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Earth-Based Scientific Segment of the Titan Saturn System Mission

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The Titan Saturn System Mission (TSSM) concept envisages a Titan Orbiter provided by NASA with two Titan in situ elements provided by ESA: the montgolfière and the probe/lake lander. The concept has been developed in the framework of the ESA' Cosmic Vision Programme as TandEM (Titan and Enceladus Mission) proposal for an L-class mission [1] and NASA's Titan Explorer in its 2007 Outer Planet Flagship studies [2]. Although not selected for the earliest launch slot in 2020, the TSSM concept remains a subject of active elaboration by the planetary science community.

Under the original scenario with the launch in 2020, TSSM would arrive 9 years later for at least a 4-year-long research programme in the Saturn system. Following delivery of the ESA *in situ* elements to Titan, the Titan Orbiter would explore the Saturn system during a 2-year tour that includes several Enceladus and Titan flybys. The montgolfière would operate for at least 6-12 months at Titan and the lake lander for 8-10 hours. Following the Saturn system tour, the Titan Orbiter would settle on a Titan-centric orbit for additional ~2 years. Coordinated complementary experiments would be planned for the Orbiter and *in situ* elements.

One overarching goal of TSSM is to explore *in situ* the atmosphere and surface of Titan. The *in situ* exploration is being studied by ESA, in collaboration with CNES. The Titan montgolfière balloon under consideration will circumnavigate Titan at the latitude of ~20º and altitudes of ~ 10 km for a minimum of 6 months. The probe/lake lander will descend through atmosphere and land on the liquid surface of Kraken Mare (~75 º north latitude).

As for any planetary science space mission and based on the Cassini-Huygens experience, Earth-based observations will be synergistic to the *in situ* studies and provide "multi-dimensional" insight in the scientific topics of TSSM. The Earth-based segment of TSSM will include observations in a broad range of EM spectrum from X-ray to radio wavelengths of Saturn and its system. In addition, Earth-based radio telescopes will observe TSSM spacecraft in order to provide estimates of their state-vectors in the interests of various scientific applications (Cimò et al., this conference). The inclusion of the Square Kilometre Array (SKA) in the Earth-based segment of TSSM would not only improve the accuracy of state-vector estimates to the level of tens of meters but also enable Direct-to-Earth backup radio link from the mission *in situ* elements [3].

This paper describes a development of the Earth-based segment of TSSM originally described in [4]. The TSSM Earth-based segment will be presented as a model for implementation in various planetary missions.

References

[1] Coustenis, A. et al. (2009) *Exp.Astr* 23, 893.

[2] Leary, J. et al. (2008) Titan Explorer Flagship Mission Study, www.lpi.usra.edu/opag/Titan_Explorer_Public_Report.pdf

[3] Fridman, P.A., Gurvits, L.I., Pogrebenko, S.V. (2008), SKA Memo No. 104, www.skatelescope.org/pages/page_skares.htm

[4] Coustenis, A. et al. (2009), *Earth, Moon, and Planets*, in press