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LINEAR POLARIZATION OF THE Be STAR 66 Oph

Eighteen wide-band (B) filter linear polarization measurements of the B2 Ve star 66 Oph were carried out over 1981 August - 1982 September. The prime purpose of this Bulletin is to compare ground-based polarimetry with IUE Satellite ultraviolet spectroscopy carried out (intermittently) in years 1981 and 1982.

All the observations being reported here were made at the Cassegrain focus of the 61 cm telescope at Columbia University's Harriman Observatory. The same filter, and

Table I

Polarization Amount and Position Angle of 66 Oph

Date (UT)	P (%)	θ (deg.)
1981 Aug. 27.07	1.28	95.6
1981 Sep. 21.02	1.26	95.6
1981 Sep. 30.04	1.28	95.2
1981 Oct. 21.03	1.30	96.5
1981 Nov. 04.98	1.29	96.1
1982 Mar. 23.36	1.24	93.6
1982 Mar. 24.36	1.25	94.9
1982 Mar. 29.33	1.26	95.2
1982 Apr. 22.24	1.27	93.4
1982 Apr. 23.23	1.22	93.2
1982 Apr. 25.24	1.28	96.4
1982 Apr. 29.23	1.22	94.0
1982 May 15.15	1.27	96.2
1982 Jun. 15.17	1.25	95.7
1982 Aug. 16.11	1.20	95.7
1982 Aug. 20.07	1.17	94.8
1982 Aug. 22.09	1.16	91.8
1982 Sep. 10.07	1.27	96.4

essentially the same polarimeter, ancillary equipment and observing procedures were used as in previous surveys of this type carried out by the author (Hayes 1978, 1980). The interested reader may consult these references for further details regarding instrumentation and observing procedures. The polarization measurements are tabulated in Table I, with P denoting the amount (expressed as a percentage), and θ denoting the direction (expressed in the equatorial coordinate system). Each measurement had a Poisson photon-count standard deviation of 0.02% for P as well as for the two Stokes parameters $Q = P \cos 2\theta$ and $U = P \sin 2\theta$. The standard deviation of θ is given by $28\overset{\circ}{.}7\ (\sigma_p/P)$. Observations were only carried out when the moonlight background was negligible.

Comparison was made with previously cited values of this star's blue-wavelength linear polarization. Twelve values were culled from the following publications: Coyne (1976), Hall (1958), Mathewson and Ford (1970), Poeckert (1975), Poeckert, Bastien, and Landstreet (1979), and Serkowski, Mathewson and Ford (1975). The magnitudes of the polarization vectors being reported here were almost invariably larger than those previously chronicled (which run the gamut from 0.97% to 1.19%). Previous reports of polarization vector orientations ranged between 92° and 97° - values consistent with those being reported here. The main results of this intercomparison is that in a historical context the Table I polarization magnitudes are strong and their orientations are consistent with previous observations. This data gives tentative evidence for collinearity when plotted in the Q - U Stokes parameter frame (the scatter of points about the least-squares straight line fit to the data has a standard deviation of 0.027%). If collinearity were upheld by further observations it would indicate an axisymmetric distribution of scatterers (vide Hayes 1980). The wide range of errors quoted by other observers precludes applying the same stringent collinearity test to all the available data.

A series of χ^2-tests [consult Hayes (1980) for details] were carried out to gauge the variability of the consolidated distribution of Q and U data points being reported here. A

test of all 18 observations yielded overwhelming evidence for variability (at the >99% confidence level). In addition to previously cited evidence for long-term variations, Serkowski et al. (1975) detected significant polarization changes in a pair of observations made on consecutive nights.

Comparison will now be made with some pertinent ultraviolet data. Peters (1982) reported that some of the resonance lines in five observations of 66 Oph made over the interval 1981 July 9 - November 12 displayed relatively narrow,-250 km s^{-1} velocity absorption features. These narrow features appeared to show variability (admittedly of nonepic proportions) over that interval. During that time the polarization was relatively strong and invariant (variability at only the 50% confidence level). In a brief abstract Sonneborn (1982) reported complex, variable velocity structure in some of this star's resonance lines over the interval 1982 September 8 - October 21. Polarimetry carried at about this time (the last four observations of Table I) evince overwhelming evidence for variability (at the >99% confidence level). The foregoing intercomparisons do not appear to be clear-cut, and may even be somewhat contradictory. The data indicates some evidence for (relatively small-scale) ultraviolet variations, but statistically significant polarization changes occur at about the time when Sonneborn reported variations in the structure of some of this star's resonance lines. The same contradictory state of affairs appears to hold for the Be star ω Ori (manuscript in preparation). The lack of a large intercomparison data base precludes making any definitive statement at this time regarding the relationship (if any) between optical polarization and ultraviolet spectroscopy in 66 Oph. Only further observations will permit a definitive conclusion.

The main results of this work may be summarized as follows. Historically, the polarization of 66 Oph was fairly strong over the course of this observing interval. Intercomparison of polarization and ultraviolet spectral features failed to uncover any consistent relationship (or, for that matter, any consistent antirelationship). The polarization

was quite strong but invariant over an interval when there were some indications of changes in ultraviolet line features. But at another epoch both the polarization and ultraviolet spectra evinced changes.

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