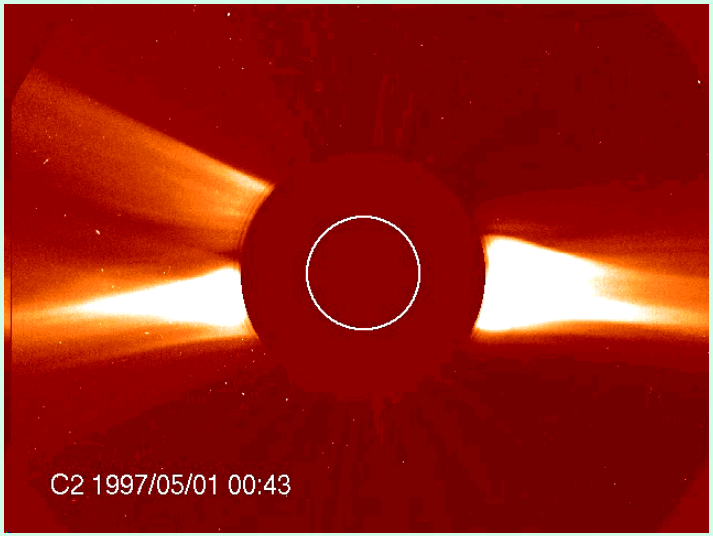
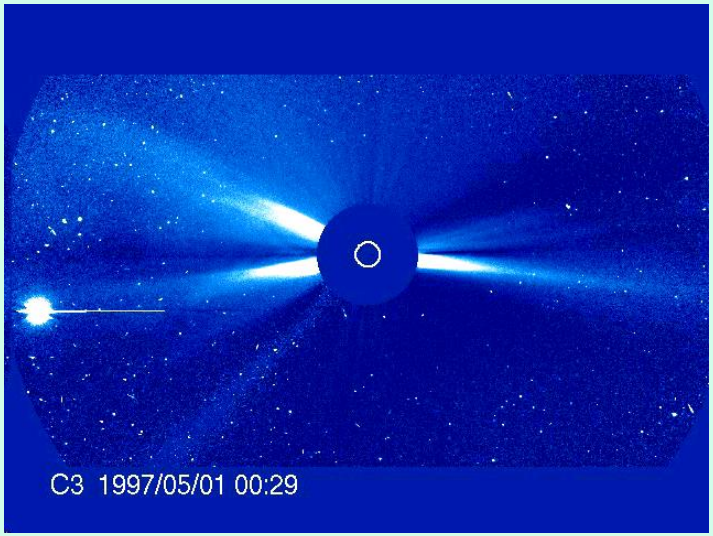
May 12, 1997 Halo CME

(A Campaign Event for SHINE, GEM, CEDAR, MURI, and CISM)

SOHO/LASCO





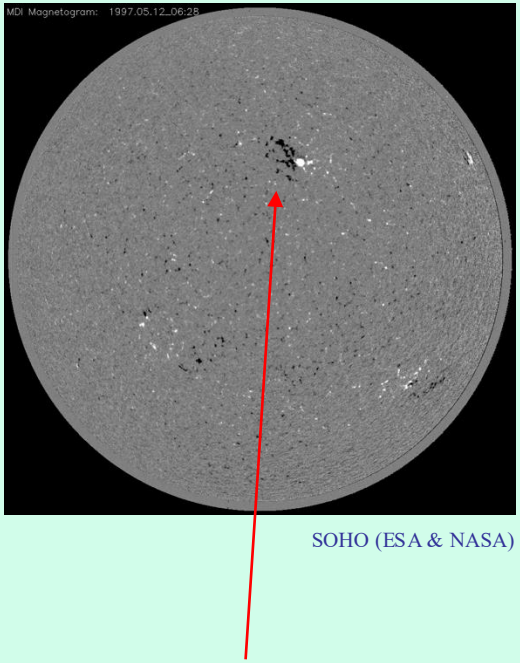
- **Completely surrounded disk as observed by LASCO**
- **Observed in C2 at 0630UT**
- **Estimated frontal speed ~600 km/s (Plunkett, 1998)**
- **Estimated CME onset time 0430-0500 UT**
- **Near disk Center**

Courtesy of SOHO/LASCO consortium. SOHO is a project of international cooperation between ESA and NASA

May 12, 1997 Halo CME

SOHO/MDI Magnetogram

1997.05.12_06:28



SOHO (ESA & NASA)

NOAA Active Region 8038 associated with the CME.

- **Only active region on entire disk (NOAA AR 8038)**
- **North of central meridian (N21 W08)**
- **New cycle polarity**
- **Rapidly evolving**

Stanford MDI Team

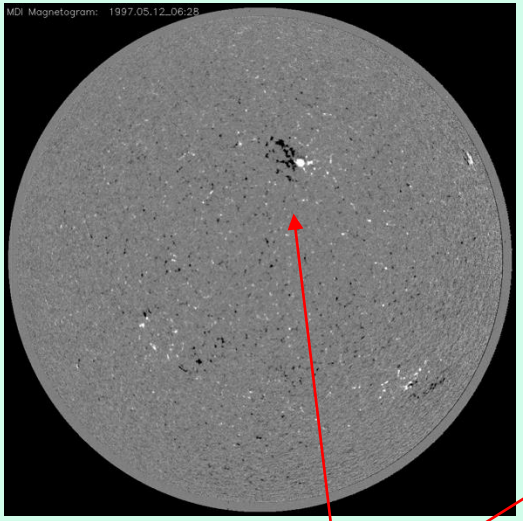
Movie Courtesy Y. Li

SOHO (ESA & NASA)

May 12, 1997 Halo CME

SOHO/MDI Magnetogram

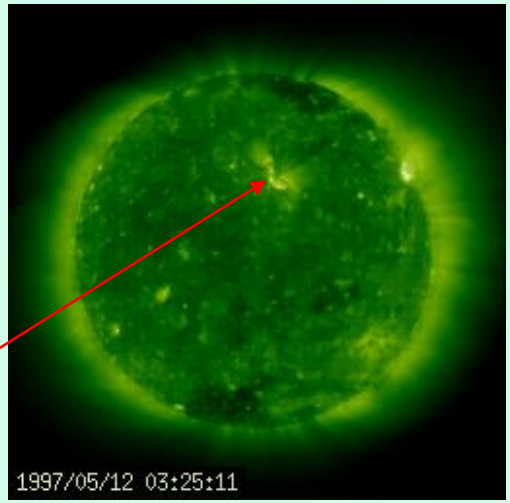
1997.05.12_06:28



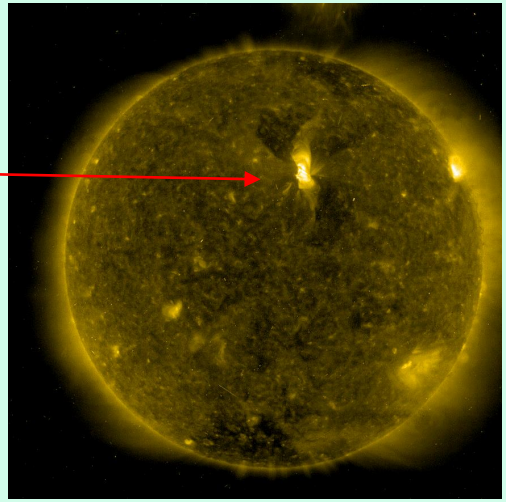
SOHO (ESA & NASA)

NOAA Active Region 8038 associated with the CME.

SOHO/EIT Disk Images



λ195Å



λ284Å

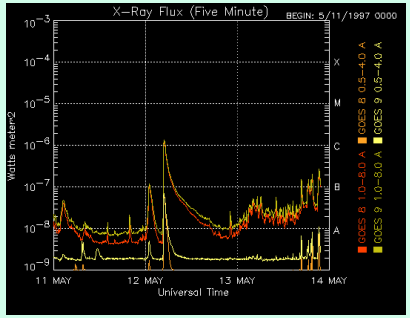
SDAC

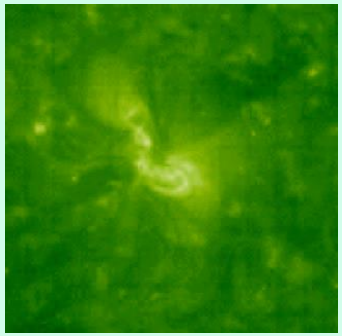
SOHO (ESA & NASA)

May 12th 1997 Halo CME

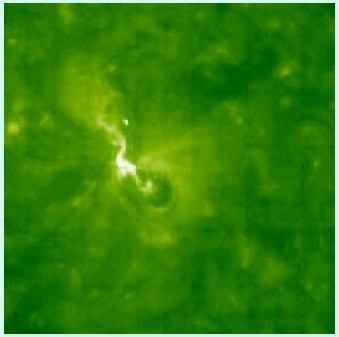
SOHO/EIT λ195Å

- Active region was the site of all flaring
- Only major flare of the day
  - Onset: 0442 UT. Peak: 0455 UT
  - Smooth LDE X-ray profile
    - Small, bright arcade formed over classic filament eruption
  - Twin NE and SE dimming regions (transient coronal holes) flanking filament eruption
    - Footpoints of flux rope? (e.g., *Webb et al. 2000*)
- EIT Wave

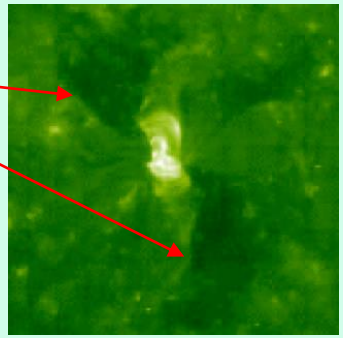




May 12, 04:34 UT



May 12, 04:50 UT

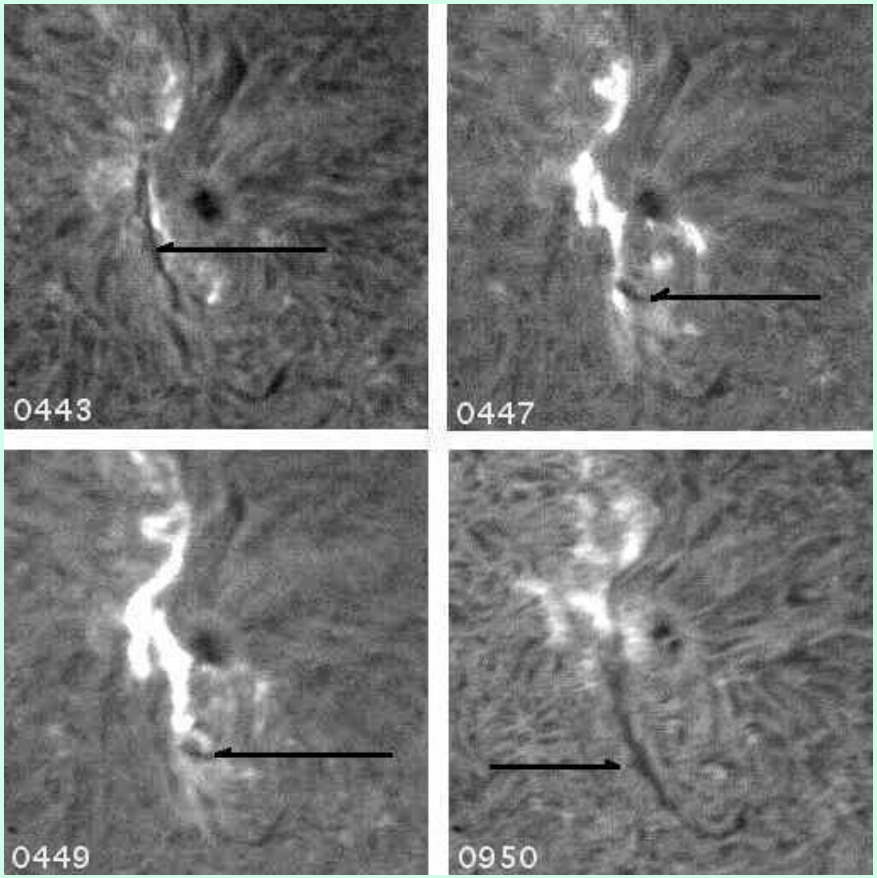


May 12, 07:45 UT

SOHO (ESA & NASA)

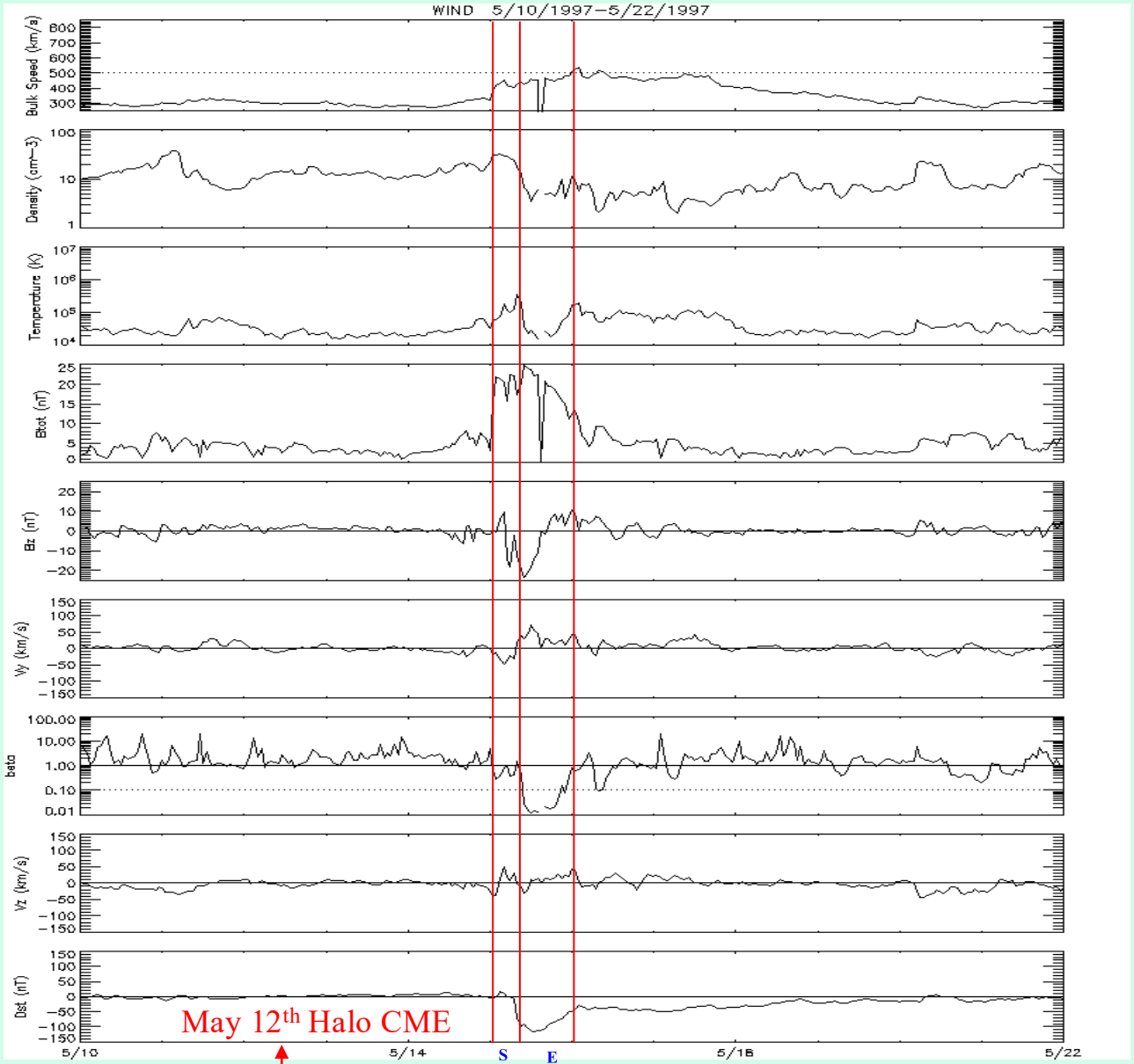
Hα SOONSPOT

- Filament originally ran in N-S direction rotated 80º deg to nearly E-W
- Filament Left-handed
- Expanding 2 ribbon Hα emission



Webb et al., 2000

WIND: Solar Wind Observations at L1



Vel.

Den.

Temp.

|B|

B_z

V_y

β

V_z

Dst

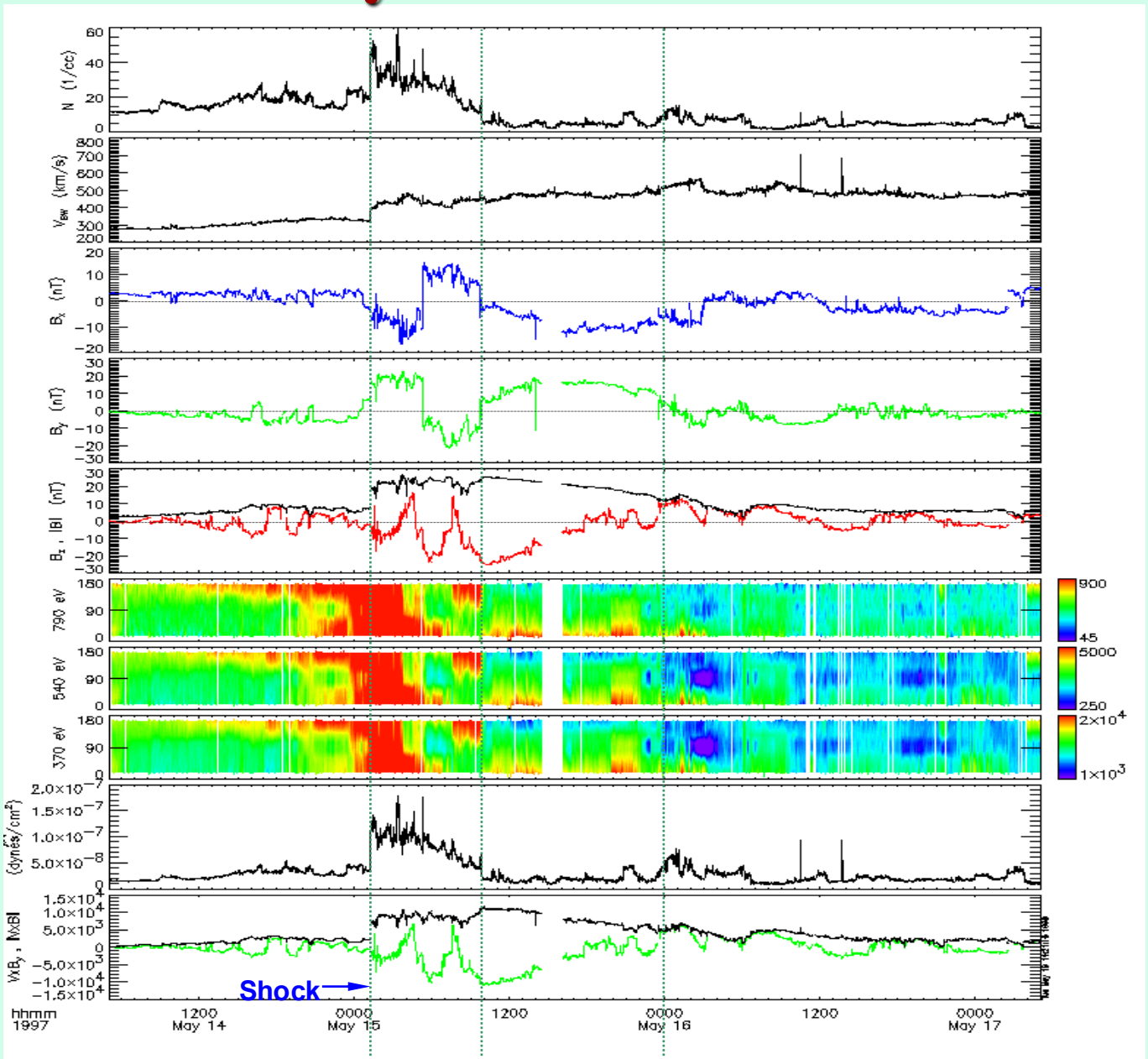
Data courtesy of wind PI's

May 15th 1997 ICME

Shock & Sheath

- Arrived at WIND on May 15th at 0115 UT
- At leading edge of modest recurring stream
- Field enhanced starting at shock and lasting for about a day
- Prior to shock/cloud arrival,
  - Heat flux
    - Opposite to field direction $\Rightarrow$ field directed inward, toward the Sun
    - (Just prior to shock) became more bi-directional and there was an increase in the number of electrons traveling parallel to the field.

May 15th 1997 ICME



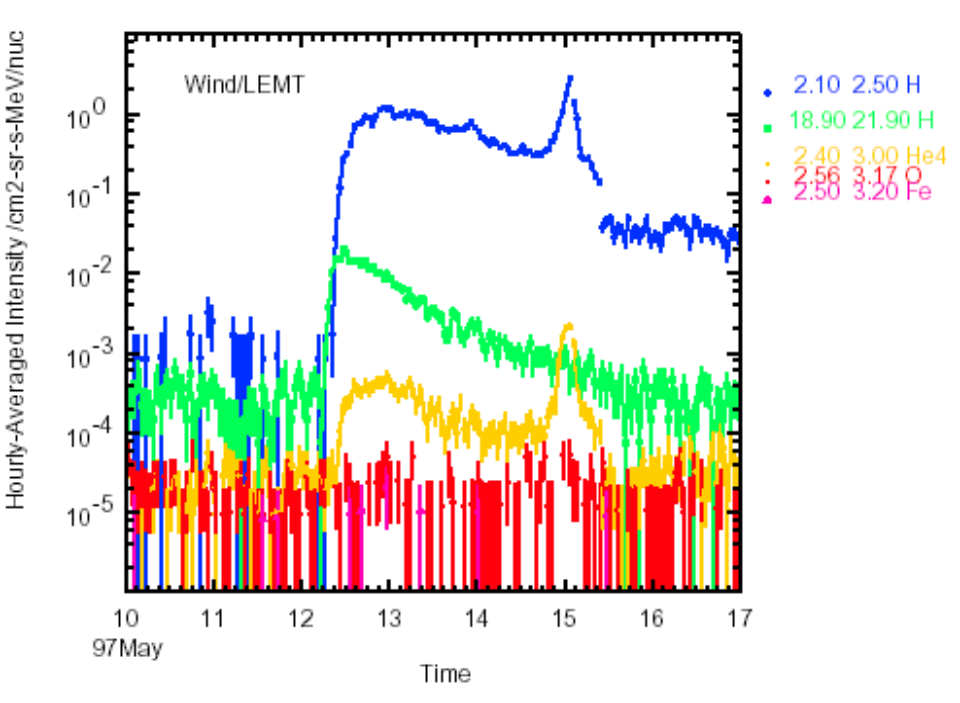
Ambient Flow | Sheath | Ejecta | Post-Ejecta Flow

From Davin Larson

Magnetic Cloud Properties

- Magnetic Cloud arrived 8 hrs after shock: onset 0950 UT
- Propagation time ~ 76 hrs ⇒ an average transit speed of 548 km/s
- Proton temperature sharply decreased
- Electron temperature typical of undisturbed solar wind
- Helium abundance enhanced
- No bidirectional electron flux observed (cloud not connected at both ends to Sun)
- Field enhanced and displayed a smooth rotation for ~¾ day
- Cloud was left-handed and
  - To good approximation cloud fits force free model.
  - Inferred cloud's axis was approximately in the (i.e., parallel to the) ecliptic plane with southward field leading and north following. (*Webb et al. 2000*).
- Avg. speed across cloud 450 km/s (front: 430 km/s, back: 500 km/s)
  - Cloud compressed from behind by a modest high-speed stream (stream source southern-hemisphere).
- Produced a moderate geomagnetic storm (*Dst* = -115nT)

May 12th 1997 WIND SEP Data



- Weak Particle Event

May 12 1997 Campaign Web Site

www.shinegroup.org

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May 12, 1997

Introduction

The May 12, 1997 halo CME occurred shortly after solar minimum when activity was low and the structure of the corona and solar wind was relatively simple. It was associated with the only active region on the solar disk [NOAA AR 8038], which was located north of the equator near central meridian. The active region was rapidly evolving, of new cycle polarity, and generated the only major flare of the day, which began at 04:42 UT and peaked around 04:55 UT. The flare was first visible in Ha and was associated with a filamaent that erupted soon thereafter followed by a pair of expanding Ha ribbons. The subsequent X-ray flare emission came from a small arcade that had formed over the region where the filament erupted. Twin dimming regions (positioned North-East and South-East) flanked the filament eruption. A classic EIT wave occurred during this event [Thompson et al., 1998].

The halo CME was observed in SOHO/LASCO C2 instrument at 06:30 UT with an estimated frontal speed of ~600 km/s [Plunkett et al., 1998] and onset time between 04:30-05:00 UT. For about 10 days before the event, the Earthward directed solar wind consisted of relatively slow (i.e., bulk flow speed less than 400 km/s) dense ambient material. The shock produced by the interplanetary coronal mass ejection (ICME) arrived at L1 early on the 15th followed by a magnetic cloud and then a high-speed stream, which is speculated [Webb et al., 2000] to have compressed the cloud from behind. The ICME produced a moderate geomagnetic storm with a maximum Dst of -115nT. Figure 1 summarizes the key solar wind plasma parameters from the WIND satellite for the nine-day period centered on the May 15th ICME arrival at L1, as well as the Dst geomagnetic index as provided by Kyoto University (http://swdcdb.kugi.kyoto-u.ac.jp/dstdir/). More comprehensive summaries of the event can be found in papers by Webb et al. [2000], Thompson et al. [1998], and Plunkett [1998] along with the references found therein.

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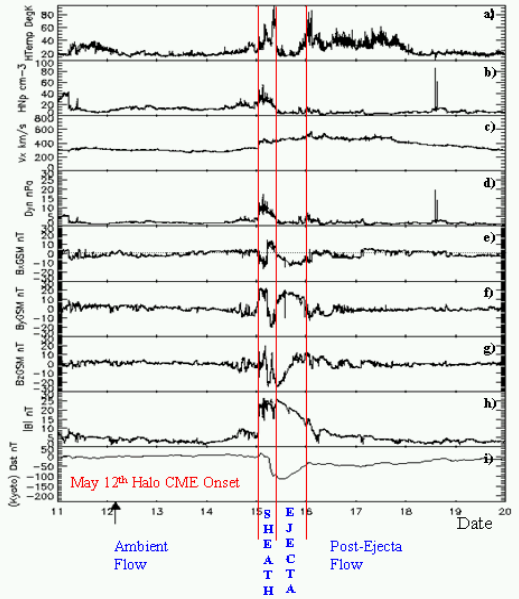

Figure 1 * Solar wind key plasma parameters from the WIND satellite (a-h) and the Dst geomagnetic index (i) as provided by Kyoto University (http://swdcdb.kugi.kyoto-u.ac.jp/dstdir/) for the nine-day period May 11-20, 1997. a) Proton temperature (K), b) Proton number density (cm-3), c) Vx (km s-1) , d) Dynamic Pressure (nPa), e) Bx(GSM) (nT), f) By(GSM) (nT), g) Bz(GSM) (nT), h) |B| (nT), i) Dst (nT). The red vertical lines separate the different types of solar wind plasma labeled at the bottom of the plot. (Plot courtesy of Dr. Yan Li.)

data/
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Please provide us with event *Data*, *Papers*, *Links*, & *Presentations.*

May 12, 1997 CME Related Papers

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Web Sites

Stanford University

http://sun.stanford.edu/~zhao/halocme2.html

http://sun.stanford.edu/~yliu/may121997/event_May_12.html

International Clearinghouse for Space Weather Information (SCOSTEP/S-RAMP)

http://data.engin.umich.edu/intl_space_weather/sramp/storms_list_97.html

CELIAS/MTOF Proton Monitor on the SOHO Spacecraft (University of Maryland)

http://umtof.umd.edu/pm/Shocks.html

Solar CISM: (U C Berkeley)

http://sprg.ssl.berkeley.edu/cism/gallery.html

MURI Events (U C Berkeley)

http://sprg.ssl.berkeley.edu/~yanli/muri/events.html

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http://data.engin.umich.edu/intl_space_weather/sramp/SHINE_GEM_CEDAR.html

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http://umbra.nascom.nasa.gov/eit/cme/may12/index.html

http://sohowww.nascom.nasa.gov/

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Li, Yan
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Webb, David
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Where Do We Go From Here?