Charging active control: PLEGPAY experiment onboard ISS results; activities on future systems

TAS-I contribution to the 14° SPINE Meeting
13-14 November 2008

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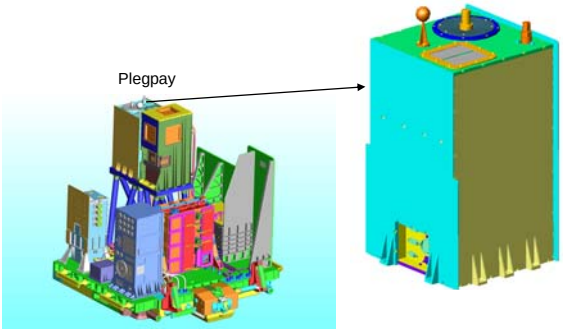
14° SPINE MEETING

PLEGPAY Instrument

PLEGPAY on ISS

Plegpay is an experiment package on-board the ISS (EuTef platform)

OBJECTIVES:
Validation of functionality and performances of the plasma contactor technology under actual iono-spheric environmental conditions and through extensive in-flight operation.
Verification of the plasma contactor clamping capability through the measurement of the emission current as function of potential unbalance.
Investigation of the the plasma contactor operation by plasma diagnostic tools



MAIN EXPERIMENTS:

Exp1 - Plasma Contactor clamping capability investigation :

- ***forced I-V characterization* due to internally-generated voltage unbalance**
- ***I-V characterization in presence of natural voltage unbalance***

Exp2 - Solar Array/ Plasma interaction

Exp4 - Long Duration Test* :1000 h *operation with on-off cycles

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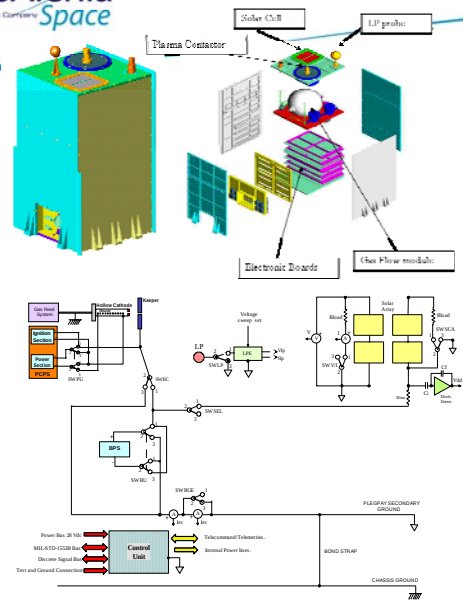
PLEGPAY on ISS



Date	GMT Day	Start Time	End Time	Description
19/02/2008	50	9.07	20.00	Commissioning: first attempt
19/03/2008	79	14.27	22.52	Commissioning: second attempt
19/03/2008	79	17.43	19.14	Experiment2
19/03/2008	79	20.49	20.57	PC Ignition
19/03/2008	79	21.24	21.25	LP Acquisition
19/03/2008	79	22.26	22.36	PC Ignition
19/03/2008	79	22.48	22.49	LP Acquisition
24/03/2008	84	23.56		LP Acquisitions
25/03/2008	85		0.16	
26/03/2008	86	16.08		Long Duration Test
31/03/2008	91		14.30	
01/04/2008	92	16.00		Long Duration Test
05/04/2008	96		12.00	
09/04/2008	100	7.23	7.57	Plegpay Xe-gas releases
09/04/2008	100	8.32	9.41	Plegpay Xe-gas releases
09/04/2008	100	10.48	11.07	Plegpay Xe-gas releases
09/04/2008	100	11.46	12.43	Plegpay Xe-gas releases
10/04/2008	101	9.55	10.30	Experiment1
12/04/2008	103	16.08	16.32	Plegpay Xe-gas releases
12/04/2008	103	17.46	18.05	Plegpay Xe-gas releases
12/04/2008	103	19.14	19.39	Plegpay Xe-gas releases
12/04/2008	103	20.44	21.06	Plegpay Xe-gas releases
12/04/2008	103	22.15	22.38	Plegpay Xe-gas releases
13/04/2008	104	22.38	22.58	Plegpay Xe-gas releases
14/04/2008	105	0.10	0.31	Plegpay Xe-gas releases
14/04/2008	105	1.40	2.02	Plegpay Xe-gas releases
14/04/2008	105	3.15	3.32	Plegpay Xe-gas releases
19/04/2008	110	4.34	4.47	LP Acquisitions
19/04/2008	110	5.22	5.40	LP Acquisitions
16/05/2008	137	20.44	23.00	DockingUndocking2 (LP Acquisitions)
02/06/2008	154	17.31	18.31	DockingUndocking3 (LP Acquisitions)
10/06/2008	162	15.54	17.05	Sequence Exp2-1-2
12/06/2008	164	17.49	18.32	Experiment1
14/06/2008	166	17.24	18.45	LP Acquisition (ISS no activities)
09/07/2008	191	13.01	13.45	Experiment1
09/07/2008	191	13.51	15.13	Experiment4
17/07/2008	199	16.29	17.12	Experiment1
17/07/2008	199	19.39	20.26	Experiment4

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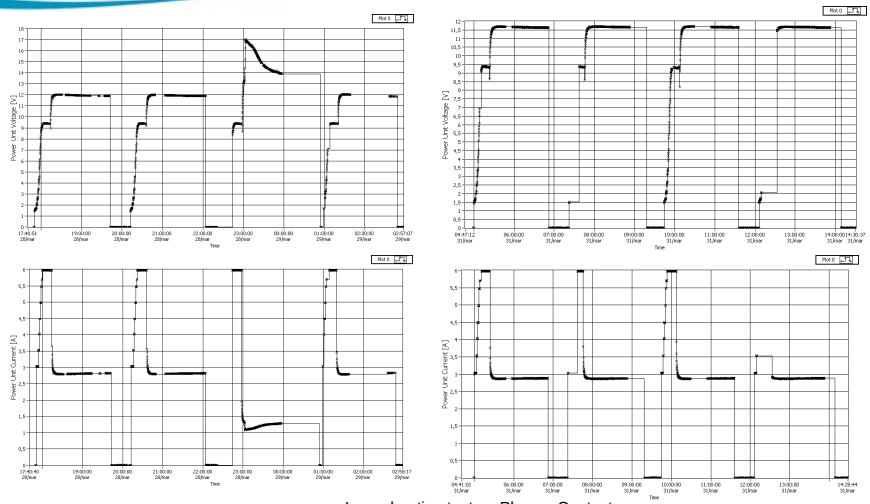
PLEGPAY on ISS



Long duration test on Plasma Contactor

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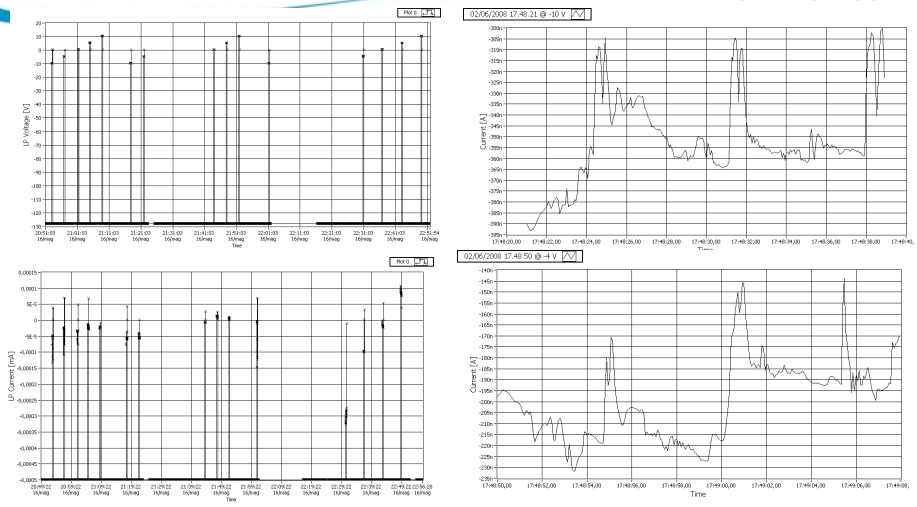
PLEGPAY on ISS



Shuttle Docking Monitoring at 16 May and 2 June

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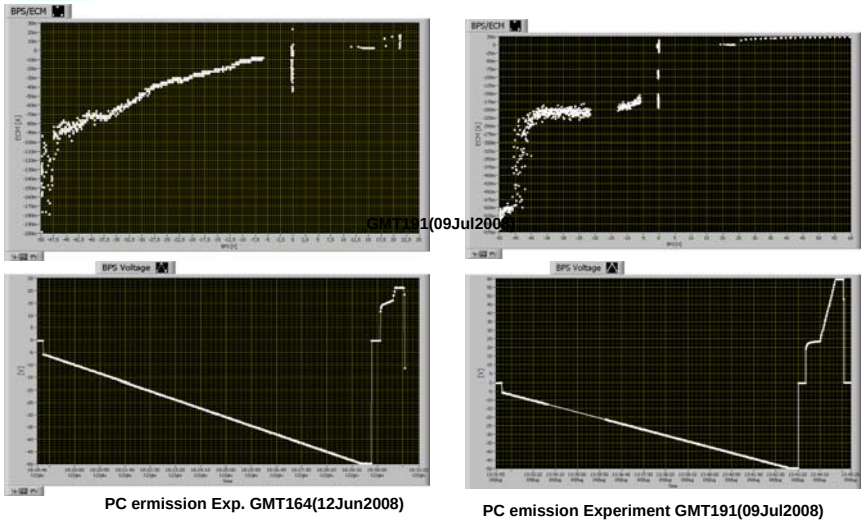
PLEGPAY on ISS

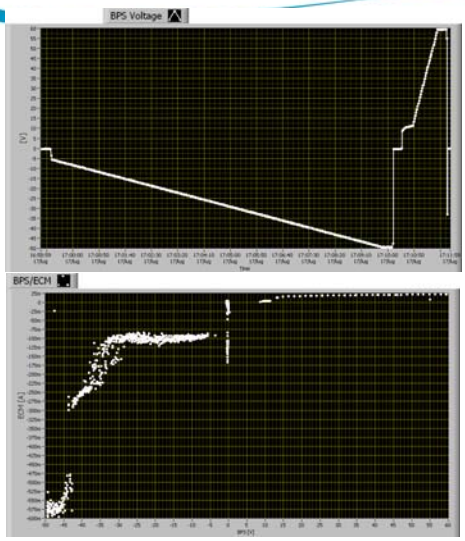


GMT191(09Jul2008)

PC ermission Exp. GMT164(12Jun2008)

PC emission Experiment GMT191(09Jul2008)

PLEGPAY on ISS



NASA Safety Panel upon detection of increase of ISS floating potential through a parallel acquisition With LP onboard the ISS up to +24V against an allowed Declared nominal value of +20V (confirming effectiveness of the Plasma contactor process) decided to consider hazardous to continue operation with PLEGPAY experiment.

It is remarked that Plegpay passed all the safety reviews during its qualification phase.

Discussion on the effective risks to operate PlegPay are On going.
Nevertheless activities are presently stopped.

PC emission Experiment GMT199(17Jul2008)

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Active charging compensator

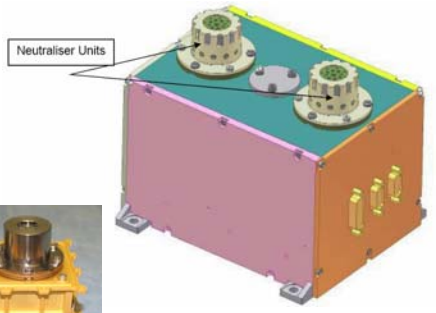
The ACCA (ACC Assembly) is composed by the following units:

- 2 Neutralizer Units (NU) with necessary provisions as e-gun sources to emit and accelerate the electrons outward the S/C towards the free space
- Power Supply & Control Unit (PSCU) able to:
  - ➢Power properly one of the two neutralizers (NUs)
  - ➢Switch power between any of the two neutralizers (NUs)
  - ➢Interface analog low power signal to drive heater,anode bias Voltages
  - ➢Generate the required TLM.

Between the 2 NU's a suitable room is left for eventually introducing (optional arrangement) a Langmuir Probe or RPA to perform a plasma diagnostics/ investigation.

Based on Neutraliser Assembly for LISA PF and MICROSCOPE programs

OBJECTIVES:
-To minimise negative absolute charging of S/Cs in GEO (and LEO polar) environments.
-To alleviate differential charging phenomena.
APPLICATIONS:
TAS-I satellites,Alphabus/Alphasat and Small GEO



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PC and ACCS compensator simulation needs

- Plasma contacting and electron emission mechanism simulation
  - 2D/3D numerical modeling;
  - improved electron and ion models with arbitrary EEDF/IEDF and real plasma effects like collisions,reflections, ionisation, double charged etc..;
  - Cathode emission process
  - RPA sheath effects on grid textures
- S/C simulation to correlate PC functions to environmental plasma parameters
  - S/C modelling with full environment
  - Interface with detailed PC modeling

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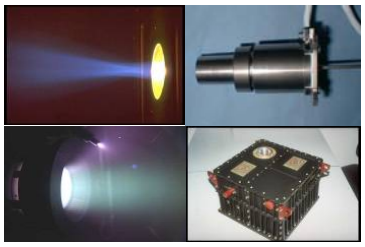
TAS-I Contribution to GST5 (Thether Systems)

- **Heritage:**
  - Development of Electron guns for TSS-1 & TSS-1 reflight missions (NASA).
  - CETEP programs: Reboosting ISS and satellite orbit raising studies.
  - PlegpPay Instrument.
  - ACCS study (foreseen)



- **Possible contributions**
  - Plasma Contactor technology
  - Electron Guns
  - Plasma Detectors