JOURNAL OF THE KOREAN ASTRONOMICAL SOCIETY
29: S61 ~ S62, 1996

PHOTOGRAPHIC AND CCD OBSERVATIONS OF THE NEARBY CLUSTERS OF GALAXIES

OMAR M. KURTANIDZE
Abastumani Astrophysical Observatory 383762 Abastumani, Georgia
e-mail: okur@abao.kheta.ge

ABSTRACT

The photometry is reported for galaxies in two clusters A1983, 2065 with redshifts 0.046, 0.072 respectively. The luminosity segregation is observed only within a magnitude from the brightest galaxy. The alignment of the galaxy major axis is observed in the Corona Borealis cluster. The intermediate distance clusters ($0.05 < z < 0.15$) will be studied by CCD mounted on 125cm RCh and 70cm meniscus type telescopes.

I. INTRODUCTION

Numerous studies of clusters of galaxies (CG) over the past two decades have added many important facts to our knowledge of their optical, X-ray and radio Radio properties (O'Dea 1986, Seitter 1984, Durrett 1985). Extensive investigation of the optical properties of CG have been carried out (Dressler 1978, Couch and Newell 1984, Butcher and Oemler 1985, Lugger 1986) in order to reveal global photometric properties of clusters.

In the middle of 1970s a photometrical study of selected CG has been undertaken at Abastumani. The objects to be studied were selected from CG's catalog (Abell 1958). The list of selected CG is presented, along with richness class, redshift, RS type and population in the table.

Table 1.

Cl	R	Z	R-S	N	Band
A119	1	.044	C	295	V
168	2	.045	I	120	V
400	1	.023	I	200	B V
779	1	.023	cD	170	B V R
1228	1	.034	F	210	B V
1314	0	.034	C	180	B V
1367	2	.021	F	460	B V R
1831	1	.075	F	230	V
1983	1	.043	F	150	Pg
2065	2	.072	C	200	Pg
2147	1	.036	F	240	V
2151	2	.037	F	360	V
2152	1	.038	F	190	V
2197	1	.030	L	350	B V R
2199	2	.031	cD	495	B V R

II. OBSERVATION AND REDUCTION

Measurements of galaxies were made on plates taken at the prime focus of the 2.6m telescope of the Byurakan Observatory and 0.7m meniscus telescope of the Abastumami Observatory with the scales 21.4 and 98 arcsec/mm respectively. The photometrical material for A1983 and 2065 were obtained on the Kodak IIa-O unfiltered plates baked in air.

Photometric calibration of the plates have been performed by means of the 12-tube spot sensitometer of known relative intensities. The calibrating exposure was made after sky exposure on a masked-off part of the plates. The photoelectrically calibrated galaxies located in clusters and sky background surface brightnesses measured photoelectrically were used for the zero point calibration. The zero point callibration for other CG has been made by CCD.

Measurements have been done on the automatic microphotometer of the Babelsberg Observatory (Fritze et al. 1977). In the regions of 0.25 sq.deg. 204 and 147 galaxies were identified up to the limiting magnitude 21.5 in photographic band. The magnitudes were integrated up to the isophote corresponding to 25^mper sq.arcsec. The completness limit is 19.5 and the numbers of galaxies up to this limit are 132 and 108, respectively.

III. LUMINOSITY DISTRIBUTION

A short summary of the history of suggested forms for the luminosity functions of CG is reviewed by Abell (1976). He suggested that the integrated luminosity function, that is, the number of galaxies brighter than a given magnitude, is well represeted by the expression

$$N(< m) \sim 10^{ax+b}$$

$$a \sim 0.8, \quad m < m^*, \quad a \sim 0.25, \quad m > m^*$$

In the $\log N$ versus magnitude diagram this function appears as a pair straight lines intersecting at m^*.

A second analytical expression has been suggested for differential luminosity function by Schechter (1976). His expression written in the form

$$N(M)dM = N^* T^{\alpha+1} e^{-T} dM$$

$$T = \text{dex}0.4(M^* - M)$$

can be interpreted as a power low at faint luminosities. For the parameters of the Abell luminosity function the values of $a(1) = 0.80, a(2) = 0.27$ and $M(pg) = -20.0$ are derived for A1983 (Kurtanidze and Richter 1987).

For the parameters of the Schechter luminosity function of A2065 the values of $\alpha = -1.25, M^* = -20.45$ were derived and for those of Abell $a(1) = 1.1$, $a(2) = 0.36$, $M(pg) = -20.65$ (Kurtanidze and Richter 1987). To investigate the luminosity segregation effect in the cluster A2065, the measured region has been divided into several concentric rings and as border magnitudes 17.5, 18.0 and 18.5 has been taken subsequantly. The luminosity segregation of the galaxies is observed only within a magnitude from the brightest galaxy.

IV. GEOMETRICAL PARAMETERS

Ozernoy (1974) has remarked that if a CG were a fossil turbulent eddy the rotation axes of galaxies might be expected to line up along the axis of the eddy. If the first mass scales to become unstable to Jeans collapse will be those that are comparable to galaxy cluster masses and the origin of galaxy rotation is related in any way to this initial cluster collapse phase, systematic galaxy alinment might also be expected (Sunyaev and Zeldovich 1972, Doroshkevich 1973, Icke 1973),

The position angle and ellipticity of galaxies were calculated from the following relations

$$D(mj) = 2\sqrt{1-\rho}\left(\frac{\cos^2\alpha}{\sigma_x^2} - \frac{2\rho\cos\alpha\sin\alpha}{\sigma_x\sigma_y} + \frac{\sin^2_\alpha}{\sigma_y^2}\right)^{-\frac{1}{2}}$$

$$D(mi) = 2\sqrt{1-\rho}\left(\frac{\sin^2\alpha}{\sigma_x^2} + \frac{2\rho\cos\alpha\sin\alpha}{\sigma_x\sigma_y} + \frac{\cos^2_\alpha}{\sigma_y^2}\right)^{-\frac{1}{2}}$$

$$\alpha = \frac{1}{2}\arctan\frac{2\sigma_{xy}^2}{\sigma_x^2\sigma_y^2}$$

with

$$\sigma_x^2 = \frac{1}{p}\int\int(x-\bar{x})^2F(x,y)dxdy$$

$$\sigma_y^2 = \frac{1}{p}\int\int(y-\bar{y})^2F(x,y)dxdy$$

$$\sigma_{xy}^2 = \frac{1}{p}\int\int(x-\bar{x})(y-\bar{y})F(x,y)dxdy$$

$$\bar{x} = \int\int xF(x,y)dxdy, \quad \bar{y} = \int\int yF(x,y)dxdy$$

$$\rho = \frac{\sigma_{xy}^2}{\sigma_x\sigma_y}, \quad P = \int\int F(x,y)dxdy.$$

Hawley and Peebles (1974) introduced a convenient procedure which can be used to check for systematic effects. In this case the observed distributions are fitted to the model

$$N(\varphi_i) = N_0(1 + A\cos 2\varphi_i + B\sin 2\varphi_i)$$

where N(φ_i) is the number of galaxies obseved to fall at the position angle φ_i, N is the mean of N(φ_i) over the n=9 bins, A and B are coefficients that describe the deviation from non randomness. For position angle distribution divided into nine bins

$$A = \frac{\sum N(\varphi_i)\cos 2\varphi_i}{4.5N_0}, \quad B = \frac{\sum N(\varphi_i)\sin 2\varphi_i}{4.5N_0}$$

The probability that the total amplitude of the distribution exseeds the observed value is then $P = \exp(-2.25NC), C = A + B$. For the sample in the Corona Borealis cluster region $A = -0.45, B = 0.0$ and $P = 0.007$. It is obvious that the galaxies in the cluster A2065 appear to be preferentially aligned. The alignment of the galaxy major axes is perpendicular to the direction of the central double galaxy orientation and that the cluster elongation.

ACKNOWLEDGEMENTS

The author is grateful to the SOC and LOC for invaluable financial support to attend the meeting.

REFERENCES

Abell G., 1958, Aph.J.S., 3, 211.

Abell G., 1976, in Galaxies and the Universe, Sandage A. ed., (Chicago:ChUP), p.601.

Butcher H., et al. 1985, Ap.J.S., 57, 665.

Couch W., Newell E., 1984, Ap.J.S., 56, 143.

Doroshkevich A., 1973, Astrophysics, 6, 320.

Dressler A. 1978, Aph.J., 223, 765.

Durrett F., Mazure A., Van Thanh Than J. 1995, ed., Clusters of Galaxies.

Fritze K., et al. 1977, Astron.Nachr., 298, 189.

Hawley D., Peebles P., 1974, A.J., 80, 477.

Icke V., 1973, Astron. and Astrophys., 27, 1.

Kurtanidze O., Richter G., 1987, Astrophysica, 26, 387.

Lugger Ph.M., 1986, Aph.J., 303, 535.

O'Dea Ch., J.M.Uson. 1986, ed., Radio continuum Processes in Clusters of Galaxies.

Ozernoy L., 1974, in IAU Symp.58.

Schechter P.,1976, Aph.J., 203, 297.

Seitter W. 1994, ed., Cosmologocal Aspect of X-Ray Clusters of Galaxies.

Sunyaev R., Zeldovich Ya., 1972, A.A. 20, 189.