.0 | 2.2 | 22.27 | 22.91 | 0.64 | 3 |  |
| 24 | -7.8 | -85.4 | 18.98 | 20.13 | 1.15 | 3 |  |
| 25 | -3.2 | -18.6 | 22.44 | 23.29 | 0.85 | 2 |  |
| 26 | -2.4 | -45.0 | 21.09 | 22.17 | 1.08 | 1 |  |
| 27 | -0.9 | -26.5 | 23.04 | 23.54 | 0.50 | 3 |  |
| 28 | 0.0 | 0.0 | 18.27 | 18.16 | -0.11 | 3 | QSO |
| 29 | 5.5 | 25.1 | 23.01 | 23.34 | 0.33 | 2 |  |
| 30 | 6.2 | 46.7 | 22.26 | 22.75 | 0.49 | 1 |  |
| 31 | 7.8 | -18.0 | 22.78 | -- | -- | 1 |  |
| 33 | 11.2 | -53.2 | 21.75 | 21.93 | 0.18 | 1 |  |
| 34 | 13.7 | -85.5 | 20.63 | 21.10 | 0.47 | 3 |  |
| 35 | 13.9 | 0.9 | 22.88 | 23.69 | 0.82 | 3 |  |
| 36 | 15.7 | -33.5 | 20.70 | 21.47 | 0.77 | 1 |  |
| 37 | 27.3 | 16.3 | 20.28 | 21.70 | 1.42 | 1 |  |
| 38 | 28.8 | -0.7 | 20.81 | 20.80 | -0.01 | 1 |  |
| 39 | 32.8 | -43.5 | 19.33 | 19.27 | -0.06 | 3 |  |
| 40 | 34.5 | -70.8 | 21.61 | 21.94 | 0.33 | 1 |  |
| 41 | 34.7 | -53.2 | 22.41 | 21.79 | -0.62 | 1 |  |
| 42 | 36.8 | -40.3 | 21.18 | 21.74 | 0.56 | 1 |  |
| 43 | 38.1 | -41.7 | 22.89 | 23.49 | 0.60 | 2 |  |
| 44 | 38.5 | 36.5 | -- | 23.27 | -- | 3 |  |
| 45 | 46.3 | -3.8 | 20.95 | 22.07 | 1.12 | 1 |  |
| 46 | 47.8 | 75.8 | 21.76 | 22.29 | 0.52 | 3 |  |
| 47 | 52.6 | -65.7 | 21.83 | 23.61 | 1.78 | 1 |  |
| 48 | 63.3 | -59.9 | 20.47 | 21.25 | 0.78 | 3 |  |
| 49 | 63.3 | -82.1 | 22.65 | 23.06 | 0.41 | 1 |  |
| 50 | 70.7 | -58.9 | 22.34 | 23.10 | 0.76 | 1 |  |
| 51 | 73.9 | -14.8 | 15.18 | 15.38 | 0.20 | 3 |  |
| 52 | 76.6 | 32.4 | 20.00 | 20.63 | 0.63 | 3 |  |
| 53 | 82.5 | -37.1 | 21.83 | 22.22 | 0.39 | 1 |  |
| 54 | 89.7 | 62.5 | 16.93 | 16.97 | 0.04 | 3 |  |



| 50 | 80.5 | 46.5 | 22.91 | -- | -- | 0 |
| ---: | ---: | ---: | ---: | :--- | :--- | :--- |
| 51 | 84.5 | 67.5 | 18.39 | -- | -- | 1 |
| 52 | 85.2 | 35.9 | 17.99 | -- | -- | 3 |
| 53 | 85.9 | -39.4 | 22.76 | -- | -- | 3 |
| 54 | 90.4 | -16.6 | 21.77 | -- | -- | 1 |
| 55 | 92.8 | -65.5 | 19.63 | -- | -- | 2 |
| 56 | 97.2 | 71.0 | 21.92 | -- | -- | 0 |
| 57 | 100.2 | -37.2 | 22.05 | -- | -- | 3 |


| ---- 1604+158 |  |  | $z=0.357$ |  |  |  |  | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 16 | 453 | . 63 | Dec:+15 | 52 | 7.3 | RL=23 | . 80 |  |
| Obj | \#RA | \#Dec | R |  | G | G-R | Class |  |
| 1 | -65.6 | 64.4 | 22.07 |  | -- | -- | 1 |  |
| 2 | -62.8 | -57.5 | 22.07 |  | -- | -- | 3 |  |
| 3 | -60.7 | 3.4 | 23.80 |  | -- | -- | 3 |  |
| 4 | -57.0 | -32.9 | 19.07 |  | -- | -- | 3 |  |
| 5 | -56.5 | 39.5 | 23.28 |  | -- | -- | 3 |  |
| 6 | -56.0 | 31.0 | 23.27 |  | -- | -- | 2 |  |
| 7 | -51.3 | -48.8 | 18.94 |  | -- | -- | 3 |  |
| 8 | -51.3 | -1.9 | 23.24 |  | -- | -- | 2 |  |
| 9 | -49.2 | 72.5 | 22.92 |  | -- | -- | 1 |  |
| 10 | -47.1 | -48.6 | 22.94 |  | -- | -- | 1 |  |
| 11 | -46.7 | 36.2 | 21.10 |  | -- | -- | 1 |  |
| 12 | -46.4 | 39.0 | 18.00 |  | -- | -- | 3 |  |
| 13 | -43.1 | -55.3 | 22.81 |  | -- | -- | 1 |  |
| 14 | -41.7 | 48.4 | 19.29 |  | -- | -- | 3 |  |
| 15 | -41.5 | 12.0 | 23.25 |  | -- | -- | 2 |  |
| 16 | -36.3 | -22.7 | 21.74 |  | -- | -- | 3 |  |
| 17 | -32.6 | 69.5 | 20.87 |  | -- | -- | 1 |  |
| 18 | -29.3 | 37.2 | 19.99 |  | -- | -- | 1 |  |
| 19 | -28.2 | 69.0 | 22.65 |  | -- | -- | 0 |  |
| 20 | -27.7 | 28.1 | 23.21 |  | -- | -- | 3 |  |
| 22 | -23.6 | 66.2 | 22.39 |  | -- | -- | 1 |  |
| 23 | -17.8 | -37.7 | 21.59 |  | -- | -- | 2 |  |
| 24 | -13.4 | -9.0 | 22.29 |  | -- | -- | 1 |  |
| 25 | -8.2 | 47.2 | 22.27 |  | -- | -- | 1 |  |
| 26 | -7.3 | 23.9 | 23.14 |  | -- | -- | 3 |  |
| 27 | -5.7 | -57.8 | 23.00 |  | -- | -- | 1 |  |
| 28 | -4.1 | -79.5 | 22.51 |  | -- | -- | 3 |  |
| 29 | -4.2 | 13.8 | 20.57 |  | -- | -- | 1 |  |
| 30 | -2.9 | 11.4 | 16.78 |  | -- | -- | 3 |  |
| 31 | -2.1 | 26.5 | 21.47 |  | -- | -- | 1 |  |
| 32 | -0.3 | -2.9 | 20.45 |  | -- | -- | 1 |  |
| 33 | 0.0 | 0.0 | 18.90 |  | -- | -- | 3 | QSO |
| 34 | 1.6 | 11.3 | 22.12 |  | -- | -- | 1 |  |
| 35 | 3.0 | -40.9 | 21.05 |  | -- | -- | 3 |  |
| 36 | 7.0 | 17.1 | 22.19 |  | -- | -- | 1 |  |
| 37 | 10.6 | 71.5 | 22.55 |  | -- | -- | 3 |  |


| 38 | 15.2 | -72.9 | 20.79 | -- | -- | 1 |
| :--- | ---: | ---: | ---: | :--- | :--- | :--- |
| 39 | 16.5 | -34.2 | 21.45 | -- | -- | 1 |
| 40 | 18.9 | 44.0 | 22.00 | -- | -- | 1 |
| 41 | 19.9 | -77.3 | 23.03 | -- | -- | 1 |
| 42 | 20.3 | 22.8 | 21.93 | -- | -- | 1 |
| 43 | 21.0 | 1.2 | 22.33 | -- | -- | 3 |
| 44 | 21.6 | 35.2 | 20.63 | -- | -- | 1 |
| 45 | 22.6 | 27.8 | 22.26 | -- | -- | 1 |
| 46 | 24.0 | 50.8 | 20.12 | -- | -- | 1 |
| 47 | 24.0 | 39.6 | 21.79 | -- | -- | 1 |
| 48 | 24.1 | 32.4 | 16.55 | -- | -- | 3 |
| 49 | 23.5 | -38.0 | 23.02 | -- | -- | 2 |
| 50 | 24.3 | -41.2 | 22.35 | -- | -- | 1 |
| 51 | 25.4 | -62.7 | 23.01 | -- | -- | 1 |
| 52 | 25.9 | -5.4 | 23.26 | -- | -- | 3 |
| 53 | 29.8 | -59.7 | 20.75 | -- | -- | 1 |
| 54 | 31.7 | -37.1 | 17.66 | -- | -- | 3 |
| 55 | 33.0 | -2.3 | 22.27 | -- | -- | 2 |
| 56 | 33.0 | -53.1 | 22.63 | -- | -- | 0 |
| 57 | 33.3 | -74.3 | 22.57 | -- | -- | 3 |
| 58 | 34.8 | 55.4 | 21.15 | -- | -- | 1 |
| 59 | 34.9 | -11.4 | 23.55 | -- | -- | 2 |
| 60 | 35.8 | -53.9 | 22.19 | -- | -- | 3 |
| 61 | 38.3 | -18.9 | 22.51 | -- | -- | 1 |
| 62 | 42.4 | 53.9 | 22.80 | -- | -- | 1 |
| 63 | 42.4 | 10.7 | 22.34 | -- | -- | 1 |
| 64 | 43.0 | -4.7 | 22.03 | -- | -- | 1 |
| 65 | 43.5 | 2.6 | 21.64 | -- | -- | 2 |
| 66 | 44.4 | -75.6 | 20.15 | -- | -- | 3 |
| 67 | 45.8 | 65.5 | 20.68 | -- | -- | 1 |
| 68 | 46.2 | -2.8 | 21.30 | -- | -- | 1 |
| 69 | 48.7 | -61.0 | 15.49 | -- | -- | 3 |
| 70 | 53.1 | 8.1 | 21.74 | -- | -- | 2 |
| 71 | 53.2 | 49.8 | 23.58 | -- | -- | 2 |
| 72 | 55.3 | -0.9 | 22.99 | -- | -- | 3 |
| 73 | 55.4 | -67.4 | 22.34 | -- | -- | 2 |
| 74 | 56.0 | 36.4 | 21.90 | -- | -- | 1 |
| 75 | 57.3 | -12.4 | 21.71 | -- | -- | 1 |
| 76 | 64.5 | 53.9 | 22.11 | -- | -- | 1 |
| 77 | 65.9 | -41.0 | 23.10 | -- | -- | 3 |
| 78 | 66.7 | 20.4 | 17.33 | -- | -- | 3 |
| 79 | 66.8 | -82.2 | 22.09 | -- | -- | 2 |
| 80 | 67.3 | -79.2 | 23.00 | -- | -- | 2 |
| 81 | 70.7 | -21.6 | 18.92 | -- | -- | 1 |
| 82 | 72.3 | -40.3 | 21.16 | -- | -- | 1 |
| 83 | 73.1 | 52.3 | 23.24 | -- | -- | 0 |
| 84 | 73.3 | 40.2 | 14.99 | -- | -- | 3 |
| 85 | 75.6 | -21.0 | 22.73 | -- | -- | 1 |
| 87 | 76.5 | 57.1 | 19.90 | -- | -- | 3 |
| 88 | 80.5 | 52.2 | 22.31 | -- | -- | 3 |
|  | 81.1 | 68.9 | 22.35 | -- | -- | 1 |
| 4 |  |  |  |  |  |  |


| 89 | 81.9 | 12.3 | 23.17 | -- | -- | 3 |
| ---: | ---: | ---: | ---: | :--- | :--- | :--- |
| 90 | 81.9 | -13.9 | 23.05 | -- | -- | 2 |
| 91 | 82.8 | 46.3 | 22.45 | -- | -- | 1 |
| 92 | 84.6 | 4.1 | 22.80 | -- | -- | 1 |
| 93 | 85.0 | -60.5 | 21.57 | -- | -- | 3 |
| 94 | 86.4 | 33.9 | 23.63 | -- | -- | 3 |
| 95 | 87.8 | -7.7 | 23.79 | -- | -- | 3 |
| 96 | 88.5 | 73.9 | 22.27 | -- | -- | 1 |
| 97 | 91.1 | -20.1 | 22.65 | -- | -- | 1 |
| 98 | 90.7 | -22.4 | 23.18 | -- | -- | 1 |
| 99 | 92.8 | -61.9 | 23.44 | -- | -- | 0 |
| 100 | 94.4 | -52.0 | 23.43 | -- | -- | 2 |
| 101 | 96.2 | 70.4 | 21.92 | -- | -- | 1 |
| 102 | 95.6 | 20.1 | 20.94 | -- | -- | 1 |
| 103 | 96.9 | -53.3 | 23.16 | -- | -- | 1 |
| 104 | 99.1 | -4.4 | 21.56 | -- | -- | 1 |
| 105 | 99.6 | -14.2 | 15.20 | -- | -- | 3 |


| ---- 1 | $1607+29$ |  |  | $z=0$ |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 16 | 7 724 | 4.90 | Dec:+29 | 324.0 | $\mathrm{RL}=23$. | 82 G | 24.03 |
| 0 bj | \#RA | \# Dec | R | G | G-R | Class | Comments |
| 1 | 125.9 | 5.5 | 23.22 | 23.90 | 0.69 | 3 |  |
| 2 | 121.1 | -82.8 | 22.31 | 22.66 | 0.35 | 1 |  |
| 3 | 121.1 | 109.9 | 16.05 | 15.37 | -0.69 | 3 |  |
| 4 | 120.5 | -42.0 | 18.94 | 19.45 | 0.51 | 3 |  |
| 5 | 120.3 | -99.2 | 21.27 | 21.73 | 0.46 | 1 |  |
| 7 | 113.3 | -80.8 | 20.92 | 20.93 | 0.01 | 3 |  |
| 8 | 113.2 | 115.2 | 21.78 | 21.98 | 0.21 | 1 |  |
| 9 | 111.2 | -19.1 | 19.82 | 20.27 | 0.45 | 3 |  |
| 10 | 110.4 | 114.8 | 22.62 | 23.03 | 0.41 | 2 |  |
| 11 | 109.7 | 0.4 | 23.69 | 23.51 | -0.18 | 3 |  |
| 12 | 107.6 | 110.1 | 20.40 | 21.19 | 0.79 | 1 |  |
| 13 | 106.6 | -57.4 | 21.62 | 23.09 | 1.47 | 1 |  |
| 14 | 107.2 | -59.8 | 23.43 | -- | -- | 1 |  |
| 15 | 106.4 | 36.5 | 15.34 | 15.30 | -0.05 | 4 |  |
| 16 | 105.6 | 111.8 | 20.84 | 22.00 | 1.17 | 3 |  |
| 17 | 105.0 | 39.5 | 16.96 | 17.07 | 0.11 | 3 |  |
| 18 | 104.9 | 10.1 | 20.56 | 20.87 | 0.30 | 1 |  |
| 19 | 100.6 | 17.9 | 23.27 | 23.57 | 0.30 | 2 |  |
| 20 | 100.1 | -38.0 | 23.62 | -- | -- | 0 |  |
| 21 | -99.9 | -60.0 | 20.03 | 21.39 | 1.36 | 1 |  |
| 22 | -99.1 | -22.2 | 2 -- | 23.71 | -- | 3 |  |
| 23 | -97.9 | 13.6 | 22.25 | 22.86 | 0.61 | 3 |  |
| 24 | -95.1 | 113.1 | 22.01 | 23.35 | 1.34 | 1 |  |
| 25 | -94.3 | -29.2 | 21.71 | 22.06 | 0.36 | 1 |  |
| 26 | -94.2 | -65.5 | 20.99 | 22.42 | 1.43 | 1 |  |
| 27 | -92.1 | -28.6 | 23.41 | -- | -- | 2 |  |
| 28 | -91.2 | -76.9 | 23.00 | 23.08 | 0.07 | 2 |  |


| 29 | -91.1 | -25.6 | -- | 23.92 | -- | 1 |
| ---: | ---: | ---: | :--- | :---: | :---: | :---: |
| 30 | -90.0 | -31.4 | 20.88 | 22.01 | 1.14 | 3 |
| 32 | -87.9 | -72.3 | 23.39 | -- | -- | 3 |
| 33 | -87.4 | -97.7 | 22.28 | 23.69 | 1.41 | 3 |
| 34 | -85.7 | 42.2 | 21.19 | 22.20 | 1.02 | 1 |
| 35 | -78.9 | 13.5 | 22.99 | 23.23 | 0.24 | 1 |
| 36 | -79.5 | -54.2 | 21.38 | 22.27 | 0.89 | 1 |
| 37 | -78.8 | 108.3 | 20.56 | 20.91 | 0.34 | 1 |
| 38 | -77.4 | -6.1 | 23.43 | 23.88 | 0.45 | 1 |
| 39 | -77.4 | -56.6 | 22.69 | 23.61 | 0.92 | 1 |
| 40 | -76.1 | 10.6 | 20.51 | 20.86 | 0.34 | 1 |
| 41 | -75.2 | -66.1 | 21.21 | 22.49 | 1.28 | 1 |
| 42 | -73.7 | -66.6 | 21.24 | 21.56 | 0.31 | 1 |
| 43 | -73.1 | -1.9 | 22.85 | 23.34 | 0.49 | 3 |
| 45 | -69.9 | 39.2 | 22.74 | 22.83 | 0.09 | 3 |
| 46 | -70.2 | -66.1 | 23.12 | 23.53 | 0.41 | 3 |
| 47 | -67.8 | 21.1 | 22.67 | -- | -- | 3 |
| 48 | -66.4 | -79.0 | 20.70 | 21.27 | 0.57 | 1 |
| 49 | -65.3 | -61.1 | 22.62 | -- | -- | 3 |
| 50 | -61.8 | -6.7 | 22.71 | 23.28 | 0.57 | 2 |
| 51 | -60.8 | 104.4 | 22.57 | 23.45 | 0.88 | 3 |
| 52 | -57.8 | -8.7 | 19.61 | 20.25 | 0.63 | 0 |
| 53 | -56.8 | 5.8 | 21.08 | 21.82 | 0.74 | 1 |
| 54 | -56.9 | -8.5 | 19.49 | 20.32 | 0.83 | 1 |
| 55 | -52.6 | -96.0 | 22.90 | -- | -- | 1 |
| 56 | -46.5 | -76.1 | 23.68 | -- | -- | 2 |
| 57 | -44.6 | -44.0 | 22.55 | 23.40 | 0.85 | 2 |
| 58 | -42.1 | -80.2 | 22.57 | 23.92 | 1.36 | 1 |
| 59 | -38.1 | -16.5 | 23.64 | -- | -- | 3 |
| 60 | -35.9 | -76.1 | 20.13 | 20.90 | 0.77 | 1 |
| 61 | -34.8 | -12.9 | 23.78 | -- | -- | 1 |
| 62 | -34.1 | -42.1 | 20.20 | 20.24 | 0.05 | 1 |
| 63 | -33.2 | -93.3 | 22.89 | 23.04 | 0.15 | 1 |
| 64 | -30.9 | -31.4 | 21.90 | 22.11 | 0.21 | 2 |
| 65 | -31.0 | -61.9 | 23.06 | -- | -- | 1 |
| 66 | -31.6 | -99.0 | 23.53 | 23.98 | 0.45 | 3 |
| 67 | -30.5 | -0.4 | 22.50 | 23.72 | 1.22 | 1 |
| 69 | -26.1 | 2.2 | 22.71 | 23.35 | 0.63 | 1 |
| 70 | -21.7 | -43.7 | 23.81 | -- | -- | 1 |
| 71 | -21.1 | 101.7 | 23.18 | -- | -- | 2 |
| 72 | -20.9 | -97.8 | 22.08 | -- | -- | 1 |
| 73 | -20.6 | -83.0 | 18.71 | 18.96 | 0.25 | 1 |
| 74 | -19.5 | 108.0 | 22.45 | 23.67 | 1.21 | 1 |
| 75 | -15.8 | -30.7 | 21.07 | 22.00 | 0.93 | 3 |
| 76 | -15.0 | -60.4 | 22.60 | 23.62 | 1.03 | 1 |
| 77 | -14.5 | -56.0 | 22.69 | 23.78 | 1.09 | 3 |
| 78 | -12.4 | -58.7 | 22.31 | 23.47 | 1.16 | 3 |
| 79 | -11.6 | -20.7 | 22.56 | 24.00 | 1.44 | 1 |
| 80 | -9.8 | -57.3 | 22.18 | 23.56 | 1.38 | 1 |
| 81 | -10.1 | -63.3 | 23.60 | -- | -- | 2 |
| 82 | -8.8 | -76.6 | 23.56 | -- | -- | 0 |
|  |  |  |  |  |  |  |


| 83 | -7.5 | 28.8 | 23.29 | 22.96 | -0.33 | 2 |
| ---: | ---: | ---: | :--- | :---: | :---: | :---: |
| 84 | -6.6 | -52.0 | 22.01 | -- | -- | 1 |
| 85 | -6.4 | -87.6 | 21.75 | 22.40 | 0.65 | 1 |
| 86 | -5.9 | -90.8 | 20.34 | 20.62 | 0.28 | 1 |
| 87 | -5.4 | -65.9 | 21.63 | 22.35 | 0.73 | 1 |
| 88 | -4.7 | -64.2 | 22.71 | 23.44 | 0.74 | 1 |
| 89 | -2.4 | -65.2 | 22.53 | 23.18 | 0.64 | 1 |
| 90 | 0.0 | 0.0 | 18.91 | 19.32 | 0.41 | 3 |
| 91 | 2.5 | -98.8 | 23.58 | -- | -- | 2 |
| 92 | 5.0 | -24.0 | 17.33 | 18.40 | 1.07 | 3 |
| 93 | 4.5 | -73.6 | 20.44 | 20.46 | 0.03 | 1 |
| 94 | 4.6 | -79.0 | 22.61 | 23.26 | 0.65 | 1 |
| 95 | 8.0 | -31.7 | 21.41 | 22.13 | 0.72 | 2 |
| 96 | 9.4 | -60.6 | 23.63 | 23.52 | -0.10 | 3 |
| 97 | 13.8 | 32.9 | 23.30 | -- | -- | 1 |
| 98 | 14.0 | -91.9 | 20.71 | 21.00 | 0.29 | 1 |
| 99 | 20.3 | 102.3 | 15.31 | 15.15 | -0.16 | 3 |
| 100 | 22.0 | -22.2 | 23.14 | 23.34 | 0.20 | 2 |
| 101 | 24.1 | -7.0 | 23.36 | -- | -- | 2 |
| 102 | 24.1 | -74.2 | 23.62 | -- | -- | 3 |
| 103 | 26.6 | -3.4 | 20.84 | 22.09 | 1.25 | 3 |
| 104 | 27.3 | -19.0 | 22.37 | 23.91 | 1.54 | 1 |
| 105 | 28.4 | -16.0 | 20.40 | 21.53 | 1.13 | 3 |
| 106 | 29.5 | 15.3 | 22.53 | 22.68 | 0.15 | 1 |
| 107 | 32.1 | -12.7 | 23.46 | -- | -- | 1 |
| 109 | 37.6 | 17.7 | 23.20 | 23.81 | 0.61 | 2 |
| 110 | 37.9 | 41.9 | 23.26 | 23.77 | 0.51 | 2 |
| 111 | 41.2 | -39.5 | 20.48 | 21.26 | 0.78 | 3 |
| 112 | 44.3 | 29.5 | 17.96 | 18.87 | 0.91 | 3 |


| ---- | 1608+11 |  |  | $z=0$ |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 16 | 811 | 1.50 | Dec:+11 | 2315.7 | RLe $=23$ | 46 | 24.14 |
| Obj | \#RA | \# Dec | R | G | G-R | Class | Comments |
| 1 | -60.9 | 85.7 | 19.31 | 19.49 | 0.18 | 3 |  |
| 2 | -60.3 | -30.0 | 22.05 | -- | -- | 1 |  |
| 3 | -59.7 | 4.5 | 21.24 | 23.01 | 1.77 | 3 |  |
| 4 | -57.5 | -21.1 | 21.33 | 23.68 | 2.36 | 1 |  |
| 5 | -56.8 | -3.1 | 20.48 | 21.67 | 1.19 | 3 |  |
| 6 | -56.4 | -47.6 | 21.40 | 22.74 | 1.35 | 1 |  |
| 7 | -55.6 | -84.5 | 18.33 | 19.55 | 1.21 | 1 |  |
| 8 | -55.3 | -28.1 | 23.17 | -- | -- | 2 |  |
| 9 | -54.6 | 24.2 | 19.87 | 21.23 | 1.36 | 1 |  |
| 10 | -51.9 | 66.6 | 23.17 | -- | -- | 2 |  |
| 11 | -48.7 | 74.1 | 20.80 | 21.17 | 0.37 | 3 |  |
| 12 | -47.2 | -22.4 | 23.17 | -- | -- | 3 |  |
| 13 | -47.0 | 67.6 | 21.97 | 22.83 | 0.86 | 1 |  |
| 14 | -43.5 | 39.5 | 23.40 | -- | -- | 1 |  |
| 15 | -42.0 | -32.3 | 22.17 | 22.80 | 0.63 | 3 |  |


| 16 | -42.1 | -81.3 | 20.22 | 21.36 | 1.14 | 2 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| 18 | -39.9 | 71.7 | 21.09 | 22.70 | 1.60 | 1 |
| 19 | -39.7 | -24.2 | 19.23 | 19.65 | 0.42 | 1 |
| 20 | -38.0 | -19.4 | 20.01 | 21.45 | 1.44 | 3 |
| 21 | -37.6 | -50.6 | 18.90 | 19.97 | 1.08 | 1 |
| 22 | -37.0 | -6.8 | 22.68 | 23.94 | 1.25 | 1 |
| 23 | -36.1 | -64.8 | 22.17 | 23.13 | 0.96 | 1 |
| 24 | -35.6 | 74.8 | 22.35 | -- | -- | 1 |
| 25 | -35.3 | 7.1 | 21.02 | 22.29 | 1.26 | 1 |
| 26 | -30.6 | -15.9 | 22.58 | 23.47 | 0.89 | 1 |
| 28 | -29.1 | -79.9 | 23.03 | -- | -- | 2 |
| 29 | -25.9 | -19.5 | 21.90 | 21.26 | -0.63 | 1 |
| 30 | -23.9 | 9.5 | 22.01 | 23.73 | 1.72 | 3 |
| 31 | -23.0 | -23.3 | 17.18 | 18.13 | 0.95 | 1 |
| 32 | -22.8 | -4.1 | 23.09 | 24.07 | 0.97 | 0 |
| 33 | -21.4 | 62.3 | 20.45 | 22.15 | 1.71 | 1 |
| 34 | -18.4 | -72.2 | 20.49 | 22.32 | 1.83 | 1 |
| 35 | -16.5 | 53.9 | 20.80 | 22.58 | 1.78 | 3 |
| 36 | -15.7 | 6.2 | 20.26 | 20.89 | 0.62 | 3 |
| 37 | -12.8 | 5.6 | 22.10 | 23.06 | 0.95 | 1 |
| 38 | -10.5 | -34.9 | 21.62 | 23.12 | 1.49 | 3 |
| 40 | -6.5 | -8.8 | 22.27 | 23.77 | 1.49 | 1 |
| 41 | -5.2 | 39.2 | 19.93 | 21.65 | 1.72 | 3 |
| 42 | -5.8 | 29.7 | 22.14 | 22.97 | 0.83 | 1 |
| 43 | -2.2 | -44.4 | 23.27 | 23.84 | 0.56 | 2 |
| 44 | -0.7 | 53.6 | 21.17 | 23.07 | 1.90 | 3 |
| 45 | -0.6 | -6.7 | 20.41 | 22.21 | 1.80 | 1 |
| 46 | 0.0 | 0.0 | 19.82 | 20.84 | 1.02 | 1 |
| 47 | 2.5 | 5.9 | 21.76 | 23.23 | 1.47 | 1 |
| 49 | 4.8 | 10.8 | 22.06 | 23.57 | 1.51 | 1 |
| 50 | 5.6 | -4.1 | 23.16 | 22.45 | -0.71 | 1 |
| 51 | 7.3 | 68.1 | 22.40 | 24.10 | 1.70 | 3 |
| 52 | 9.2 | 81.3 | 22.23 | 23.34 | 1.11 | 1 |
| 53 | 11.3 | -54.2 | 22.69 | -- | -- | 3 |
| 54 | 16.9 | -6.0 | 21.63 | 22.84 | 1.21 | 3 |
| 56 | 27.2 | 30.0 | 21.15 | 22.29 | 1.14 | 3 |
| 57 | 27.3 | 16.0 | 22.02 | 22.51 | 0.49 | 1 |
| 58 | 27.7 | 45.8 | -- | 23.83 | -- | 3 |
| 59 | 29.1 | 2.6 | 20.09 | 20.98 | 0.89 | 1 |
| 60 | 30.3 | -76.9 | 22.44 | 23.36 | 0.92 | 2 |
| 61 | 34.5 | 40.7 | 21.35 | 22.66 | 1.30 | 2 |
| 62 | 38.7 | 37.9 | 22.83 | -- | -- | 3 |
| 63 | 40.4 | 28.8 | 22.56 | 24.09 | 1.53 | 2 |
| 64 | 41.9 | -74.1 | 22.27 | 23.14 | 0.87 | 1 |
| 65 | 47.3 | -39.9 | 17.99 | 18.54 | 0.56 | 3 |
| 66 | 48.0 | 58.0 | 22.84 | 23.82 | 0.97 | 3 |
| 67 | 48.6 | 31.9 | 22.35 | 23.77 | 1.42 | 1 |
| 68 | 49.4 | 16.0 | 23.14 | -- | -- | 1 |
| 79 | 53.1 | 86.3 | 21.26 | 22.35 | 1.09 | 0 |
| 71 | 54.9 | 51.6 | 23.20 | -- | -- | 1 |
|  | 59.0 | 62.7 | 22.52 | 23.50 | 0.98 | 1 |
| 1 |  |  |  |  |  |  |


| 72 | 65.2 | 68.9 | 19.61 | 20.54 | 0.93 | 1 |
| :--- | ---: | ---: | ---: | ---: | ---: | ---: |
| 73 | 67.2 | 14.6 | 21.21 | 22.21 | 1.00 | 1 |
| 74 | 68.9 | -78.8 | 20.71 | 21.95 | 1.23 | 3 |
| 75 | 69.7 | 20.5 | 17.32 | 17.80 | 0.48 | 3 |
| 76 | 72.3 | -59.3 | 21.18 | 23.08 | 1.90 | 3 |
| 77 | 72.7 | -47.8 | 20.98 | 22.16 | 1.18 | 1 |
| 78 | 75.3 | 49.8 | 21.28 | 21.92 | 0.63 | 1 |
| 79 | 77.1 | -68.3 | 18.39 | 18.96 | 0.58 | 3 |
| 80 | 77.6 | -57.3 | 19.95 | 21.68 | 1.73 | 1 |
| 81 | 83.0 | -55.8 | 22.30 | 24.10 | 1.80 | 3 |
| 82 | 83.4 | -10.9 | 20.64 | 21.84 | 1.20 | 1 |
| 83 | 83.4 | -69.1 | 21.67 | 23.70 | 2.03 | 1 |
| 84 | 87.2 | -63.7 | 20.48 | 21.97 | 1.49 | 3 |
| 85 | 86.6 | -67.3 | 21.76 | 22.46 | 0.70 | 3 |
| 86 | 94.0 | 23.7 | 20.29 | 21.80 | 1.51 | 1 |


| ---- 1640+396 |  |  | $z=0.540$ |  |  |  | $\mathrm{GL}=23.98$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 16 | 640 | 6.10 | Dec:+39 | 4048.0 | RL=23. |  |  |
| Obj | \#RA | \# Dec | R | G | G-R | Class | 3 Comments |
| 1 | -78.3 | -82.6 | 19.92 | 20.25 | 0.33 | 1 |  |
| 2 | -73.9 | 20.7 | 21.58 | 22.87 | 1.29 | 1 |  |
| 3 | -74.2 | -88.1 | 21.68 | 21.91 | 0.24 | 2 |  |
| 4 | -71.7 | -2.1 | 23.06 | 23.76 | 0.69 | 3 |  |
| 5 | -68.7 | 9.0 | 22.60 | 23.55 | 0.95 | 2 |  |
| 7 | -62.0 | 44.0 | 18.77 | 19.70 | 0.93 | 3 |  |
| 8 | -61.6 | -53.0 | 0 -- | 23.38 | -- | 2 |  |
| 9 | -61.7 | -35.2 | 17.08 | 17.85 | 0.77 | 3 |  |
| 10 | -61.0 | 25.8 | 19.74 | 20.53 | 0.80 | 1 |  |
| 11 | -59.8 | 77.2 | 22.87 | 23.74 | 0.87 | 1 |  |
| 12 | -57.8 | 32.8 | 22.13 | 23.73 | 1.61 | 1 |  |
| 13 | -54.6 | 25.8 | 14.91 | 14.77 | -0.14 | 4 |  |
| 14 | -54.4 | -21.1 | 19.80 | 20.00 | 0.20 | 3 |  |
| 15 | -53.1 | -79.6 | 15.66 | 15.21 | -0.45 | 4 |  |
| 16 | -51.0 | -24.6 | 23.12 | 22.76 | -0.35 | 1 |  |
| 17 | -50.1 | 5.4 | 22.77 | 23.45 | 0.68 | 1 |  |
| 18 | -46.7 | -88.0 | 22.30 | -- | -- | 1 |  |
| 19 | -45.8 | -66.7 | 22.97 | 22.81 | -0.16 | 1 |  |
| 20 | -42.2 | -54.8 | 22.18 | 22.60 | 0.42 | 1 |  |
| 21 | -36.3 | -90.0 | 23.42 | 23.27 | -0.15 | 3 |  |
| 22 | -32.9 | 39.5 | 19.36 | 20.29 | 0.93 | 3 |  |
| 23 | -29.9 | 72.1 | 22.92 | 23.07 | 0.15 | 1 |  |
| 24 | -27.0 | 45.5 | -- | 23.24 | -- | 3 |  |
| 25 | -25.0 | 63.0 | -- | 23.45 | -- | 2 |  |
| 26 | -23.8 | -78.4 | 22.62 | 23.35 | 0.73 | 3 |  |
| 27 | -14.4 | -63.7 | 21.01 | 21.94 | 0.93 | 1 |  |
| 28 | -7.6 | -23.5 | 23.07 | 23.69 | 0.62 | 1 |  |
| 29 | -4.1 | -35.7 | 23.00 | 23.48 | 0.48 | 1 |  |
| 30 | -3.2 | -12.9 | 22.34 | 23.28 | 0.94 | 1 |  |

31
$-1.8-20.4 \quad 23.38$
21.16
-- 3
32
33 $-1.0-16.0 \quad 20.27$ $0.0 \quad 0.0$ $1.9-24.8$
19.53
19.31
$\begin{array}{rr}0.89 & 1 \\ -0.22 & 2 \\ 0.78 & 3\end{array}$
$2.4 \quad 66.8 \quad 22.07$
21.93
$\begin{array}{llll}2.6 & 6.9 & 21.49 & 22.92\end{array}$
$\begin{array}{llll}5.0 & 53.7 & 23.07 & 23.36\end{array}$
$\begin{array}{llll}6.9 & -12.5 & 22.88 & 23.72\end{array}$
$7.3-41.0 \quad 18.10$
$\begin{array}{rrr}9.2 & -7.5 & 22.63 \\ 11.3 & 74.5 & 23.01\end{array}$

| 18 |
| :--- |
| 23 |

$\begin{array}{ll}14.9 & 29.3\end{array}$
23.33
$\begin{array}{lll}15.6 & -19.7 & 23.28 \\ 20.4 & -10.8 & 21.70\end{array}$
$\begin{array}{rrr}20.4 & -10.8 & 21.70 \\ 24.0 & 62.6 & 21.98\end{array}$
$24.1 \quad 21.5 \quad 20.46$
26.3-26.9 22.72
22.59
26.4-61.7
22.61
0.783
1.013
$\begin{array}{ll}1.43 & 3 \\ 0.28 & 1\end{array}$
36
38
40
41
42
45
47
48
50

| 30.2 | 53.6 | 21.46 |
| :--- | :--- | :--- |

- 

21
21
$\begin{array}{lll}30.7 & 20.1 & 19.99 \\ 32.0 & 15.4 & 17.76\end{array}$
53
54
55
$\begin{array}{lrr}32.6 & 0.9 & 22.90 \\ 33.2 & -40.8 & 22.51\end{array}$
$33.6 \quad 28.2$
$\begin{array}{lll}34.5 & -22.9 & 20.27\end{array}$
$35.5 \quad 48.5 \quad 21.39$
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
35.5-61.5
38.5-22.7 20.05
$38.4 \quad 39.1 \quad 23.25$
$\begin{array}{lll}40.8 & 19.6 & 22.18 \\ 41.5 & 23.8 & 19.81\end{array}$
0.841
$-0.093$
$0.81 \quad 1$
$\begin{array}{ll}-- & 2 \\ -- & 2 \\ -- & 1\end{array}$
$\begin{array}{cc}-- & 1 \\ 0.89 & 1 \\ 0.62 & 1\end{array}$
$\begin{array}{ll}0.62 & 1 \\ 1.10 & 3\end{array}$
-- $\quad 2$
QSO
aso

| 84 | 76.0 | -58.9 | 21.87 | 21.82 | -0.04 | 3 |
| ---: | ---: | ---: | ---: | :---: | :---: | :---: |
| 85 | 77.1 | 79.2 | 21.97 | 23.25 | 1.28 | 3 |
| 86 | 77.2 | 31.3 | 21.94 | 22.72 | 0.77 | 1 |
| 87 | 78.3 | -49.7 | 22.36 | 22.74 | 0.38 | 1 |
| 88 | 85.3 | 31.3 | 22.65 | -- | -- | 1 |
| 89 | 89.4 | 26.3 | 21.34 | 21.75 | 0.41 | 1 |
| 90 | 89.7 | 67.8 | 23.06 | 23.24 | 0.18 | 1 |
| 91 | 89.7 | -0.7 | 23.10 | 23.98 | 0.89 | 1 |
| 92 | 90.1 | -27.0 | -- | 23.72 | -- | 3 |


| -- | 4 C 61. |  |  | $z=0$ |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 17 | 7422 | 1.60 | Dec:+61 | 711.0 | RL=23. | 50 G | 23.89 |
| Obj | \#RA | \#Dec | R | G | G-R | Class | Comments |
| 1 | 104.7 | 51.9 | 22.37 | 22.41 | 0.04 | 2 |  |
| 2 | 102.0 | 6.3 | 23.12 | -- | -- | 1 |  |
| 4 | -99.8 | -48.9 | 23.43 | 23.68 | 0.25 | 2 |  |
| 6 | -98.0 | 23.6 | 19.54 | 20.59 | 1.04 | 3 |  |
| 7 | -95.3 | 15.5 | 21.91 | 22.68 | 0.77 | 1 |  |
| 8 | -94.6 | 53.2 | 21.36 | 23.10 | 1.74 | 1 |  |
| 9 | -94.2 | 41.6 | 20.51 | 20.38 | -0.13 | 1 |  |
| 10 | -93.1 | -25.4 | 20.83 | 22.07 | 1.24 | 3 |  |
| 11 | -90.9 | 48.1 | 20.93 | 21.84 | 0.91 | 1 |  |
| 12 | -85.1 | -65.0 | 23.40 | 23.57 | 0.17 | 3 |  |
| 13 | -83.0 | 75.1 | 20.31 | 21.14 | 0.83 | 3 |  |
| 14 | -82.0 | 26.6 | 21.60 | 21.66 | 0.06 | 3 |  |
| 15 | -80.5 | 17.1 | 17.71 | 17.75 | 0.04 | 3 |  |
| 16 | -79.8 | -74.8 | 20.64 | 21.83 | 1.19 | 2 |  |
| 17 | -78.9 | -40.5 | 16.96 | 17.00 | 0.05 | 3 |  |
| 18 | -76.7 | 73.0 | 21.69 | 22.75 | 1.06 | 3 |  |
| 19 | -76.4 | 52.9 | 23.26 | 23.82 | 0.56 | 2 |  |
| 20 | -72.6 | -33.0 | 22.04 | 23.33 | 1.29 | 3 |  |
| 21 | -72.2 | -1.0 | 21.82 | 22.51 | 0.69 | 1 |  |
| 22 | -71.6 | 9.2 | 21.36 | 22.33 | 0.97 | 1 |  |
| 23 | -71.6 | -40.7 | 22.55 | -- | -- | 2 |  |
| 24 | -58.8 | 5.9 | 22.86 | 23.46 | 0.61 | 2 |  |
| 25 | -57.4 | -20.0 | 23.22 | 23.44 | 0.23 | 1 |  |
| 26 | -56.7 | -86.1 | 20.89 | 21.92 | 1.03 | 1 |  |
| 27 | -56.2 | -92.9 | 21.18 | 22.21 | 1.03 | 1 |  |
| 28 | -55.3 | 16.8 | 20.77 | 21.39 | 0.62 | 3 |  |
| 29 | -55.3 | -56.2 | 22.36 | 22.34 | -0.02 | 2 |  |
| 31 | -50.2 | -2.1 | 22.64 | 23.75 | 1.10 | 1 |  |
| 32 | -50.0 | -51.3 | 20.78 | 21.73 | 0.95 | 3 |  |
| 33 | -49.2 | -63.3 | 21.65 | 23.55 | 1.90 | 3 |  |
| 34 | -48.4 | 0.2 | 21.36 | 22.22 | 0.86 | 1 |  |
| 35 | -48.2 | -78.4 | 20.85 | 21.97 | 1.13 | 3 |  |
| 36 | -48.0 | 19.8 | 17.67 | 18.41 | 0.74 | 3 |  |
| 37 | -46.8 | -3.7 | 22.39 | 23.21 | 0.83 | 2 |  |
| 38 | -46.7 | -72.1 | 20.94 | 22.35 | 1.40 | 1 |  |


| 39 | -46.2 | -33.4 | 20.85 | 21.93 | 1.07 | 3 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 40 | -44.5 | 3.2 | 22.88 | 23.76 | 0.88 | 2 |  |
| 41 | -40.6 | -26.8 | 22.25 | 23.47 | 1.22 | 1 |  |
| 42 | -38.8 | -16.3 | 23.30 | 22.42 | -0.88 | 2 |  |
| 43 | -35.8 | -60.2 | 22.99 | 23.59 | 0.60 | 1 |  |
| 44 | -33.6 | -83.6 | 22.66 | 23.16 | 0.51 | 2 |  |
| 45 | -31.7 | -75.3 | -- | 23.67 | -- | 2 |  |
| 46 | -29.3 | 65.8 | 21.80 | 22.53 | 0.73 | 1 |  |
| 47 | -26.9 | -12.4 | 20.71 | 22.01 | 1.30 | 3 |  |
| 48 | -26.0 | -27.9 | 19.24 | 20.30 | 1.06 | 3 |  |
| 49 | -25.3 | -24.0 | 22.42 | -- | -- | 1 |  |
| 50 | -25.7 | -48.0 | 22.52 | 23.65 | 1.14 | 1 |  |
| 51 | -25.2 | 50.4 | 22.32 | 23.14 | 0.82 | 2 |  |
| 52 | -19.6 | -7.8 | 21.58 | 22.69 | 1.11 | 1 |  |
| 53 | -17.0 | 41.4 | 20.93 | 21.20 | 0.27 | 2 |  |
| 54 | -15.8 | 12.5 | 17.30 | 18.05 | 0.75 | 3 |  |
| 55 | -14.6 | 2.2 | 22.43 | -- | -- | 1 |  |
| 56 | -11.7 | 21.6 | 22.18 | 22.90 | 0.72 | 1 |  |
| 57 | -8.3 | -40.8 | 22.43 | -- | -- | 2 |  |
| 58 | -6.9 | -15.7 | 21.66 | 23.16 | 1.50 | 3 |  |
| 59 | -4.8 | -67.7 | 22.58 | 23.27 | 0.69 | 1 |  |
| 60 | -4.7 | -70.3 | 23.27 | -- | -- | 3 |  |
| 61 | -4.1 | -23.7 | 21.51 | 22.48 | 0.97 | 3 |  |
| 62 | -3.0 | -78.7 | 22.88 | -- | -- | 2 |  |
| 63 | -2.3 | -38.8 | 22.19 | 23.65 | 1.46 | 1 |  |
| 64 | -1.8 | -35.9 | 21.43 | 22.68 | 1.25 | 3 |  |
| 65 | 0.1 | 60.5 | 22.97 | 23.39 | 0.41 | 1 |  |
| 66 | 0.0 | 0.0 | 18.31 | 18.12 | -0.20 | 2 | QSO |
| 67 | 0.6 | 30.1 | 23.41 | 23.24 | -0.17 | 2 |  |
| 68 | 0.6 | 6.9 | 22.31 | 23.41 | 1.09 | 3 |  |
| 69 | 9.9 | 69.1 | 19.36 | 19.75 | 0.38 | 1 |  |
| 70 | 10.5 | 25.4 | 22.28 | 23.18 | 0.90 | 1 |  |
| 71 | 10.9 | 12.4 | 23.46 | -- | -- | 2 |  |
| 72 | 11.4 | -11.0 | 22.35 | 22.91 | 0.56 | 1 |  |
| 74 | 23.2 | 1.4 | 19.61 | 21.76 | 2.15 | 3 |  |
| 75 | 23.8 | 72.4 | 22.26 | 23.66 | 1.40 | 3 |  |
| 76 | 24.7 | -25.3 | 21.45 | 21.60 | 0.15 | 1 |  |
| 77 | 31.0 | 7.0 | 23.22 | 23.78 | 0.56 | 3 |  |
| 78 | 32.7 | -78.0 | 21.90 | 22.66 | 0.75 | 1 |  |
| 79 | 37.1 | 10.6 | 22.34 | 22.85 | 0.51 | 1 |  |
| 80 | 38.7 | 60.4 | 19.13 | 19.10 | -0.03 | 3 |  |
| 81 | 41.0 | -79.8 | 22.15 | 22.84 | 0.69 | 2 |  |
| 82 | 42.4 | 70.4 | 21.77 | 21.79 | 0.02 | 2 |  |
| 83 | 43.1 | -62.3 | 16.58 | 16.70 | 0.11 | 3 |  |
| 84 | 43.8 | 49.3 | 22.48 | 23.81 | 1.33 | 2 |  |
| 85 | 50.0 | -5.8 | 20.97 | 21.99 | 1.02 | 1 |  |
| 86 | 51.9 | -87.3 | 21.25 | 22.52 | 1.27 | 1 |  |
| 87 | 56.6 | -6.0 | 22.04 | 22.20 | 0.15 | 1 |  |
| 88 | 59.2 | -29.1 | 21.83 | 23.02 | 1.19 | 1 |  |



| 56 | -29.8 | 49.3 | 22.93 | -- | -- | 1 |
| ---: | ---: | ---: | ---: | :--- | :--- | :--- |
| 57 | -29.4 | -65.8 | 19.01 | -- | -- | 3 |
| 58 | -28.0 | -34.9 | 20.62 | -- | -- | 3 |
| 59 | -27.4 | -27.5 | 22.17 | -- | -- | 1 |
| 61 | -25.6 | 21.9 | 21.99 | -- | -- | 0 |
| 62 | -24.0 | -13.6 | 22.63 | -- | -- | 1 |
| 63 | -20.8 | 8.8 | 18.38 | -- | -- | 3 |
| 64 | -19.8 | 53.9 | 20.53 | -- | -- | 3 |
| 65 | -17.0 | -31.4 | 22.75 | -- | -- | 3 |
| 66 | -15.4 | 39.0 | 20.31 | -- | -- | 1 |
| 67 | -15.0 | 41.0 | 21.15 | -- | -- | 1 |
| 68 | -13.8 | -45.9 | 23.20 | -- | -- | 1 |
| 69 | -12.0 | -16.7 | 19.94 | -- | -- | 1 |
| 70 | -12.3 | -57.7 | 23.26 | -- | -- | 0 |
| 71 | -10.8 | -73.8 | 17.25 | -- | -- | 3 |
| 72 | -10.5 | -13.8 | 21.79 | -- | -- | 1 |
| 73 | -9.8 | 26.5 | 20.90 | -- | -- | 1 |
| 74 | -9.2 | -20.0 | 16.60 | -- | -- | 3 |
| 75 | -5.2 | 19.7 | 15.59 | -- | -- | 3 |
| 76 | -2.7 | -68.6 | 21.56 | -- | -- | 3 |
| 78 | -1.6 | -42.7 | 21.32 | -- | -- | 3 |
| 79 | -1.7 | -20.8 | 23.19 | -- | -- | 2 |
| 80 | 0.0 | 0.0 | 18.99 | -- | -- | 3 |
| 81 | 11.2 | -17.1 | 22.63 | -- | -- | 3 |
| 82 | 12.1 | 105.9 | 20.09 | -- | -- | 3 |
| 83 | 12.7 | 17.0 | 22.85 | -- | -- | 1 |
| 84 | 13.6 | -12.8 | 18.75 | -- | -- | 3 |
| 85 | 13.5 | -89.6 | 19.78 | -- | -- | 3 |
| 86 | 16.3 | 42.7 | 17.52 | -- | -- | 3 |
| 87 | 18.1 | -75.2 | 21.90 | -- | -- | 2 |
| 88 | 20.6 | 41.8 | 22.33 | -- | -- | 1 |
| 89 | 23.4 | 29.8 | 20.92 | -- | -- | 3 |
| 90 | 26.7 | -42.6 | 19.64 | -- | -- | 3 |
| 91 | 26.7 | 64.5 | 21.89 | -- | -- | 0 |
| 92 | 27.3 | -94.1 | 21.29 | -- | -- | 1 |
| 93 | 33.4 | 31.7 | 17.85 | -- | -- | 3 |
| 94 | 34.8 | -24.8 | 20.70 | -- | -- | 3 |
| 95 | 35.7 | -43.3 | 22.64 | -- | -- | 2 |
| 96 | 37.7 | -94.6 | 21.97 | -- | -- | 1 |
| 97 | 40.8 | -45.8 | 20.24 | -- | -- | 3 |
| 98 | 43.5 | -86.1 | 22.48 | -- | -- | 0 |
| 99 | 46.7 | 3.4 | 18.47 | -- | -- | 3 |
| 100 | 49.1 | -16.5 | 18.72 | -- | -- | 1 |
| 101 | 52.7 | -10.6 | 19.43 | -- | -- | 2 |
| 102 | 53.5 | -55.3 | 20.22 | -- | -- | 2 |
| 103 | 53.5 | 6.1 | 23.17 | -- | -- | 3 |
| 106 | 55.2 | -59.1 | 22.05 | -- | -- | 1 |
| 107 | 55.5 | 37.8 | 22.12 | -- | -- | 1 |
| 108 | 59.0 | -61.8 | 20.72 | -- | -- | 3 |
|  | 60.1 | 103.1 | 23.28 | -- | -- | 0 |
| 10.8 | 16.49 | -- | -- | 0 |  |  |
| 10 |  |  |  |  |  |  |


| ---- 2113+056 |  |  |  | $z=0.509$ |  |  | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 21 | 1339 | . 63 | Dec:+ 536 | 5.0 | RL=23 | 67 |  |
| Obj | \#RA | \#Dec | R | G | G-R | Class |  |
| 1 | -74.0 | 17.7 | 20.79 | -- | -- | 1 |  |
| 2 | -73.8 | -0.9 | 19.97 | -- | -- | 3 |  |
| 3 | -70.5 | 24.3 | 22.30 | -- | -- | 1 |  |
| 4 | -67.3 | -31.9 | 21.25 | -- | -- | 1 |  |
| 5 | -67.3 | -55.3 | 21.35 | -- | -- | 3 |  |
| 6 | -65.9 | -37.2 | 21.88 | -- | -- | 3 |  |
| 7 | -64.1 | 48.0 | 23.13 | -- | -- | 3 |  |
| 8 | -61.9 | 46.5 | 21.38 | -- | -- | 1 |  |
| 9 | -59.4 | 77.9 | 21.56 | -- | -- | 2 |  |
| 10 | -57.5 | 51.1 | 20.43 | -- | -- | 1 |  |
| 11 | -57.2 | -0.1 | 19.97 | -- | -- | 1 |  |
| 12 | -57.0 | -49.9 | 20.34 | -- | -- | 3 |  |
| 13 | -54.4 | 31.9 | 21.70 | -- | -- | 2 |  |
| 14 | -54.1 | -30.0 | 17.92 | -- | -- | 3 |  |
| 15 | -52.7 | 44.0 | 22.32 | -- | -- | 1 |  |
| 16 | -49.2 | -2.7 | 14.62 | -- | -- | 4 |  |
| 17 | -47.3 | 15.1 | 19.08 | -- | -- | 3 |  |
| 18 | -46.5 | 31.6 | 21.83 | -- | -- | 3 |  |
| 19 | -45.4 | 43.9 | 21.05 | -- | -- | 3 |  |
| 20 | -44.4 | 30.3 | 23.04 | -- | -- | 0 |  |
| 21 | -43.7 | 6.6 | 19.99 | -- | -- | 1 |  |
| 22 | -42.7 | 58.1 | 23.10 | -- | -- | 2 |  |
| 23 | -40.0 | 51.7 | 21.75 | -- | -- | 3 |  |
| 24 | -38.7 | 75.3 | 23.01 | -- | -- | 3 |  |
| 25 | -38.6 | 13.1 | 18.55 | -- | -- | 2 |  |
| 26 | -38.5 | -11.7 | 21.24 | -- | -- | 1 |  |
| 27 | -35.2 | -78.8 | 22.54 | -- | -- | 3 |  |
| 28 | -33.9 | -25.0 | 20.43 | -- | -- | 3 |  |
| 29 | -32.5 | -70.7 | 22.58 | -- | -- | 1 |  |
| 30 | -31.8 | -5.7 | 23.40 | -- | -- | 3 |  |
| 31 | -31.1 | -0.6 | - 21.55 | -- | -- | 1 |  |
| 32 | -30.7 | 89.1 | 20.40 | -- | -- | 3 |  |
| 34 | -25.4 | -7.9 | 18.19 | -- | -- | 3 |  |
| 35 | -18.6 | 65.2 | 22.03 | -- | -- | 3 |  |
| 36 | -18.6 | -44.5 | 21.98 | -- | -- | 3 |  |
| 37 | -14.7 | -19.7 | 22.16 | -- | -- | 1 |  |
| 38 | -15.4 | -52.1 | 21.86 | -- | -- | 1 |  |
| 39 | -14.6 | 85.2 | 20.12 | -- | -- | 3 |  |
| 40 | -14.3 | 59.3 | 22.95 | -- | -- | 3 |  |
| 41 | -14.5 | -36.0 | 18.59 | -- | -- | 2 |  |
| 43 | -14.1 | 44.8 | 21.98 | -- | -- | 3 |  |
| 44 | -8.7 | 32.7 | 23.46 | -- | -- | 1 |  |
| 45 | -4.6 | 81.3 | 22.12 | -- | -- | 1 |  |
| 46 | -4.0 | 4.9 | 22.78 | -- | -- | 3 |  |
| 47 | -3.3 | 62.8 | 22.18 | -- | -- | 2 |  |
| 48 | -3.5 | 16.1 | 17.06 | -- | -- | 3 |  |
| 49 | -1.7 | 59.2 | 21.05 | -- | -- | 3 |  |
| 50 | -1.1 | -37.9 | 22.79 | -- | -- | 1 |  |


| 51 | -0.2 | 18.1 | 19.90 | -- | -- | 3 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 52 | 0.0 | 0.0 | 19.35 | -- | -- | 1 | QSO |
| 53 | 1.0 | 63.8 | 18.57 | -- | -- | 3 |  |
| 54 | 2.0 | -53.1 | 22.47 | -- | -- | 0 |  |
| 55 | 2.9 | -34.3 | 23.01 | -- | -- | 1 |  |
| 56 | 3.2 | 62.3 | 21.72 | -- | -- | 1 |  |
| 58 | 9.0 | 14.3 | 21.66 | -- | -- | 1 |  |
| 60 | 11.7 | -19.0 | 21.37 | -- | -- | 3 |  |
| 61 | 11.2 | -61.2 | 19.58 | -- | -- | 3 |  |
| 63 | 15.3 | -45.6 | 19.26 | -- | -- | 1 |  |
| 64 | 16.5 | 15.4 | 23.03 | -- | -- | 1 |  |
| 65 | 18.3 | 79.9 | 21.36 | -- | -- | 1 |  |
| 66 | 20.2 | 24.9 | 18.23 | -- | -- | 3 |  |
| 67 | 20.7 | -34.8 | 22.75 | -- | -- | 2 |  |
| 68 | 24.5 | 66.9 | 20.79 | -- | -- | 3 |  |
| 69 | 25.1 | -48.1 | 23.58 | -- | -- | 3 |  |
| 70 | 26.2 | 44.4 | 22.17 | -- | -- | 2 |  |
| 71 | 26.2 | 4.2 | 20.77 | -- | -- | 1 |  |
| 72 | 28.7 | 86.1 | 22.08 | -- | -- | 1 |  |
| 73 | 31.9 | -42.4 | 22.55 | -- | -- | 3 |  |
| 74 | 33.8 | 17.0 | 22.80 | -- | -- | 3 |  |
| 75 | 34.7 | 69.6 | 21.46 | -- | -- | 1 |  |
| 76 | 35.5 | -77.5 | 17.34 | -- | -- | 3 |  |
| 77 | 35.4 | -4.3 | 23.42 | -- | -- | 3 |  |
| 78 | 37.1 | -57.7 | 23.66 | -- | -- | 3 |  |
| 79 | 37.4 | -13.5 | 19.66 | -- | -- | 3 |  |
| 80 | 38.5 | -48.4 | 20.87 | -- | -- | 3 |  |
| 81 | 39.5 | 44.2 | 16.37 | -- | -- | 3 |  |
| 82 | 39.9 | -29.5 | 22.23 | -- | -- | 1 |  |
| 83 | 44.5 | 55.6 | 22.82 | -- | -- | 3 |  |
| 84 | 44.7 | -2.0 | 23.55 | -- | -- | 1 |  |
| 85 | 50.3 | -64.8 | 22.40 | -- | -- | 1 |  |
| 86 | 54.9 | 8.2 | 22.54 | -- | -- | 3 |  |
| 87 | 57.6 | 62.6 | 23.49 | -- | -- | 3 |  |
| 88 | 58.5 | 39.0 | 19.48 | -- | -- | 3 |  |
| 89 | 58.6 | 33.5 | 22.08 | -- | -- | 0 |  |
| 90 | 59.2 | -60.6 | 17.96 | -- | -- | 1 |  |
| 91 | 59.5 | -68.1 | 22.34 | -- | -- | 1 |  |
| 92 | 60.7 | 59.6 | 22.72 | -- | -- | 1 |  |
| 94 | 61.0 | -59.1 | 19.45 | -- | -- | 1 |  |
| 95 | 61.7 | -52.0 | 22.24 | -- | -- | 1 |  |
| 96 | 61.8 | -67.6 | 20.49 | -- | -- | 1 |  |
| 97 | 62.7 | 12.6 | 21.32 | -- | -- | 3 |  |
| 98 | 64.1 | -69.4 | 22.58 | -- | -- | 1 |  |
| 99 | 67.3 | -42.5 | 23.17 | -- | -- | 3 |  |
| 100 | 68.5 | 52.1 | 20.31 | -- | -- | 3 |  |
| 101 | 68.5 | -32.9 | 22.34 | -- | -- | 1 |  |
| 102 | 69.3 | 27.7 | 21.92 | -- | -- | 1 |  |
| 103 | 70.3 | 55.3 | 20.71 | -- | -- | 3 |  |
| 104 | 71.2 | -60.5 | 22.56 | -- | -- | 1 |  |
| 105 | 72.7 | 22.0 | 18.76 | -- | -- | 3 |  |


| 106 | 73.7 | -27.5 | 22.74 | - | - | - |
| :--- | ---: | ---: | ---: | :--- | :--- | :--- |
| 107 | 74.3 | 45.1 | 22.98 | - | - | 2 |
| 108 | 74.1 | -45.9 | 21.90 | - | - | 3 |
| 109 | 78.4 | 26.9 | 17.20 | -- | -- | 3 |
| 110 | 80.1 | -62.6 | 19.38 | -- | -- | 3 |
| 112 | 81.0 | 92.1 | 20.89 | -- | -- | 0 |
| 113 | 81.1 | -26.8 | 22.00 | -- | -- | 1 |


| ---- 2140-048 |  |  | $z=0.344$ |  |  |  | $\mathrm{L}=24.12$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 21 | 40 | 0.50 | Dec:- 4 | 5129.0 | RL=23. |  |  |
| Obj | \# RA | \#Dec | R | G | G-R | Clasi | Comments |
| 1 | -47.6 | -50.3 | 20.98 | 20.94 | -0.03 | 1 |  |
| 2 | -45.5 | -2.9 | 22.64 | 23.57 | 0.93 | 2 |  |
| 3 | -35.3 | 28.3 | 21.30 | 22.62 | 1.32 | 1 |  |
| 4 | -34.1 | -10.6 | 23.37 | -- | -- | 3 |  |
| 5 | -34.1 | 45.6 | 6 -- | 23.73 | -- | 3 |  |
| 6 | -33.5 | -57.0 | 19.44 | 19.98 | 0.54 | 3 |  |
| 7 | -32.6 | -29.8 | 20.04 | 21.59 | 1.55 | 3 |  |
| 8 | -31.8 | 54.3 | 22.41 | 23.01 | 0.60 | 1 |  |
| 9 | -29.4 | 45.2 | 22.22 | 22.98 | 0.76 | 3 |  |
| 10 | -27.5 | -17.8 | 21.21 | 20.93 | -0.28 | 2 |  |
| 11 | -23.2 | -22.2 | 22.22 | 22.40 | 0.18 | 1 |  |
| 12 | -22.6 | -60.7 | 20.73 | 22.57 | 1.84 | 1 |  |
| 13 | -22.0 | 17.7 | 22.82 | 23.01 | 0.19 | 1 |  |
| 14 | -21.3 | -64.1 | 21.32 | 22.51 | 1.18 | 3 |  |
| 16 | -10.5 | -42.5 | 16.15 | 16.37 | 0.21 | 3 |  |
| 17 | -7.7 | -26.0 | 20.76 | 22.00 | 1.24 | 1 |  |
| 18 | -6.8 | -53.9 | 21.57 | 22.75 | 1.18 | 3 |  |
| 19 | -3.2 | -16.9 | 21.27 | 22.50 | 1.24 | 1 |  |
| 20 | -1.3 | 47.3 | 21.12 | 22.01 | 0.89 | 1 |  |
| 21 | 0.1 | 13.8 | 22.36 | 22.52 | 0.16 | 3 |  |
| 22 | 0.0 | 0.0 | 17.15 | 16.70 | -0.45 | 3 | QSO |
| 23 | 0.1 | -83.7 | 17.99 | 18.55 | 0.56 | 1 |  |
| 24 | 1.1 | -47.5 | 23.19 | 23.65 | 0.46 | 1 |  |
| 25 | 3.2 | -38.1 | -- | 22.60 | -- | 1 |  |
| 26 | 5.9 | -19.8 | 8 -- | 23.49 | -- | 1 |  |
| 27 | 6.6 | 29.0 | 21.57 | 23.68 | 2.11 | 1 |  |
| 28 | 8.1 | 19.0 | 23.27 | 22.43 | -0.84 | 1 |  |
| 29 | 10.2 | 9.3 | 22.18 | 22.23 | 0.05 | 2 |  |
| 30 | 14.6 | -19.4 | 22.48 | 22.27 | -0.20 | 1 |  |
| 31 | 15.3 | 17.4 | 21.97 | 22.25 | 0.28 | 1 |  |
| 32 | 17.1 | -75.3 | 22.06 | 22.00 | -0.06 | 2 |  |



| Obj | \#RA | \#Dec | R | G | G-R | Class | Comments |
| :---: | ---: | ---: | :---: | :---: | :---: | :---: | ---: |
| 1 | -41.7 | -37.8 | 19.61 | 20.95 | 1.34 | 1 |  |
| 2 | -40.5 | -23.2 | 21.64 | 23.33 | 1.69 | 1 |  |
| 4 | -36.6 | 68.5 | -- | 23.72 | -- | 1 |  |
| 8 | -26.9 | -3.0 | 22.85 | -- | -- | 3 |  |
| 10 | -18.7 | -50.1 | 19.55 | 20.56 | 1.02 | 1 |  |
| 11 | -18.2 | 24.3 | 20.00 | 21.59 | 1.60 | 1 |  |
| 12 | -16.6 | -23.8 | 20.87 | 22.22 | 1.35 | 1 |  |
| 13 | -16.1 | -45.4 | 21.97 | 22.38 | 0.40 | 1 |  |
| 14 | -15.7 | 41.4 | 22.09 | 22.22 | 0.14 | 3 |  |
| 15 | -15.4 | 31.3 | 22.31 | 23.04 | 0.72 | 1 |  |
| 16 | -13.6 | -2.4 | 22.21 | 23.53 | 1.32 | 1 |  |
| 18 | -10.7 | -35.3 | 21.52 | 22.30 | 0.79 | 3 |  |
| 19 | -9.3 | -29.8 | 22.05 | 22.30 | 0.25 | 1 |  |
| 20 | -9.2 | 25.0 | 21.07 | 22.61 | 1.54 | 2 |  |
| 21 | -6.2 | 24.1 | -- | 23.76 | -- | 3 |  |
| 22 | -3.5 | -51.5 | 22.42 | 23.77 | 1.35 | 1 |  |
| 23 | -3.0 | 59.9 | 22.61 | 22.70 | 0.09 | 2 |  |
| 24 | -3.2 | 8.6 | 21.69 | 22.12 | 0.43 | 1 |  |
| 25 | -1.3 | 57.1 | 20.93 | 22.01 | 1.09 | 3 |  |
| 26 | 0.0 | 0.0 | 19.62 | 18.77 | -0.85 | 3 | QSO |
| 27 | 0.1 | -56.6 | 21.50 | 22.07 | 0.57 | 1 |  |
| 28 | 1.0 | 63.8 | 19.01 | 19.93 | 0.92 | 3 |  |
| 29 | 2.1 | 43.7 | 20.31 | 21.73 | 1.42 | 3 |  |
| 30 | 4.4 | -9.7 | 21.42 | 22.41 | 0.98 | 1 |  |
| 31 | 7.2 | 67.3 | 20.96 | 20.55 | -0.41 | 2 |  |
| 32 | 9.5 | -29.9 | 22.84 | 22.70 | -0.14 | 1 |  |
| 33 | 9.3 | 32.3 | 21.84 | 22.88 | 1.04 | 3 |  |
| 34 | 9.2 | -32.0 | 21.21 | 22.40 | 1.19 | 2 |  |
| 35 | 11.1 | 13.7 | 20.89 | 22.36 | 1.47 | 1 |  |
| 36 | 12.6 | -47.1 | 22.78 | 22.90 | 0.12 | 1 |  |
| 37 | 12.9 | 25.9 | -- | 23.82 | -- | 3 |  |
| 38 | 12.9 | -2.4 | 21.79 | 22.01 | 0.22 | 1 |  |
| 39 | 14.4 | 49.2 | -- | 23.59 | -- | 3 |  |
| 40 | 15.3 | -52.6 | 20.93 | 21.21 | 0.28 | 1 |  |
| 41 | 16.1 | 41.6 | 21.92 | 22.35 | 0.43 | 1 |  |
| 42 | 16.2 | -51.3 | 22.51 | 21.84 | -0.68 | 1 |  |
| 43 | 16.8 | 64.2 | -- | 23.20 | -- | 0 |  |
| 44 | 20.0 | 23.5 | -- | 23.74 | -- | 1 |  |
| 46 | 27.8 | -11.0 | -- | 23.66 | -- | 0 |  |
| 47 | 32.7 | -14.1 | 22.97 | 23.22 | 0.25 | 3 |  |
| 48 | 32.8 | 31.9 | 20.96 | 21.70 | 0.74 | 3 |  |
| 49 | 33.9 | -24.3 | 22.44 | 23.41 | 0.97 | 1 |  |
| 50 | 37.3 | 79.0 | -- | 23.48 | -- | 3 |  |
| 52 | 44.2 | 70.6 | -- | 23.73 | -- | 2 |  |
|  |  |  |  |  |  |  |  |



| Obj | \#RA | \#Dec | R | G | G-R | Class | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | -49.8 | -11.1 | 21.25 | 22.46 | 1.22 | 0 |  |
| 2 | -47.3 | 39.4 | 22.64 | 23.79 | 1.16 | 2 |  |
| 3 | -46.1 | -46.6 | 19.30 | 20.39 | 1.10 | 3 |  |
| 4 | -44.5 | 39.0 | 22.97 | 23.69 | 0.72 | 3 |  |
| 5 | -44.2 | 30.7 | 22.74 | 23.07 | 0.33 | 1 |  |
| 6 | -43.4 | -30.7 | 22.71 | 23.15 | 0.44 | 3 |  |
| 7 | -41.8 | -54.5 | 23.23 | 23.70 | 0.47 | 2 |  |
| 8 | -39.6 | -20.1 | 20.05 | 20.81 | 0.76 | 3 |  |
| 9 | -37.5 | -47.8 | 23.76 | -- | -- | 3 |  |
| 10 | -35.2 | 31.8 | 21.90 | 21.76 | -0.14 | 0 |  |
| 11 | -34.3 | 28.0 | 22.48 | 22.48 | 0.00 | 1 |  |
| 12 | -33.0 | 22.7 | 21.04 | 22.36 | 1.32 | 3 |  |
| 13 | -33.2 | -14.0 | 17.73 | 18.93 | 1.20 | 3 |  |
| 14 | -29.7 | 23.1 | 23.25 | 23.08 | -0.18 | 3 |  |
| 15 | -28.6 | -22.4 | 15.40 | 14.99 | -0.40 | 3 |  |
| 16 | -22.3 | 42.1 | 23.11 | -- | -- | 2 |  |
| 17 | -18.7 | -2.8 | 20.77 | 21.56 | 0.79 | 3 |  |
| 18 | -10.4 | -23.5 | 20.70 | 21.41 | 0.70 | 1 |  |
| 19 | -9.6 | -56.1 | 23.30 | -- | -- | 1 |  |
| 20 | -8.7 | -12.9 | 16.20 | 16.12 | -0.07 | 3 |  |
| 21 | -8.0 | -36.0 | 22.07 | 22.19 | 0.11 | 1 |  |
| 22 | -8.0 | -57.2 | 22.88 | -- | -- | 2 |  |
| 23 | -5.6 | 37.9 | 22.23 | 23.31 | 1.08 | 1 |  |
| 24 | -3.4 | 15.4 | 21.39 | 22.89 | 1.49 | 1 |  |
| 25 | -3.2 | -16.3 | 22.55 | -- | -- | 2 |  |
| 26 | -2.3 | 47.5 | 20.57 | 21.68 | 1.11 | 3 |  |
| 27 | 0.0 | 0.0 | 19.42 | 19.62 | 0.20 | 2 | QSO |
| 28 | 1.4 | -54.6 | 21.86 | 22.51 | 0.65 | 1 |  |
| 29 | 1.5 | 25.9 | 22.78 | 23.18 | 0.40 | 1 |  |
| 30 | 1.3 | 1.8 | 20.75 | 21.54 | 0.80 | 2 |  |
| 31 | 4.7 | 39.5 | 18.59 | 19.56 | 0.97 | 3 |  |
| 32 | 5.1 | -6.5 | 22.97 | 23.77 | 0.80 | 2 |  |
| 33 | 5.6 | 35.7 | 19.47 | 20.52 | 1.05 | 3 |  |
| 34 | 8.1 | -4.6 | 19.64 | 20.54 | 0.89 | 3 |  |
| 35 | 9.6 | 45.8 | 22.35 | -- | -- | 2 |  |
| 36 | 11.6 | 21.7 | 21.96 | 22.38 | 0.42 | 1 |  |
| 37 | 18.6 | 3.5 | 21.29 | 21.32 | 0.03 | 3 |  |
| 38 | 23.7 | -31.2 | 23.36 | -- | -- | 3 |  |
| 39 | 24.2 | -57.5 | 19.11 | 20.16 | 1.05 | 3 |  |
| 40 | 25.5 | 5.7 | 22.52 | -- | -- | 2 |  |
| 41 | 27.5 | 37.2 | 20.71 | 20.83 | 0.12 | 3 |  |
| 42 | 28.4 | -9.0 | 23.33 | -- | -- | 2 |  |
| 43 | 30.9 | 6.7 | 22.97 | 23.34 | 0.36 | 2 |  |
| 44 | 31.3 | 30.4 | 20.59 | 20.52 | -0.07 | 1 |  |
| 45 | 30.9 | -29.9 | 22.34 | 23.60 | 1.26 | 1 |  |
| 46 | 31.1 | -47.2 | 22.68 | -- | -- | 3 |  |
| 47 | 32.7 | -9.7 | 21.94 | 23.07 | 1.13 | 3 |  |
| 48 | 33.6 | 42.9 | 23.77 | 21.04 | -2.73 | 1 |  |
| 49 | 40.0 | 47.2 | 22.78 | -- | -- | 2 |  |
| 50 | 43.6 | 9.0 | 21.26 | 22.17 | 0.91 | 1 |  |


| 51 | 47.4 | 30.1 | 22.91 | -- | .- | 2 |
| ---: | ---: | ---: | ---: | :---: | :---: | :---: |
| 52 | 48.8 | -24.6 | 23.47 | 23.64 | 0.17 | 3 |
| 53 | 48.8 | -42.0 | 22.03 | 22.96 | 0.93 | 1 |
| 54 | 50.3 | -41.5 | 21.39 | 21.88 | 0.48 | 1 |
| 55 | 52.0 | -37.7 | 23.51 | -- | -- | 2 |
| 56 | 53.7 | 45.8 | 22.06 | 23.23 | 1.17 | 1 |


| ---- 3CR 455 |  |  | $z=0.543$ |  |  | . | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 22 | 513 | 4.50 | Dec:+12 | 5733.5 | RL=23 | . 48 |  |
| Obj | \#RA | \# Dec | R | G | G-R | Class |  |
| 1 | -35.5 | -13.9 | 19.88 | 8 | -- | 1 |  |
| 2 | -35.0 | 50.3 | 22.74 | 4 | -- | 3 |  |
| 4 | -26.3 | -48.5 | 16.05 | 5 | -- | 1 |  |
| 5 | -23.1 | 0.8 | 22.39 | - | -- | 1 |  |
| 6 | -21.5 | -8.2 | 18.45 | 5 | -- | 1 |  |
| 7 | -20.9 | -43.4 | 22.19 | - | -- | 3 |  |
| 8 | -20.9 | 4.5 | 22.88 |  | -- | 3 |  |
| 9 | -16.4 | 11.1 | 22.60 |  | -- | 0 |  |
| 10 | -16.1 | 12.3 | 22.32 | 2 | -- | 1 |  |
| 11 | -12.6 | -20.4 | 14.67 | 7 | -- | 1 |  |
| 12 | -10.9 | 30.0 | 20.50 | 0 | -- | 1 |  |
| 13 | -9.4 | -35.5 | 18.65 | 5 | -- | 1 |  |
| 14 | -2.7 | 7.3 | 22.42 |  | -- | 1 |  |
| 15 | -2.0 | -54.3 | 23.36 | 6 | -- | 0 |  |
| 16 | -0.7 | 18.6 | 20.08 | 8 | -- | 1 |  |
| 17 | -0.4 | 28.7 | 22.71 | 1 | -- | 3 |  |
| 18 | 0.0 | 0.0 | 19.57 | 7 | -- | 3 | Qso |
| 19 | -0.1 | 11.1 | 22.25 | 5 | -- | 3 |  |
| 20 | 5.9 | 7.6 | 16.63 | 3 | -- | 3 |  |
| 21 | 6.8 | 48.9 | 20.74 | 4 | -- | 1 |  |
| 22 | 7.1 | 26.0 | 20.04 | 4 | -- | 1 |  |
| 23 | 9.1 | -37.3 | 21.84 | 4 | -- | 1 |  |
| 24 | 9.9 | -41.0 | 23.37 | 7 | -- | 3 |  |
| 25 | 13.9 | -52.7 | 23.27 | 7 | -- | 0 |  |
| 26 | 15.1 | -51.4 | 22.44 |  | -- | 1 |  |
| 27 | 19.3 | 34.1 | 22.65 | 5 | -- | 2 |  |
| 28 | 20.2 | -6.6 | 23.05 | 5 | -- | 0 |  |
| 29 | 25.9 | -48.0 | 22.05 | 5 | -- | 2 |  |
| 30 | 26.0 | 30.0 | 21.75 | 5 | -- | 3 |  |
| 31 | 31.8 | 40.3 | 20.02 | 2 | -- | 3 |  |
| 32 | 39.1 | -1.3 | 23.29 | - | -- | 3 |  |
| 33 | 42.9 | 5.7 | 22.74 | - | -- | 2 |  |
| 34 | 45.7 | 38.1 | 19.63 | - | -- | 3 |  |
| 35 | 46.3 | -46.4 | 21.11 | -- | -- | 3 |  |
| 36 | 48.8 | -4.9 | 20.29 | - | -- | 1 |  |
| 37 | 50.6 | -19.7 | 20.79 | - | -- | 3 |  |
| 38 | 50.8 | -25.3 | 22.44 | -- | -- | 0 |  |
| 39 | 55.6 | -18.2 | 21.79 | -- | -- | 3 |  |


| 40 | 60.1 | -13.3 | 23.26 | -- | -- | 3 |
| ---: | ---: | ---: | ---: | :--- | :--- | :--- |
| 41 | 60.2 | -27.4 | 22.21 | -- | -- | 3 |
| 42 | 61.0 | 42.7 | 22.72 | -- | -- | 1 |
| 43 | 61.9 | 47.8 | 21.18 | -- | -- | 1 |


| ---- 2344+006 |  |  |  | $z=0.400$ |  |  | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 23 | 445 | . 80 | Dec:+ 036 | 4.0 | $\mathrm{RL}=22$ |  |  |
| Obj | \%ra | \# Dec | R | G | G-R | Class |  |
| 1 | -44.5 | 46.0 | 22.20 | -- | -- | 2 |  |
| 2 | -36.7 | 31.2 | 21.86 | -- | -- | 3 |  |
| 3 | -35.6 | -34.3 | 19.71 | -- | -- | 1 |  |
| 4 | -18.6 | 21.0 | 22.75 | -- | -- | 0 |  |
| 5 | -15.5 | 6.9 | 21.52 | -- | -- | 1 |  |
| 6 | -6.0 | -27.4 | 19.94 | -- | -- | 1 |  |
| 7 | -4.3 | 44.7 | 21.50 | -- | -- | 0 |  |
| 8 | 0.0 | 0.0 | 20.14 | -- | -- | 0 | QSO |
| 9 | 1.2 | $-48.3$ | 31.67 | -- | -- | 0 |  |
| 10 | 15.0 | 4.8 | 19.20 | -- | -- | 3 |  |
| 11 | 15.4 | 44.6 | - 20.78 | -- | -- | 3 |  |
| 13 | 42.0 | 13.7 | 20.63 | -- | -- | 1 |  |
| 14 | 56.9 | -47.7 | 21.41 | -- | -- | 1 |  |
| 15 | 57.2 | 4.8 | 22.08 | -- | -- | 3 |  |
| 16 | 61.5 | -41.1 | 22.60 | -- | -- | 0 |  |


| -- 2347+005 |  |  | $z=0.420$ |  |  |  | L=24.19 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 23 | 4721 | 1.00 | Dec:+ 0 | 38.0 | RL=23 |  |  |
| Obj | \#RA | \# Dec | R | G | G-R | Class | Comments |
| 1 | -46.6 | -21.4 | 41.29 | 23.33 | 2.04 | 2 |  |
| 2 | -45.9 | 32.3 | 22.60 | 23.80 | 1.21 | 1 |  |
| 3 | -38.5 | -31.2 | 22.11 | 23.35 | 1.24 | 3 |  |
| 4 | -35.3 | 58.2 | 20.47 | 21.36 | 0.90 | 1 |  |
| 5 | -27.0 | 4.3 | 20.84 | 22.58 | 1.74 | 3 |  |
| 6 | -17.2 | -55.1 | 21.65 | 22.93 | 1.29 | 2 |  |
| 7 | -16.6 | -7.6 | 20.72 | 20.51 | -0.21 | 3 |  |
| 8 | -10.7 | 20.0 | 21.76 | 22.73 | 0.98 | 1 |  |
| 9 | -3.0 | 31.4 | 23.22 | -- | -- | 3 |  |
| 10 | 0.0 | 0.0 | 21.70 | 22.51 | 0.81 | 3 | QSO |
| 11 | 3.8 | 62.7 | 21.57 | 23.77 | 2.19 | 1 |  |
| 12 | 12.8 | 67.4 | 20.86 | 23.35 | 2.49 | 3 |  |
| 14 | 17.3 | -64.6 | 22.17 | 24.14 | 1.97 | 2 |  |
| 15 | 19.5 | -59.8 | 23.19 | -- | -- | 0 |  |
| 16 | 21.4 | 30.5 | 21.18 | 23.61 | 2.42 | 3 |  |
| 17 | 24.5 | -3.3 | 21.48 | 22.56 | 1.08 | 3 |  |
| 18 | 25.0 | 2.5 | 18.48 | 18.82 | 0.35 | 3 |  |
| 19 | 29.3 | -10.1 | 22.57 | 23.66 | 1.09 | 3 |  |


| ---- 2351-006 |  |  | $z=0.463$ |  |  |  | $\mathrm{L}=24.38$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RA: 23 | 513 | 5.40 | Dec:- 0 | 3628.9 | RL=23. | 86 |  |
| Obj | \#RA | \#Dec | R | G | G-R | Class | Comments |
| 1 | -45.7 | 15.1 | 22.88 | 23.77 | 0.89 | 1 |  |
| 2 | -33.7 | -44.2 | 23.22 | 23.27 | 0.05 | 2 |  |
| 3 | -24.6 | 46.7 | 19.28 | 21.06 | 1.78 | 1 |  |
| 4 | -22.2 | 40.0 | 22.17 | 23.42 | 1.25 | 1 |  |
| 5 | -20.7 | 42.1 | 22.66 | 23.15 | 0.48 | 1 |  |
| 6 | -18.1 | -16.4 | 20.38 | 21.55 | 1.17 | 3 |  |
| 7 | -14.0 | -36.7 | 20.38 | 21.71 | 1.33 | 1 |  |
| 8 | -13.1 | 9.9 | 23.32 | 23.54 | 0.21 | 2 |  |
| 9 | -12.2 | 28.8 | 23.57 | -- | -- | 2 |  |
| 10 | -9.4 | 12.3 | 23.25 | 24.12 | 0.87 | 1 |  |
| 11 | -7.3 | 34.4 | 22.10 | 23.47 | 1.37 | 2 |  |
| 12 | -5.2 | 6.2 | 23.21 | -- | -- | 2 |  |
| 13 | -2.9 | -37.7 | 23.36 | 24.38 | 1.02 | 3 |  |
| 14 | 0.0 | 0.0 | 18.02 | 18.15 | 0.13 | 3 | QSO |
| 15 | 0.7 | -6.8 | 22.62 | 23.93 | 1.31 | 3 |  |
| 16 | 6.8 | -3.6 | 21.31 | 22.88 | 1.56 | 3 |  |
| 17 | 13.2 | 1.0 | 21.31 | 21.91 | 0.60 | 2 |  |
| 18 | 13.4 | -4.7 | 22.43 | 24.20 | 1.78 | 3 |  |
| $1{ }^{18}$ | 15.5 | -11.7 | 20.09 | 20.40 | 0.31 | 1 |  |
| 20 | 19.0 | -37.0 | 20.97 | 22.07 | 1.09 | 0 |  |
| 21 | 22.5 | -34.3 | 14.91 | 15.15 | 0.24 | 4 |  |
| 22 | 23.7 | -28.6 | 19.87 | 20.67 | 0.79 | 1 |  |
| 23 | 26.2 | 21.1 | 22.42 | 23.02 | 0.60 | 1 |  |
| 24 | 45.6 | 27.4 | 20.35 | 21.03 | 0.69 | 1 |  |
| 25 | 46.6 | -26.2 | 23.26 | -- | -- | 1 |  |
| 26 | 50.9 | 27.1 | 22.98 | 22.93 | -0.05 | 3 |  |
| 27 | 53.1 | -46.3 | 23.55 | 24.23 | 0.68 | 3 |  |
| 28 | 55.4 | -54.0 | 23.49 | 23.77 | 0.28 | 3 |  |
| 29 | 55.8 | 49.4 | 22.68 | 22.91 | 0.23 | 3 |  |
| 30 | 59.9 | -34.0 | 21.86 | 22.14 | 0.28 | 1 |  |
| 31 | 65.2 | 32.2 | 19.91 | 20.21 | 0.30 | 1 |  |
| 32 | 65.2 | 36.9 | 21.19 | 21.34 | 0.15 | 1 |  |

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