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LINES OF MGI DETECTED IN SOLAR PROMINENCES

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Abstract. Using the flare spectrograph at Ondřejov observatory, we have observed several prominences with the aim to detect the MgI lines. These lines play an important diagnostic role, complementary to MgII resonance lines now routinely observed by the IRIS satellite. Our preliminary analysis shows that a rather weak MgI emission, e.g. in the 5172.7 Å line, is detectable and this correlates well with the presence of extended bright regions on the solar disk visible in SDO/AIA 1600 Å band. Physical reasons for such a correlation are discussed.

Key words: prominences - limb-flare - MgI emission

1. Observations

Dynamic eruptive events were observed on 21 April 2015, 22 May 2016 and 23 April 2014 by SDO and Ondřejov spectrograph. Bellow we show the slit-jaw images, Hα and MgI spectra, as well as SDO 304 Å and 1600 Å images with marked position of the spectrograph slit.

2. Images and spectra

We present here three examples selected from our set of recent observations. Each of them represents a specific type of an eruptive event, with different visibility of the MgI triplet lines. An eruptive prominence resembling an atypical prominence structure (tornado), see Levens et al. 2016 was detected on the limb on 21 April 2015. In the Hα line we see highly dynamical event and a complex prominence structure is also visible in the HeI 304

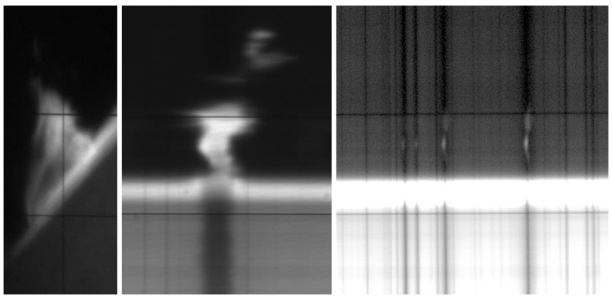

Figure 1: Active prominence observed by the Ondřejov spectrograph on 21 April 2015 13:14:32 UT. The slit-jaw image (left part) and Hα, MgI lines (right part).

Å channel of SDO/AIA (Fig. 1 and 2). In this example, the MgI lines are in emission above the limb, seen on the background of the scattered photospheric spectrum. The lines are much narrower compared to Hα, but they exhibit similar dynamics. We also show two SDO/AIA 1600 Å images where an enhanced active region is well visible just below the prominence. In this channel, also a weak emission is detected in the position of the prominence. Second example (Fig. 3) is also an active limb prominence (22 May 2016) with substantial Hα dynamics but no emission detected in MgI lines. Quite interestingly, the limb region below the prominence is rather dark in SDO/AIA 1600 Å channel and no prominence counterpart is observed in this channel. The last example (Fig. 4) is identified as a small C 5.1 limb flare which appeared on 23 April 2014 in the active region close to the limb (see SDO/AIA images). Hα line is a very broad indication of the flare, MgI lines are well visible above the limb (in Fig. 5 we also show their photometric profiles calibrated to absolute units). The flare has very compact shape, but appears very bright even in SDO/AIA 1600 Å channel. Also the nearby active region is bright in this AIA channel.

3. Discussion and conclusions

Emission in MgI triplet lines was previously observed in some bright prominences, see summary in Morozhenko 1984 and the study of Landman 1984. Our observations indicate an interesting correlation between MgI emission and the underlying disk activity seen in SDO/AIA 1600 Å channel. We thus

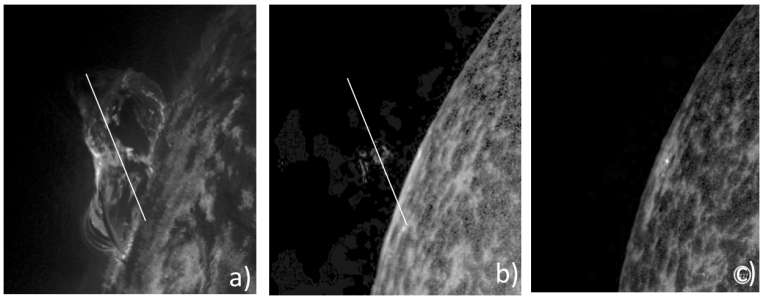

Figure 2: Images: a) SDO 304 Å ; 1600 Å b) 21-04-2015 13:14:32 UT; c) 22-04-2015 06:17:32 UT with marked position of the spectrograph slit.

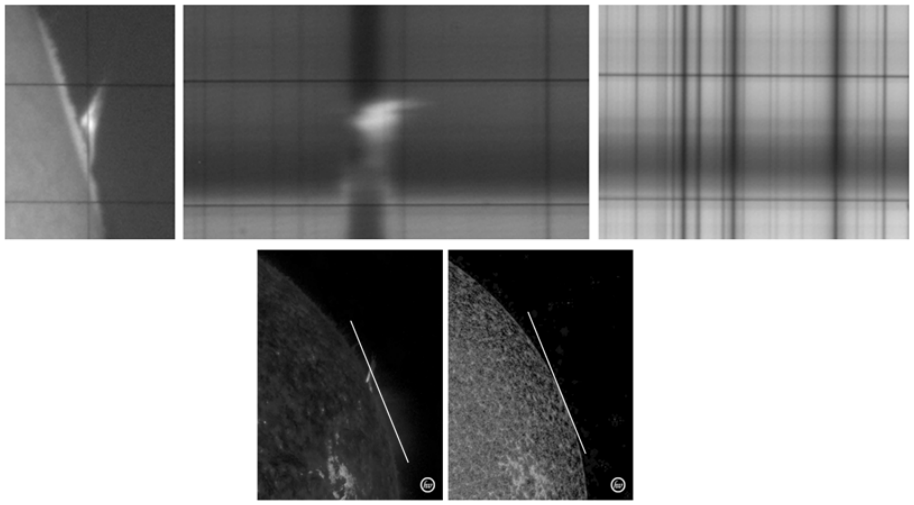

Figure 3: Active prominence X = 874", Y = 438" observed by the Ondřejov spectrograph on 22 May 2016 12:14:48 UT. The slit-jaw image (left part) and Hα, MgI lines (right part). At the bottom: images SDO 304 Å and 1600 Å .

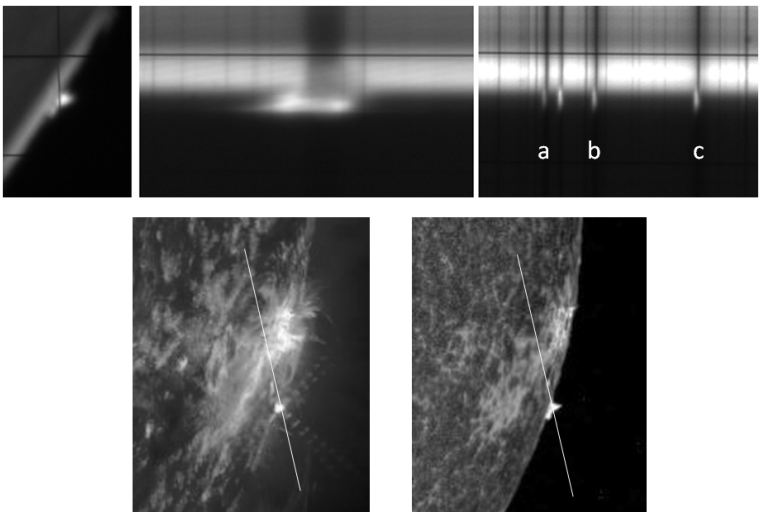

Figure 4: Limb flare X = 914", Y = -312", C5.1 observed by the Ondřejov spectrograph on 23 April 2014 12:54:41 UT. The slit-jaw image (left part) and Hα, MgI lines: a) 5167.3; b) 5172.7 ; c) 5183.6 Å (right part). At the bottom: images SDO 304 Å and 1600 Å .

assume that MgI gets photoionized in the resonance continuum below 1622 Å by the underlying radiation field and the triplet lower state is populated by recombinations from dominant MgII (for the atomic model see Mauas et al. 1988). The triplet lines are then formed by scattering of the photospheric line radiation. Detailed non-LTE modeling is now in progress to confirm this idea. However, the prominence and limb-flare emission seen in the two examples on SDO/AIA 1600 Å images is more problematic. This can be either due to enhanced opacity in Si continua at this wavelength range (e.g. Gray 2005), or due to enhanced emission of UV lines formed within the PCTR (prominence-corona transition region). Another possibility is a direct recombination to the ground level of MgI, after previous photoionization by enhanced disk radiation below 1622 Å . The latter could explain the lack of 1600 Å emission in 22 May 2016 eruptive prominence. Finally, the study of MgI emission is important in relation to MgII h and k line observations of solar prominences by IRIS (Heinzel et al. 2015).

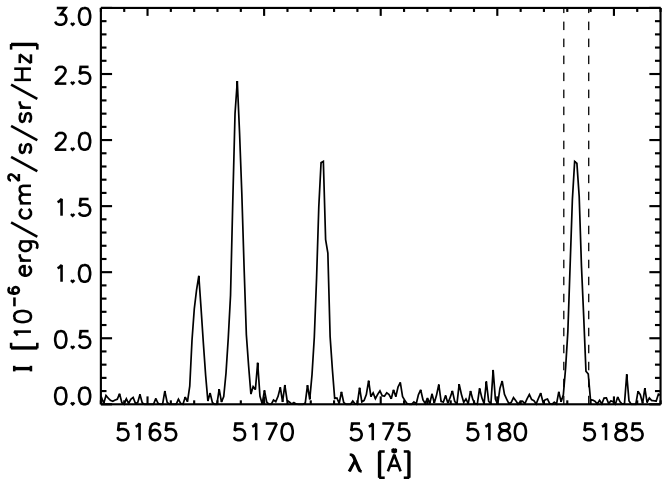

Figure 5: Profiles of spectral lines of the Mg I triplet (5167.3, 5172.7, 5183.6 Å) on 23 April 2014 12:54:41 UT. Height above the limb 30 arcsec.

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