Light curve solutions and study of roles of magnetic fields in period variations of the UV Leo system

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Abstract
The solutions of photometric BV light curves for the Algol like system UV Leo were obtained using Wilson-Devinney code. The physical and orbital parameters along with absolute dimensions of the system were determined. It has been found that to best fit the V light curve of the system, assumptions of three dark spots were necessary; two on the secondary and one on the primary. The absolute visual magnitudes ($M_v$) of the individual components i.e., primary and secondary were estimated to 4.41 and 4.43, respectively, through the color curve analysis. The period analysis of the system presented elsewhere, indicated a cyclic period change of 12 yr duration, which was attributed to magnetic activity cycle, as a main cause of period variation in the system, through the Applegate mechanism. To verify the Applegate model I preformed calculations of some related parameters barrowed from Apllegate and Kalimeris. Values of all the calculated parameters were in accordance to those obtained for similar systems by Applegate. The differential magnitudes $\Delta B$ and $\Delta V$, along with corresponding values of $\Delta(B-V)$ color index. The cyclic variations in brightness are quite clear. There are three predictions of Applegate's theory concerning effects of cyclic magnetic changes on the period variations, which can be checked through the observations, these are as follows:  I) The long term variations in mean brightness (at outside of eclipses) and cyclic changes of orbital period, vary with the same period. II) The active star gets bluer as it gets brightened and/or the brightness and color variations are to be in phase. III) Changes in luminosity due to changes in quadrupole moment should be of the order 0.1 mag. All the above mentioned predictions of Applegate’s theory are verified. These results combined with cyclic character of P(E) presented elsewhere and also consistency of parameters which are obtained in this paper, led me to conclude that one the main causes of period variability in UV Leo system is magnetic activity cycle (newly presented here. Since both components (G0&G2) of this system magnetically can be active, and separation of the components is relatively low (3.9Rs), the magnetic braking could also cause the period change. The magnetized star winds move outward from the star, but are twisted due to rapid rotation of star. Charged particles in the stars wind become trapped in the star's magnetic field and are dragged along the field lines .The result is angular momentum (AM) transfer from the star by magnetic field to the charged particles. As the winds leave the star surface they are dragged by the magnetic field which in turn slows down the star's rotation.

Keywords: eclipsing binary stars, magnetic fields, stars- individuals UV Leo

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