Mon. Not. R. Astron. Soc. **000**, 1–?? (2010) Printed 16 June 2011 (MN LATEX style file v2.2)

Broad-band Optical Polarimetric Studies of Berkeley 59

C. Eswaraiah et al

16 June 2011

ABSTRACT

(to be written)

Key words: Polarization- dust, extinction - open clusters and associations: individual (Berkeley 59).

1 INTRODUCTION

Interstellar grains are aspherical in nature and are supposed to be aligned in space with respect to the Galactic magnetic field (Davis & Greenstein 1951). The effective extinction cross sections of the particles are greatest when the electric vector of the incident light is parallel to the long axes of the particles as projected on the plane of the sky, and least when parallel to the short axes. This differential extinction introduces a small degree of linear polarization in the transmitted light.

Studies of polarization due to the interstellar matter (ISM) are important as these provide information about the properties of the dust associated with the ISM and intra-cluster matter as well as help to trace the Galactic magnetic field. As the grains are thought to align due to the local magnetic field, the observed polarization vectors map the general geometry of the magnetic field. The observed maximum upper limit relation between the degree of the polarization and the color excess $E(B-V)$ is found to be $P_{max} = 9 \times E(B-V)$ (Aannestad & Purcell 1973). The relation between P_{max} and colour excess, and the variation of P with wavelength are interpreted in terms of the grain properties and the efficiency of the grain alignment. Therefore, polarimetry is a useful technique to investigate the properties

like maximum polarization $P_{\lambda_{max}}$, the wavelength λ_{max} corresponding to $P_{\lambda_{max}}$ and the orientation of the magnetic field in various Galactic locations.

Polarimetric studies of star-forming regions/young star clusters are specially important because physical parameters such as distance, age, membership and color excess $E(B-V)$ of these regions are known accurately and consequently help in analyzing the polarimetric data in a meaningful way. Strong ultraviolet radiation from OB type stars in these regions have strong impact on the surrounding medium. Dust grains can undergo destruction processes due to direct radiative pressure, grain-grain collisions, sputtering and shattering etc. As a result, it is likely that the mean size of the dust grains could be biased towards smaller size. The stars in front of star forming regions can help to understand the nature of dust as well as the magnetic field in the foreground.

Young star clusters (age $<$ 10 Myr), still embedded in the parent molecular cloud, are unique laboratories to understand the dust properties as well as the nature of interaction between young star(s) and the surrounding medium. Be 59 (α = 00h 02m 13s, δ= +67° 25′ 11″; l = 118°.22, b = 5°.00) is such a young star cluster associated with a heavily obscured gas-dust complex of the Cepheus OB4 association. The cluster Be 59 is located at the center of the sharpless region S171 and contains nine 07-B3 stars (cf. Pandey et al. 2008; here after P08). P08 have found that the distance and $E(B-V)$ for Be 59 is 1.00 ± 0.05 kpc and ∼ 1.4 – 1.8 mag respectively. The extent of the cluster was found to be 2.9 pc (P08).

As a part of ongoing project to understand the dust characteristics in star forming regions and to map the structure of magnetic field at diverse environments of the Milky Way Galaxy, we have carried out broad-band optical polarimetric observations towards Be 59.

The paper is organized in the following manner. In section 2, we briefly present on the observations and data reduction. We present results and discussion in section 3 and dust properties in section 4. We conclude our results in section 5.

2 OBSERVATIONS AND DATA ACQUISITION

Polarimetric observations were carried out on seven nights (2009 November 23, 24, 25 and December 24, 26, 27 and 28), using the ARIES Imaging Polarimeter (AIMPOL; Rautela, Joshi & Pandey, 2004) mounted at the Cassegrain focus of the 104-cm Sampurnanand telescope of the Aryabhatta Research Institute of observational sciencES (ARIES), Nainital, India. The observations were carried out in B, V, R_c and I_c ($\lambda_{B_{eff}}$=0.440μm, $\lambda_{V_{eff}}$=0.530μm,