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# THE HD 133029 - IS IT A "BONA FIDE" IRREGULAR MAGNETIC VARIABLE?

After the Babcock's first work on magnetic stars it became evident that by more detailed investigation the magnetic variables, classified as irregular, proved to be periodic. Preston (1970) put forward the idea that all magnetic variables should be periodic. This idea is implied from the rotator model of magnetic stars, which explaines the variations in magnetic field, spectral lines and light as due to the changes of aspect of a rotating star, the surface of the star assumed inhomogeneous.

The HD 133029 is the last star from the Babcock's list (1958), classified as irregular, for which no reliable period up to now has been found. The existence though of only one irregular magnetic variable would be critical for the rotator model. Much effort has been concentrated, but also much controversy awakened between the works, devoted to this subject. We shall quote them briefly.

In an attempt to find the period of the star Renson (1969) determined with the Babcock's data a period of about $1^d$, slightly variable. With the same data Steinitz and Pyper (1971) found a period of about 4 hours.

The photometric variability of HD 133029 with a period of $2\overset{d}{.}89$ was found by Winzer (1974). This period was later confirmed by Wolff and Morrison (1975) and by Rakosch and Fiedler (1978) on the ground of their own photometry.

Another investigation of the light variability in U, B, V was made by Panov and Schöneich (1976), who determined a period of $0\overset{d}{.}741285$. The two photometric periods found are correlated with each other via the observational period (the sidereal day).

In fact there is a whole series of correlated periods, which is given by:

$$\frac{1}{P_s} = \frac{1}{P} \pm \frac{1}{0.997}$$

where P is the true period and $P_s$ - spurious period. When P is substituted by the $P_s$, one obtaines a second spurious period and so on. The series of correlated periods of HD 133029, constructed with the period of $0^{d}.741285$ in this way is :

| | | | |
|---|---|---|---|
| $0^{d}.741285$; | $2^{d}.890173$; | $1^{d}.522049$ | |
| 0.425167 | | 0.602403 | (1) |
| 0.298060 | | 0.375513 | |
| and so on | | and so on | |

We think that one of them should be the real period. Unfortunately, none of the two photometric periods proposed fits the Babcock's data for the magnetic field variations. The work of Bonsack (1977) showed that his magnetic field measurements could not be fitted with the $2^{d}.89$ period and the search for another period was unsuccessful. Thus Bonsack believes HD 133029 would be the first magnetic variable, proved to be irregular.

It could be shown that the period of $0^{d}.741285$ does not fit Bonsack's magnetic field data either (though it fits the Bonsack's radial velocity data).

In this situation it seems that both $2^{d},89$ and $0^{d}.74$ periods were spurious. In the hope that the rotational period could still be found, we made another attempt for period searching. The values greater than 0.74 in the series (1) seem already to be excluded. From the values less than 0.74, only the period of about $0^{d}.6$ is great enough to secure rotational stability. In the vicinity of the value 0.6 we made a computer searching with the method of Lafler-Kinman (1965) (small deviations form the series - values are to be expected, when the observational period deviates from $0^{d}.997$), both with Bonsack's data and with our photometric data. Four possible periods were found for the magnetic variation : $0^{d}.6080772$, $0^{d}.6080722$, $0^{d}.6079971$, $0^{d}.6079907$ - but on the ground of the photometry the last two are to be excluded. The periods of $0^{d}.6080772$ and $0^{d}.6080722$ give very similar patterns and we are not able for the present to choose between them. We have chosen arbitrarily the second one:

$$\mathrm{JD(Min.light=Min.mag.field)} = 2440767^{d}.26 + 0^{d}.6080722 \cdot E.$$

Figure 1 shows the pattern of light in V, B, U (data from Panov and Schöneich, 1976), radial velocity and magnetic field variation (data from Bonsack, 1977). The magnetic field varies in phase with the light from about 1500 to 2500 gauss. The scattering on the magnetic field curve is greater than usual and could possibly be due to instrinsic magnetic field variations, superposed to the rotational variation. The Babcock's magnetic field data cannot be fitted with the accepted period and the problem with his measurements remains. From other photometric work only the data from Rakosch and Fiedler (1978) is available but the fit is not so good. There is an indication of a secondary light minimum around the phase 0.5.

With v.sini=21 $\mathrm{km.sec}^{-1}$ (Bonsack, 1977), $R=3R_{\odot}$ (Preston, 1970) and $P=0\overset{d}{.}6$ the angle between rotational axis and the line of sight ( i ) would be about $5^{\circ}$. Hence, the star would be seen almost from the pole.

With: $\mathrm{tg}\beta = (1-\tau)(1+\tau)$ cotgi and $\tau = H_e(\min)/H_e(\max)$ we have $\beta \approx 82^{\circ}$, i.e. the magnetic axis lies near the rotational equator. The radial velocity variation (in phase with the magnetic field) could perhaps be explained as spurious in the sense proposed by Bora (1974). The change in the surface aspect (by the star's rotation) would be only about 10% and this has to account for changes in the magnetic field up to 50%. Thus, if the 0.6 period is real, it implies strong magnetic field inhomogeneitis.

The predominant positive polarity could be interpreted within the proposed model, if the positive magnetic pole is stronger than the negative one. Thus the proposed model of HD 133029 is consistent with the off-center dipole model of magnetic stars.

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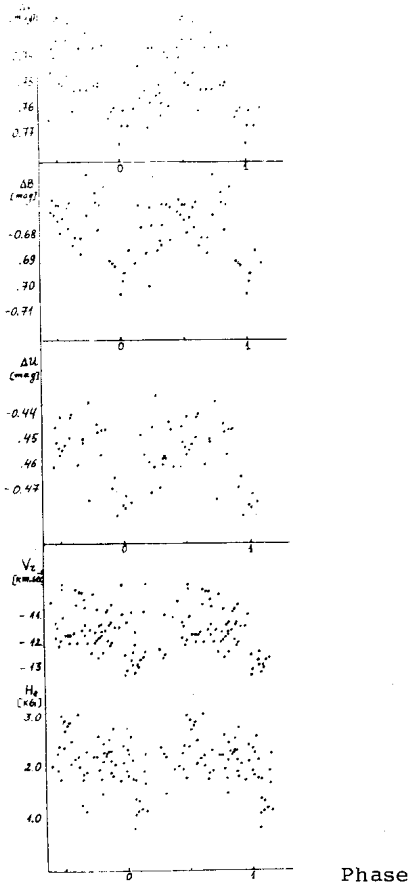

Figure 1

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