

# **The Coronal-Dimming Footprint of a Streamer-Puff Coronal Mass Ejection: Confirmation of the Magnetic-Arch-Blowout Scenario**

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**A Synopsis of the paper of the same title and authors  
published in the May 20, 2007 issue of ApJ, volume 661, page 543**

# ABSTRACT

A streamer puff is a recently identified variety of coronal mass ejection (CME) of narrow to moderate width. It (1) travels out along a streamer, transiently inflating the streamer but leaving it largely intact, and (2) occurs in step with a compact ejective flare in an outer flank of the base of the streamer. These aspects suggest the following magnetic-arch-blowout scenario for the production of these CMEs: the magnetic explosion that produces the flare also produces a plasmoid that explodes up the leg of an outer loop of the arcade base of the streamer, blows out the top of this loop, and becomes the core of the CME. In this paper, we present a streamer-puff CME that produced a coronal-dimming footprint. The coronal dimming, its magnetic setting, and the timing and magnetic setting of a strong compact ejective flare within the dimming footprint nicely confirm the magnetic-arch-blowout scenario. From these observations, together with several published cases of a trans-equatorial CME produced in tandem with an ejective flare or filament eruption that was far offset from directly under the CME, we propose the following. Streamer-puff CMEs are a subclass (one variety) of a broader class of “over-and-out” CMEs that are often much larger than streamer puffs but are similar to them in that they are produced by the blowout of a large quasi-potential magnetic arch by a magnetic explosion that erupts from one foot of the large arch, where it is marked by a filament eruption and/or an ejective flare.

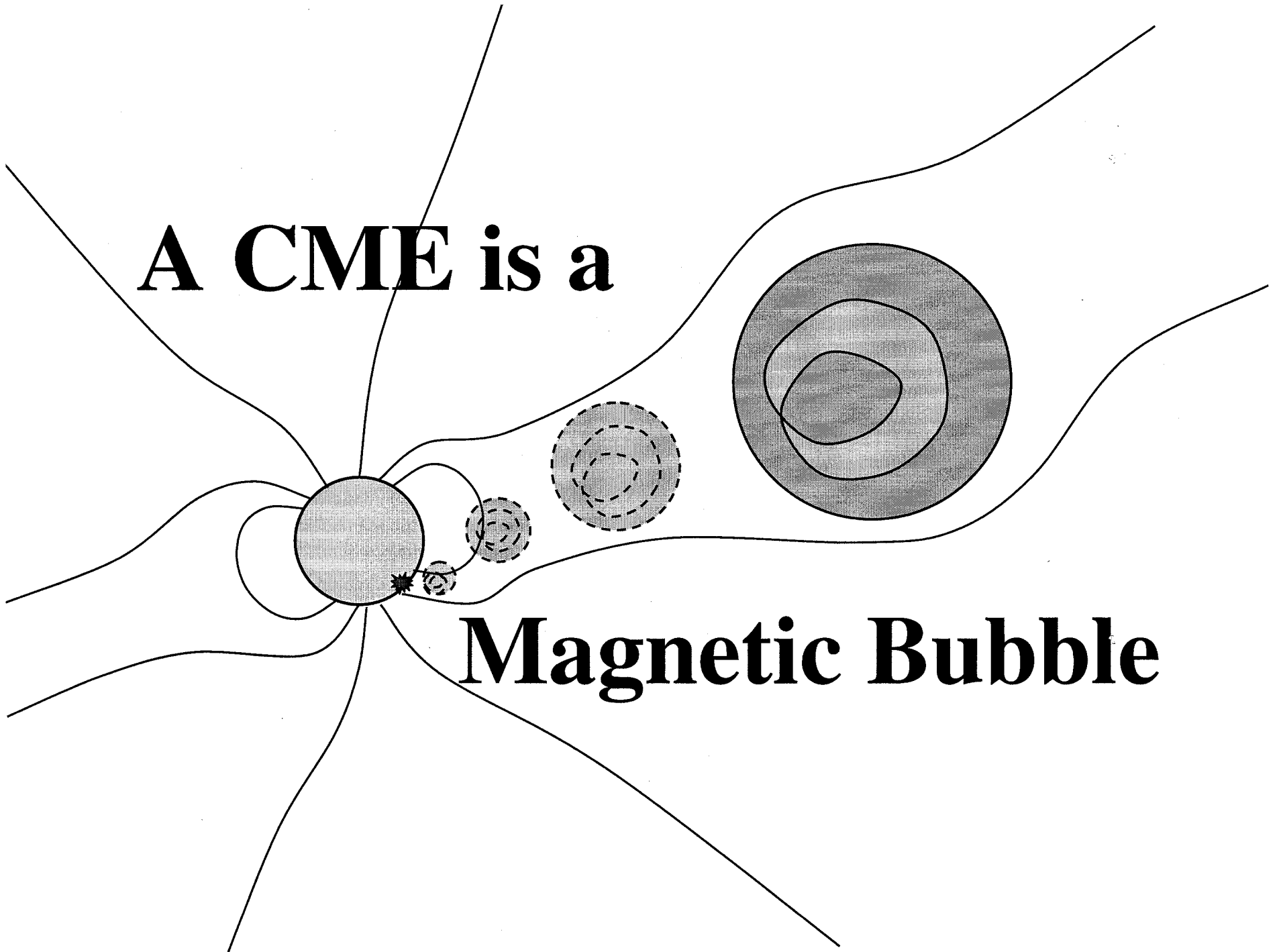
This work was funded by the Heliophysics Division of NASA’s Science Mission Directorate.

# MAIN POINTS

- **An over-and-out CME is any CME that in the outer corona is noticeably laterally far offset from the source of its driving magnetic explosion.**
- **A streamer-puff CME is one kind of over-and-out CME.**
- **Streamer-puff CMEs and many larger over-and-out CMEs fit the magnetic-arch-blowout scenario: each is produced by the blowout of a large magnetic arch by a plasmoid that explodes from an ejective flare in one foot of the arch.**
- **Whether or not it is an over-and-out CME, any major CME is basically a plasmoid (a magnetic bubble) that explodes from a sheared-core magnetic arcade and that is driven by the pressure of its own magnetic field.**

**A CME is a**

**Magnetic Bubble**



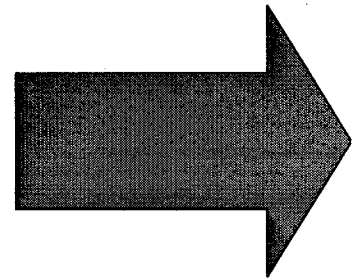


**Streamer-puff CMEs**

**discovered by**

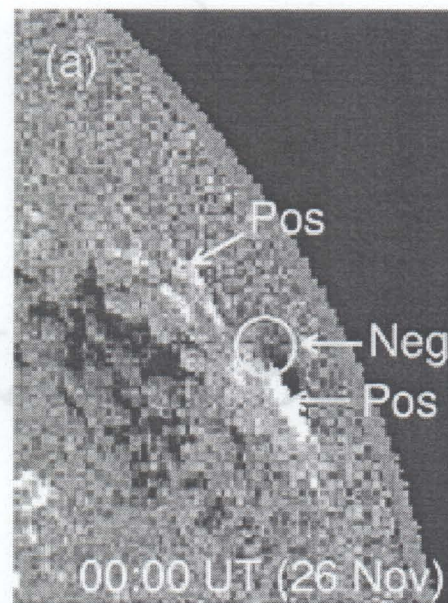
**Bemporad et al**

**(2005, ApJ, 635, L189)**

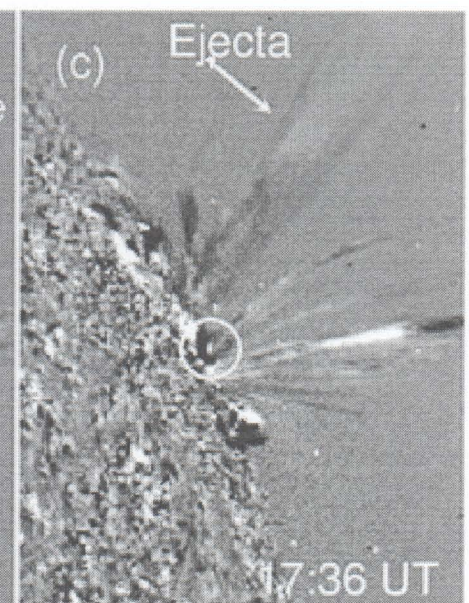
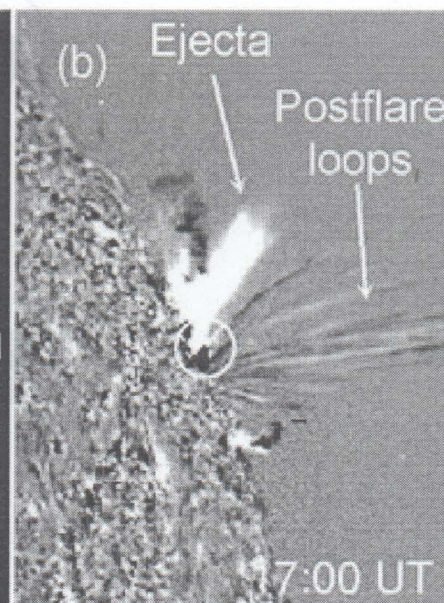


# Example Event 2002 Nov 27

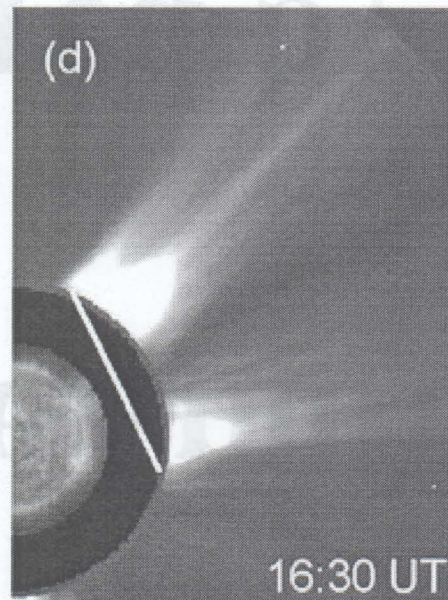
Magnetogram



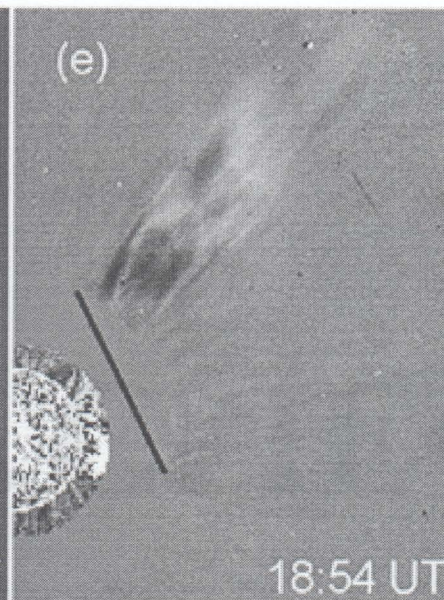
EIT He II  $\lambda 304$  Å difference images



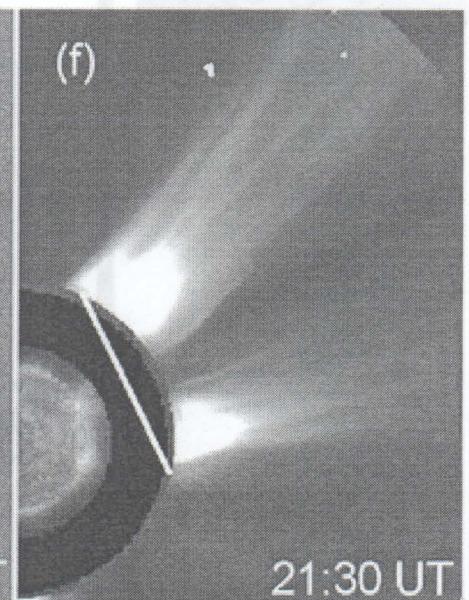
LASCO/C2



difference image

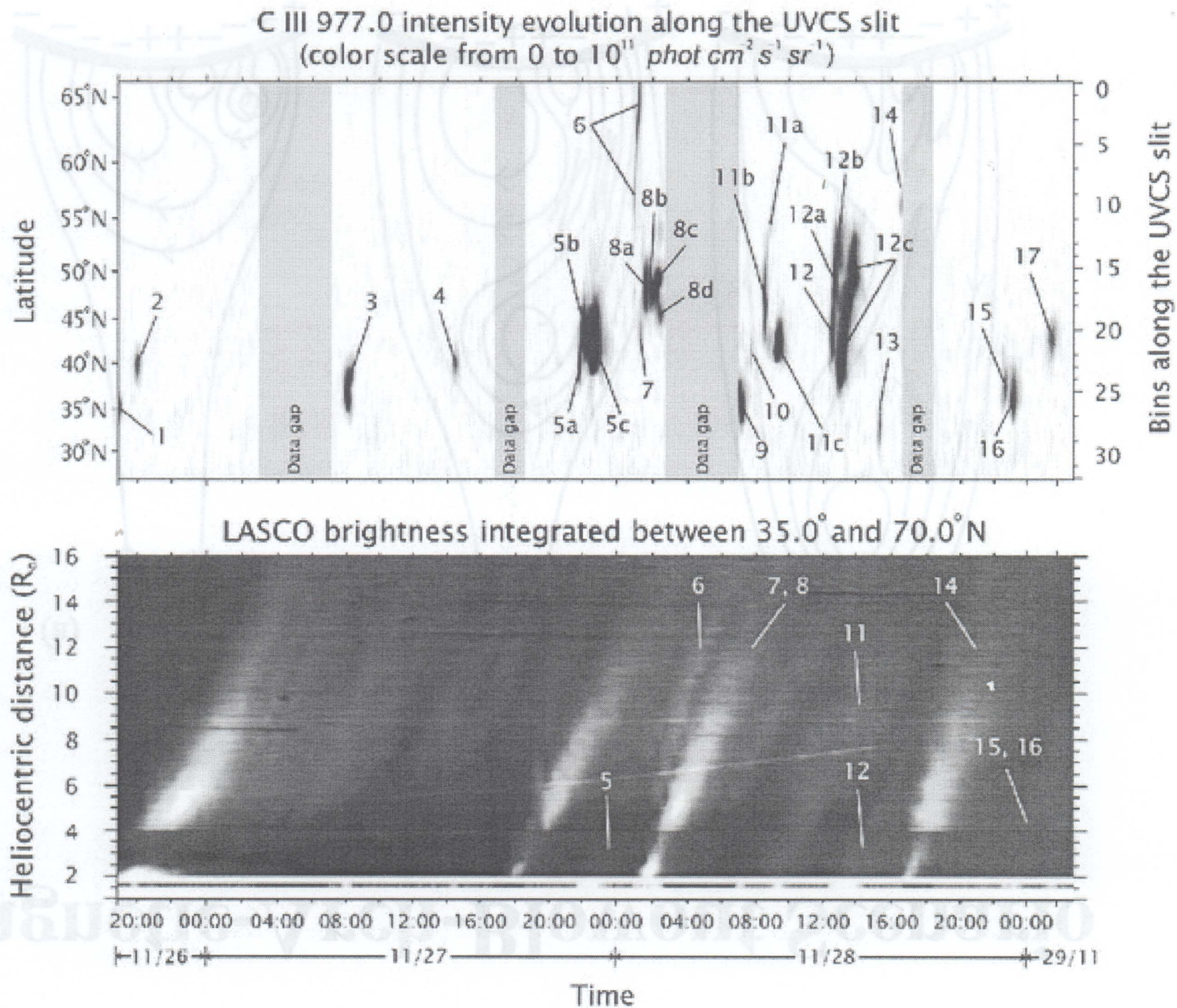


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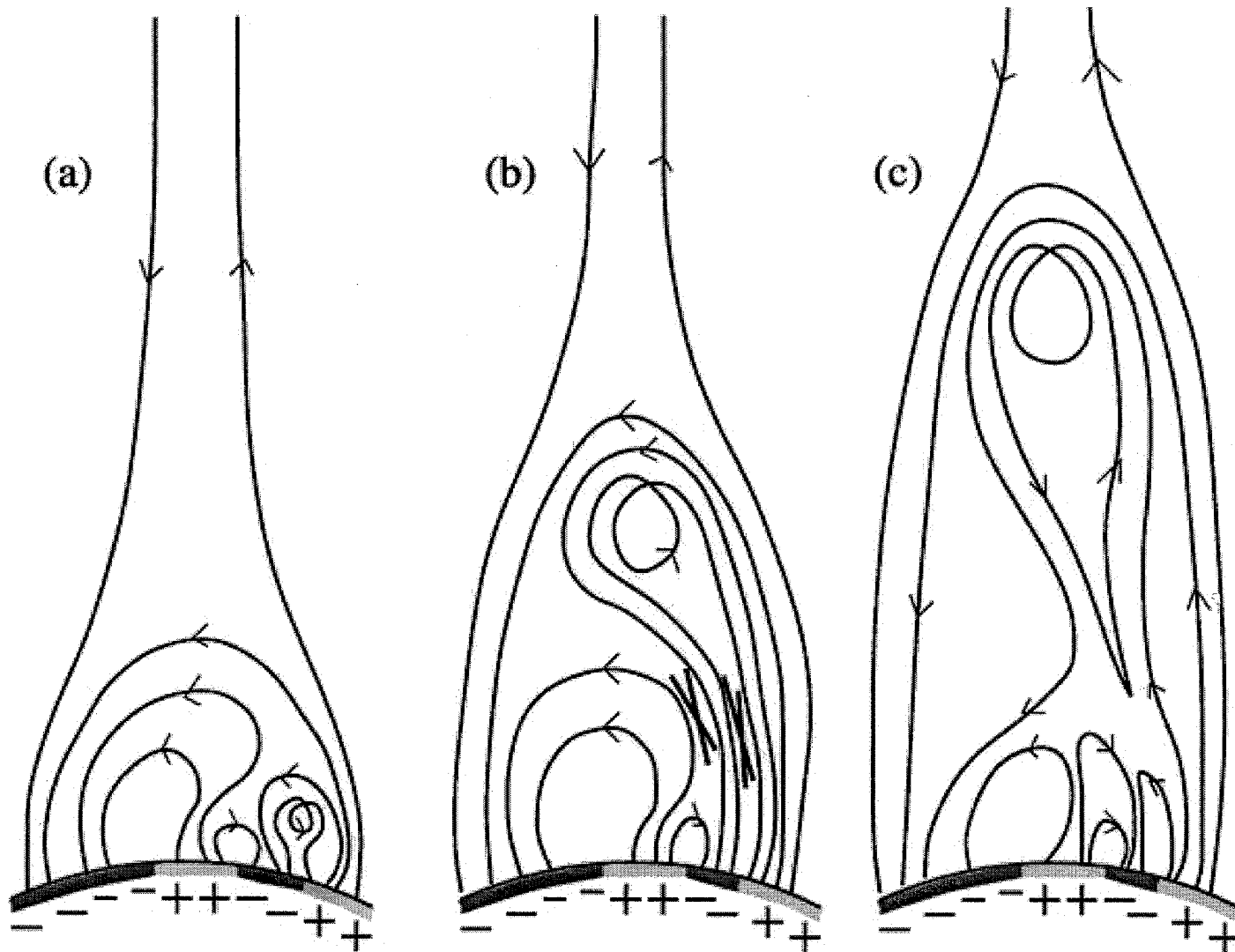




# Homologous Sequence of Puffs



# Magnetic-Arch-Blowout Scenario

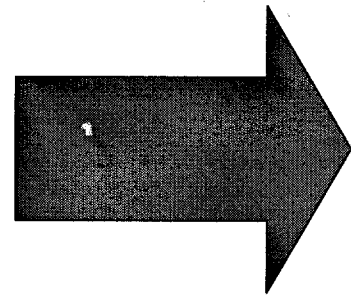


**Rosetta-stone**

**streamer-puff CME**

**found by us**

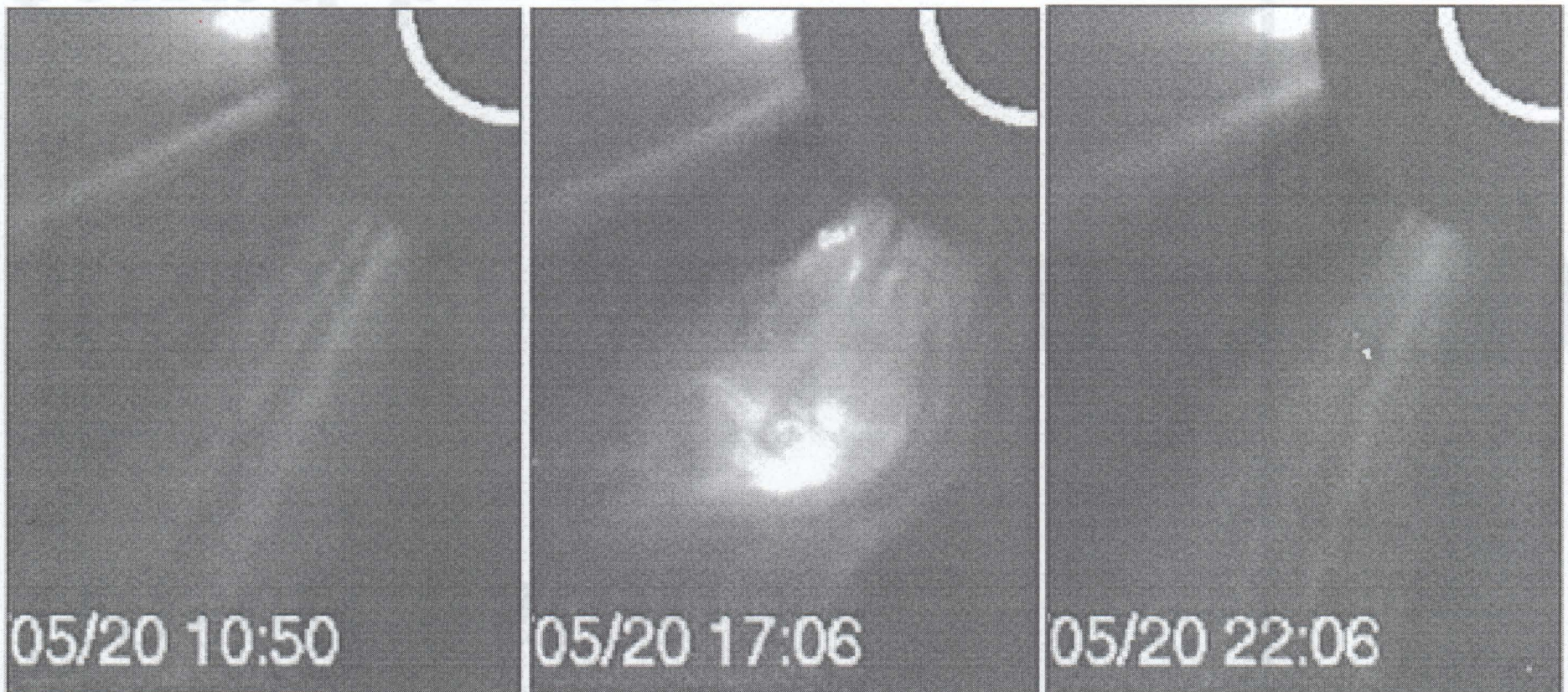
**(Moore & Sterling 2007,  
ApJ, 661, 543)**





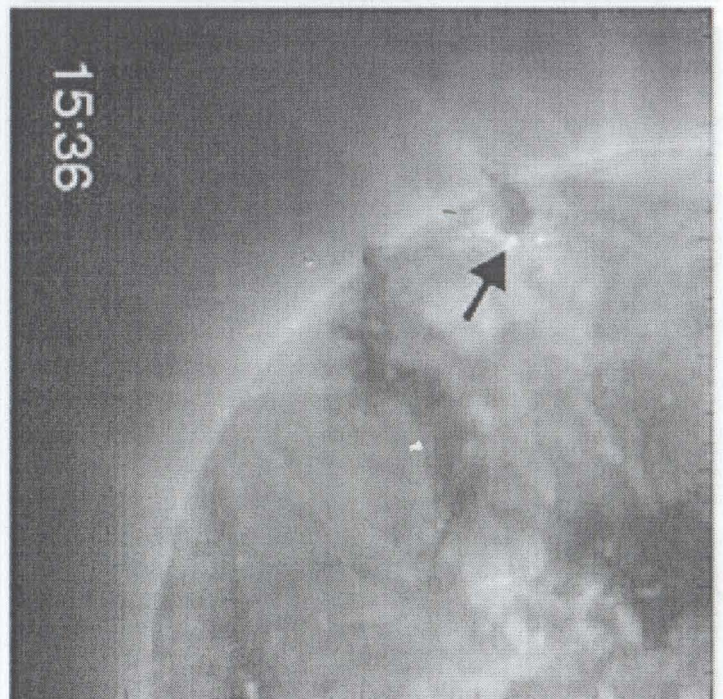
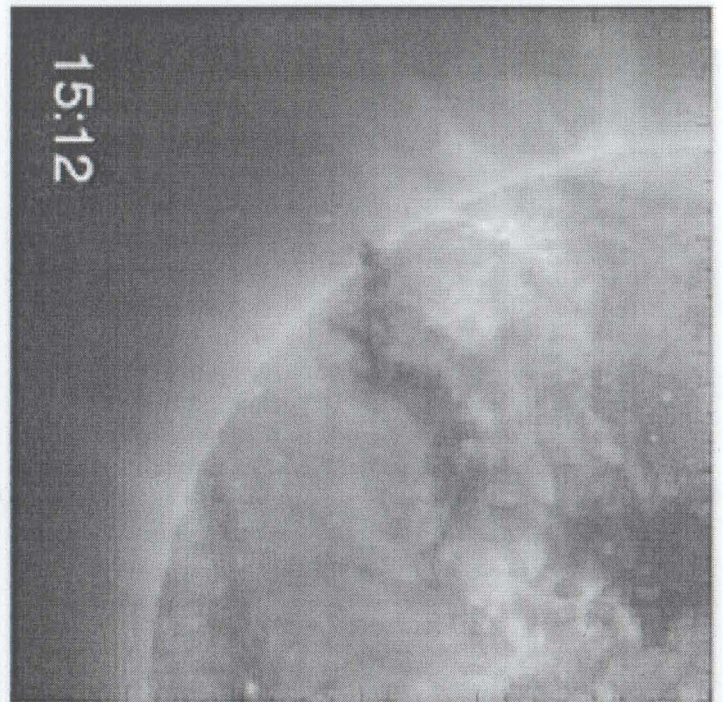
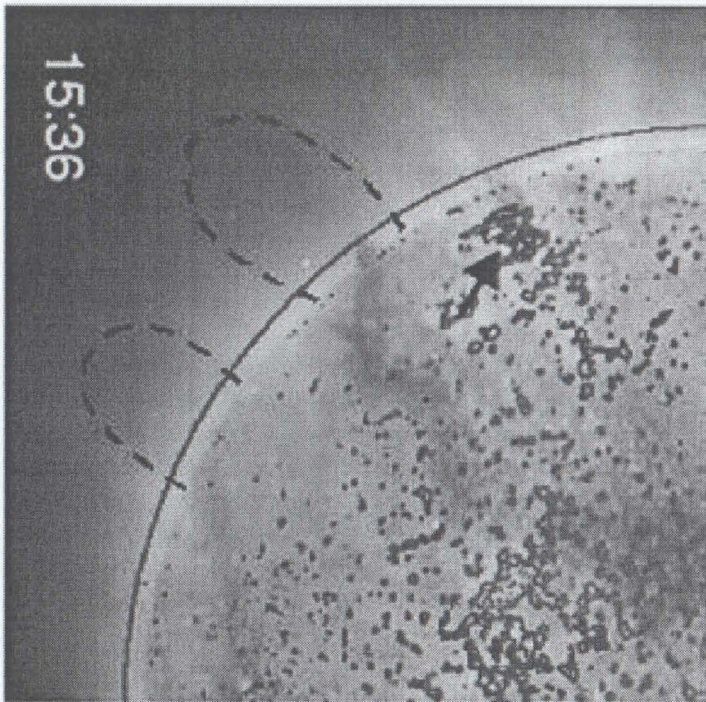
# Streamer and Large Streamer-Puff CME

2002 May 20  
(from LASCO/C2)



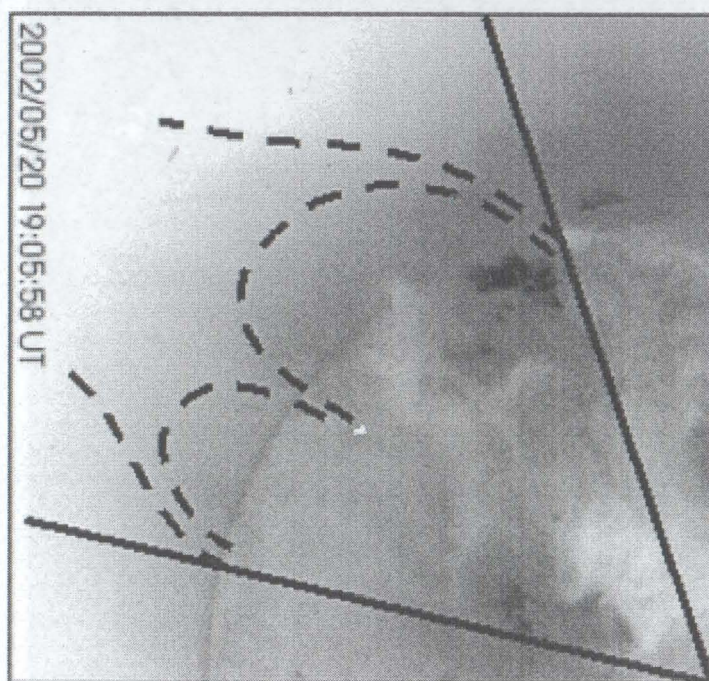
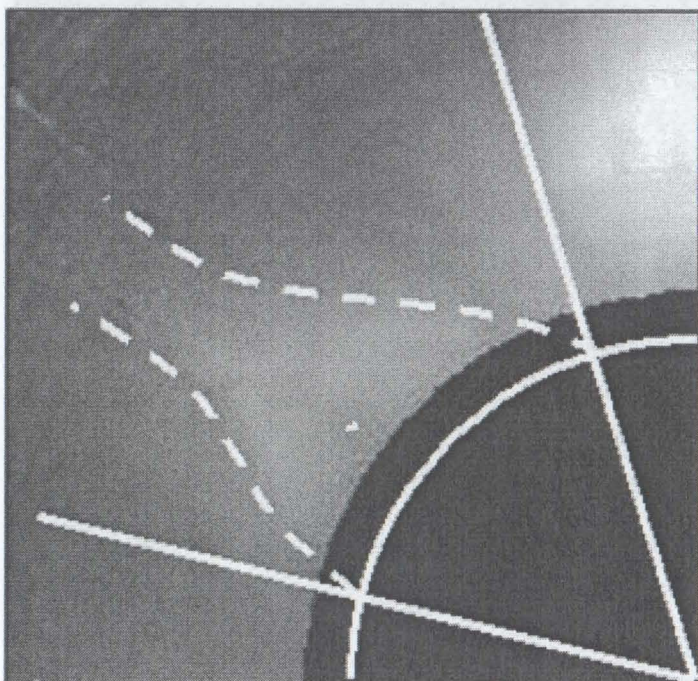
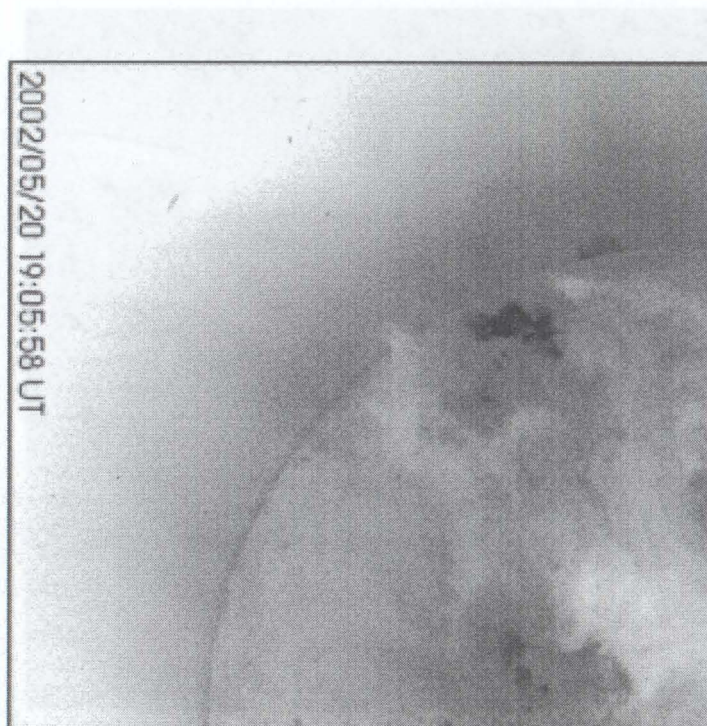
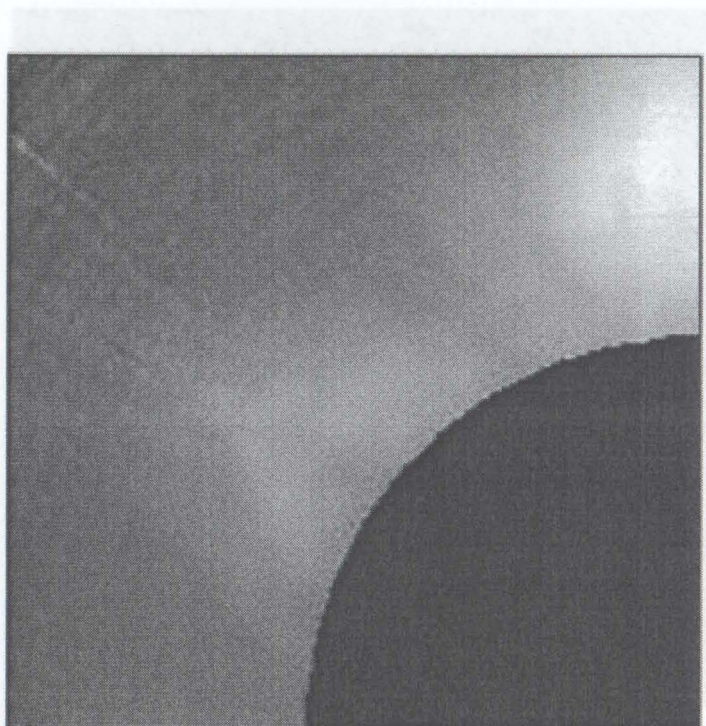


# Compact Ejective X-class Flare, CME's Coronal-Dimming Footprint, and their Magnetic Setting (from EIT/Fe XII and MDI)



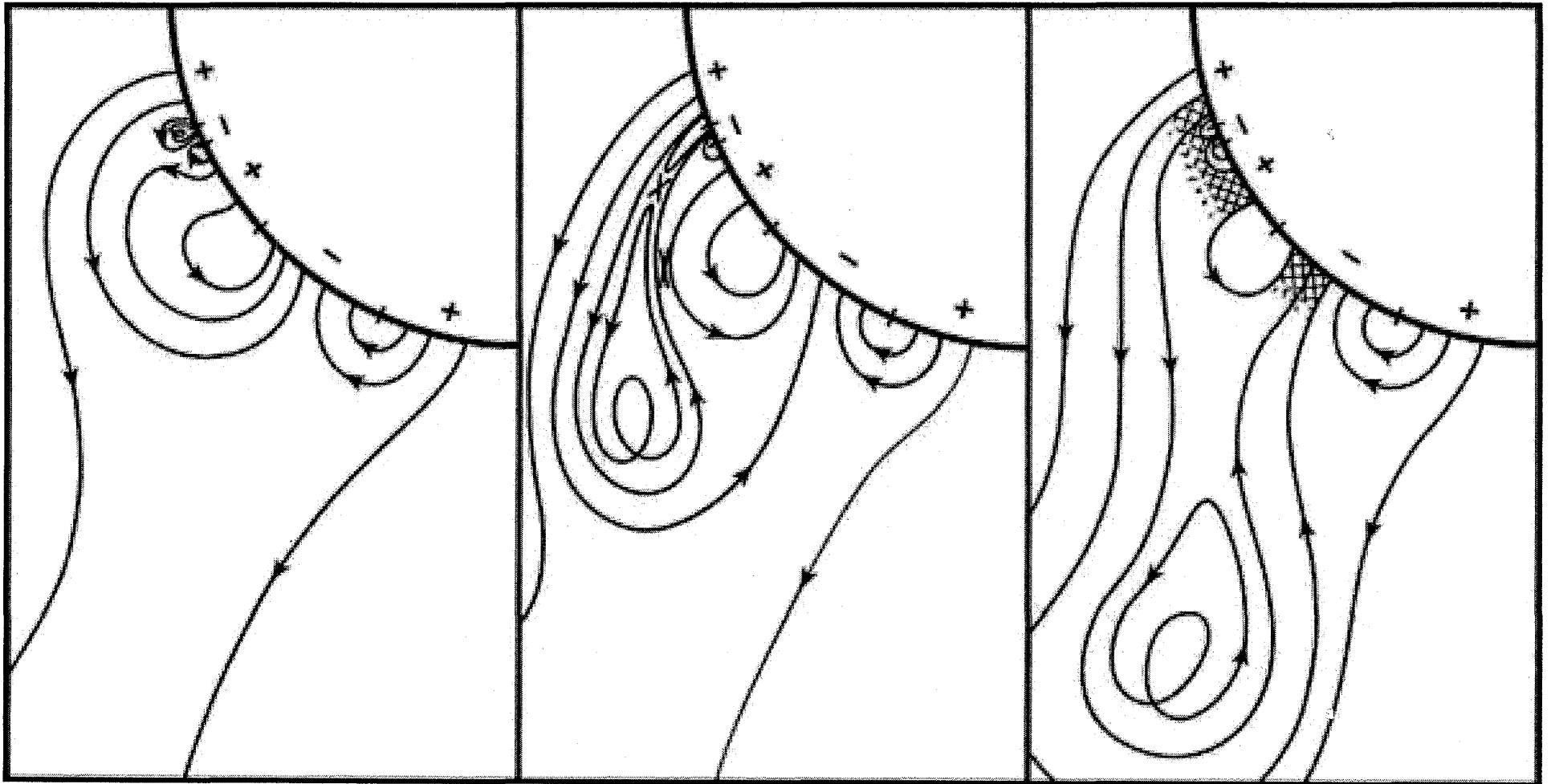


# Span and Double-Arcade Composition of Base of (Pseudo) Streamer (from EIT/Fe XV and MLSO Mark-4)

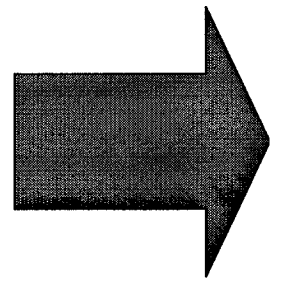




# **Magnetic-Arch-Blowout Scenario for Production of the 2002 May 20 Streamer-Puff CME and the Coronal Dimming at its Feet**

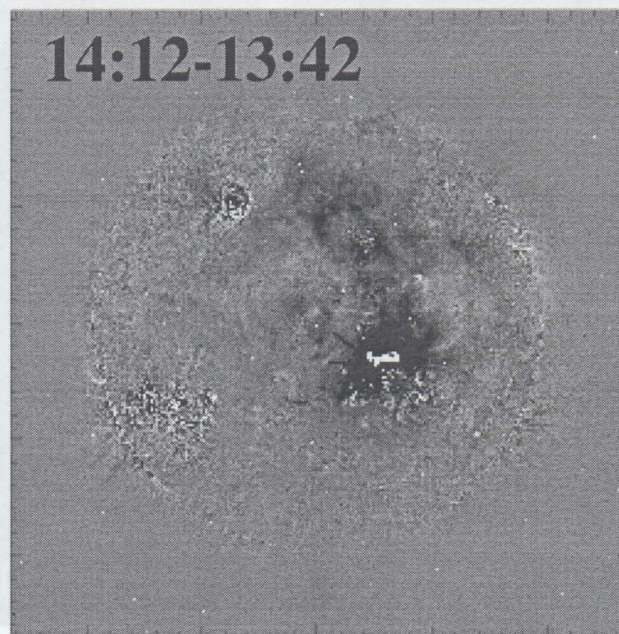
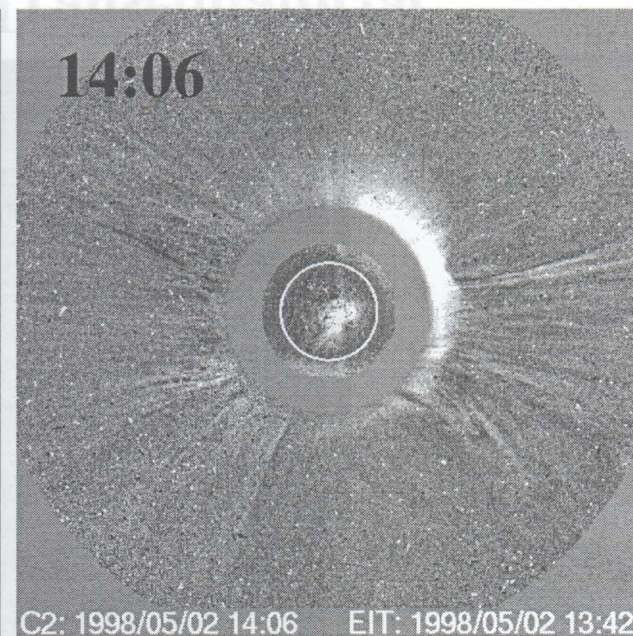
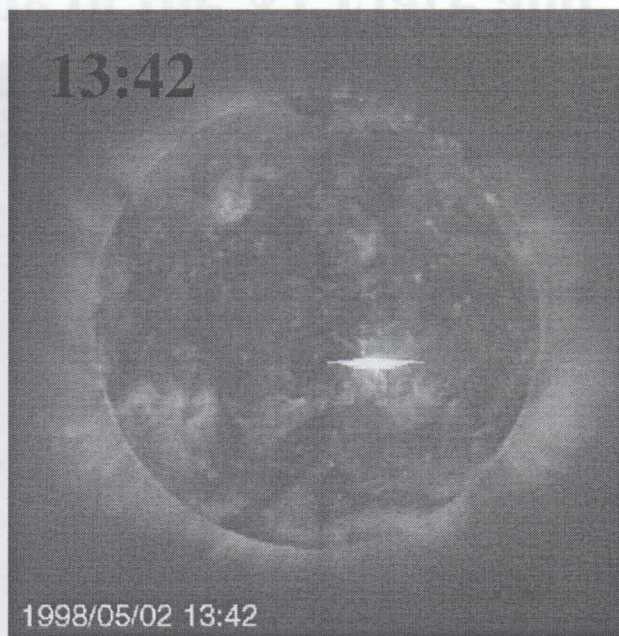


**Sequence of large  
trans-equatorial CMEs  
that occurred together  
with major ejective  
flares seated S15° in  
north side of AR 8210**



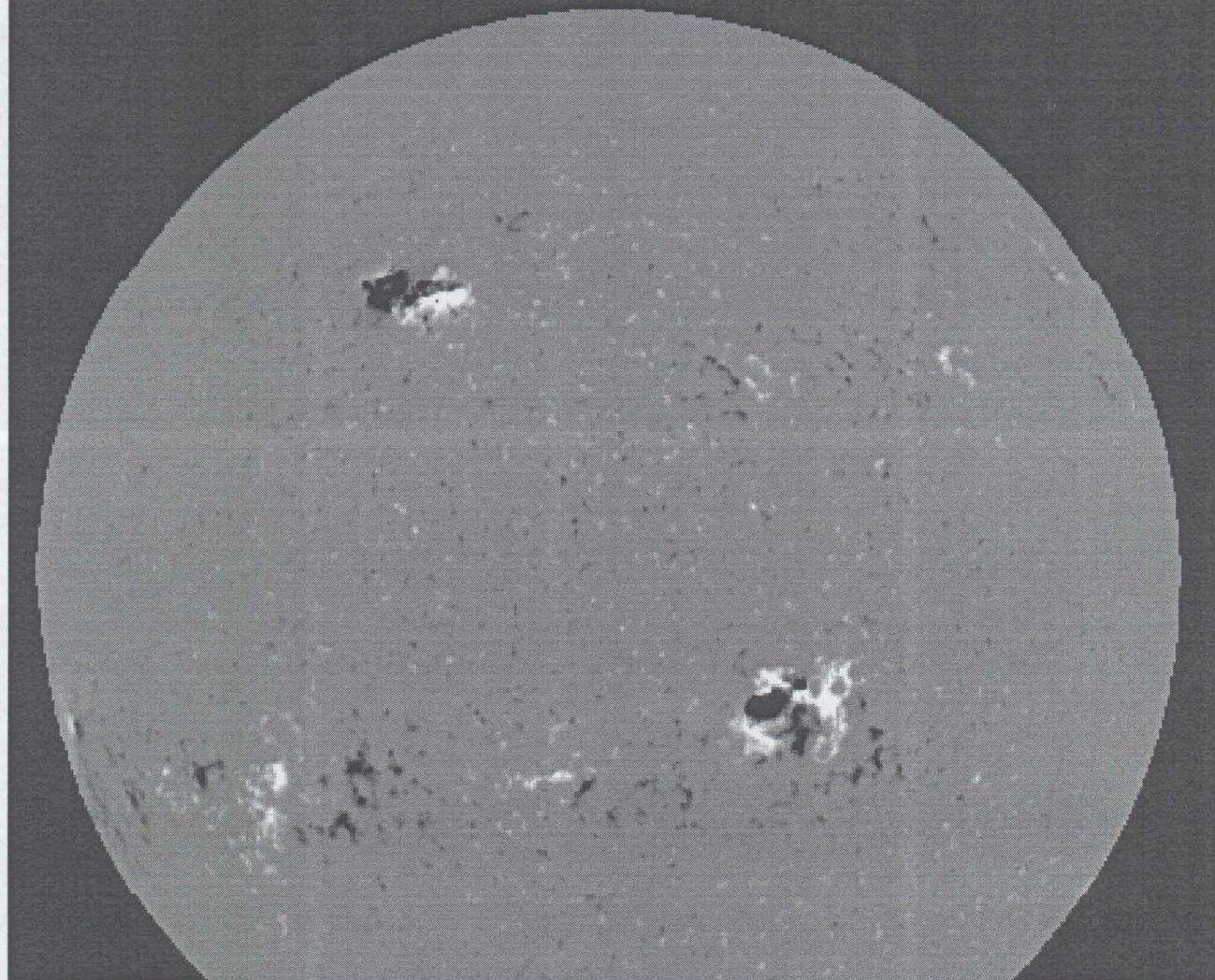


# X1 Flare, Trans-Equator Coronal Dimming, and NW Halo CME 1998 May 2





Nat. Solar Obs. at Kitt Peak, Magnetogram, synoptic map  
May 02, 1998 at 17:45

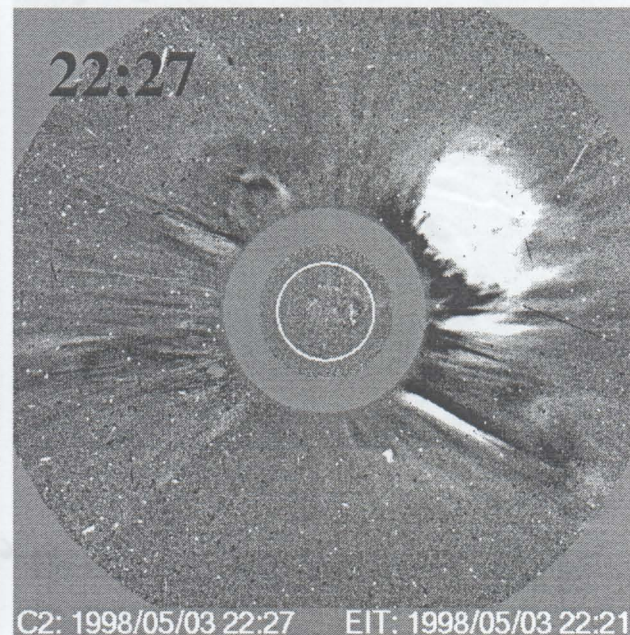
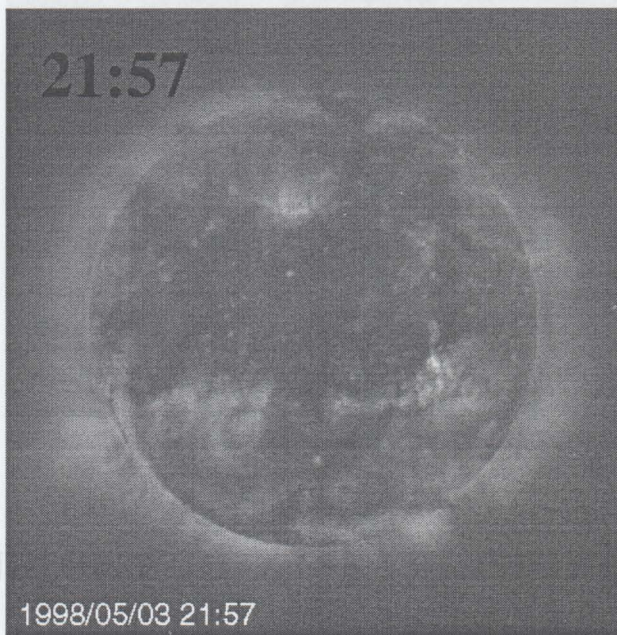
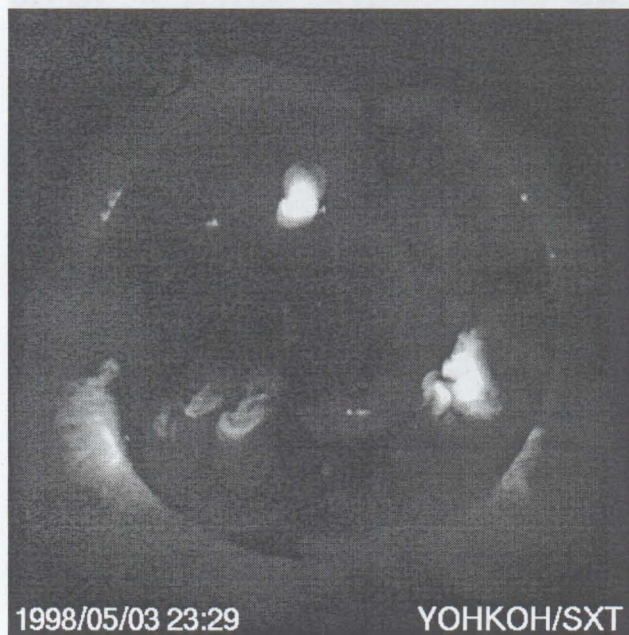
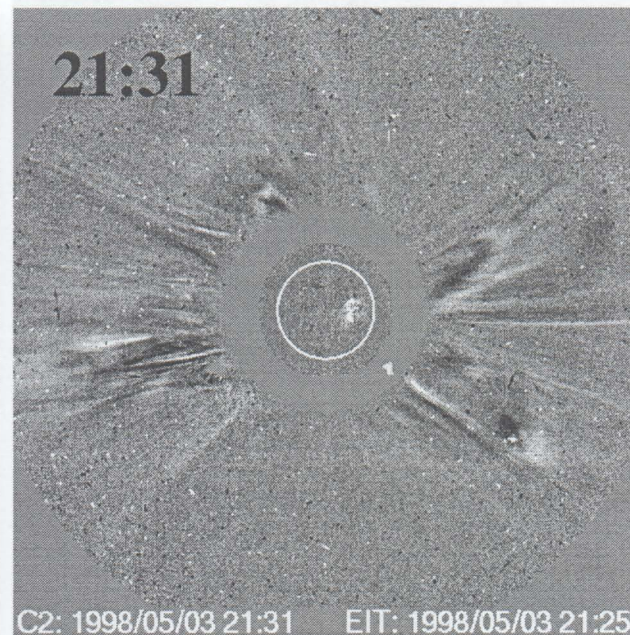
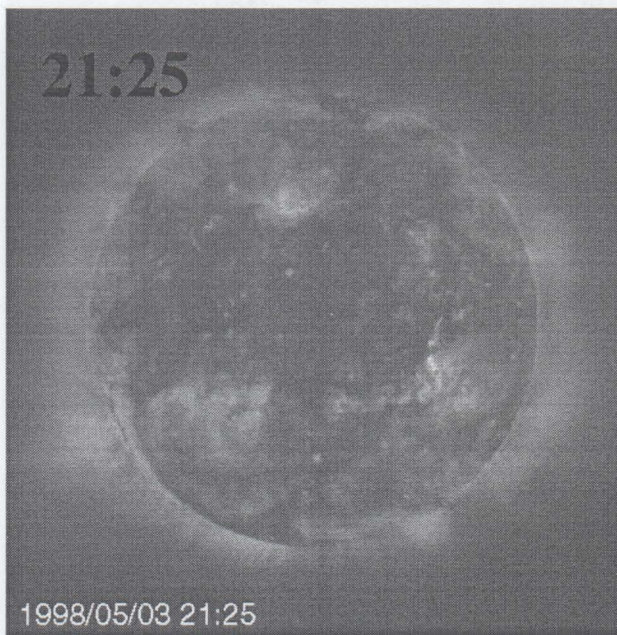


**Magnetic Setting of the X1 Flare and Transequatorial  
Coronal Dimming in the Birth of the NW Halo CME of 1998 May 2**



# M1 Flare, Trans-Equator Coronal Dimming, and NW CME

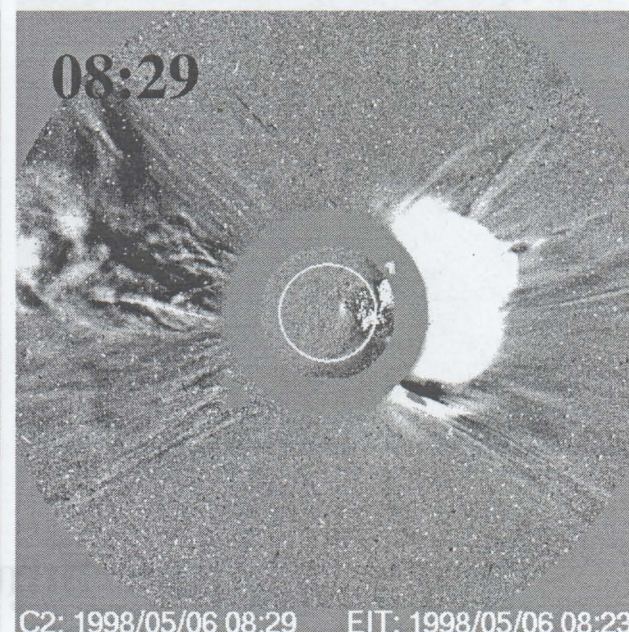
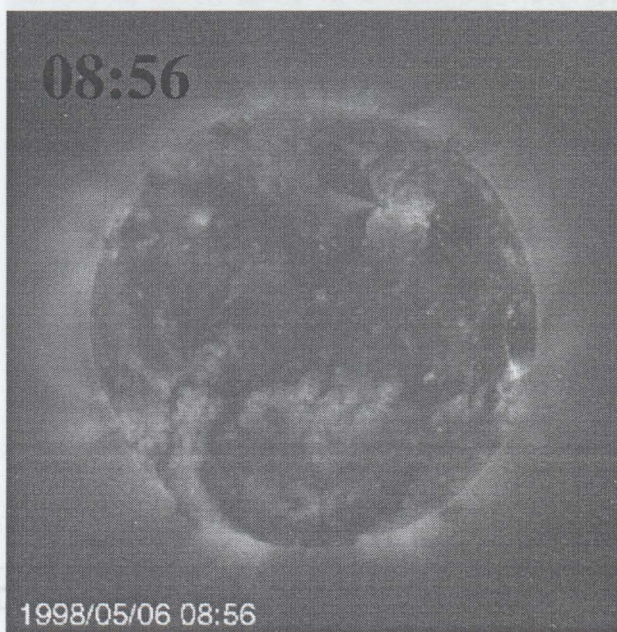
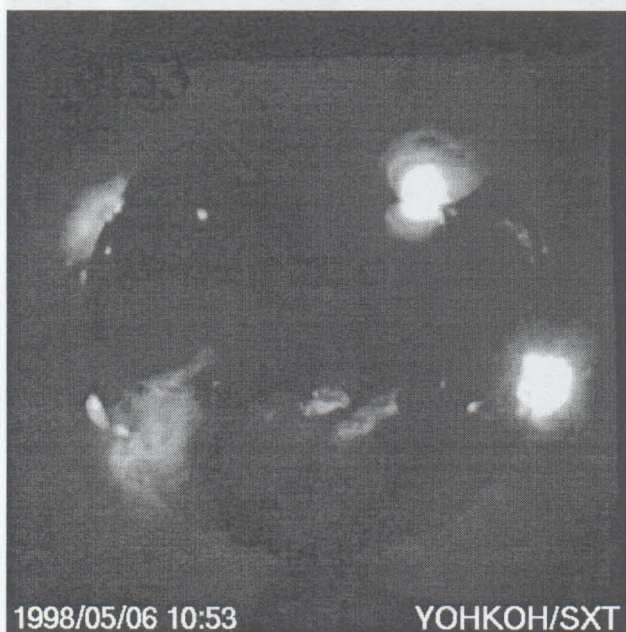
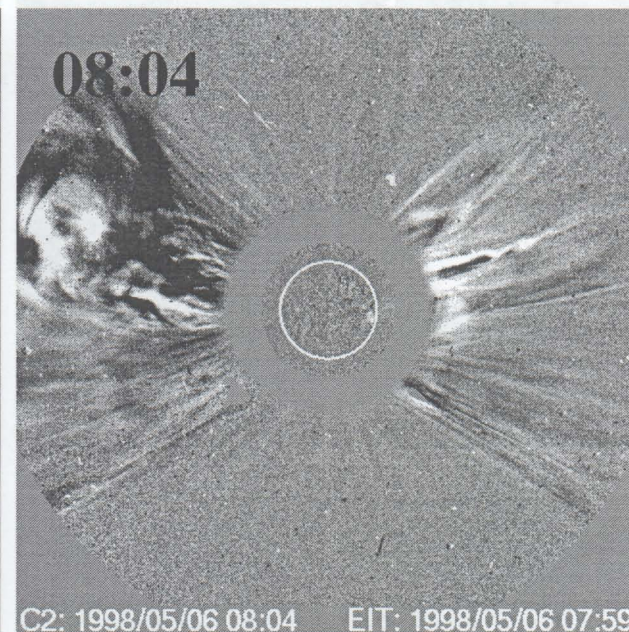
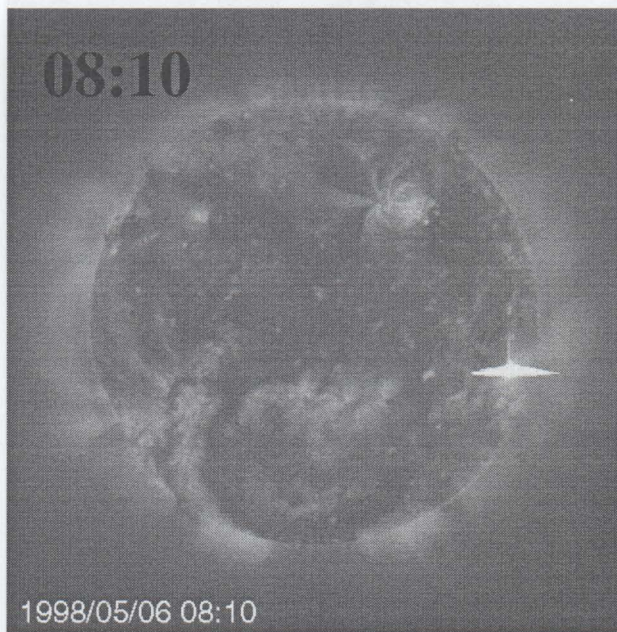
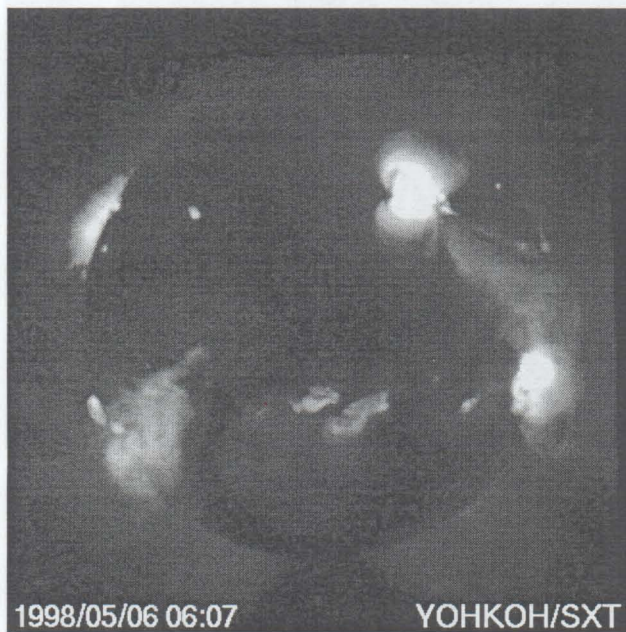
## 1998 May 3





# X3 Flare, Trans-Equator Coronal Dimming, and Westward CME

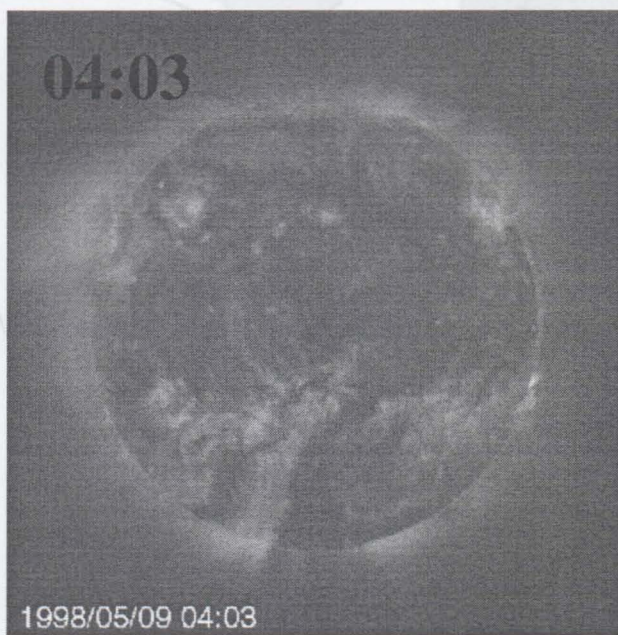
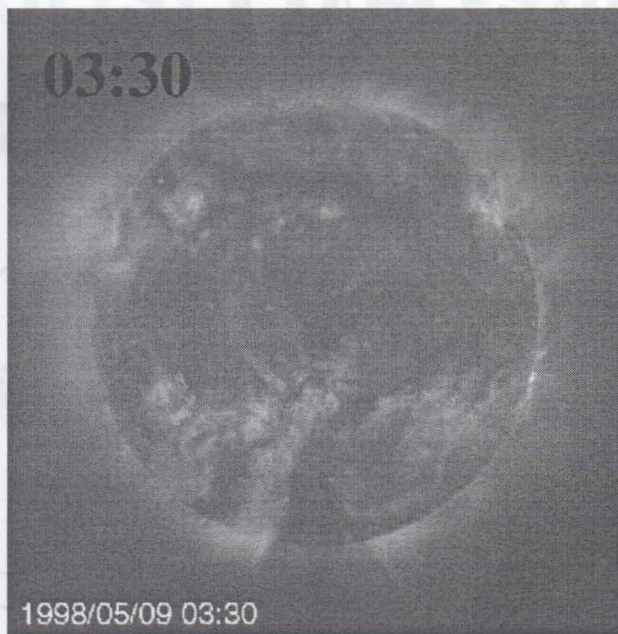
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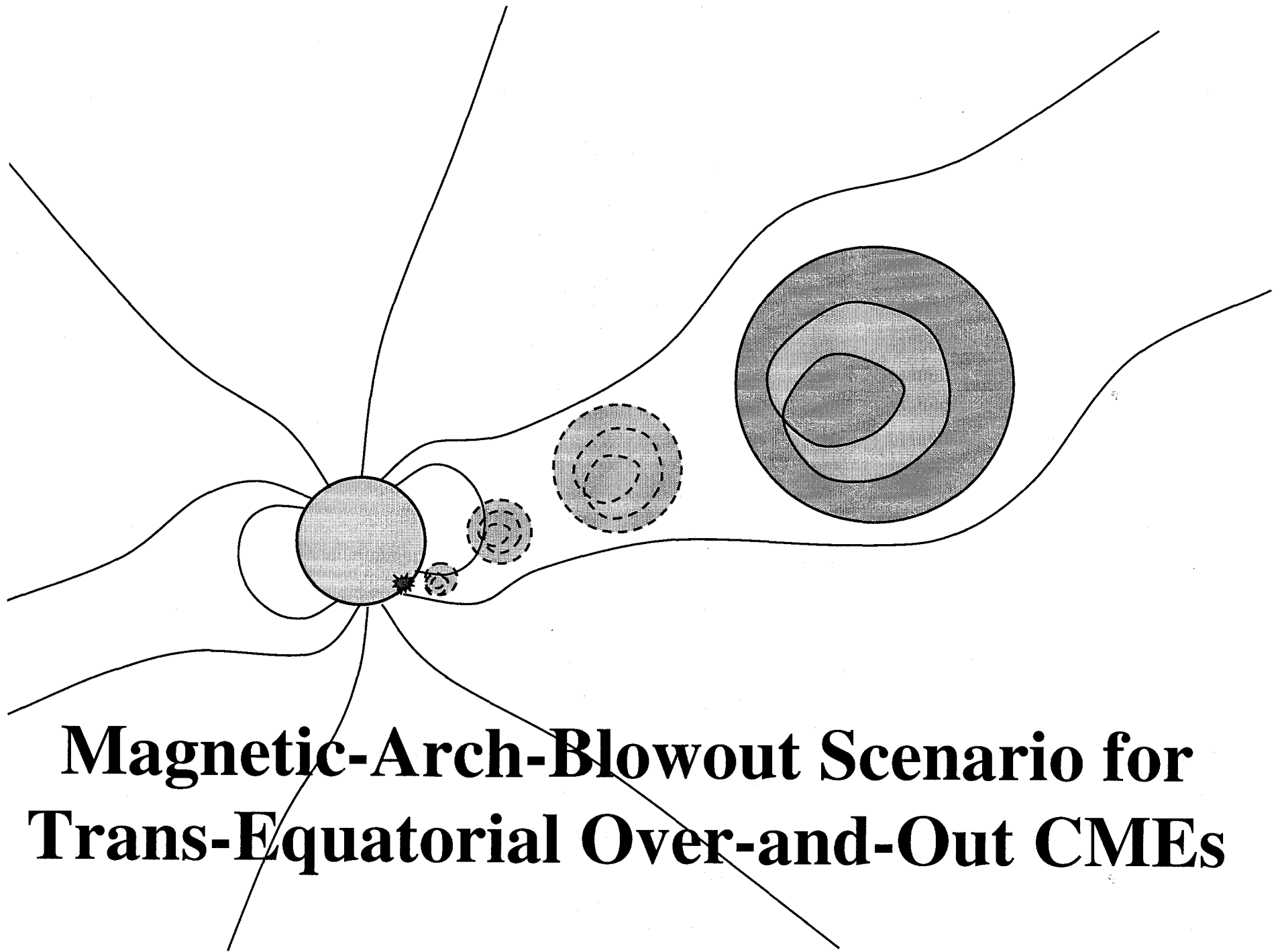


# M8 Flare, Trans-Equator Coronal Dimming, and Westward CME

## 1998 May 9







# **Magnetic-Arch-Blowout Scenario for Trans-Equatorial Over-and-Out CMEs**