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Photometric CCD sequences for calibration of the ESO/SERC atlas⋆,⋆⋆

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Abstract. For calibration of ESO/SERC survey plates, photometric CCD sequences have been obtained for 10 ESO/SERC fields in the area $10^h00^m <$ R.A. $< 15^h30^m$ and $-34° <$ Decl. $< -18°$. The sequences contain B, V and R magnitudes for 117 galaxies and 162 stars with $12.7 < V < 21.0$.

Key words: techniques: photometric — galaxies: photometry — atlas

1. Introduction

In 1991, a project for obtaining CCD magnitudes of galaxies and stars with magnitudes fainter than $V = 10$ was started at the Astronomical Institute of Münster University, Germany. This project is part of the cosmological Muenster Redshift Project MRSP (e.g. Seitter 1992; Schuecker 1996) which uses filmcopies of the ESO/SERC(J) and ESO/SERC(R) surveys and of low-dispersion objective prism plates obtained with the UK Schmidt Telescope.

The CCD sequences are used for magnitude calibration of the J and R plates. Their photometric passbands are defined by the IIIa-J emulsion and GG395 filter (wavelength region: 395 nm $< \lambda <$ 540 nm) and by the IIIa-F emulsion and RG630 filter (wavelength region: 630 nm $< \lambda <$ 700 nm), respectively. For calibration of the photographic magnitudes, B, V and R magnitudes are needed.

Since 1991, a large number of CCD sequences have been obtained for this project (Cunow 1993; Cunow & Wargau 1993, 1994; Cunow & Ungruhe 1995). These sequences cover 34 ESO/SERC fields in the area from 20^h30^m to 5^h30^m in right ascension and from $-73°$ to $-20°$ in declination. They contain B, V and R magnitudes for 131 galaxies and 190 stars, and V and R magnitudes for another 191 galaxies and 180 stars. Their magnitudes are in the range $11 < V < 22$. The CCD magnitudes are calibrated to the Kron-Cousins system.

In this paper, photometric CCD sequences of a different part of the sky are presented. They have been obtained in 10 ESO/SERC fields in the area $10^h00^m <$ R.A. $< 15^h30^m$ and $-34° <$ Decl. $< -18°$.

2. Observations

The CCD sequences have been observed in March 1995 with the 1.0 m telescope at the South African Astronomical Observatory (SAAO) in Sutherland, South Africa. The CCD camera contains a Tek chip of 512×512 pixels. The pixel size is 27 μm which corresponds to a scale of 0.35 arcsec/pixel and to an image size of $3'.0 \times 3'.0$. The filters available are Johnson B and V and Cousins R.

The CCD observations were made during five photometric nights. The seeing varied between $1''.5$ and $2''.0$ FWHM. In order to observe as many galaxies as possible, all sequences were taken in dense areas of clusters of galaxies chosen from Abell et al. (1989). For each ESO/SERC field (except field No. 576), two CCD fields were observed. For each CCD field B, V and R frames were taken. The exposure times were 1800 s in B and 900 s in V and R, respectively.

The CCD magnitudes are calibrated with the magnitudes of 18 E-region stars given by Menzies et al. (1980).

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⋆ Based on observations collected at the South African Astronomical Observatory, Sutherland, Republic of South Africa.

⋆⋆ Tables 2 to 20 are only available in electronic form at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via http://cdsweb.u-strasbg.fr/Abstract.html

The magnitude and colour ranges of the chosen stars were $8.13 < V < 10.65$ and $-0.02 < B-V < 1.53$, respectively. The standard stars were observed several times during a night at different airmasses with exposure times between 3 s and 12 s per frame. With these data, the coefficients for transforming the instrumental CCD system into the standard magnitude system were determined.

3. Photometry

The instrumental CCD magnitudes were measured using the procedures described in Cunow (1993). The dark current was found to be negligible for this CCD chip. The instrumental CCD magnitudes are aperture magnitudes with apertures being large enough to contain the whole object. The following aperture radii were used: 5.″3, 6.″7, 8.″1, 9.″1, 11.″6, 13.″7, 18.″2 and 22.″8. The aperture chosen for an individual object is the smallest one with a diameter which is at least twice as large as the object size. Checks by eye ensured that the chosen aperture is always larger than the whole object.

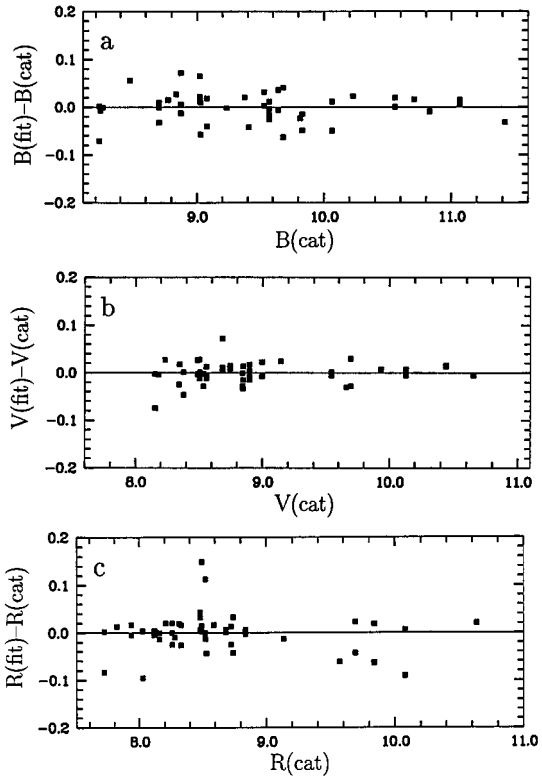

Fig. 1. Comparison of catalogue magnitudes with the CCD magnitudes for the E-region stars. **a)** shows the B measurements, **b)** the V measurements and **c)** the R measurements

For transformation of the instrumental magnitudes to the standard system, the following equations were used:

$$B_{\rm CCD} = B + k_{1,B} + k_{2,B}X + k_{3,B}(B-V) \quad (1)$$

$$V_{\rm CCD} = V + k_{1,V} + k_{2,V}X + k_{3,V}(B-V) \quad (2)$$

$$R_{\rm CCD} = R + k_{1,R} + k_{2,R}X + k_{3,R}(V-R). \quad (3)$$

X is the airmass, $B_{\rm CCD}$, $V_{\rm CCD}$ and $R_{\rm CCD}$ are the instrumental magnitudes and B, V and R the magnitudes in the Kron-Cousins-System. The coefficients k were obtained from the standard stars by a fitting procedure following the guidelines by Harris et al. (1981). Small colour terms were found:

$$k_{3,B} = -0.066 \pm 0.008 \quad (4)$$

$$k_{3,V} = 0.017 \pm 0.010 \quad (5)$$

$$k_{3,R} = -0.032 \pm 0.029. \quad (6)$$

Table 1. List of cluster fields

Abell cluster no.	ESO/SERC field no.	α(2000.0) h	m	δ(2000.0) °	′
0916	567	10	03.9	−19	22
S0645	569	10	46.2	−18	27
3471	438	11	11.2	−30	09
3528	443	12	54.3	−29	01
S0726	382	13	15.2	−33	38
1732	576	13	25.0	−20	13
3558	444	13	27.9	−31	29
3576	445	13	52.8	−30	17
1996	513	14	57.4	−23	55
3621	514	15	28.7	−24	52

Figure 1 shows the CCD magnitudes versus the catalogue magnitude for the E-region stars. From the scatter the random magnitude errors for these stars were determined for the different filters: $\sigma_B = 0.^{\rm m}031$, $\sigma_V = 0.^{\rm m}023$ and $\sigma_R = 0.^{\rm m}042$. These errors are similar to the ones found for our previous CCD sequences (Cunow 1993; Cunow & Wargau 1993, 1994; Cunow & Ungruhe 1995). From this similarity and from the fact that in this work observations and reductions were done in the same way as for our previous CCD sequences, the same magnitude errors as given in those papers are expected for the programme objects in this work (from $\sigma = 0.^{\rm m}05$ for the bright objects to $\sigma = 0.^{\rm m}15$ for the very faint objects).

4. Catalogue of the CCD sequences

CCD sequences have been measured in 10 southern Abell clusters. Table 1 gives the cluster coordinates according to Abell et al. (1989). The final catalogue, given in Tables 2 to 20, contains B, V and R magnitudes for 117 galaxies and 162 stars with $12.7 < V < 21.0$. Column 2 gives the object type, S for star, G for galaxy. The positions were measured from scans of the direct Schmidt plates with one of the PDS 2020 GM$^{\rm plus}$ machines at the Astronomisches

Institut, Münster, Germany. Their accuracy is between 0.″5 and 1.″0.

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