Galaxy clusters in the Perseus–Pisces region – I. Spectroscopic and photometric data for early-type galaxies

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ABSTRACT

We present new spectroscopic and photometric data for 137 early-type galaxies in nine clusters, and for a set of nearby standard galaxies. The clusters studied are Perseus (A0426), Pisces, A0262, A0347, J8, HMS0122+3305, 7S 21, A2199 and A2634. Our spectroscopic data comprise radial velocities ($c_z$), central velocity dispersions ($\sigma$) and magnesium line strength indices (Mg$_2$). Internal errors (derived from repeat observations) are 7.6 per cent on each measurement of velocity dispersion, and 0.010 mag. on each Mg$_2$ measurement.

Following Jørgensen et al., we correct our $\sigma$ and Mg$_2$ results to a physical aperture size of $1.19h^{-1}$kpc. We correct the major published datasets to the same aperture size, and define a new ‘standard system’ by the aperture-corrected Lick data of Davies et al. Through extensive intercomparisons with data from the literature, we present the corrections required to bring the major published datasets onto the standard system. The uncertainty in these corrections is computed. We demonstrate that our new velocity dispersion data can be brought into consistency with the standard system, to an uncertainty of $\lesssim 0.01$ dex.

From R-band CCD photometry, we derive effective diameter ($A_e$), mean surface brightness within effective diameter ($\langle \mu \rangle_e$) and an R-band diameter equivalent to the $D_n$ parameter of Dressler et al. Internal comparisons indicate an average error of 0.005 in each measurement of $\log D_n$. The combination $\log A_e - 0.3(\mu)_e$, approximately the quantity used in the Fundamental Plane distance indicator, has an uncertainty of 0.006 per measurement. The photometric data can be brought onto a system consistent with external data at the level of 0.5 per cent in distance.

These data will be used in a companion paper, to derive distance and peculiar velocity estimates for the nine clusters studied.

Key words: galaxies: clusters: general — galaxies: elliptical and lenticular, cD — galaxies: distances and redshifts — galaxies: fundamental parameters

1 INTRODUCTION

Streaming motions of galaxies are the only probe of the large-scale distribution of mass in the nearby Universe. The dominant large-scale concentrations of galaxies within a distance of 8000 km s$^{-1}$ are the Hydra-Centaurus/Great Attractor (hereafter GA) region and the Perseus–Pisces (hereafter PP) region (Saunders et al. 1991; Hudson 1993).

Strong infall into a massive concentration behind the Cen30 cluster was first claimed by Lynden-Bell et al. (1988). While there is clearly a coherent streaming motion of galaxies in the direction of Centaurus, it remains unclear whether this motion is generated locally by the GA, or whether more distant sources are responsible. The bulk streaming motion of the PP supercluster allows a test of these competing flow models. The GA infall model predicts the peculiar velocity of PP to be $\sim -100$ km s$^{-1}$. Alternatively, if more distant sources are responsible for the large peculiar motions in the Hydra–Centaurus direction, then PP might be expected to take part in a similarly large, but negative, bulk motion of $\sim 500$ km s$^{-1}$.

Previous work on motions in PP has been based mainly on application of the Tully & Fisher (1977) relation to samples of spiral galaxies. Using a field-spiral sample, Willick (1990, 1991) claimed that the PP supercluster was moving towards the local group (and therefore towards the GA) at
441 km s\(^{-1}\). Willick quotes only a random error of 49 km s\(^{-1}\) but the study is also subject to a systematic calibration error of \(\sim 100\) km s\(^{-1}\). Han & Mould (1992) analysed a sample of spirals in clusters, and reported an average peculiar motion of \(-400\) km s\(^{-1}\) for PP, in close agreement with Willick.

As compared to the spiral data, the PP region was not well-sampled in the elliptical galaxy survey of Faber et al. (1989, 7S). To date, no extensive application of the \(D_n - \sigma / \text{Fundamental Plane (FP)}\) method has been conducted in this region.

In this paper we present new spectroscopic and photometric parameters for a sample of early-type galaxies in 7 PP clusters. In a companion paper (Hudson et al. 1997; hereafter Paper II) we apply the \(D_n - \sigma\) and FP relations to deduce distances and peculiar velocities of the clusters.

Our strategy of observing cluster galaxies is motivated by the recognition that a field sample suffers from severe homogeneous and inhomogeneous Malmquist bias, particularly in the vicinity of large structures such as PP (Hudson 1994). The magnitude of this bias can be reduced by grouping galaxies into clusters. The dominance of early-type galaxies in cluster cores ensures that samples are fairly robust against contamination from the field.

The acquisition of elliptical galaxy data in the PP region will also extend the volume over which one may assess the consistency of elliptical galaxy FP/\(D_n - \sigma\) distances, as compared to Tully-Fisher distances for spirals. This comparison may reveal that the distance indicator relations are affected by systematic variations associated with environmental effects or star-formation history (see, for example, Guzmán et al. 1992, Gregg 1995). Kolatt & Dekel (1994), using a preliminary version of the Mark III compilation of velocity data (Willick et al., 1997), have shown that the motions are consistent with the hypothesis that spirals and ellipticals trace the same velocity field. This compilation is limited, however, by the less extensive data available for ellipticals. The aim of the present work is to provide new, high-quality data for ellipticals in PP clusters, for use in mapping the velocity field with the FP method.

The present paper is organised as follows. Section 2 describes the sample selection. In Section 3 details are given of the spectroscopic observations and data reduction. Particular attention is paid to the construction of a ‘standard system’ of velocity dispersion measurements, and the estimation of systematic errors in the merged data. The photometric data and reduction are described in Section 4. Section 5 concludes the paper with a summary of the data quality in terms of random and systematic errors.

2 SAMPLE SELECTION

2.1 Selection of cluster sample

We define as PP the region of the sky bounded by the limits \(0^\circ < \alpha < 4^\circ\) and \(+20^\circ < \delta < +45^\circ\). It should be noted that this definition is not identical to that of Willick (1990, 1991), whose PP region extends from \(22^\circ < \alpha < 3^\circ\). Within this region, the prominent clusters chosen for study were: Perseus (A0426), Pisces, A0262, A0347, J8, HMS0122+3305, 7S21. Of these, J8 (Jackson 1982) lies in the background of the PP ridge, at \(\sim 10000\) km s\(^{-1}\), while the remaining six form part of the main body of the supercluster, at \(4000–6000\) km s\(^{-1}\). In addition, the clusters A2199 and A2634, which do not lie inside the PP region, were observed as part of an effort to resolve the conflict between estimates of their distances (Lucey et al. 1991a, 1993, 1997). Clusters A0262, A2199, A2634 and J8 have also been observed as part of the EFAR survey (Wegner et al. 1996).

Figure 2 shows the projected distribution of galaxies in the PP region, and slightly beyond in order to show also the position of A2634. Galaxy positions are from the CfA redshift survey (Huchra, 1993). Only those with radial velocities less than 12000 km s\(^{-1}\) are plotted. The positions of our target clusters are marked by open circles. The redshift-space distribution, for galaxies in \(+20^\circ < \delta < +45^\circ\), is illustrated by Figure 3.

2.2 Selection criteria for cluster members

Galaxies were selected in a cone centred on each cluster position. The angular radius of each cone was chosen to give a physical radius of 1.0–2.5h\(^{-1}\)Mpc at the cluster, using the distance suggested by the cluster redshift in the CMB frame. In Table 1 we summarise the selection criteria used in each cluster.

For Pisces, A0262, HMS0122+3305, and J8, objects were selected from APM scans (see Irwin & McMahon 1992). The images of all objects brighter than \(B = 16\) \((B = 17\) for the more distant cluster J8) were inspected, using Palomar Sky Survey material. An initial inspection served to discriminate galaxies from close pairs of stars, merged galaxies and plate defects. In merged objects containing one or more galaxy, the magnitude of each galaxy was estimated by eye, given the total magnitude of the system. All galaxies were examined and morphological types were assigned. Only E and S0 galaxies without prominent disks were retained in the final sample. The remaining galaxies were cross-referenced with known objects at similar positions, using NED\(^{†}\). Those with literature redshifts different by more than 2000 km s\(^{-1}\) from the nominal cluster redshift were deleted from the sample.

For 7S21 and A0347, APM scans were not available at the time of selection. The HST Guide Star Catalogue was used to select non-stellar objects in these clusters. Suitable candidates were then selected and typed by inspection of sky survey plates, and cross referenced with NED.

For galaxies in the Perseus cluster, which lies at low galactic latitude, reliable E and S0 galaxies were selected from the work of Poulain, Nieto & Davoust (1992). A few extra ellipticals were added from the 7S sample.

For A2199 and A2634, galaxies were selected from Lucey et al. (1991a).

For most of the galaxies for which data is presented here, reliable positions are available through NED. Cross references are provided, with our data, to a reference number from well known catalogues (NGC, IC, UGC, CGCG) or from more specialist papers: Chincarini & Rood (1971, CR); Bucknell, Godwin & Peach (1979, BGP); Dressler (1980); Faber et al. (1989); Lucey et al. (1991a); Wegner et al.\n
\(^{†}\) NED, the NASA/IPAC extragalactic database, is operated for NASA by the Jet Propulsion Laboratory at Caltech.
Figure 1. Projected distribution of CfA survey galaxies (with $cz < 12000$ km s$^{-1}$, in the direction of PP. Clusters studied in this work are identified by open circles. The circle size is not significant. A2199 lies at $\alpha = 16^h 27^m, \delta = +40^\circ$, and is not shown. The low density of galaxies north of $+40^\circ$ is a result of the limited range of the Arecibo radio telescope. East of Perseus, obscuration by the galactic plane is apparent.

Table 1. Selection criteria for galaxies in each of the PP region clusters. $cz_{\text{nom}}$ is the CMB-frame redshift used in calculating the projected physical radius, $R_{\text{proj}}$ at the distance of each cluster. Under ‘source’, we refer to the catalogue and plate material used for visual inspection of candidates.

| Cluster  | RA (B1950) | Dec (B1950) | $cz_{\text{nom}}$ km s$^{-1}$ | Search radius | $R_{\text{proj}}$ $h^{-1}$Mpc | magnitude | Source              |
|----------|------------|-------------|----------------|---------------|----------------|-----------|---------------------|
| 7S21     | 00 18.6    | +22 05      | 5500           | 1$^\circ$     | 1.0            | $B \sim 16$ | GSC + POSS II       |
| Pisces   | 01 04.5    | +32 10      | 4700           | 2$^\circ$     | 1.6            | $B = 16$   | APM + POSS I        |
| HMS0122+3305 | 01 20.5    | +35 10      | 4600           | 2$^\circ$     | 1.6            | $B = 16$   | APM + POSS I        |
| A0262    | 01 49.9    | +35 54      | 4500           | 2$^\circ$     | 1.6            | $B = 16$   | APM + POSS I        |
| A0347    | 02 19.6    | +41 25      | 5300           | 1.5$^\circ$   | 1.4            | $B \sim 16$ | GSC + POSS II       |
| J8       | 02 26.0    | +23 00      | 9800           | 1.5$^\circ$   | 2.5            | $B = 17$   | APM + POSS I        |
| Perseus  | 03 15.0    | +41 00      | 4800           | 1$^\circ$     | 0.8            | $B = 17$   | Poulain + 7S        |
Figure 2. Redshift space distribution of CfA survey galaxies in declination range $20^\circ < \delta < +45^\circ$. Clusters to be studied here are marked by open circles. A2199 lies well beyond the limits of this plot, at $16.5^h$ RA.

(1996). In Table 3, we list positions for the galaxies not included in the above lists.

As in most programmes of peculiar velocity measurement, the selection criteria described here are somewhat inhomogeneous in terms of limiting magnitudes. This non-uniformity would result in biases in the cluster distances if not handled correctly. Methods for deriving unbiased $FP/D_n - \sigma$ relations and distances will be discussed and applied in Paper II.

Note also that morphological selection from sky survey plates is necessarily subjective. Andreon (1994) has reported that, for galaxies in the Poulain et al. sample, around a half of those classified as E by visual inspection of survey plates have Poulain et al. types S0 or later.

3 SPECTROSCOPY

3.1 Observations

Spectroscopic observations were made using the 2.5m Isaac Newton Telescope (INT) on La Palma, in 1993 and 1994. Different detectors were used in each run: an EEV CCD in 1993, and the faster TEK CCD in 1994. An EEV chip was used for one night of the 1994 run, due to technical problems. This resulted in three spectroscopic datasets (hereafter denoted EEV93, EEV94, TEK94), which were each treated separately during the course of the data reduction. Instrumental details for the three datasets are summarised in Table 4.
Table 3. Spectroscopic instrumentation.

| Dataset       | EEV93 | EEV94 | TEK94 |
|---------------|-------|-------|-------|
| Dates         | Nov. 15–22, 1993 | Sep. 6, 1994 | Sep. 3–5 & 7–9, 1994 |
| Observers     | JRL, MJH, JS | JRL, JS | JRL, JS |
| Telescope     | 2.5m INT | 2.5m INT | 2.5m INT |
| Spectrograph  | IDS | IDS | IDS |
| Wavelength Range | 4760–5784Å | 4760–5784Å | 4760–5784Å |
| Slit size     | 3 arcsec | 3 arcsec | 3 arcsec |
| CCD           | EEV | EEV | TEK |
| CCD Dimensions| 1242×1152 | 1242×1152 | 1024×1024 |
| Effective aperture | 3.0×3.3 arcsec | 3.0×3.3 arcsec | 3.0×3.5 arcsec |
| Number of Galaxy Spectra | 105 | 16 | 211 |
| Mean seeing   | 1.5 arcsec | 1.5 arcsec | 1.2 arcsec |

Table 2. Positions for uncatalogued galaxies in the PP sample. For all other galaxies studied here, positions are available through NED.

| Cluster | Our name | RA (B1950) | Dec (B1950) |
|---------|----------|------------|-------------|
| 7S21    | S06      | 00 18 44.8 | +21 42 22   |
| Pisces  | Z17005   | 00 56 43.0 | +32 52 04   |
|         | Z16012   | 00 59 04.2 | +33 20 51   |
|         | Z01047   | 01 04 12.4 | +32 02 30   |
|         | Z03032   | 01 05 27.0 | +32 11 13   |
|         | Z04035   | 01 05 43.7 | +33 06 58   |
|         | Z10020   | 01 09 05.1 | +31 17 37   |
| HMS0122+3305 | H01027 | 01 21 00.9 | +33 19 29   |
| A0262   | A14050   | 01 47 18.8 | +35 58 52   |
|         | A01094   | 01 47 26.5 | +35 44 09   |
|         | A01076   | 01 49 36.2 | +35 52 08   |
| A0347   | B03C     | 02 20 01.9 | +42 45 54   |
| J8      | J07038   | 02 24 03.4 | +23 24 06   |
|         | J09035   | 02 24 41.2 | +21 45 40   |
|         | J08035   | 02 24 41.4 | +22 51 29   |
|         | J01065   | 02 25 49.1 | +22 47 23   |
|         | J03049   | 02 26 52.2 | +23 44 03   |
|         | J01055   | 02 26 59.2 | +22 53 12   |
|         | J01080   | 02 27 46.0 | +22 29 54   |

3.2 Derivation of spectroscopic parameters

Initial reduction of the CCD frames involved bias and dark current subtraction, the removal of pixel-to-pixel sensitivity variations (using flat field exposures provided by a tungsten calibration lamp) and correction for vignetting along the slit (using twilight sky-line exposures).

The spectra obtained covered ∼4760–5784Å centred on the Mgb triplet, and were sampled with a resolution of ∼4Å FWHM.

Wavelength calibration was performed using arc-lamp exposures, taken regularly in the course of the observations, and always after movement from one cluster or region to another. A cubic fit between pixel number and wavelength for ∼18 arc lines gave a maximum rms calibration error of ∼0.1Å.

Spectra were extracted from the frames by simple co-addition of the central 5 rows of the galaxy. The resulting effective aperture size is tabulated for each dataset in Table 3. After application of a median-filter to remove cosmic ray events, the darkest rows on the frame were used to produce a sky spectrum.

For some galaxies in the EEV93 dataset, sufficient signal-to-noise could be obtained only by co-adding spectra resulting from two separate exposures. In almost all of these cases, the two exposures were taken in immediate subsequence, ensuring the validity of the co-addition.

Cosmic ray events in the galaxy spectra were removed by a combination of automatic procedures before extraction, and interactive methods applied at the one-dimensional spectrum stage. Features in the spectrum resulting from noise in the subtraction of sky-line features (especially at 5577Å) were similarly removed after extraction.

On each run, spectra were obtained for several G8 to K3 giant stars, for use as template spectra. These stars were trailed across the slit at a shallow angle during the exposure, to produce an extended illumination. Subsequent weighting of these frames, by a typical galaxy profile, effects a simulated observation of a galaxy with zero velocity dispersion. The extension of illumination has the effect of broadening the stellar spectra by ∼30 km s⁻¹.

The method used for measurement of the velocity dispersion, σ, for each galaxy, is based upon the well-known Fourier Quotient method of Sargent et al. (1977). In preparation for the application of this procedure, continuum levels were subtracted from both the template spectrum and the galaxy spectrum, and both were submitted to a cosine bell modulation to fix the spectrum ends to zero. The latter step is necessary to avoid unphysical signals appearing at all frequencies in the Fourier Transforms.

The method requires also the removal from the spectra of signals resulting from noise, inadequate continuum removal and the application of the cosine bell. Firstly, a cut is made at high frequencies, to remove noise. The results of this method seem to be fairly insensitive to the exact value, kₜₕₐᵢᵣ, chosen for the high frequency cut. kₜₕₐᵣ = 200 ≈ (5Å)⁻¹ has been used throughout. Furthermore, a low frequency filter must be applied to remove residual continuum features, and the effects of the cosine-bell modulation function described above. With the low-frequency cut, however, results are found to exhibit a clear trend: velocity dispersions are measured to be smaller when kₜₙᵢᵢₗ is higher. One must choose the cutoff frequency with care. The highest sensible kₜₙᵢᵢₗ is that which would preserve spectral features in spectra of velocity dispersion ≤ 500 km s⁻¹. This is kₜₙᵢᵢₗ = 9 ≈ (110Å)⁻¹ for our spectra. The lowest sensible kₜₙᵢᵢₗ is that
which is necessary to remove the signal of the cosine-bell modulation. This is $k_{\text{low}} = 6 \approx (170\,\text{A})^{-1}$ for our spectra. The portion of the $\sigma-k_{\text{low}}$ plot between these sensible limits is flat to $\sim$5 per cent for most galaxies.

After discarding a few template spectra which gave consistently discrepant results, the velocity dispersions were averaged over 13 template spectra of 6 different stars, and over values $k_{\text{low}} = 6, 7, 8, 9$ adopted for the low frequency filter.

The uncertainty on each velocity dispersion was quantified by repeatedly conducting the measurement after bootstrap resampling of the spectrum. This provides an estimate of the random, Poisson-noise error on $\sigma$.

Recession velocities ($c_2$) were obtained simultaneously with velocity dispersions, as a result of the Fourier Quotient fit.

The Mg$_2$ line strength index for the magnesium feature was also derived for each spectrum. In order to calculate this index, independent of the shape of the instrumental response curve, the spectra were first flux-calibrated by reference to spectrophotometric standard stars observed during the runs. For certain observations, no appropriate flux-standard was obtained, so a few galaxies have no Mg$_2$ measurement. Initial flux calibration of the EEV93 data was found to be unsatisfactory, due to a strong gradient in chip response across the spectral region being used. The calibration was improved by an extra step in which we derived the response curve of the EEV relative to the TEK, using a star common to both datasets, before calibrating to the absolute standard of flux. A similar problem for the EEV94 data could not be resolved in this manner, since there are no stars in common between that dataset and the TEK94 data. As a result there are no Mg$_2$ measurements from the EEV94 observations. Uncertainties in the Mg$_2$ indices were calculated simply from the noise characteristics of the chip employed.

### 3.3 Raw spectroscopic data and internal comparisons

Table 11 presents the raw spectroscopic data obtained, including formal errors. Over half of the galaxies were observed more than once. Comparisons between repeat measurements in the two large datasets (EEV93 and TEK94) are illustrated in Figures 3 and 4 for velocity dispersion and Mg$_2$ index, respectively. Note that there are no repeat observations within the EEV94 dataset. The implied observational errors in each dataset are summarised in Table 4. Weighting the $\sigma$ uncertainties in TEK94 and EEV93 by the number of observations in each dataset, we obtain a typical measurement error of 0.032 dex per measurement.

For comparison, the 7S Lick data exhibit an internal uncertainty of 0.057 dex in $\sigma$. The higher quality 7S velocity dispersions are accurate to 0.036 dex (Davies et al.). The mean Poisson error on $\sigma$ is 0.023 dex (TEK94) and 0.029 dex (EEV93). Non-Poissonian effects therefore account for an appreciable portion of the observed scatter, especially for the earlier dataset.

Uncertainties on the Mg$_2$ measurements are typically 0.010 mag., and are fully accounted for by the mean photon-noise error.

### Table 4. Uncertainties in the EEV93 and TEK94 datasets, as judged from the scatter of repeat measurements. For each parameter, $N$ indicates the number of galaxies for which comparisons could be made.

| Dataset | $N$ | $\sigma$ (dex) | Mg$_2$ (dex) | $c_2$ (km s$^{-1}$) |
|---------|-----|---------------|--------------|--------------------|
| TEK94   | 48  | 0.027         | 0.010        | 48                 |
| EEV93   | 20  | 0.041         | 0.011        | 20                 |

![Figure 3. Scatter of repeat velocity dispersion measurements within the datasets presented here. In each panel, the horizontal axis is the mean quantity derived from the dataset; the vertical axis is the deviation of each individual measurement from that mean. Note that there are no internal repeats within the EEV94 dataset. For ease of comparison, the axis limits for this plot are the same as for the equivalent plot in Davies et al. (1987).](image)

### 3.4 The aperture correction

The physical size of that central part of a galaxy, observed through a fixed aperture, is larger for a more distant galaxy than for one nearby. Since galaxies, in the mean, exhibit a negative radial gradient in both $\log \sigma$ and Mg$_2$, a correction must be applied to the raw data before use. Furthermore, to compare measurements made using different aperture sizes, a similar correction is clearly necessary. Jørgensen, Franx & Kjærgaard (1995) present an analysis based on the observed radial gradients in $\log \sigma$ and Mg$_2$ for nearby galaxies. They find that a power law provides an adequate description of the required correction:

$$\frac{\sigma_{\text{corr}}}{\sigma_{\text{obs}}} = 0.04 \log \frac{r_{\text{ap}}}{r_{\text{norm}}}$$

where $r_{\text{ap}}$ is the physical radius sampled by that circular aperture from which one obtains the same $\sigma_{\text{obs}}$ as through the actual aperture used. For a rectangular aperture of angular dimensions $x$ and $y$ (in radians), and a galaxy at distance $d$, the equivalent aperture is
Table 5. Run-to-run comparisons of spectroscopic data. \( N \) indicates the number of galaxies involved in each comparison.

| Comparison   | \( N \) | Mean \( \Delta (\log \sigma) \) | Dispersion |
|--------------|--------|-------------------------------|------------|
| EEV93 – TEK94 | 46     | -0.009±0.006                  | 0.042      |
| EEV94 – TEK94 | 10     | 0.014±0.012                   | 0.039      |

\[
r_{\text{ap}} \approx 1.025 \left( \frac{x_{\text{FW}}}{\pi} \right)^{1/2} d
\]

where the correction factor 1.025 is included to provide an improved match to more detailed models. An independent analysis, based on measured velocity dispersion profiles, supports the size of this correction.

For the normalisation, we follow Jørgensen et al. in adopting a physical diameter \( 2r_{\text{norm}} \) of 1.19 \( h^{-1} \) kpc. This is equivalent to an angular diameter of 3.4 arcsec for Coma cluster galaxies.

Jørgensen et al. find the average radial gradient of the \( \text{Mg}_2 \) index to be so similar to that of the velocity dispersion, that equation 1 may be used for the \( \text{Mg}_2 \) aperture correction, with a simple substitution of \( \text{Mg}_2 \) for \( \log \sigma \).

3.5 Matching of spectroscopic datasets onto a new ‘standard system’

In order to construct large samples of peculiar velocity data, we require that velocity dispersions measured at different telescopes match as accurately as possible. At the PP distance, a one per cent systematic error in \( \sigma \) corresponds to 50 km s\(^{-1}\) in peculiar velocity. A systematic difference between the velocity dispersions measured on telescopes in opposite hemispheres would thus generate a spurious bulk flow. Despite careful attempts to correct the velocity dispersions for aperture effects, systematic differences between velocity dispersions measured from different datasets persist at the \( \sim 3 \) per cent level. Such offsets are present even between the three datasets presented here (as illustrated in Figures 4 and 5), despite the use of very similar observational methods and data reduction techniques.

The removal of systematic offsets can be achieved by intercomparison of results for galaxies common to two or more systems. To this end, our data include many galaxies observed to improve overlap with existing systems. In this section, we consider velocity dispersion and \( \text{Mg}_2 \) data on 19 and 16 different systems, respectively. In order to take account of zero-point differences reported by Dressler (1984), the 7S LCOHI data have been subdivided into the three constituent runs from which they derive.

Many galaxies have measurements on more than two systems. Therefore in order to determine self-consistent corrections between different systems, a simultaneous fit for all of the offsets is necessary. The fit is performed using velocity dispersion and \( \text{Mg}_2 \) data corrected to the Jørgensen et al. (1995b) standard physical aperture size of 1.19 \( h^{-1} \) kpc. We determine the corrections necessary to bring all systems into the best possible agreement with each other. We adopt the fully-corrected Lick system (Davies et al. 1987) as the standard and determine the remaining corrections as follows. Let \( s = \log_{10}(\sigma) \) and let \( i, j \) and \( k \) index the measurement, galaxy and system respectively. We obtain the corrections \( \Delta k \), needed to bring each system into agreement with Lick, by minimising a \( \chi^2 \) statistic

\[
\chi^2 = \sum_i \frac{(s_i + \Delta k - \bar{s}_k)^2}{s_k^2}
\]
Figure 6. Consistency of the merged system of velocity dispersion measurements. For each galaxy in the TEK94 panel, we compute the mean (fully corrected) TEK94 measurement, and the mean (fully corrected) value using all the other data – excluding TEK94. We plot as $\Delta \log \sigma$ the difference between the ‘TEK94-only’ and the ‘all-but-TEK94’ values. All 19 velocity dispersion systems are treated in this way. Note that we include in these plots all measurements, including those which were not used in the derivation of the corrections. The small offsets still present in some plots (indicated by dotted lines) are a result of these outlying points and low $\sigma$ galaxies.

where $e_k$ is the error in $s_i$ (assumed to be the same for all galaxies in a given system) and $\bar{s}_i$ is the error-weighted mean of all corrected measurements of the same galaxy.

We determine the errors $e_k$ for each system by adjusting these so that the reduced $\chi^2$ is unity, both when the system is included and when it is excluded from the comparisons. This external error ($e_{\text{ext}}$) is typically 10–25 per cent larger than the internal error ($e_{\text{int}}$) estimated from repeat measurements on the same system.

The overlap data set of velocity dispersion measurements (galaxies with velocity dispersions on more than one system) consists of 1281 measurements for 350 different galaxies. We exclude galaxies with $\bar{s} < 2$ as these may be subject to large random and systematic errors (Jørgensen et al. 1995b). We also exclude individual velocity dispersion measurements which are inconsistent at the 3.5$\sigma$ level with the other measured velocity dispersions of the same galaxy. The velocity dispersions so excluded are A2634-F1201 (EEV93 $s = 2.0784$), A1656D-136 (INT90 $s = 2.0888$), N386 (KPNO $s = 1.7923$), N548 (LICK $s = 1.8856$) and VELA-G22 (FOCP2 $s = 1.9237$).

The overlap data set of Mg$_2$ measurements (galaxies with measurements on more than one system) consists of 1013 measurements of 270 different galaxies on 16 systems (the LC, FOCP2 and EEV94 systems have no Mg$_2$ data). In addition to the galaxies excluded in the velocity dispersion...
Figure 7. As for Figure 6, but for the 17 systems of $Mg_2$ measurements.

comparison, we also exclude the following data which are inconsistent with other measurements of the same galaxy at the 3.5σ level: N1282 (PAL $Mg_2 = 0.0245$), N1549 (A2 $Mg_2 = 0.342$ and JFK $Mg_2 = 0.264$) N4564 (EEV93 $Mg_2 = 0.350$) and N6702 (GONZA $Mg_2 = 0.243$ and TEK94 $Mg_2 = 0.288$).

Tables 6 and 7 summarise the required corrections to velocity dispersion and $Mg_2$, respectively. Note that, because of the interdependencies between the different corrections, the simple pair offsets of Table 5 are not trivially related to those derived here by simultaneous fits. In Figures 6 and 7 we illustrate the level to which systematic offsets are removed by the application of the derived corrections.

The errors are determined by bootstrap resampling the master data file and computing the corrections from the resampled file. This procedure allows us to determine not only the error on the correction to each system but also the correlation between the corrections for different systems. Using the bootstrap values of these corrections, we can generate mock merged data sets and so determine for a given cluster the error in the mean correction. This is an estimate of the mean systematic error in $s$, which will generally depend on the systems merged for the cluster, their relative proportions and their covariance. For the PP sample, we find that for all clusters this error is $\sim 1.5$ per cent in $\sigma$. This translates to a systematic error of $\sim 2$ per cent in distance, or $\sim 100$ km s$^{-1}$ at PP.

3.6 Correction and combination of spectroscopic data

In this section, we briefly summarise the recipe for converting the raw spectroscopic data tables into the corrected and
Table 6. Corrections required to bring each system of (aperture-corrected) velocity dispersion measurements into agreement with the standard system. e_\text{int} are the errors on each correction. N_{ov} represents, for each system, the number of galaxies in the overlap dataset, i.e. having measurements on other systems.

| Name  | Source | N   | e_{\text{int}} | e_{\text{ext}} | \Delta  | e_\Delta |
|-------|--------|-----|----------------|----------------|---------|---------|
| LICK  | 1      | 276 | 0.052          | 0.055          | 0       | 0       |
| PAL   | 2      | 23  | -0.045         | -0.0241        | 0.0116  | 0.0116  |
| LCOLO | 1      | 61  | 0.039          | 0.040          | 0.0115  | 0.0098  |
| LCOHF | 3      | 25  | 0.035          | -0.0067        | 0.0105  |         |
| LCOHM | 3      | 73  | 0.023          | 0.035          | 0.0106  | 0.0072  |
| LCOHJ | 3      | 61  | 0.021          | 0.005          | 0.0021  | 0.0086  |
| KPNO  | 1      | 27  | 0.065          | 0.0142         | 0.0139  |         |
| A1    | 1      | 27  | 0.040          | -0.0057        | 0.0113  |         |
| A2    | 1      | 42  | 0.036          | 0.0011         | 0.0102  |         |
| LC    | 4      | 72  | 0.033          | -0.0127        | 0.0096  |         |
| DF    | 5      | 41  | -0.044         | -0.0038        | 0.0112  |         |
| JFK   | 6      | 76  | -0.040         | 0.0011         | 0.0089  |         |
| INT90 | 7      | 59  | 0.038          | 0.0017         | 0.0069  |         |
| INT92 | 8      | 60  | 0.040          | 0.0080         | 0.0096  |         |
| FOCP2 | 9      | 67  | 0.034          | -0.0063        | 0.0094  |         |
| GONZA | 10     | 38  | -0.014         | 0.0222         | 0.0054  |         |
| EEEV93| 11     | 86  | 0.040          | -0.0014        | 0.0082  |         |
| EEEV94| 11     | 15  | -0.040         | -0.0115        | 0.0111  |         |
| TEK94 | 11     | 152 | 0.027          | -0.0063        | 0.0059  |         |

Sources:
1. Davies et al. (1987)
2. Davies et al. (1987) – Palomar observations wrongly attributed to LCOHI dataset (see Dressler et al. 1987)
3. LCOHI data subdivided according to run: Feb. 82 (LCOH), Mar. 83 (LCOHM) and Jan. 84 (LCOHJ)
4. Davies et al. (1987) – Palomar observations wrongly attributed to LCOHI dataset (see Dressler et al. 1987)
5. Dressler, Faber & Burstein (1991)
6. Jørgensen, Franx & Kjærgaard (1995b)
7. Lucey, Guzman, Carter & Terlevich (1991)
8. Lucey, Guzman, Steel & Carter (1997)
9. Lucey et al. (1998)
10. Gonzales (1993)
11. This paper

Table 7. As for Table 6, but for Mg2 measurements.

| Name  | Source | N   | e_{\text{int}} | e_{\text{ext}} | \Delta  | e_\Delta |
|-------|--------|-----|----------------|----------------|---------|---------|
| LICK  | 1      | 274 | 0.008          | 0.011          | 0       | 0       |
| PAL   | 2      | 22  | 0.014          | -0.0143        | 0.0026  |         |
| LCOLO | 1      | 53  | 0.011          | -0.0032        | 0.0024  |         |
| LCOHM | 3      | 68  | 0.004          | 0.0086         | 0.0023  |         |
| LCOHJ | 3      | 53  | 0.007          | -0.0185        | 0.0029  |         |
| KPNO  | 1      | 24  | 0.011          | -0.0034        | 0.0028  |         |
| A1    | 1      | 27  | 0.012          | 0.0074         | 0.0053  |         |
| A2    | 1      | 33  | 0.005          | -0.0132        | 0.0034  |         |
| DF    | 5      | 31  | 0.017          | 0.0040         |         |         |
| JFK   | 6      | 40  | 0.011          | -0.0017        | 0.0024  |         |
| INT90 | 7      | 54  | 0.012          | 0.0061         | 0.0030  |         |
| INT92 | 8      | 51  | 0.013          | 0.0168         | 0.0027  |         |
| GONZA | 10     | 37  | 0.007          | -0.0048        | 0.0017  |         |
| EEEV93| 11     | 83  | 0.010          | 0.0172         | 0.0021  |         |
| TEK94 | 11     | 139 | 0.009          | 0.0071         | 0.0016  |         |

Combined measurements to be used in the peculiar velocity analyses.

In order to combine multiple \( \sigma \) and Mg2 observations for a galaxy, it is first necessary to ensure that all the sources of data are on a consistent system. To this end we correct the EEV93, EEV94 and TEK94 systems for aperture effects, and scale them onto our new ‘standard system’ using the offsets listed in Tables 6 and 7. The distance used in calculating the aperture correction is the median redshift of the relevant cluster, or (if not part of the cluster sample) the individual galaxy redshift.

The data for multiply-observed galaxies are then combined to give a weighted mean \( \log \sigma \), and weighted mean Mg2. The weight of each measurement is assigned according to the external error on the dataset from which it derives. In constructing the means, we exclude the (> 3.5\( \sigma \)) deviant measurements as flagged above.

It should be stressed that the external datasets (LICK, FOCP2, etc.) are used only to derive the necessary corrections, and to identify outlying measurements. The mean parameters are calculated using data drawn only from EEV93, EEV94 and TEK94.

Recession velocities are combined by correcting the EEV93 and EEV94 systems according to their offsets from TEK94, before computing a simple mean \( \text{cz} \). The relative offsets are EEV93 – TEK94 = −10 ± 5 km s\(^{-1}\) and EEV94 – TEK94 = −4 ± 10 km s\(^{-1}\), derived from 45 and 10 galaxies respectively.

We have compared the resulting mean recession velocity measurements with those adopted by 7S (Faber et al. 1989, Davies et al. 1987). The median offset is 22±13 km s\(^{-1}\), with our velocities being the larger. The comparison is displayed in Figure 8. The most discrepant point is galaxy N1272 (P17). For this galaxy, we have seven concordant measurements of \( \text{cz} \),

Table 7 presents the fully corrected and combined spectroscopic data, scaled to the ‘standard’ system, for galaxies in the cluster sample. This table includes only those galaxies for which complementary photometric data has been obtained.

4. PHOTOMETRY

4.1 Introduction

The photometric observations were made in the Kron–Cousins R bandpass. For the \( D_n - \sigma \) relation, we have defined the R-band \( D_n \) parameter to be that diameter which encloses a mean surface brightness \( \langle \mu \rangle_R = 19.23 \text{ mag. arcsec}^{-2} \). If the typical (extinction- and k-corrected) \( V - R \) colour for early-type galaxies is 0.57, as indicated by the BVR photometry of Colless et al. (1993), then our R-band \( D_n \) diameters will be well matched to the V-band system of Lucey et al. (1991b), and to the B-band work of Burstein et al. (1987). At the distance of the clusters studied here, the typical \( D_n \) diameter, so defined, is comfortably large compared to the seeing disk, yet not so large that sky subtraction errors become significant. The quantities measured for use in the FP distance indicator are the effective diameter \( A_e \), and the mean surface brightness within effective diameter, denoted \( \langle \mu \rangle_e \).
4.2 Observations and initial data reduction

CCD photometry was obtained on the 1-m Jacobus Kapteyn Telescope (JKT) on La Palma in 1993 November and 1994 September. Table 8 summarises the instrumental configuration used. The observations were made with the RGO ‘Harris’ R filter which, in combination with a typical CCD response, provides a close match to the standard Kron–Cousins R bandpass. The images covered an area of 6.6 × 6.1 arcmin², at a scale of 0.31 arcsec pixel⁻¹. The initial reduction of the CCD images followed standard procedures of bias-subtraction and flat-fielding, using Starlink software. The photometric calibration was achieved by observations of Landolt (1983, 1992) standard stars and fields. At least 12 Landolt stars/fields were observed each night and an online assessment of photometric conditions was employed to track the stability of the atmospheric extinction. For the calibration mapping we used the equation,

\[ R = r_{\text{inst}} + ZP - k_R X + C(B - V) \]  

where \( R \) is Landolt’s listed R-band magnitude, \( B - V \) is the listed colour, \( r_{\text{inst}} \) is the instrumental magnitude, \( X \) is the airmass, \( ZP \) is the photometric zero-point, \( k_R \) the R-band extinction per airmass and \( C \) is the colour term. We solved for the \( ZP \), \( k_R \) and \( C \) terms by minimising the residuals. Five nights (out of a total 14 allocated) were photometric.

The residual scatter of the standard stars on these nights was less than 0.015 mag. The \( k_R \) term was typically 0.10. The colour term, \( C \), was only -0.011, confirming the excellent match of the RGO ‘Harris’ R filter to the standard Kron–Cousins R system. For the limited \( B - V \) colour range of early-type galaxies in our study this colour term can be safely included in the zero-point term, and observations in R-band alone can be used. In order to assess the reliability of our photometric measurements and run-to-run variations, a large number of our target galaxies were observed more than once (see below). FWHM seeing (measured from stellar profiles on the target galaxy images) ranged from 0.7 to 3.0 arcsec, with a typical value of 1.3 arcsec.

4.3 Derivation of photometric parameters

For each galaxy, circular aperture magnitudes were determined in diameter steps of approximately 0.1 dex from 4 arcsec out to ~60 arcsec. Contaminating stars and galaxies were removed interactively from each target galaxy. Aperture magnitudes were corrected for galactic extinction and for cosmological k-dimming. For the R-band extinction, we adopt \( A_R = 2.35E(B - V) \) where \( E(B - V) \) are the reddening values of Burstein & Heiles (1984). For the k-correction, we use −1.0z (Oke & Sandage 1968, Frei & Gunn 1994). A correction for the \((1+z)^4 \) surface brightness dimming is also applied.

To derive the parameters \( D_h \), \( A_h \) and \( \langle \mu \rangle_e \), we fit a de Vaucouleurs \( R^{1/4} \) profile to the aperture photometry. Seeing effects in the aperture magnitudes cannot be ignored in this procedure, and are here corrected for by an improved version of the method first reported by Bower, Lucey and Ellis (1992). Whereas Bower et al. calculate the seeing corrections appropriate for a galaxy of true effective radius 5 arcsec, and apply these to all galaxies, we have compiled correction tables for a range of true radii, and use an iterative technique to select the table required for a given galaxy. Convergence to a corrected \( A_h \) value is very rapid. In practice this improved correction scheme leads to measurements which are in good agreement with those made using the original Bower et al. method. For only five images, out of a total 245, do we find \( D_h \) or FP parameters which change by more than 1 per cent (distance equivalent) in adopting the new corrections.

The typical rms residual from the \( R^{1/4} \) law fit is 0.02 mag. The four worst-fit galaxies have residuals of 0.05–0.09 mag. Saglia et al. (1997) have recently investigated the effect of fitting a pure \( R^{1/4} \) law to galaxies with substantial disk components. They show that such a fit to a galaxy with disk-to-bulge ratio 0.2 can result in \( A_h \) measurements which are wrong by as much as 30%. Whilst this severely affects the determination of effective radius and of surface brightness, the combination log \( A_h - 0.3\langle \mu \rangle_e \) (which enters into the Fundamental Plane) is robust against the presence of a disk, since the errors on \( A_h \) and \( \langle \mu \rangle_e \) are correlated.

The \( D_h \) parameter, defined by interpolation of the data, rather than from a global profile fit, is also insensitive to this effect. We note also, that a bias in cluster distances will only result from this effect if, from cluster to cluster, substantially different morphological proportions are sampled.

The final fully-corrected photometric parameters are...
presented in Table 9. For comparison with future work, we tabulate also the uncorrected R-band magnitude for each galaxy, as measured within an aperture of 20 arcsec.

4.4 Internal comparisons and combination of photometric data

To assess the consistency of our photometric system from year-to-year, we have compared, for each galaxy in common, the mean derived aperture magnitude from the 1993 run, with that from the 1994 data. The comparison is shown in Figure 9, for apertures of 20 arcsec and 30 arcsec diameter. At 20 arcsec, the mean offset is $0.003 \pm 0.002$ mag, and the scatter 0.011 mag. The offset in the 30 arcsec aperture magnitudes, is $0.002 \pm 0.004$ mag, with a scatter of 0.020 mag. The increased scatter for the larger aperture results from the treatment of contaminating sources, companion galaxies, etc. We are confident, therefore, that our photometric system is internally consistent to better than 0.01 mag. Applying the same year-to-year test for $D_n$ measurements, we find an offset between the runs of $0.000 \pm 0.001$ dex.

Since our photometric data are on the same system, we can combine repeated measurements of log $D_n$, log $A_e$ and $langle \mu_r e \rangle$, to give simple mean values. These are presented in Table 3 along with the spectroscopic parameters for each galaxy.

From a subset of 50 galaxies which have repeat observations, an estimate can be made of the typical uncertainty in our measurements of the photometric parameters. Figure 11 shows the comparison of these measurements. The scatter implies an error of 0.005 in each determination of log $D_n$. For the FP parameters taken individually, the scatters are larger: 0.032 dex on $A_e$ and 0.113 mag. arcsec$^{-2}$ on $langle \mu_r e \rangle$. The errors on these parameters are correlated, however. If we construct the quantity log $A_e - 0.3(langle \mu_r e \rangle$, the combination often used to give an edge-on projection of the Fundamental Plane, we find that the uncertainty in this quantity is only 0.006, only slightly larger than that on log $D_n$.

4.5 External comparisons

4.5.1 Aperture photometry

Figure 12 illustrates comparisons between our CCD aperture magnitudes, and R-band magnitudes tabulated by other authors, for galaxies in common. The comparisons are quantified in Table 10.

In the comparison with the photoelectric aperture photometry of Colless et al. (1993), we find a scatter which is well matched to the quadrature sum of our internal errors quoted above, and the similar uncertainties claimed by Colless et al. There exists, however, a small but significant offset of 0.037 mag. between the two datasets.
brightenings from their paper are therefore corrected for a colour of 0.37 mag, in $r - R$.

The FP variables are compared in combination rather than separately, since the individual parameters log $A_e$ and $\langle \mu \rangle_e$ can acquire correlated mean offsets from author to author, when the profile fit is performed over different ranges. The FP combination is, however, robust against changes to the range of fit.

The R-band photometry of Steel offers an independent validation of the present data, free from complications concerning band mis-matches, etc. The two samples agree to within 0.003 in both log $D_n$ and the FP combination.

From the excellent agreement of the R-band $D_n$ measurements, presented here, with the V-band data of Lucey et al., we justify, a posteriori, the definition of our R-band $D_n$ diameter at $\langle \mu \rangle_R = 19.23$ mag. The slight trend may be a reflection of the $V - R$ colour–magnitude relation for the Coma cluster. The slope found here (converted to magnitudes) is $-0.03 \pm 0.01$, which may be compared with the $V - K$ colour–magnitude slope of $-0.08 \pm 0.01$ reported by Bower et al. (1992). We note that the trend is in the expected sense, such that brighter galaxies are redder.

The $D_n$ comparison with the Gunn-r data of Jørgensen et al. exhibits a curious bimodality. This is a result of their data being presented to only two decimal places in log $D_n$, rather than three, as in our data. This is unfortunate, since their data is clearly more accurate than quoted, the dispersion given in Table 1 being consequently overestimated.

The significant offset found between this work and that of Jørgensen et al. is, of course, sensitive to the adopted $r - R$ colour. From a comparison of our aperture magnitudes with magnitudes predicted from their tabulated r-band parameters, we derive a mean $r - R$ colour of 0.33 mag. If a colour correction were applied based on this result, the offsets of between this work and that of Jørgensen et al. would be reduced to 0.004±0.002 in log $D_n$ and $-0.006\pm0.003$ in the FP combination.

The photoelectric data of Burstein et al. have been corrected for the $(1 + z)^4$ surface brightness dimming before comparison. The large offsets with respect to this source can be accounted for by the absence of a seeing correction in their data, as demonstrated by Jørgensen et al.

The scatter in the comparisons is sufficiently small that our $D_n / FP$ measurements may be brought onto a system consistent with external CCD data, to within 0.003 dex in implied distance.

5 CONCLUSION

This paper has presented spectroscopic and photometric data to be used in a study of cluster peculiar motions in the Perseus–Pisces supercluster. The data comprise observations of 137 early-type galaxies in 9 clusters, and additional standard galaxies.

From intermediate-dispersion spectroscopy, the velocity dispersion $\sigma$ has been derived for each galaxy, with a typical uncertainty of 7.6 per cent per measurement. The spectroscopic data also yield recession velocities ($cz$) (to an uncertainty of about 30 km s$^{-1}$), and Mg$_2$ indices (typical
error 0.010 mag. per measurement). Extensive external comparisons are presented, allowing the $\sigma$ and Mg$_2$ data to be placed onto a new ‘standard system’, with an uncertainty of less than 0.01 dex.

R-band CCD photometry is used to derive global photometric parameters. The photometric data comprise effective diameter ($A_e$), mean surface brightness within effective diameter ($\langle \mu \rangle_e$), and an R-band $D_n$ parameter, defined analogously to the B-band photometric diameter of Dressler et al. (1987). The scatter of repeat observations indicates the following uncertainties – log $A_e$: ±0.032; $\langle \mu \rangle_e$: ±0.113; log $D_n$: ±0.005; log $A_e$ – $0.3 \langle \mu \rangle_e$: ±0.006. The aperture magnitudes, from which the profile is determined, show systematic offsets (at the level of a few 0.01 mag) with respect to literature data. The derived log $D_n$ and Fundamental Plane parameter (log $A_e$ – $0.3 \langle \mu \rangle_e$) show a typical scatter of ~0.010 with respect to similar data from the literature.

The scatter in the FP relation is ~0.08 dex, so that intrinsic scatter is dominant over random measurement errors. Currently, a major challenge in peculiar velocity work is to recognize and reduce the effects of systematic errors. We will defer until Paper II, a full discussion concerning such errors. For the present, we note that the high quality of the data presented here, together with the generous overlap secured with literature datasets, will allow us to address realistically the systematic errors in our peculiar velocity measurements.

ACKNOWLEDGMENTS

The Isaac Newton Telescope and Jacobus Kapteyn Telescope are operated on the island of La Palma by the Royal Greenwich Observatory in the Spanish Observatorio del Roque de los Muchachos of the Instituto de Astrofísica de Canarias. Data reduction was performed using Starlink facilities at Durham. JS and RJS acknowledge financial support from the PPARC. MJH acknowledges financial support from the PPARC; from a CITA National Fellowship; and from the Natural Sciences and Engineering Research Council of Canada, through operating grants to F. D. A. Hartwick and C. J. Pritchet. Alan Dressler is thanked for providing information for the subdivision of his Las Campanas datasets.

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Figure 12. External comparisons of $D_n$ and FP combination ($\log A_e - 0.3(\mu_e)$). The comparison data are taken from Steel (1997) (R-band), Lucey et al. (1997) (V-band), Jørgensen et al. (1995b) (r-band) and Burstein et al. (1987) (B-band). $\Delta D_n$ and $\Delta$FP are plotted in the sense ‘this work’ – ‘literature’, against the mean of our measurement and the literature value. The dotted line indicates the mean offset in each panel.
Table 11. Raw spectroscopic data. In addition to our reference number for each galaxy, we tabulate under ‘Other ID’ the relevant number from NGC, IC, UGC, CGCG catalogues, or from other published work. For each individual observation we list: the dataset from which values derive; $cz = \text{heliocentric recession velocity}$; $\sigma = \text{central velocity dispersion (kms}^{-1}\text{)}$; $\epsilon_{\sigma} = \text{poisson error on } \sigma$; $Mg_2 = \text{magnesium index (magnitudes)}$ and $\epsilon_{Mg_2} = \text{Poisson error on } Mg_2$.

| Our ID | Other ID | Dataset | $cz$ | $\sigma$ | $\epsilon_{\sigma}$ | $Mg_2$ | $\epsilon_{Mg_2}$ |
|--------|----------|---------|------|--------|-------------------|-------|-----------------|
| S01    | N0079    | TEK94   | 5479 | 194    | 11                | 0.307 | 0.012           |
| S02    | N0085A   | TEK94   | 6189 | 108    | 6                 | 0.239 | 0.012           |
| S03    | N0083    | TEK94   | 6263 | 253    | 14                | 0.321 | 0.013           |
| S04    | N0080    | TEK94   | 5748 | 261    | 12                | 0.300 | 0.010           |
| S05    | I1548    | TEK94   | 5734 | 249    | 13                | 0.305 | 0.009           |
| S06    | -        | TEK94   | 5775 | 149    | 6                 | 0.197 | 0.008           |
| S07    | CGCG457-008 | TEK94 | 5926 | 115    | 8                 | 0.254 | 0.012           |

Cluster : Taurus

| Z01026 | N0398 | EEV93 | 4912 | 104 | 6 | 0.261 | 0.009 |
| Z01027 | N0379 | EEV93 | 5503 | 225 | 10 | 0.298 | 0.009 |
| Z01030 | N0380 | EEV93 | 5492 | 243 | 16 | 0.287 | 0.012 |
| Z01032 | -     | EEV93 | 4753 | 104 | 9 | 0.262 | 0.015 |
| Z01034 | CGCG501-077 | EEV93 | 5151 | 115 | 11 | 0.258 | 0.013 |
| Z01035 | N0383 | EEV93 | 5082 | 269 | 11 | 0.293 | 0.008 |
| Z01036 | I1618 | EEV93 | 4720 | 90 | 9 | 0.214 | 0.017 |
| Z01041 | N0386 | EEV93 | 5563 | 145 | 9 | 0.248 | 0.012 |
| Z01043 | N0375 | EEV93 | 5154 | 314 | 13 | 0.306 | 0.009 |
| Z01046 | N0388 | EEV93 | 5243 | 222 | 10 | 0.275 | 0.009 |
| Z01049 | N0384 | EEV93 | 4258 | 275 | 10 | 0.313 | 0.008 |
| Z01053 | CGCG501-102 | EEV93 | 5174 | 172 | 10 | 0.276 | 0.011 |
| Z02057 | N0420 | EEV93 | 5038 | 196 | 13 | 0.229 | 0.011 |
| Z04035 | -     | EEV93 | 23995 | 261 | 17 | 0.238 | 0.013 |
| Z04049 | N0394 | EEV93 | 4378 | 172 | 7 | 0.253 | 0.010 |
| Z04050 | N0392 | EEV93 | 4684 | 234 | 8 | 0.291 | 0.008 |
| Z04051 | N0397 | TEK94 | 4988 | 124 | 8 | 0.258 | 0.009 |
| Z05034 | I1638 | EEV93 | 4810 | 141 | 8 | 0.256 | 0.010 |
| Z05044 | I1648 | TEK94 | 5541 | 124 | 8 | 0.260 | 0.010 |
| Z05052 | N0410 | EEV93 | 5315 | 292 | 11 | 0.344 | 0.007 |
| Z10020 | -     | TEK94 | 4852 | 85 | 7 | 0.227 | 0.013 |
### Table 11 – continued

| Our ID   | Other ID | Dataset | cz  | $\sigma$ | $\epsilon$ | $\epsilon_{Mg2}$ | $\epsilon_{Mg2}$ |
|----------|----------|---------|-----|----------|------------|-----------------|----------------|
| Z14028   | CCGG501-070 TEK94 | 4264 | 206 | 8 | 0.328 | 0.008 |
| Z16012   | - EEV93 | 4252 | 192 | 10 | 0.307 | 0.009 |
| Z17005   | - TEK94 | 4651 | 105 | 6 | 0.205 | 0.010 |

**Cluster: HMS0122+3305**

| Cluster ID | Other ID | Dataset | cz  | $\sigma$ | $\epsilon$ | $\epsilon_{Mg2}$ | $\epsilon_{Mg2}$ |
|------------|----------|---------|-----|----------|------------|-----------------|----------------|
| H01022     | N0528 EEV93 | 4806 | 245 | 9 | - | - |
| H01027     | - TEK94 | 4976 | 99 | 9 | 0.210 | 0.011 |
| H01041     | N0499 EEV93 | 4387 | 267 | 13 | - | - |
| H01044     | N0501 TEK94 | 5010 | 163 | 15 | 0.304 | 0.011 |
| H01056     | H1680 TEK94 | 4418 | 136 | 6 | 0.267 | 0.010 |

**Cluster: A0262**

| Cluster ID | Other ID | Dataset | cz  | $\sigma$ | $\epsilon$ | $\epsilon_{Mg2}$ | $\epsilon_{Mg2}$ |
|------------|----------|---------|-----|----------|------------|-----------------|----------------|
| A01043     | N0687 EEV93 | 5112 | 204 | 10 | 0.276 | 0.011 |
| A01047     | CCGG522-048 TEK94 | 4151 | 144 | 7 | 0.263 | 0.008 |
| A01067     | N0703 TEK94 | 5580 | 225 | 8 | 0.311 | 0.008 |
| A01069     | N0708 TEK94 | 4855 | 219 | 16 | 0.321 | 0.016 |
| A01071     | N0705 EEV93 | 4874 | 230 | 18 | 0.316 | 0.013 |
| A01074     | N0704 EEV93 | 4709 | 161 | 10 | 0.296 | 0.013 |

**Cluster: J8**

| Cluster ID | Other ID | Dataset | cz  | $\sigma$ | $\epsilon$ | $\epsilon_{Mg2}$ | $\epsilon_{Mg2}$ |
|------------|----------|---------|-----|----------|------------|-----------------|----------------|
| J01049     | CCGG483-070 EEV93 | 8555 | 316 | 24 | 0.298 | 0.012 |
| J01055     | - TEK94 | 8556 | 312 | 17 | 0.308 | 0.009 |
| J01056     | CCGG483-068 EEV93 | 9438 | 212 | 17 | 0.333 | 0.016 |
| J01060     | I1803 TEK94 | 9583 | 366 | 13 | 0.337 | 0.007 |
| J01065     | - TEK94 | 9103 | 133 | 10 | 0.153 | 0.010 |
| J01067     | EFAJ-8-I TEK94 | 9233 | 199 | 11 | 0.301 | 0.012 |
Table 11 – continued

| Our ID   | Other ID | Dataset | cz  | σ  | ε  | Mg2 | εMg2 |
|----------|----------|---------|-----|----|----|-----|------|
| J01069   | I1807    | TEK94   | 9694 | 199 | 9  | 0.266 | 0.009 |
| J01070   | I1806    | EEV93   | 9013 | 208 | 14 | 0.252 | 0.014 |
| J01080   | I1807    | TEK94   | 10190 | 177 | 23 | 0.306 | 0.017 |
| J01090   | I1807    | TEK94   | 10211 | 219 | 11 | 0.296 | 0.011 |
| J01099   | I1809    | TEK94   | 10236 | 245 | 24 | 0.286 | 0.018 |
| J01100   | I1807    | TEK94   | 9731  | 164 | 12 | 0.240 | 0.012 |
| J01101   | I1807    | TEK94   | 9929  | 264 | 27 | 0.244 | 0.017 |
| J01102   | I1807    | TEK94   | 9927  | 242 | 19 | 0.265 | 0.011 |
| J02000   | I1807    | TEK94   | 9286  | 135 | 5  | 0.273 | 0.007 |
| J02001   | I1808    | TEK94   | 10136 | 182 | 11 | 0.269 | 0.012 |
| J02002   | I1808    | TEK94   | 10099 | 81  | 11 | 0.167 | 0.017 |
| J02003   | I1808    | TEK94   | 9802  | 204 | 11 | 0.283 | 0.010 |
| J02004   | I1808    | TEK94   | 9817  | 196 | 14 | 0.267 | 0.018 |
| Cluster : Perseus (A0426) |
| P01      | I0293    | EEV93   | 4704  | 150 | 11 | 0.260 | 0.015 |
| P02      | I0224    | TEK94   | 5235  | 247 | 10 | 0.270 | 0.009 |
| P03      | B0310    | TEK94   | 5560  | 218 | 12 | 0.249 | 0.010 |
| P04      | B0312    | EEV93   | 4978  | 222 | 13 | 0.296 | 0.012 |
| P05      | CR19     | TEK94   | 3544  | 123 | 10 | 0.239 | 0.015 |
| P06      | CR20     | TEK94   | 6454  | 188 | 13 | 0.271 | 0.017 |
| P07      | CR21     | TEK94   | 6469  | 215 | 11 | 0.259 | 0.012 |
| P08      | CR22     | TEK94   | 4247  | 159 | 14 | 0.275 | 0.014 |
| P09      | CR23     | TEK94   | 4965  | 351 | 16 | 0.350 | 0.008 |
| P10      | CR24     | TEK94   | 5019  | 341 | 14 | 0.355 | 0.014 |
| P11      | PER195   | TEK94   | 8391  | 163 | 7  | 0.275 | 0.009 |
| P12      | PER199   | TEK94   | 8392  | 193 | 20 | 0.283 | 0.018 |
| P13      | PER199   | TEK94   | 5078  | 226 | 16 | 0.275 | 0.016 |
| P14      | PER199   | TEK94   | 5105  | 210 | 14 | 0.290 | 0.016 |
| P15      | PER199   | TEK94   | 5113  | 213 | 7  | 0.279 | 0.008 |
| P16      | PER199   | TEK94   | 8053  | 171 | 13 | 0.266 | 0.012 |
| P17      | N1272    | TEK94   | 3802  | 272 | 16 | 0.331 | 0.011 |
| P18      | N1273    | TEK94   | 5387  | 207 | 15 | 0.249 | 0.013 |
| P19      | I1907    | EEV93   | 4479  | 195 | 18 | 0.278 | 0.016 |
| P20      | BGP111   | TEK94   | 3963  | 86  | 8  | 0.279 | 0.020 |
| P21      | PER152   | TEK94   | 3937  | 142 | 9  | 0.309 | 0.015 |
| P22      | CR36     | EEV93   | 7460  | 202 | 14 | 0.280 | 0.012 |
| P23      | N1278    | TEK94   | 6044  | 235 | 15 | 0.292 | 0.011 |
| P24      | N1281    | TEK94   | 4300  | 276 | 12 | 0.324 | 0.010 |
| P25      | N1282    | TEK94   | 2210  | 213 | 7  | 0.292 | 0.009 |
| P26      | BGP59    | TEK94   | 5315  | 207 | 9  | 0.283 | 0.010 |
| P27      | U02673   | EEV93   | 4424  | 197 | 14 | 0.288 | 0.013 |
| P28      | N1283    | TEK94   | 6744  | 224 | 12 | 0.277 | 0.012 |
| P29      | N1285    | TEK94   | 6735  | 204 | 13 | 0.277 | 0.012 |
| P30      | N1283    | EEV93   | 6735  | 204 | 13 | 0.277 | 0.012 |
| P31      | PER153   | TEK94   | 5483  | 200 | 11 | 0.293 | 0.013 |
| P32      | PER153   | TEK94   | 5480  | 164 | 7  | 0.278 | 0.012 |
| P33      | BGP33    | TEK94   | 4950  | 168 | 8  | 0.289 | 0.009 |
| P34      | B0313    | TEK94   | 4432  | 242 | 11 | 0.331 | 0.009 |
| P35      | N1293    | TEK94   | 4170  | 216 | 12 | 0.293 | 0.011 |
| P36      | N1293    | EEV93   | 4149  | 218 | 23 | 0.307 | 0.015 |
| P37      | U02698   | EEV93   | 6472  | 373 | 22 | 0.318 | 0.012 |
| P38      | U02717   | EEV93   | 6421  | 364 | 14 | 0.340 | 0.009 |
| P39      | U02725   | TEK94   | 6215  | 220 | 10 | 0.293 | 0.008 |


Table 11 – continued

| Our ID | Other ID | Dataset | cz   | σ   | ε   | Mg2  | εMg2 |
|--------|----------|---------|------|-----|-----|------|------|
|        |          |         |      |     |     |      |      |
| Cluster : Coma (A1656) | | | | | | | |
| N4875  | COMA-D104 | EEV93  | 8047 | 168 | 13  | 0.272 | 0.014 |
| N4886  | COMA-D151 | EEV93  | 6372 | 167 | 8   | 0.252 | 0.014 |
| N4860  | COMA-D194 | EEV93  | 7944 | 312 | 27  | 0.324 | 0.015 |
| N4881  | COMA-D217 | EEV93  | 6732 | 166 | 14  | 0.270 | 0.016 |
| I4011  | COMA-D150 | EEV93  | 7233 | 113 | 13  | 0.260 | 0.012 |
| COMA-D125 |         | EEV93  | 6910 | 174 | 19  | 0.232 | 0.017 |
| Cluster : A2199 | | | | | | | |
| A21-F113 | - | TEK94 | 7995 | 169 | 14  | 0.242 | 0.016 |
| A21-F114 | - | TEK94 | 8068 | 163 | 12  | 0.263 | 0.013 |
| A21-F121 | A2199-S26 | TEK94 | 8783 | 177 | 15  | 0.270 | 0.013 |
| A21-F144 | A2199-S30 | TEK94 | 8754 | 170 | 11  | 0.278 | 0.012 |
| A21-F145 | - | TEK94 | 7586 | 152 | 8   | 0.270 | 0.012 |
| A21-F146 | A2199-S34 | TEK94 | 8302 | 154 | 9   | 0.263 | 0.014 |
| A21-F164 | N6166 | TEK94 | 9329 | 269 | 25  | 0.321 | 0.014 |
| A21-Z34A | A2199-Z34A | TEK94 | 8724 | 208 | 10  | 0.260 | 0.008 |
| A21-Z34AC | - | TEK94 | 8949 | 227 | 9   | 0.297 | 0.008 |
| N6158  | - | TEK94 | 8936 | 197 | 14  | 0.272 | 0.016 |
| Cluster : A2634 | | | | | | | |
| A26-F102 | A2634-D107 | TEK94 | 9298 | 213 | 13  | -    | -    |
| A26-F1201 | A2634-D79 | TEK94 | 10156 | 188 | 12  | 0.272 | 0.014 |
| A26-F121 | A2634-D80 | TEK94 | 9547 | 206 | 16  | 0.284 | 0.014 |
| A26-F1221 | N7720 | EEV93 | 9117 | 354 | 23  | 0.308 | 0.010 |
| A26-F1222 | A2634-D76 | EEV93 | 8107 | 230 | 15  | 0.276 | 0.013 |
| A26-F129 | A2634-D74 | EEV93 | 8423 | 199 | 16  | 0.267 | 0.015 |
| A26-F134 | A2634-D55 | EEV93 | 9281 | 221 | 14  | 0.279 | 0.012 |
| A26-F138 | A2634-D58 | EEV93 | 10883 | 240 | 18  | 0.287 | 0.012 |
| A26-F139 | A2634-D57 | EEV93 | 9604 | 206 | 11  | 0.300 | 0.012 |
| A26-F1482 | A2634-D38 | TEK94 | 9345 | 240 | 22  | -    | -    |

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### Table 11 – continued

| Our ID  | Other ID  | Dataset  | cz   | σ   | εcz | Mg2  | εMg2 |
|---------|-----------|----------|------|-----|-----|------|------|
| N0541   | -         | TEK94    | 5443 | 218 | 13  | 0.307| 0.010|
| N0545   | -         | TEK94    | 5341 | 244 | 10  | 0.303| 0.008|
| N0547   | -         | TEK94    | 5545 | 250 | 12  | 0.314| 0.008|
| N0548   | -         | TEK94    | 5410 | 148 | 8   | 0.237| 0.011|
| N0584   | -         | TEK94    | 1833 | 205 | 11  | 0.291| 0.009|
| N0596   | -         | TEK94    | 1872 | 162 | 5   | 0.251| 0.006|
| N0621   | U01147    | EEV93    | 5086 | 198 | 12  | 0.273| 0.013|
| N0661   | U01215    | EEV93    | 3827 | 197 | 7   | 0.288| 0.008|
| N0680   | U01286    | EEV93    | 3817 | 186 | 6   | 0   | 0    |
| N0741   | -         | TEK94    | 5545 | 264 | 23  | 0.343| 0.029|
| N0770   | U01463    | EEV93    | 2569 | 111 | 10  | 0.213| 0.012|
| N0821   | -         | TEK94    | 1758 | 196 | 13  | 0.304| 0.014|
| N0936   | -         | TEK94    | 1439 | 205 | 12  | 0.304| 0.014|
| N0968   | U02040    | EEV93    | 3627 | 237 | 11  | 0.267| 0.011|
| N1023   | -         | EEV93    | 614  | 194 | 18  | 0.326| 0.014|
| N1198   | U02533    | EEV93    | 1592 | 74  | 6   | 0.113| 0.008|
| N3377   | -         | EEV93    | 655  | 174 | 7   | 0.274| 0.006|
| N3379   | -         | EEV93    | 679  | 129 | 7   | 0.206| 0.007|
| N3384   | -         | EEV93    | 896  | 216 | 5   | 0.313| 0.004|
| N3412   | -         | EEV93    | 735  | 171 | 4   | 0.310| 0.006|
| N3489   | -         | EEV93    | 857  | 104 | 4   | 0.238| 0.007|
| N3862   | -         | EEV93    | 690  | 96  | 4   | 0.188| 0.005|
| N4472   | -         | EEV93    | 966  | 270 | 18  | 0.307| 0.017|
| N4478   | -         | EEV93    | 1356 | 159 | 11  | 0.270| 0.022|
| N4564   | -         | EEV93    | 1158 | 191 | 19  | 0.380| 0.015|
| N6173   | -         | TEK94    | 8790 | 292 | 13  | 0.295| 0.007|
| N6411   | -         | TEK94    | 3756 | 192 | 13  | 0.277| 0.011|
| N6482   | -         | TEK94    | 3845 | 175 | 7   | 0.209| 0.009|
| N6494   | -         | TEK94    | 3931 | 295 | 14  | 0.329| 0.016|
| N6702   | -         | TEK94    | 4761 | 196 | 12  | 0.263| 0.013|
| N6703   | -         | TEK94    | 4748 | 169 | 9   | 0.202| 0.011|
| N6703   | -         | TEK94    | 4739 | 177 | 16  | 0.293| 0.012|
| N6703   | -         | TEK94    | 2393 | 190 | 12  | 0.281| 0.010|
| N7236   | -         | TEK94    | 2408 | 201 | 8   | 0.265| 0.007|
| N7237   | -         | TEK94    | 2388 | 195 | 7   | 0.281| 0.007|
| N7385   | -         | TEK94    | 7879 | 247 | 10  | 0.270| 0.008|
| N7391   | -         | TEK94    | 7868 | 203 | 11  | 0.312| 0.014|
| N7454   | -         | TEK94    | 7856 | 282 | 15  | 0.321| 0.009|
| N7562   | -         | TEK94    | 3048 | 259 | 9   | 0.324| 0.009|
| N7617   | -         | TEK94    | 3814 | 337 | 12  | 0.335| 0.007|
| N7619   | -         | TEK94    | 3836 | 338 | 14  | 0   | 0    |
| N7626   | -         | TEK94    | 3425 | 281 | 13  | 0.322| 0.010|
| N7768   | -         | TEK94    | 3454 | 274 | 7   | 0   | 0    |
| I2955   | -         | EEV93    | 6478 | 245 | 20  | 0.228| 0.019|
| U02554  | -         | TEK94    | 2863 | 135 | 19  | 0.261| 0.017|
| U03115  | -         | TEK94    | 3255 | 120 | 18  | 0.119| 0.021|
| Q05     | CGCG477-023 | TEK94   | 8432 | 204 | 11  | 0.296| 0.010|
Table 12. Photometric data. Together with identification numbers, we tabulate: $R_{20}$ = raw magnitude within 20 arcsec diameter aperture; $A_B$ = B-band galactic extinction; psf = FWHM seeing (arcsec), as measured from stellar images; log $A_e$ = log effective diameter (arcsec); $\langle \mu \rangle_e$ = mean surface brightness (mag. arcsec$^{-2}$) within $A_e$; rms = rms residual of galaxy profile to best-fit $R^{1/4}$ law (magnitudes); log $D_n$ = log R-band photometric $D_n$ parameter (arcsec).

| Cluster : 7S21 | | | | | |
|----------------|------------------|---------|-----|------|------|-----------|
| Our ID | Other ID | $R_{20}$ | $A_B$ | psf | log $A_e$ | $\langle \mu \rangle_e$ | rms | log $D_n$ |
| S01 | N0079 | 13.69 | 0.05 | 1.8 | 1.354 | 20.00 | 0.01 | 1.132 |
| S02 | N0085A | 14.16 | 0.05 | 1.5 | 1.502 | 20.99 | 0.03 | 0.953 |
| S03 | N0083 | 13.10 | 0.09 | 1.5 | 1.659 | 20.43 | 0.04 | 1.318 |
| S04 | N0080 | 12.95 | 0.09 | 1.6 | 1.691 | 20.28 | 0.04 | 1.364 |
| S05 | I1548 | 14.04 | 0.09 | 1.2 | 0.992 | 18.91 | 0.03 | 1.072 |
| S06 | - | 14.88 | 0.09 | 1.0 | 1.128 | 20.34 | 0.01 | 0.796 |
| S07 | CGCG457-008 | 14.07 | 0.11 | 1.3 | 1.128 | 19.47 | 0.02 | 1.055 |

| Cluster : Pisces | | | | | |
|------------------|------------------|---------|-----|------|------|-----------|
| Z01026 | N0398 | 14.10 | 0.18 | 1.1 | 1.155 | 19.63 | 0.01 | 1.046 |
| Z01027 | N0379 | 12.92 | 0.17 | 1.2 | 1.518 | 19.81 | 0.07 | 1.380 |
| Z01030 | N0380 | 12.86 | 0.17 | 1.1 | 1.341 | 19.03 | 0.03 | 1.385 |
| Z01031 | N0381 | 12.65 | 0.17 | 1.5 | 1.307 | 18.90 | 0.02 | 1.387 |
| Z01032 | - | 14.78 | 0.18 | 2.0 | 1.100 | 20.08 | 0.01 | 1.852 |
| Z01034 | CGCG501-077 | 14.19 | 0.16 | 1.0 | 1.192 | 19.79 | 0.04 | 1.026 |
| Z01035 | N0382 | 12.59 | 0.17 | 1.0 | 1.788 | 20.27 | 0.04 | 1.483 |
| Z01035C1 | N0383 | 12.58 | 0.17 | 1.2 | 1.791 | 20.27 | 0.04 | 1.486 |
| Z01046 | N0384 | 13.64 | 0.17 | 1.0 | 1.093 | 19.93 | 0.04 | 1.186 |
| Z01047 | - | 14.44 | 0.17 | 0.8 | 0.839 | 18.66 | 0.01 | 0.991 |
| Z01049 | N0385 | 13.24 | 0.17 | 1.1 | 1.187 | 18.88 | 0.02 | 1.281 |
| Z01073 | CGCG501-102 | 14.08 | 0.18 | 1.1 | 1.072 | 19.22 | 0.04 | 1.283 |
| Z02057 | N0420 | 13.08 | 0.16 | 1.1 | 1.523 | 19.87 | 0.02 | 1.330 |
| Z04049 | N0394 | 13.61 | 0.18 | 1.1 | 1.074 | 18.82 | 0.01 | 1.188 |
| Z04050 | N0392 | 13.00 | 0.18 | 1.1 | 1.366 | 19.26 | 0.02 | 1.351 |
| Z04051 | N0397 | 13.01 | 0.18 | 1.1 | 1.382 | 19.32 | 0.02 | 1.351 |
| Z05034 | I1638 | 14.36 | 0.18 | 1.0 | 1.005 | 19.25 | 0.01 | 1.350 |
| Z05044 | I1648 | 14.34 | 0.18 | 1.8 | 1.032 | 19.32 | 0.02 | 1.003 |
| Z05052 | N0410 | 13.80 | 0.16 | 1.1 | 1.236 | 19.60 | 0.03 | 1.119 |
| Z10092 | CGCG501-126 | 14.62 | 0.20 | 1.4 | 1.134 | 20.08 | 0.03 | 0.879 |
| Z14028 | CGCG501-070 | 13.78 | 0.18 | 1.2 | 0.928 | 18.39 | 0.02 | 1.143 |
| Z16012 | - | 14.35 | 0.18 | 1.4 | 1.011 | 18.62 | 0.03 | 1.183 |
| Z17005 | - | 14.47 | 0.17 | 1.5 | 0.937 | 19.14 | 0.03 | 0.969 |

Cluster : HMS0122+3305

| H01022 | N0528 | 13.05 | 0.17 | 1.2 | 1.330 | 19.20 | 0.01 | 1.338 |
| H01041 | N0499 | 12.55 | 0.17 | 1.2 | 1.545 | 19.44 | 0.01 | 1.481 |
| H01044 | N0501 | 14.14 | 0.16 | 1.2 | 1.029 | 19.16 | 0.02 | 1.041 |
| H01051 | CGCG502-043 | 14.08 | 0.13 | 1.1 | 1.100 | 19.41 | 0.01 | 1.048 |
| H01056 | I1680 | 14.03 | 0.17 | 1.1 | 1.035 | 19.05 | 0.03 | 1.073 |
### Table 12 – continued

| Cluster | Our ID | psf | log A_p | log D_n | Our ID | psf | log A_p | log D_n |
|---------|--------|-----|---------|---------|--------|-----|---------|---------|
| Cluster : A0262 | B02 | U01837 | 13.52 | 0.34 | 1.4 | 1.589 | 20.43 | 0.01 | 1.234 |
| | B03 | U01841 | 13.18 | 0.34 | 1.4 | 1.826 | 20.77 | 0.02 | 1.344 |
| | B03C | - | 13.22 | 0.34 | 1.4 | 1.799 | 20.74 | 0.02 | 1.329 |
| | B06 | U01859 | 13.20 | 0.31 | 1.4 | 1.822 | 19.86 | 0.02 | 1.321 |
| | B07 | CGCG538-065 | 13.66 | 0.39 | 1.5 | 1.888 | 19.20 | 0.01 | 1.203 |
| | B08 | N969 | 13.48 | 0.27 | 1.2 | 1.841 | 19.36 | 0.03 | 1.235 |
| | B09 | N910 | 13.42 | 0.27 | 1.4 | 1.025 | 21.66 | 0.01 | 1.227 |
| | B10 | N911 | 13.21 | 0.27 | 1.5 | 1.206 | 18.81 | 0.02 | 1.312 |
| | B11 | N912 | 13.81 | 0.24 | 1.2 | 1.219 | 19.52 | 0.01 | 1.138 |
| | B16 | CGCG539-042 | 13.88 | 0.30 | 1.6 | 1.336 | 19.94 | 0.03 | 1.120 |
| Cluster : A0347 | J01049 | CGCG483-070 | 13.93 | 0.31 | 1.5 | 1.612 | 19.32 | 0.01 | 1.136 |
| | J01055 | - | 14.43 | 0.28 | 1.4 | 1.917 | 22.31 | 0.02 | 0.829 |
| | J01056 | CGCG483-068 | 14.08 | 0.31 | 1.4 | 1.667 | 21.14 | 0.03 | 1.058 |
| | J01060 | I1803 | 13.43 | 0.28 | 1.8 | 1.278 | 19.22 | 0.02 | 1.273 |
| | J01065 | - | 14.83 | 0.28 | 2.0 | 0.856 | 19.01 | 0.01 | 0.912 |
| | J01067 | EFAR-J8-I | 14.65 | 0.28 | 1.0 | 0.829 | 19.90 | 0.02 | 0.914 |
| | J01069 | I1807 | 14.19 | 0.31 | 2.0 | 1.118 | 19.44 | 0.03 | 1.062 |
| | J01070 | I1806 | 14.37 | 0.31 | 2.4 | 1.299 | 20.22 | 0.01 | 1.004 |
| | J01080 | - | 14.37 | 0.31 | 1.8 | 1.290 | 20.20 | 0.01 | 1.004 |
| | J01082 | - | 15.09 | 0.34 | 1.8 | 0.869 | 19.28 | 0.01 | 0.855 |
| | J03049 | - | 14.11 | 0.28 | 2.2 | 1.431 | 20.48 | 0.01 | 1.062 |
| | J07038 | - | 14.11 | 0.28 | 1.6 | 1.445 | 20.53 | 0.02 | 1.062 |
| | J08035 | - | 15.07 | 0.32 | 2.4 | 0.991 | 19.74 | 0.01 | 0.846 |
| | J08036 | EFAR-J8-K | 14.53 | 0.33 | 1.9 | 1.215 | 20.06 | 0.02 | 0.972 |
| | J09035 | - | 14.84 | 0.35 | 2.0 | 1.197 | 20.99 | 0.02 | 0.972 |
| Cluster : Perseus (A0426) | P01 | I0293 | 13.93 | 0.56 | 0.9 | 1.597 | 20.76 | 0.03 | 1.114 |
| | P02 | N1224 | 13.34 | 0.56 | 1.0 | 1.455 | 19.71 | 0.01 | 1.322 |
| | P03 | I0310 | 13.20 | 0.60 | 1.0 | 1.628 | 20.06 | 0.01 | 1.377 |
| | P05 | I0312 | 13.49 | 0.76 | 1.2 | 1.399 | 19.58 | 0.03 | 1.310 |
| | P07 | CR19 | 14.69 | 0.65 | 1.3 | 1.356 | 20.61 | 0.02 | 0.912 |
| | P08 | CR20 | 13.70 | 0.65 | 1.3 | 1.482 | 20.14 | 0.04 | 1.234 |
| | P11 | BGP44 | 14.25 | 0.60 | 1.1 | 1.726 | 19.94 | 0.02 | 1.072 |
| | P12 | N1270 | 13.00 | 0.65 | 1.2 | 1.656 | 18.23 | 0.02 | 1.419 |
| | P13 | PER195 | 13.01 | 0.65 | 1.5 | 1.145 | 18.17 | 0.02 | 1.416 |
| | P14 | PER199 | 14.10 | 0.69 | 1.1 | 1.052 | 18.88 | 0.02 | 1.147 |
### Table 12 – continued

| Cluster | Name | RA (deg) | Dec (deg) | Distance (Mpc) | Redshift | Type | Mass (M☉) | Temperature (K) | X-ray Luminosity (Lx) |
|---------|------|----------|----------|----------------|-----------|------|-----------|-----------------|-----------------------|
| Perseus | A2199 | 15.45 | 0.00 | 1.3 | 0.617 | 18.74 | 0.00 | 0.750 |
| Pisces  | A2199-S26 | 14.43 | 0.00 | 1.7 | 1.265 | 20.38 | 0.00 | 0.924 |
|         | A2199-S30 | 14.74 | 0.00 | 1.2 | 0.599 | 17.93 | 0.01 | 0.934 |
|         | A2199-S34 | 14.76 | 0.00 | 1.3 | 0.602 | 17.88 | 0.00 | 0.927 |
|         | A2199-Z34A | 14.60 | 0.00 | 1.3 | 1.182 | 20.28 | 0.00 | 0.866 |
|         | A2199-Z34B | 15.30 | 0.00 | 1.3 | 0.696 | 18.93 | 0.01 | 0.779 |
|         | A2199-Z34C | 15.30 | 0.00 | 1.3 | 1.251 | 19.95 | 0.00 | 1.035 |

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| Our ID | Other ID | $R_{20}$ | $A_B$ | psf | log $A_e$ | $\langle \mu \rangle_e$ | rms | log $D_n$ |
|--------|----------|---------|-------|-----|--------|--------|-----|---------|
| A26-F1201 | A2634-D79 | 15.18 | 0.18 | 1.6 | 0.791 | 19.11 | 0.01 | 0.823 |
|         |          | 15.17 | 0.18 | 2.5 | 0.803 | 19.16 | 0.01 | 0.819 |
| A26-F121 | A2634-D80 | 15.28 | 0.18 | 1.6 | 0.660 | 18.64 | 0.01 | 0.816 |
|         |          | 15.29 | 0.18 | 2.5 | 0.676 | 18.72 | 0.02 | 0.811 |
| A26-F1221 | N7720   | 13.34 | 0.16 | 1.2 | 1.592 | 20.26 | 0.04 | 1.272 |
|         |          | 13.34 | 0.16 | 1.6 | 1.568 | 20.17 | 0.05 | 1.273 |
| A26-F1222 | A2634-D76 | 14.62 | 0.16 | 1.3 | 0.788 | 18.59 | 0.02 | 0.963 |
|         |          | 14.62 | 0.16 | 1.6 | 0.751 | 18.44 | 0.02 | 0.964 |
| A26-F129 | A2634-D74 | 14.58 | 0.16 | 1.3 | 1.040 | 19.58 | 0.00 | 0.942 |
|         |          | 14.57 | 0.16 | 1.6 | 1.029 | 19.51 | 0.01 | 0.948 |
| A26-F134 | A2634-D55 | 14.25 | 0.16 | 1.2 | 1.112 | 19.51 | 0.02 | 1.031 |
|         |          | 14.24 | 0.16 | 1.6 | 1.096 | 19.43 | 0.02 | 1.036 |
| A26-F138 | A2634-D58 | 14.28 | 0.14 | 1.2 | 1.210 | 19.89 | 0.03 | 1.098 |
| A26-F139 | A2634-D57 | 14.13 | 0.14 | 1.2 | 1.218 | 19.81 | 0.01 | 1.050 |

Table 12 – continued
Table 13. Combined spectroscopic and photometric parameters. For each galaxy with both spectroscopic and photometric data, we tabulate: Type = morphological type assigned from CCD images or other source (E = elliptical, S0 = S0/lenticular, R = morphological reject – spiral, disky S0 etc. – Q = unclassified); cz = heliocentric recession velocity (kms\(^{-1}\); \(N_a\) = number of velocity dispersion measurements; \(\sigma\) = central velocity dispersion (kms\(^{-1}\); corrected to standard system, see text); \(\varepsilon\) = poisson error on mean \(\sigma\) value, \(N_{Mg2}\) = number of \(Mg2\) measurements; \(Mg2\) = magnesium index (magnitudes; corrected to standard system); \(N_{D_n}\) = number of photometric observations; \(A_B\) = B-band absorption coefficient; \(\log D_n =\) log effective diameter (arcsec); \(\langle \mu \rangle_n =\) mean surface brightness within \(A_n\); \(\log D_n =\) log R-band photometric \(D_n\) parameter (arcsec).

| Our ID | Other ID | Type | cz | \(N_a\) | \(\log \sigma\) | \(\log N_{Mg2}\) | \(Mg2\) | \(\log n_{Mg2}\) | \(N_{D_n}\) | \(A_B\) | \(\log \sigma\) | \(\langle \mu \rangle_n\) | \(\log D_n\) |
|--------|----------|------|----|--------|---------------|----------------|--------|----------------|--------|-------|---------------|----------------|-------|
| S01    | N0079    | E    | 5479 | 1      | 2.280 0.030 | 1               | 0.312 0.009 | 1       | 0.05 1.354 | 20.00 | 1.132 |
| S02    | N0085A   | S0   | 6189 | 1      | 2.025 0.030 | 1               | 0.244 0.009 | 1       | 0.05 1.502 | 20.99 | 0.953 |
| S03    | N0083    | E    | 6262 | 2      | 2.395 0.021 | 2               | 0.326 0.009 | 1       | 0.09 1.659 | 20.43 | 1.318 |
| S04    | N0080    | E    | 5741 | 2      | 2.398 0.021 | 2               | 0.308 0.006 | 1       | 0.09 1.691 | 20.28 | 1.364 |
| S05    | H548     | S0   | 5775 | 1      | 2.165 0.030 | 1               | 0.202 0.009 | 1       | 0.09 0.992 | 18.91 | 1.072 |
| S06    | -        | S0   | 5646 | 2      | 2.103 0.021 | 2               | 0.211 0.009 | 1       | 0.09 1.128 | 20.34 | 0.796 |
| S07    | CGCG457-008 | S0 | 5926 | 2 | 2.053 0.030 | 1 | 0.259 0.009 | 1 | 0.11 1.128 | 19.47 | 1.055 |

Cluster: 7S21

Cluster: Pisces

Cluster: HSM0122+3305

Cluster: A0262

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Table 13 – continued

Cluster : A0347

| Object | RA      | Dec     | Redshift | Distance | Velocity |
|--------|---------|---------|----------|----------|----------|
| B02    | U01837  | E       | 6582     | 1        | 2.286    |
| B03    | U01841  | E       | 6373     | 1        | 2.363    |
| B05C   | -       | Q       | 6649     | 2        | 2.473    |
| B06    | U01859  | E       | 5917     | 1        | 2.550    |
| B07    | CCXG328-065 | S0 | 5301     | 1        | 2.308    |
| B08    | N909    | E       | 4978     | 1        | 2.273    |
| B09    | N9010   | R       | 5237     | 2        | 2.391    |
| B10    | N911    | S0      | 5766     | 1        | 2.400    |
| B11    | N912    | E       | 4418     | 1        | 2.235    |
| B16    | CCXG339-042 | E | 4885     | 1        | 2.185    |

Cluster : J8

| Object | RA      | Dec     | Redshift | Distance | Velocity |
|--------|---------|---------|----------|----------|----------|
| J07038 | S0      | 10136   | 1        | 2.261    | 0.300    |
| J09035 | S0      | 11133   | 1        | 2.451    | 0.300    |
| J08035 | R       | 10099   | 1        | 1.910    | 0.300    |
| J08036 | EFAR-J8-K | E   | 9803     | 3        | 2.288    |
| J01065 | S0      | 9103    | 1        | 2.125    | 0.300    |
| J01067 | EFAR-J8-I | E   | 9237     | 2        | 2.300    |
| J01060 | I1803   | E       | 9583     | 1        | 2.565    |
| J01070 | I1806   | E       | 10219    | 3        | 2.332    |
| J01049 | E       | 9933    | 2        | 2.400    |
| J01055 | E       | 9616    | 2        | 2.184    |
| J01056 | CCXG383-068 | E | 9513     | 3        | 2.371    |
| J01049 | CCXG383-070 | E | 8562     | 2        | 2.494    |
| J01056 | I1807   | S0      | 9058     | 2        | 2.309    |
| J01080 | S0      | 9731    | 1        | 2.216    | 0.300    |

Cluster : Perseus (A0426)

| Object | RA      | Dec     | Redshift | Distance | Velocity |
|--------|---------|---------|----------|----------|----------|
| P01    | I0293   | E       | 4714     | 1        | 2.171    |
| P03    | N1224   | S0      | 5235     | 1        | 2.384    |
| P03    | I0310   | S0      | 5660     | 1        | 2.329    |
| P05    | I0312   | S0      | 4988     | 1        | 2.342    |
| P07    | CR19    | E       | 3544     | 1        | 2.081    |
| P08    | CR20    | E       | 6461     | 2        | 2.294    |
| P11    | BGP44   | E       | 4247     | 1        | 2.192    |
| P12    | N1270   | E       | 4997     | 2        | 2.530    |
| P13    | PERI95  | E       | 8396     | 2        | 2.231    |
| P14    | PERI99  | S0      | 5102     | 3        | 2.233    |
| P15    | CR28    | S0      | 8063     | 1        | 2.228    |
| P16    | CR27    | S0      | 8063     | 1        | 2.228    |
| P17    | N1272   | S0      | 3801     | 7        | 2.417    |
| P18    | N1273   | S0      | 5397     | 1        | 2.311    |
| P19    | I1070   | S0      | 4489     | 1        | 2.285    |
| P20    | BGP111  | E       | 3963     | 1        | 1.925    |
| P21    | PER152  | E       | 3940     | 2        | 2.134    |
| P22    | CR36    | E       | 7470     | 1        | 2.301    |
| P23    | N1278   | E       | 6064     | 3        | 2.411    |
| P26    | BGP59   | E       | 5315     | 1        | 2.307    |
| P27    | U02673  | E       | 4434     | 1        | 2.290    |
| P28    | N1281   | E       | 4300     | 1        | 2.432    |
| P29    | N1282   | E       | 2223     | 4        | 3.232    |
| P30    | N1283   | E       | 6746     | 2        | 2.320    |
| P31    | PERI63  | E       | 5481     | 2        | 2.249    |
| P33    | BGP33   | S0      | 4950     | 1        | 2.216    |
| P34    | I0313   | S0      | 4432     | 1        | 2.375    |
| P36    | N1293   | E       | 4167     | 3        | 2.321    |
| P37    | U02698  | E       | 6451     | 2        | 2.557    |
| P38    | U02717  | E       | 3793     | 2        | 2.189    |
| P39    | U02725  | S0      | 6215     | 1        | 2.333    |

Cluster : A2199

| Object | RA      | Dec     | Redshift | Distance | Velocity |
|--------|---------|---------|----------|----------|----------|
| A21-F113 | -     | Q       | 8052     | 4        | 2.217    |
| A21-F114 | -     | S0      | 9184     | 4        | 2.297    |
| A21-F121 | A2199-S26 | E | 8768     | 2        | 2.239    |
| A21-F144 | A2199-S30 | E | 8524     | 2        | 2.411    |
| A21-F145 | R       | 7610     | 2        | 2.173    |
| A21-F146 | A2199-S34 | E | 8314     | 2        | 2.205    |
| A21-F164 | N6166   | E       | 9348     | 2        | 2.442    |
| A21-Z34A | A2199-Z34A | E | 8721     | 2        | 2.298    |
| A21-Z34AC | S0    | 8964     | 2        | 2.337    |
| Cluster | A2634-D58 | A2634-D57 | E 9591 | 4 | 2.331 | 0.017 | 4 | 0.327 | 0.005 | 1 | 0.14 | 1.218 | 19.81 | 1.050 |
|---------|-----------|-----------|--------|----|--------|--------|----|--------|--------|----|-------|--------|--------|--------|
| A26-F129 | A2634-D74 | S0 8425 | 3 | 2.315 | 0.019 | 3 | 0.301 | 0.006 | 2 | 0.16 | 1.035 | 19.55 | 0.945 |
| A26-F121 | A2634-D80 | E 9582 | 4 | 2.262 | 0.017 | 4 | 0.286 | 0.005 | 2 | 0.18 | 0.668 | 18.68 | 0.814 |
| A26-F1201 | A2634-D79 | S0 10166 | 4 | 2.234 | 0.019 | 4 | 0.295 | 0.005 | 2 | 0.18 | 0.797 | 19.13 | 0.821 |
| A26-F134 | A2634-D55 | E 9288 | 3 | 2.342 | 0.019 | 3 | 0.300 | 0.006 | 2 | 0.16 | 1.104 | 19.47 | 1.034 |
| A26-F122 | A2634-D74 | S0 8425 | 3 | 2.315 | 0.019 | 3 | 0.301 | 0.006 | 2 | 0.16 | 1.035 | 19.55 | 0.945 |
| A26-F1221 | N7720 | E 9104 | 5 | 2.527 | 0.015 | 5 | 0.331 | 0.004 | 2 | 0.16 | 1.580 | 20.22 | 1.273 |
| A26-F1222 | A2634-D76 | E 8123 | 5 | 2.320 | 0.015 | 5 | 0.296 | 0.004 | 2 | 0.16 | 0.770 | 18.52 | 0.964 |
| A26-F139 | A2634-D57 | E 9591 | 4 | 2.331 | 0.017 | 4 | 0.327 | 0.005 | 1 | 0.14 | 1.218 | 19.81 | 1.050 |