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NEW OUTBURST OF AX PERSEI IN 2012

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The well-known eclipsing binary AX Per consists of the a giant M4.5 (T_{eff}=3400 ± 150 K) and a white dwarf with the orbital inclination i ≈ 90° and mass ratio of 2.4 (Skopal et al. 2011; Mürset & Schmid 1999; Mikolajewska & Kenyon 1992). During its history this object underwent some active stages. The major outburst (1988-1992) has led AX Per to the optical brightening about 3^m (Skopal et al. 2001). The next active stage has begun in 2007 (Skopal et al. 2011). Some flashes were registered in 2009-2010 (Munari & Siviero 2009, 2010). Later on, instead of the expected quiescence phase a new brightening began in 2012 July (Munari et al. 2012). We observed the continuation and the development of this event at the end of 2012.

Our photometric observations have been made using two reflectors: the 1-meter Carl Zeiss Jena and the 70 cm telescope AZT-8, equipped with ST-7 and ST-8 CCD cameras, respectively and samples of B, V, R Johnson filters. All frames were dark subtracted and flat fielded. The stars: HD10465, HD10546 and HD10054 were adopted as standards. The results of photometry: B, V, R magnitudes are compiled in Table 1. Photometric phases were computed according to the ephemeris: JD_{min}=2447551.26+E×680.83 day (Skopal et al. 2011). Figure 1 shows the photometric data of AX Per, obtained in 2009-2013 by Skopal et al. (2011, 2012) and Munari et al. (2012) together with our results. There is a good agreement between our results for 2009-2011 and the data of other authors. The flash, registered in 2012, lasted about 200 days. The B and V values, measured in the maximum, are comparable and even a little bit above the values measured in the maximum phase, 2007-2010, but below the magnitudes ($V \approx 9.3^m$), achieved in 1990 (see Fig. 1). However, most likely the true maximum happened between July and October, 2012.

Spectral observations have been carried out with the same telescopes of the Fessenkov Astrophysical Institute. The slit spectrographs were equipped with the CCD cameras ST-8. Wavelength calibration was done using laboratory sources of HeI, NeI and ArI emission lines. Spectra of standard stars HD 12279, HD 12303, obtained just before or after the target were used for the flux calibration. All spectrograms were corrected for atmospheric extinction. Spectrograms with dispersions of 0.75 and 0.49 Å pixel^{-1} were obtained in the ranges 4340-5200 and 6100-7000 Å with the 70-cm and 1-meter telescopes, respectively. Exposure time was 20-30 minutes for the object and 1-2 minutes for the standard. The fluxes of emission lines are compiled in Table 2.

It is seen that increase of the fluxes of all presented lines were registered in 2009 October, and it was a residual phenomenon of the object brightening, which was observed in 2009 April by Munari & Siviero (2009). The very last active stage was followed by an even larger strengthening of emission lines.

Table 1: Photometric results

Date	HJD	Phase	B	V	R
	2400000+		mag	mag	mag
23.10.2009	55127.288	0.128	12.11±0.01	11.39±0.01	9.56±0.01
12.11.2009	55148.257	0.158	11.99±0.05	11.27±0.05	9.38±0.05
16.11.2009	55152.179	0.164	11.87±0.05	11.42±0.05	9.37±0.04
12.10.2010	55482.229	0.649	12.69±0.05	11.82±0.05	9.53±0.01
08.11.2010	55509.158	0.689	12.52±0.04	11.55±0.03	9.63±0.02
26.09.2011	55831.292	0.162	12.52±0.01	11.65±0.01	9.70±0.01
23.12.2011	55919.146	0.291	12.72±0.02	11.50±0.01	9.51±0.05
11.10.2012	56212.263	0.721	11.04±0.01	10.23±0.01	9.96±0.01
20.11.2012	56252.149	0.780	11.18±0.05	10.44±0.01	9.09±0.01
04.12.2012	56266.127	0.800	11.52±0.02	10.57±0.01	8.90±0.04
09.01.2013	56302.046	0.853	12.08±0.01	11.01±0.02	9.14±0.03
11.02.2013	56335.050	0.902	12.35±0.02	11.08±0.02	9.26±0.01

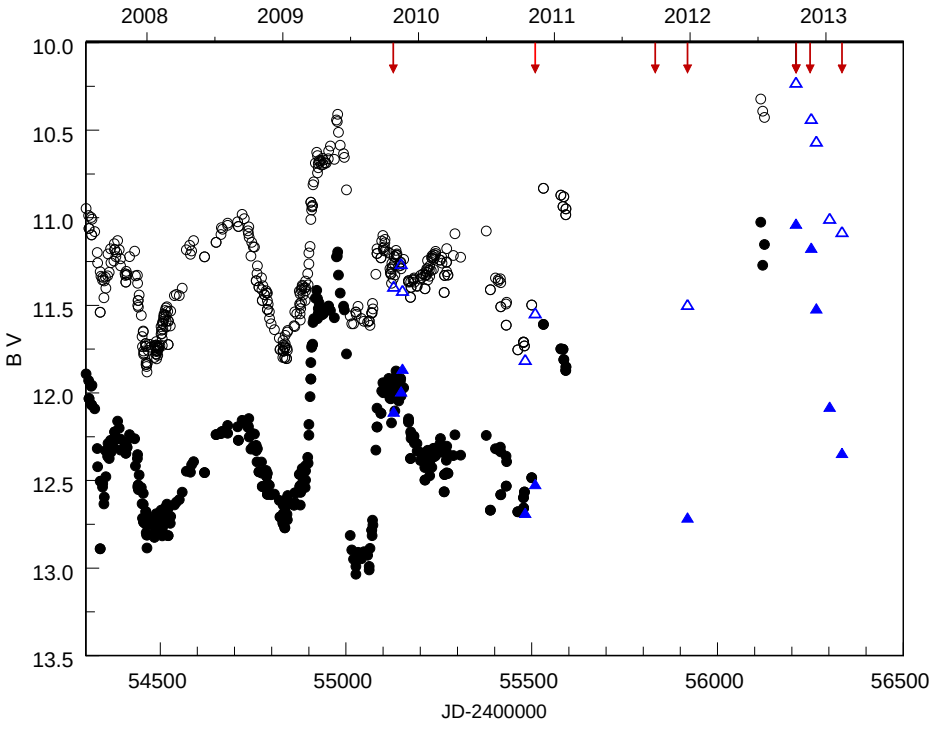

Figure 1. The B and V magnitudes of AX Per in 2008-2013. Data of Skopal et al. (2011, 2012) and Munari et al. (2012) are denoted by circles (empty for V and solid for B), our results are denoted by blue triangles, empty for V and solid for B. Arrows at the top denote dates of our spectral observations.

Table 2: Observed fluxes of selected emission lines in the AX Per spectrum

Date		22.10 2009	08.11 2010	27.09 2011	23.12 2011	10.10 2012	11.10 2012	17.11 2012	11.02 2013
HJD2450000+		5127.23	5509.19	5832.21	5919.09	6211.32	6212.00	6249.15	6335.09
Phase		0.128	0.689	0.163	0.291	0.720	0.721	0.775	0.902
Telescope		0.7 m	1 m	1 m	1 m	1 m	1 m	1 m	0.7 m
λ	ion	Flux in 10^{-12}erg cm^{-2}sec^{-1}							
4363	[OIII]	1.41	0.26	0.12		1.06	1.06	0.74	0.59
4471	HeI	0.39	0.11	0.23		0.88	0.90	0.82	0.13
4634	NIII	0.40	0.20			0.22	0.30	0.08	0.07
4641	NIII	0.68	0.16	0.28	0.29	0.61	0.52	0.56	0.09
4647	CIII	0.52	0.17	0.34		0.50	0.43	0.46	0.03
4686	HeII	2.57	1.32	2.34	1.57	2.50	2.54	1.40	1.22
4713	HeI	0.12	0.07	0.19		0.32	0.34	0.26	0.06
4861	Hβ	4.60	3.09	2.84	3.39	11.5	11.4	9.73	2.30
4922	HeI	0.74	0.28	0.29	0.14	0.90	0.93	0.84	0.43
4959	[OIII]	0.67	0.12	0.16	0.11	0.79	0.76	0.53	0.29
5007	[OIII]	2.15	0.38	0.49	0.33	2.44	2.40	2.18	0.99
5015	HeI		0.04	0.05		0.98	0.94	0.68	0.59
6563	Hα	33.5	48.2		31.5	65.0		60.6	19.2
6678	HeI	1.42	1.71		0.85	1.63		1.43	0.53

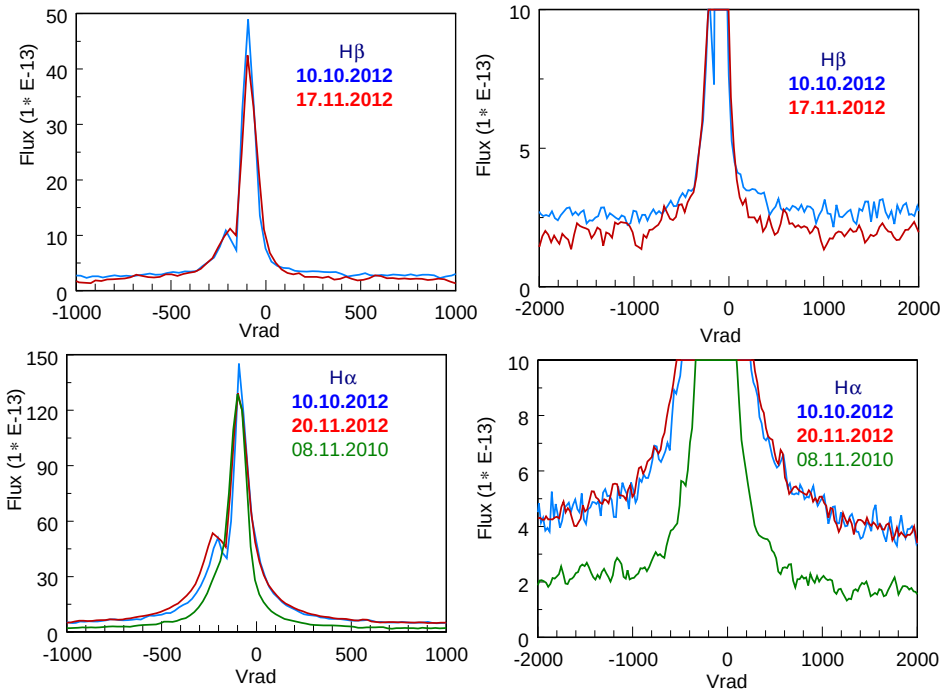

Figure 2. Left panels: the Hβ and Hα profiles, obtained with 0.49 Å dispersion pixel^{-1}. The horizontal axis corresponds to radial velocities in (km sec^{-1}). The vertical axis shows the fluxes on the scale (10^{-13} erg cm^{-2}sec^{-1}Å^{-1}). Dates of observations are presented on the panels. The right panels are the same, but with expanded vertical range and with the broader interval of radial velocities.

Munari et al. (2012) reported that on 2012 July 18 the line profiles were sharp Gaussian-like, with no P Cyg absorption components. However in October and in November the profiles of Hβ and Hα were distorted by absorption components. Spectrograms taken on December 4 with 0.75 Å dispersion pixel^{-1} (without an absolute calibration) show the single profiles, probably due to the lower dispersion. It is seen from Figure 2 that the profiles, obtained on different dates during the maximum are broader and have more extended wings than the single profile obtained on 2010 November 8, when the object was in quiescence.

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