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POSTER PAPER

Multicolour photometry and CORAVEL radial velocities of stars of the open cluster NGC 2489

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Abstract. We present CCD BVI photometry in the field of the open cluster NGC 2489, supplemented with CORAVEL radial velocities (RVs) for 7 red giant candidates. A cluster angular radius of (3.5 ± 0.3) pc is estimated from star counts. The comparison of the cluster colour-magnitude diagram with isochrones of the Padova group yields E(B-V) = 0.30 ± 0.05, E(V-I) = 0.40 ± 0.05, and V-M_V = 12.20 ± 0.25 for log age = 8.70 and Z = 0.019. The analysis of the RVs allowed us to confirm cluster membership for 6 red giants, one of them being a spectroscopic binary. The properties of a sample of open clusters aligned along the line-of-sight to NGC 2489 are examined.

Resumen. Presentamos fotometría CCD BVI en la región del cúmulo abierto NGC 2489, juntamente con velocidades radiales (VRs) CORAVEL de 7 candidatas a gigantes rojas. En base a recuentos estelares estimamos el radio lineal del cúmulo en (3.5 ± 0.3) pc. La comparación de los diagramas color-magnitud con isócronas del grupo de Padova para Z = 0.019 condujo a los siguientes valores: E(B-V) = 0.30 ± 0.05, E(V-I) = 0.40 ± 0.05, V-M_V = 12.20 ± 0.25 y log edad = 8.70. El análisis de las VRs permitió confirmar la condición de miembros de 6 de las 7 candidatas a gigantes rojas, una de las cuales resultó ser una binaria espectroscópica. Analizamos además las propiedades de una decena de cúmulos abiertos proyectados casi en la misma dirección que NGC 2489.

1. CCD photometry and Coravel observations

NGC 2489 is located in a moderately rich star field in Puppis at l = 247^o, b = -0.8^o. CCD images were obtained with the Johnson B and V and Kron-Cousins I filters using the CTIO 0.9 m telescope. Seven stars brighter than V = 12.20 and redder than B-V = 1.20 were selected as red giant candidates and observed with the CORAVEL instrument at the 1.54 m telescope at La Silla (Chile).

2. Structural features and cluster fundamental parameters

We determined the cluster centre and its extension following the procedure described in Piatti et al. (2004). We built the cluster stellar density profile and adopted r = 1000 ± 100 pixels as the cluster angular radius, equivalent to 6.7´ ± 0.6´. We then considered the region for r > 1000 pixels as the "star field area". Note that the main body of NGC 2489 is confined to a radius of ∼ 400 pixels (∼ 2.7') and that a faint corona extends up to the cluster boundary.

The resulting (V,B-V) and (V,V-I) CMDs are depicted in Fig. 1. They reveal well populated and relatively narrow sequences of stars that trace the cluster main sequence (MS) along ∼ 7 mags with clear evidence of some evolution. A clump of red stars is also clearly visible. Although the corona has an annular radius 1.5 times larger than the radius of the central cluster region, it contains no more than ∼ 35% of the cluster stars because of its relatively low star density. We then used r < 400 pixels CMDs in the estimation of the cluster parameters to guarantee the presence of a predominant number of cluster stars over field stars. We fitted Padova theoretical isochrones to the observed CMDs to estimate the basic cluster parameters. Since a previous cluster abundance estimate from Clariá et al. (1996) indicates a solar metal content, we adopted Z = 0.019 for the isochrone sets. We first derived E(V-I) = 0.40 ± 0.05 and V-M_V = 12.20 ± 0.25 from the (V,V-I) CMD. Then, we adopted the latter and looked for the corresponding E(B-V) by shifting in colour the Zero-Age Main Sequence (ZAMS) onto the observed cluster (V,B-V) CMD until we obtained a satisfactory fit of the unevolved cluster MS. We thus estimated E(B-V) = 0.30 ± 0.05. Next, we selected isochrones of log t larger than 8.0 and used the derived V-M_V and E(V-I) values to estimate the cluster age. The isochrone of log t = 8.70 turned out to be the one which most accurately reproduces the cluster features in the (V,V-I) CMD (Fig. 2). We derived a distance from the Sun of (1.8 ± 0.3) kpc and a Galactocentric distance of ∼ 9.4 kpc, assuming the Sun's distance from the centre of the Galaxy to be 8.5 kpc.

Based on the CORAVEL radial velocities, 6 out of the 7 red stars observed can be treated as unarguable members of NGC 2489. The mean radial velocity from these stars is 38.13 ± 0.33 km/s and has been adopted for the cluster. Cluster membership among the possible red giants was also examined by Clariá et al. (1996), who obtained high precision UBV and DDO data for 6 of the 7 stars here observed with the CORAVEL instrument. Their results are based on photometric criteria and show very good agreement with those coming from the present radial-velocity data.

Our resulting age confirms that NGC 2489 is a Hyades-like open cluster of ∼ 500 Myr. The cluster fits well in the expected locus in the position-metallicity relationship. Searching in the WEBDA database, we found 10 open clusters located at $(l,b)_{cluster} = (l,b)_{NGC2489} \pm 5^o$ with well-determined E(B-V) colour excesses and distances from the Sun. Fig. 3 shows the relationship between the visual absorption A_V and the distance d from the Sun for these clusters (open circles) and for NGC 2489 (open star). Note that the distance between the outermost and the innermost clusters is nearly 4.5 kpc. For the sake of

comparison, we also included the A_V vs. d relationship corresponding to the Baade's Window [(l.b) = (1^o,-3.9^o)] - situated not far from the direction here considered - obtained by Ng et al. (1996), which is represented by a solid line. Note that from the Sun outwards up to $\sim$ 3 kpc, the clusters approximately follow the extinction law of the Baade's Window. At that distance, however, there occurs a large dispersion in the interstellar visual absorption. According to the schematic map of the Galaxy of Drimmel & Spergel (2001), there are no spiral arms passing near to these five clusters. An explanation for this scatter might be the existence of dark clouds in front of them or simply the evidence that the dust distribution in the Galactic plane is not homogeneous.

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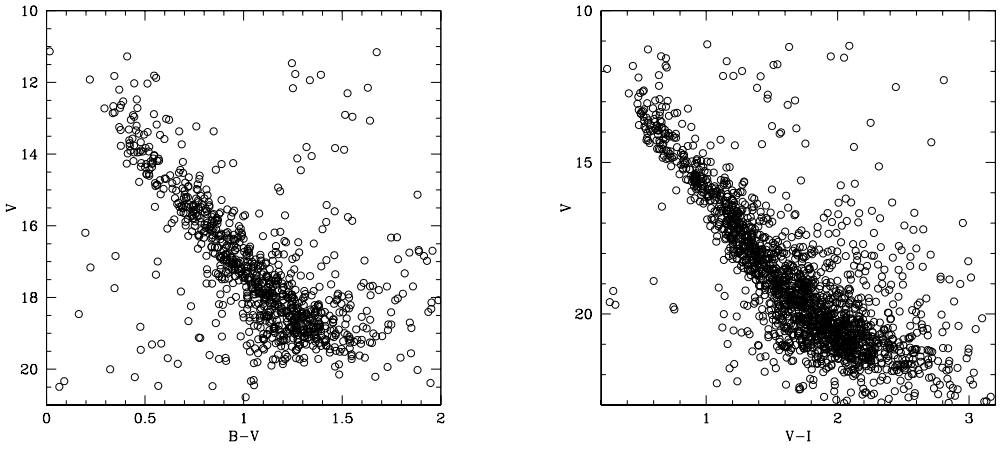

Figure 1. (V,B-V) and (V,V-I) CMDs for stars observed in the field of NGC 2489.

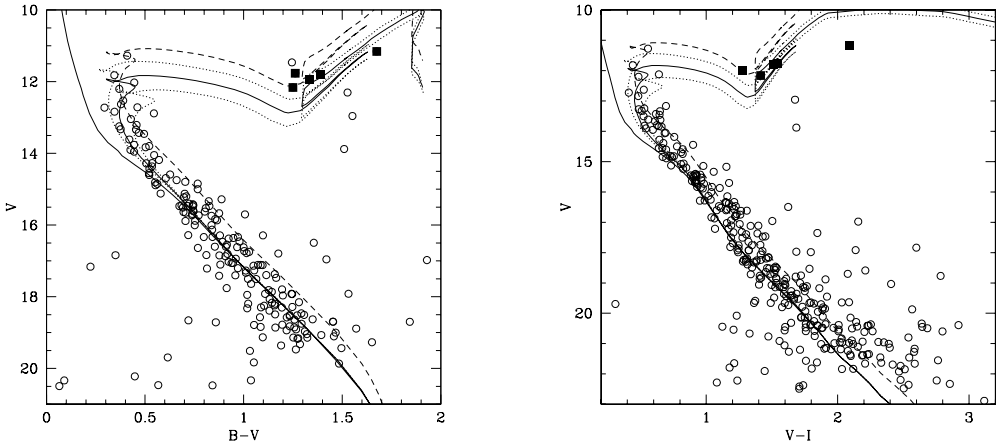

Figure 2. *Left:* r < 400 pixels (V,B-V) CMD for stars in NGC 2489. The ZAMS and the Padova isochrone of log t = 8.70 are overplotted (solid lines). Two additional isochrones for log t = 8.6 and 8.8 are also drawn for comparison purposes (dotted lines). The dashed curve is the isochrone of log t = 8.70 shifted by 0.75 mag to reproduce the upper binary ridge. The filled squares correspond to the cluster giant members with RVs.
Right: r < 400 pixels (V,V-I) CMD. Lines and symbols as in the left hand panel.

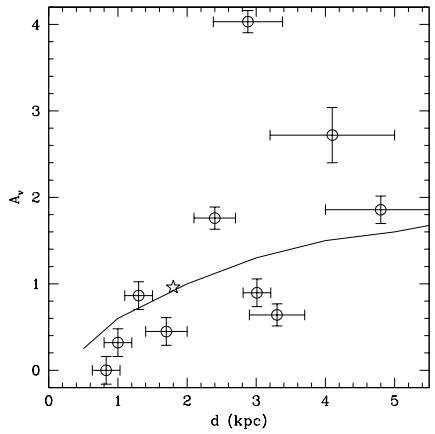

Figure 3. Relation between the distance from the Sun and the visual absorption for known open clusters projected in the direction to NGC 2489. Selected clusters and NGC 2489 are represented by open circles and by an open star, respectively. The relationship corresponding to the Baade's Window is shown as a solid line.