LETTERS TO NATURE

Optical Circular Polarization of X Persei

THE possible identification[1] of X Per with the X-ray source[2] 2ASE 0352+30 has stimulated interest in other properties of the star. In addition to detailed observations of the optical spectrum by Crampton and Hutchings[3], attempts to observe radio emissions[4] of the object at 21 cm have yielded no positive results. An attempt by Baud and Tinbergen[5] to observe circular polarization in visible light showed no component greater than 0.02% of the total intensity.

We observed X Per on six nights in September and October 1972, with the Battelle 31-inch reflector and a polarimeter which utilizes a birefringence modulator of the type developed by Kemp[6]. We employ a series of 90° rotations of our analyser and polarimeter to eliminate the spurious circular polarization signal due to linear polarization in the beam. Our system also employs a photon-counting sychronous detection system which allows us to obtain polarization data which is independent of atmospheric extinction fluctuations. From observations of 25 unpolarized stars, we conclude that our instrumental residuals are less than 0.003% of the incident intensity.

Table 1 Stokes Parameters V_s for X Per

Filter	Observing time	10^5 V_s
B	156 min	$+9.2\pm6.4$
V	260 min	$+8.5\pm5.8$
R	320 min	$+0.7\pm5.3$

Our initial observations were made using wideband astronomical colour filters, with a minimum of three runs in each colour. Table 1 is a summary of the results of the observations. We list the Stokes parameter V_s normalized to unit total intensity. The numbers shown are the weighted means for three runs each with the *B* and *V* filters and four runs with the *R* filter. In each case the error is the standard deviation in the mean for all runs in a given colour. The measurements are photon limited. Our positive sign refers to circular polarization such that, to an observer facing the source, the rotation of the electric vector in a fixed plane is clockwise.

It is not clear from the results whether the polarization is intrinsic to the star or the result of processes in the interstellar medium, or even a circumstellar cloud. Interstellar circular polarization is thought to result from processes[7] which would produce a minimum signal in the bandpass of the *V* filter and signals of opposite sign in the *B* and *R* filters. Our data indicate polarization of the same magnitude, 0.01%, in the *B* and *V* filters with no polarization greater than 0.005% in the red.

We plan further observations with narrow band filters to determine the dependence of polarization upon wavelength and to check on source variability.

ROBERT A. STOKES
REXFORD W. AVERY
JOSEPH J. MICHALSKY, jun.

Battelle Observatory,
Battelle Northwest Laboratories,
Richland, Washington 99352

Received October 31, 1972.

1 van den Bergh, S., *Nature*, **235**, 273 (1972).
2 Giacconi, R., Gursky, H., Murray, S., Schreier, E., and Tananbaum, H., *Astrophys. J.* (in the press).
3 Crampton, D., and Hutchings, J. B., *Nature*, **237**, 92 (1972).
4 Braes, L. L., and Miley, G. K., *Nature*, **235**, 273 (1972).
5 Baud, B., and Tinbergen, J., *Nature*, **237**, 29 (1972).
6 Kemp, J. C., *J. Opt. Soc. Amer.*, **59**, 950 (1969).
7 Kemp, J. C., and Wolstencroft, R. D., *Astrophys. J. Lett.*, **176**, L115 (1972).

Ionization Potential–Redshift Correlations in Absorption Line QSOs

BAHCALL[1] drew attention to an apparent correlation between ionization potential (IP) and redshift in the absorption line spectrum of the QSO 3C 191. The relationship was further discussed by Burbidge and Lynds[2], but no systematic pattern was found by Bahcall *et al.*[3]. The work of these authors has been reviewed in detail by Piper[4], and a model to account for the correlation in 3C 191 was proposed by Falla[5]. Several QSOs have now been found to possess complex absorption line spectra, and here I consider whether any correlation, similar to that seemingly present in the spectrum of 3C 191, exists in the absorption spectra of any other QSO.

A plot of Δz, the difference between the mean emission line redshift ($\bar{z}_e$) of the QSO and the absorption line redshift of any ion, against the IP of the atom or ion having one electron more than the absorbing ion, is shown in Fig. 1 for 3C 191 (from the data of ref. 6). The vertical bars connect points corresponding to absorption lines that originate in the same ground state, and give some indication of the error in redshift[1]. The total spread in Δz (which I denote by $\langle\Delta z\rangle$) is about 6.8×10^{-3} for 3C 191.

It is essential that values of observed wavelength be accurately determined if the presence of any correlation is to be established; any error $\delta\lambda$ in the observed wavelength will result in an error

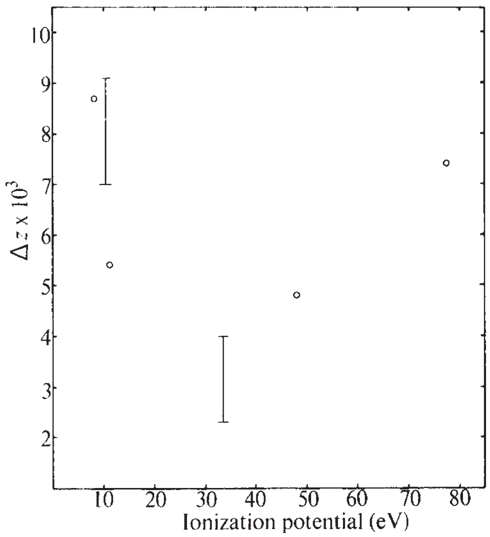

Fig. 1 Plot of ionization potential (in eV) against Δz for 3C 191 (from the data of ref. 6). Δz is defined throughout in the sense $\bar{z}_e - z_a$.