THE ASTROPHYSICAL JOURNAL, 190:L25–L26, 1974 May 15

THE WAVELENGTH DEPENDENCE OF CIRCULAR POLARIZATION IN GD 229

J. D. LANDSTREET
Department of Astronomy, University of Western Ontario
AND
J. R. P. ANGEL*
Department of Astronomy, University of Texas at Austin
Received 1974 February 25

ABSTRACT

Circular polarization measurements of GD 229 in narrow wavelength bands show structure down to the instrumental resolution of 160 Å. Our data do not indicate any significant variability on a night-to-night basis in any region of the spectrum.

Subject headings: magnetic stars — polarization — white dwarf stars

The white dwarf suspect GD 229 has been found by Swedlund, Wolstencraft, Michalsky, and Kemp (1974) to show elliptical polarization. These authors report variable polarization in red light on time scales of a few minutes and a day, the linear component taking values from 1.4 to 11 percent, and the circular component from −2 to 4 percent. Variability has been established previously in only one other magnetic white dwarf, G 195-19 (Angel, Illing, and Landstreet 1972), where the circular component in red light varies from 0.4 to 1.2 percent with a period of 1.33 days.

We have observed the circular polarization spectrum of GD 229 on three successive nights with the 5-meter Hale telescope. A polarizing modulator was used in conjunction with the multichannel spectrophotometer, as described by Angel and Landstreet (1974). The polarization was measured in 27 separate wavelength bins, 160 Å wide over the range 3260–5720 Å and 360 Å wide over the range 5320–9260 Å. Each night's data were reduced separately, correction being made for the sky background measured periodically during the night, and for instrument efficiency. Calibration of the system was made by placing polaroids (HNP'B and HR) and a Fresnel rhomb in the incoming beam.

When the data for each night are compared, no significant changes in the individual 160 and 360 Å bands are apparent. In order to search for variability in broad wavelength bands we have computed the average polarization in the ranges 3180–4760 Å, 4760–6020 Å, 6020–7460 Å, weighting each narrow band according to its accuracy. The circular polarizations in percent found for these bands are given in Table 1. Clearly in the first two bands there is no evidence for day-to-day variability within the accuracy of the measurements, typically 0.1 percent. In the red band, which is essentially identical to the red band of Swedlund *et al.* (1974), the agreement is not quite so good, but still the deviations are within 0.25 percent of the mean and are not significant even at the 2σ level. In view of the lack of significant variation in any color region, we have combined the data for all three nights to obtain the most accurate picture of wavelength dependence. This is shown in figure 1. The histogram shows the measured values in each channel of the spectrophotometer. The vertical lines are drawn to show the standard deviation above and below these values, derived from counting statistics.

The polarization shows definite structure, especially in the region 3500–5000 Å. The sharp drop at 3960 Å, sharp rise at 4280 Å, and slow fall to 5000 Å are real

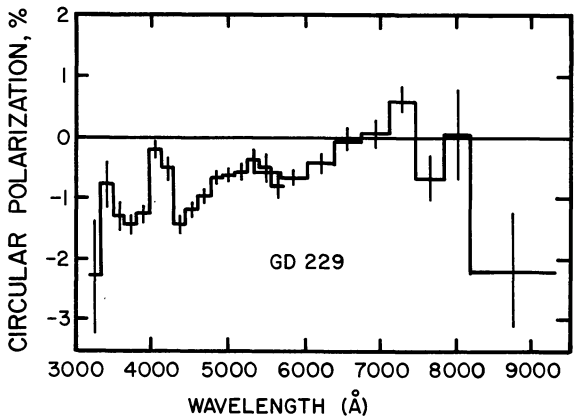

FIG. 1.—Data from three nights combined to give wavelength dependence of circular polarization in GD 229. Vertical lines indicate the error due to counting statistics. Three 360 Å bins were combined to give the data point above 8000 Å.

* Alfred P. Sloan Research Fellow on leave from Columbia University. Present Address: Steward Observatory, University of Arizona, Tucson, Arizona 85721

TABLE 1

NIGHTLY BROAD-BAND AVERAGES OF CIRCULAR POLARIZATION

DATE (1973)	TIME OF RUN (UT)	CIRCULAR POLARIZATION (percent) 3180–4760 Å	4760–6020 Å	6020–7460 Å
November 6.....	0240–0640	−0.95±0.07	−0.60±0.06	−0.14±0.10
November 7.....	0300–0545	−0.92±0.10	−0.58±0.10	+0.21±0.16
November 8.....	0255–0500	−1.06±0.10	−0.64±0.12	−0.14±0.22

features which are apparent in the data for each of the three nights separately. The wavelength dependence is clearly not resolved at the 160 Å bin width used. Comparing with the other magnetic white dwarfs, the sharp step at 4280 Å is at the same wavelength as the G band Zeeman structure in G 99-37 (Angel and Landstreet 1974); however, the spectra and temperatures are not similar. (Greenstein, Schmidt, and Searle 1974).

Concerning the possible variability of GD 229, our circular polarization data do not indicate any changes on the three successive nights of observation. The data was not recorded in short enough periods to allow analysis on a timescale of minutes. The linear polarization has been further studied since the initial report by Swedlund *et al.* Dr. P. Martin obtained one broad-band measurement of linear polarization for us on December 22 at the 82-inch Struve telescope of McDonald Observatory. In a band from 3900 to 5600 Å, defined by a GaAs phototube and Corning 4-96 filter, the polarization was $2.9 \pm 0.1\%$, $\theta = 78°.4 \pm 1°$. Measurements by Coyne a few days previously with blue filter and no filter are in good agreement with this value, as are Kemp's results on the same and following nights (Kemp, Coyne, Swedlund, and Wolstencroft 1974). The originally reported variability is thus not confirmed in either the circular or linear polarization.

We are grateful to Drs. Coyne, Greenstein, Kemp, and Swedlund for communicating their results to us before publication, and to the Director of the Hale Observatories for making the 5-meter telescope available to us. This work is supported by the National Science Foundation, the Research Corporation and the National Research Council of Canada.

REFERENCES

Angel, J. R. P., and Landstreet, J. D. 1974, *Ap. J.*, in press.
Angel, J. R. P., Illing, R., and Landstreet, J. D. 1972, *Ap. J. (Letters)*, **175**, L85.
Greenstein, J. L., Schmidt, M., and Searle, L. 1974, *Ap. J. (Letters)*, **190**, L27.
Kemp, J. C., Coyne, G. V., Swedlund, J. B., and Wolstencroft, R. D. 1974, **189**, L79.
Swedlund, J. B., Wolstencroft, R. D., Michalsky, J. J., and Kemp, J. C. 1974, *Ap. J. (Letters)*, **187**, L121.