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NEW FIELD VARIABLE STARS II

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In the course of photometric and astrometric observations of selected minor planets, we obtained more than 4000 individual CCD frames at the Konkoly Observatory between April, 1998 and January, 2000. We have surveyed all of the time-series CCD photometric observations in order to identify and/or discover variable stars observed by chance in these images. We have discovered 17 new variable stars and the first 11 was presented in the first part of this series (Csák et al. 2000, Paper I). The remaining 6 stars are in the focus of this paper.

The observations, the instruments and the applied methods of analysis were the same as described in Paper I. The individual data shown in Figs. 1 and 2 are available upon request from the first author. The sparse phase coverage did not allow reliable classification of the variable stars, though the majority seem to be eclipsing binaries. V17 has the best data series, because we made 3-hour long follow-up observations on two nights in January 2000 (Fig. 2). This enabled a more accurate period determination which resulted in a period of 0.1275 ± 0.0001 days. The unfavourable data distribution caused all data to cover very similar phases, therefore, any multiplet of this shortest value cannot be ruled out. Basic data (identifications, celestial coordinates and magnitudes) of the new variables are summarized in Table 1. The given types of variability (based on the light curve shapes and USNO-A2.0 colours) should be considered only as approximate ones.

In addition to the photometry, we obtained low-resolution spectra with an objective prism at the Konkoly Observatory in February, 2000. The telescope and the detector were the same as above, while the prism has a refracting angle of 5° giving 580 Å/mm resolution at Hγ (Kun 1992). Since the observations were unfiltered, a wide spectral region (approximately between 3800 Å and 9000 Å) was detected limited by the spectral response of the CCD and the atmospheric transmission.

We took 10-minute spectra of all stars, but V12 and V13 turned out to be too faint. Almost 300 MK spectral standards taken from Jaschek et al. (1964) were observed to form a homogeneous basis for a preliminary spectral type determination that makes use of integral properties of the obtained digital spectra. The spectral extraction was done with a newly developed software which automatically detects the boundaries of the spectral images. The extracted spectra were adjusted to match the strongest atmospheric telluric

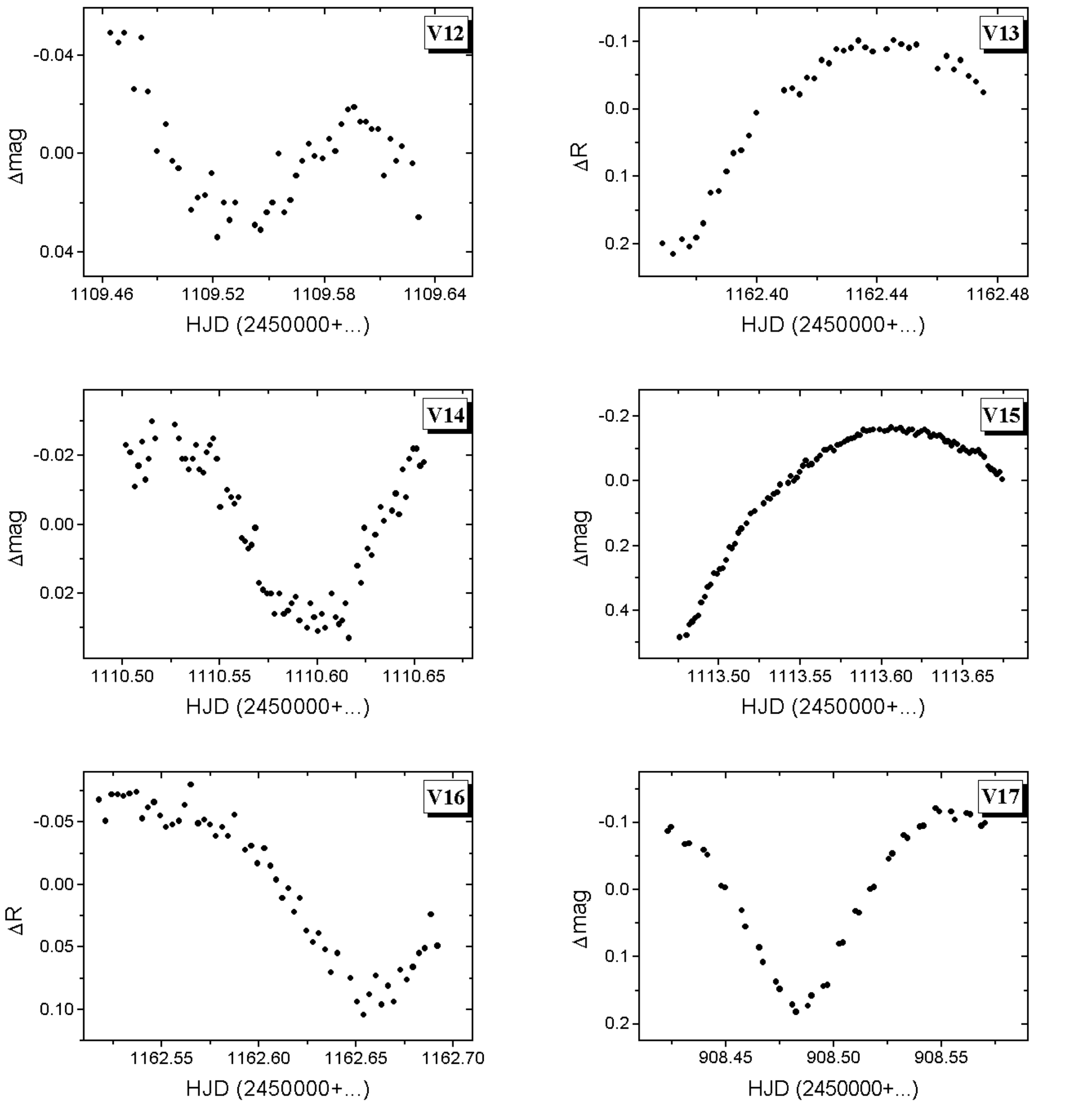

Figure 1. Light curves of 6 new variable stars

Table 1: Basic data of the new variables. The coordinates, red and blue magnitudes were taken from USNO-A2.0

Variable	R.A. (2000)	Dec. (2000)	Red mag.	Blue mag.	Sp. type	Type
V12	$03^{h}36^{m}27^{s}.60$	$+36^\circ22'27''.03$	15.5	16.9	–	EW
V13	$05^{h}02^{m}53^{s}.72$	$+10^\circ36'49''.93$	15.2	16.1	–	EW
V14	$05^{h}26^{m}30^{s}.92$	$+12^\circ57'27''.33$	12.8	14.0	G4	EW
V15	$05^{h}31^{m}34^{s}.58$	$+10^\circ33'59''.49$	14.0	14.8	F3	–
V16	$11^{h}42^{m}15^{s}.70$	$+27^\circ33'05''.33$	14.9	14.8	G3	EW
V17	$13^{h}14^{m}47^{s}.64$	$-03^\circ54'42''.70$	13.6	14.3	F8	EW

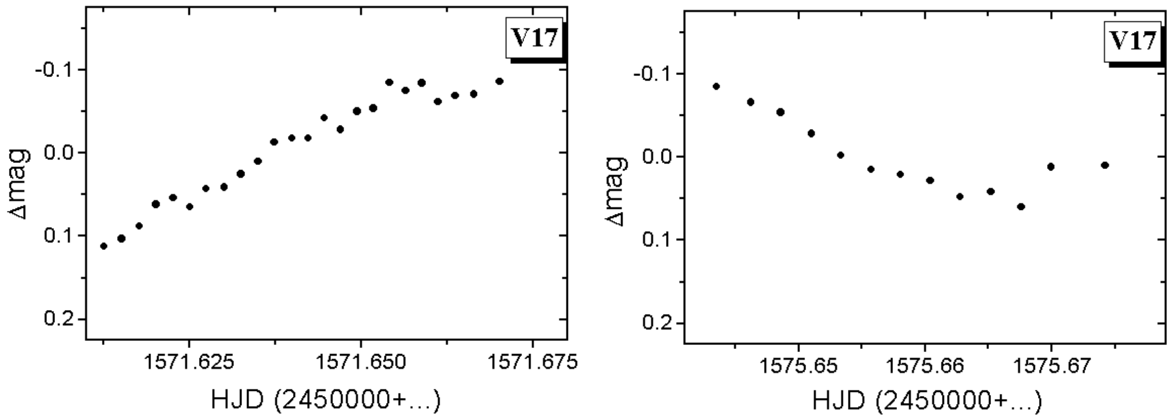

Figure 2. Follow-up observations of V17

band O_2 at 7594 Å (see, e.g., Appendix E in Gray, 1992) and normalized to their maximum values near 7500 Å. The wavelength calibration was based on the hydrogen Balmer series lines in the spectrum of α Lyr. The spectral response function of the CCD chip was calibrated with the same spectrum of Vega, knowing its tabulated absolute flux spectrum taken from Gray (1992). All of the observed spectra were divided by the resulting spectral response function. Sample spectra are plotted in Fig. 3.

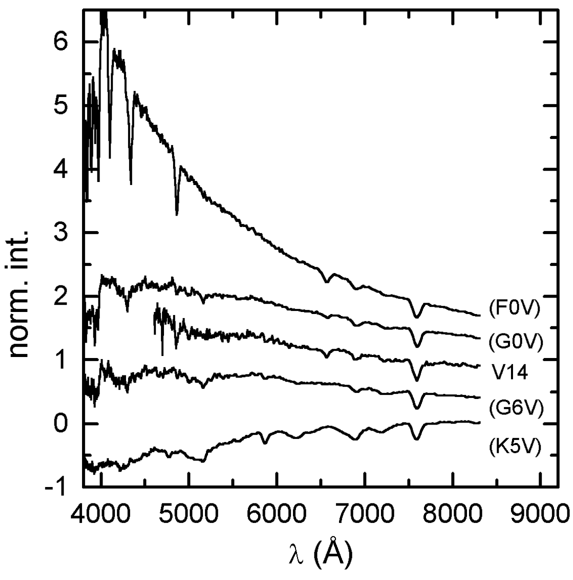

Figure 3. Sample spectra of standard stars and V14. The marked spectral standards are the following ones: HD150553 (F0V), HD72905 (G0V), HD112859 (G6V) and HD75632 (K5V).

We calculated a simple empirical parameter (A) by integrating the normalized and calibrated spectra between 4600 and 7500 Å ($A = \sum_{4600}^{7500} i(\lambda)\Delta\lambda$). A is related with the mean slope of the continuum, which is a considerably tight function of the spectral type (Gray 1992). The spectral type was parametrized by assigning 20 to B0, 30 to A0, ...

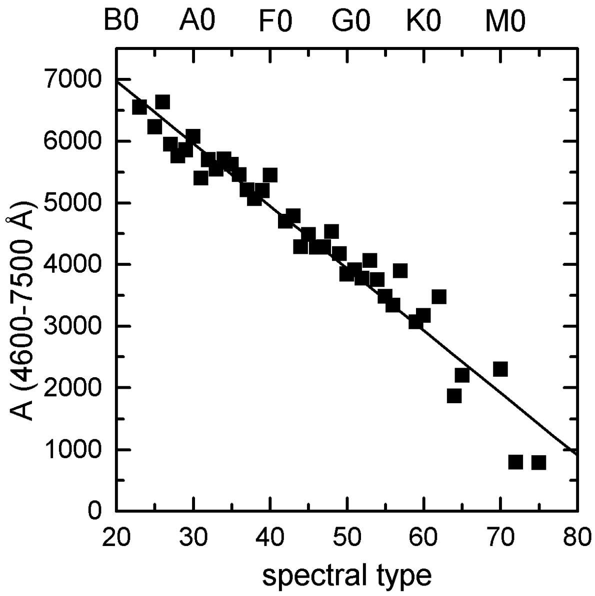

Figure 4. The relation between the integrated parameter A and spectral type.

being one of the usual ways in semi-automatic spectral type determinations (e.g. Stock 1994). We determined a linear fit to estimate the spectral types of new variables with an error of 3 subclass (see Fig. 4). Since this method suffers from the possible effects of the interstellar reddening, the spectral class was also checked by visual comparison of different standards (as in Fig. 3). The fact that we did not have to change the resulting spectral class of any of the variables indicates the usefulness of the method.

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