ON THE DUST AND GAS ASSOCIATED WITH SHARPLESS 252*

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(Received 27 June, 1986)

Abstract. The stellar cluster and the massive molecular cloud associated with the H II region Sharpless 252 have been studied by means of multicolour polarization and molecular line measurements. The average wavelength of the maximum polarization $\lambda_{\text{max}}$ and polarization efficiency for the cluster stars are similar to the values observed for the nearby field stars. Two local maxima lying only 2' apart were found in the molecular cloud core in CO, NH$_3$, and HCO$^+$. The excitation conditions and radial velocities associated with the maxima are different.

1. Introduction

The H II region Sharpless 252 (diameter 0.5) lies in the galactic plane in the direction of the galactic anticentre at a distance of 2.2 kpc. The main ionizing source of the region is the O6.5V star HD 42088. Two stellar clusters (S 252main and S 252small) lie in the direction of the H II region (Pismis, 1969). The ages of these clusters are of the order of 1 (S 252main) and 6 million years (S 252small) and they are both associated with S 252 (Haikala, 1986). Six small size thermal radio sources (S 252A, B, C, E, and F) were detected by Felli et al. (1977) at 1415 and 4995 MHz. These sources coincide with small nebulosities seen projected on the diffuse and extended H II region. S 252C is the strong ionization front at the interface of the molecular cloud and the H II region. The molecular cloud (extension 1.5-1.5 associated with S 252 was mapped by Lada and Wooden (1979) (here after LW) in $^{12}$CO and $^{13}$CO using 3' spatial resolution. LW found also an H$_2$O maser near S 252A.

2. UBVRI Polarimetry

The observations were made in November 1982 with the two-channel photometer-polarimeter (Proetel et al., 1975) at the 1.23 m telescope in Calar Alto. Early-type stars, 37 in the direction of S 252 and 60 within two degrees of it, were observed in the approximate Johnson BV and UBVRI bands. These observations have been discussed in Haikala (1986) together with the photometric data.

The observed polarizations of field stars lie mostly between 1 and 3%. The


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polarizations can be well fitted with the empirical interstellar wavelength dependence of polarization (Serkowski, 1973). The normalized field star polarizations are plotted in Figure 1(a) together with the ‘Serkowski curve’. The average of the wavelengths where the polarization reaches its maximum $\lambda_{\text{max}}$ for these stars is $0.54 \pm 0.02\mu$ (error of the mean, ten stars). This is a typical value for normal interstellar polarization. The polarization efficiency (the ratio of the polarization degree and visual extinction) is high in the general direction of the galactic anticentre (Hiltner, 1956). The present observations are in agreement with this (see Figure 1(b)). This implies that one is observing nearly perpendicular to the galactic magnetic field and that in this direction the direction of the field does not essentially change within 2 kpc from the Sun.

![Figure 1a-b](image)

(a) Normalised field star polarization. The continuous curve is ‘Serkowski’s law’. (b) Observed visual polarization and the colour excess of the field stars. The empirical upper limit $P = 3E(B - V)$ is also shown.

The observed polarizations of stars associated with S 252 range between 2 and 6%. Two exceptionally high polarizations, 8.9 and 12%, are observed for the probable ionization sources of S 252A and C, respectively.

The polarizations of the cluster stars do not show any significant deviations from the ‘Serkowski’s law’ (Figure 2(a)). The average $\lambda_{\text{max}}$ for these stars is $0.53 \pm 0.01\mu$ (nine stars) which is the same as for field stars. The observed polarization efficiency for the stars associated with S 252 is as high as for the field stars (Figure 2(b)).

It was shown by Serkowski et al. (1974) (hereafter referred to as SMF) that the three colour excess ratios $E(V - I)/E(V - R)$, $E(V - K)/E(V - R)$, and $E(V - K)/E(B - V)$ correlate well with the wavelength of maximum polarization. Using the relation $R = A\nu/E(B - V) = 1.1 \times E(V - K)/E(B - V)$ given by Carrasco et al. (1973) and the observed correlation between $\lambda_{\text{max}}$ and $E(V - K)/E(B - V)$ SMF calculate that $R$ and $\lambda_{\text{max}}$ are related by $R = 5.5\lambda_{\text{max}}$.

The colour excess ratio $E(B - V)/E(V - R)$ and $\lambda_{\text{max}}$ can be calculated for eight stars...