Bull. Astr. Soc. India (2001) **29**, 339–342

PRLNIC3 observations of star forming cloud L1340

Shashikiran Ganesh, U.C. Joshi, Kiran S Baliyan, Chhaya R Shah, J.K. Jain, G.S. Rajpurohit, Kaushar Sanchawala and A.B. Shah

Physical Research Laboratory, Navarangpura, Ahmedabad 380009, India

Abstract. Due mainly to high extinction in optical, the structure of our galaxy, Milky Way, is not very well understood. The Galactic disk and bulge contain a host of heavily reddened open clusters which are deeply embedded within dark molecular clouds of dust and gas. The extremely young stellar objects in these clouds can provide important informations for the study of stellar evolution and star formation. We report near infrared photometric study of one such cloud, Lynds 1340 in the survey mode. The cloud contains several nebulous regions and is shown to harbour a young cluster RN07. The near IR study provides detailed information on the embedded sources.

Key words : NICMOS camera, dark clouds, star forming regions, Near Infrared, clusters.

1. Introduction

In spite of much work, the structure of our own galaxy, Milky Way, is not very well understood. There are a number of dark molecular clouds which harbour regions of intense star formation activity. The Galactic disk and bulge contain a host of heavily reddened open clusters which are deeply embedded within such dark molecular clouds of dust and gas. These are hiding extremely young stellar objects which can provide important clues to the study of stellar evolution and star formation. Since these objects have varying amount of circumstellar gas and dust, they radiate significantly in the infrared. A near infrared study, therefore, will provide detailed information on the embedded sources in these clouds as there is large extinction at shorter wavelengths.

2. Lynds cloud L1340

Since lot of gas and dust are pre-requisite for the star formation activity, dark molecular clouds are perfect candidates for Near IR study. One such interesting field, Lynds 1340 molecular cloud, is taken up for photometric study using NICMOS-3 IR array camera PRLNIC-3 mounted at the Cassegrain focus of 1.2m telescope at the Mt. Abu Infrared Observatory (MIRO). Lynds 1340 is a small molecular cloud in the Cassiopeia constellation with galactic coordinates

l = 130°, b = 11.5° and RA & DEC. : α (J2000) $2^h\ 30^m\ 40^s$ δ (J2000) 72° 57′ 19″. Approximate distance of this cloud is 660 ± 30 pc and it lies in a region of relatively low extinction. It contains several nebulous regions; RN07-consisting of many bright stars, RN08 - a faint nebulous region, RN09 - towards south consisting of couple of stars. Intense molecular emission is shown in the ^{13}CO survey observations done with 4 m radio telescope of Nagoya University (Yonekura et al., 1994). Some cold IRAS sources in this cloud are suggestive of star forming activity. Interstellar molecular clouds associated with reflection nebulae are important in the study of star formation and early stellar evolution. Spectrometric and photometric study of stars illuminating the nebulae can be used to provide a better estimate of the cloud distances. UBV photometry of some objects in this cloud is reported by Kun et al. (1994).

3. Observations

Photometric observations of a large field in L1340 cloud were made during November, December 1999 and January 2000 in the near IR using 1.2 m IRtelescope at Mt. Abu Observatory. These were made in the survey mode covering about 0.5 deg square field using PRLNIC-3 IR camera. The camera is a HgCdTe 256 x 256 pixels array with 4′ x 4′ and 2′ x 2′ fields of view (Joshi et al 1999). The observations made in J and H bands were completed using 4 x 4 arcmin^2 field of view. The exposure times given in J and H filters were 30 seconds and 20 seconds, respectively. To improve the signal to noise ratio, several frames of these exposure times were taken at each location in both the filters. We have also made observations in J, H and K bands at higher resolution using 2′ x 2′ FOV for RN07 - a small cluster field in L1340 cloud. A number of standard stars (Hunt et al 1998) were also observed during each night. Dark frames were taken corresponding to each exposure time during each observing run. Observations were done in rows of constant declination. Each strip of constant declination had images with overlap of about 30 arcsec in RA. this helps in preparing a mosaic image of the field.

3. Data reduction and analysis

Several hundred Mb of observational data is obtained during each observing night. The data reduction was done using IRAF with additional locally developed tasks as necessary. All the images at one location were average combined to produce a single frame per location in the sky. These images then were subjected to following pre-processing steps to remove instrumental signatures.

Sky correction : A sky frame was constructed at each observed location by median combining all observations of the strip except the one for which the sky was constructed. The resulting sky frame was subtracted from the observed frame.

Dark correction : A master dark frame is constructed for each exposure time by median combining a large number of dark frames.

Flat correction : A single frame was created from the sky frames by median combining all the sky frames and subtracting the dark frame for the corresponding exposure time. The resulting frame was converted into a master flat field for the filter after dividing by the mode value of

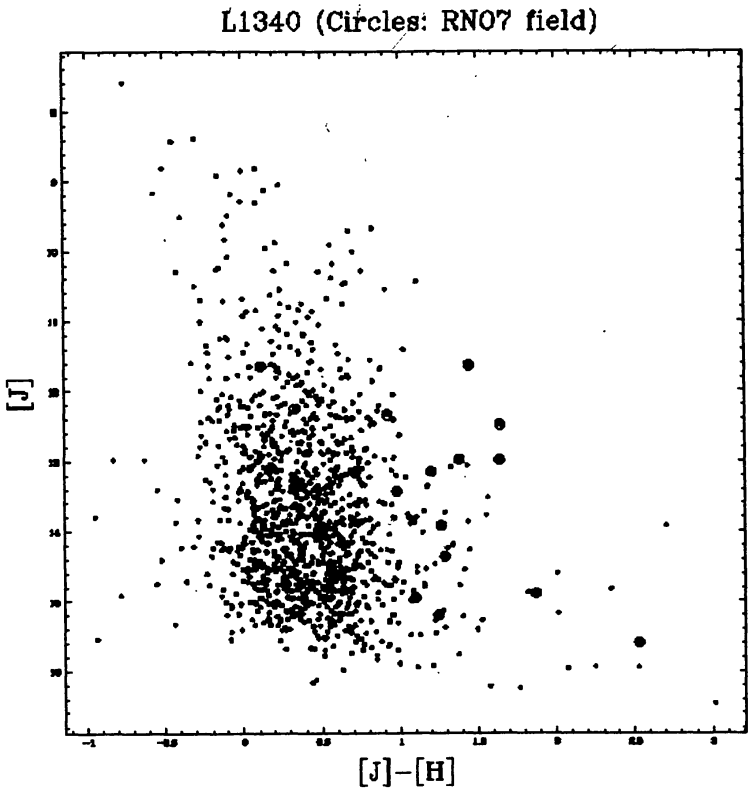

Figure 1. J v/s J - H diagram for L1340. The circled stars belong to RN07 cluster.

the frame. This master flat field frame was applied to all the sky corrected frames. After bad pixel correction, a residual sky correction (DC offset) was applied to each of these frames resulting in a clean final image at each location without sky and instrumental signatures.

Now the clean images are ready for photometry. Photometry was done using IRAF daophot tasks. Aperture photometry is done using psf fitting as some fields were very crowded. Psf fits for individual frames were applied taking 20 to 30 stars and using Gaussian fitting. This was decided after trying several fitting algorithms. This constant Psf was used for the photometry of all stars in the frame.

4. Results and discussion

The L1340 field contains a large number of stars of varying magnitudes. We notice several bright stars in the form of cluster RN07 which is mentioned as nebulous region by Kun et al (1994). This region has been identified with Hα emission stars embedded in the nebulosity (Kun et al 1994). This emission provides most conspicuous optical feature of young, solar type pre-main sequence stars. These stars, therefore, are good candidates for the 'young stellar objects' and form study case for the early phases of the stellar evolution. We have performed near infrared photometry of large number of stars in this field and a color magnitude diagram is shown here. A detailed study of the distribution of various classes of the stars will be presented elsewhere.

5. Acknowledgements

This work was partially funded by the Indo-French Centre, New Delhi and the Department of Space, Govt. of India. One of us (KS) is thankful to the Indo-French Center for Promotion of the Advanced Research (IFCPAR) for a project associateship.

References

Joshi U.C. et al. 1999, EAMA conf proceedings
Hunt L.K., et al 1998, AJ 115, 2594
Kun M. Obugashi A., Sato F et al., 1994, A & A 292, 249