

Planetary Radio Interferometry and Doppler Experiment (PRIDE) for the Europa Jupiter System Mission

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Abstract

The Planetary Radio Interferometry and Doppler Experiment (PRIDE) is a proposed multi-disciplinary enhancement of the scientific suite of the Europa Jupiter System Mission (EJSM). The essence of PRIDE is the estimation of the state-vector of a spacecraft using Very Long Baseline Interferometry (VLBI) tracking and multi-station Doppler measurements in phase-referencing mode. PRIDE will exploit the technique of VLBI observations of spacecraft and natural celestial reference radio sources by a network of Earth-based radio telescopes. This technique proved to be very efficient in the VLBI experiment with the Huygens probe carried out during its descent on the surface of Titan [1].

Several scientific topics can be addressed by the PRIDE measurements of the EJSM spacecraft and landers/penetrators on surface of the Jovian moons. Ultra-precise celestial mechanics model of the Jovian system will be achieved. Geodynamic observations of the internal structure and composition of Ganymede and Europa will be possible, as well as accurate measurements of the shape and gravimetry of Callisto. From a broader point of view, PRIDE will study the electric properties of icy satellite surfaces and their plasma environments, and will contribute to fundamental physics effects such as the anomalous accelerations of deep space probes [2].

This experiment offers a high degree of synergy with EJSM on-board instrumentation and does not include components requiring mission-critical technology developments. The Earth-based

segment of PRIDE includes a network of radio telescopes and specialized data processing center. These components of PRIDE constitute a backbone of the European (EVN) and global VLBI networks.

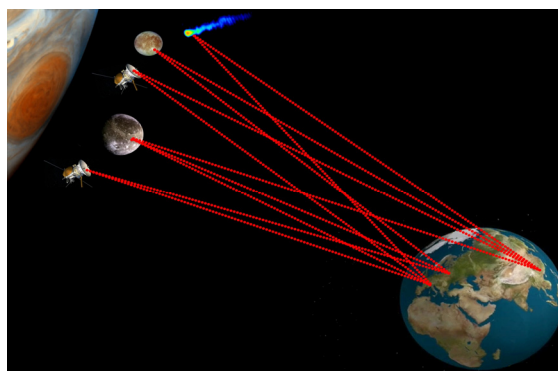


Figure 1: A schematic concept of PRIDE.

In addition to science topics, PRIDE will provide support to mission operations, in particular, mission navigation and trajectory determination as well as on-board systems and instrumentation diagnostics. A separate and potentially beneficial application of PRIDE is its ability to provide limited Direct-to-Earth delivery of data from the planned EJSM landers/penetrators [3].

References

- [1] Huygens VLBI tracking experiment (2008), *JIVE Research Note* 0011.
- [2] Christophe, B., et al, (2009) *Experimental Astronomy*, V 23.
- [3] Fridman P.A., et al, (2008) SKA Memo 104.