On rotation of prominences observed by ground based spectrographs at Ondřejov

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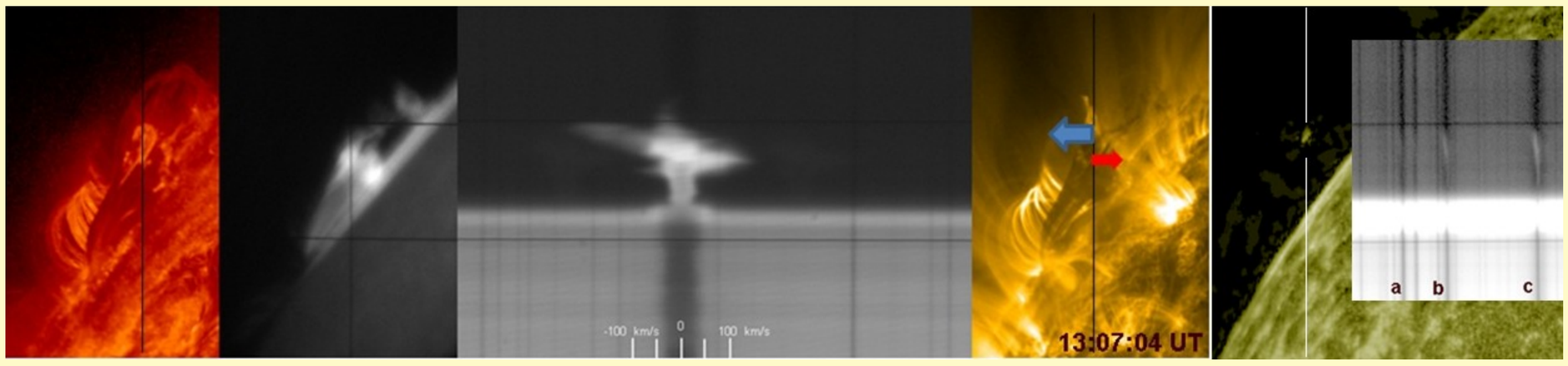
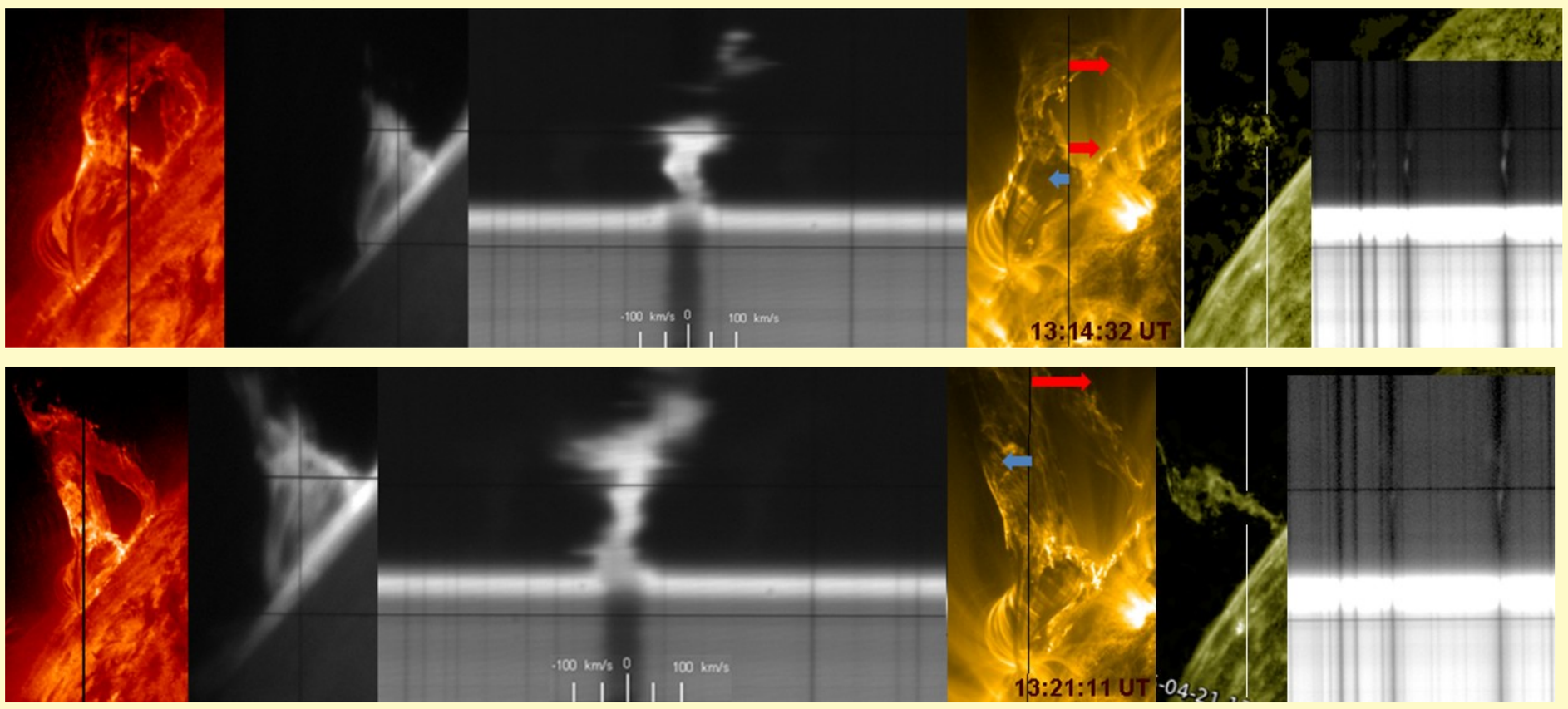
Motions of the solar prominence mass are always a marker of its activity. In some cases the motion can be interpreted as rotation and the most enigmatic kind of the rotation looks like terrestrial tornadoes. Nowadays there are sets of rotation in prominences based on the EUV observations by space observatories. However, only spectral observations could give us the direct information about the rotation parameters. Rotation of the prominence body can be detected from the typically inclined spectral lines. We present a study of parameters of prominence rotation according a selected Hα spectral and filtergram observations by the ground-based MFS&HSFA2 spectrographs at Ondřejov for 2000 - 2016 period. Maximal Doppler velocities are displayed in the Table 1. Observations are compiled in a database containing basic information about time of observation of prominences, Hα slit-jaw image, Hα spectrum and related data from Solar Dynamics Observatory. We carried out study of the structure and dynamics of several selected prominences and compared Hα data with those of 304 Å, 193 Å, 171 Å images. The catalogue is available at http://radegast.asu.cas.cz/MFS/morfolog_cataloque/01.html.

2015-04-21 13:05 – 13:58 UT X = -939″, Y = 323″



The image is composed (from left to right): 304 Å (SDO): Hα filtergram and Hα spectrogram (MFS spectrograph at Ondřejov): 171 Å (SDO); 1600 Å, spectrum Mg I a) 5167.3 : b) 5172.7: c) 5183.6 Å (MFS spectrograph at Ondřejov). The vertical line corresponds to the position of the slit of the spectrograph. The distance between the horizontal lines corresponds to 77.5 Mm.



Date	Time	Velocity [km/s]	xray	E,W
2001-05-09	04:57 - 11:37	+150, -120	C2 (09:00)	E
2001-05-20	05:58 - 10:51	+200, -200	M1(09:30)	W
2002-06-26	05:47 – 09:00	+ 60, - 90	B8 (08:10)	E
2002-08-04	09:01 – 09:47	+200, - 250	M5 (09:15)	E
2003-08-01	10:20 – 10:40	+200, -100	B5 (10:23)	W
2004-04-23	05:58 – 12:13	+115, -110	M1 (12:00)	W
2011-06-25	06:33 – 13:53	+41, -18	B6 (10:20)	E
2012-05-10	07:13 – 09:06	+11, -10	C1 (07:30)	E
2012-05-20	05:18 – 13:48	+9, -25	B9 (10:10)	E
2012-05-25	05:36 - 10:47	+10, -13	C1 (10:15)	W
2012-05-26	05:41 – 08:18	+8, -11	B8 (06:05)	W
2012-06-11	13:10 – 13:20	+182, -12	-	W
2012-06-21	07:05 – 09:23	+5, -24	-	W
2014-03-30	06:51 – 11:15	+22,-27	-	E
2014-04-12	07:16 - 07:51	+100, -150	-	E
2014-04-19	09:32 - 09:42	+75, -80	-	W
2014-05-23	07:08 – 07:50	+15, - 10	-	W
2015-04-15	12:58 – 13:07	+5, -7	-	E
2015-04-21	12:58 – 13:50	+100,-140	-	E
2015-05-24	06:21 – 06:52	+3, -2	-	E
2015-10-02	05:44 – 13:02	+80, - 75	C4 (08:50)	W
2016-04-03	06:21 – 14:55	+4, -3	B3 (13:40)	W

Table 1.
Date and time of observation, Doppler velocity in the line Hα, presence of solar flares during observation, E or W limb, presence of emission in the line Mg I – (by red letters, observation in lines Mg I started on October 14, 2014).

Summary

We observed the 22 "tornado" events during the 2001-2016. The numbers of the events occurring on the Eastern and the Western limbs are equal. Thus we haven't found the east-west asymmetry in the observed "tornado" events .

The most of the observed events were associated with the onsets of the solar flares from B5 to M5 GOES classes. The "red“ Doppler velocities are within 3 - 200 km/sec while the "blue" velocities within the -200 to -2 km/sec.

We can separate the observed events into two sub-types. The first type of events shows the quasi-symmetry of the values of the "blue" and 'red" velocity .The events of the other subtype demonstrate a difference of the velocities up to the factor of 10. This fact could be explained by the orientation of the rotation plane relative to the line-of-sight and could be used for reconstruction of this parameters in the 3D coordinates.

Acknowledgments

P.K. and Yu.A.K. appreciate a support from Grant GACR No. 16-18495S.