CIRCULAR POLARIMETRY OF AM HERCULIS

V. Piirola, O. Vilhu and I. Tuominen
University of Helsinki
Observatory and Astrophysics Laboratory

ABSTRACT

Circular polarimetry in the red and simultaneous photometric observations in the UBVRI bands during the period June 1-3, 1981, are discussed. The peak value of negative circular polarization $P_V \sim -15$ % is stronger than observed in 1976-79. Variations in the shape of the polarization and light curves occur from night to night. The positive crossover and reversal of the sign of the circular polarization are only marginal. A probable explanation of the short term variations seems to be the changing shape and position of the accretion columns with respect to the magnetic axis.

1. INTRODUCTION

In the present paper we give a preliminary report of circular polarimetry and simultaneous UBVRI photometry of AM Herculis on three nights in June 1981.

The binary system AM Herculis shows a strong circular polarization varying with the $3\overset{h}{.}1$ orbital period (Tapia, 1977). Both the polarization and light variations are largest in the near infrared and decrease steeply towards the ultraviolet. The general interpretation for this behaviour is that circular polarization is produced by cyclotron radiation from thermal electrons near the magnetic poles of a highly magnetized ($B \sim 10^7$ G) white dwarf accreting material from a close companion star (see e.g. Kruszewski, 1978, Chanmugam and Dulk, 1981).

2. OBSERVATIONS AND RESULTS

Our observations were carried out with the 1.25 m telescope of the Crimean Astrophysical Observatory using the double image chopping polarimeter of the Observatory of the University of Helsinki. Dichroic filters were used to split the light into five spectral regions. The re-

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sulting passbands are close to the standard UBVRI-system. For circular polarization observations an achromatic quarter-wave retarder was rotated with 90^o steps in front of the plane parallel calcite beam splitter. Each polarization observation consists of two 40 s integrations with rotation of the retarder between the integrations.

The observations of the circular polarization in the red colour on the nights June 2 and 3, 1981 are displayed in Figure 1. Standard error bars ($\pm \sigma$) computed from photon statistics are given. The peak value of the negative circular polarization $P_V \sim -15$ % is stronger than observed in 1976-79. The polarization approaches zero when the direction of the magnetic field is perpendicular to the line of sight (about 22^h UT on June 3). In contrary to the earlier observations the polarization does not clearly change the sign. The few positive values may be due to observational scatter. This indicates changes in the effective direction of the magnetic field since 1979. It has been suggested (Bailey and Axon, 1981) that the long term variations in polarization, especially the different widths of polarization reversals in 1976 and 1979, are due to precession of the axis of rotation of the white dwarf about the binary axis. However, the duration of the phase interval where circular polarization remains close to zero (near 22^h UT on June 3) is clearly different on the two nights in Figure 1, indicating that other mechanisms than precession can considerably change the polarization curve on time scale of days. Probable explanation of the short term variations seems to be the changing shape and position of the accretion columns with respect to the magnetic axis.

For comparison the total flux in the I band is given below the polarization curves in Figure 1. Both the polarization and photometric maxima and minima occur approximately at the same phase suggesting that both are of the same origin, i.e. due to cyclotron radiation. The light curves show considerable variation and flarelike activity is present. The wavelength dependence of light curves from infrared to ultraviolet can be seen in Figure 2. The variability decreases rapidly towards the blue and the ultraviolet.

The proposed models cannot explain very well the details of the light curves. Especially the changes in the shape of the light curves are larger than in the polarization curves, suggesting that a part of the radiation from the accretion column is not due to cyclotron radiation.

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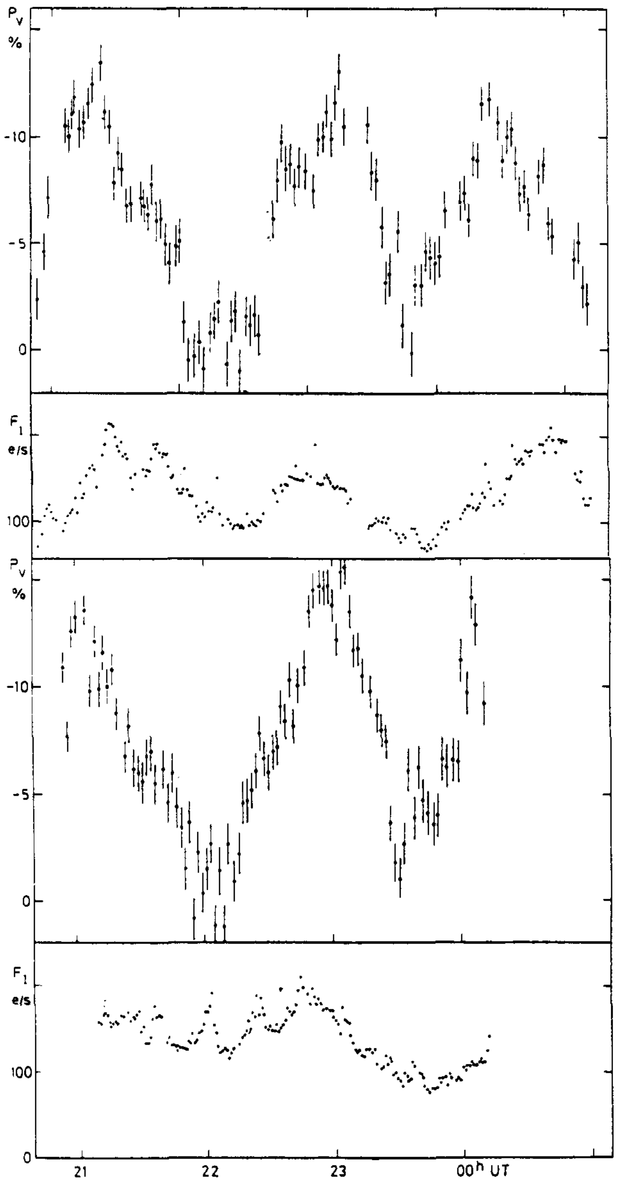

Figure 1. Circular polarization P_V (%) and infrared flux F_I (photo-electrons/s) of AM Herculis on June 2/3 (upper part) and June 3/4, 1981

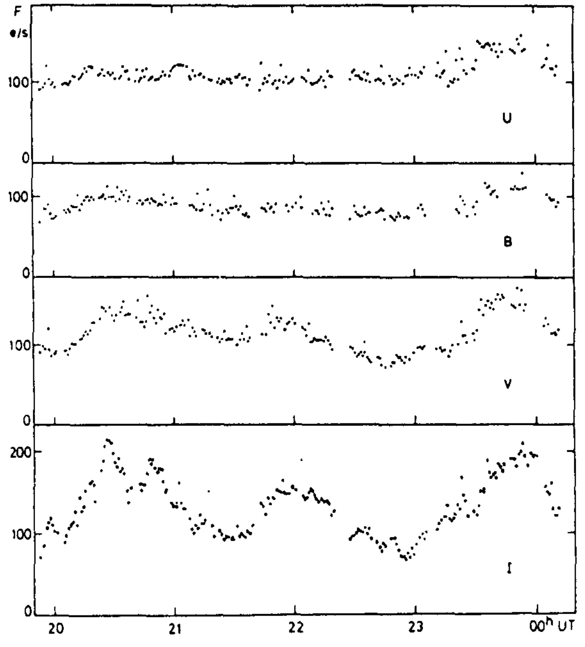

Figure 2. Light curves of AM Herculis on June 2/3, 1981, in the U,B,V and I regions. Each dot represents a 40 s integration. Intensity is expressed in units of photoelectrons/s.

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