

DIFFERENT TYPES PROMINENCE ERUPTIONS ASSOCIATED WITH CMEs

M. DECHEV¹, K KOLEVA², P. DUCHLEV¹, Z. SIMIC³, R. CHANDRA⁴

¹Institute of Astronomy with NAO, BAS, Bulgaria

²Space Research and Technology Institute, BAS, Bulgaria

³Astronomical Observatory, Belgrade, Serbia

⁴Department of Physics, DSB Campus, Kumaun University, Nainital 263 002, India

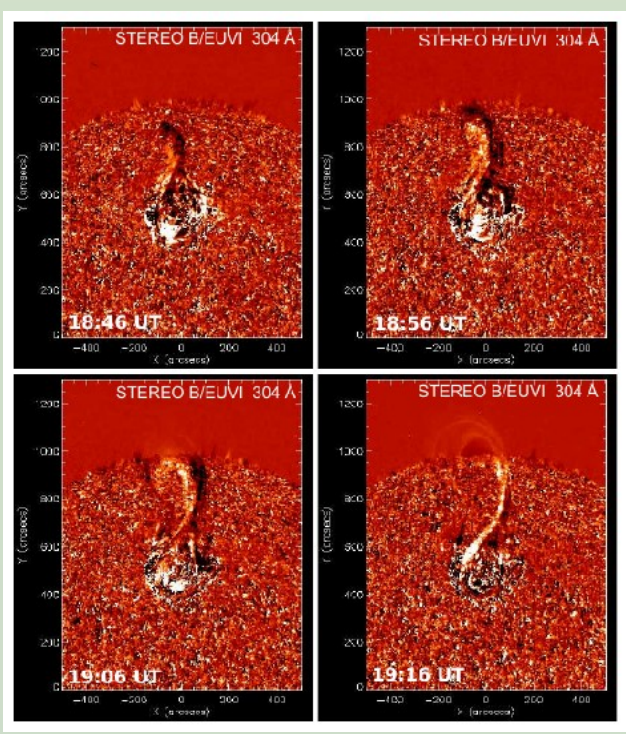
Abstract: It is commonly accepted that the prominence/filament eruptions, CMEs and flares are different manifestations of a large single magnetically driven process in the solar atmosphere. Here we focus on the prominence eruptions (PEs) and their associated CMEs in six events. The presented events differ by the type, pre-eruptive conditions and eruption evolution. We calculate kinematic parameters of the eruption and discuss magnetic properties of the region of origin as a main factor for the specific PE and CME evolution.

Prominence eruption on 2010 March 30

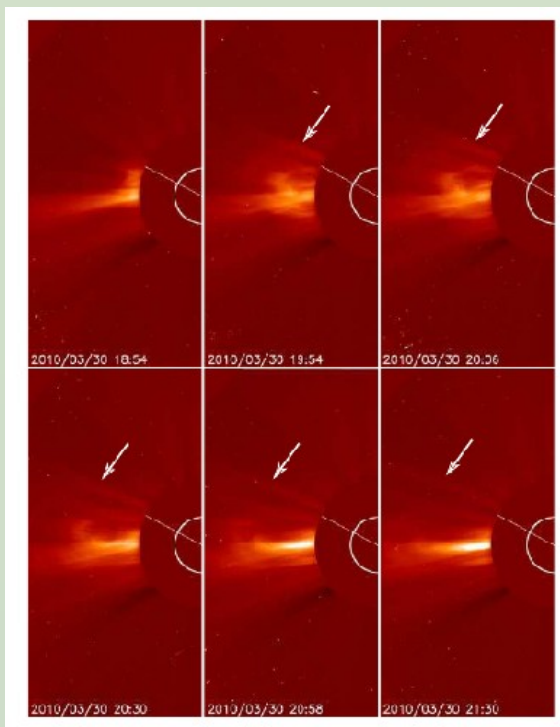
The PE north-east solar limb between 17:30 UT and 19:30 UT at a mean position angle 66° and represented a height-expanding twisted loop with legs anchored in the chromosphere.

3 phases: activation – 10km/s; acceleration – 15 to 166km/s, a – between 46 m/s² and 430 m/s²; const. Velocity – 91km/s

Reformed days after PE – failed type of eruption



Running difference images from EUVI/STEREO B in the He II 304 Å channel showing the morphology and the kink evolution of the erupting filament. Frames reproduced from Koleva et al. (2012).



SOHO/LASCO C2 registrations between 18:54 UT and 23:42 UT on 30 March 2010. The CME is first shown at 18:54 UT. The white arrows point out the narrow CME loop above the PE, which is a part of the northern CME periphery.

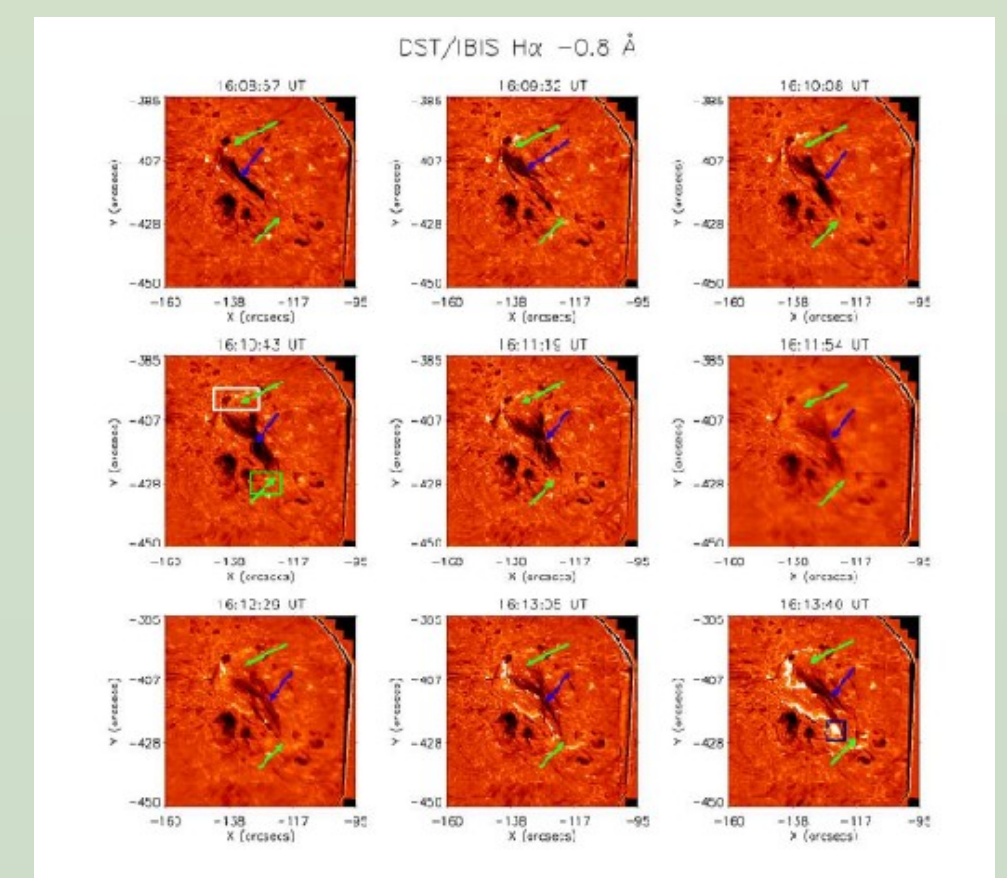
Filament eruption on 2010 November 11

Complex FE/flare/CME phenomenon. It occurred between 15:14 UT and 17:08 UT in AR NOAA 11123

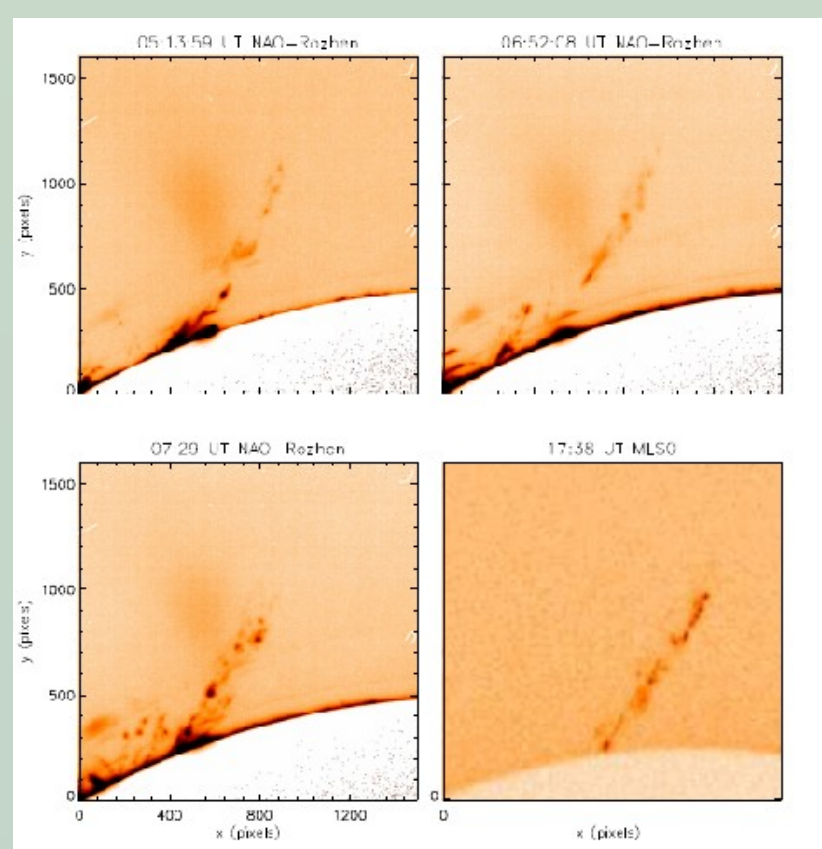
complex $\beta\gamma$ configuration that produced five GOES C-class flares, with the strongest one of class C4.7.

A surge-like event with a circular ribbon in one of the filament footpoints was determined to be the trigger of the filament destabilization.

The FE/flare event produced a relatively narrow CME (width 59° – 66°), comprising two clouds released with a time interval ~ 10 min.



Homologous prominence eruptions on 2006 August 22

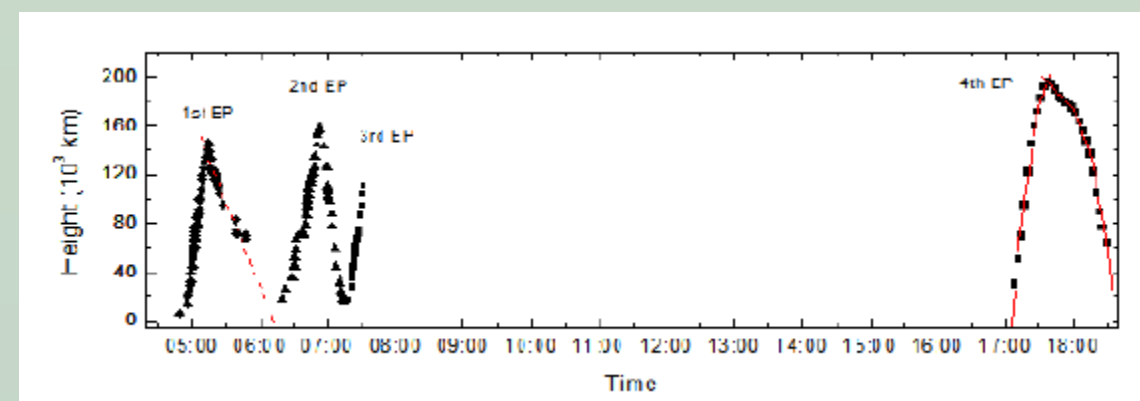


The event on 2006 August 22 presents a sequence of four homologous nonradial PEs.

AR 10904 $\beta\gamma/\beta\gamma \rightarrow \alpha/\beta$

The LASCO C2 coronagraph observed four CMEs associated with the AR 10904 events

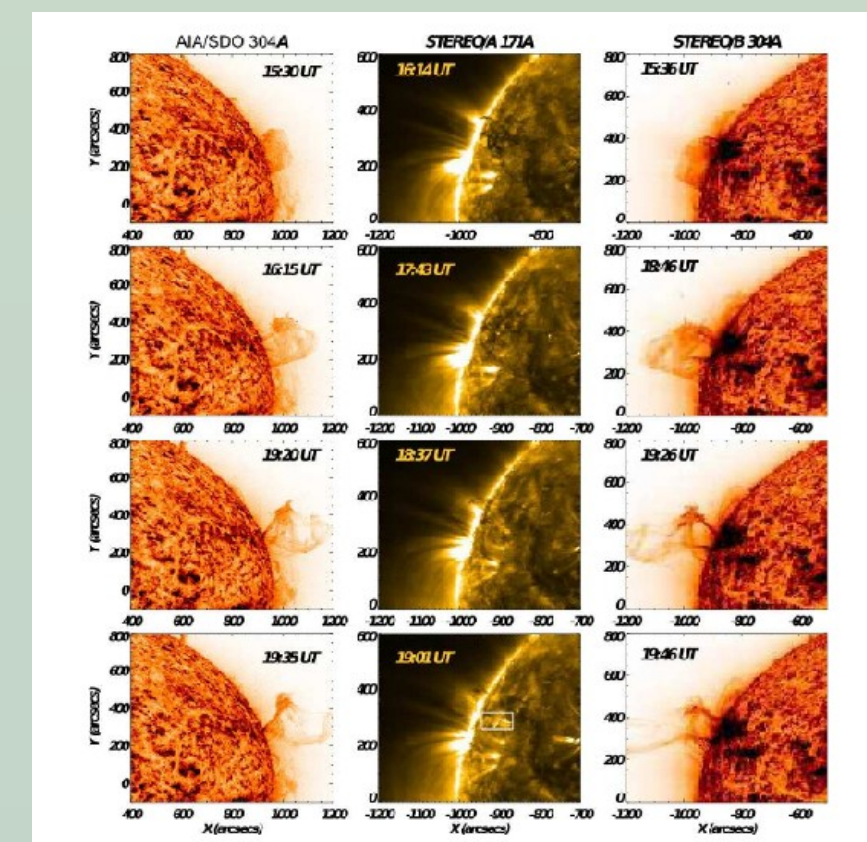
Moreover, each of these events was associated with a weak B-class flare and an interplanetary type III burst



Height-time profiles of the four homologous prominence eruptions on 22 August 2006.

Eruptions of two nearby FRs of the same prominence

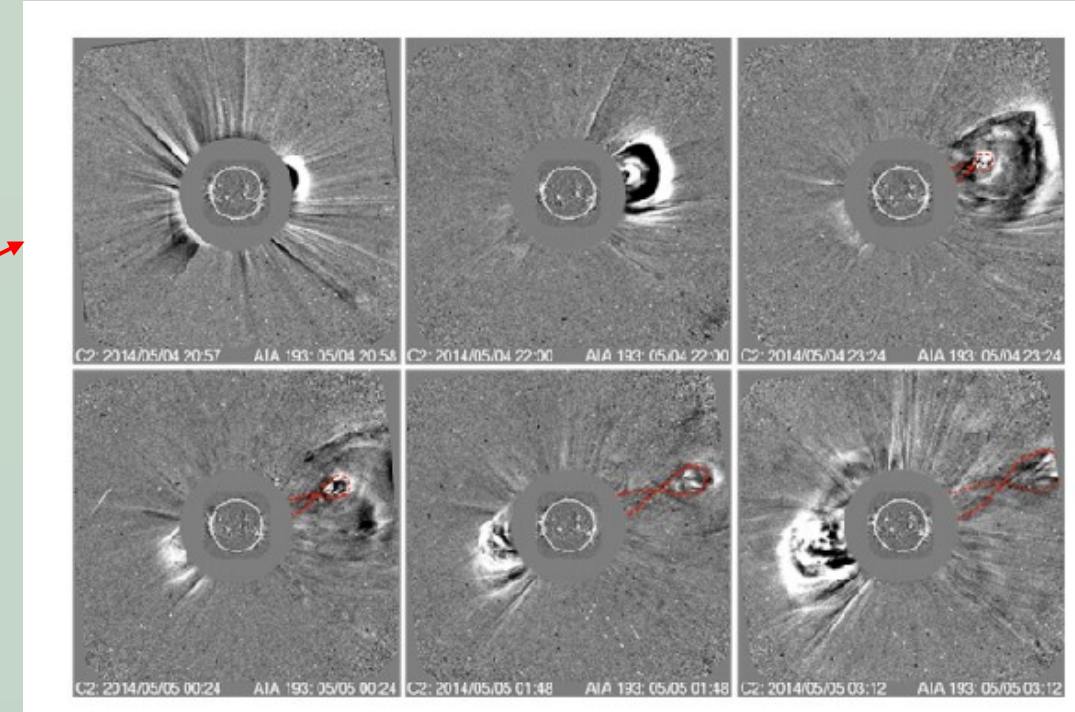
Eruptions of two coupled prominence FRs on 2014 May 4



The erupted filament part was composed of two closely coupled FRs with the same, left-handed twist: top-located compact one (FR1) and bottom-located more diffuse one (FR2).

A CME associated with the FR1 eruption was well observed by the coronagraphs of SOHO/LASCO C2 and C3.

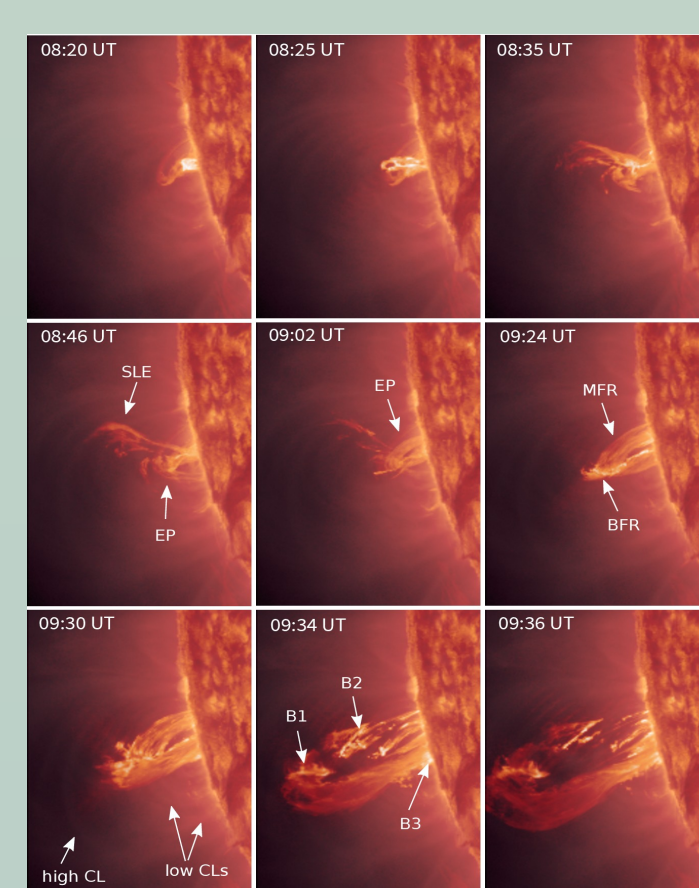
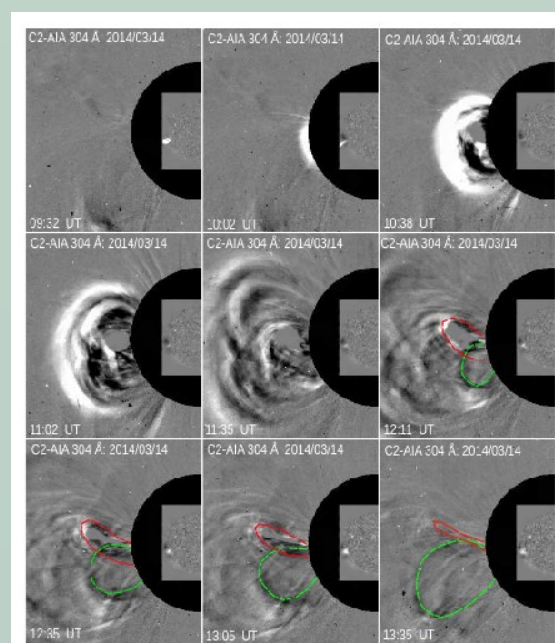
In the late PE stage, the FR1 appeared as a bright CME core.



Interaction and eruption of two nearby prominence FRs on 2014 March 14

The source of the PE was a filament located along a PIL in a young short-lived AR SPoCa: SOL2014-03-14T04:081, still in its emergence phase

A sequence of LASCO C2 and SDO/AIA 304 Å running difference images showing the progression of the 2014 March 14 prominence eruption as a bright core of partial-halo CME. The dashed lines in the last four frames trace the loops of EP FRs: green - MFR and red - BFR.



SDO/AIA 304 Å and 211 Å combined images presenting basic stages in the evolution of the EP and its coronal environment

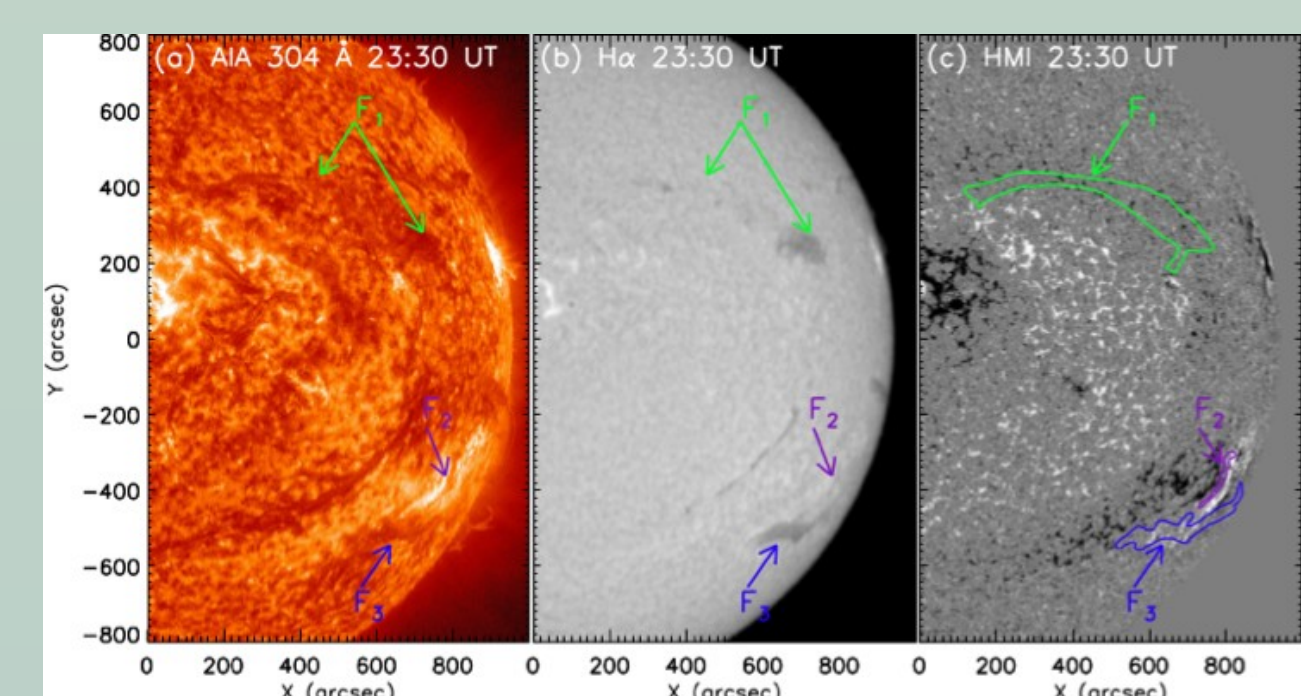
Three filaments eruptions on 19 July 2015

Three filaments eruptions on 19 July 2015 (one quiescent - F1, two active region - F2 & F3)

Data: AIA/SDO; HMI/SDO; H-alpha (GONG)

F1 - projection length ~ 450 Mm, observed from 11 to 19 July 2015

All eruptions were associated with CMEs.



F1, F2 and F3 in AIA 304 Å and Hα on 18 July 2015. The contours of 304 Å filaments F1, F2, and F3 are over-plotted over HMI magnetogram.

Summary: Three events represent an eruption of a single prominence/filament flux rope (FR). The other events present interaction and eruption of two nearby FRs of the same prominence. The six events differ from one another by the type, pre-eruption and eruption evolution of PEs and specific properties of the linked CMEs. The magnetic properties of the source region and overlying magnetic arcade as main factors for the specific physical linkage between PE and CME are discussed for the five events. Events 1 and 2 present eruptions of single loop-like FRs with legs latched in the photosphere, observed on-limb (PE) and on-disk (FE), respectively. Event 1 represents kink-induced PE appearing in a quiet region plage and in strongly asymmetric position about the overlying CME. Event 2 represents surge-triggered failed FE appearing in $\beta\gamma$ AR composed of eight sunspots, i.e. in a complex multi-flux system rich in GOES C-class flares. Event 3 presents one of the very rarely reported cases of quadruple homologous PEs. Event 4 presents a rarely reported case of slow kink-induced eruptions of two coupled FRs of the same prominence in a quiet region, which interacted during the eruption. Event 5 presents an eruption of two interacting nearby prominence FRs, which also belongs to rarely reported cases.