

SECCHI and SOHO Observations of Metric type II Bursts in 2007

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SECCHI & SWAVES Teams

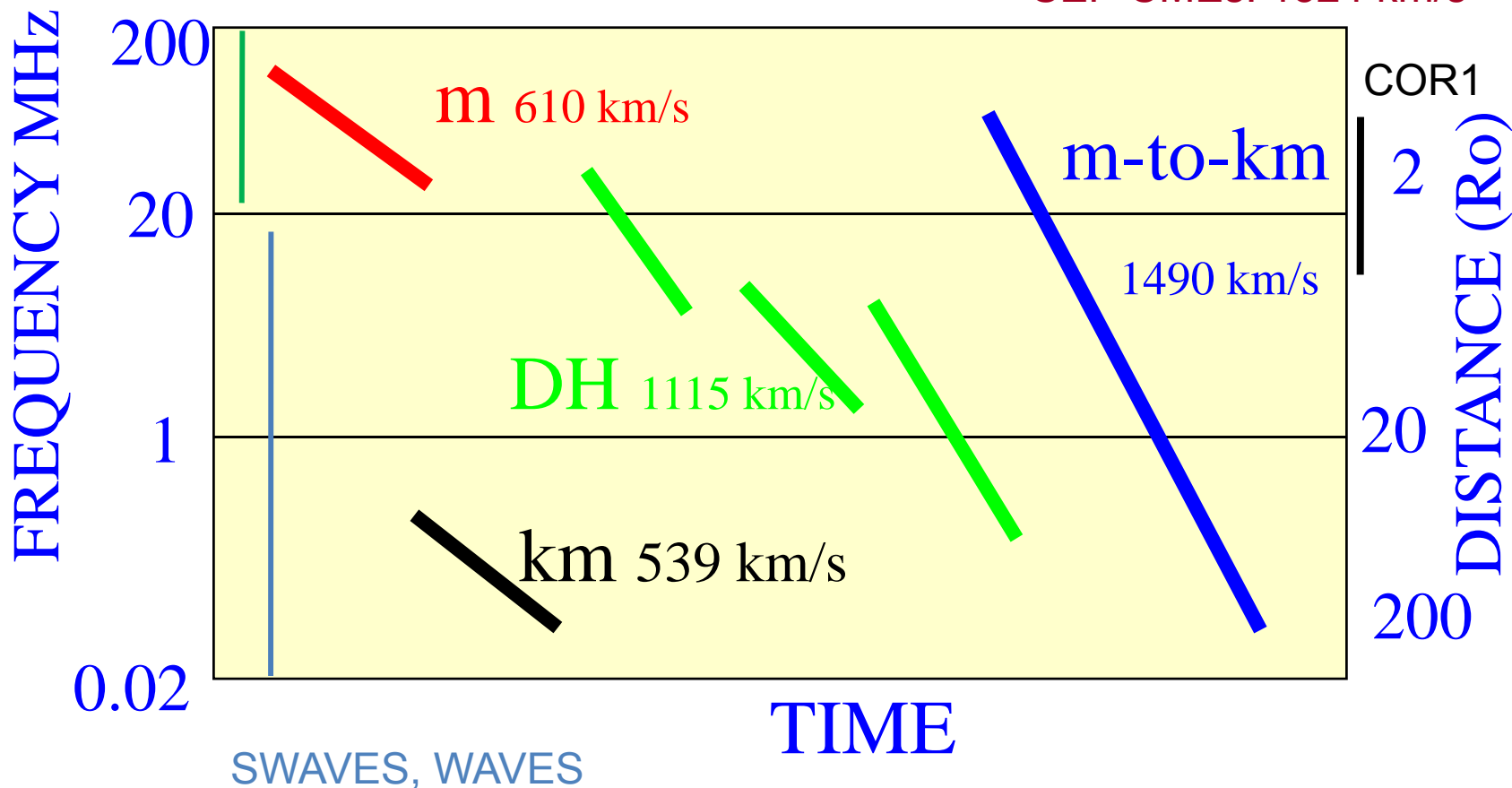


Type II Bursts: Earliest Indicators of Shock

GROUND BASED

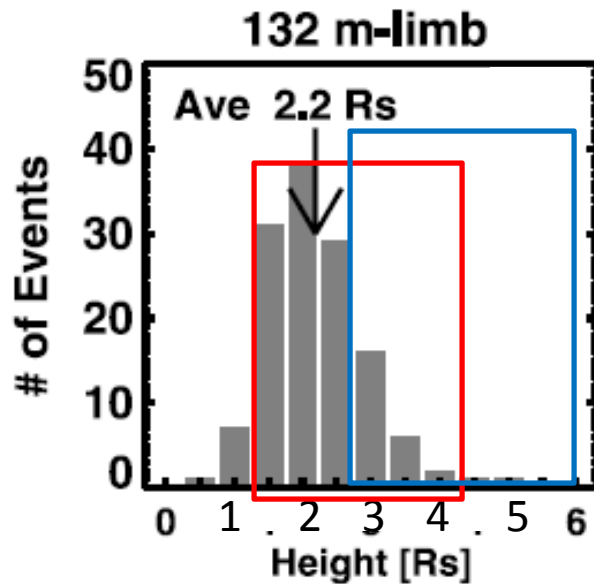
All CMEs: 480 km/s

SEP CMEs: 1524 km/s



CME height at metric type II onset

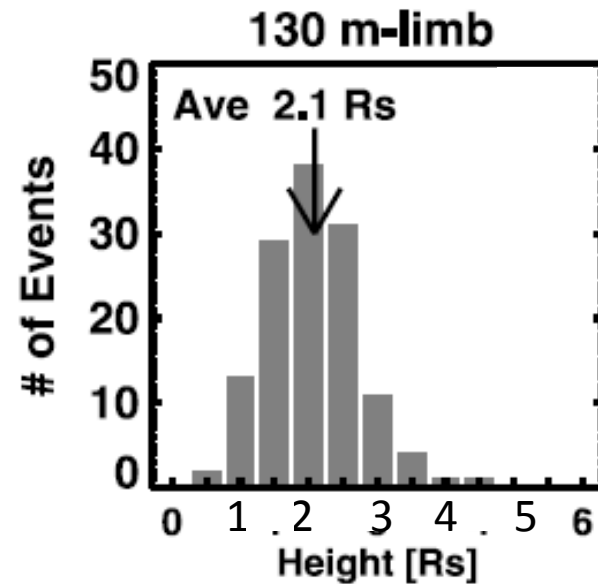
1.8 Rs mkm



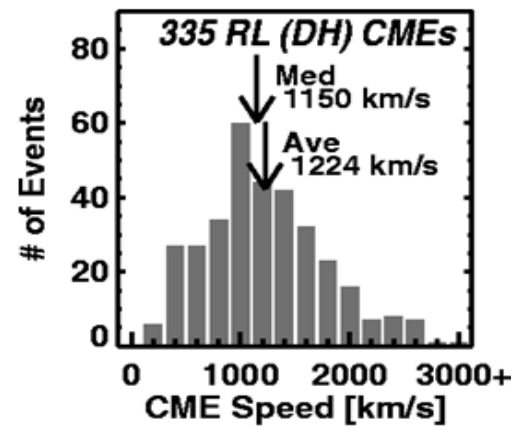
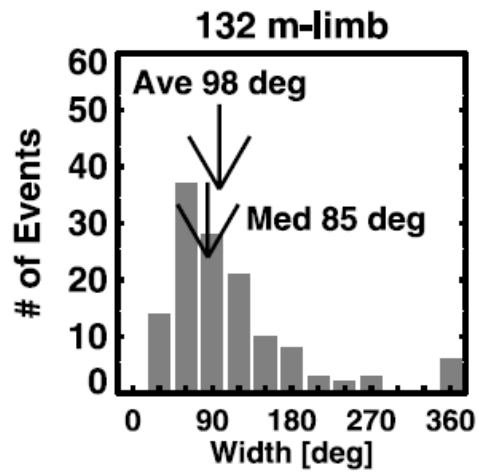
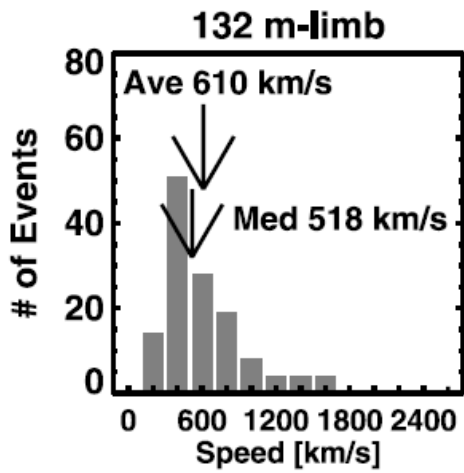
SECCHI/COR1 FOV

LASCO/C2 FOV

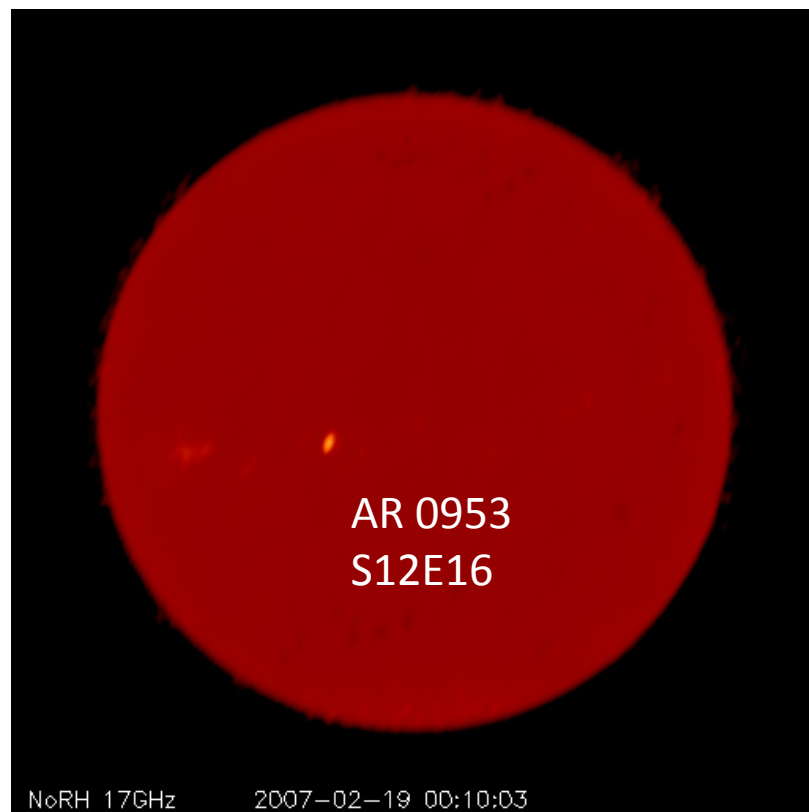
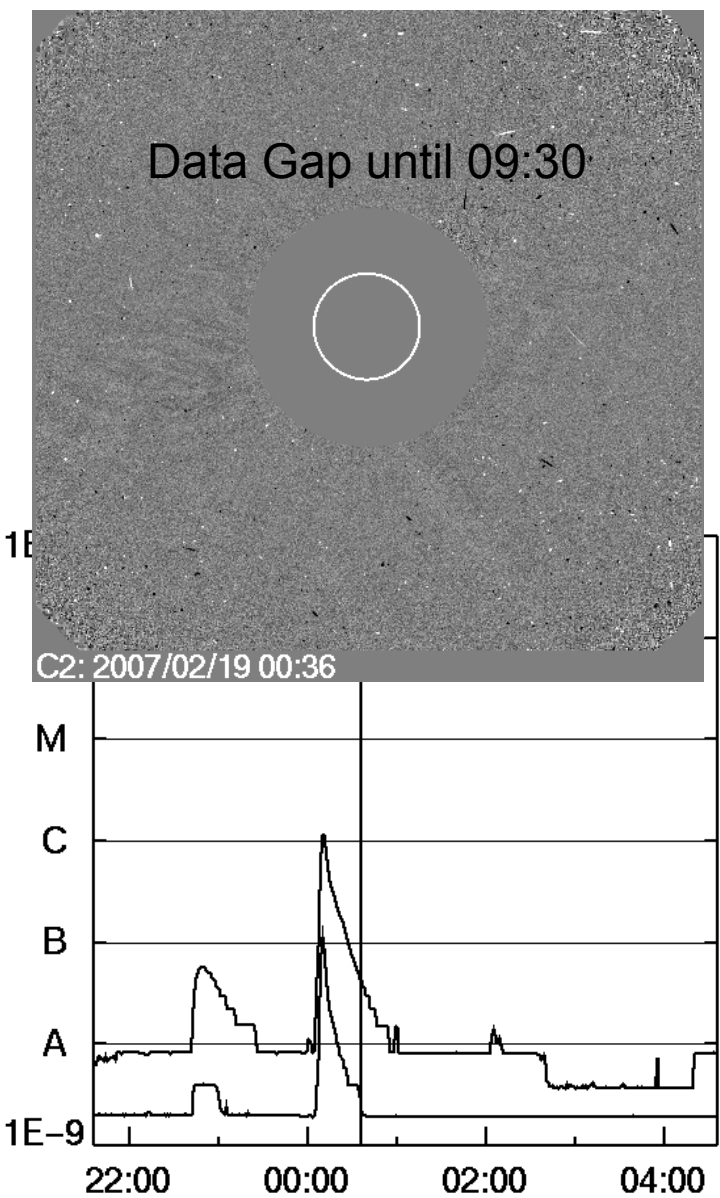
1.6 Rs mkm



Date/Time	Time range	Freq range (MHz)	SWAVES?	Cor1 speed km/s	LASCO C2 Speed km/s	Width deg	
07/02/19	00:18-00:25	57-90	no	?	DG	DG	AR953
07/05/19	12:51-13:18	25-167	yes	?	958 (-13.4)	106	}
07/05/22	14:36-14:55	25-82	no	335	544 (7.9)	108	
07/05/23	07:22-07:33	25-180 (360)	no	581	679 (6.2)	90	
07/06/03	09:28-0942	28-120	yes?	449	393 (1.7)	70	AR960?



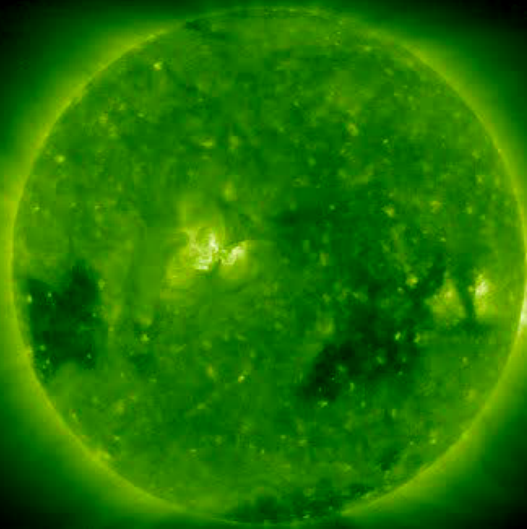
20020219



17 GHz image from Nobeyama

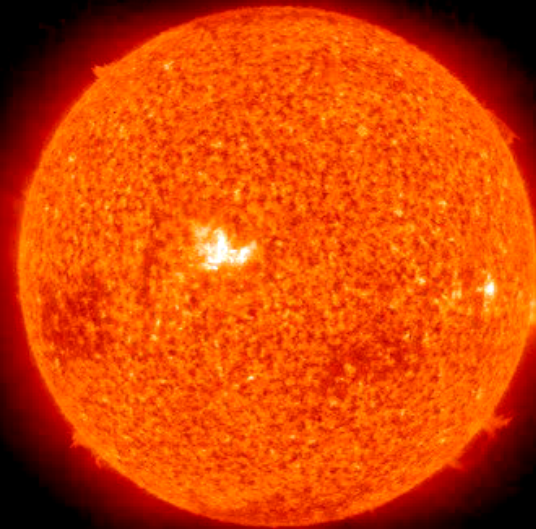
2007/05/19 AR 0956 N07W06

STEREO Ahead EUVI 195



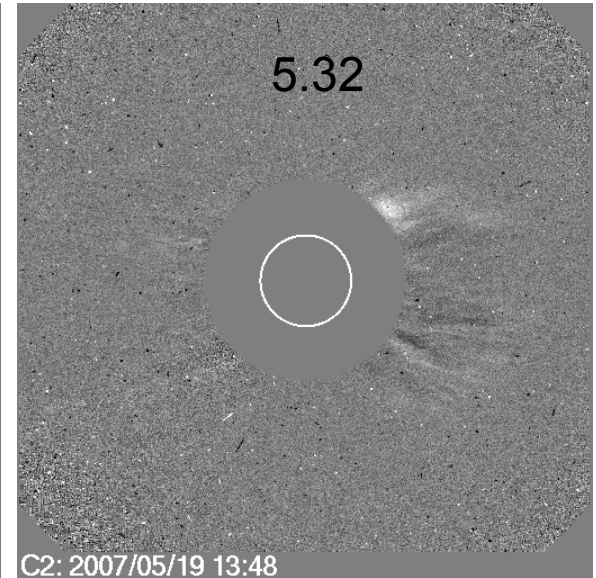
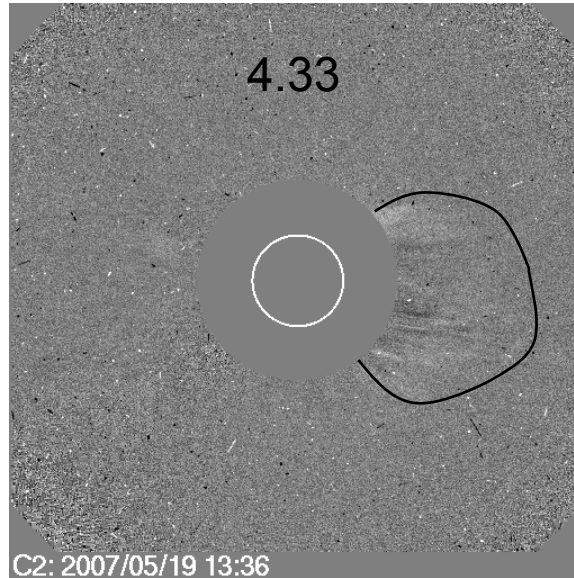
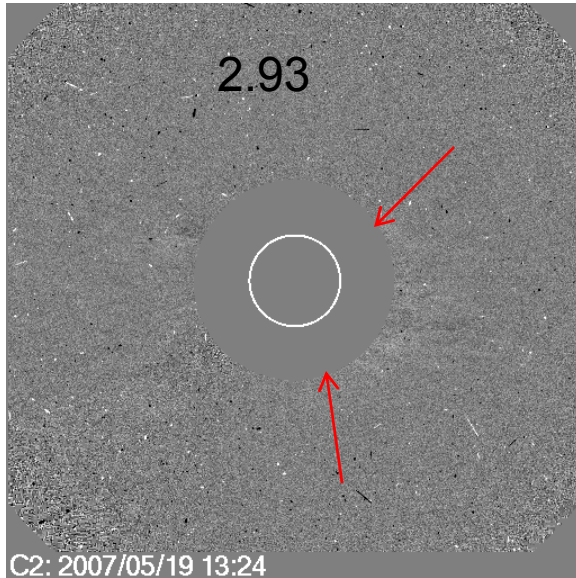
2007-05-19 00:12:00

STEREO Ahead EUVI 304



2007-05-19 00:11:45

LADCO C2

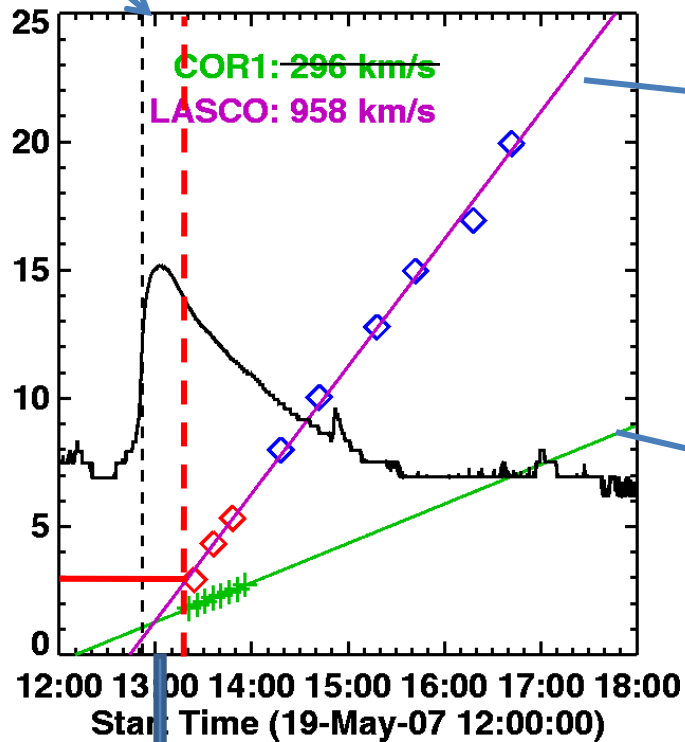


Type II ended before
CME first appearance in C2
COR1 saw something but the
Speed is uncertain

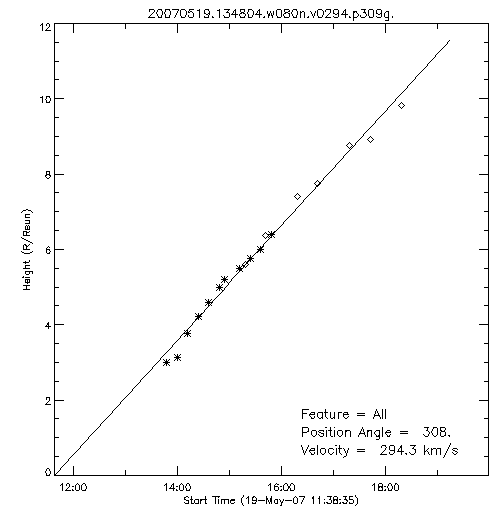
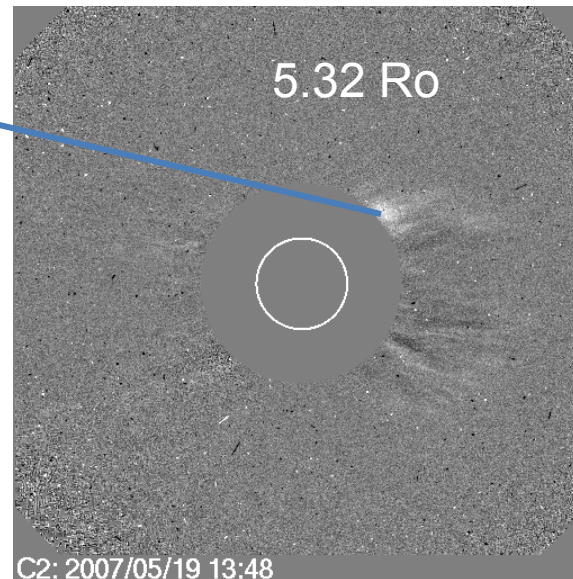
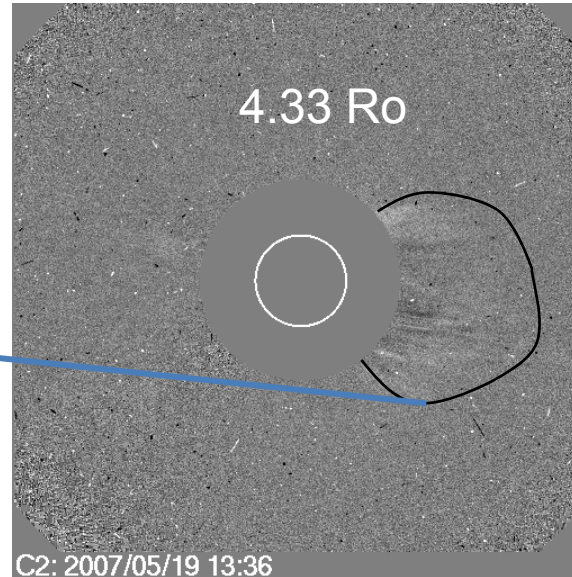
2007/05/19 Type II & CMEs

Metric Type 2
12:52 – 13:18

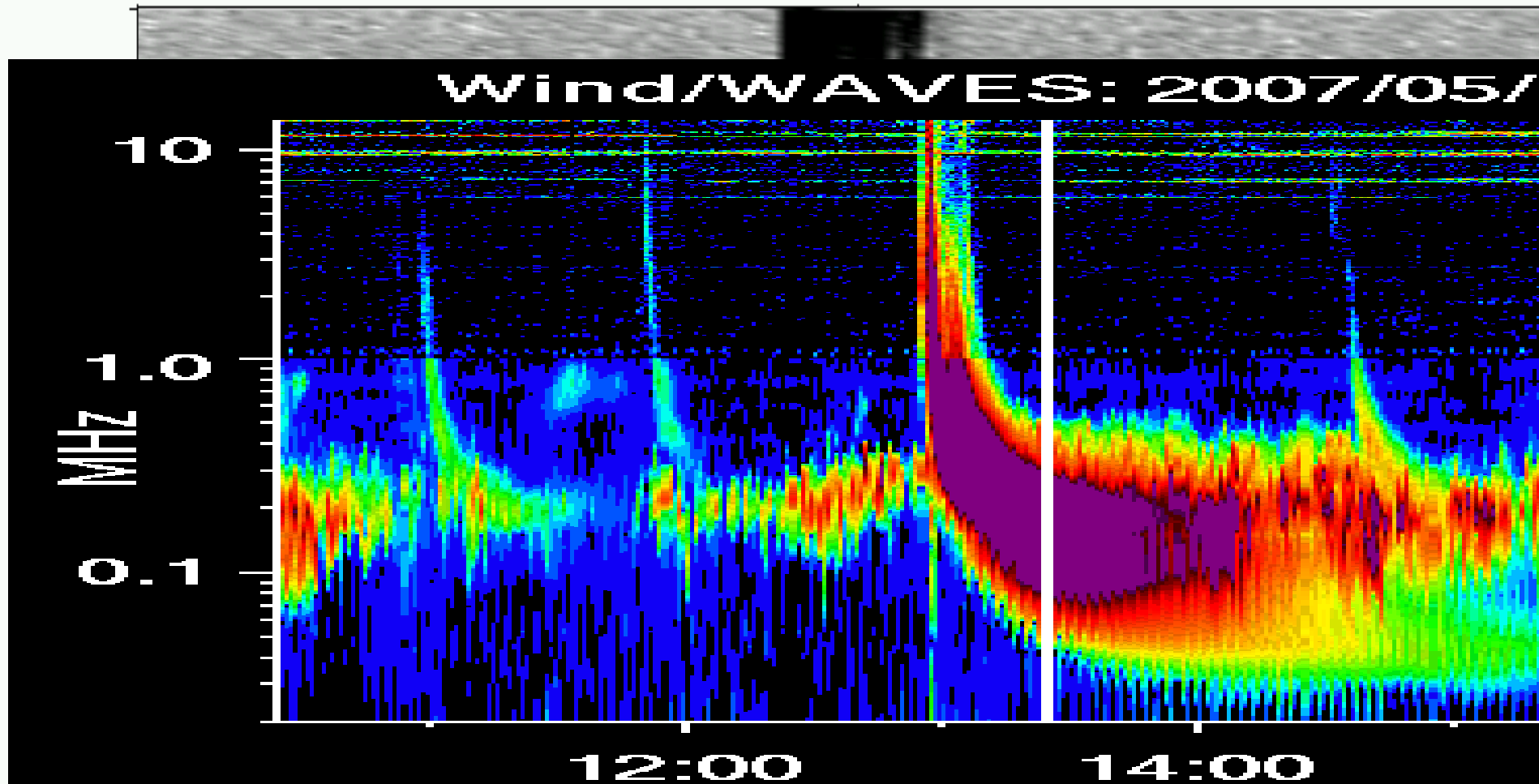
2007/05/19 12:52



SWAVES 13:02 -13:05

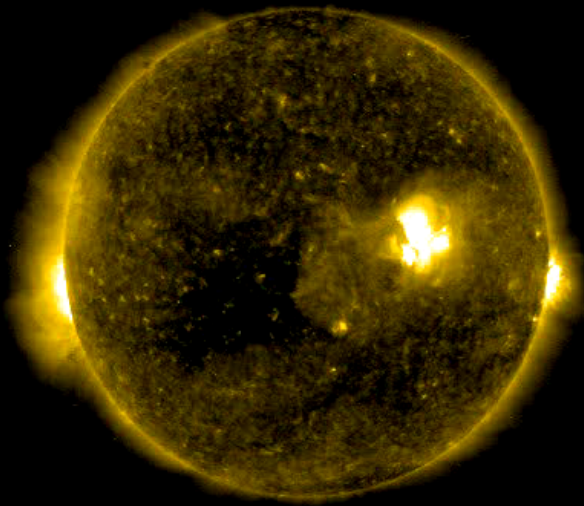


STEREO Waves 2007/5/19



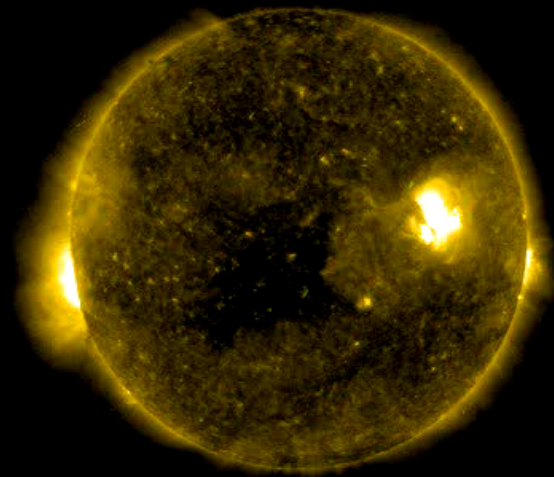
2007/05/22 AR 956 N02W40

STEREO Ahead EUVI 284



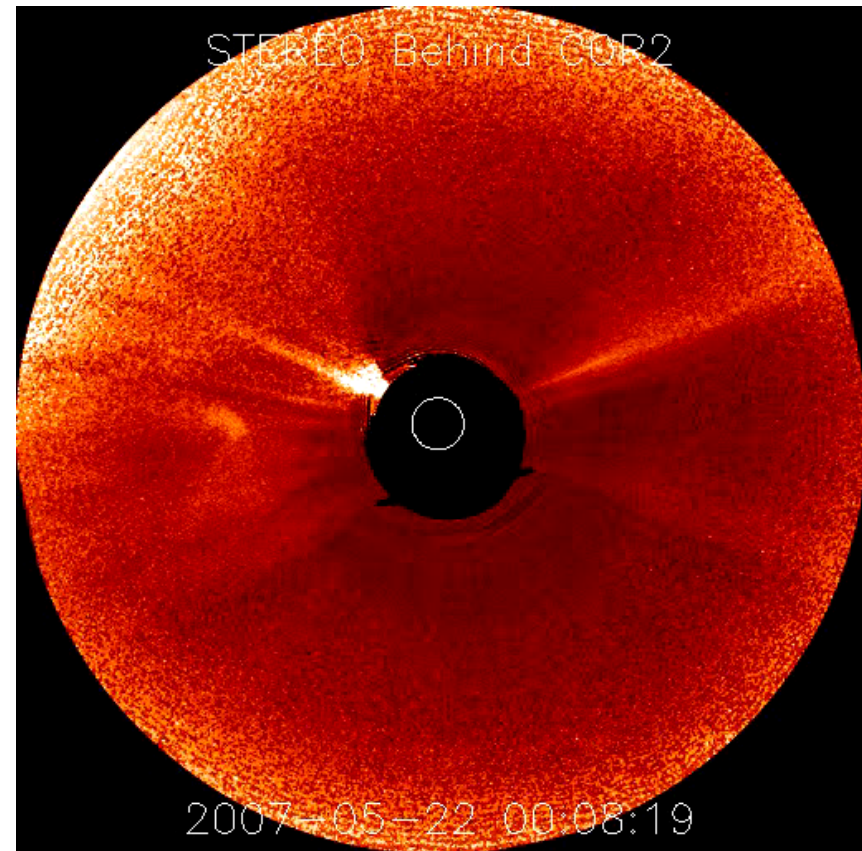
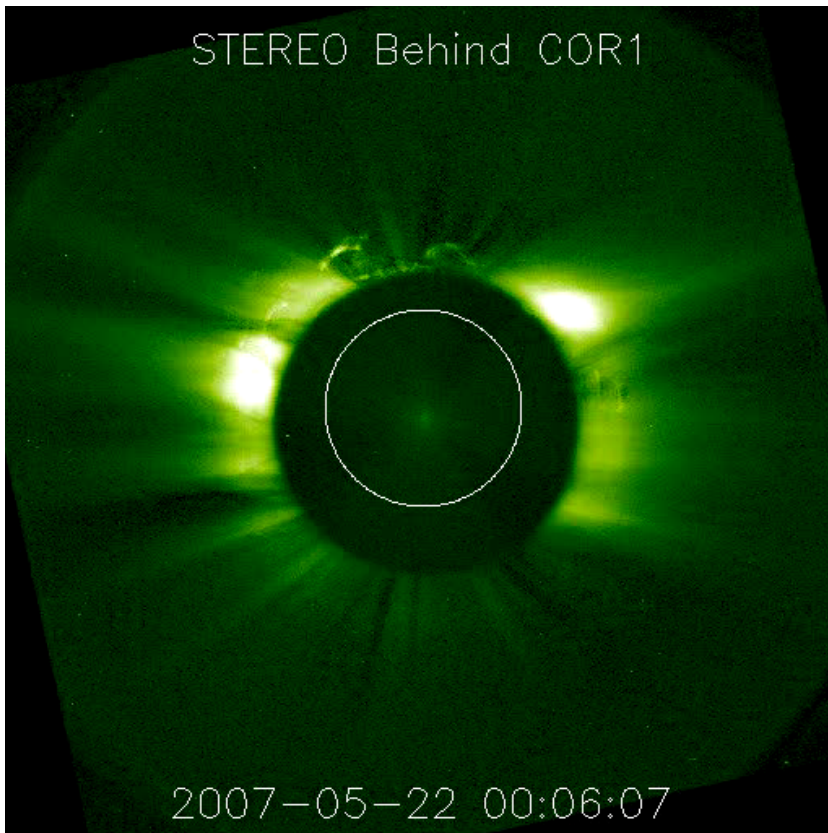
2007-05-22 00:20:52

STEREO Behind EUVI 284

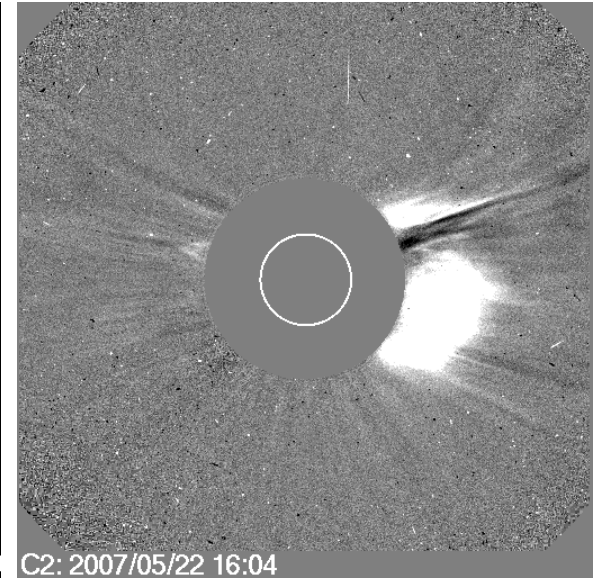
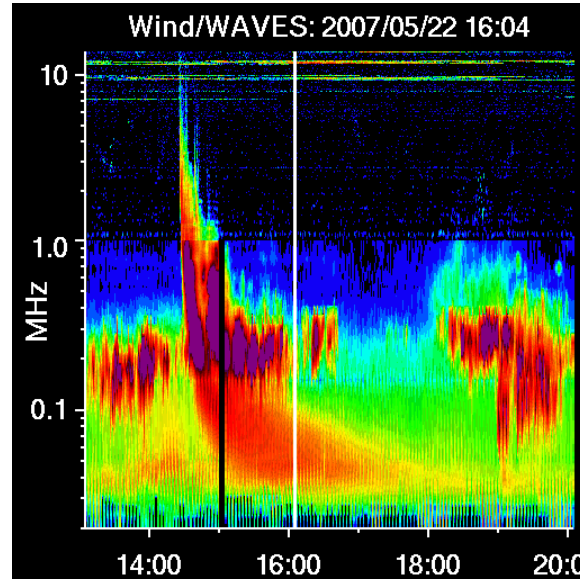
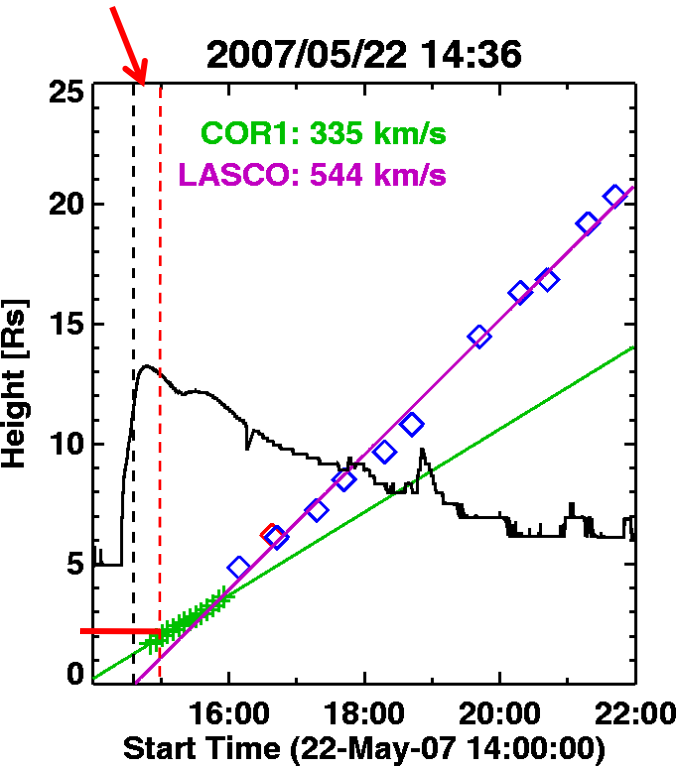


2007-05-22 00:21:41

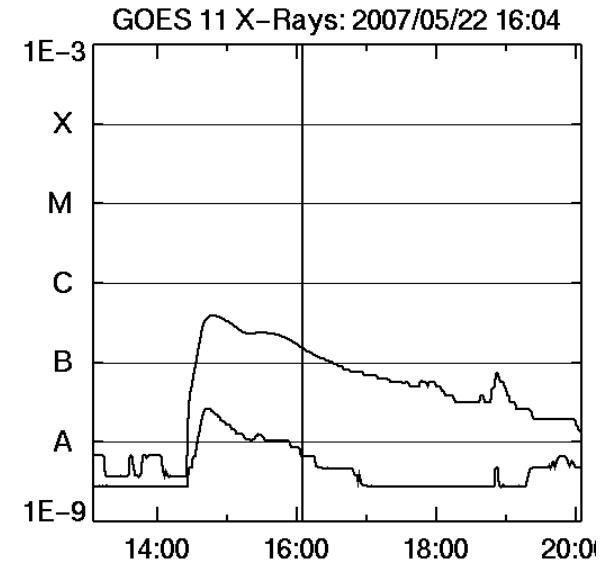
COR1 & COR2



Type II 14:36-14:55

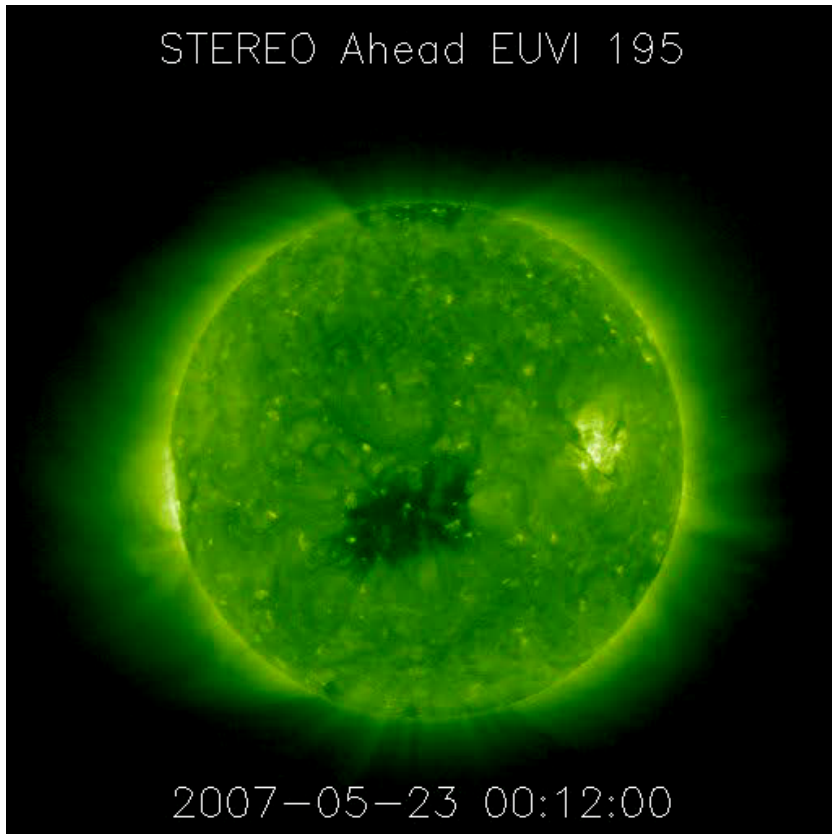


Type II ends when the CME is at 2 Rs



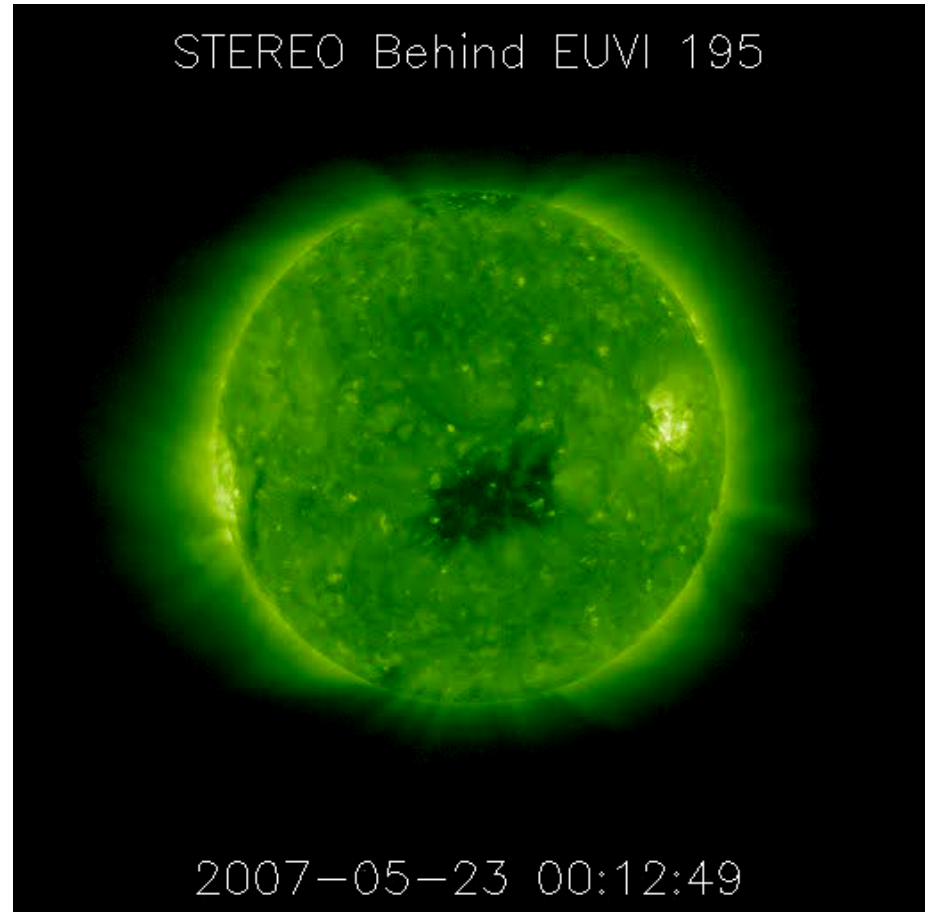
2007/05/23 AR 956 N02W50

STEREO Ahead EUVI 195



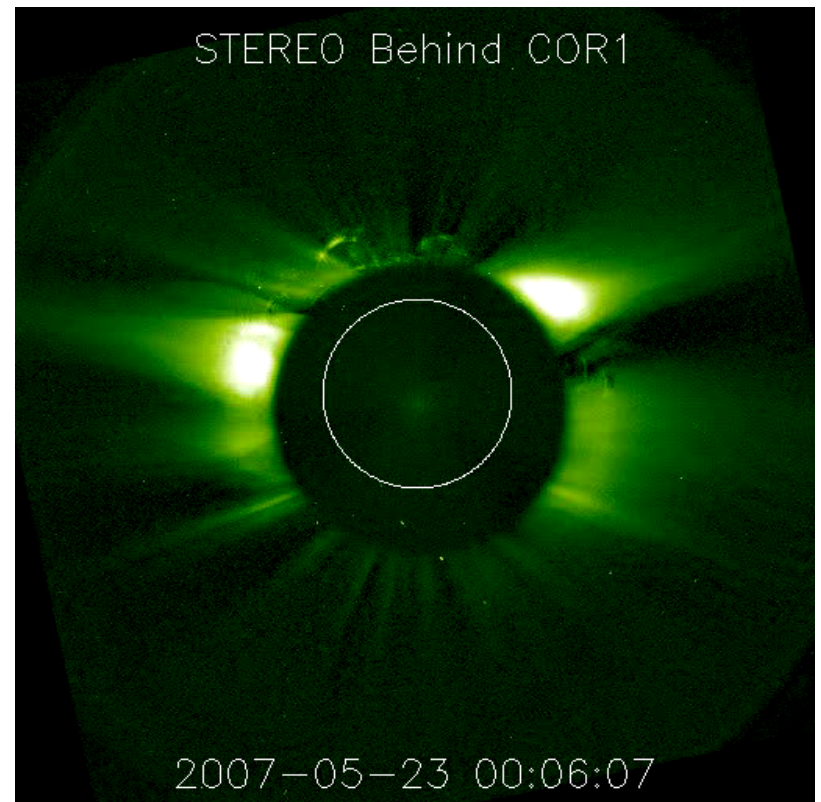
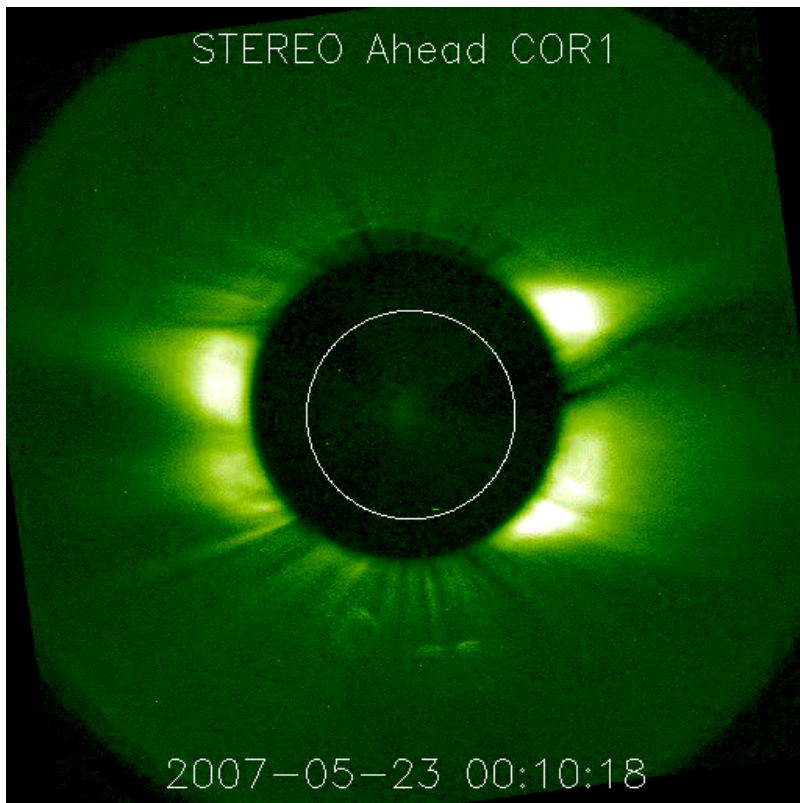
2007-05-23 00:12:00

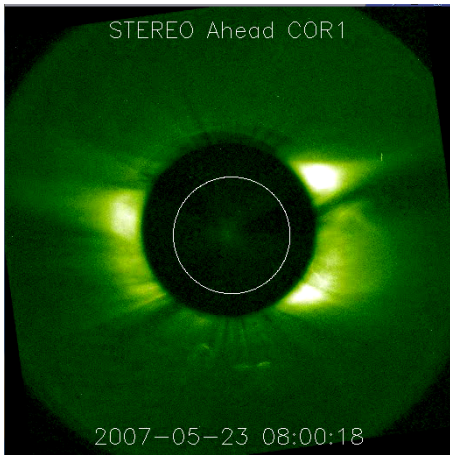
STEREO Behind EUVI 195



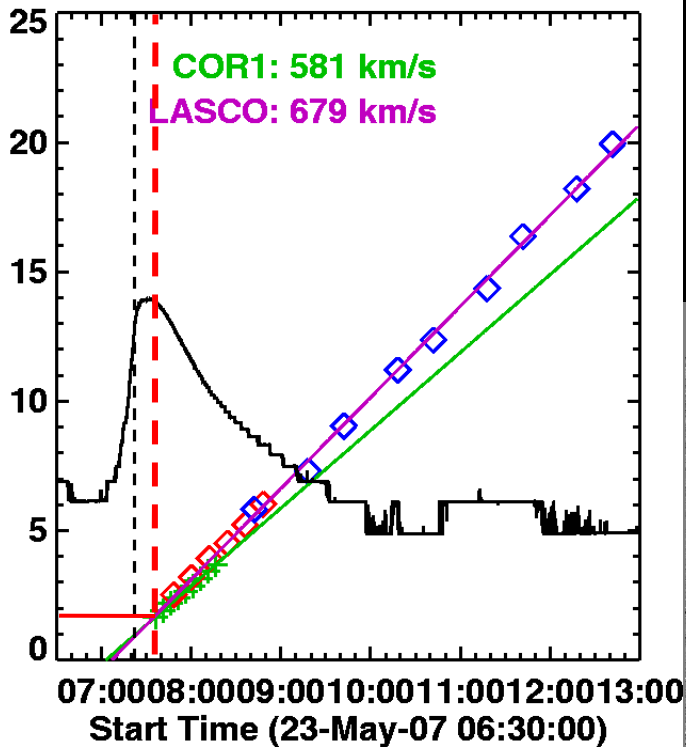
2007-05-23 00:12:49

COR1 & COR2

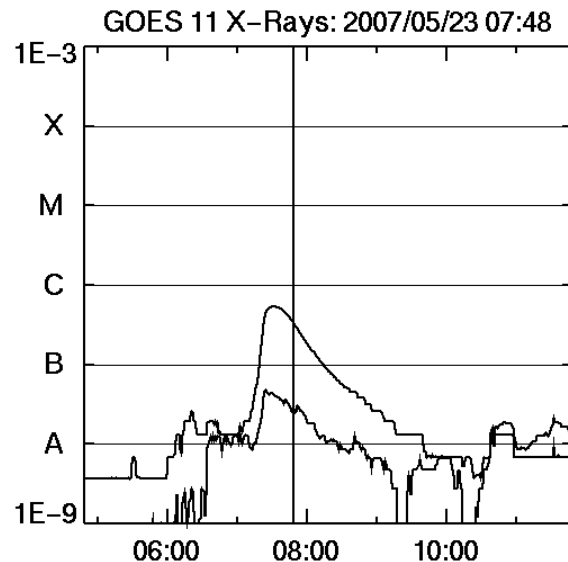
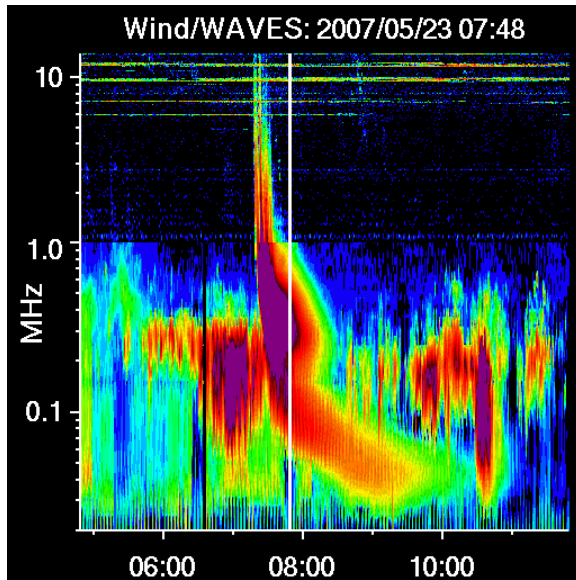




2007/05/23 07:22

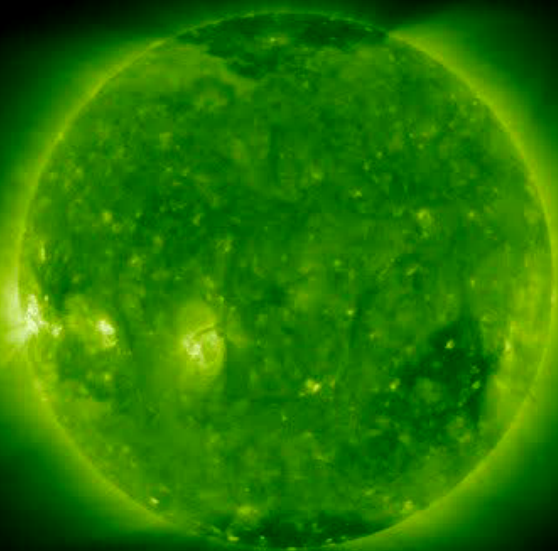


Type II 7:22 – 7:33



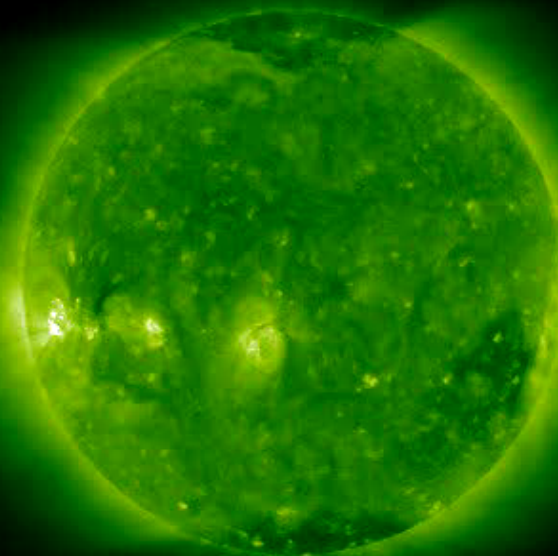
2007/06/03 AR960 S06E63 or Backsided?

STEREO Ahead EUVI 195



2007-06-03 00:05:30

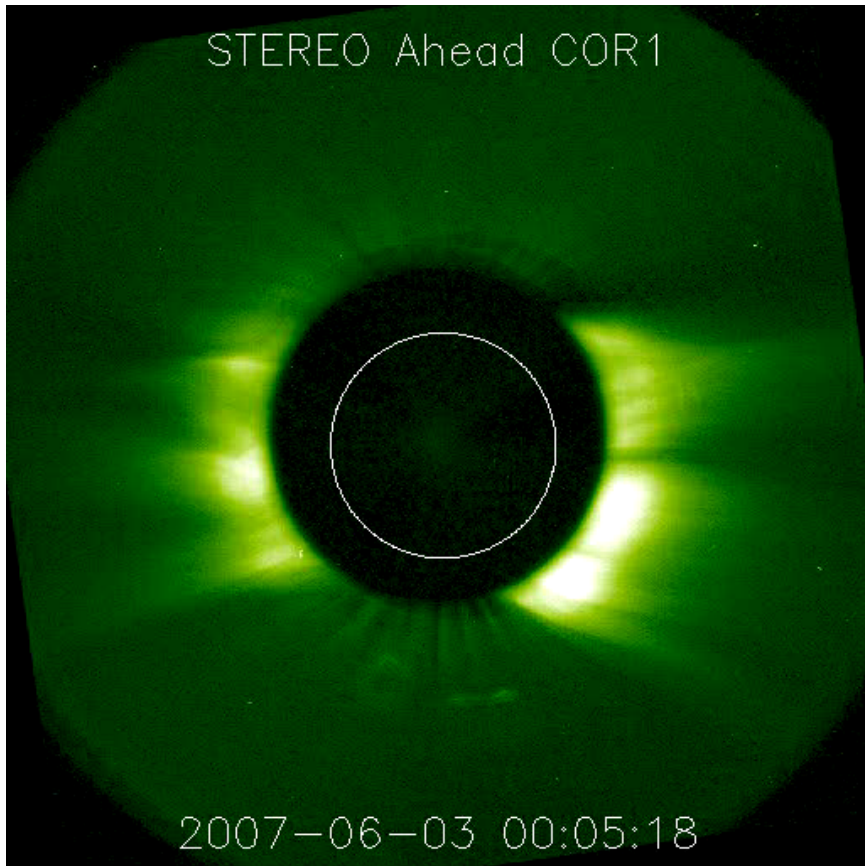
STEREO Behind EUVI 195



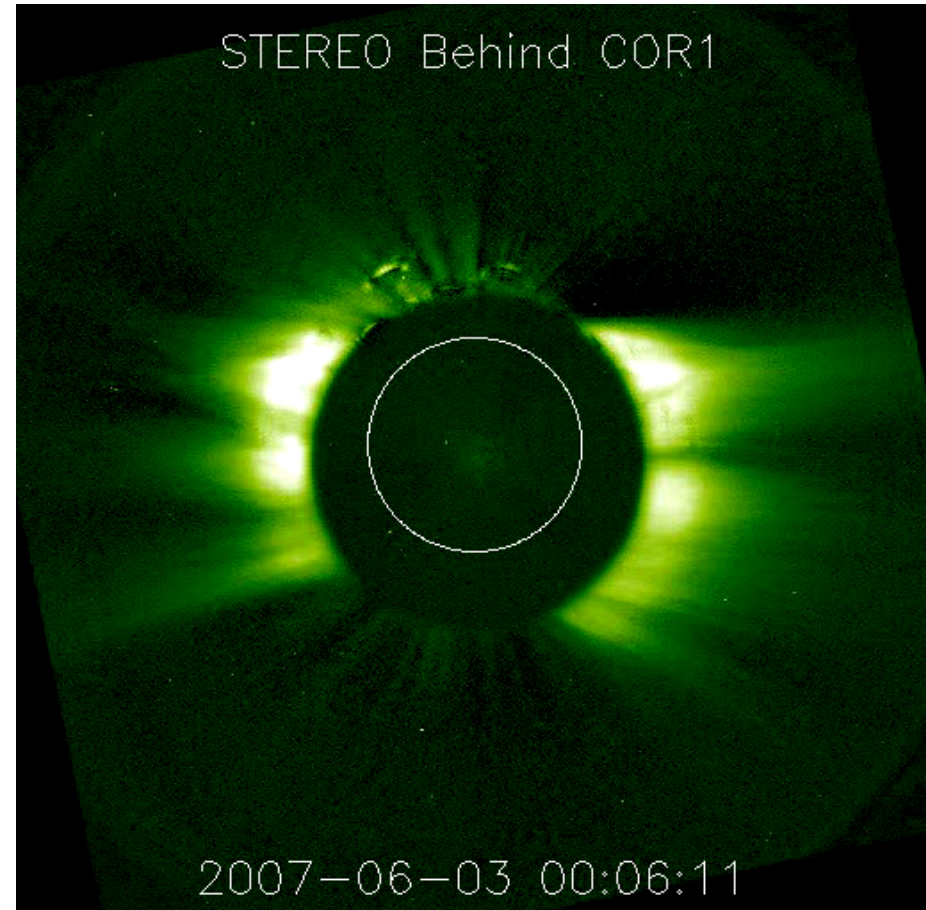
2007-06-03 00:06:23

COR1

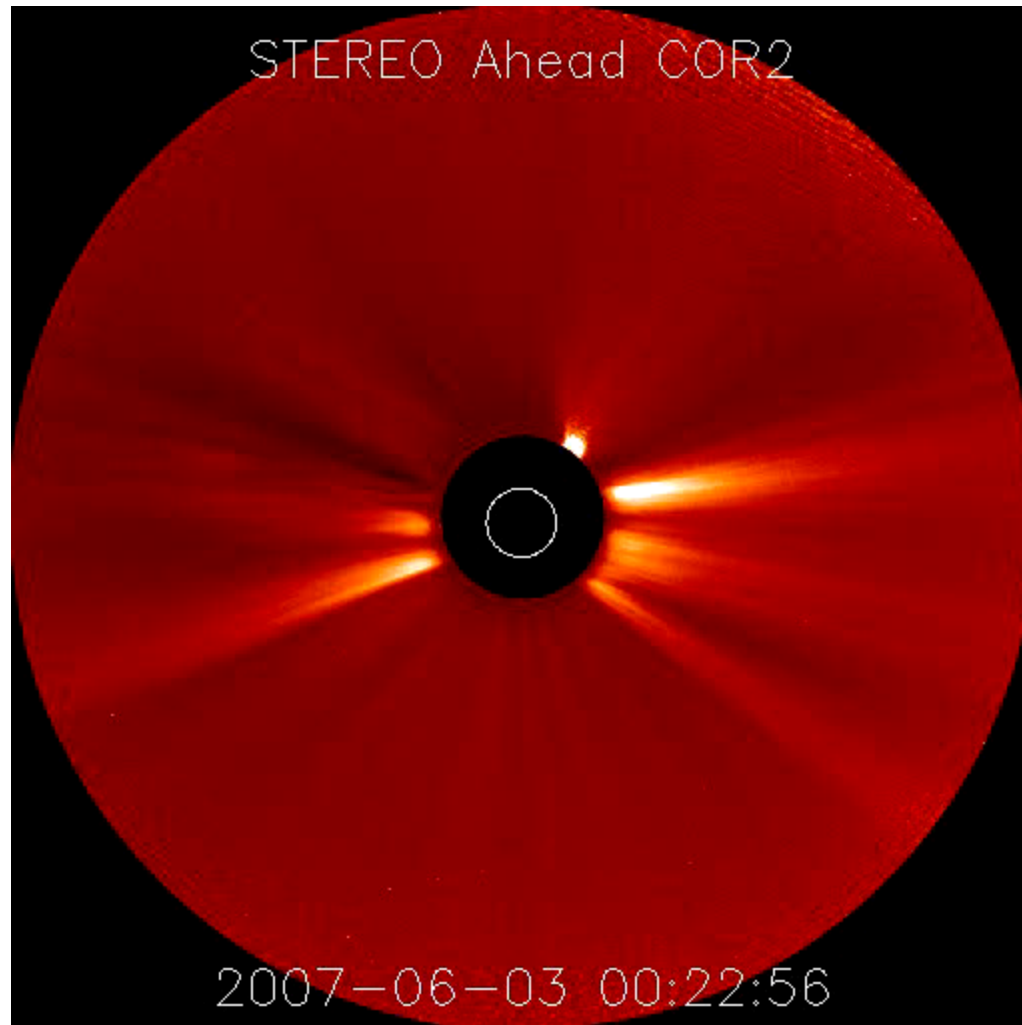
STEREO Ahead COR1



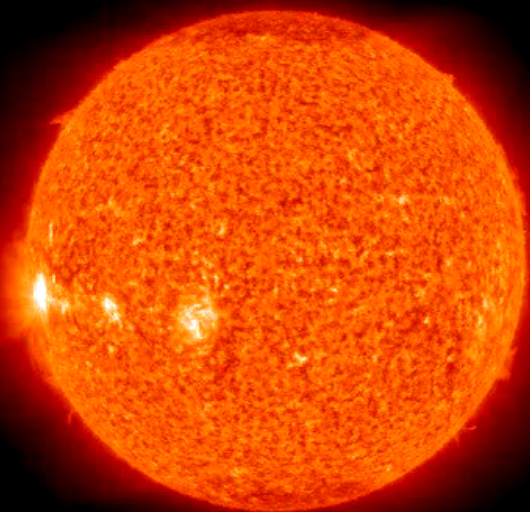
STEREO Behind COR1



COR2

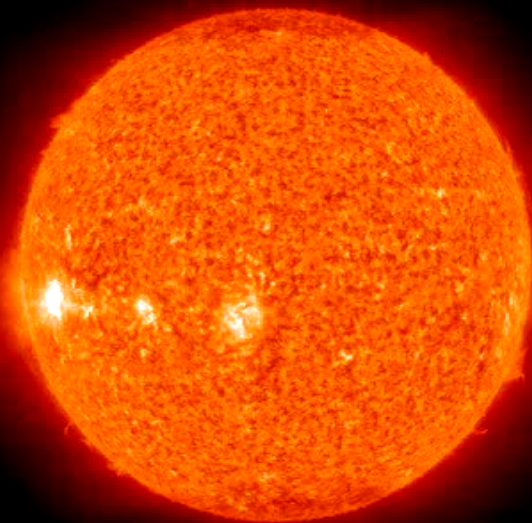


STEREO Ahead EUVI 304



2007-06-03 00:06:15

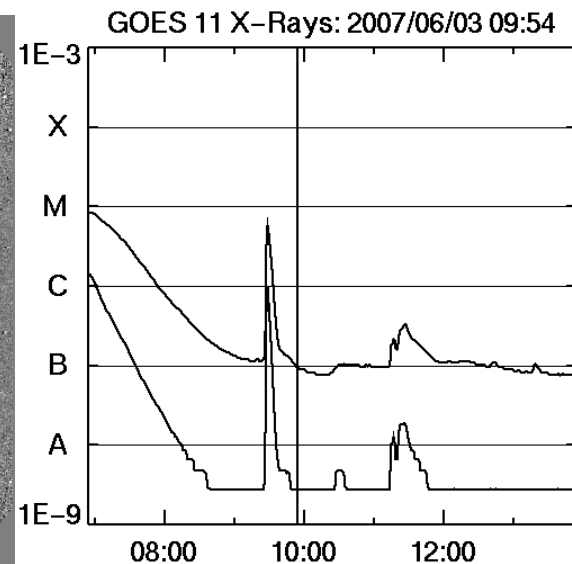
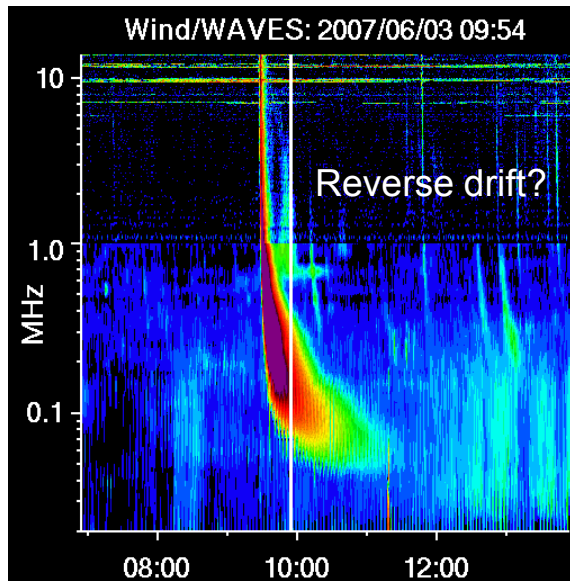
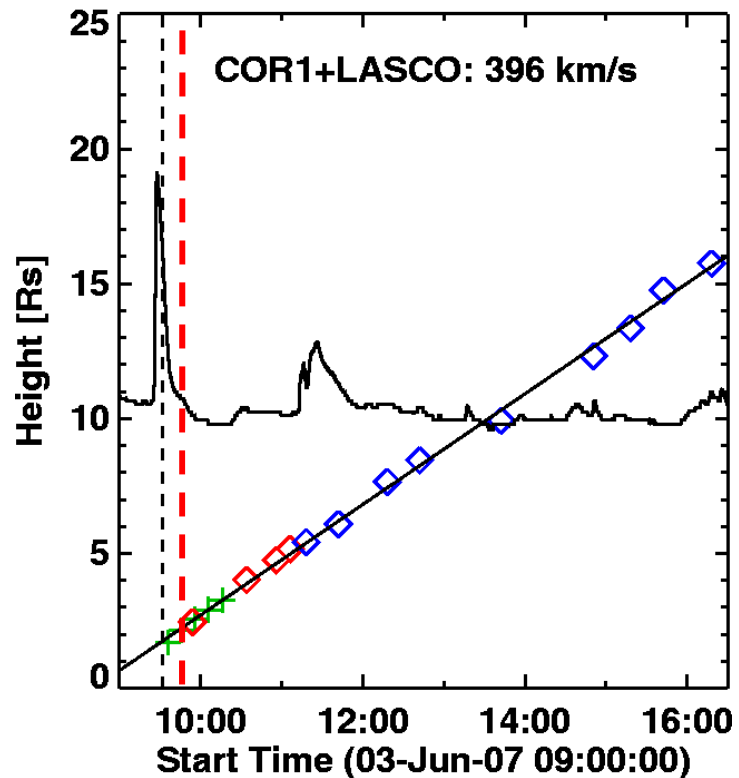
STEREO Behind EUVI 304

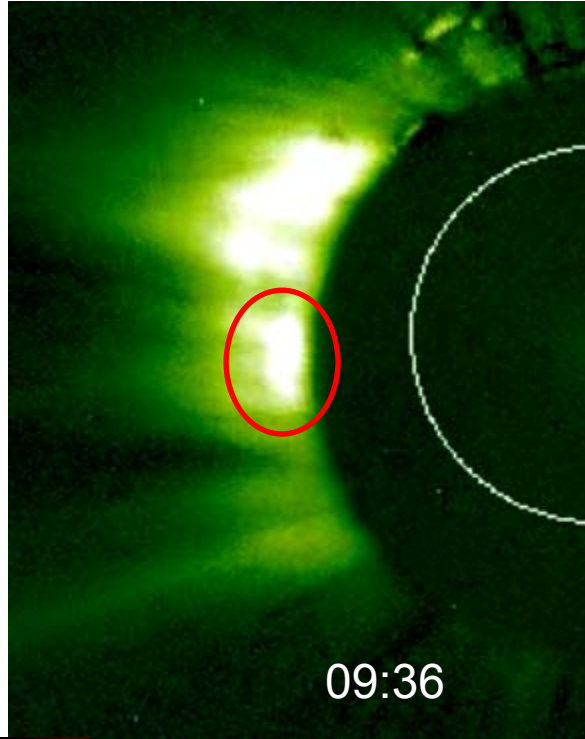
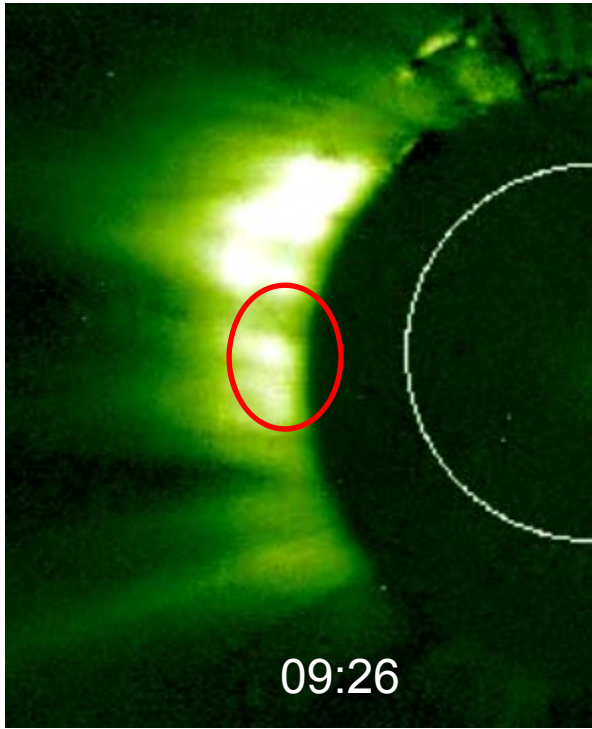


2007-06-03 00:07:08

Type II
09:28-09:42

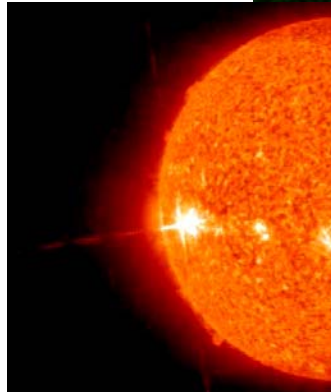
2007/06/03 09:32



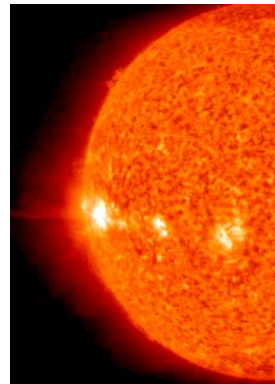


Type II
09:28 – 09:42

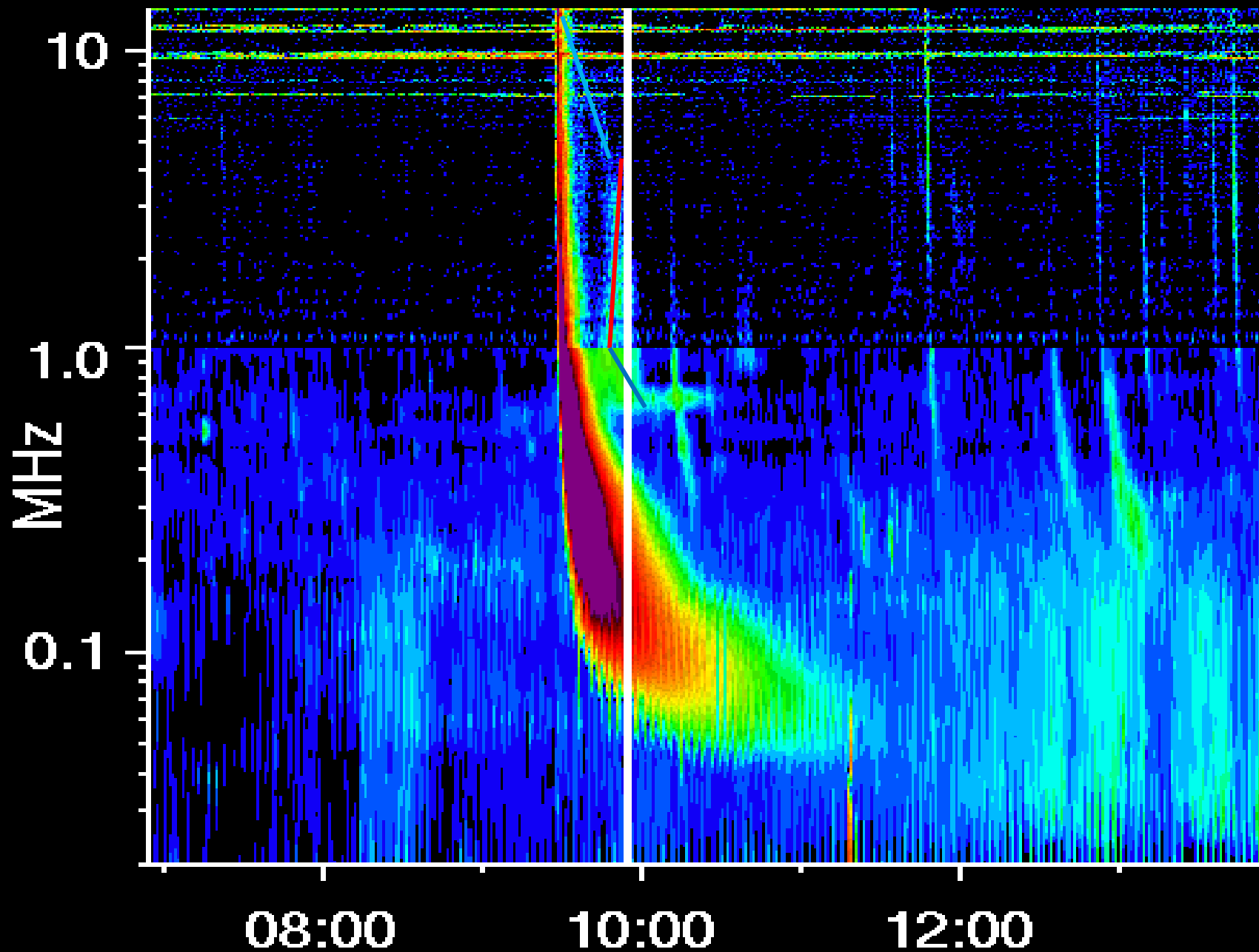
09:27



09:56



Wind/WAVES: 2007/06/03 09:54



Speed increase in the metric corona

Shock travels with a speed V emitting at successively lower f determined by the local plasma density:

$$n \sim r^{-\alpha} \quad \text{or} \quad f \sim r^{-\alpha/2}$$

$$|df/dt| = V(df/dr) \sim Vf^{(\alpha+2)/\alpha} = Vf^2$$

if $V=\text{const.}$ & $\alpha=2$ (Vrsnak et al., 2001)

If speed varies: $V \sim r^{-\beta} \sim f^{2\beta/\alpha}$

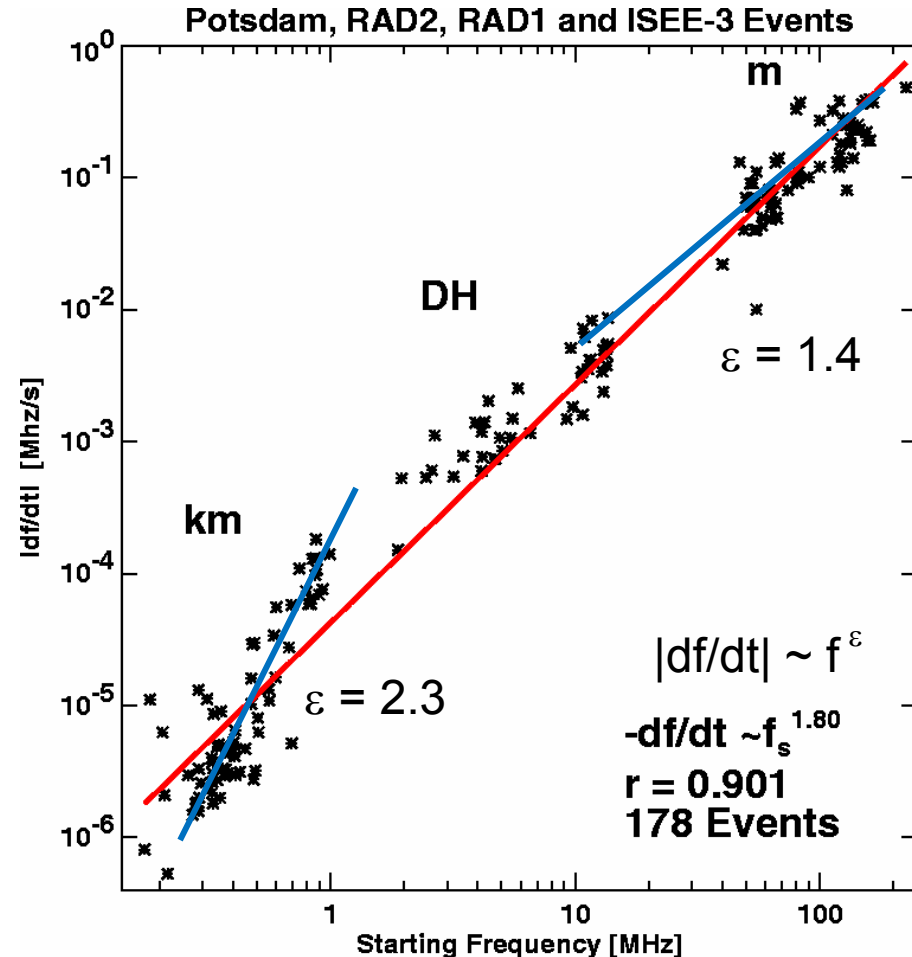
$$|df/dt| \sim f^{(\alpha+2\beta+2)/\alpha} = f^\varepsilon \quad \text{with} \quad \varepsilon = (\alpha+2\beta+2)/\alpha$$

$$\varepsilon = 2+\beta \quad \text{for} \quad \alpha=2$$

$$\beta = -0.6 \quad \text{for} \quad m \text{ type II } (V \uparrow) \quad \text{so} \quad \varepsilon = 1.4$$

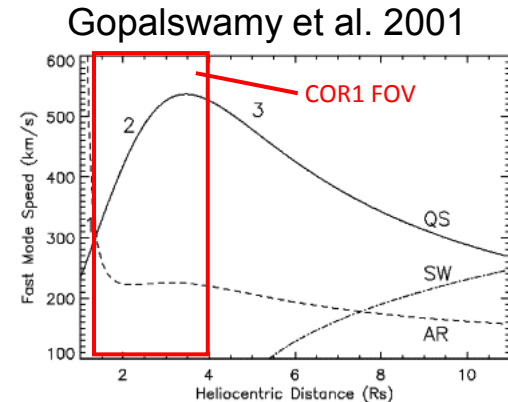
$$\beta = 0.3 \quad \text{for} \quad km \text{ type II } (V \downarrow) \quad \text{so} \quad \varepsilon = 2.3$$

Driver with a steady speed: CME



Summary

- All metric type II bursts have associated CMEs in overlapping spatial domain
- COR1 speeds \leq C2 speed: explains drift rate spectrum
- Type II bursts associated with EUV waves
- SWAVES data consistent with type II CME hierarchy
- Space speed of CME to be obtained by combining STEREO A and B data



Future Prospects

Sudden decline at 100 Rs (Manoharan et al.)

Radio observations not consistent

Take limb mkm events

Get CME height as a function of frequency

Get CME heights when type 2 at 1 MHz

Get CME heights when type 2 at 10 MHz

Histograms: Deceleration starts much earlier than IPS?

Explaining universal drift rate relationship

1) Take mkm limb events

2) Compute speed from first c2 points

3) Speed from all C2 points

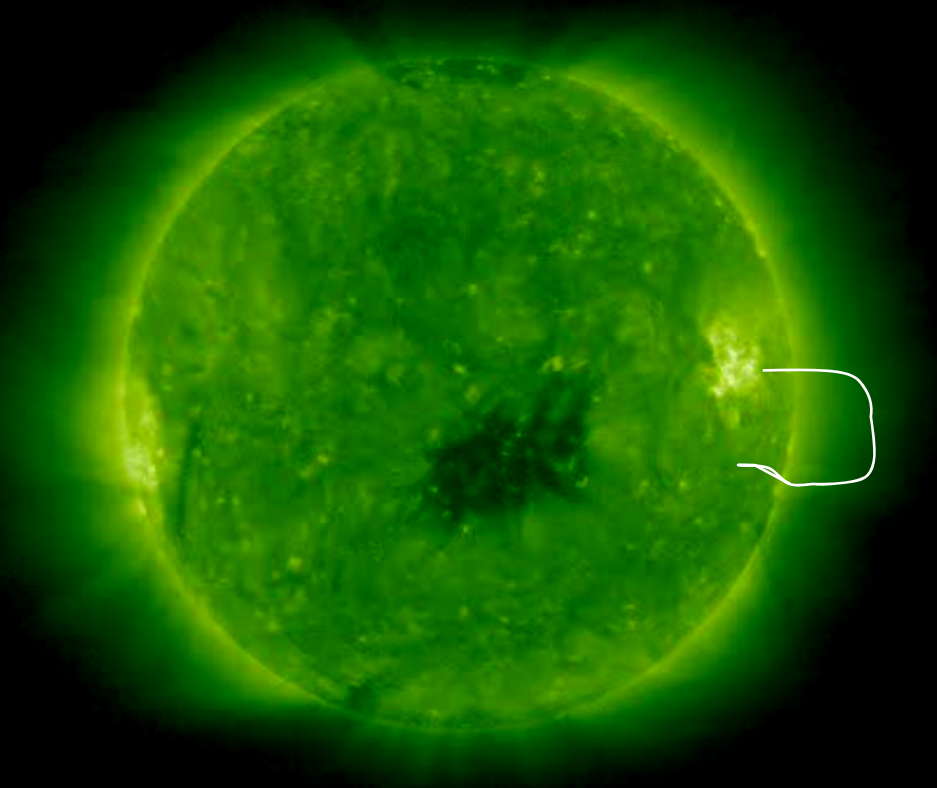
4) Speed from all c3 points

5) Expect increase in speed and then decrease

2007/05/23 EUVI

STEREO Behind EUVI 195

07:12:50



STEREO Behind EUVI 195

07:22:50

