



The Mysterious Case of the Missing Filaments



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INTRODUCTION

Filaments are an important component of Coronal Mass Ejections (CMEs) by conveying information about the local magnetic field and play a role in their eruptions. When a CME is observed by coronagraphs, its inner core consists of a bright feature which is regarded as the same filament that erupted from the Sun. However, there are too many inconsistencies with the bright feature to believe they are actually filaments. So, what is going on? That's what we are trying to find out.

METHODS

We identified 50 "classic" three-part CMEs and searched for evidence of a filament eruption from the Sun. These were placed into categories describing their association with the CME core. The list of 50 events were sorted into categories using the following instruments and spacecraft:

- JHelioviewer
- SOHO LASCO CME Catalog < http://cdaw.gsfc.nasa.gov/CME_list/ >
- SDO AIA Filament Eruption Catalog < <http://aia.cfa.harvard.edu/filament/> >
- STEREO-A and STEREO-B, COR1, COR2

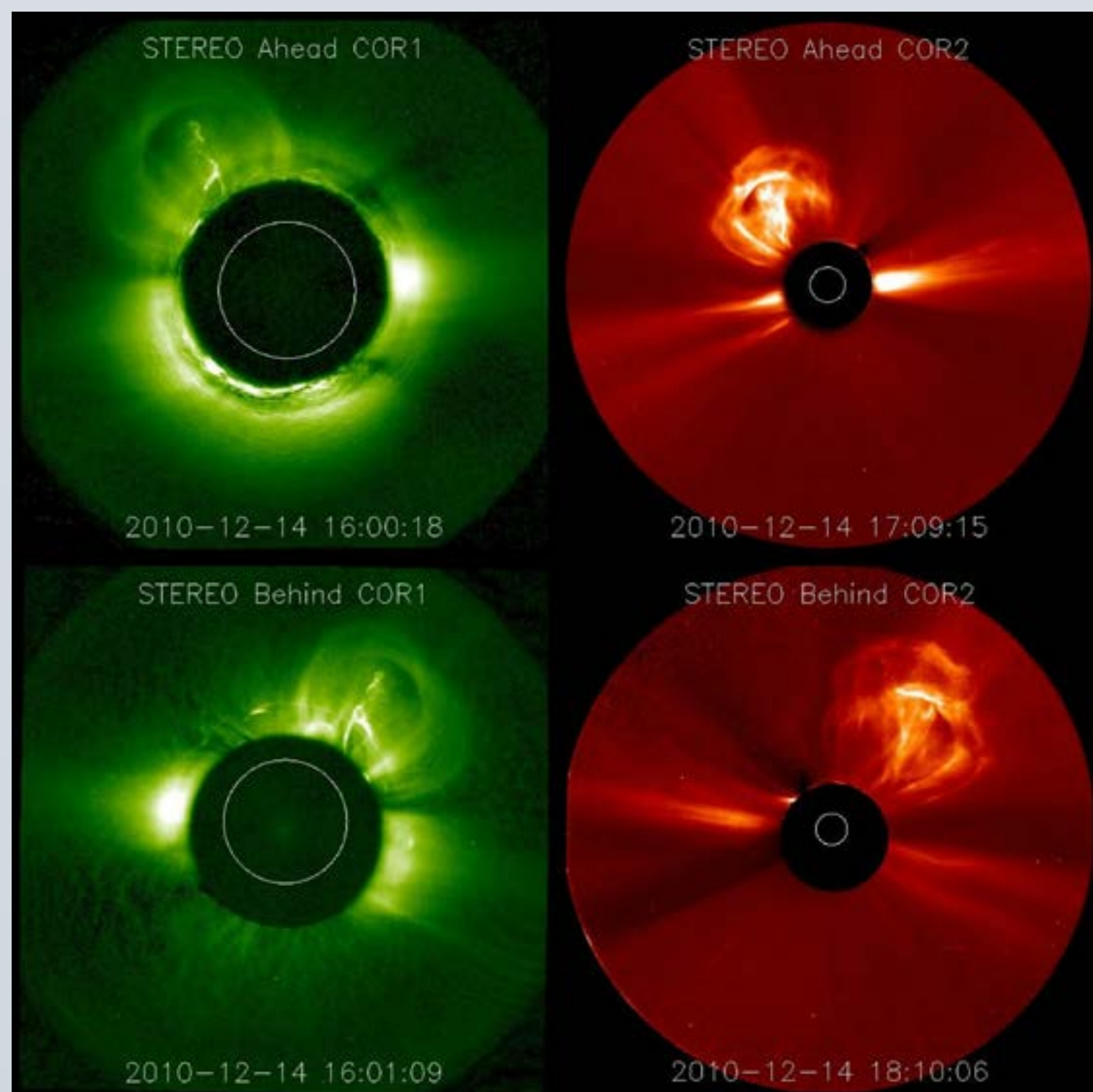
The categories are as follows:

- A: Yes, I see a filament erupt and it looks like what is in the three-part CME when it erupts
- B-D: Yes, I see a filament but it does not match in distance of where it should be within the CME when it erupts
- B-T: Yes, I see a filament erupt but it does not match the timing of where it should be within the CME when it erupts
- B-DT: Yes, I see a filament but it does not match in distance or time
- C: I do not see a filament erupt at the surface when the CME erupts

EXAMPLE OF 'A' CATEGORY

- As you can see in STEREO-A and STEREO-B COR1 the filament appears within the CME as the brightest part which you can also see in STEREO-A and STEREO-B COR2

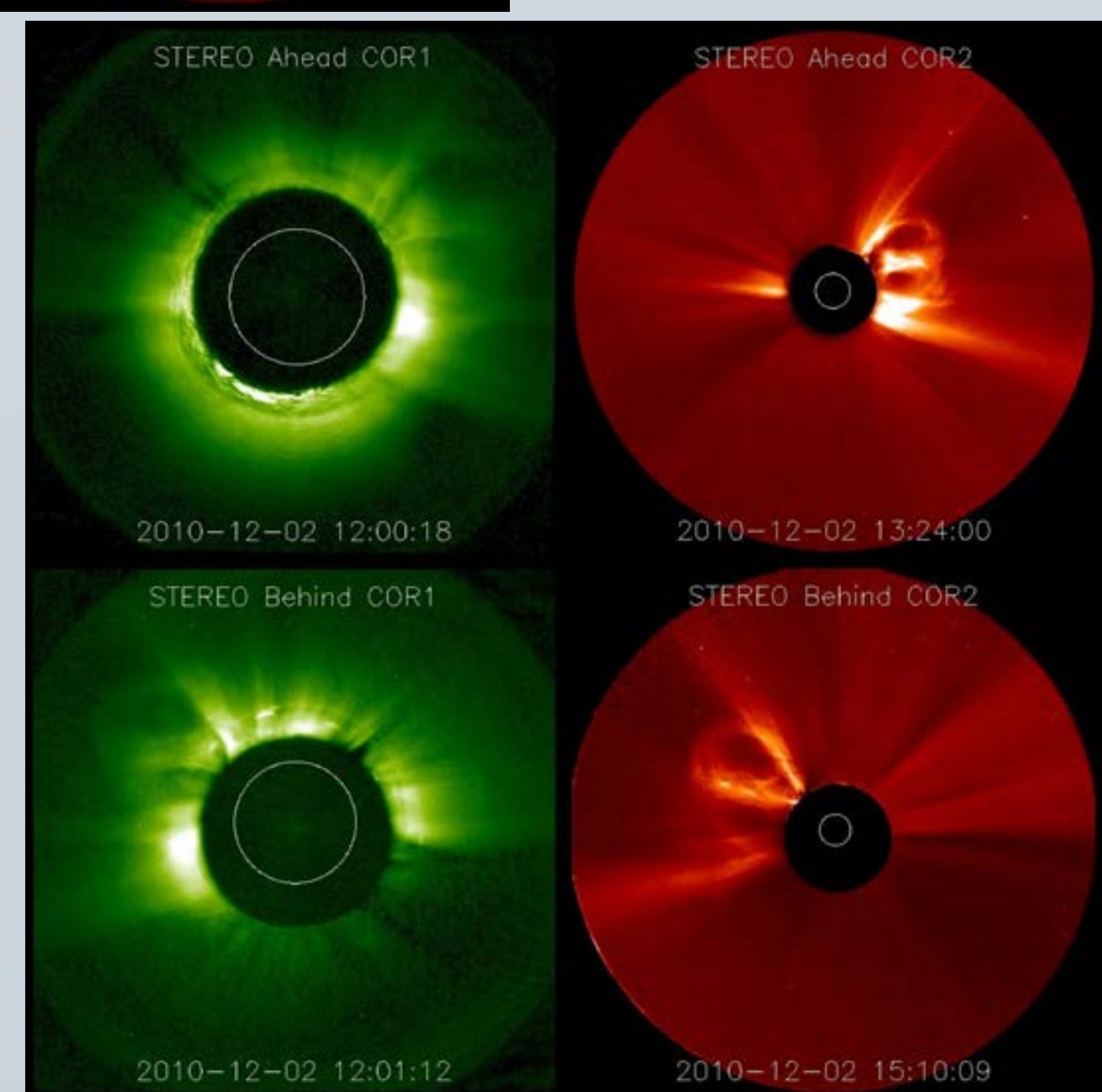
Images from 2010-12-14



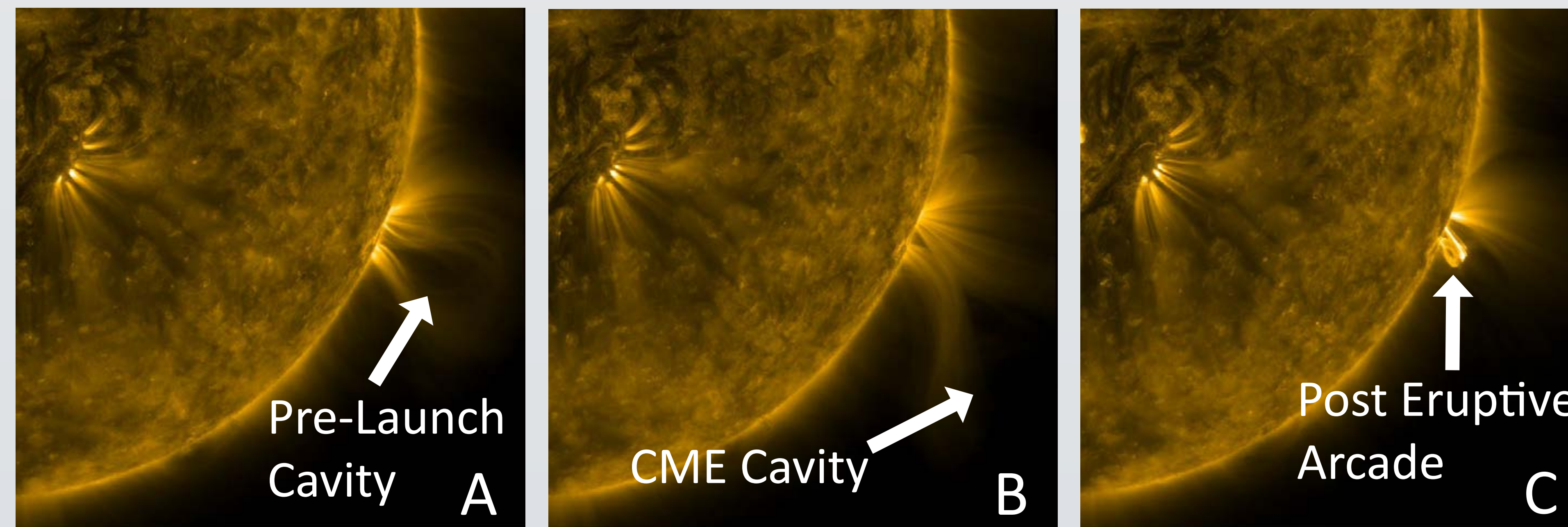
EXAMPLE OF 'C' CATEGORY

- For this example, you can see the CME clearly in STEREO-A and STEREO-B COR2, but you can not find the filament or see the filament in STEREO-A and STEREO-B COR1

Images from 2010-12-02

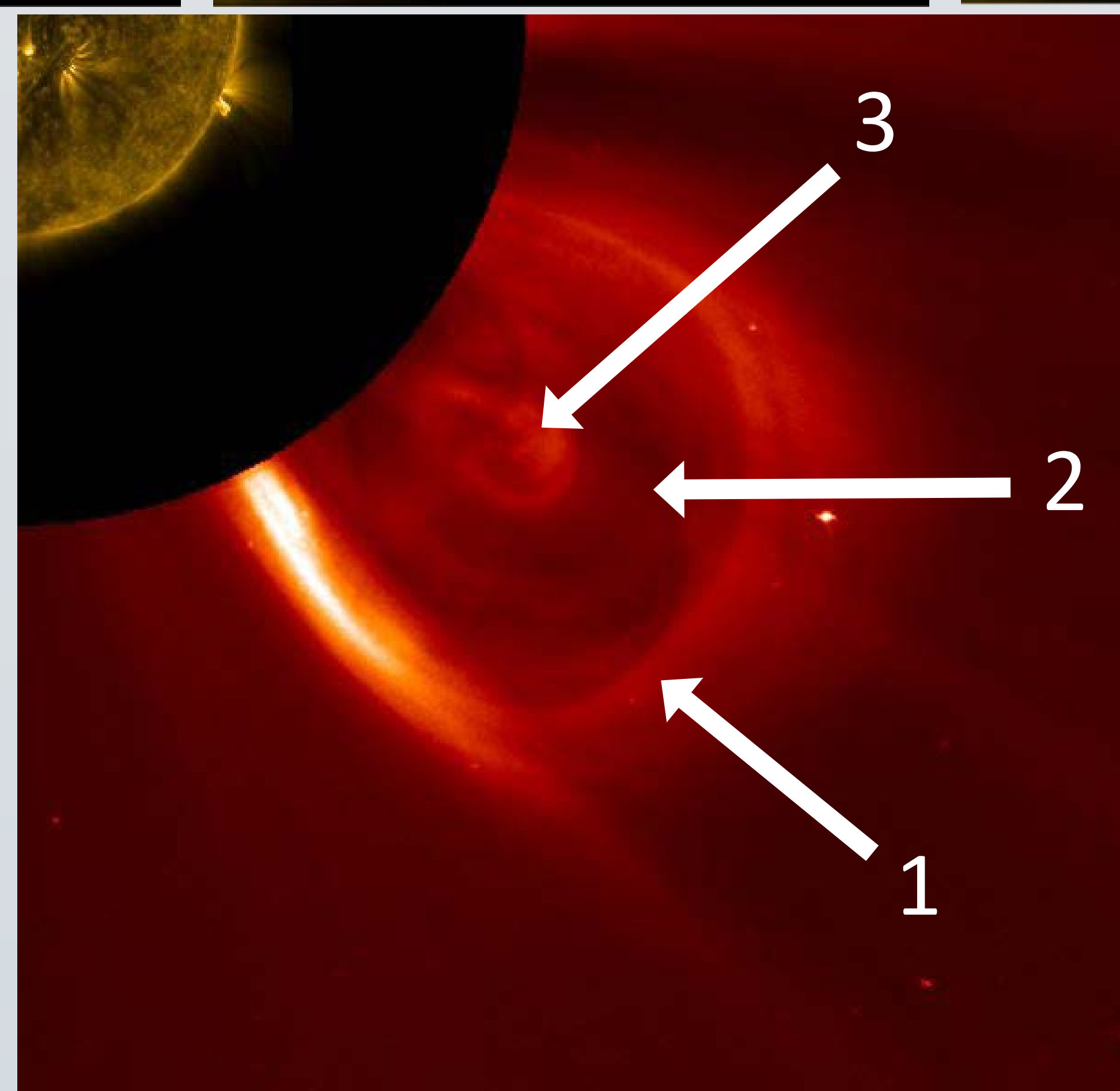


EXAMPLE OF A 'B-D' CATEGORY



1. **Leading Edge:**
This is where the coronal material piles up from the eruption.

2. **Cavity:**
This is where the flux rope is.



3. **Filament?**
This is where the supposed filament is. But if you look closer at images A, B, and C, it is not in the cavity that became the CME.

Images from 2012-01-27

CATEGORY SPREADSHEET

Out of 50 events we have:

- 16 A category events (32%)
- 3 B-D category events (6%)
- 7 B-T category events (14%)
- 4 B-DT category events (8%)
- 13 C category events (26%)
- 7 Unknown/poor data events (14%)

	DATE	TIME	AW	CATEGORY	Where is STEREO-B? (Heliocentric Distance (AU))	Angular Separation (between Earth and STEREO-B)	Where is Earth? (Heliocentric Distance (AU))	Where is STEREO-A? (Heliocentric Distance (AU))	Angular Separation (between Earth and STEREO-A)	COR1? (A)	COR1? (B)	COR1?	CME(?)
1	2010-01-05	18:30:03	112	?(not 3-part CME?)	1.038869	68.708	0.983313	0.965817	64.125	n?	?	n?	CME(A/B)
2	2010-03-14	06:06:05	77	C (blind spot?)	1.00249	71.452	0.994177	0.959709	66.237	?/n?	y (B)	y (B)	CME(B)
3	2010-04-12	03:30:05	36	?	1.000077	70.996	1.002354	0.957453	68.058	n	n?	n	CME(A)
4	2010-04-13	06:06:05	55	A?	1.000186	70.969	1.002671	0.957387	68.14	y (A)	y (B)	y (AB)	CME(A/B)
5	2010-05-02	19:30:05	64	A	1.004508	70.447	1.007891	0.956535	69.715	n?	n	n	CME(B)
6	2010-06-12	09:54:57	76	B-T	1.025285	69.772	1.015491	0.956919	73.555	n?	n	n	CME(A/B)
7	2010-07-03	09:32:23	121	B-T?	1.039565	69.99	1.016679	0.958202	75.657	n	n	n	CME(A/B)
8	2010-07-10	08:30:05	100	B-T?	1.039535	70.18	1.016678	0.958198	76.342	?	n?	n?	CME(A)
9	2010-07-28	14:54:06	69	A	1.056841	70.973	1.015374	0.960412	78.084	n?	n	n	CME(A)
10	2010-08-15	06:24:05	61	B-T?	1.06761	72.156	1.012831	0.962158	79.634	?	n	n	CME(B)

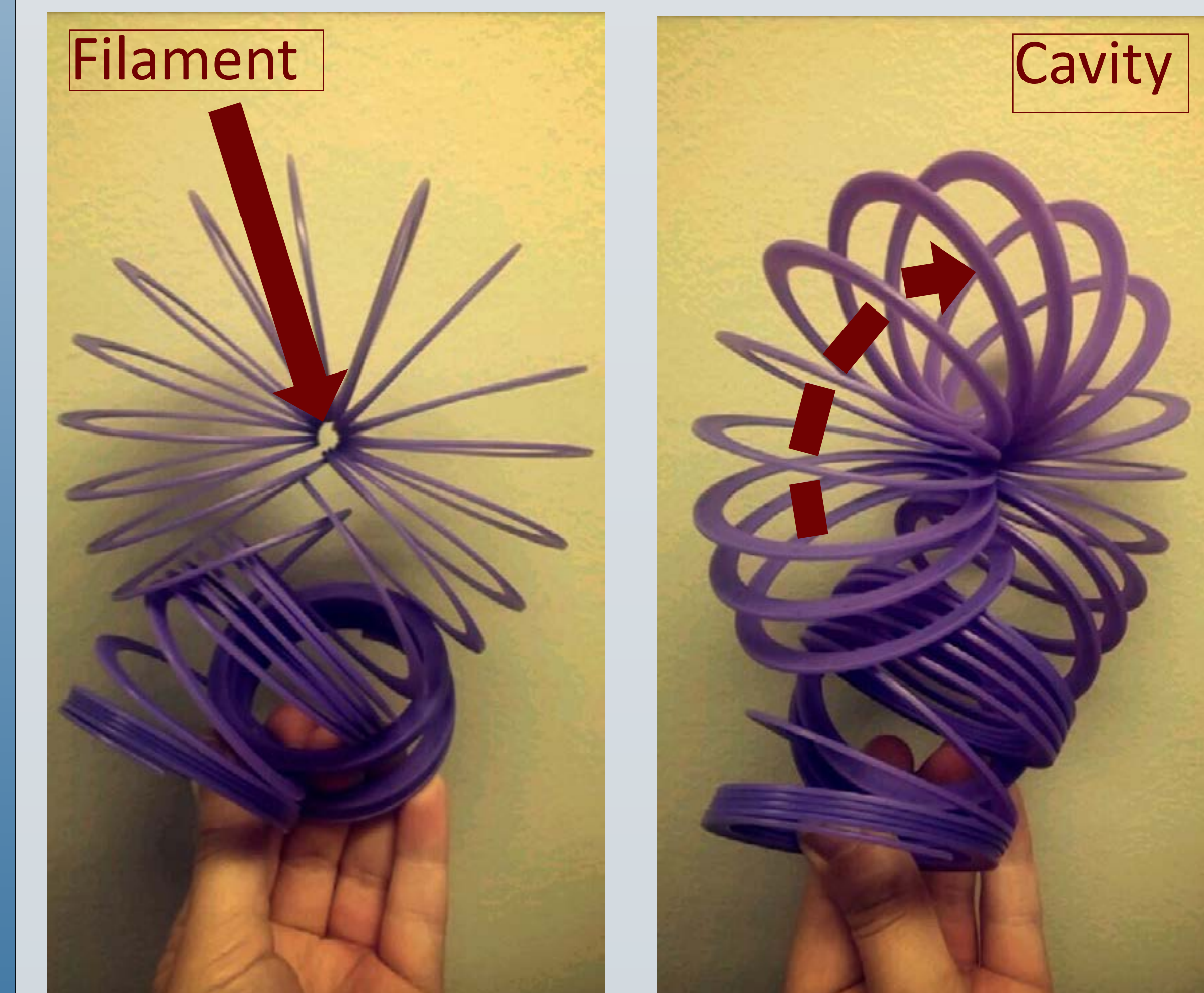
RESULTS

- Solar filaments are not always within three-part CMEs
- For 13 events, we found that our three-part CME was not associated with any eruptive filament at the Sun
- We have found 14 cases where this is possibly true if we can prove the filament is not within the CME seen in the SOHO LASCO coronagraph
- We have also found 16 cases where the filament is within the CME seen in the SOHO LASCO coronagraph
- The inconsistencies with these filaments suggest that what we believe we see is not always the case when looking closer to the Sun's surface

DISCUSSION

If the central core of a three-part CME is not a filament, then what is it?

- One possibility we are exploring is of an optical illusion (a mathematical caustic) caused by a twisted flux rope. This might create the appearance of a bright central core
- Below is an example using a slinky spring to illustrate this possibility



FUTURE WORK

- Look at kinematic properties [height-time, speed]
- Comparison of geometric structure
- Polarization properties [looking for evidence of H-alpha]

ACKNOWLEDGMENTS

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