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**28 NEW VARIABLE STARS FROM SAVS**

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28 new variable stars were discovered by the Semi-Automatic Variability Search sky survey (Niedzielski et al. 2003) operating at the Astronomical Observatory of the Nicolaus Copernicus University in Piwnice, near Toruń. Photometric data were collected with the semi-automatic CCD camera equipped with a 135/2.8 telephoto lens and SBIG ST-7 CCD camera with KAF 400 chip. Observations were gathered while monitoring 23 selected fields covering 138 square degrees of the northern hemisphere between September 2003 and January 2004. About 18,000 stars brighter than 13 mag were observed in near-Johnson V band. The list of observed fields, detailed hardware specification and description of data reducing software as well as original data are available on survey's web site <http://www.astri.uni.torun.pl/~gm/SAVS>.

For some of the new variables additional spectral observations were performed with the 0.9m Schmidt-Cassegrain telescope equipped with the Richardson spectrograph and a Wright CCD camera. Using the 600 gr/mm grating we obtained spectra between 3800 and 5800 Å with 2 Å/pix reciprocal dispersion. These spectra, after standard reduction performed with IRAF<sup>1</sup> were used for spectral classification.

A list of the new variable stars is presented in Table 1. The stars which variability type cannot be resolved with our photometric data (mostly long-term red irregular or semi-regular variables), were classified as “miscellaneous” and marked with MISC in Table 1. Light curves in near V filter of new variables are shown in Figures 1, 2 and 3. For regular periodic variables phased light curves are displayed. For long-term variables the data points were averaged over single nights and the standard deviation was taken as the near V magnitude error estimate. The original photometric data are available at the surveys web site.

The medium resolution spectra used for determination of spectral types of selected variables are presented in Figures 4 and 5 for early and late spectral types, respectively. Some characteristic spectral features used in classification are marked.

SAVS 225956+350948 (the infrared source IRAS 22575+3453) was observed as gradually fading object changing its brightness from about  $m_V = 11$  mag at the beginning of monitoring. Near HJD 2452955 it became out of range of our instrument and was not detected in later CCD frames. It is possible that SAVS 225956+3509483 is a faint

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<sup>1</sup>IRAF is distributed by the National Optical Astronomy Observatories, which are operated by the Association of Universities for Research in Astronomy, Inc., under cooperative agreement with the National Science Foundation.

variable of Mira type. The higher resolution spectrum of this star is shown in Figure 6. It was obtained with 1200 gr/mm grating covering spectral range between 5800 and 6800 Å (reciprocal dispersion of 1 Å/pix). Strong  $H_\alpha$  emission line is clearly visible.

**Table 1.** List of new variables. *SAVS ID* – identifier consisted of Right Ascension and Declination of a star calculated for J2000.0, *Other ID* – cross-identification with other catalogs,  $m_V$  – observed maximal brightness in near-Johnson V band,  $\Delta m_V$  – amplitude of variation,  $N_{data}$  – number of collected data points (for long-term variables a number of observed nights are also given),  $T_0$  – time of primary minimum for eclipsing binary systems or time of maximum for periodic pulsating variables (in Heliocentric Julian Days),  $P$  – period of variation in days, *Type* – type of variability in GCVS (Kholopov et al. 1998) convention.

SAVS ID	Other ID	$m_V$	$\Delta m_V$	$N_{data}$	$T_0 - 2450000$	$P$ [days]	Type
004430+564550	GSC 3663-913	9.81	0.18	139/24	3033.2823	57.61(5)	SR
004534+561626	C27	11.29	0.45	141/24	...	...	MISC
004611+571305	GSC 3663-2412	10.81	0.32	124/22	...	...	MISC
012728+290618	GSC 1754-1133	10.79	0.33	200	2929.8486	0.491495(3)	EB
013237+615811	BD+61°285	9.35	0.10	176	2933.0564	0.67410(8)	BCEP
013333+613329	BD+60°265	8.51	0.21	180/31	3155.3509	92.6(6)	SR
022430+350810	GSC 2331-731	12.14	0.48	210	2931.3523	0.36907(2)	EB
022708+342319	GSC 2331-960	11.69	0.38	217	2939.1813	3.1078(2)	DCEP:
022841+342948	GSC 2331-1491	10.91	0.34	196/27	...	...	MISC
085324+564910	HD 237760	9.35	0.48	75/14	...	...	MISC
085744+524727	GSC 3805-1092	10.95	1.40	75/15	...	...	MISC
085759+524041	HD 233586	10.28	0.29	93/16	...	...	MISC
085819+522627	GSC 3423-745	10.73	0.97	95/16	3224.0235	101.7(1)	SR
213927+271556	BD+26°4227	9.81	0.20	178/44	...	...	MISC
223446+581804	GSC 3995-1441	9.97	0.31	287	2891.1763	1.955103(5)	EA
223949+583254	HD 240017	9.38	0.50	301	2894.2908	3.09209(3)	EA
224203+580404	GSC 3992-80	10.14	0.19	182/37	...	...	MISC
224621+595731	GSC 3996-312	11.28	0.27	279	2896.9093	3.0332(1)	DCEP
224712+595834	GSC 3996-574	12.13	0.34	308	2892.0818	0.425526(2)	EW
224823+602417	GSC 4265-193	12.09	0.64	299	2897.6785	4.27785(2)	DCEP
225956+350948	IRAS 22575+3453	11.03	1.83	126/18	...	...	M:
230131+304427	GSC 2750-854	10.66	0.40	274	2884.4259	0.471653(3)	EA/EB
230310+342508	GSC 2758-1820	12.40	0.58	132	2909.3356	0.318833(2)	RRAB
230623+340932	GSC 2759-1917	11.50	0.48	202/37	...	...	MISC
230915+341924	GSC 2759-1657	10.93	0.47	215/37	...	...	MISC
231034+314253	GSC 2751-1007	12.34	0.51	262	2885.2469	0.417461(3)	EW
232358+313933	GSC 2752-1159	11.49	0.63	239/39	3034.3841	50.11(3)	SRD
232629+312040	GSC 2765-348	12.04	0.62	277	2905.5446	0.28351(1)	EW

## References:

- Kholopov, P. N., Samus, N. N., Frolov, M. S., Goranskij, V. P., Gorynya, N. A., Karit-skaya, E. A., Kazarovets, E. V., Kireeva, N. N., Kukarkina, N. P., Kurochkin, N. E., Medvedeva, G. I., Pastukhova, E. N., Perova, N. B., Rastorguev, A. S., Shugarov, S. Yu., 1998, *The Combined General Catalog of Variable Stars*, 4.1 Edition (available via the Internet: <http://cdsweb.u-strasbg.fr/cgi-bin/Cat?II/214A>)
- Niedzielski, A., Maciejewski, G., Czart, K., 2003, *AcA*, **53**, 281

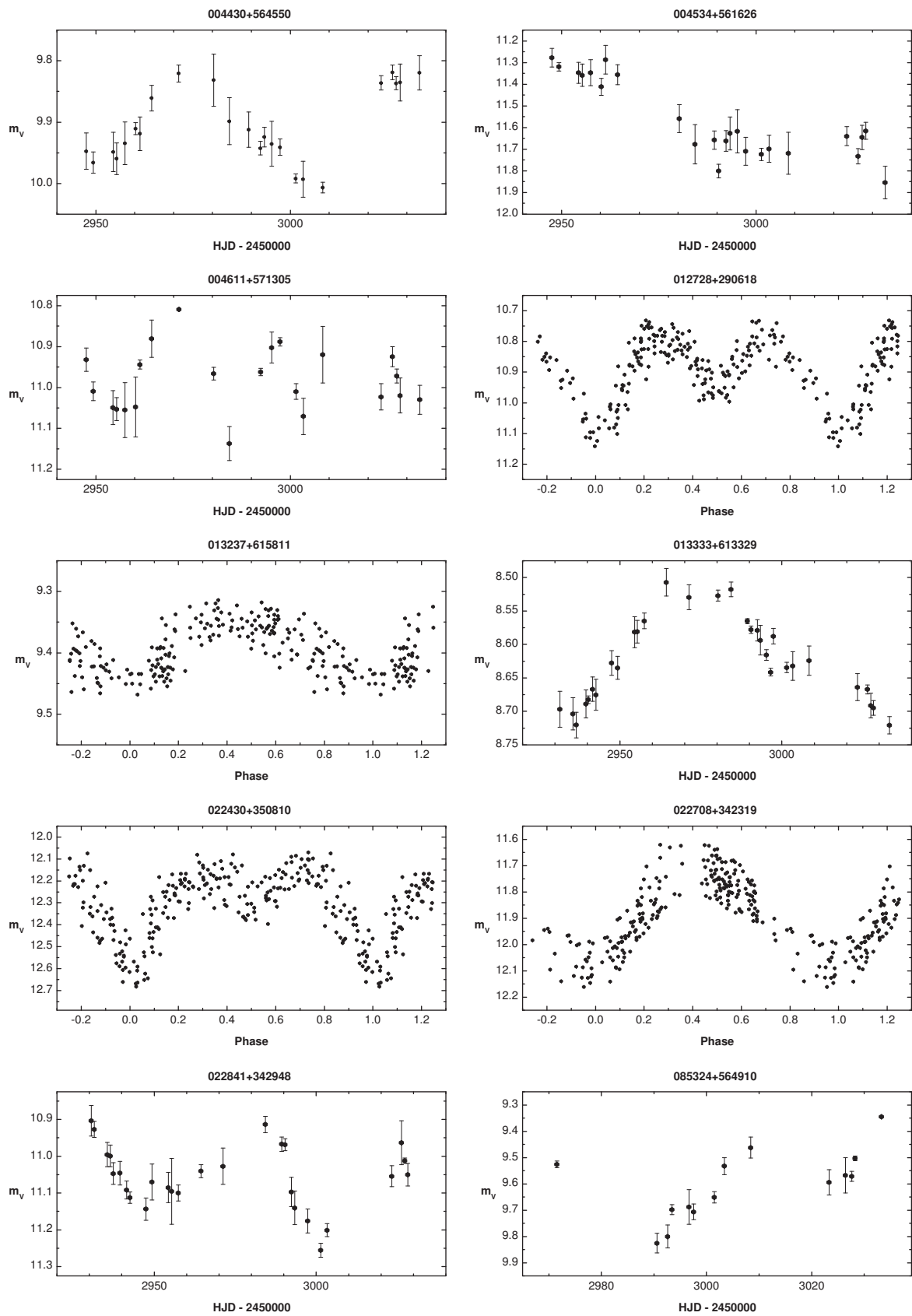


Figure 1. Light curves of new variables.

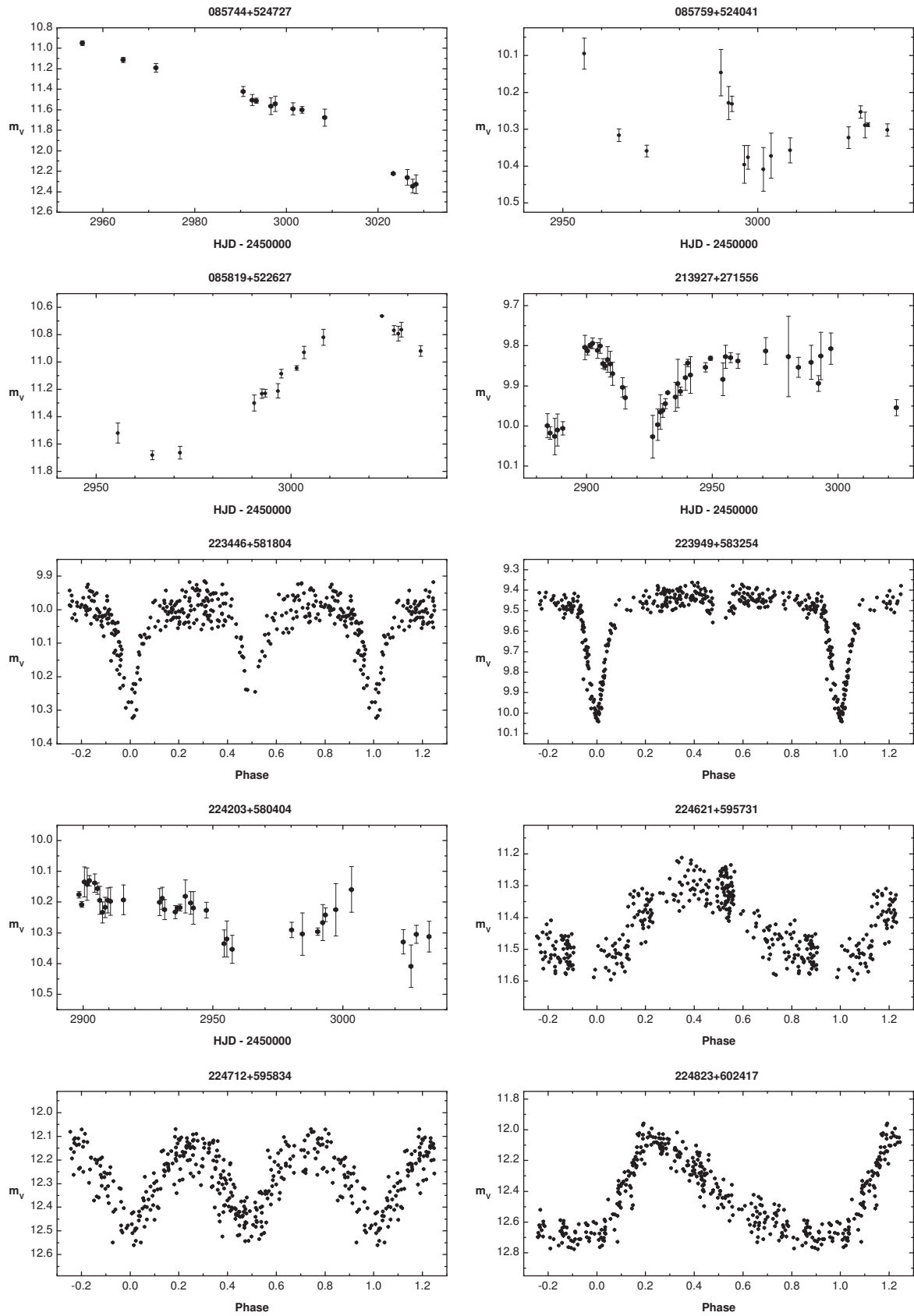


Figure 2. Light curves of new variables.

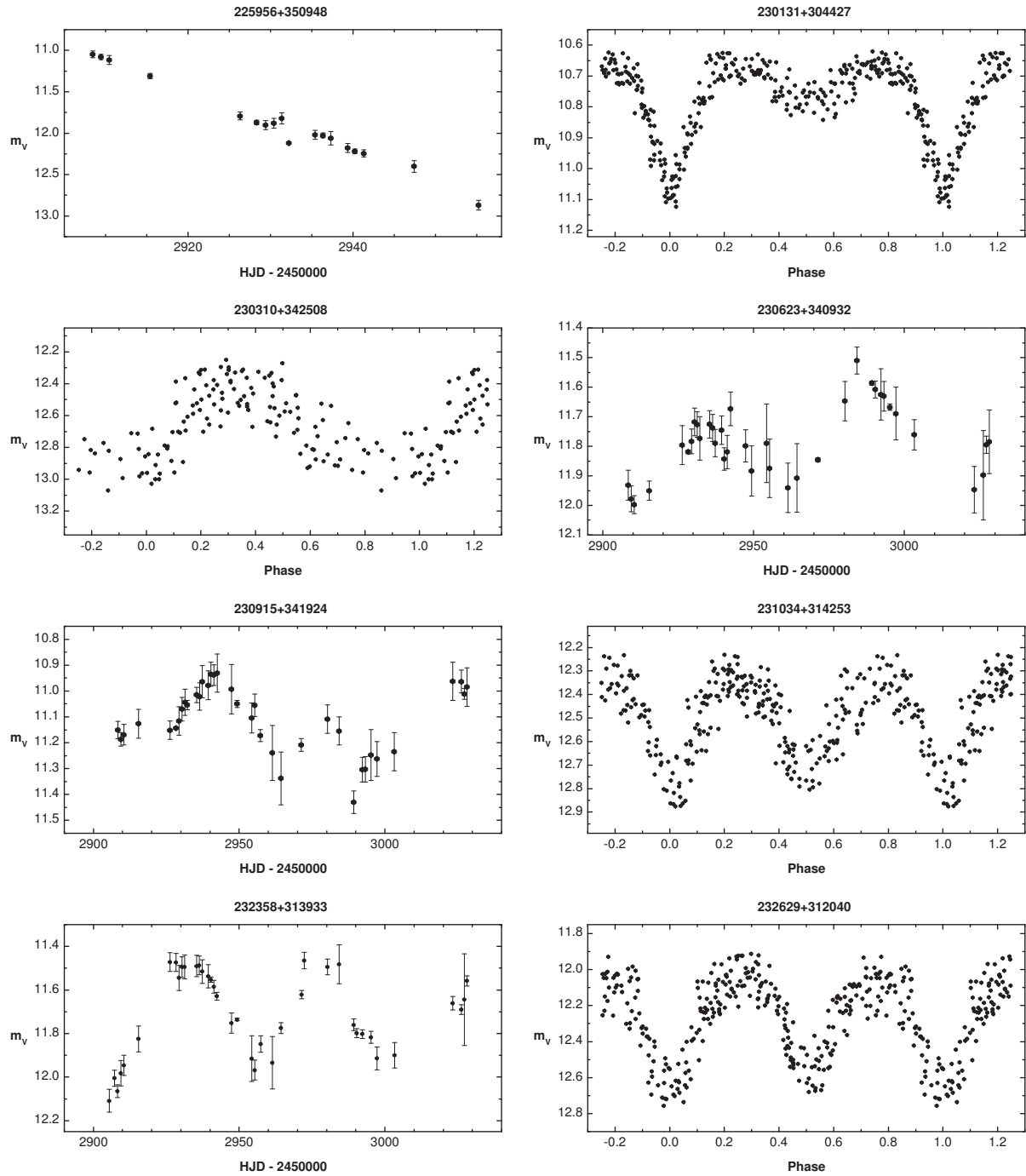


Figure 3. Light curves of new variables.

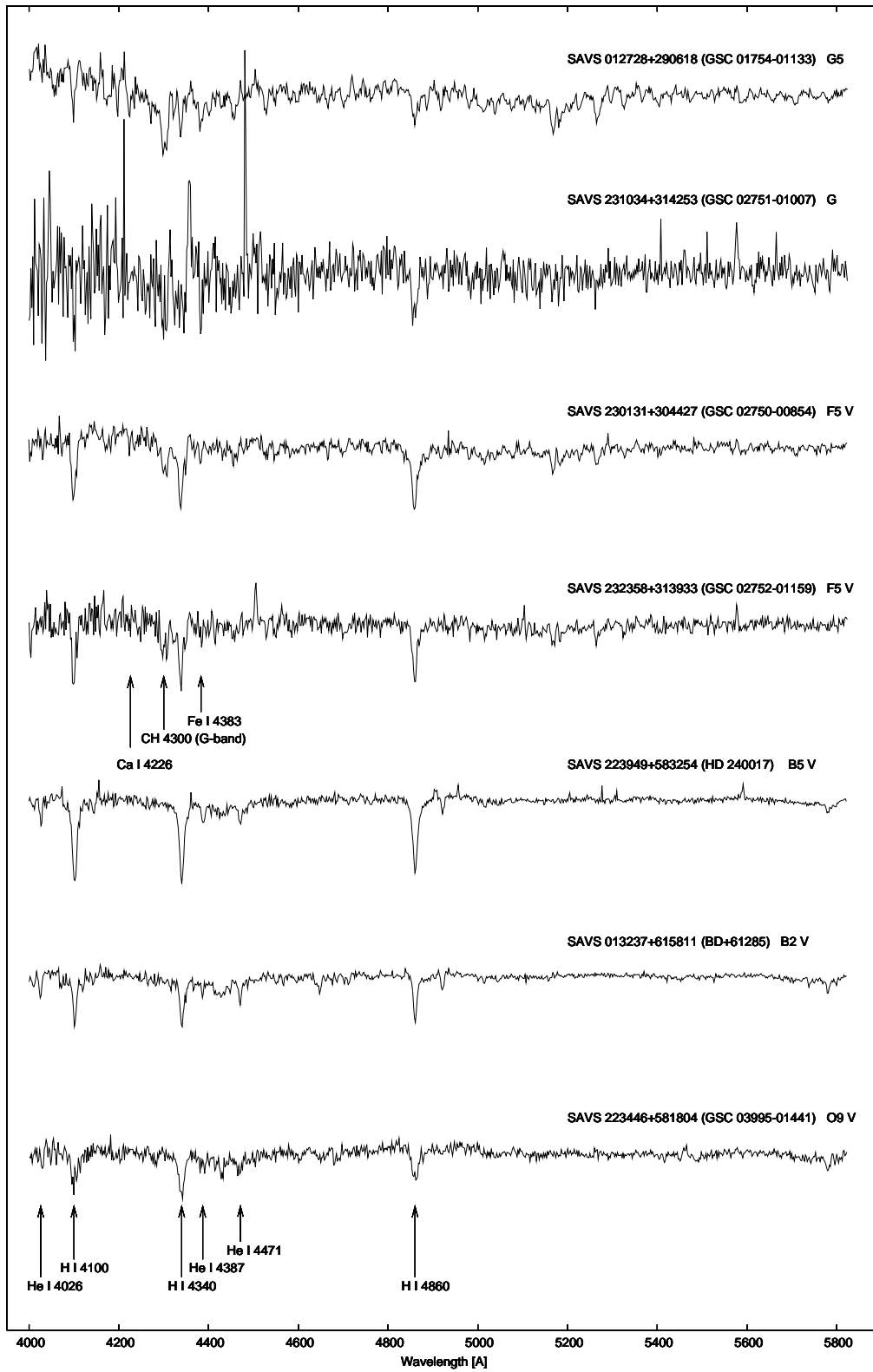


Figure 4. Spectra of several newly detected variables of early spectral type.

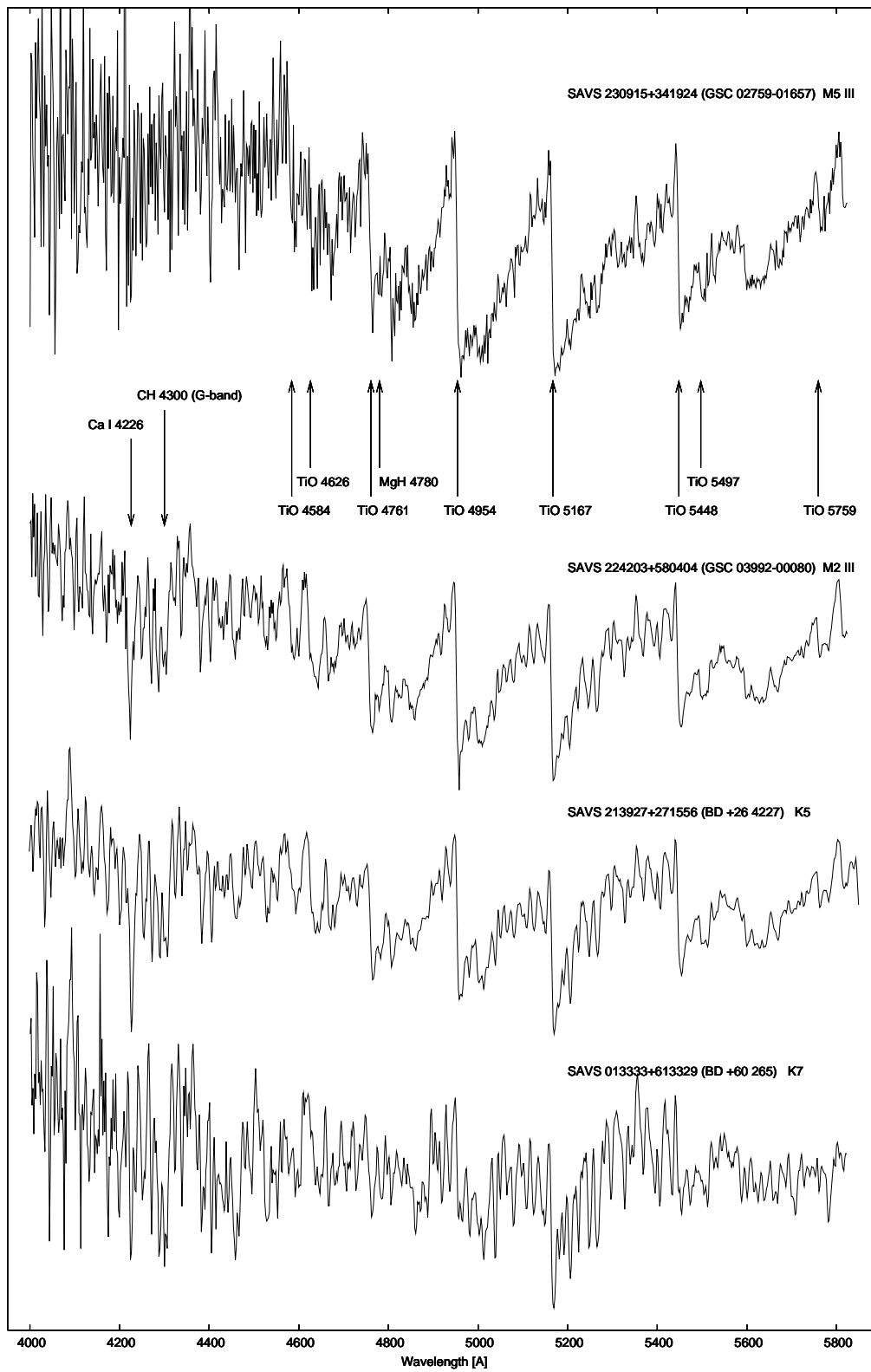
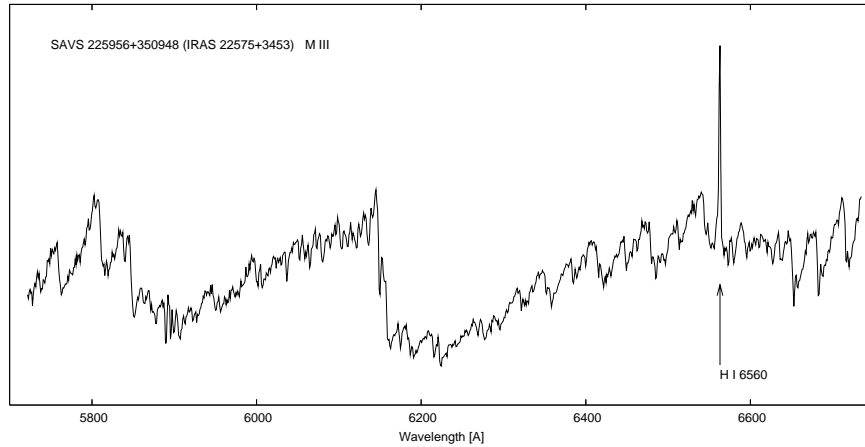


Figure 5. Spectra of several newly detected variables of late spectral type.

**Table 2.** Journal of spectroscopic observations. *SAVS ID* - identifier consisted of RA and Dec (J2000.0), *Other ID* - cross-identification with other catalogues, *HJD* - heliocentric Julian Date, *Exptime* - exposure time in seconds,  $\lambda_1 - \lambda_2$  - wavelength range in Å, *Sp Type* - spectral type and luminosity class

SAVS ID	Other ID	Date	HJD - 2450000	Exptime[s]	$\lambda_1 - \lambda_2$	Sp Type
012728+290618	GSC 1754-1133	2004-01-18	3023.36884	1200	3725-5820	G5
013237+615811	BD+61°285	2004-01-15	3020.39014	1200	3725-5820	B2 V
013333+613329	BD+60°265	2004-01-15	3020.40665	1200	3725-5820	K7
213927+271556	BD+26°4227	2004-09-22	2905.41351	1200	3790-5845	M2 III
		2004-09-22	2905.42801	1200	3790-5845	
		2004-09-23	2905.51252	1200	5640-7700	
		2004-09-23	2905.52720	1200	5640-7700	
		2004-01-18	3023.22933	1200	3725-5820	
223446+581804	GSC 3995-1441	2004-01-15	3020.42474	1200	3725-5820	O9 V
223949+583254	HD 240017	2003-09-22	2905.38013	1200	3790-5845	B5 V
		2003-09-22	2905.39436	1200	3790-5845	
		2003-09-23	2905.54437	1200	5640-7700	
		2003-09-23	2905.55868	1200	5640-7700	
		2004-01-15	3020.36355	1200	3725-5820	
224203+580404	GSC 3992-80	2004-01-18	3023.30773	1200	3725-5820	M2 III
225956+350948	IRAS 22575+3453	2003-10-18	2931.37519	1200	5725-6730	Me III
		2003-10-18	2931.39148	1200	5725-6730	
		2003-10-18	2931.51110	1200	3985-5010	
		2004-01-18	3023.21266	1200	3725-5820	
230131+304427	GSC 2750-854	2004-01-18	3023.21266	1200	3725-5820	F5 V
230915+341924	GSC 2759-1657	2004-01-18	3023.34918	1200	3725-5820	M5 III
231034+314253	GSC 2751-1007	2004-01-18	3023.25182	1200	3725-5820	Ge
232358+313933	GSC 2752-1159	2004-01-18	3023.27144	1200	3725-5820	F5e V



**Figure 6.** Higher resolution spectrum of IRAS 22575+3453 showing H $\alpha$  emission.