



## **PICASSO-SLP: a Langmuir probe instrument for monitoring the upper ionosphere on board a pico-satellite**

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A novel Langmuir probe instrument, which will fly on board the Pico-Satellite for Atmospheric and Space Science Observations (PICASSO), is under development at the Royal Belgian Institute for Space Aeronomy. PICASSO, an ESA in-orbit demonstrator, is a triple unit CubeSat of dimensions 340.5x100x100 mm.

The sweeping Langmuir probe (SLP) instrument, which includes four thin cylindrical probes whose electrical potential is swept, is designed to measure both plasma density and electron temperature at an altitude varying from about 400 km up to 700 km from a high inclination orbit. Therefore, the plasma density is expected to fluctuate over a wide range, from about  $1e8/m^3$  at high latitude and high altitude up to several times  $1e12/m^3$  at low/mid latitude and low altitude. The electron temperature is expected to lie between approximately 1.000 K and 10.000 K.

Given the high inclination of the orbit, the SLP instrument will allow a global monitoring of the ionosphere with a maximum spatial resolution of the order of 150 m for the electron density and temperature, and up to a few meters for electron density only. The main goals are to study 1) the ionosphere-plasmasphere coupling, 2) the subauroral ionosphere and corresponding magnetospheric features, 3) auroral structures, 4) polar caps, 5) for the density, the multi-scale behaviour, spectral properties and turbulence of processes typical for the auroral regions, and 6) ionospheric dynamics via coordinated observations with EISCAT's heating radar.

Along the orbit, the Debye length is expected to vary from a few millimetres up to a few meters. Due to the tight constraints in terms of mass and volume inherent to pico-satellites, the use of long booms, which would guarantee that the probes are outside the sheath of the spacecraft (several Debye lengths away), is not possible. Consequently, the probes might be in the sheath of the spacecraft in polar regions. Extensive modelling and simulations of the sheath effects on the measured current/voltage characteristics will be performed to ensure an accurate parameter extraction from the measured data. Another issue implied by the use of a pico-satellite platform for a Langmuir probe instrument is the limited conducting area of the spacecraft which can lead to spacecraft charging. In order to avoid this problem, a specific measurement technique that includes the simultaneous measurement of the potential and current of different probes, has been developed to retrieve consistent current-voltage characteristics that can be used to estimate the plasma parameters mentioned above.

The resulting measurement data rate is compatible with the limited telemetry bandwidth available on PICASSO, which will have an S-band downlink session when it passes over the ground station every few orbits.