PHOTOMETRIC AND SPECTROSCOPIC STUDY OF δ^2 LYRAE

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ABSTRACT. The bright star δ^2 Lyr has been observed photoelectrically in the V and B pass bands for three years. The star is a long period variable with an amplitude of 0.2 mag and a period of 83 days. Light changes are coupled with small range velocity changes. On some well-exposed spectrograms the emission features of the H and K lines of CaII appear.

1. INTRODUCTION

The fourth magnitude star δ^2 Lyr of spectral type M4 II has for long been suspected of variability. In the late fifties Biskupski (1960) observed the star visually, however he did not derive the type of variability nor the period. Eggen (1977) classified the star as a variable belonging to young disk population stars and derived its absolute bolometric magnitude as -5.75.

2. OBSERVATIONS

δ^2 Lyr has been observed in Waterloo since 1982 and more recently at the Skalnate Pleso Observatory in the V and B colour bands. The variable was compared with the star HD 176051 and checked against the star HD 175635. Both stars are of spectral type G. The period of the light variations has been derived from four epochs of minima and four epochs of maxima by the method of least squares. The average period has been adopted, P = 82.7736 days, as the period of light variations. The above period has been used to derive a mean light curve as a function of phase. The light curve exhibits three maxima, a high maximum at phase 0.15, a broad, lower maximum at phase 0.65 and third, low maximum at phase 0.92. The amplitude of light variations is 0.25 mag.

The colour index, Δ(B-V) changes by 0.1 mag between maxima and minima of the light curve in the sense that the colour index is bluest at the time of minimum brightness of the star. This is true for the minima associated with the first maximum.

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Between 1969 and 1983 eleven spectrograms were obtained at David Dunlap Observatory having a dispersion of 12 A/mm. Although the range of radial velocities is only 5 kms^{-1} there is a correlation with the light curve in the sense that both curves reach a maximum at phase 0.15. The minimum is at phase 0.65.

On three well-exposed spectrograms the emission of the H and K lines appears. The radial velocities of the emission features K_2V and K_2R as well as of the absorption component K_3 have been measured. These velocities are respectively -43, -7 and +33 kms^{-1}.

3. DISCUSSION

The light curves so far obtained do not present a complete picture of light variations of this star. However, it can be said that the light curves do not repeat themselves rigorously and that the derived period represents an average period of light variations. The amplitude of the light curves is also variable.

The colour index, $\Delta(B-V)$, changes by about 0.1 mag between the maximum and minimum light of the star. Since the surface temperature of an M4 II star is about 3300°K the change of the colour index by the observed value would produce a change of about 150°K in the surface temperature of the star.

The radial velocity data indicate that the maximum velocity is reached at the time of the light maximum. If it is assumed that the velocity variations are produced by pulsations of the star then the most positive velocity (i.e. a contraction of the star) is associated with an increase of brightness, as indicated by the change in the colour index. The second and the third maximum of the light curve must have a different cause, for instance, shock waves as suggested by Wallerstein (1977).

Finally, a few comments about the emission features of the H and K lines. The emission features indicate an expanding chromosphere of the star while the deep absorption feature represents a circumstellar envelope (Deutsch, 1960). It is formed by matter ejected from the photosphere with a velocity close to the velocity of escape.

In summary, it has been shown that δ^2 Lyr is a small amplitude long period variable, easily accessible to small telescopes, in need of frequent observations extending over a time interval of years.

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