



Broadband optical polarimetric studies of Be 59

C. Eswaraiah* and A. K. Pandey

Aryabhata Research Institute of Observational Sciences (ARIES), Nainital, 263129, India

Abstract. We present results based on multiwavelength optical polarimetric observations of 69 stars of the young Galactic open cluster Berkeley 59. Our observations reveal the presence of three dust layers at distances of ~ 300 pc, ~ 500 pc and ~ 700 pc towards the direction of Be 59. The mean polarization and polarization angles due to these dust layers are found to increase systematically with increasing distance. The magnetic field orientation in the intracluster medium is significantly different and deviated from that in the foreground medium. The dust grain size is found to be different in the intra-cluster medium in comparison to that in the foreground medium.

Keywords : ISM: dust, magnetic field – stars: clusters – Be 59

1. Introduction

Polarimetric studies are useful tools to understand the distribution and properties of dust associated with interstellar medium as well as to map the magnetic field orientation at various Galactic environments. Star-forming regions/young star clusters are in fact unique laboratories to understand the properties of dust layers present along the line of sight as well as to trace the local physical conditions within the intra-cluster medium. With the help of Serkowski's law one can find the dust properties such as P_{max} and λ_{max} .

As a part of the on going project to investigate dust properties at various Galactic environments, we obtained polarimetric observations of the stars towards the young open cluster Berkeley 59 ($\alpha = 00^h 02^m 13^s$, $\delta = +67^\circ 25' 11''$; $l = 118^\circ.22$, $b = 5^\circ.00$), which is located at the distance of 1.00 ± 0.05 kpc and reddened by ≈ 1.4 - 1.8 mag (cf., Pandey et al. 2008).

*eswar@aries.res.in

2. Results

Observations in B , V , R_c & I_c photometric bands were carried out using ARIES Imaging Polarimeter (AIMPOL). The data reduction has been done using the standard procedures (cf. Eswaraiyah et al. 2011).

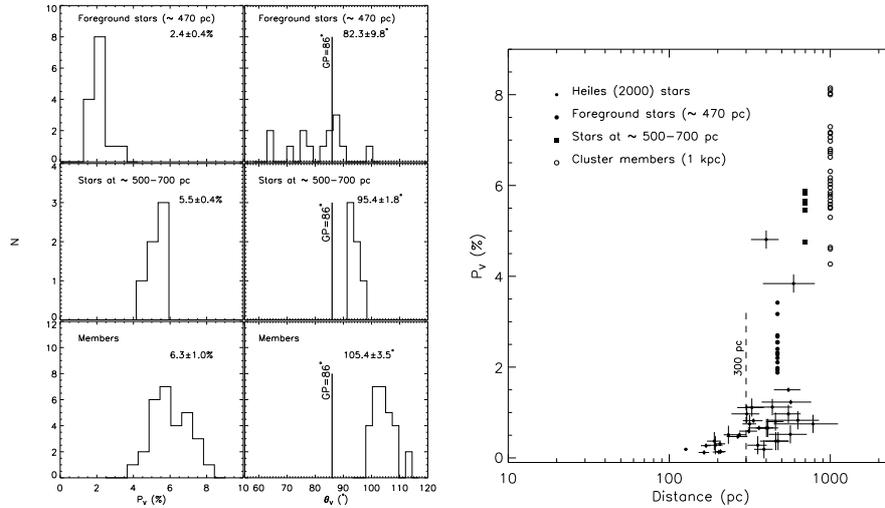


Figure 1. (left panel): The histograms of P_V and θ_V for the foreground stars lying at ~ 470 pc (top panel), stars lying at $500-700$ pc (middle panel) and the cluster members (lower panel). The position angle (86°) of the Galactic plane (GP) towards the direction of Be 59 has also been shown with thick line. The mean and standard deviation of P_V and θ_V values for each group is also mentioned. (right panel): Polarization versus distance. Various group of stars are represented with different symbols in the figure.

The cluster probable members have been identified using polarimetric measurements in combination with optical $(U - B) - (B - V)$ colour-colour diagrams (for details see Eswaraiyah et al. 2011). Two groups of foreground stars at ~ 470 pc and $\sim 500-700$ pc have also been identified. The left panel of Fig. 1 shows the histograms of P_V and θ_V for the three groups of stars. The degree of polarization, polarization angle and the deviation of the mean polarization angle from GP increase with the increasing distance from the Sun. Right panel of Fig.1 shows the degree of polarization versus distance for the stars observed by us (filled circles, filled squares and open circles respectively, represent the foreground stars at ~ 470 pc, at $\sim 500-700$ pc and cluster members). The polarization and distance measurements for the stars distributed in a circle of 10° radius around the cluster Be 59 shown with small filled circles are taken from Heiles (2000) and van Leeuwen (2007), respectively. Fig. 1 (right panel) manifests three sudden jumps in the distribution of P_V , which indicate the presence of three dust layers at ~ 300 pc, ~ 500 pc and ~ 700 pc. The large dispersion in the polarization of cluster members indicates the presence of variable reddening

in the intra-cluster medium. The weighted mean of λ_{max} for cluster members and foreground stars comes out to be $0.54 \pm 0.01 \mu\text{m}$ and $0.50 \pm 0.02 \mu\text{m}$ respectively, which indicates that the dust grain size in the intra-cluster medium is different from that in the foreground medium.

3. Conclusions

In this presentation, we present optical polarimetric studies of 69 stars towards the young star cluster Be 59. We found that the light of cluster stars has been polarized upto ~ 8 per cent. The foreground and cluster members have been found to exhibit different polarimetric components. Our results reveal three dust layers towards the direction of Be 59 at ~ 300 pc, ~ 500 pc and ~ 700 pc. The magnetic field orientation within intra-cluster medium is different from that in the foreground ISM. Mean degree of polarization, polarization angle and the deviation of the mean polarization angle from the GP increase with increasing distance from the Sun. The dust grain size in the intra-cluster medium is found to be relatively larger than that in the foreground medium.

References

- Eswaraiah C., Pandey A. K., Maheswar G., Medhi B. J., Pandey J. C., Ojha D. K., Chen W. P., 2011, MNRAS, 411, 1418
Heiles C., 2000, AJ, 119, 923
Pandey A. K., Sharma S., Ogura K., Ojha D. K., Chen W. P., Bhatt B. C., Ghosh S. K., 2008, MNRAS, 383, 1241
van Leeuwen F., 2007, A&A, 474, 653