DSLP – Intrument / Operations status

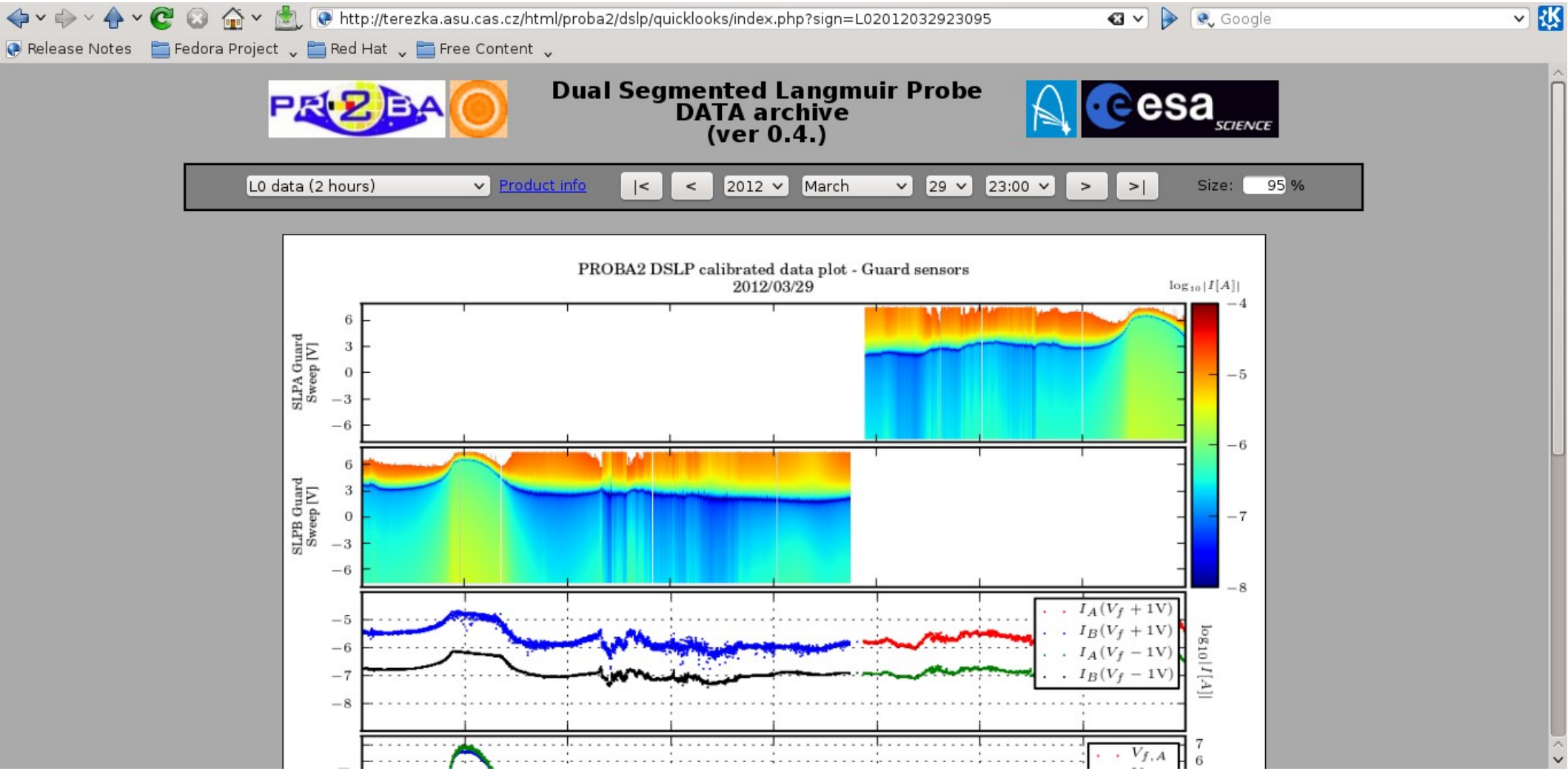
- Regular scientific operations running from 06/2010
- Current operational schema (active from 01/2012)
  - Weekly schema
  - TC schedules managed by MOC operators (Redu)
  - 5 days of continual survey (Mo-Fr)
  - 2 days of burst snapshots (Sa-Su)
- No malfunction of DSLP functionality encountered till present
- Data acquisition summary (2010-present)
  - > 12,000 full orbits (up to 14 orbits per day)
  - > 70 millions data samples (up to 6000 samples per orbit)

DSLP – Ground segment status

- 08/2011 – ESA Contract No. 4000104021/11/NL/CBi – DSLP data processing and archiving
- 11/2013 – archive copy delivery to ESA and successful contract closure
- Full data processing chain (MOC raw TM data – Derived products – Archive update) running daily
- Data archive access
  - Data volume - http://terezka.asu.cas.cz/html/proba2/dslp/archive/
  - QL browser - http://terezka.asu.cas.cz/html/proba2/dslp/quicklooks/
  - ESAC archive mirror site in preparation (TB released Q1/Q2 2014)

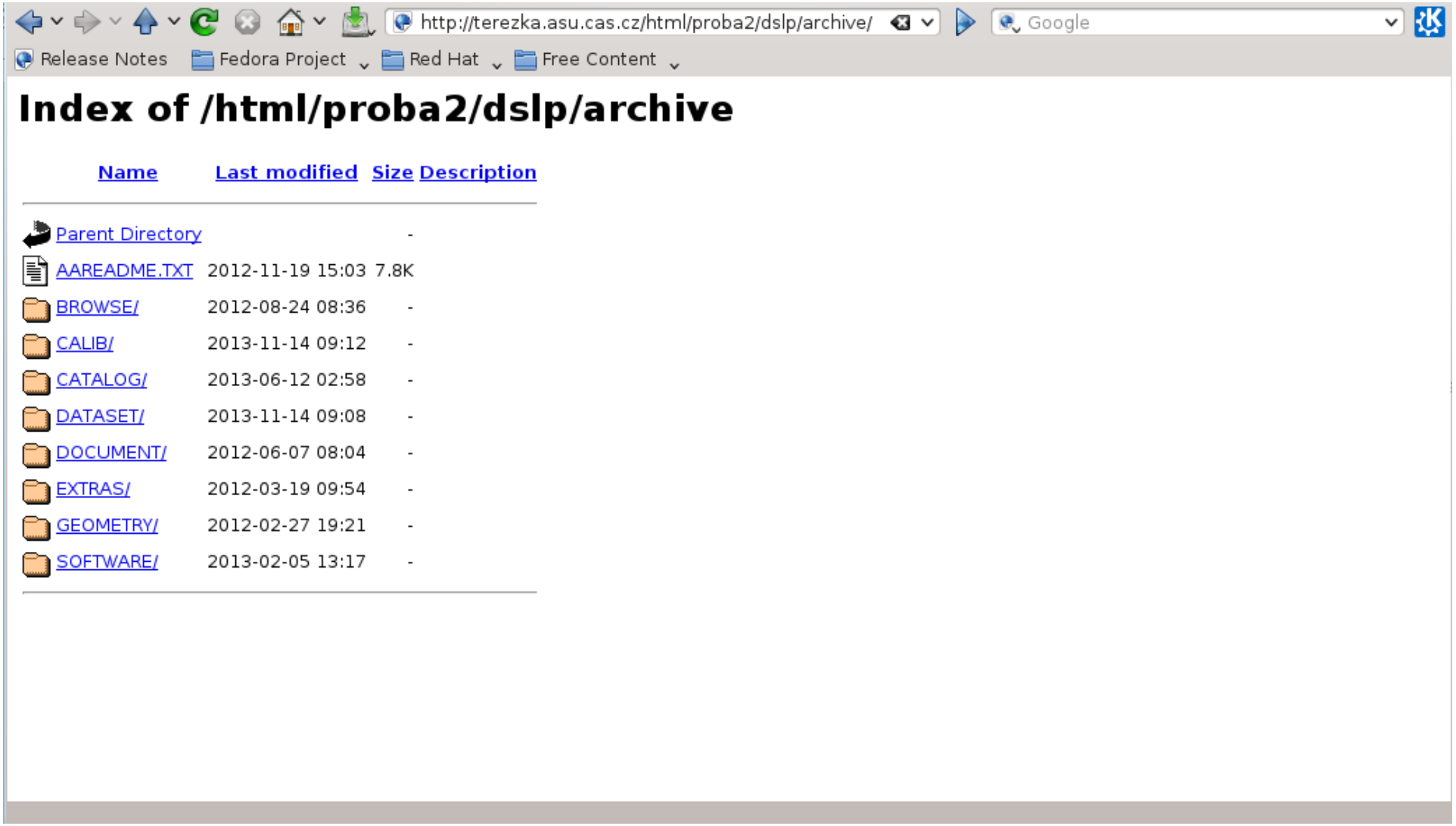
DSLP – user web services

- http://terezka.asu.cas.cz/html/proba2/dslp/quicklooks/

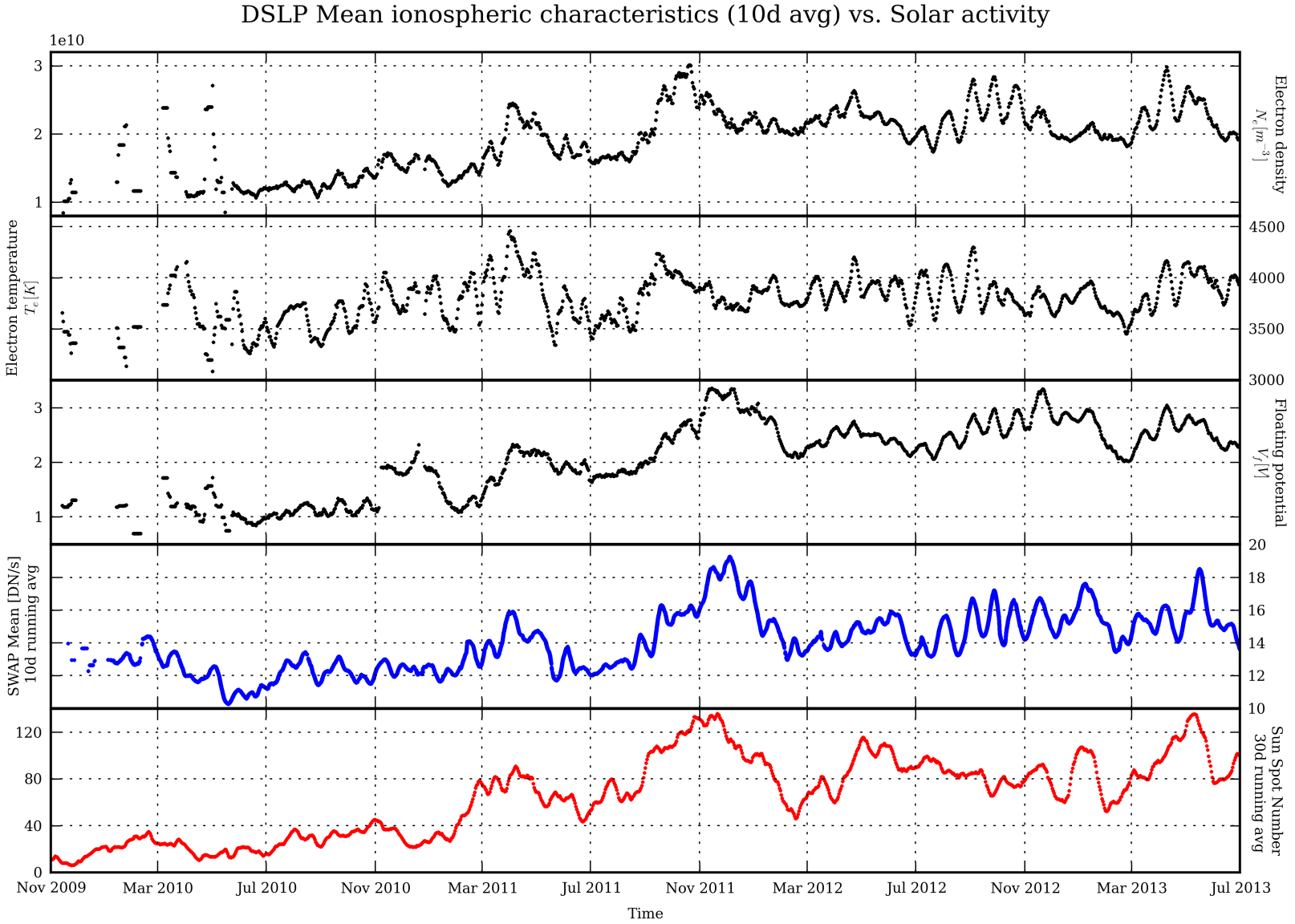


DSLP – user web services

- http://terezka.asu.cas.cz/html/proba2/dslp/archive/



DSLP – observations summary



DSLP - Publications

- DSLP instrument paper (TB submitted in 12/2013)
- DSLP observation summary paper under preparation

The DSLP experiment on board micro-satellite PROBA2: Scientific performance and instrument design

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Abstract

The Dual Segmented Langmuir Probe (DSLP) implements an improved concept of the electrostatic plasma diagnostic technique for direct in situ measurements of basic space plasma parameters, namely the plasma density, electron temperature and local plasma potential. The plasma parameters are derived by use of two identical spherical sensors, both based on the so-called segmented Langmuir probe concept (SLP) providing directional variation of the measured characteristics. As a part of the scientific payload on board the PROBA2 mission (ESA) the DSLP instrument aims to map characteristic macroscopic plasma properties in the upper terrestrial ionosphere and identify observed irregularities in the frame of intermittent solar-terrestrial and space weather effects. The scientific performance and detail design of the DSLP instrument are described herein to provide a required reference documentation for scientific analysis and interpretation of the DSLP measurements.

Keywords: Space instrumentation, Ionospheric plasma, Langmuir probes

1. Introduction

The Dual Segmented Langmuir Probe (DSLP) experiment provides in situ plasma diagnostics using the standard electrostatic Langmuir probe (LP) technique (Langmuir and Moth-Smith, 1924), intensively used on rockets and satellites since the very beginning of the space age (Brace, 1998) to investigate plasma properties in the Earth's ionosphere as well as in space near other solar system bodies. With first probes adopted from laboratory experiments a satisfactory design for ionospheric measurements has been achieved with spherical and cylindrical probes already in 1950's (Boggeess et al., 1959). Recent LP instruments are extensively used not only for Earth's ionospheric missions (e.g. Lebreton et al. (2006)) but also magnetosphere (Gustafsson et al., 1997) or even other planetary (Gurnett et al., 2004) or cometary (Eriksson et al., 2006) applications.

The LP plasma diagnostic technique uses active measurements of the plasma current response to a variable potential typically applied on the sensor's electrode with respect to the reference electrical ground to estimate the basic plasma properties, namely the plasma density together with the electron temperature and the reference floating and plasma potentials. The DSLP employs two identical spherical LP sensors (see Figure 1), both of them based on the so-called segmented Langmuir probe (SLP). In addition to standard LP technique, segmented probes are designed to provide the measured plasma characteristics with directional sensitivity and thus enable to study, e.g., plasma flow direction or even potential anisotropy effects. The novel SLP concept inherited in DSLP design has been originally applied on the ISL experiment (Lebreton et al., 2006) on-board the French micro-satellite DEMETER (Cussac et al., 2006).

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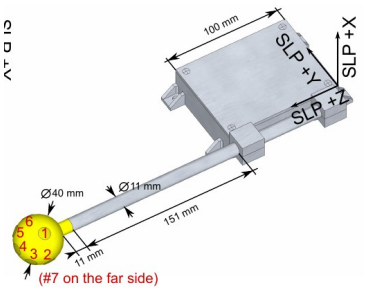


al design. The spherical sensor with the seven disk-shaped segments is attached on a fixed oviding interface to the main data processing unit. The drawing identifies the basic dimensions The yellow color indicates the active surface of the sensor used for DSLP measurements.

so that the segment (4) is pointing the +Z direction.
ing support is built in titanium alloy (Ti-6%Al-4%V) with a upper layer of (1992) has shown the TiN surface treatment to provide required uniformity reliable plasma diagnostic in the cold ionospheric plasma. Identical mate- that is the ISL experiment (Lebreton et al., 2006) on DEMETER mission. parts, i.e., the boom and the front-end box, are fabricated from a standard ed eloxal coating. Total mass of one single DSLP probe is 410 g.
ted inside the satellites platform is housing one single printed circuit board the data processing unit. Serving as a mechanical support for the TPMU 7 mm of the main box are given by the size of the TPMU sensors. Just like fabricated from the same Aluminum alloy with eloxal coating of the whole is shown in Figure 6. The upper and lower panels show the top and bottom supply in the right and data processing unit in the middle and left sections the left provides the power and data interface to the PROBA2 satellite. The interface the DSLP sensors. The middle connectors was used for ground her with the TPMU electronics and sensors the total weight of the common

eriment is divided into three major parts that are the control logic, the digital y. While the control logic and power supply are accommodated in the main are partly split between the main and the two sensor front-end boxes. The LP electronics is shown in Figure 7.
ocessing unit is based on an Intel CPU (series 51) and a ProASIC flash al communication with the satellite, memory decoder logic, and controllers of the satellite commands and data transmission interface into the central andard RS422 protocol at maximum data transition rate of 19200 b/s. The ROM store and another [illegible] memory buffer for data

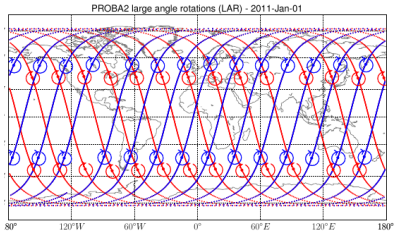


Figure 9: TODO

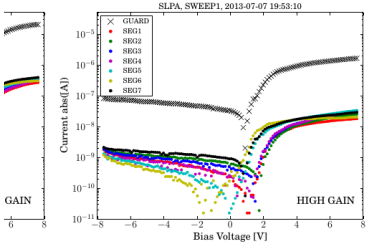
l data rates (including the communication overhead) are summarized nount of raw data acquired by DSLP instrument ranges from about 2

/s	DSLP1-3	DSLP4	DSLP5
l	1,409	1,403	1,365
	1,154	1,251	1,420
	1,154	1,342	N/A
	306	573	N/A

mes (BURST-HIGH, BURST-LOW, NORMAL, and SURVEY) and the five available tes per second are given including the data format overhead of the instrument/system

ed on a Sun-synchronous circular polar orbit at an altitudes of roughly f 6:00 and 18:00 respectively for the ascending and descending half- inutes at an orbital speed of about 7.5 km/s. The nominal PROBA2 bservation mode (Santandrea et al., 2013) in which the satellite has nsors (SWAP and LYRA) being constantly pointed towards the Sun ion of the flight. In order to avoid blinding of the star trackers by the irect Earth visibility for the communication subsystems, the constant each orbit by a large-angle rotation (LAR) of 90 degrees around the X n the directional DSLP measurements. Times for the rotations are not eal time and are changing for different periods. One LAR is typically de with its four LAR's and their exact occurrence for a sample period

November 2009 the DSLP experiment has currently spent more than data set was acquired already in November 2009 as a part of the ini- followed from [illegible] quality of



.PA sensor in the low (dense plasma) and high gain (tenuous plasma) current regimes t measured on the guard is indicated by black crosses and the measurements from s the y-axes displays the absolute value of the measured current in the logarithmic ials) and as well of the floating potentials (zero-current) on the individual segments ments.

as

$$I_p) = min\{a + bU_p, 0\} \quad (5)$$

otential wrt. the local plasma potential V_p. The reasoning for (5) ith respect to their bulk speed (i.e., the satellite's orbital velocity v_s an be thus treated in a good approximation as a monokinetic beam ormulas (A.2) with (A.6) then give (for $q_i = e$)

$$I\left\{-e\pi R_p^2 n_i v_s\left(1 - \frac{2eU_p}{m_i v_s^2}\right), 0\right\} \quad (6)$$

nd b in (5) as

$$-e\pi R_p^2 n_i v_s\ ,\ b = -I_{i,0}\frac{2e}{m_i v_s^2} \quad (7)$$

$_{offset}$ is added to a (thus $a = I_{i,0} + I_{offset}$) in order to capture the s. Once the least-square fitting of I_{tot} on the measured data is done, of the electron current the electron density n_e and temperature T_e ial V_p. Furthermore, assuming the charge neutrality ($n_e = n_i$), the

$$_{fset} = a + e\pi R_p^2 n_e v_s \quad (8)$$

btained from the parameter b as

$$m_i = -I_{i,0}\frac{2e}{bv_s^2}. \quad (9)$$

a parameters for one data sample acquired on the guard segment of linear (left panel) and logarithmic scale (right panel). The measured oretical model current obtained from the least-square fit is displayed [illegible] current [illegible]

...design, operations, data processing