PHOTOELECTRIC OBSERVATIONS OF A MAGNITUDE AND COLOR VARIABLE OBJECT IN PERSEUS

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Received 1979 November 15

ABSTRACT We made U' B' V' photoelectric observations of the light and color variable object in Perseus, [1, 2], and found that it differed from the typical early type shell star BS Tau in two particulars: 1) its amplitude in U' is greater than that in B' or V'; 2) its U' magnitude is positively correlated with U' - B' and uncorrelated with B' - V'.

The magnitude and color variable object discovered in Perseus, [1], is now known to be a radio N-galaxy through observations by D. M. O'Dell of Mallard Radio Astronomy Observatory. It is now believed to be a B-type star with an accompanying nebulosity after Kondo et al. [2] observed obvious shell activities. At the end of 1978 and the beginning of 1979, we observed it photoelectrically in U' B' V' on 7 nights, to confirm the short time-scale light and color variations caused by such activities.

We used the integrated photoelectric photometer newly installed at the Cassegrain focus of our 60 cm reflector. This has an LMI502 B photomultiplier, and the filters U', B', 2mm GG15, 1mm GG12, V'. The entrance aperture is 2mm and the integration time was usually 8 seconds. As a rough assessment of our measuring accuracy, we observed the stars Nos. 2 and 4 in the identification chart of [1] four times in one night, and found the following magnitude differences: ΔU' = 0.079 ± 0.02, ΔB' = 0.060 ± 0.01, ΔV' = 0.058 ± 0.02. We now list the magnitude differences between this variable object and star No. 2 in Table 1. The light curves and the color curves being shown in Fig. 1.

During this observing run, the largest variations were found in ΔU', hence efforts were made to repeat the observations when ΔU' was at a maximum or a minimum. Also, when ΔU' had the largest amplitude, the light changes in U', B', V' were in step. The light curve at the time of drastic changes in ΔU' looks like what Walker [3] obtained in 1982 when observing the early-type shell star EN Lac on the night of 1981 August 31, and Walker observed such a light curve only on that one night out of his entire observing period between 1959 and 1982.

For our object in Perseus, maxima in ΔV' were all fainter than 1.5mag and were usually about 1.55mag. Observations on the night 1979 February 28/ March 1 (J.D. 2443953) show that each time both ΔV' and ΔB' brightened up, ΔV' would show a flat top after reaching maximum light. This is similar to the observations of HR 5999 reported in [4].

On the other hand, in all 7 nights' observations, ΔU' showed greater amplitude than ΔB' or ΔV'. This is the first difference between this Perseus object and BS Tau, [5, 7].
Next, according to [8], for BU Tau, the B magnitude is negatively correlated with B-V and positively correlated with B-V. From data in [7], we found that for BU Tau, the U magnitude was likewise correlated with the colors. For our object, however, the situation is different. Fig. 2 shows that, in our case, the B' magnitude is correlated with the colors in the same sense as before, but the U' magnitude is correlated positively with B'-V' and not correlated at all with B'-V'. (By "correlated" we mean "significantly correlated at the 1% level").

The light and color variations we observed in this object in Perseus are likely to be a reflection of shell activities. The central star surrounded by nebulosity is probably a young B-type star, rather, it is an early type star whose shell activities are present at present. But it also differs from the typical early type shell star BU Tau in showing different light and color correlations, as mentioned. Our shell type spectra have sharp and narrow absorption lines, similar to an AO spectrum, but are easily confused with supergiant stars of the same spectral type. This is the case here. From the traces of asymmetry in the line profiles of the Balmer lines observed in this object, shell activity does seem to be present during their observations. The other observations lend support to each other.

The color-color observations we obtained are not enough, they can only suggest the providing some confirmation of short-scale light and color variations and shell activities. Much more observation is required before we can claim like a complete picture of this object, particularly as spectroscopic observations can only give the combined light from the star and nebulosity.
ACKNOWLEDGMENT. We thank Lung Ke-nin and Xia Jian-ping for participating in the observations, and Chao Yu-feng for checking some of the reductions and drawing the diagrams.

REFERENCES


PLASMA EMISSION AND THE DECIMETRE PORTION
OF TYPE-IV SOLAR BURSTS

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Received 1979 December 12

ABSTRACT An attempt is made to account for the decimetre portion of the Type-IV solar radio bursts by plasma emission. Non-thermal electrons (E ≲ 500 keV) trapped in a magnetic mirror (IV burst source) having a loss-cone gap distribution excite plasma waves which are transformed into transverse waves through non-linear scattering by ions. A good agreement was reached between the calculated spectrum and the observed fluxes for the event of 1972 August 2. A distribution of the number of non-thermal electrons with height, and a total number of 10^{22}, were obtained. Also it was found that the Langmuir waves can accelerate some background thermal electrons to the MeV range.

INTRODUCTION

As Sextö states in [1], we little understand the radiating mechanism of Type IV bursts. There are many difficulties in explaining these bursts by the gyroresonance mechanism. Plasma emission has been suggested as an alternative, but so far the meaning along this line has remained qualitative rather than quantitative.

Type IV bursts are characterized by a narrow frequency band, a large spectral index, and high and highly variable flux. Take, for example, the Type IV event of 1972 August 2: the frequency range is 100 - 1500 MHz, with a peak at 410 MHz, the peak flux is 190 000 sfu, some 6 times the unperturbed component, and some 18 times the peak flux of the corresponding II burst. Such high flux densities are difficult to explain by the gyro-synchrotron mechanism.

In this paper I shall attempt to explain the Type IV bursts by plasma emission. Non-thermal Langmuir waves are excited by trapped non-thermal electrons and non-linear scattering by ions [2] converts them into the transverse waves of a IV burst. I shall also discuss the acceleration of the electrons by the Langmuir turbulences. Some quantitative estimations will be made using data taken from [3, 4, 5].

SPECTRUM OF LANGMUIR WAVES AND THEIR TRANSFORMATION INTO TRANSVERSE WAVES

According to the theory of plasma instability, when the particles have an anisotropic distribution in the momentum space, the excited Langmuir waves may be unstable and may grow exponentially, ("Induced scattering"). Accordingly, I adopted the "loss-cone gap distribution" [6, 7]. For this distribution the emission coefficient and growth rate per unit wave length interval of the Langmuir waves in the direction perpendicular to the magnetic field...