



# Comprehensive analysis of CME propagation speeds in STEREO COR2 and HI1 instruments

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M. Venzmer, N. Mrotzek, R. Harrison, C. Möstl & P. Boakes



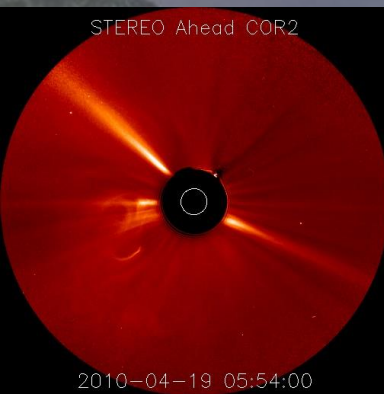
# HELCAAT COR2-HI1 CME lists (2007-2011)

## UGOE/GCS

“GCS modeling results list” (241 events, COR2-A & B)

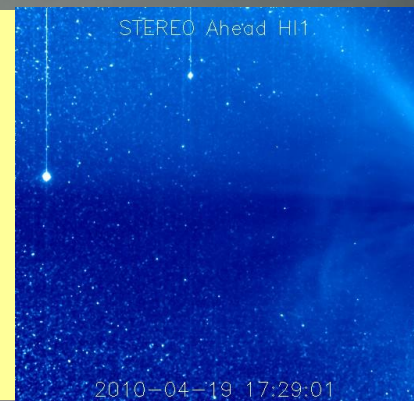
## RAL -List

CME HI-1 List (496 events)



## Criteria/Indicators for “positiv match”:

- Date, Time (COR2, HI1)
- SR Lat (COR2) <-> PA (HI1)
- SOHO & CAT CME Speed (COR2),  
Speed from FPF, SSEF, HMF (HI1)



109 CMEs visible in COR A&B and HI1 A or B



# HELCASTS COR2-HI1 database

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Your search returned 109 results.

HEL no	CME no	Preevent date	Preevent time	Last Cor2 date	Last Cor2 time	GCS carlon	GCS stoney lon	GCS lat	GCS tilt	GCS Asp. Ratio	GCS h_angle	HI first date	HI first time	APEX SPEED	CME-Mass	SpeedFPF
[-]	[-]	[yyyymmdd]	[hh:mm:ss]	[yyyymmdd]	[hh:mm:ss]	[deg]	[lon,old]	[deg]	[deg]	[-]	[deg]	[yyyymmdd]	[hh:mm:ss]	[km/s]	[g]	[km/s]
1	35	09.05.2007	02:22:30	09.05.2007	12:52:30	88	-116	1	-17	0,43	10,06	09.05.2007	10:50	282	9,5E+15	256
2	38	15.05.2007	18:52:30	16.05.2007	01:22:30	39	-79	13	52	0,35	28,23	16.05.2007	00:50	352	4,00E+15	352
3	49	04.06.2007	17:00:00	05.06.2007	09:23:59	320	111	-10	2	0,45	27,95	05.06.2007	09:29	192	3,75E+15	319
4	50	07.06.2007	18:30:00	08.06.2007	03:54:00	240	68	-12	-10	0,26	17,05	08.06.2007	03:29	292	1,60E+15	469
5	60	08.07.2007	16:52:30	09.07.2007	00:52:30	55	-69	-8	7	0,23	24,6	08.07.2007	22:49	337	5,00E+14	504
6	71	21.08.2007	07:00:00	21.08.2007	14:23:00	25	118	-13	33	0,24	13,14	21.08.2007	15:30	409	2,85E+15	407
7	78	08.10.2007	14:20:00	09.10.2007	01:24:00	40	52	10	1	0,3	12,58	09.10.2007	00:49	238	2,75E+15	334
8	83	04.11.2007	10:22:20	04.11.2007	22:52:20	310	-43	12	-27	0,3	18,45	04.11.2007	21:29	259	3,10E+15	425
9	86	16.11.2007	09:20:00	16.11.2007	16:23:00	323	125	-15	6	0,32	18,45	16.11.2007	20:09	344	1,55E+15	334
10	92	31.12.2007	00:22:20	31.12.2007	03:52:20	239	-93	-21	-12	0,68	5,59	31.12.2007	02:49	-	-	347
11	93	02.01.2008	09:52:20	02.01.2008	13:22:20	249	-52	-8	13	0,43	9,5	02.01.2008	12:49	773	-	681

# HELCATS COR2-HI1 database

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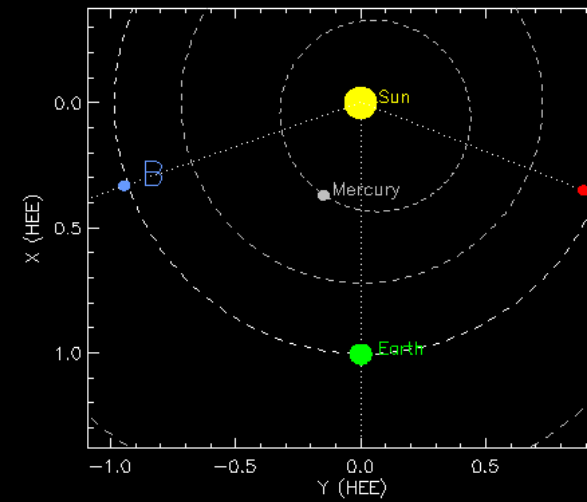
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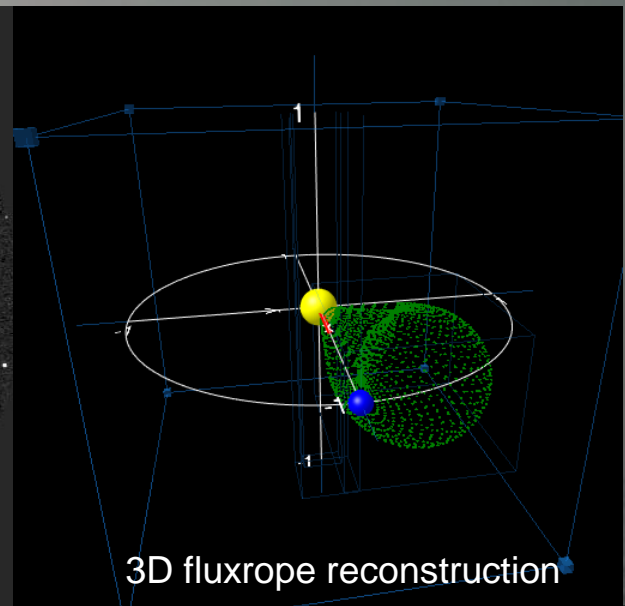
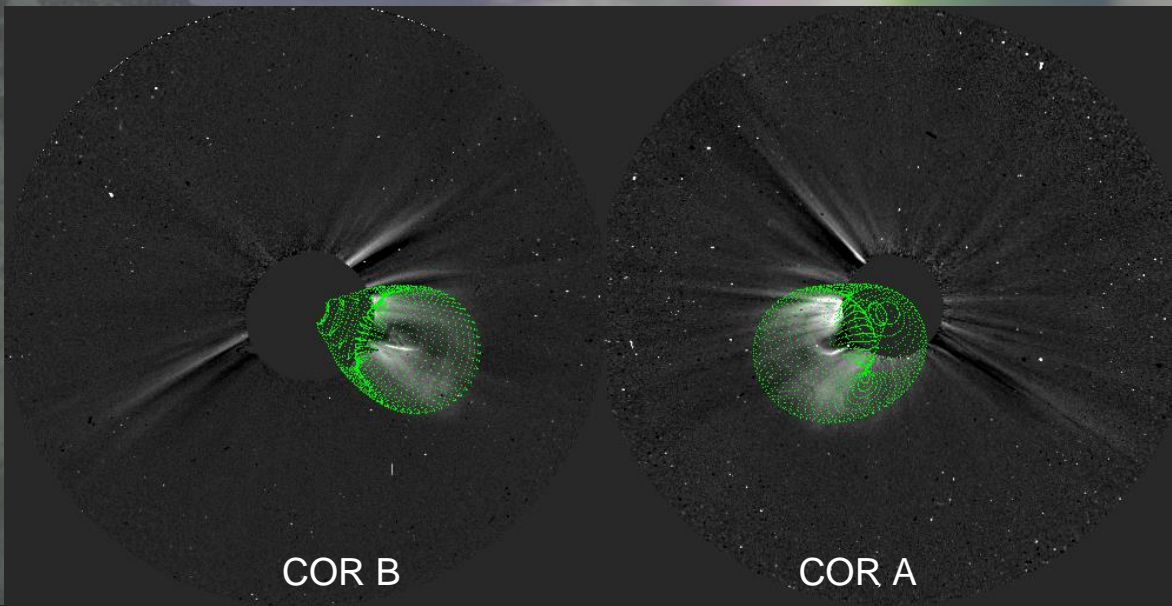
Your search returned 109 results.

CS lon	GCS stoney lon	GCS lat	GCS tilt	GCS Asp. Ratio	GCS h_angle	HI first date	HI first time	APEX SPEED	CME-Mass	SpeedFPF	FPF LON	FPF LAT	SpeedSSEF	SSEF LON	SSEF LAT	SpeedHMF	HMF LON	HMF LAT
[deg]	[lon,old]	[deg]	[deg]	[-]	[deg]	[yyyymmdd]	[hh:mm:ss]	[km/s]	[g]	[km/s]	[deg]	[deg]	[km/s]	[deg]	[deg]	[km/s]	[deg]	[deg]
88	-116	1	-17	0,43	10,06	09.05.2007	10:50	282	9,5E15	256	-92	0	274	-105	1	297	-120	1
39	-79	13	52	0,35	28,23	16.05.2007	00:50	352	4,00E+15	352	-47	7	368	-53	8	378	-59	8
320	111	-10	2	0,45	27,95	05.06.2007	09:29	192	3,75E+15	319	92	0	347	107	0	381	123	0
240	68	-12	-10	0,26	17,05	08.06.2007	03:29	292	1,60E+15	469	57	-22	479	61	-23	485	66	-23
55	-69	-8	7	0,23	24,6	08.07.2007	22:49	337	5,00E+14	504	-72	11	546	-86	9	593	-102	7
25	118	-13	33	0,24	13,14	21.08.2007	15:30	409	2,85E+15	407	76	-15	437	90	-16	475	106	-16
40	52	10	1	0,3	12,58	09.10.2007	00:49	238	2,75E+15	334	34	8	343	38	8	348	43	8
310	-43	12	-27	0,3	18,45	04.11.2007	21:29	259	3,10E+15	425	-33	9	440	-39	9	449	-44	10
323	125	-15	6	0,32	18,45	16.11.2007	20:09	344	1,55E+15	334	-44	9	343	-50	9	348	-56	10
239	-93	-21	-12	0,68	5,59	31.12.2007	02:49	-	-	347	-36	-24	391	-52	-25	430	-69	-25
249	-52	-8	13	0,43	9,5	02.01.2008	12:49	773	-	681	-56	-6	711	-66	-5	741	-77	-4

# Sample mass and velocity determination for a CME observed on 19 April 2010.

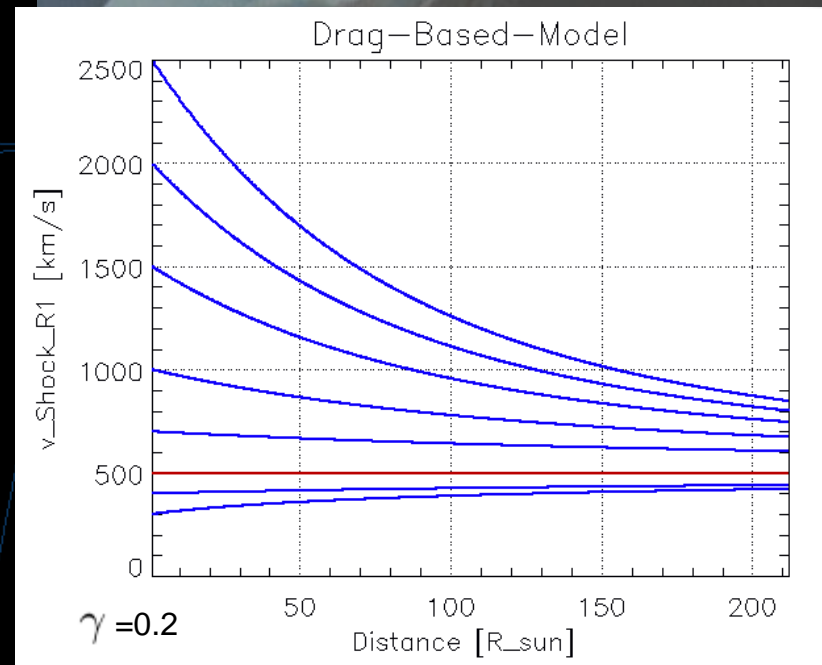
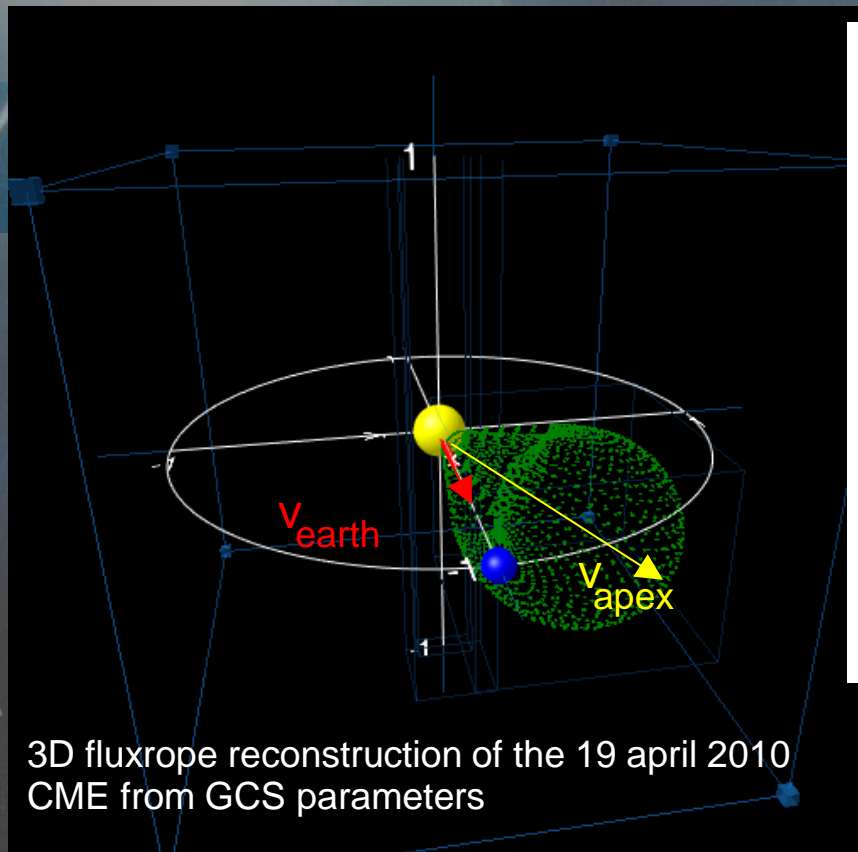


Positions of STEREO B and A 2010-04-19 14:00 U





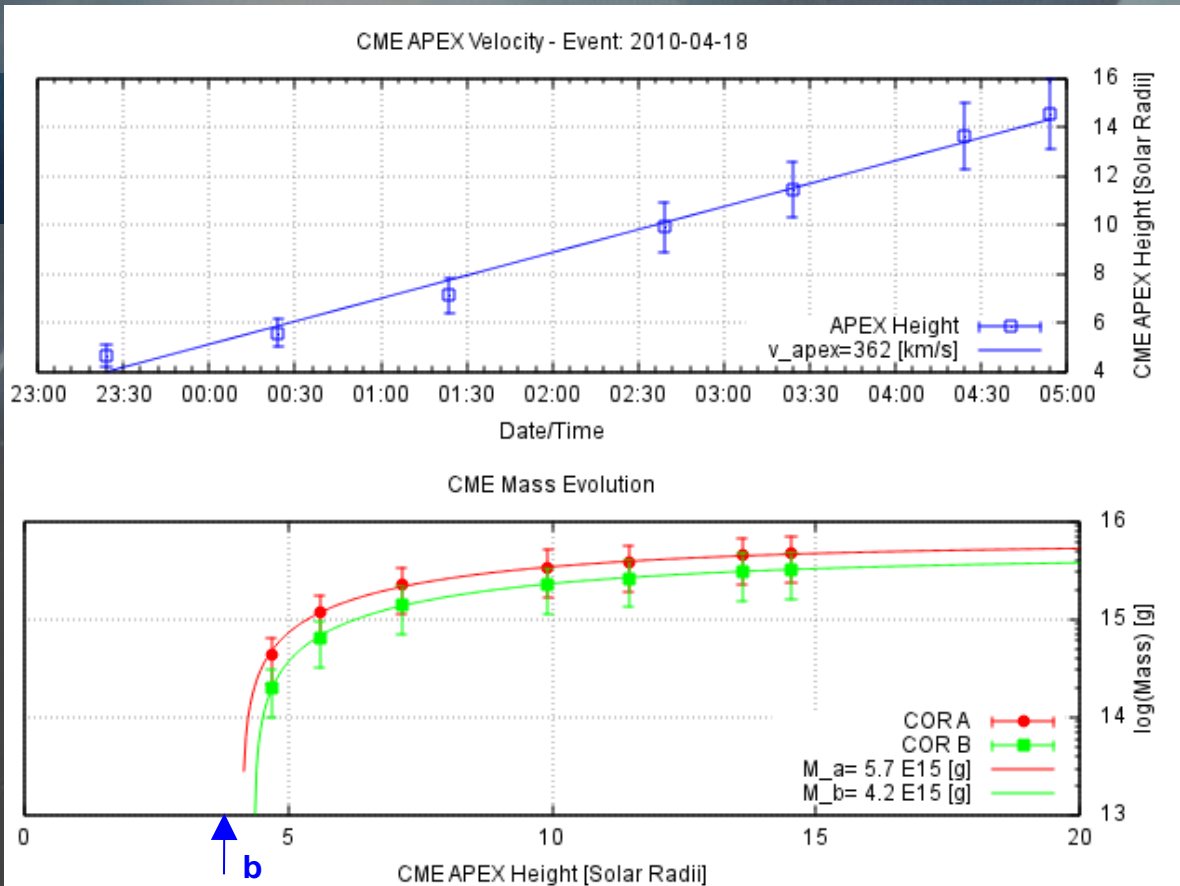
# How the calculation of the CME mass might improve arrival time predictions



$$\frac{d^2 r}{dt^2} = -\gamma(r) \left( \frac{dr}{dt} - w(r) \right) \left| \frac{dr}{dt} - w(r) \right|$$

DBM developed by Vršnak (2001)

# Demo result: Mass and velocity fitting



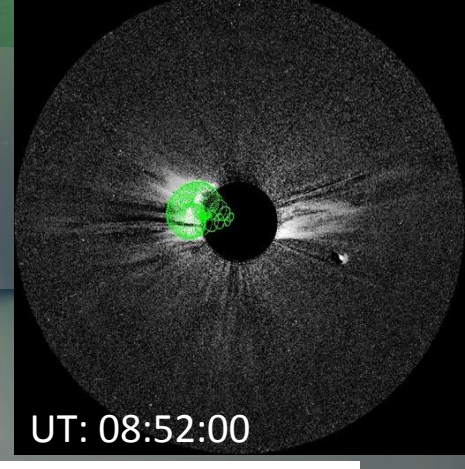
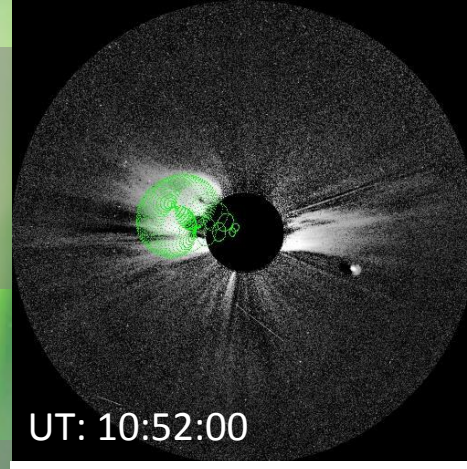
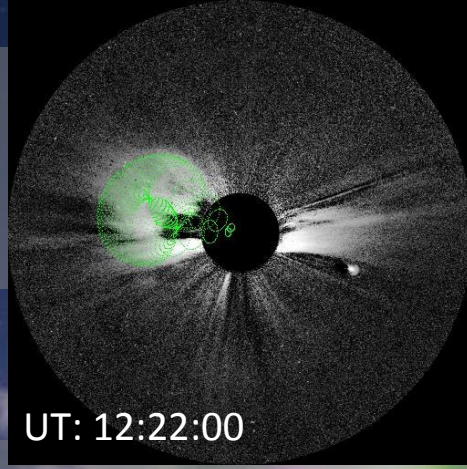
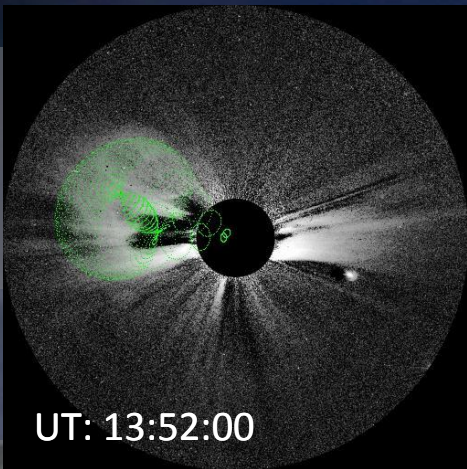
Used modified mass fitting function:

$$M_{CME}(h) = M_a \left( 1 - e^{-(h-b)/H_a} \right)$$

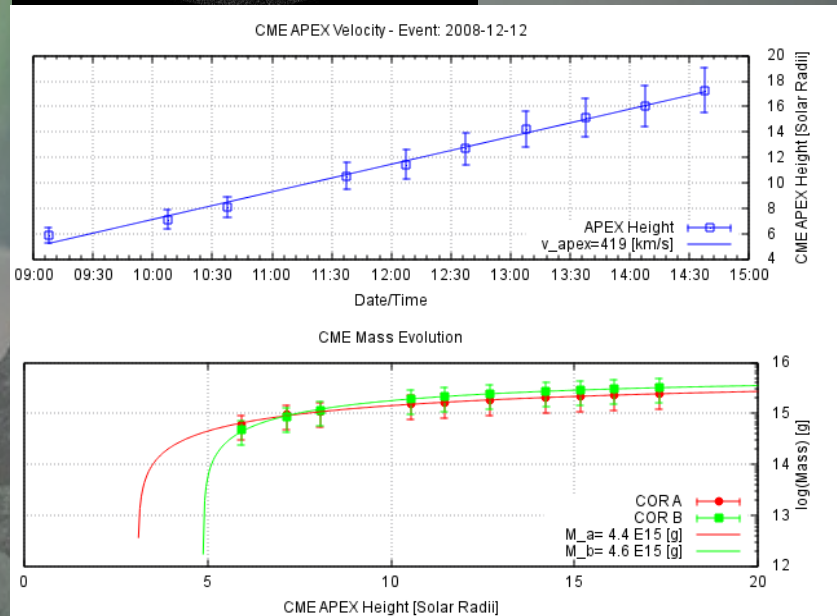
from Colaninno & Vourlidas (2009)

height of first visibility in COR

# HI Speed



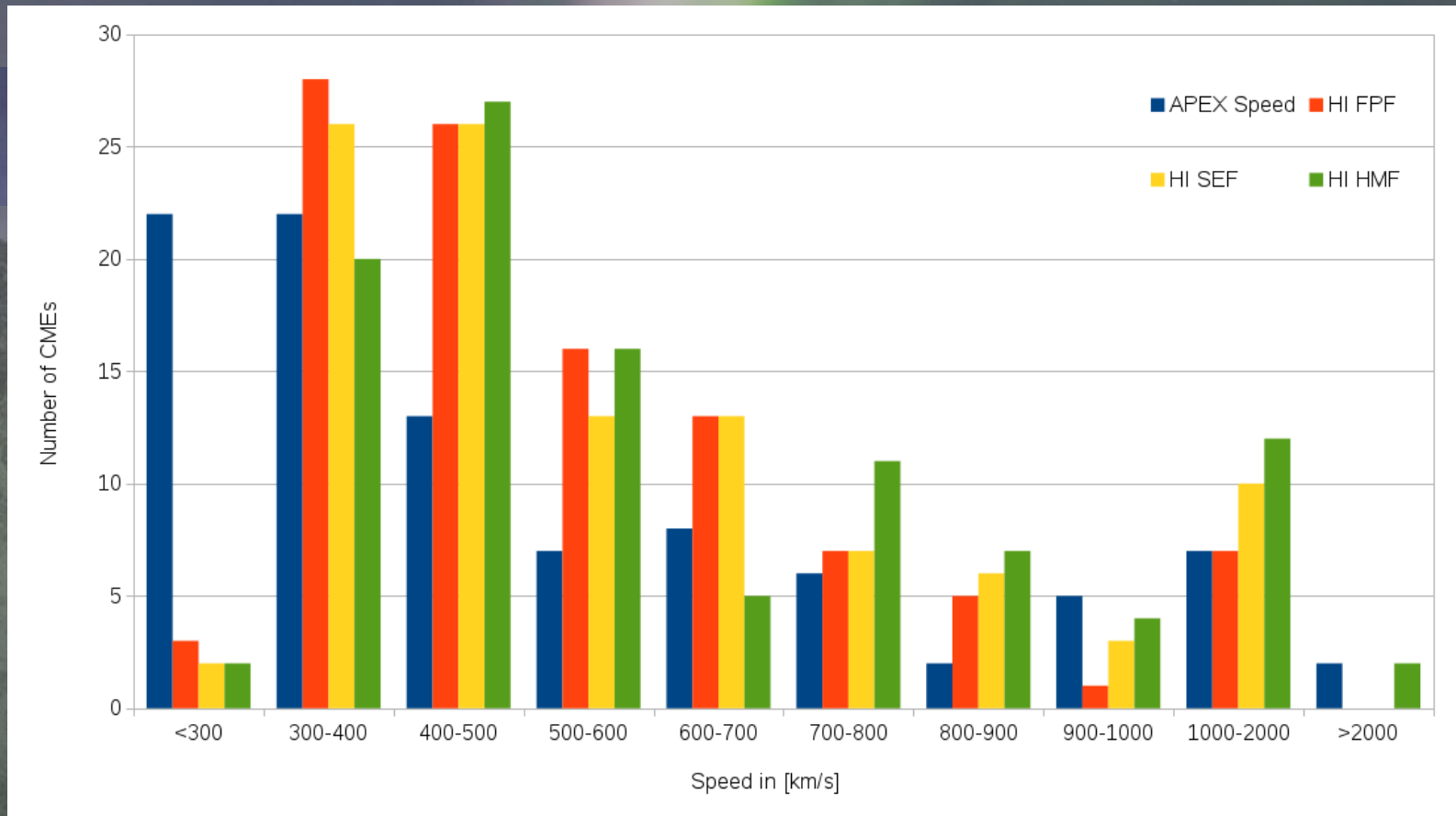
Time	Height	GCS	value
08:52:00	6.43	Longitude	70.434
10:52:00	9.29	Latitude	5.031
12:22:00	12.36	Tilt Angle	50.870
13:52:00	15.57	Aspect Ratio	0.268
14:22:00	16.07	Half Angle	10.061



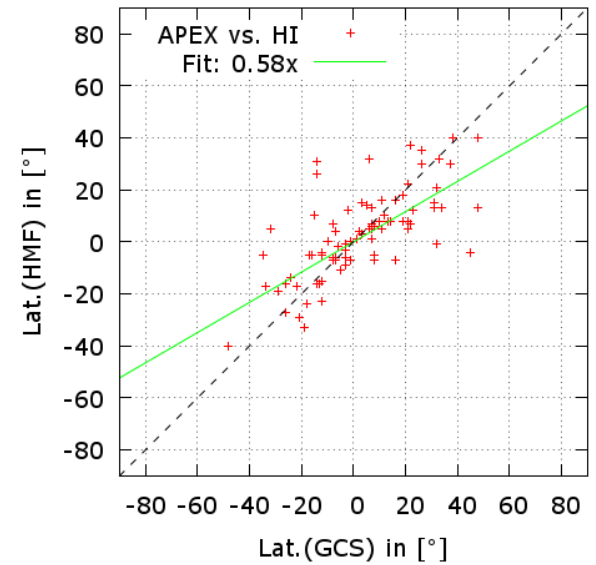
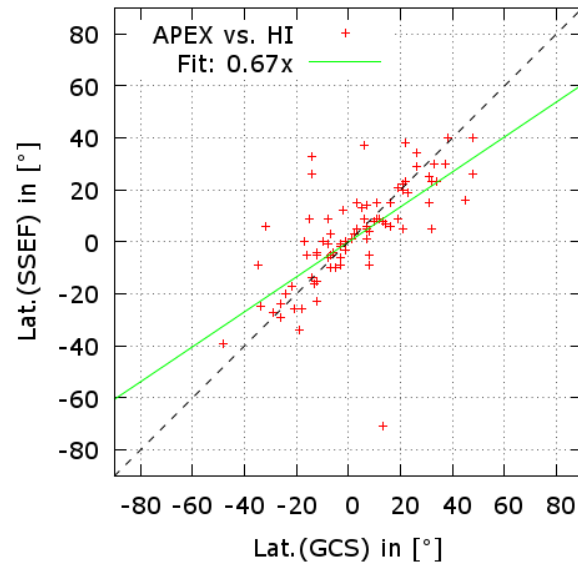
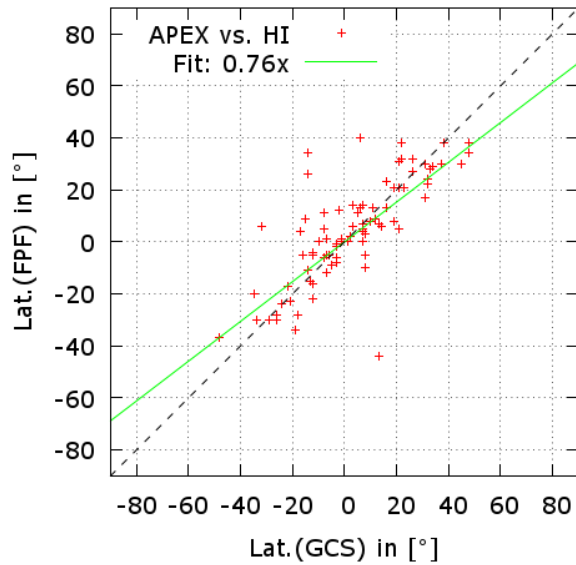
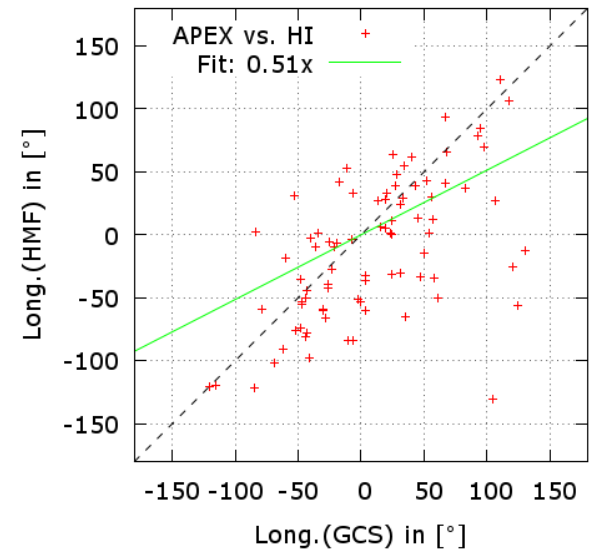
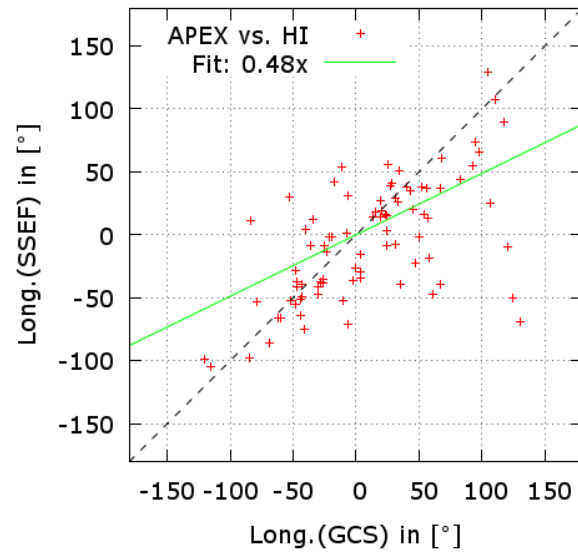
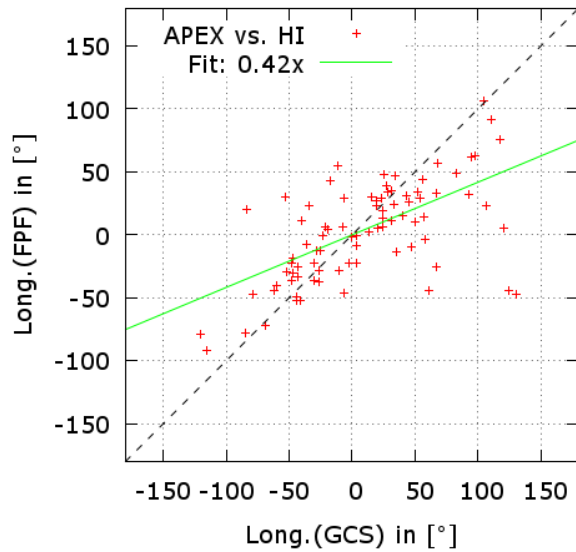
GCS parameters fixed apart from height



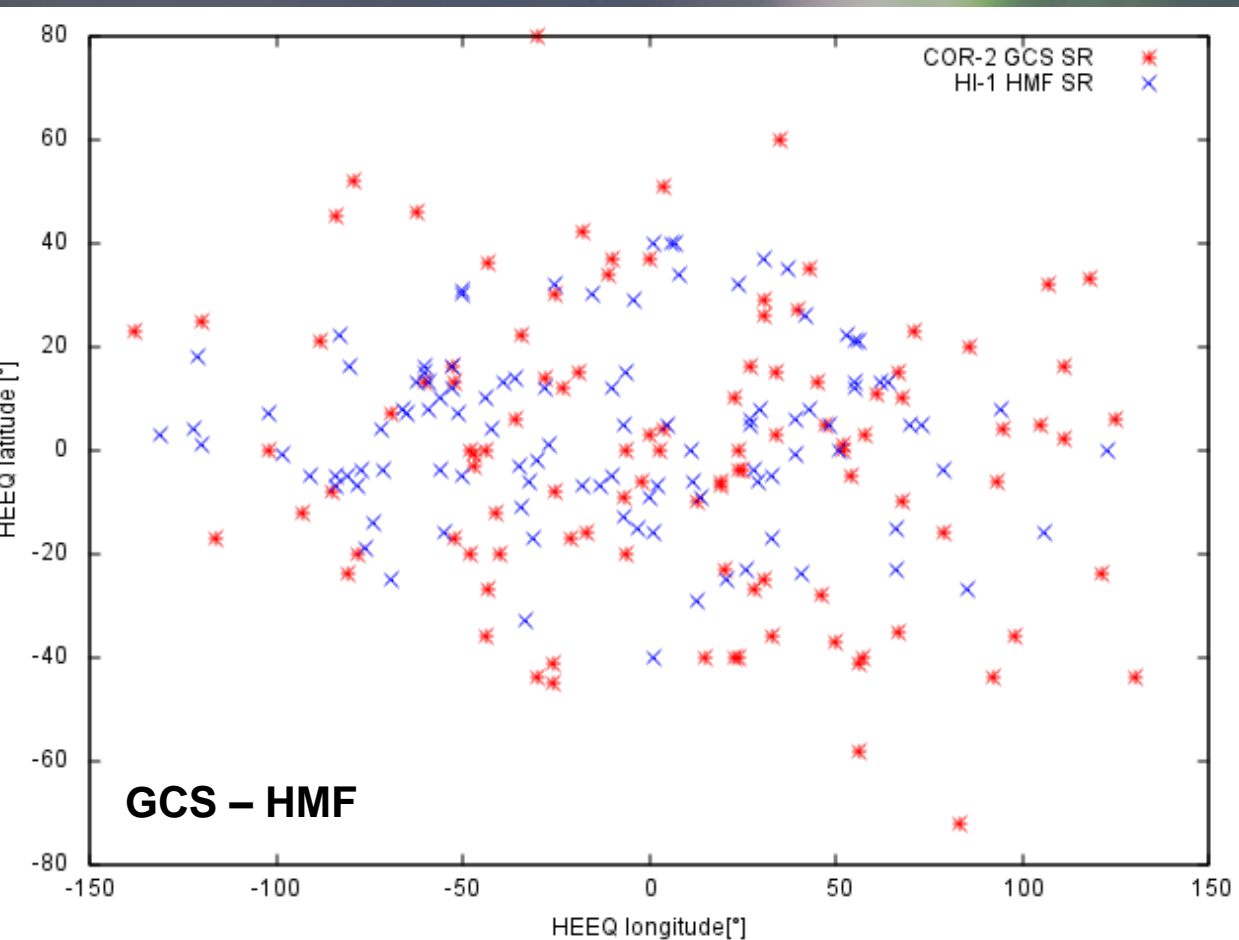
# Overview: determined CME speeds



# COR2-HI1 longitudes and latitudes



# Comparison of modelled source regions

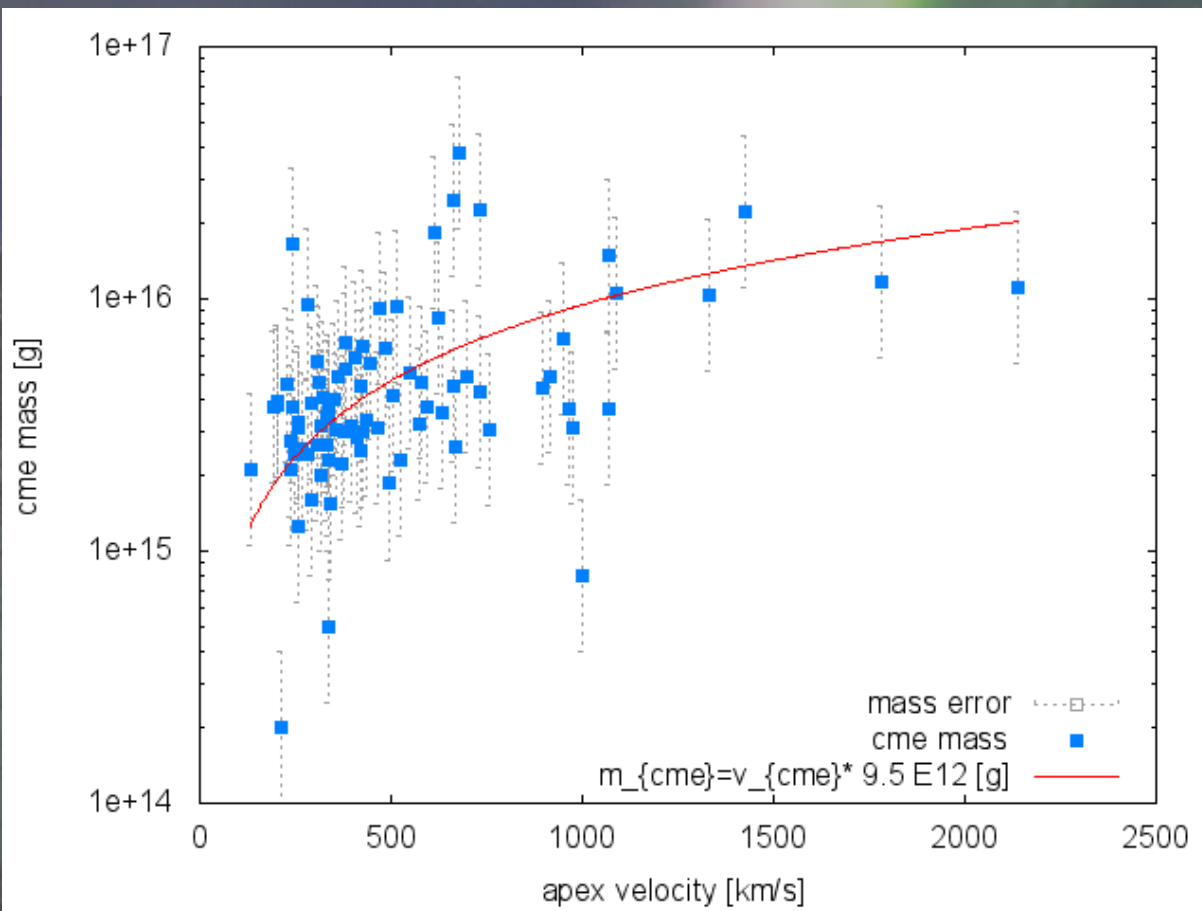


avg lon. shift:  $20^\circ$

avg lat. shift:  $+11^\circ$



## CME speed and mass correlation for HELCATS COR2 – HI1 list



The data analysis methods were developed in collaboration with the STEREO/SECCHI PI institution at the Naval Research Laboratory, Washington, DC, USA (A. Vourlidas, R. Howard, A Thernisien, N. Savani). The results will be made available through an online database catalogue under development.