CCD PHOTOMETRY OF LATE-TYPE STARS IN THE YOUNG OPEN CLUSTER STOCK 2

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ABSTRACT. We present the results of a photometric survey of the 100 Myr open cluster Stock 2. BVRI CCD photometry was obtained for 21 5 $\times$ 5 arcmin fields. 59 candidate members were selected from (B,B-V) and (R,R-I) colour magnitude diagrams using the theoretical isochrones of D'Antona & Mazzitelli (1994). An analysis of the proper motions of these stars is used to reduce the contamination of this sample by field stars. 29 of the stars selected by photometric means are likely to be cluster members.

1. Introduction

Stock 2 is an open cluster that was discovered in 1955 by Jürgen Stock (1955). The nominal cluster center is at $\alpha\,(1950) = 2^{\mathrm{h}}11.4^{\mathrm{m}}$, $\delta\,(1950) = -59°2'$ ($l = 133.4°$, $b = -1.9°$) (Lynga 1987). Stock estimated the distance of the cluster to be $\sim$300pc ($m-M = 7.5$). Analysis of UBV photoelectric photometry by Krzemiński and Serkowski (1966) agreed with this distance, and found the mean reddening to be $E_{B-V} = 0.375$. More recently, in a study of 68 open clusters Piskunov (1980), using existing photometry, redetermined the ages and distances of these clusters. For Stock 2 he found the age to be 100 Myr, and the distance modulus to be $m - M = 7.4$. In a study of the integrated parameters of open clusters Pandy et al. (1989) also lists details of Stock 2. They quote a age of 100 Myr, but a distance of $m - M = 8.36$ and a reddening of $E_{B-V} = 0.30$. Since this distance is so at odds with all previous studies we will ignore it. There have been no studies to date of cluster members fainter than $V \sim 13$.

2. Observations

Our photometry was obtained using the JKT on La Palma, on the nights of the 20th and 21st October 1995. A 1024$\times$1024 pixel Tek CCD was used at the Cassegrain focus so that each pixel corresponds to 0.33 arcsec on the sky. Observations were made through Johnson B and V filters and Harris R and I filters. Exposure times for the cluster fields were 700:100:60:60 seconds respectively. 12 5$\times$5arcmin fields were observed on the 20th October and an additional 9 fields on the following night. The basic CCD reduction was carried out in IRAF (Tody 1986) using the CCDRED package. The reduction of the crowded fields was carried out using the DAOPHOT (Stetson 1987, Stetson et al. 1990) package in IRAF. The proper motions of stars in the field, defined relative to the mean proper motion, were determined from analysis of two SuperCOSMOS scanned POSS plates with a baseline of 37.5 years.

3. Results

The resulting photometric data obtained for the cluster fields is summarized as (B,B-V) (Figure 1) and (R,R-I) (Figure 2) colour-magnitude diagrams. Superimposed on these diagrams are 120 and 80Myr isochrones (solid lines) from D'Antona & Mazzitelli (1994), after conversion to observational colours and magnitudes. We have included the effects of various uncertainties on these isochrones by imposing on them estimates of the effects of binarity, uncertainty in the distance to the cluster and magnitude dependent photometric uncertainties. The dashed tracks in the colour magnitude diagrams indicate the effect of these uncertainties. Stars selected in both colour-magnitude diagrams were deemed *candidate cluster members* (filled circles). We have found 59 candidate cluster members in the 21 5x5 arcmin fields.

The proper motions of all the stars in the field can be seen in Figure 3. The cluster stars are clearly visible at (-15,-10). We estimate that roughly 29 of the photometrically selected stars are likely to be candidate members. By looking at the number of photometrically selected stars at a similar distance from the central distribution but in a different quadrant of the plot, we estimate that only one or two of the 29 star are non-members.

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References

D'Antona, F. & Mazzitelli, I. 1984, *Astrophys. J. Suppl.* **90**, 467

Krzemiński, W. & Serkowski 1966, *Astron. J.* **147**, 988

Landolt, A. U. 1992, *Astron. J.* **104**, 340

Lynga, G. 1987, in *Catalogue of Open Cluster Data*, CDS, Strasbourg

Pandey, A. K., Bhatt, B. C., Mahra, H. S. & Sagar, R. 1989, *Mon. Not. R. Astr. Soc.* **236**, 263

Piskunov, A. 1980, *Bull. Inform. CDS*, **19**, 67

Sanders, W. L. 1971, *Astron. Astrophys.* **14**, 226

Stetson, P. B. 1987, *Publ. Astr. Soc. Pacific* **99**, 191

Stetson, P. B., Davis, L. E. & Crabtree, D.B. 1990, in *CCDs in Astronomy*, ASP Conference Series, **8**, 289

Stock, J. 1956, *Astrophys. J.* **123**, 258

Tody, D. 1986, *IRAF User Manual*, NOAO Laboratory

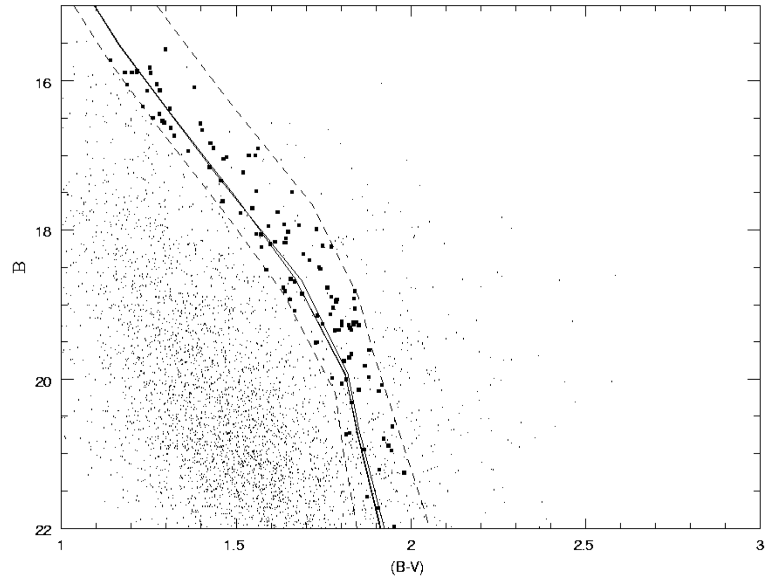

Fig. 1. A (B,B-V) colour magnitude diagram for stars in the region of Stock2. The symbols are described in the text.

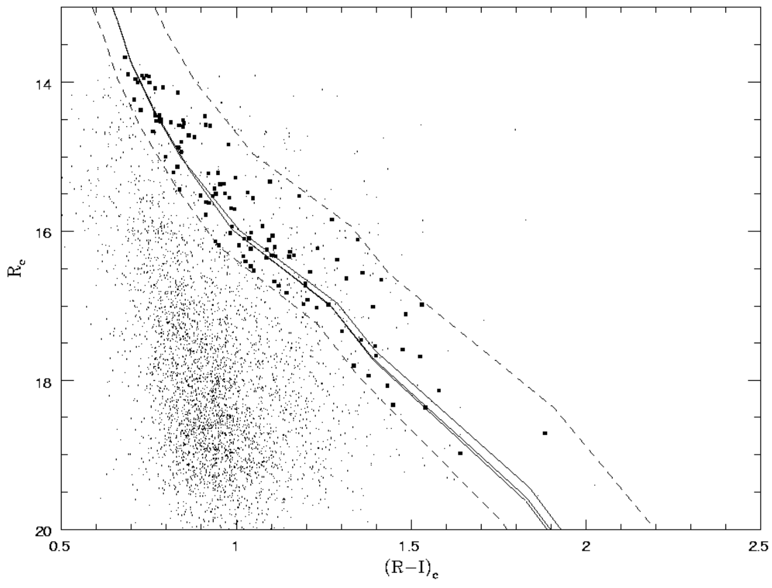

Fig. 2. A (R,R-I) colour magnitude diagram for stars in the region of Stock2.

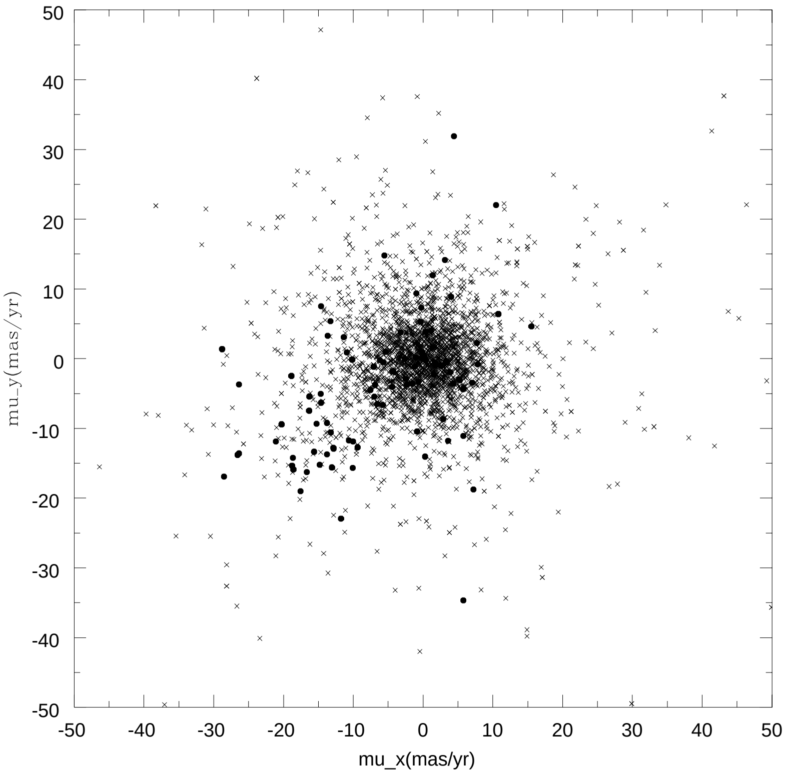

Fig. 3. A proper motion vector-point diagram for stars in the region of Stock2. The filled circles are the stars photometrically selected as candidate cluster members.