

Polarization of Light From Distant Stars by Interstellar Medium

W. A. Hiltner

Yerkes Observatory, University of Chicago

IN THE COURSE OF PHOTOELECTRIC OBSERVATIONS made last summer with the 82-inch telescope of the McDonald Observatory (University of Texas) the writer found that the light from distant galactic stars is polarized. Polarizations as high as 12 percent were found. The plane of polarization appears to be close to the galactic plane in the cases examined. More recently control measures were made at the Lick Observatory, thanks to the courtesy of Director Shane and Dr. G. Kron; and during December the work at the McDonald Observatory was extended to different regions of the Milky Way.

In view of the unexpected nature of this result the circumstances leading to its discovery are recorded. Photometric observations for the detection of partially polarized radiation from eclipsing binary stars have been in progress at the Yerkes Observatory for several years with a view to establishing observationally the effect pointed out by Chandrasekhar that the continuous radiation of early-type stars should be polarized (1, 2). On the assumption that the opacity of early-type stars is due to scattering by electrons, the continuous radiation emerging from a star should be polarized with a maximum of polarization of 11 percent at the limb. Since the presence of this polarization can be detected only when the early-type star is partially eclipsed by a larger-type companion of the system, the effect is masked by radiation from this companion so that the expected maximum observable effect was only of the order of 1.2 percent in one case investigated (RY Persei).

At this stage Dr. John Hall, of Amherst College, proposed to the writer a program of collaboration whereby Dr. Hall would construct a "flicker" photometer which was to be tested jointly at the McDonald Observatory. Independently the writer was developing his own equipment which used polaroids. Dr. Hall's equipment was tested in August 1947, during a short session at the McDonald Observatory, but no dependable results were obtained and it was found that the equipment had to be remodeled. Unfortu-

nately, Dr. Hall was unable to come for a second trial period, scheduled for August 1948.

Meanwhile the writer's own equipment was completed and put to use during the summer of 1948 and was found satisfactory. Certain Wolf Rayet stars which were known or suspected to be eclipsing binaries were examined for polarization. Fairly large polarizations were found, but *they did not appear to depend on the phase of the binary motion*. The possibility of instrumental polarization was considered, of course, but ruled out by control measures on check stars. The Wolf Rayet stars give the following results:

Star	Polarization	
	%	Position angle
CQ Cep	10.0	62°
BD 55°2721	8.0	44
WN Anon*	12.5	44

*Coordinates: 22^h08^m + 57°26' (1945); 12.5 magnitude.

The control stars had similar color and brightness, but showed no polarization except for one object, BD 55°2723, which gave 3 percent. This star, however, is a giant and more distant than the other control stars. Similar observations made on a group of Wolf Rayet stars in Cygnus showed no appreciable polarization, while two stars in Scutum gave positive results. Other regions, such as the double cluster in Perseus, also show polarization with values ranging up to 12 percent.

We conclude from the positive and negative results quoted that the measured polarization does not arise in the atmospheres of these stars but must have been introduced by the intervening interstellar medium. If this conclusion is accepted, a new factor in the study of interstellar clouds is introduced. Further observations are in progress for relating this phenomenon with other observable characteristics of interstellar medium. As has been stated, the results already at hand indicate that the plane of polarization approximates the plane of the galaxy.

References

1. CHANDRASEKHAR, S. *Astrophys. J.*, 1946, **103**, 365.
2. HILTNER, W. A. *Astrophys. J.*, 1947, **106**, 231.