

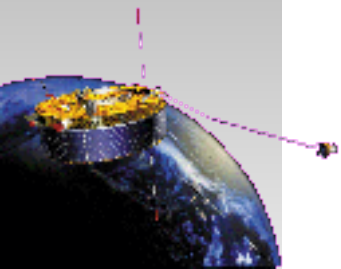
Cluster EFW Operations

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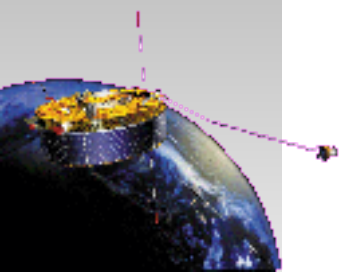
Boundary conditions

- EFW is part of WEC
- Master Science Plan regulates telemetry allocation to WEC, and thus all our possibilities. Available at <http://jsoc1.bnsc.rl.ac.uk/>
- JSOC coordinates all instrument planning
- DWP team in Sheffield coordinates WEC
- Planning lead time about 3.5 weeks
- Some params can be changed ~1 week in advance



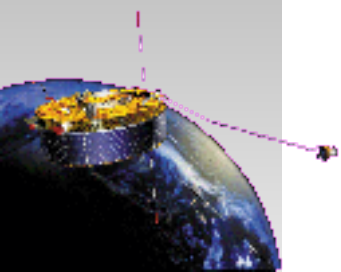
Most used real time sampling

- NM telemetry (1.4 kbit/s):
 - 2 E-field signals (V12, V34), 25 S/s, 10 Hz filter
 - 180 Hz filter on SC2 (also all s/c August 2001)
 - SC1 and SC3 2001/2002 -- Sep 2003 and from Jan 2006: (V2, V34)
 - SC1 and SC3 Oct 2003 -- Dec 2005: (V23, V34)
 - 4 single probe signals, 5 S/s, 10 Hz filter
- BM1 telemetry (15 kbit/s):
 - 2 E-field signals (V12, V34), 450 S/s, 180 Hz filter
 - SC1 and SC3 as for NM above (though still with V23 rather than V2 also in 2006)
 - 4 single probe signals, 5 S/s, 10 Hz filter



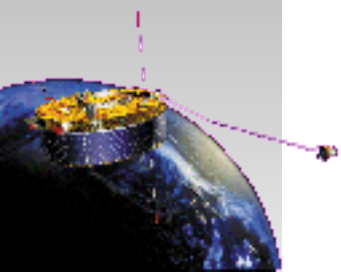
E-field bias settings

- Bias current set to probe
 - until April 2001: P12 -180 nA, P34 -220 nA
 - May 2001: -180 nA on all
 - June 2001 onwards: -140 nA on all
- Voltage offset on puck +1 V
- Voltage offset on guard -6 V
- Extensive tests during commissioning
- Occasional tests later on



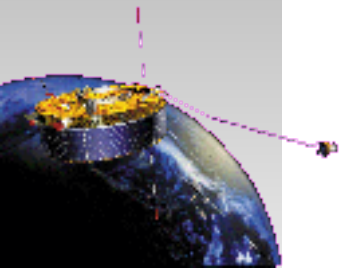
Occasionally used modes

- In BM1 telemetry, EFW can get more than 15 kbit/s (at the expense of other WEC instruments), allowing:
 - 3 signals (V12, V3, V4) at 450 samples/s
 - 4 signals (V1, V2, V3, V4) at 450 samples/s
 - **Can be used after motivated requests! Please!**
- Possible to put ± 40 V voltage bias on any probe (Langmuir mode)

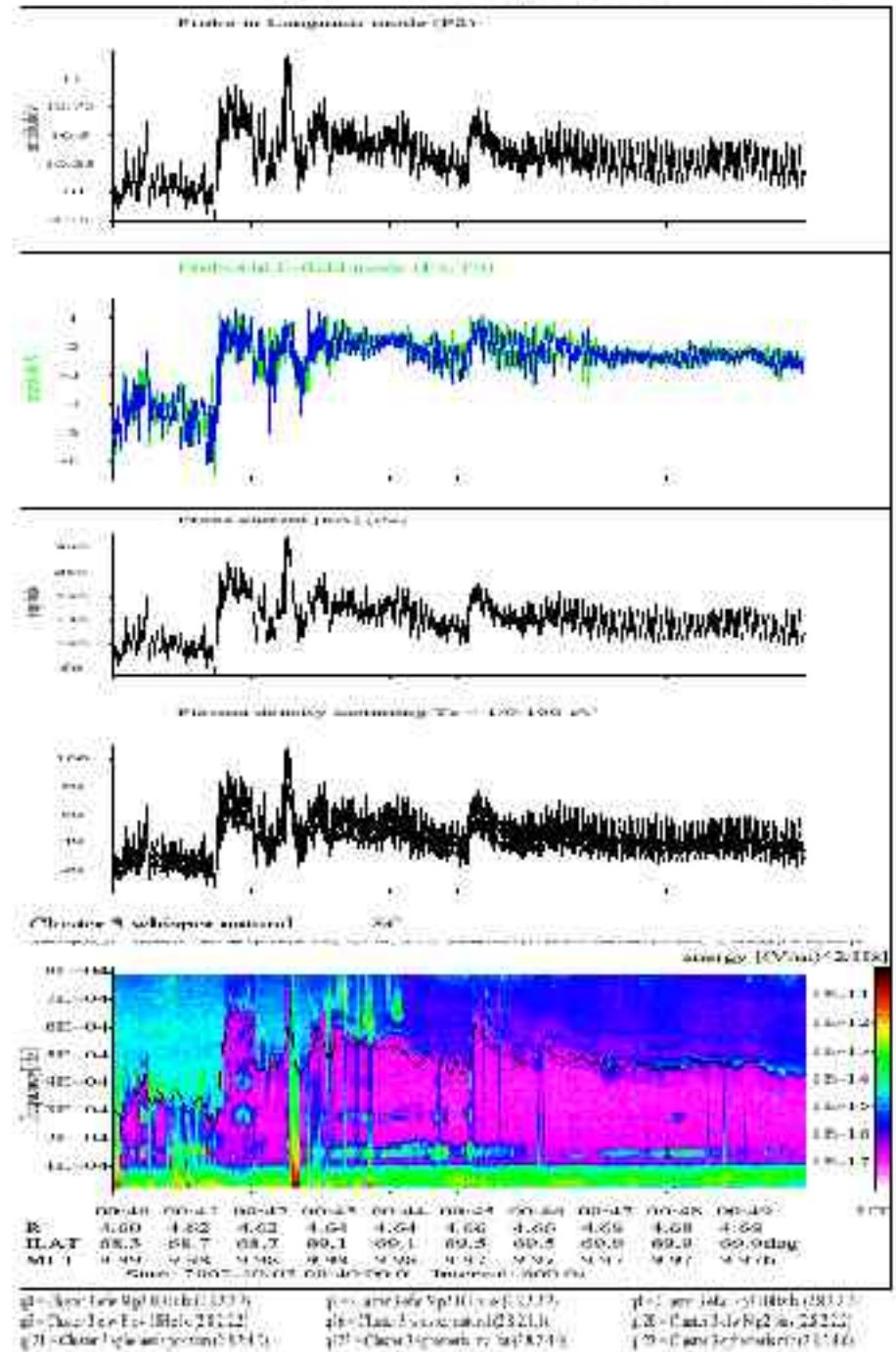


Langmuir mode

- Probe at bias voltage
- Intricate calibration:
 - $I = (V_{\text{meas}} - V_{\text{bias}})/R$
 - $R = 5 \text{ Mohm}$
 - Different calibration for V_{meas} and V_{bias}
- Occasionally used on P2 on SC13
- Works well in dense plasmas
- More spin modulation than in Vps
- Not studied in detail
- Used on demand = very seldom, essentially autumn 2002

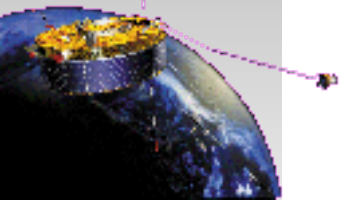


EFW Langmuir mode example plot 2002-10-02 SC3

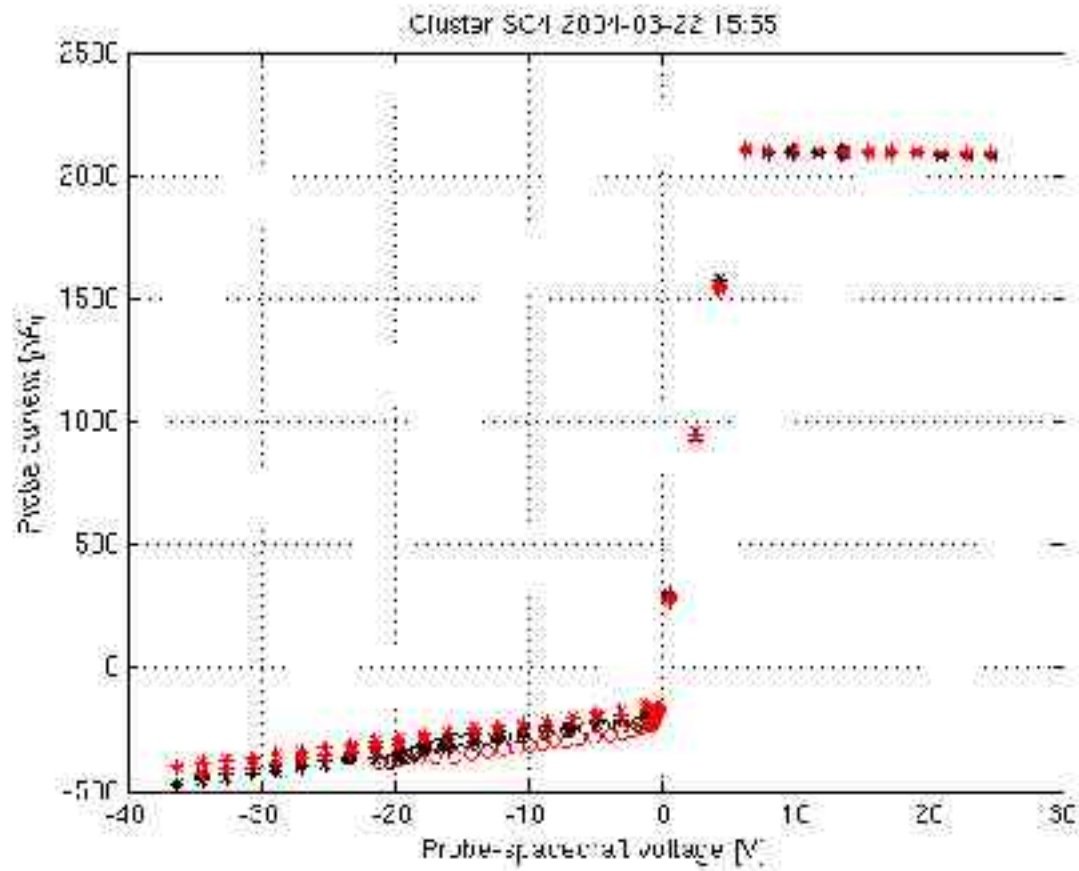


EFW bias sweeps

- Brief (few seconds) bias sweeps are routinely made to determine:
 - photoelectron emission
 - sheath resistance (wave diagnostics)
 - plasma
- We sweep bias current as well as voltage
- Current sweeps too fast until spring 2003
- Bug made sweeps too infrequent until Dec 2002
- Voltage sweeps ~~apparently buggy~~ work well!



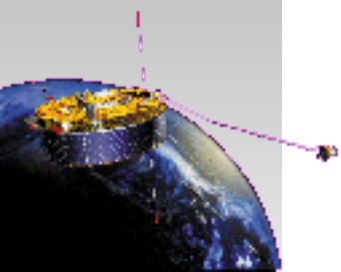
EFW bias sweep example



P1 black, P2 red

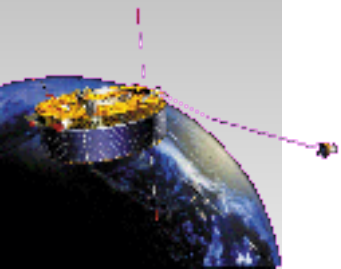
* = Bias voltage sweep (Langmuir mode)

o = bias current sweep (E-field mode)



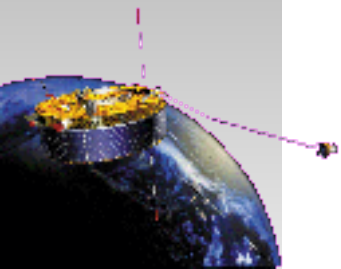
EFW internal bursts

- We have two ADCs sampling at 36 kS/s and can sample:
 - with loss of real-time TM: 2 x 36, 4 x 18, 8 x 9 kS/s
 - without loss: 2 x 18, 4 x 9, 8 x 4.5, 8 x 2.25, 8 x 0.9, 8 x 0.45 kS/s
- Internal memory of 1 Mbyte
- Analog quantities that can be sampled:
 - Unfiltered: V1, V2, V3, V4
 - 50 Hz - 8 kHz filter: V12, V34
 - 4 kHz filter: V1, V2, V3, V4, BX, BY, BZ (STAFF)
 - 180 Hz filter: V1, V2, V3, V4, V12, V34
- Can trig burst on
 - signal level from any EFW quantity, ...
 - ... or time tag



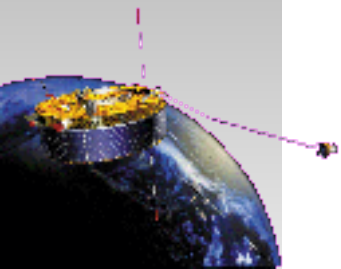
Burst settings

- Default settings used for pre-planned BM1 (~50% of all bursts)
- Default June 2001:
 - V12, V34 at 18 kS/s, 50 Hz - 8 kHz, trig on BP12
- Default July 2001 - October 2002:
 - V1, V2, V3, V4 at 9 kS/s, unfiltered, trig on V12M
- Default Nov 2002 - Jan 2004, and from Apr 2005:
 - V1, V2, V3, V4 at 9 kS/s, 4 kHz filter, trig on V12M
- Default from Feb 2004 - March 2005
 - V1,V2,V3,V4, BX, BY, BZ, 4 kHz filter, at 4.5 kS/s, trig on V12M or BP34
- Specials for SC1 and SC3 (broken P1):
 - Replace V1H by V3U, and V1U by V3H, trig on BP12
- Often used by manual commanding:
 - V1,V2,V3,V4, BX, BY, BZ at 450 S/s or 4.5 kS/s
 - Unfiltered data



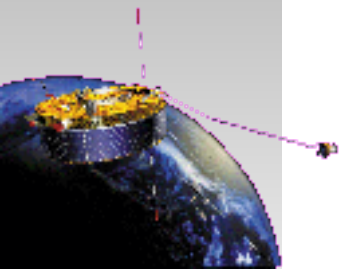
Burst operations

- Dumping of 1 MB memory unrealistic in NM telemetry (1.4 kbit/s)
- Special "BM3 dumps" during 6 minutes, twice per orbit => 2 bursts/orbit
- Burst enabled almost all the time in 2001
- Now the burst is enabled for an interval of 30 min -- a few hours in "interesting" regions. *See later presentation by Niklas Edberg*



Burst scheduling

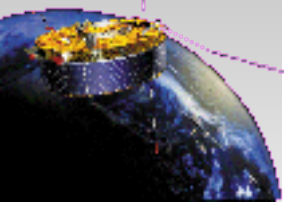
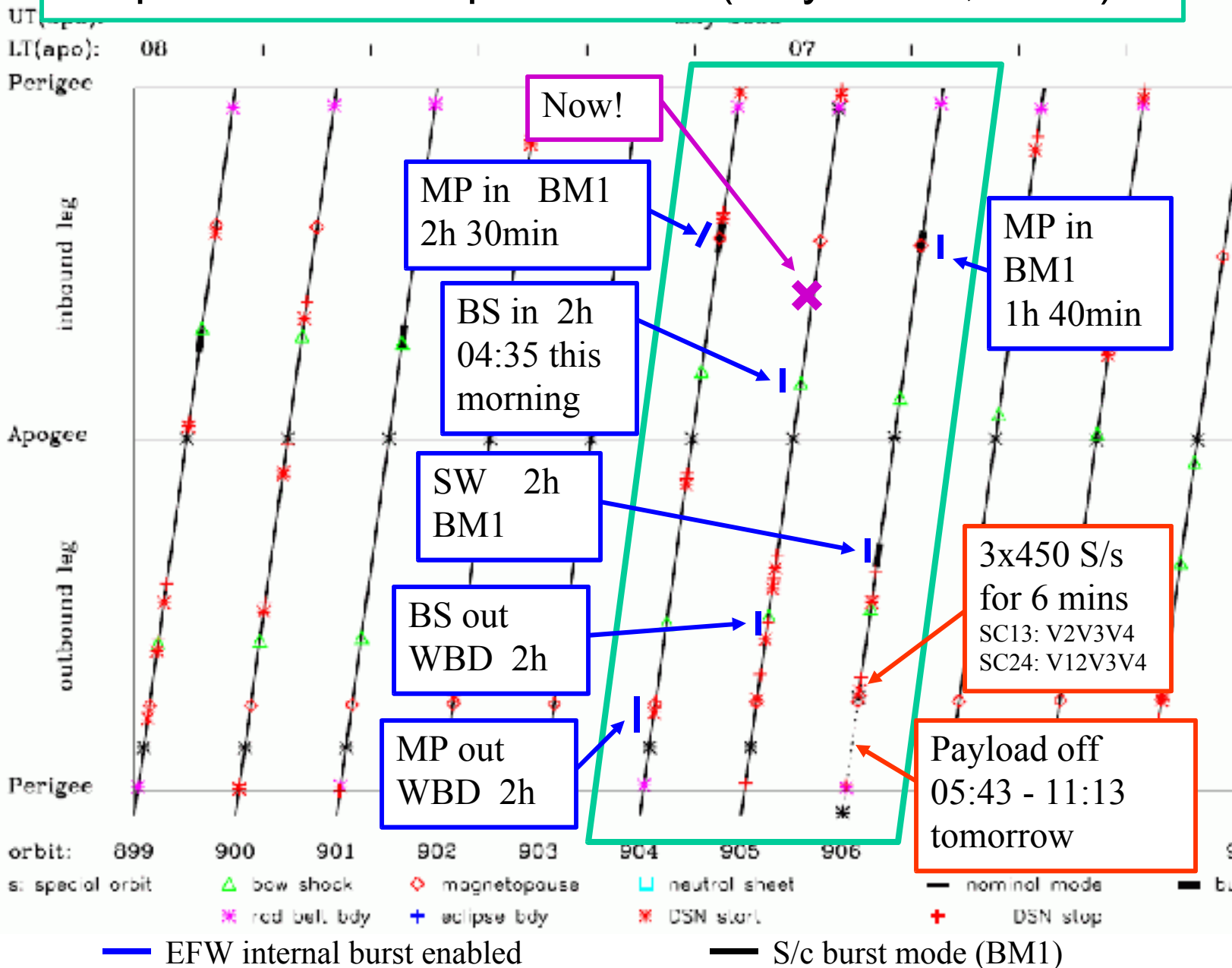
- Always a burst between memory dumps -- no wasted opportunities
- Baseline priorities for burst scheduling:
 - BM1 period (EFW 450 S/s)
 - Specific requests (e.g. E-parallel in aurora)
 - WBD period
 - MP, BS, aurora, NS, plasmopause, ...
- Requests **welcome!**



Operations example: PP313 (May 14-21, 2006)

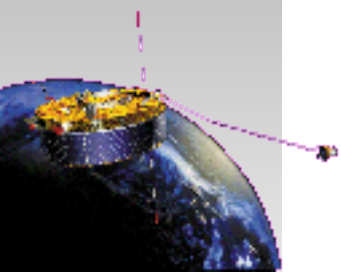


EFW Operations



Information on operations

- JSOC - MSP, event files, ...
<http://jsoc1.bnsc.rl.ac.uk/>
- EFW operations page:
<http://www.cluster.irfu.se/efw/ops>
 - Now in public domain, though some ESA info remain under access control
 - Includes anomaly list (non-standard operations);
 - Check this when you find strange things in data



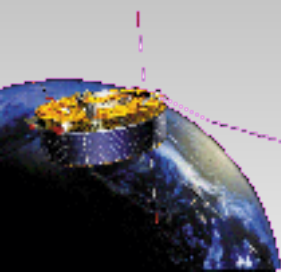
EFW ops page: standard ops

<http://www.cluster.irfu.se/efw/ops>

Standard operations

These are the default settings, defined by the ISOC henceforth parameters. Note that we quite often run individual bursts with different settings than those shown, and (during autumn 2002) quite often used Langmuir mode on SC13 P2. Significant deviations from the standard settings below are reflected in the [table of non-standard operations](#) (though this table usually does not show all burst parameters and SC13 P2 Langmuir mode).

Valid from YYYY-MM-DD HH:MM	Change	Settings	Comments
2001-02-01	Initial operational setup	All probes in E-field mode (current bias) -180 nA on P12, -200 nA on P34 Puck: 1 V, guard: 0.1 V HX in NM: V12L, V34L HX in BM1: V12M, V34M IX: V11, V21, V31, V41, P10, P12 Sleep interval: 3h 15mins	Start of nominal operations
2001-03-07 15:38	Probe voltage sweeps extended from 64 to 96 steps	All probes in E-field mode (current bias) -180 nA on P12, -200 nA on P34 Puck: -1 V, guard: -0.1 V IX in NM: V12L, V34L HX in BM1: V12M, V34M IX: V11, V21, V31, V41, P10, P12 Sweep interval: 2h 15mins	To open maximum available $-eU$ range
2001-04-26	-180 nA on all probes	All probes in E-field mode (current bias) -180 nA on all probes Puck: 1 V, guard: 0.1 V IX in NM: V12L, V34L HX in BM1: V12M, V34M	To symmetrize probes and decrease saturation problem in some plasmas



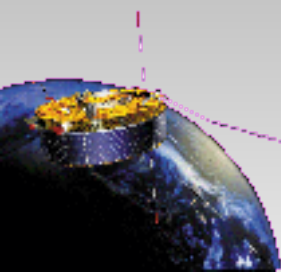
EFW ops page: non-standard ops

http://www.cluster.irfu.se/efw/ops/ns_ops.html

List with some 350 items (today)

This list is intended to cover all non-standard operations of EFW, planned or accidental, from 2001-10-01.

Start	dt (sec)	Cluster ID	Description	Resources	Plan	short Desc
2001-07-25 00:06:45	-1	2	The 10Hz filter on probe 3 failed at this time, and has never recovered.		no	no_10Hz_filt
2001-10-01 07:30:00	2100	1 2 3 4	Verify sweep interval settings. Will cause loss of spin fits for 25 minutes. 07:30 After reset at start of AI, do not uplink spin patch or set burst. Start sweeps every 30 s (SC1), 1 min (SC2), 90 s (SC3), 2 min (SC4). 07:45 Setup burst (SWEC1349). 07:55 Spinfit patch (SWEC1354). 08:05 Test completed: change sweep interval to 30 mins on all. (SWEC1340 and 339).	1. Ieuan	yes	no_spin_fits
2001-10-11 12:34:41	1258	1	TM loss due to s/c anomaly	1. ESOC 011012 2. ESOC 011015	no	no_tm
2001-10-15 00:55:00	61680	1	Probe 1 latched at -70 V	1. Anders 011015	no	no_p1
2001-10-17 05:48:43	90	1 2 3 4	Time tagged burst operations with 2E+3B components at perigee. Loss of data for a little more than a minute expected.	1. Commented excerpt from PIOR 2. Mail to Nicole and Milan	yes	no_tm
2001-11-07 19:59:00	2640	3	SC3 system reboot. No data during this time.	1. ESOC 011107 2. ESOC 011108	yes	no_tm
2001-11-14 18:16:00	26880	1	Data loss due to ESA ground station problem	1. ESOC 011121	no	no_tm
2001-11-18 06:07:14	39496	2	Probe 1 latched at +68 V. Probe 1 problem cured by EFW reset.	1. Pec-Arne 011120 2. Anders 011129	no	no_p1
				1. Pec-Arne 020102		



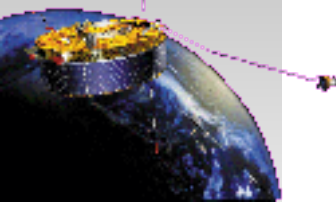
EFW ops page: burst log

http://www.cluster.irfu.se/efw/ops/list_nice.txt

Contents of all EFW internal bursts

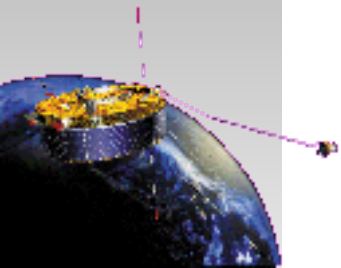
Isdat	file name	fs	q	ss	cc	Quantities									
11510001045949we.114		450	8	2	10	V1M, V2M, V3M, V4M, SCX, SCY, SCZ, BP12									
051001045939we.04		450	8	2	10	V1M, V2M, V3M, V4M, SCX, SCY, SCZ, BP12									
051002193030we.01		450	8	2	10	V3U, V4U, V3M, V4M, SCX, SCY, SCZ, BP12									
051002193030we.01		450	8	2	10	V3U, V4U, V3M, V4M, SCX, SCY, SCZ, BP12									
051002193030we.03		450	8	2	10	V3U, V4U, V3M, V4M, SCX, SCY, SCZ, BP12									
051002193030we.03		450	8	2	10	V3U, V4U, V3M, V4M, SCX, SCY, SCZ, DP12									
051002193753we.04		450	8	2	10	V1M, V2M, V3M, V4M, SCX, SCY, SCZ, BP12									
051002193753we.04		450	8	2	10	V1M, V2M, V3M, V4M, SCX, SCY, SCZ, BP12									
051002210000we.02	4.5k	0	2	12		SCX, SCY, SCZ, BP12, V1H, V2H, V3H, V4H									
051002213300we.02	4.5k	8	2	12		SCX, SCY, SCZ, BP12, V1H, V2H, V3H, V4H									
11510003120044we.112		9k	4	2	10	V1H, V2H, V3H, V4H									
051003120345we.02		9k	4	2	10	V1H, V2H, V3H, V4H									
051003123356we.04		9k	4	2	10	V1H, V2H, V3H, V4H									
051003123356we.04		9k	4	2	10	V1H, V2H, V3H, V4H									
051003133420we.01		9k	4	2	10	V3U, V4U, V3H, V4H									
051003133420we.01		9k	4	2	10	V3U, V4U, V3H, V4H									
051003133706we.03		9k	4	2	10	V3U, V4U, V3H, V4H									
051003133706we.03		9k	4	2	10	V3U, V4U, V3H, V4H									
051005074309we.01		9k	4	2	10	V3U, V4U, V3H, V4H									
051005074309we.01		9k	4	2	10	V3U, V4U, V3H, V4H									

(all entries doubled in this version, will be fixed)



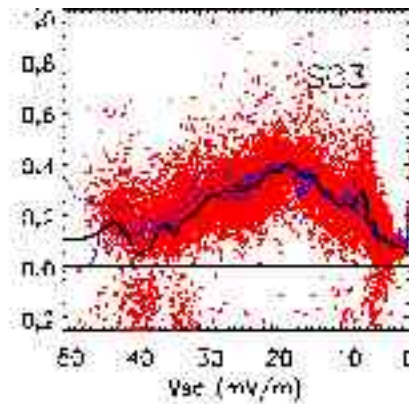
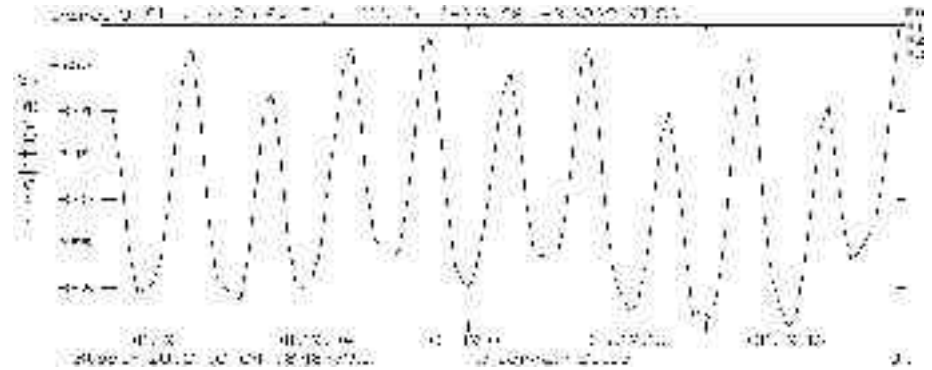
Who does what?

- JSOC presents MSP, iterated with Pis
- Sheffield (mainly Keith Yearby) coordinates WEC (weekly) through WEC ops group. *The Sheffield team does an important but laborious and rather thankless job to keep WEC running -- many thanks to them!*
- Anders E prepares EFW commands (weekly)
- Per-Arne fixes urgent problems
- Mail us (AIE, PAL, MA) if you discover a problem or **when you have an idea of something you want to do!**

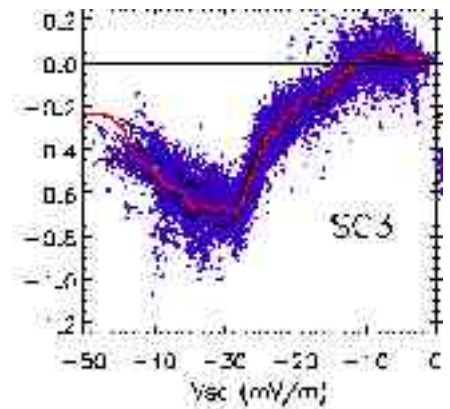


Nominal data: Vps

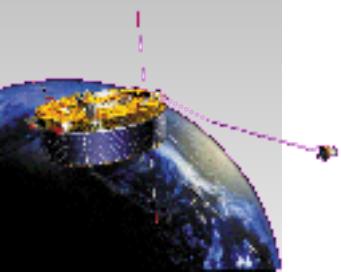
- Probe-to-s/c potential often used as density proxy
- Spin modulation
- Depends on
 - Total bias current
 - EDI current
 - ASPOC!

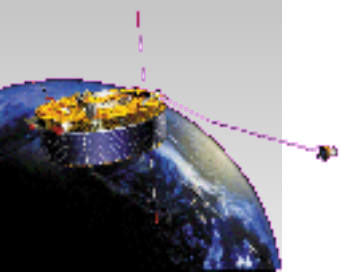


2 x fspin



4 x fspin





Nominal data:

E-field

E-field offsets

- In spinning frame:
 - Probes are individuals
 - Boom length differences
 - Electronics offsets (ADCs)
- In despun frame:
 - Mainly due to photoelectron asymmetries in probe environment

