Near Infrared Photometry of the Young Star Cluster NGC 2384

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Abstract. This work involves near infrared photometry of the young cluster NGC 2384. Observations were taken at the Mt Abu Infrared Observatory using the NIC-MOS3 detector in February 2000. The distance to the cluster is obtained as 2187 pc. The HR diagram for this cluster has been extended to $M_J \approx 5^m$ and the gaps studied. The age has been determined as 40 Myr. The luminosity function for NGC 2384 is plotted.

Keywords : Young star clusters – near infrared photometry – color-magnitude diagrams – luminosity function

1. Introduction

NGC 2384 lies at $\alpha_{2000} = 7^h22^m9^s$, $\delta_{2000} = -20°56''$ and is classified as IV 3 p. The earliest study of this cluster was by Trumpler (1930) and he estimated the distance as 2.6 kpc. Collinder (1931) found the distance to the cluster to be 4.55 – 4.75 kpc. Vogt and Moffat (1972) obtained photoelectric measurements of 15 stars in the UBV passbands and estimated a distance of 3.28 kpc and color excess $E(B-V)$ of 0.29. Babu (1985) and Hassan (1984) also studied the cluster. Photometry in the $BVRI$ bands was done by Subramaniam and Sagar (1999) and they determined the distance as 2925 pc, reddening, age (20 Myr) and mass function slope for this cluster. These would be the first results obtained using JHK data of this cluster.
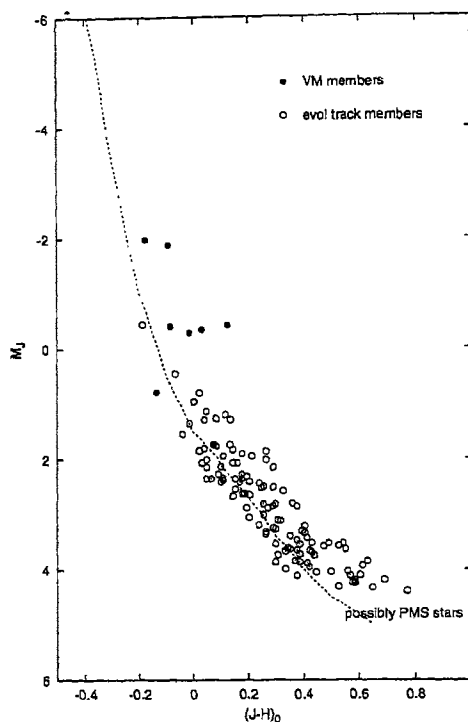
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Figure 1. NGC 2384: Isochrones fit to the color–magnitude diagram

2. Photometry and Results

The instrumental magnitudes were converted to the standard system using the transformation coefficients. The errors in the J, H and K bands do not exceed 0.03, 0.04 and 0.05 respectively. The data was corrected for interstellar reddening using the coefficients given by Bessell and Brett (1988) and $E(B - V) = 0.25$ is the mean color excess for the cluster was taken from Subramaniam and Sagar (1999). To justify the use of the mean color excess value, a comparison was made between the observed unreddened colors and intrinsic colors of stars in the cluster having a known spectral type. Cluster membership was established using the spectroscopic members identified by Vogt and Moffat (1972) (8 stars) and also through the photometric criterion (113 stars). The distance to the cluster was obtained through sliding fit of the standard main sequence with that of the color–magnitude and gave a true distance modulus of $11^m.7 \pm 0.1$ corresponding to a distance of 2187 pc which agrees with that obtained by previous authors. The color–magnitude diagram for all members is shown in Fig. 1. Evolutionary track members are shown with open circles, while filled circles show members identified by Vogt and Moffat (1972). The dashed line represents the standard main sequence. The stars in this cluster range from very bright OB type stars to K types. The cluster is very young and hence there are some stars in the color–
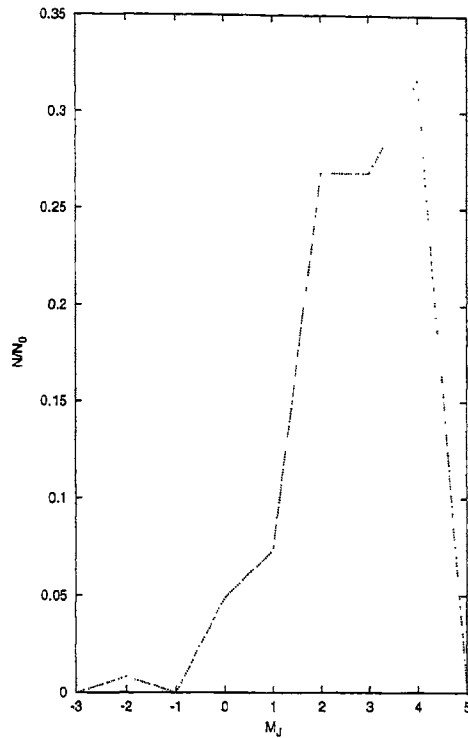
Figure 2. Luminosity functions of NGC 2384

magnitude diagram, which were identified as members using the evolutionary track technique, but appear to be pre-main sequence stars from their position in the color–magnitude diagram. As seen in the HR diagrams, there are gaps corresponding to the Mermilloid gap at B8V stars with $(J - H)_0 = -0.05$ and the Canterna and M11 gaps for early A type stars at $(J - H)_0 = 0.01$ and $(J - H)_0 = 0.04$ respectively. These are possibly related to the way the Balmer jump and Balmer lines behave in late B and early A stars. Determination of the age of this cluster is difficult as there are no evolved stars in the cluster. The isochrones used are from Bertelli et al. (1994) for metallicity 0.02. Based on the brighter stars, the age has been determined as 40 Myr, where $\log t = 7.6 \pm 0.1$, but the cluster could be still younger or older depending upon the weight we give for a particular member in choosing the isochrones. Figure 1 also shows the isochrone fit to the color–magnitude diagram of the cluster. The 2MASS data obtained for this cluster has been compared with that obtained by observations and shows satisfactory agreement.

The luminosity function for NGC 2384 is shown in Fig. 2. The absolute magnitudes of the members range from -1^m to 5^m, with a peak at around 4^m. This peak is associated to the possible pre-main sequence stars seen at $(J - H)_0 \approx 0.4$ in the color–magnitude diagrams.

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