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DISCOVERY OF δ SCT TYPE PULSATIONS IN THE ECLIPSING BINARY IK Vir

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We report the detection of δ Sct type variations in the eclipsing binary system, IK Vir (V=11.54 mag, A6, $P_{\rm orb}$ = 0.72 d, Velichko et al. 1991 and Kazarovets et al. 1993), in our V-band photometry. The observations were carried out with Moravian G2–1600 CCD camera attached to 28 cm Schmidt-Cassegrain telescope at Akazawa Funao Observatory. Total observational runs are twenty one nights from March 26 to May 26 in 2015. IK Vir is measured differentially to BD+02 2522 = GSC 0281–0223 as the comparison star. BD+02 2522 is measured to GSC 0281–0255 as the check star. All the data in this observational season are shown in the lower light curve in Figure 1. To highlight short period (about 30 minutes) variations, data from only five observing runs, chosen so that there is no overlap in the same phase range, are plotted in the upper light curve in Figure 1. All the V-band photometric data obtained for this study are available as electronic tables(`6211-t3.txt`) from IBVS website.

The light curves in Fig. 2 for three individual nights show beat phenomena, which suggests that the variations are multiply periodic. In order to extract short period variations, third-order polynomials are fitted and subtracted from data for eight nights runs which covered out-of-eclipse phases.The residuals are analysed by the Period04 program (Lenz and Breger, 2005). The first six dominant frequencies are listed in Table 1 and their power spectra at each subtraction phase are shown in Fig. 3. The over-plotted solid line in Fig. 2 shows the light curve synthesized from the detected multiple periods.

When we tried to subtract the synthesized light curve from observational data, the short period variations were naturally cancelled in the residuals out-of-eclipse. However, in the period between the phase of about -0.15 to 0.15 covering the primary eclipse, the short period variations could not well cancelled (Fig. 4). This indicates that the pulsating component is the primary and it might indicates that nonradial oscillations of a specific low order mode are emphasized by the eclipse and that some phase shift has occurred (Unno et al. 1989). The new times of minima obtained in 2015 are listed in Table 2. Together with the times of minima listed in the O–C Gateway[1] since 1999, a new ephemeris for primary minimum could be calculated as follows:

$$HJD_{\rm Min} = 2451275.3649312(1) + 0.7236021(2) \times E$$

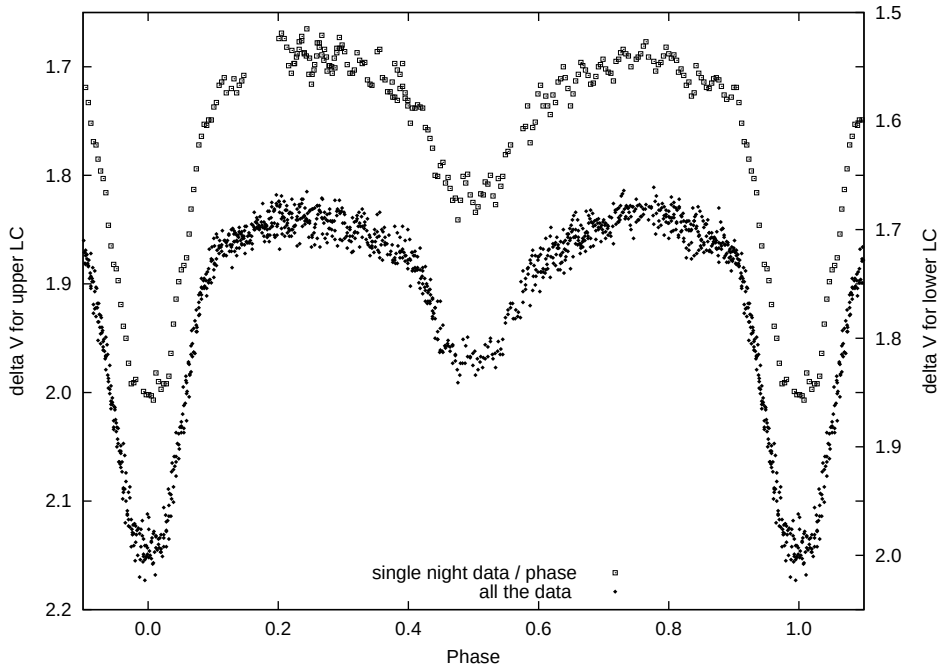

Figure 1. Light curve of IK Vir. Upper one consists of five night runs with no overlap. In the lower one we plotted all the data we obtained.

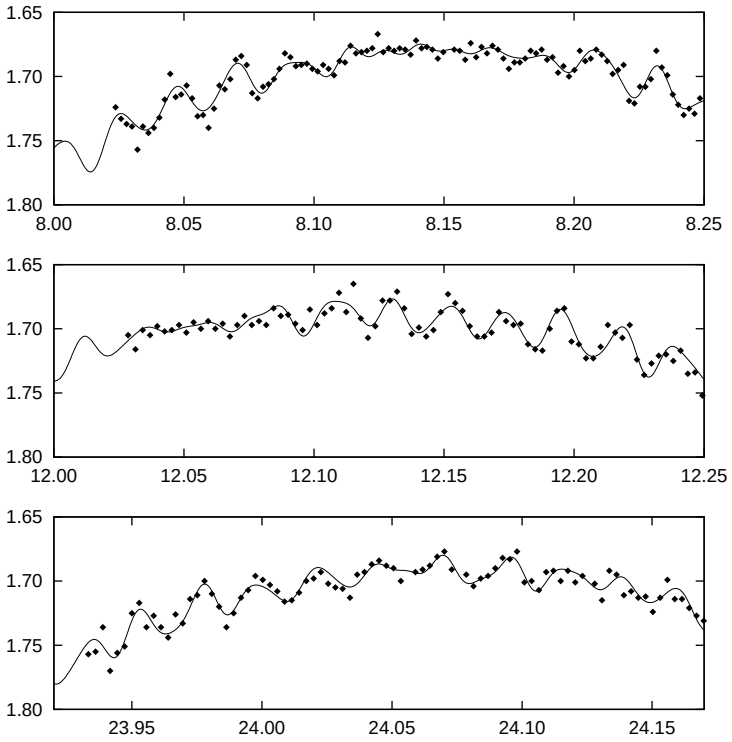

Figure 2. The beat phenomenon in V band light curve. The line indicates the light curve calculated from the six frequencies in Table 2.

Table 1: Most dominant six frequencies and the corresponding amplitudes.

	Frequency(c/d)	amplitude
F1	43.87960	0.00167
F2	48.22544	0.00074
F3	46.69045	0.00049
F4	38.87607	0.00041
F5	75.70104	0.00037
F6	29.40399	0.00044

Table 2: New times of minima of IK Vir.

HJD−2450000	Uncertainty	Type	$O-C$
7127.13421	0.00039	I	−0.00090
7130.02980	0.00010	I	0.00028
7134.00844	0.00010	II	−0.00089
7135.09531	0.00009	I	0.00057
7139.07266	0.00010	II	−0.00189
7164.03957	0.00009	I	0.00075

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Velichko, F.P. , Kwiatkowski, T. and Krugly, Yu.N., 1991, *Astr Tsirk*, **1548**, 27

[1] http://var.astro.cz/ocgate/

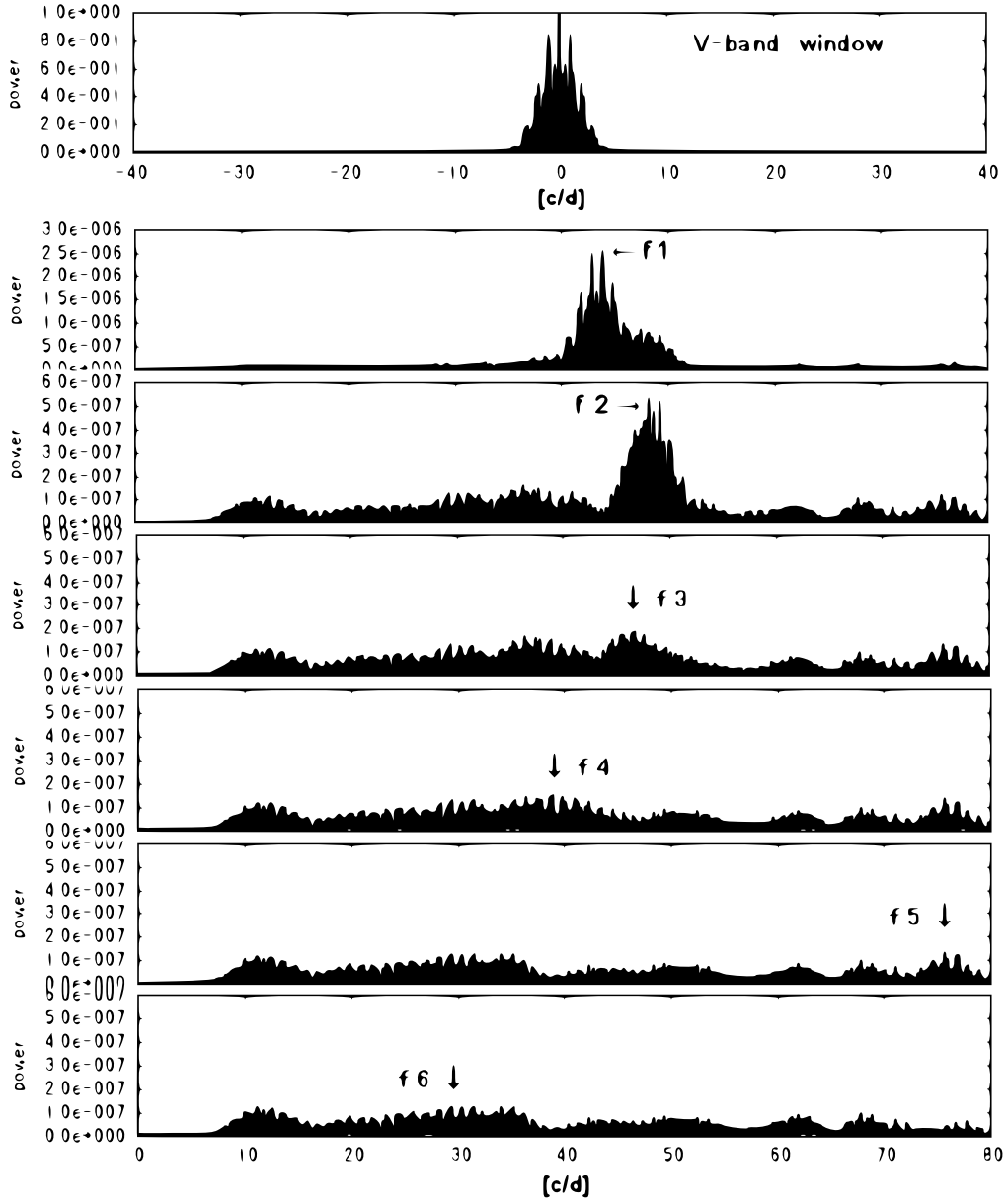

Figure 3. Power spectra of short period variations out-of-eclipse of IK Vir.

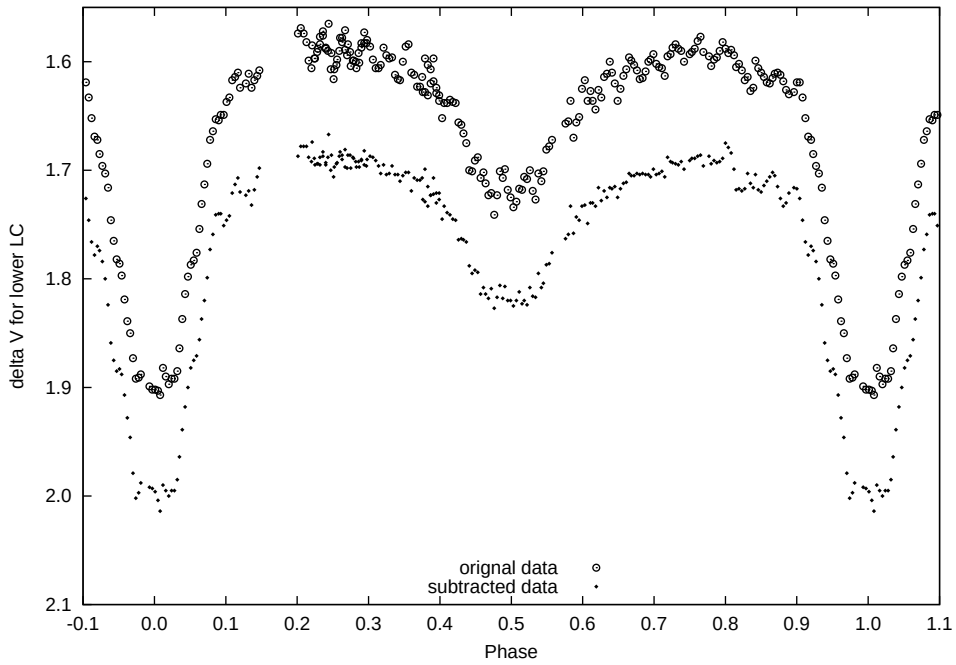

Figure 4. The light curves of IK Vir. Upper one is the plot of the original data which is the same as in Fig. 1. Lower one is a light curve in which the synthesized short period variations are subtracted from the upper one.