Dust in Outer Layers of B5 Globule

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We present results of $UBVRI$ polarimetry of about 30 stars in a vicinity of the well-studied Bok globule Barnard 5 (B5). We find a correlation of the maximum polarization wavelength λ_{max} with extinction in the cloud when $A_V > 1.5$ mag. We conclude that multicolor polarimetry of background stars can be a useful tool to characterize dust in outer regions of dark clouds.

The properties of dust in dark clouds are still not well understood. Recent studies of extinction law, scattered light and submm emissivity have inferred changes in dust properties with an increase of depth inside a cloud (e.g., [1]). However, there are doubts that the wavelength dependence of polarization $P(\lambda)$ of background stars can be useful to characterize dust grains as different factors can affect this dependence in typical molecular clouds [2]. For globules, being smaller and more simple geometrically and physically, the situation can be different, but observations of $P(\lambda)$ variations with the depth have not been made since the work [3].

We performed $UBVRI$ polarimetric observations of about 30 stars around B5 at 2.6-m ZTS and 1.25-m AZT-11 telescopes with the standard equipment at the Crimea Observatory in 1990–93. These polarimetric data supplemented with those available in the literature allowed us to derive much more reliable estimates of λ_{max} than in [3] (see as examples the values of λ_{max} in micron in the table).

Stars	data from [3]	this work
J1	0.79 ± 0.06	0.77 ± 0.02
J6	0.80 ± 0.11	0.55 ± 0.06

Stars	data from [3]	this work
J2	0.85 ± 0.08	0.76 ± 0.02
J16	1.11 ± 0.29	0.93 ± 0.12

For 20 out of 36 stars considered, we accepted the spectral classes found from Vilnius system photometry in [4]. For other 8 stars, we took the classes given by HDEC and assumed that the stars belong to the MS. For the weakest rest 8 stars, we estimated spectral classes from 2MASS data in a usual way. That gave us estimates of A_V and distances to the stars as photometric data are available.

We used data from the COMPLETE survey that has given various detailed maps of several star-forming regions including that in Perseus with the globule B5 being located at its edge [5]. In the figure we show a map of B5 with the

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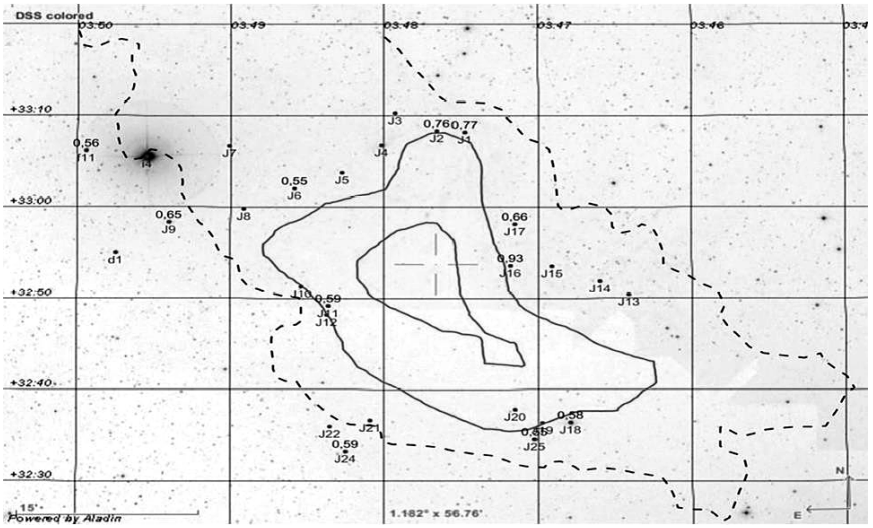

Figure 1: Map of B5 globule. Continuous lines present the extinction contours with $A_V = 3$ and 5 mag from [5]. Points with the number marks show our stars. Numbers above these marks give the obtained values of λ_{max} in micron.

extinction contours from this survey (and our stars with λ_{max} values derived). We find a good agreement of our estimates of A_V with those of [5].

For the field stars, we found locally increased $\lambda_{max} \approx 0.6 \pm 0.05\,\mu$m, which is typical of star-forming regions and is usually related to an effect of close stars.

Our data show that the stars J11, J18, J25 and F11 are foreground as the distance to them is less than that to B5 ($\sim$350 pc). For other stars, we see a certain increase of λ_{max} values when the cloud contribution to A_V grows.

Generally, we did not find clear effects of the halo on the maximum polarization wavelength, but detected a certain increase of λ_{max} when the contribution of the outer layers was significant ($A_V > 1.5$ mag).

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