Observations of Periodic Magnetic Fields in the B9p Star ET And [1])

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The B9p Si II star ET And has roused interest because of a manifold periodicity of the luminosity and radial velocity variations. The basic period derived from radial velocity observations by Ouhrabka and Grygar (1979) is that of a close spectroscopic binary amounting to 48.3 days with the extreme eccentricity of 0.46, which certainly is bound to the peculiar behavior of the star. A period of 1.61883 d determined by Hildebrandt and Hempelmann (1981) basing on photoelectrical observations is attributed to the star's rotation. Panov (1978) found a light variation with a period by 140 min, which has been corroborated by Gerth, Panov, and Scholz (1981) and completed by a radial velocity period of 280 min, being exactly the double. Hildebrandt and Hempelmann established additionally a period of 170 min. Panov (1984) reported further on much shorter periods of 9.3 min, 7.5 min, and 5.8 min. Periods in the order of 40 min were found by Gerth (1986) in the radial velocity data.

On the background of such an intricacy of periods it seems worthwhile to look for variations of other physical quantities or correlations that could help to disentangle the complicated system of periods. Therefore we used the opportunity of being the star-magnetometer at the 6m-telescope in Zelenchuk (USSR) in the night of November llth, 1984 ready for observation of magnetic stars, including promptly ET And. By the way of comparing the measurements of different stars we could be sure that the device worked well so that we can rely on the results. Nevertheless, we withheld the results for several years, because they seemed to us anyhow unreliable. After having proved the measuring conditions once more thoroughly, we decided to commit them here in Table 1.

The measuring data are separated into two groups of measuring runs lasting nearly one hour each. In the meantime of 2 hours between the runs the (well-known to the authors) magnetic stars 52 Her and 53 Cam were measured yielding the expected results, establishing thus the correctness of the measuring procedure. For the measurement of the magnetic field strength the Zeeman-displacement of the line profiles of H_γ has been used.

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Table 1

N	JUL.DATE	B_{eff}
1	2445922.407	-484.0
2	.411	1217.5
3	.416	-399.0
4	.419	-197.0
5	.423	-680.0
6	.426	2145.5
7	.430	462.0
8	.433	-615.5
9	.437	-498.0
10	.440	-149.0
11	.443	-378.0
12	.529	-556.5
13	.531	-637.5
14	.534	1070.0
15	.537	-2519.0
16	.540	769.0
17	.543	1709.0
18	.545	951.5
19	.547	1514.0
20	.550	1155.5
21	.552	-1154.5
22	.555	-325.0

The Instrumentation of the star-magnetometer is described by BYCHKOV et al. (1988). Subjecting the data to a search for periods we find three significant periods (Table 2):

Table 2

	Period	Power quotient	Amplitude
1.	$P_1 = 0.019442$ d $= 28.0$ min	0.1458	821
2.	$P_2 = 0.007645$ d $= 11.0$ min	0.1980	956
3.	$P_3 = 0.004932$ d $= 7.1$ min	0.0952	332

The three frequencies constitute an overwave series with the harmonics l, 3, and 4, which determine the curvature of the basic wave of 28 min. Small deviations from the correct values are normal because of scatter and the truncation of the periodic function. Lower periods are due to reflection at the (NYQUIST-limit **N** $\rightarrow$ in Fig. 1) defined by the temporal spacing of the measurements by 6 min. The power and window spectra are represented in Fig. 1.

The power diagrams of the single data groups look smooth but resemble each other, whereas the power maxima of both groups put together show the typical interference pattern of two separated data groups, which are the window spectrum shifted to each significant frequency (1/period) by the FOURIER-transformed convolution theorem. So we conclude for the same physical process producing them during the two measuring runs.

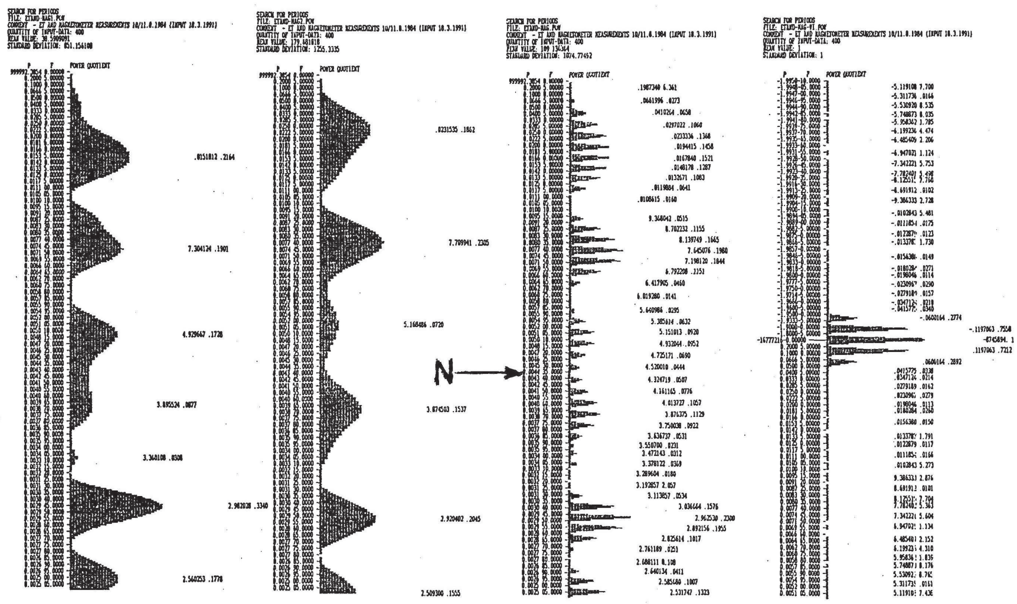

Fig. 1 Power diagrams of the magnetic field data of ET And secured on Aug. $10/11^{th}$, 1984
The first two diagrams: 2 runs separated by 2 hours.
Third diagram: The 2 runs taken together – interference pattern.
The reflection of the pattern at the NYQUIST-frequency is pointed by **N**.
Fourth diagram: Window spectrum, giving the individual shape of the interference pattern of any frequency contained in the fluctuating data.
(The graphics was obtained by a program for search of periods based on the Fourier-transform – written by E. Gerth in BASIC on COMMODORE 128.)

The origin of the rather strong magnetic field of nearly 1000 Gauss at the star ET And is quite unclear yet. The magnetic periods are of similar order as the light variation ones stated by PANOV (1984), which at first were traced back to pulsations in the star. However, the time scales are too short for the excitation of a magnetic field. What could be the reason? - In any case the measurement of the magnetic field in ET And demand repetition.

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