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**DISCOVERY OF RAPID PULSATIONS IN THE A3 V COMPONENT
OF THE ECLIPSING BINARY SYSTEM AS ERIDANI**

GAMAROVA, A. YU.¹; MKRTICHIAN, D. E.¹; KUSAKIN, A. V.²

¹ Astronomical Observatory, Odessa State University, Shevchenko Park, Odessa, 65014, Ukraine
email: david@oao.odessa.ua

² Sternberg State Astronomical Institute, Universitetsky prospect, 13, Moscow, 119899, Russia

According to the strategy of Central Asian Network (CAN) collaboration (Mkrtichian et al. 1998) we started the survey for search for and study of new pulsating components in eclipsing binary stars. In the previous publication (Mkrtichian and Gamarova 2000) we reported about our first discovery of the new pulsating F0 V component of the eclipsing binary system R CMa. In this paper we present our second detection of δ Scuti-type pulsations in the bright component of the eclipsing binary system AS Eri. The Algol-type variability of AS Eri was discovered by Hoffmeister (1934). It is a semi-detached binary system with A3 V primary and K0 IV secondary components. According to spectral class the primary component of AS Eri is situated inside the instability strip. For search for the pulsational light variations we used published photometric data in blue filter which were obtained during 1955–1957 on the 36-inch Steward reflector in Tucson (Koch 1960). During the initial stages of analysis we selected out-of-eclipse parts of light curves and subtracted the slow orbital trends. The phases of orbital period were calculated according to the ephemeris $HJD(\text{Min}1) = 2428538.066 + 2.664152 \times E$ (Koch 1960). For search for pulsations we analysed the residual data for nights with good photometric quality. For precise determination of frequencies and amplitudes of pulsations we used DFT program in combination with iterative sine-wave least-squares routines (Andronov 1994).

The four upper panels in Fig. 1 shows the amplitude spectrum acquired on four good nights JD 2435456, JD 2435508, JD 2435755 and JD 2435803. The 59 c/d signal appears on all these nights. The amplitude spectrum of merged data of AS Eri is presented in Fig. 2. It shows the well visible peak at the frequency of 59.03 c/d (24.39 min) and confirms the presence of rapid pulsations. The uncertainty of frequency of pulsations is the ± 1 c/d due to spectral window pattern of single-site observations.

The mean semi-amplitude of pulsations is 4.5 ± 0.9 mmag. The amplitude of the light-curve is modulated, that may be an evidence of multiperiodicity. Fig. 3 shows the pulsational light curve folded with the frequency $f = 59.03$ (c/d).

The comparison star used by Koch (1960) is BD $-3^\circ 576$. It has A2 V spectral type, so it is close to the blue border of the instability strip. That is why we were uncertain that the acquired evidence of δ Scuti type variations pointed out the variability of the primary component of AS Eri.

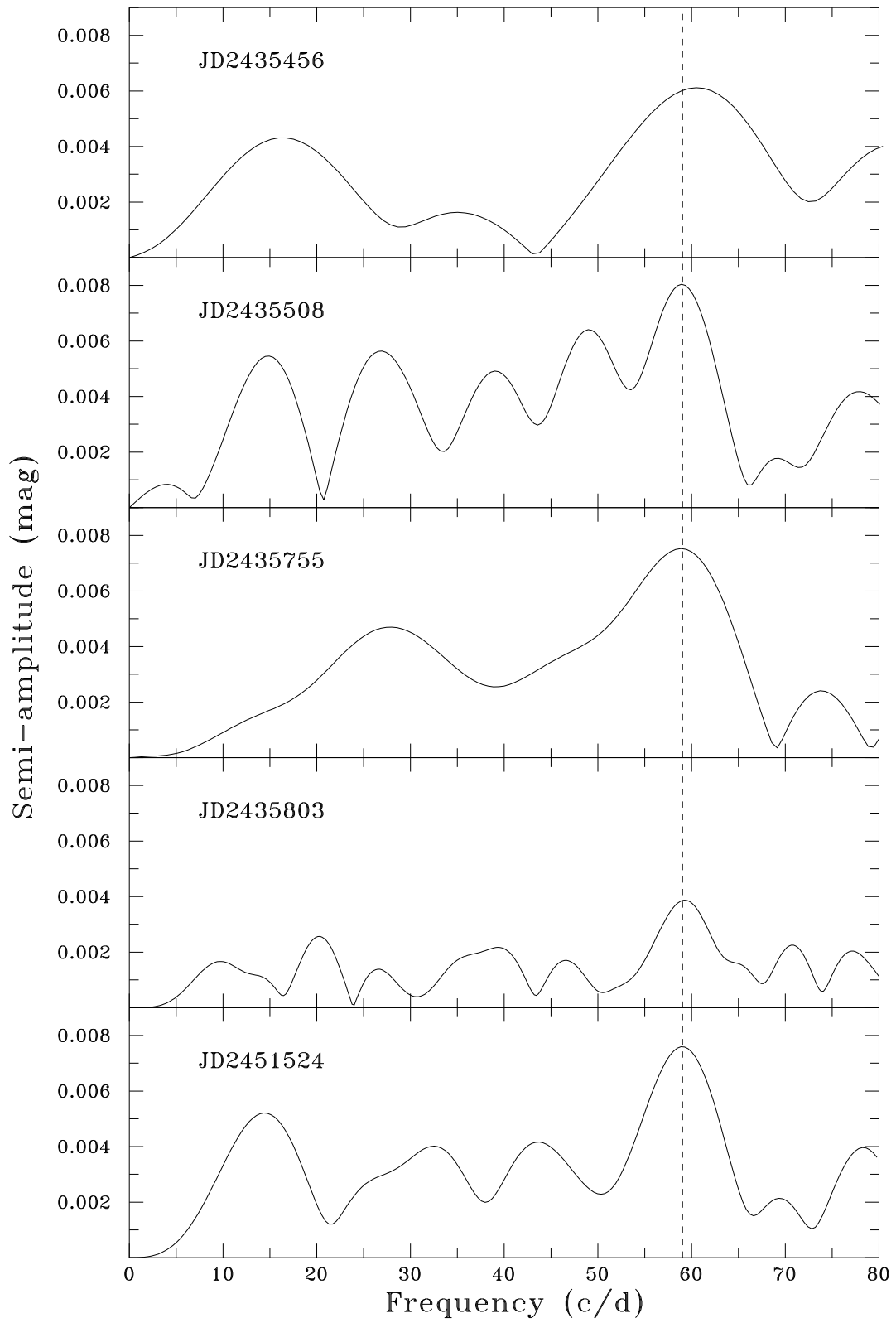


Figure 1. The amplitude spectra

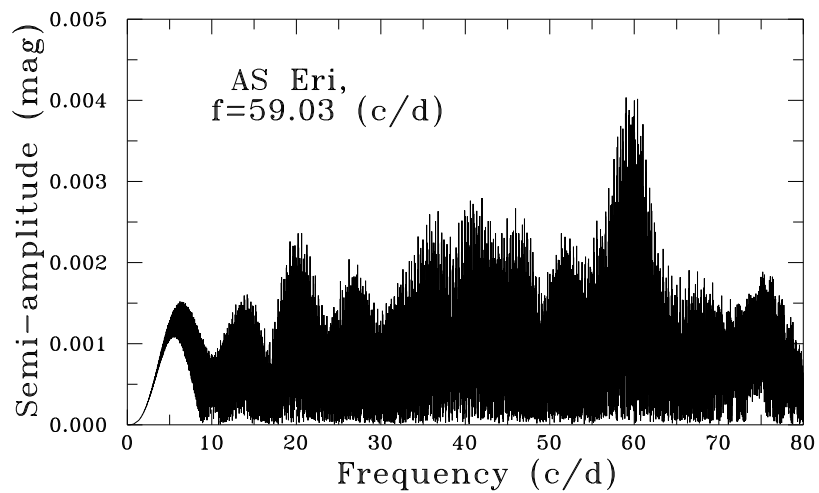


Figure 2. The amplitude spectrum of the merged data of 1955–1957

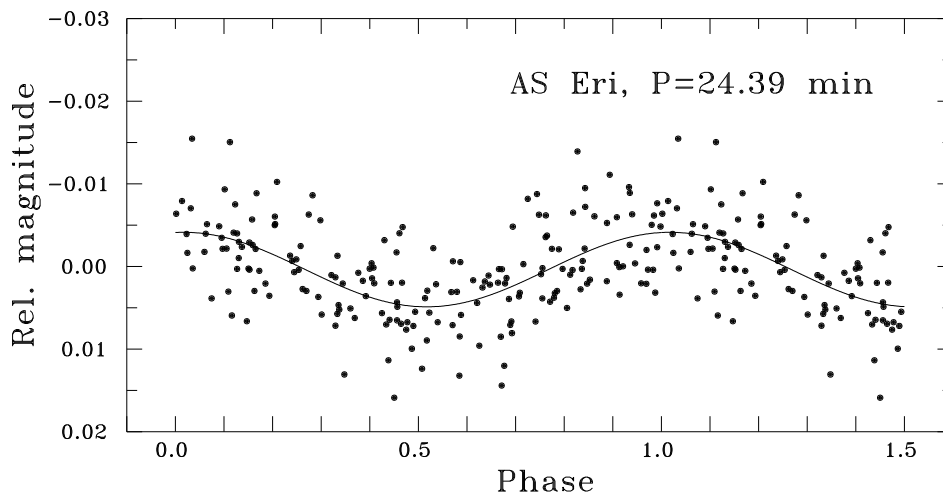


Figure 3. The phase curve of Koch's data

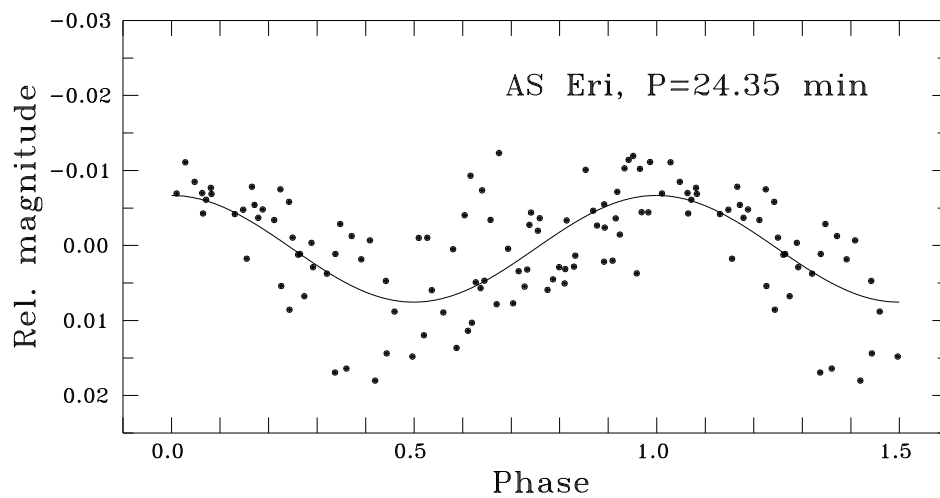


Figure 4. The phase curve on night 11/12 December 1999.

For checking whether the variability is related to AS Eri we carried out independent observations through Johnson V filter using another comparison star (HD 21887 = BD $-04^{\circ} 613$, $V = 7^m 18$, Sp = G5). The observations were carried out on December 11/12, 1999 (JD 2451524) on the 0.48-m telescope of Tien-Shan Astronomical Observatory. The data were reduced in the same manner as described above. Fig. 1 (lowest panel) shows the DFT amplitude spectrum of night 11/12 December 1999 (JD 2451524). The peak at the frequency of 59.14 ± 0.57 c/d with semi-amplitude 7.5 ± 0.1 mmag is well visible and it coincides with the frequency of 59.03 (c/d) found from Koch's data within the errors. Thus, the reality of our detection of δ Scuti-type pulsations in the A3 component of AS Eri is well established.

The excitation of rapid pulsations in A3 V component of AS Eri is unusual. A period of 24.39 min is rather short for δ Scuti-type variability known till now, but it is close to the period of 22.43 min of the A4 V δ Scuti-type primary component recently discovered in RZ Cas (Ohshima et al. 1998, Mkrtichian et al., in preparation). So, AS Eri is the second known δ Scuti-type star with the shortest pulsation period.

It is not ruled out that the excitation of short periodic pulsations in binary stars is one of their specific feature. Increase the number of known eclipsing binaries with pulsating components, accurate determination of properties of these stars and frequency spectra, further theoretical modeling and asteroseismology may shed light on the mechanism selecting such short-periodic pulsations.

References:

- Andronov, I. L., 1994, *Odessa Astronomical Publications*, **7**, part 1, 49
Hoffmeister, C., 1934, *Astron. Nachr.*, **253**, 195
Koch, R. H., 1960, *AJ*, **65**, 139
Mkrtichian, D. E., Kusakina, A. V., Janiashvili, E. B., Lominadze, J. G., Kuratov, K., Kornilov, V. G., Dorokhov, N. I., Mukhamednazarov, S., 1998, *Contrib. Astron. Obs. Skalnaté Pleso*, **27**, 238
Mkrtichian, D. E., Gamarova, A. Yu. 2000, *IBVS*, No. 4836
Ohshima, O., Shin-Ya, N., Hidehiko, A., Mitsugu, F., Tetsuya, K., Nobuo, O., 1998, *IBVS*, No. 4581