

Interplanetary coronal mass ejections and interplanetary shocks at Venus, Earth and Mars

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Multispacecraft observations of near-Earth IP shocks

- ~ 80 IP shocks of different origin (ICME, SIR).
- Different missions used: Cluster, Themis/Arthememis, ACE, Wind.
- Shock parameters calculated (mach numbers, local shock normals, shock strengths).
- Range of inter SC distances from 40km – 10⁵ km.

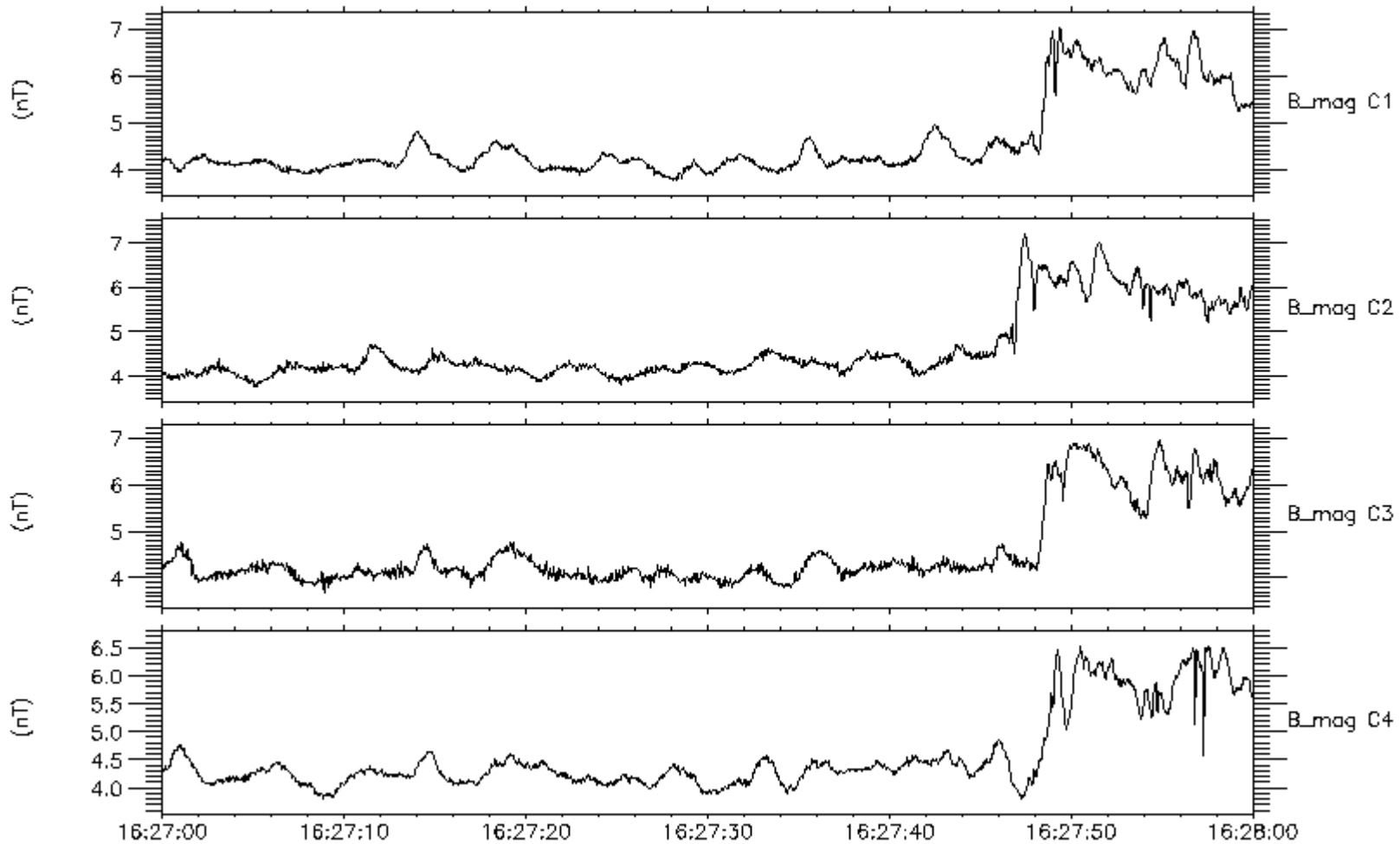
Year	Month	Day	Hour	Minute	Second	Spacecraft	B2/B1	N2/N1	\hat{I}^{SV} [km/s]	U_{Sun} [km/s]	V_a [km/s]	Ma1	Ma2	Ms	Mms	\hat{I}^2	Method	Shock normal			\hat{I}^{BN} [\hat{I}^{S}]	Minimum spacecraft separation [km]
																		Nx	Ny	Nz		
2001	1	10	15	19	41	ACE	1.62							1.41	1.06	1.41	MC	0.36	0.92	-0.15	48	1.08E-003
																	MX1					
																	MX2					
																	MX3					
																	VC					
			16	17	48	C1	1.67										MC	0.93	-0.1	-0.35	35	
																	MX1					
																	MX2					
																	MX3					
																	VC					
			16	17	47	C4	1.66										MC	0.92	-0.1	-0.39	38	
																	MX1					
																	MX2					
																	MX3					
																	VC					
			16	9	3	Win	1.36	1.73	29.37	-409	43.85	1.6	2.53				MC	0.99	0.06	-0.08	32	
																	MX1	0.98	0.12	-0.15	32	
																	MX2	0.98	0.14	-0.16	33	
																	MX3	0.97	0.16	-0.18	33	
																	VC	-0.92	-0.39	-0.06	52	
2001	1	17	15	31	51	ACE	1.92							0.38	1.28	8.35	MC	0.39	0.82	0.41	62	1.04E-002
																	MX1					
																	MX2					
																	MX3					
																	VC					
			16	27	49	C1	1.47										MC	0.88	0.26	0.39	45	
																	MX1					
																	MX2					
																	MX3					

<http://usuarios.geofisica.unam.mx/primoz/Shocks.html>

Possible uses:

1. Study of shock properties at different points in space.

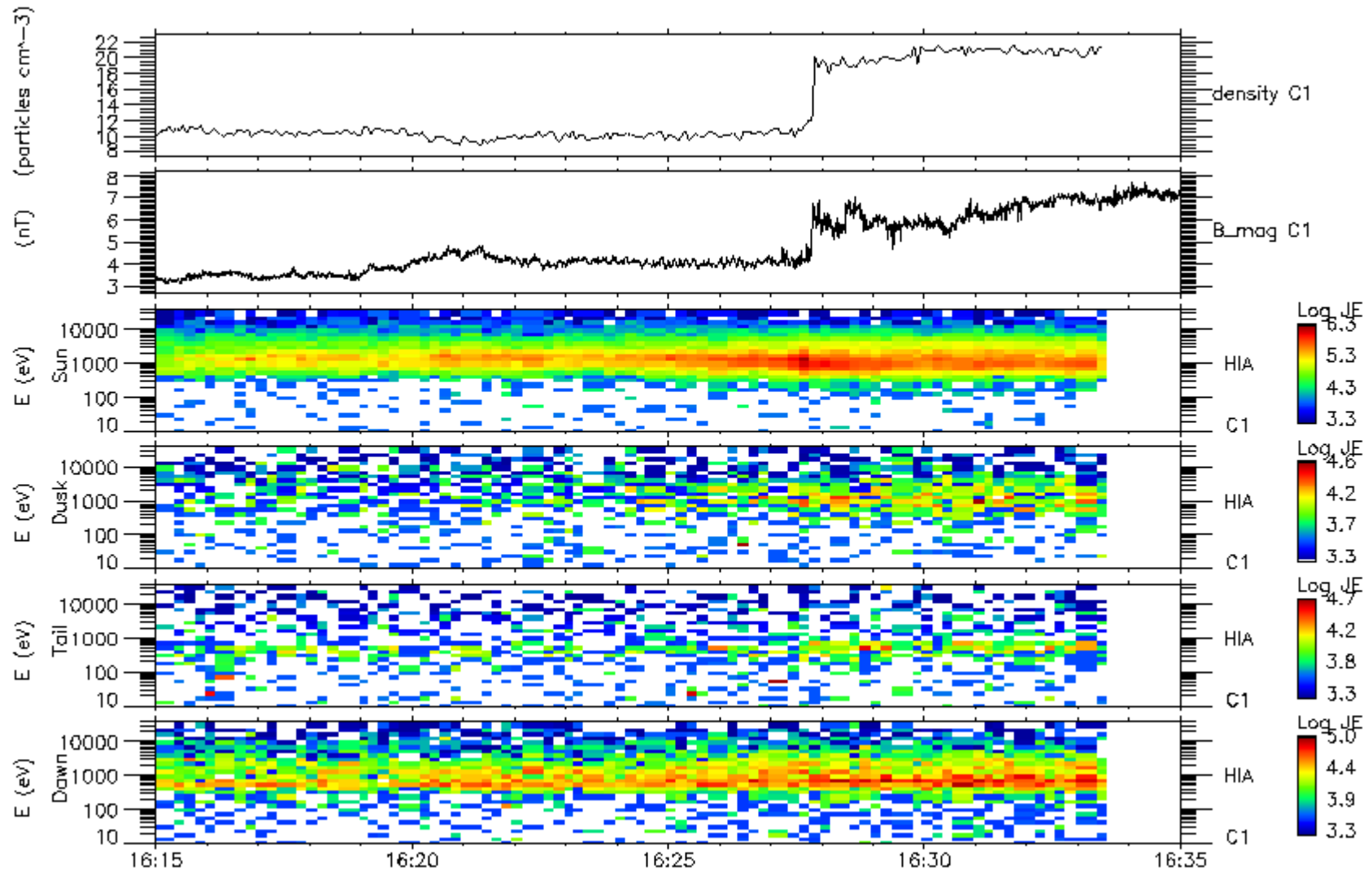
17/Jan/2001



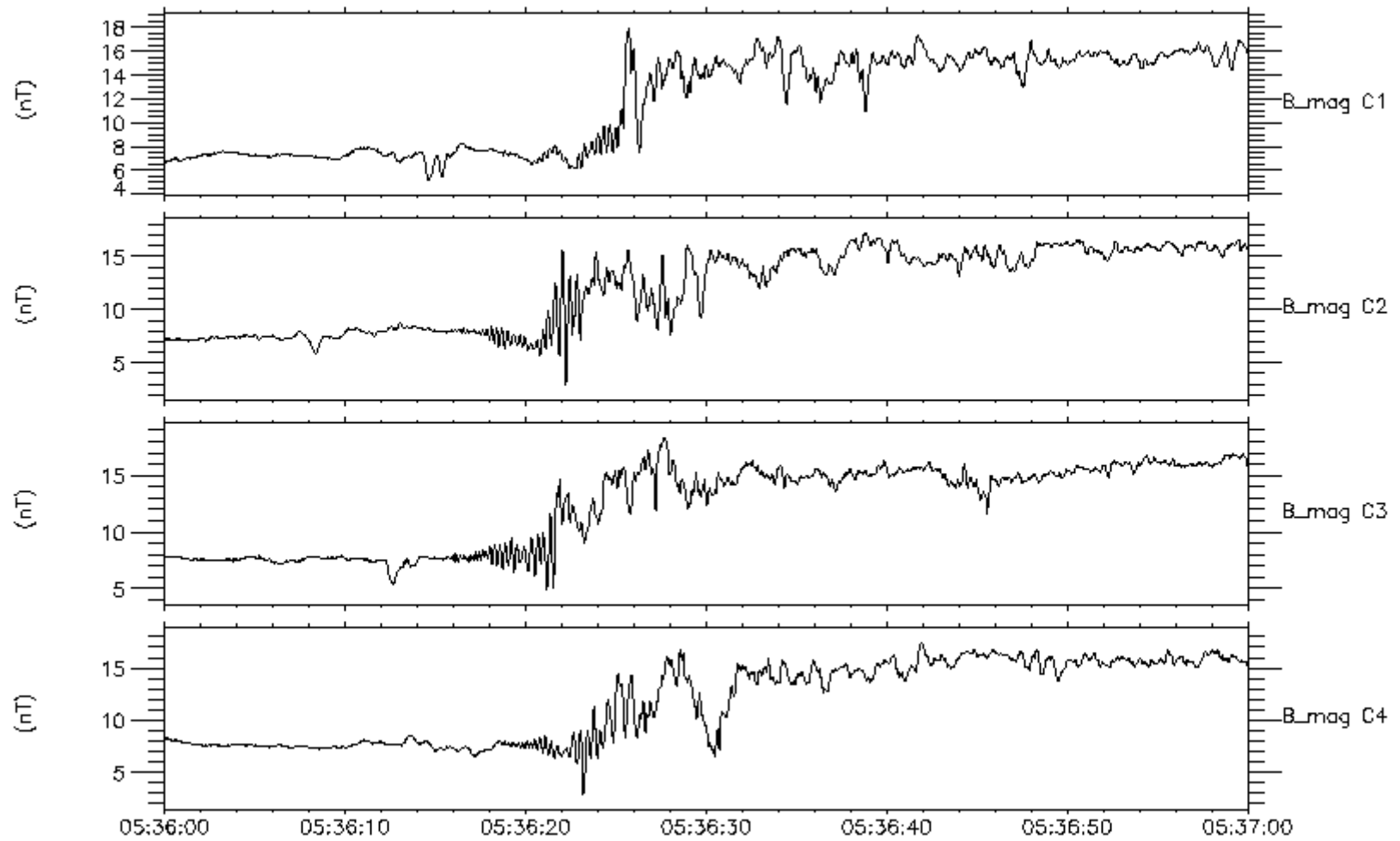
Minimum SC separation 200 km.

2. Study of IP foreshocks.

17/Jan/2001



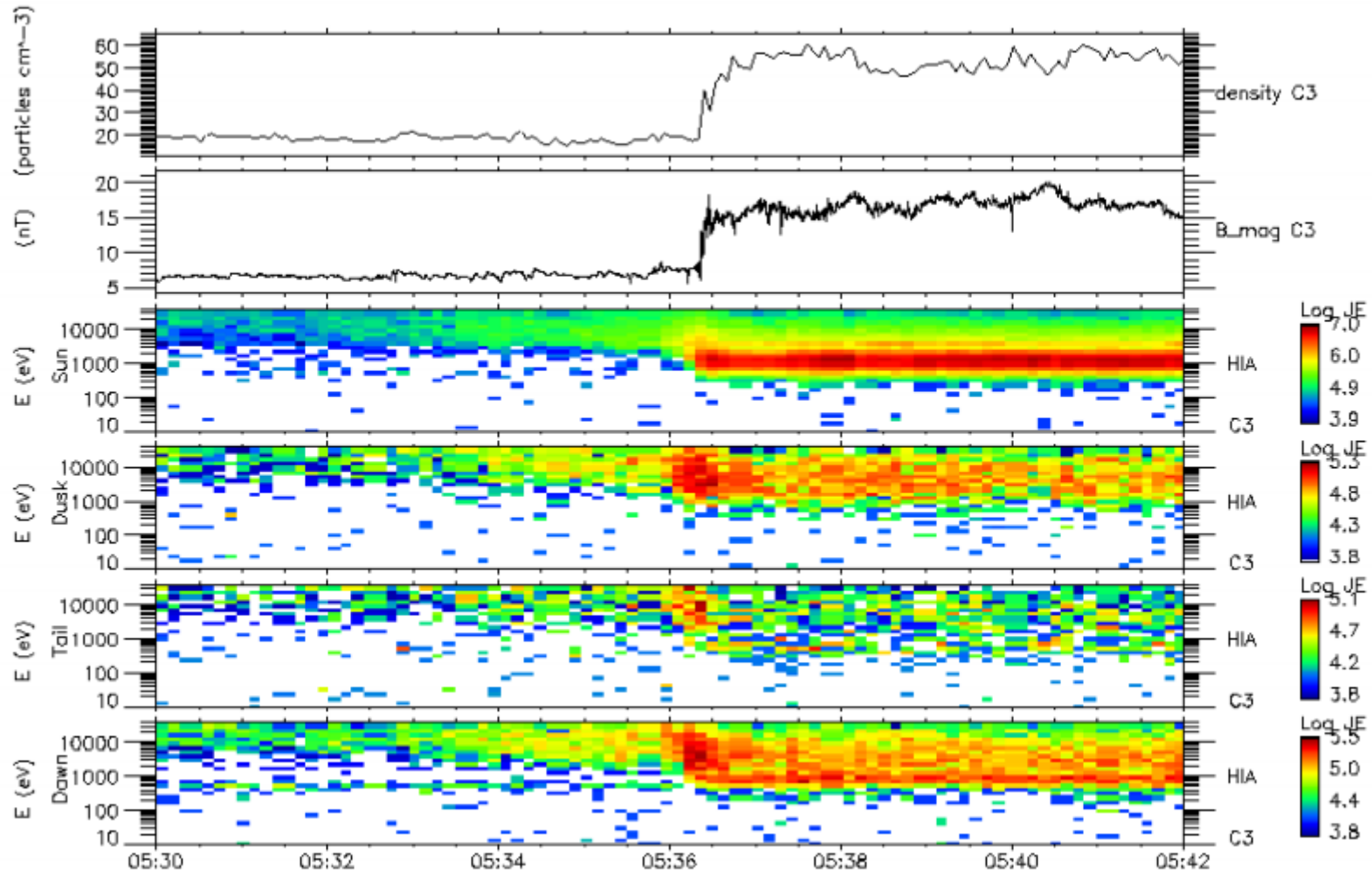
29/Dec/2001



Minimum SC separation 2000 km.

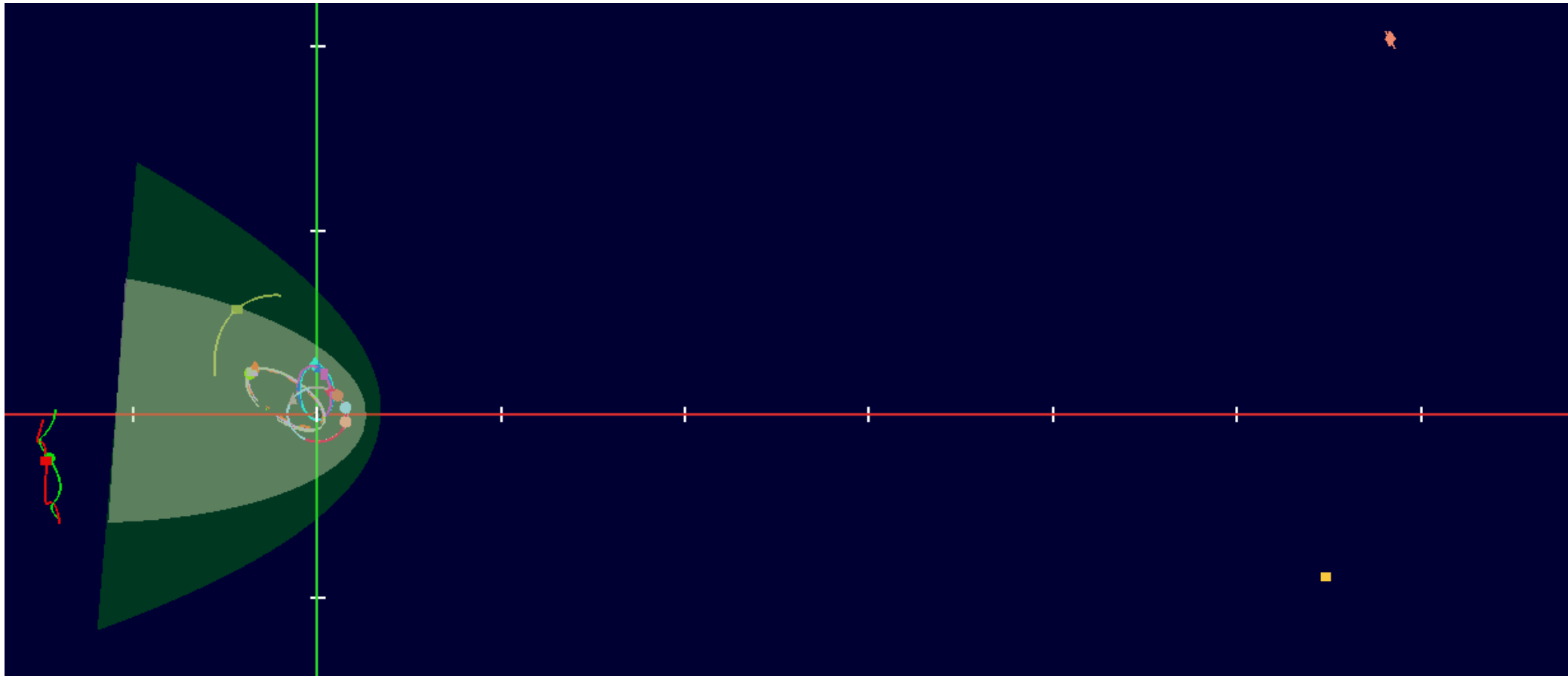
Cluster 3

29/Dec/2001

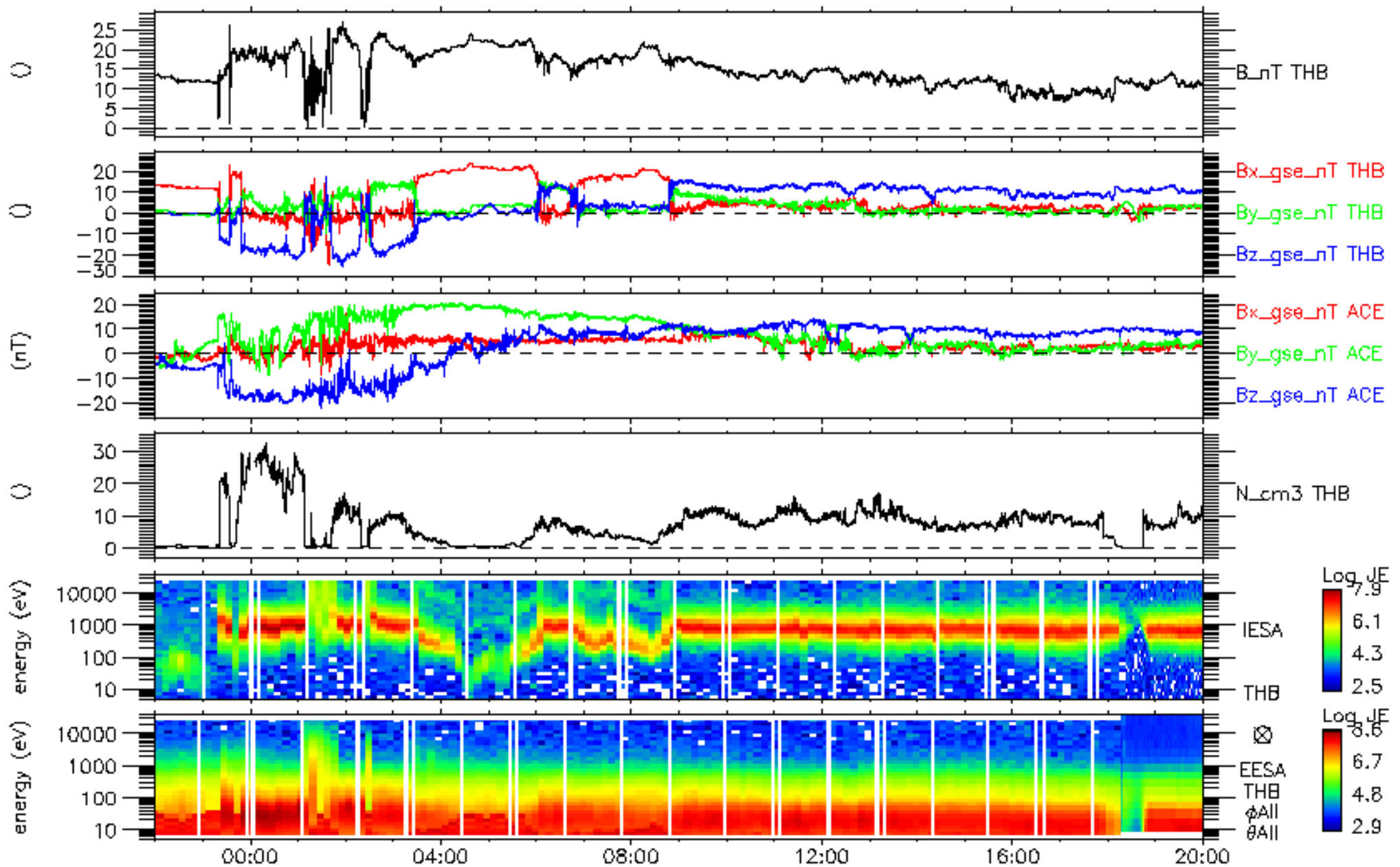


3. Study of geoeffective ICMEs

30 September 2012



30/Sep/2012



ICMEs at Mars and 1AU

Multipoint observations of Interplanetary Coronal Mass Ejections

Table 1: ICMEs observed at Mars and other points in interplanetary space

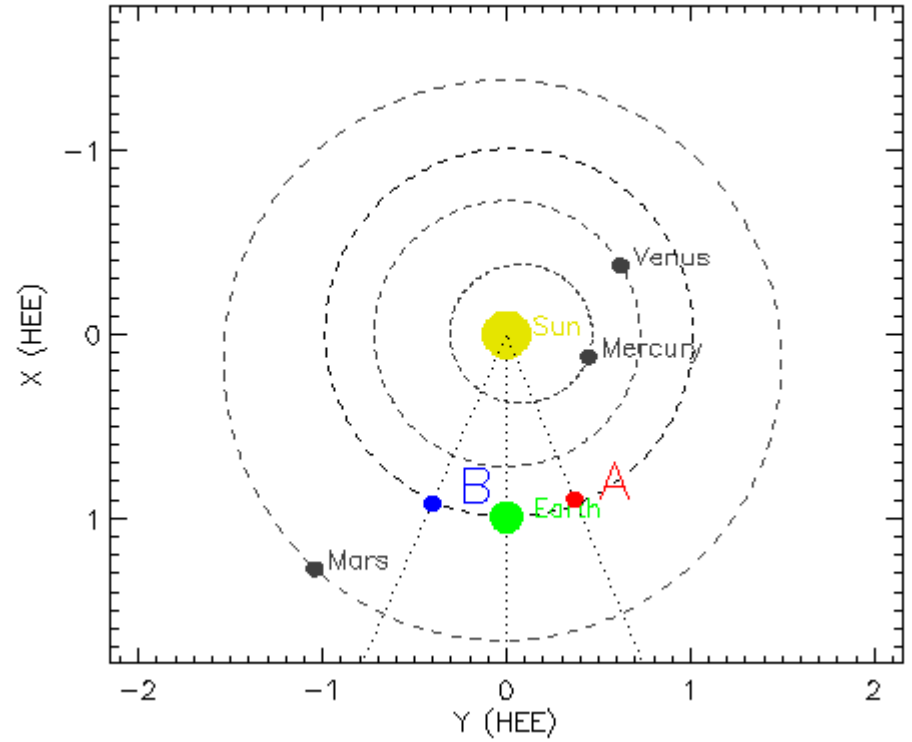
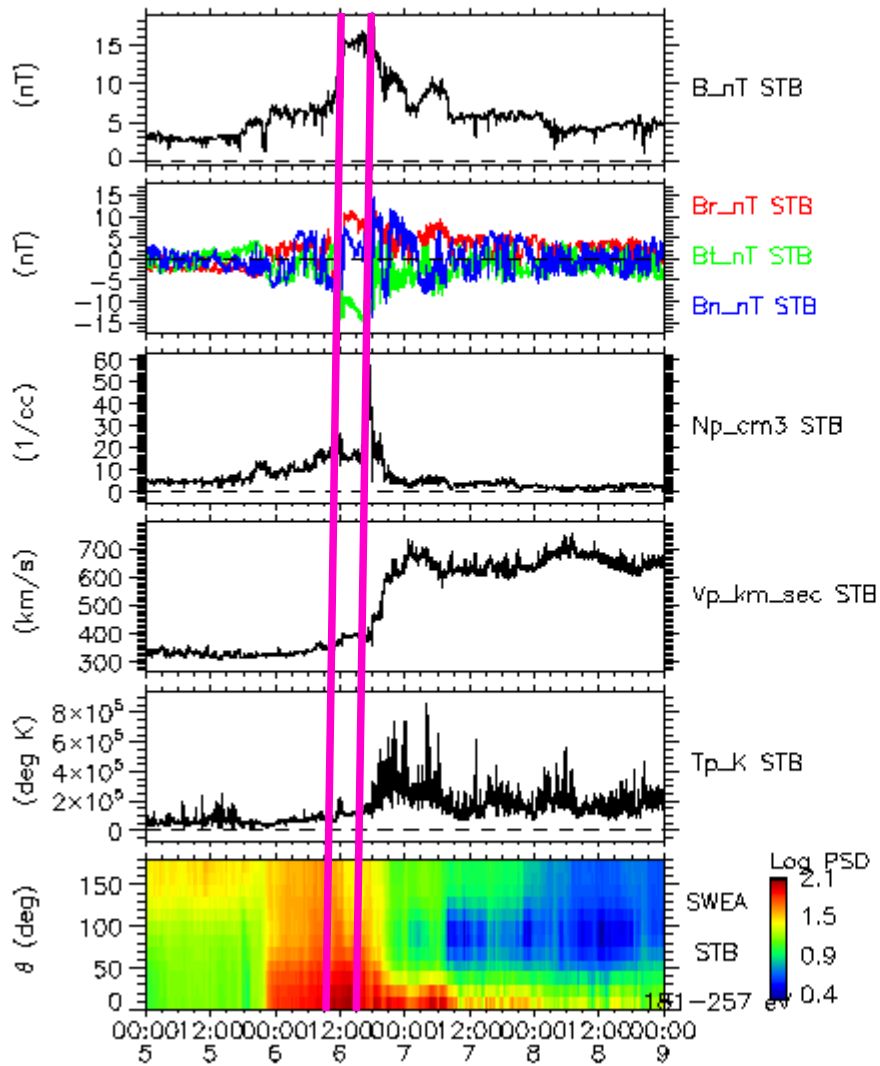
SUN	MERCURY	VENUS	EARTH	MARS
15/November/2007		18/November/2007	19/November/2007	22 /November/2007
31/January/2008	2/February/2008		5/February/2008	Possible 12/February/2008
2/March/2008			6/March/2008	8/ March/ 2008
11/October/2009			16/October/2009	Possible 17/October/2009
25/October/2009			29,30 October and 1 November/2009	Possible 30/October/2009
5/November/2009			10/November/2009	14/November/2009
20, 22/November/2009			25,27/November/2009	Possible 26/November/2009
15/December/2009			19/December/2009	Possible 20/December/2009
2/February/2010			7/February/2010	Possible 10/February/2010
2/June/2010			7/June/2010	10/June/2010
11/June/2010			15/June/2010	Possible 18/June/2010
19/June/2010	19/June/2010		23/June/2010	Possible 25 or 27/June/2010
30/August/2011			4/September/2011	Possible 8/September/2011
4/September/2011			8/September/2011	11/September/2011
29/September/2011			2/October/2011	Possible 5/October/2011
16/June/2013			20/June/2013	Possible 23, 25/June/2013
22/June/2013			27/June/2013	Possible 30/June/2013

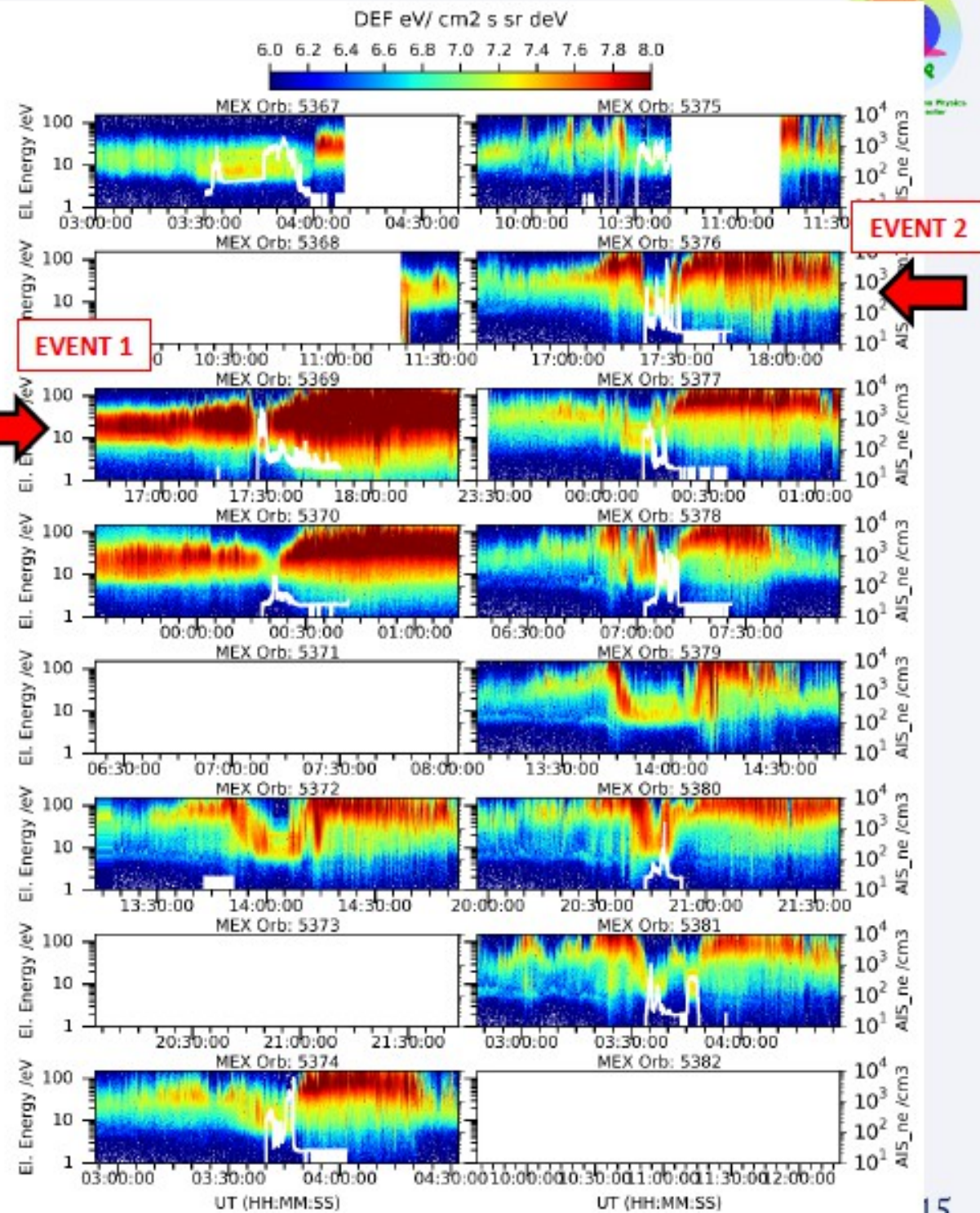
<http://usuarios.geofisica.unam.mx/primoz/ICMETableFinal.html>

Uses: ICME effects on Mars

Stereo B

05/Mar/2008





Sánchez-Cano et al. 2015

ICMEs at Venus

Table 2: ICMEs observed at Venus and other points in interplanetary space

<i>MERCURY</i>	<i>VENUS</i>	<i>EARTH</i>	<i>STEREO A</i>	<i>STEREO B</i>
	05/July/2006			
	11/September/2006			
19/May/2007	19/May/2007		22/May/2007	22/May/2007
25/June/2007	25/June/2007			
13/July/2007	13/July/2007	13/July/2007		
18/November/2007	18/November/2007		19/November/2007	
	09/February/2008			
	03/October/2009			
17/October/2009	17/October/2009			
	03/March/2010		05/March/2010	
18/March/2010	18/March/2010			
10/August/2010	10/August/2010			
20/August/2010	20/August/2010		20/August/2010	
	09/October/2010	09/October/2010		
	19/February/2011			
	11/April/2011		11/April/2011	
	21/April/2011		21,23/April/2011	
21/May/2011	21/May/2011			

<http://usuarios.geofisica.unam.mx/primoz/ICMETableFinal.html>