Nature of Prominences and their role in Space Weather
Proceedings IAU Symposium No. 300, 2013
B. Schmieder, J.-M. Malherbe & S. T. Wu, eds.

doi:10.1017/S1743921313011757

Observation and simulation of a filament eruption associated with the contraction of the overlying coronal loops and the filament rotation

X. L. Yan[1], Z. K. Xue[1,2] and Z. X. Mei[1]

[1]Yunnan Astronomical Observatory, Chinese Academy of Sciences, Kunming 650011, China
email: yanxl@ynao.ac.cn

[2]University of Chinese Academy of Sciences, Zhongguancun Beijing 100049, China

Abstract. By using the data of Solar Dynamics Observatory (SDO), we present a case study of the contraction of the overlying coronal loop and the rotation motion of a sigmoid filament on 2012 May 22. At the beginning of the filament eruption, the overlying coronal loop experienced a significant contraction. In the following, the filament started to rotate counterclockwise. We also carried the simulation to investigate the process of the filament eruption.

1. Introduction

The contraction of the magnetic loop associated with flares and flarelike events has been shown by a number of authors (Forbes & Acton 1996; Švestka *et al.* 1997; Liu *et al.* 2010). The shrinkage of large-scale loop without flares was also reported by Wang *et al.* (1997) using data of the Yohkoh Soft X-ray telescope. Wang *et al.* (1997) suggested that the shrinkage is not an apparent motion, but a real contraction of the coronal loops as a result of the heating at the footpoints followed by gradual cooling. Hudson (2000) suggested that a magnetic implosion at preflare energy storage must occur simultaneously with coronal events such as flares or coronal mass ejections.

2. Observation

The Atmospheric Imaging Assembly (AIA; Lemen *et al.* 2012) on board Solar Dynamics Observatory (SDO) provides multiple simultaneous high resolution full-disk images of the corona and the transition region. The observational range of the AIA can extend to 1.3 $R_\odot$. We analyzed the contraction process of the overlying coronal loop and the rotation of the filament by using the 171 Å and 304 Å images of the AIA, which have high temporal (~12 s) and spatial resolution (0.6″).

3. Result

The successive contraction of the coronal loops overlying the filament can be seen from a series of 171 Å images before the filament eruption (see the white arrows in Fig. 1). The maximum contraction speed was 45 km/s. After the contraction of the overlying coronal loops, the left part of the filament began to rotate counter-clockwise seen from the 304 Å observation (Fig. 2). Meanwhile, the counterclockwise rotation of the right foot of the filament was also observed during its eruption (Yan *et al.* 2013). We also carried out the simulation of filament eruption (Fig. 3). We started with a parameter set that is used

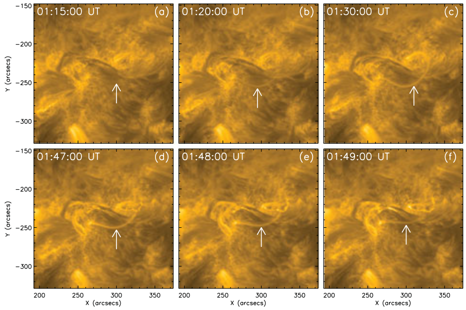

Figure 1. A sequence of images acquired at 171 Å to show the contraction process of the coronal loop overlying the sigmoid filament from 01:15:00UT to 01:49:00UT on 2012 May 22. The white arrows point to the coronal loop.

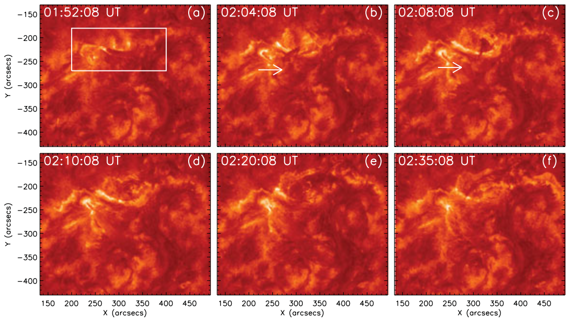

Figure 2. A sequence of images acquired at 304 Å to show the rotation process of the sigmoid filament from 01:52:08UT to 02:35:08UT on 2012 May 22. The white box and the arrows denote the filament.

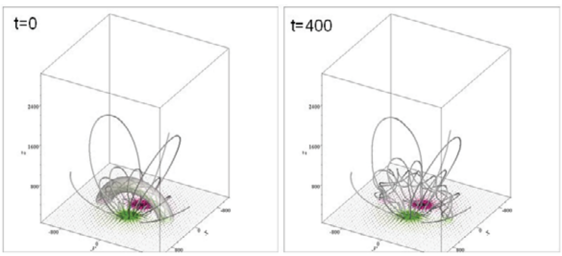

Figure 3. The 3D-MHD simulation of a filament eruption.

by Titov & Demoulin (1999). The IRVANA code was used to carry out the simulation (Ziegler 2008). At the initial phase of filament eruption, we find that the coronal loop overlying the filament began to contract due to the expansion of the filament in our simulation. During the filament eruption, the overlying coronal loops at the end of the filament present the contraction as the coronal loops start to contract toward the below of the filament.

4. Conclusion

During the filament eruption, the contraction of the overlying coronal loops and the rotation motion of the filament was observed. Through the MHD simulation of filament eruption, the contraction of overlying coronal loop is found at the initial stage of the filament eruption. We explain that the contraction of the overlying coronal loops was due to the decrease of magnetic pressure and magnetic energy release. The obvious rotation of the right foot of the filament is caused by the unwinding motion of the filament during its eruption.

Acknowledgements

SDO is a mission of NASA's Living With a Star Program. This work is supported by the National Science Foundation of China (NSFC) under grant numbers 11373066, Key Laboratory of Solar Activity of CAS under number KLSA201303.

References

Forbes T. G. 2000, *J. Geophys. Res.*, 105, 23153
Hudson, H. S. 2000, *ApJ* (Letters), 531, L75
Liu, R. & Wang, H. M. 2010, *ApJ*, 714, L41
Lemen, J. R., Title, A. M., Akin, D. J., Boerner, P. F., Chou, C., Drake, J. F., Duncan, D. W., *et al.* 2012, *Solar Phys.*, 275, 17
Švestka, Z. F., Fontenla, J. M., Machado, M. E., Martin, S. F., & Neidig, D. F. 1987, *Solar Phys.*, 108, 273
Titov, V. S. & Demoulin, P. 1999, *A&A*, 351, 707
Wang, J., Shibata, K., Nitta, N., Slater, G. L., Savy, S. K., & Ogawara, Y. 1997, *ApJ* (Letters), 478, L41
Yan, X. L., Pan, G. M., Liu, J. H., Qu, Z. Q., Xue, Z. K., *et al.* 2013, *AJ*, 145, 153
Ziegler, U. 2008, *Computer Physics Communications*, 179, 227