THE JOINT NASA-ESA TITAN SATURN SYSTEM MISSION (TSSM) STUDY

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Introduction: In 2008, a study was performed jointly by NASA and ESA for a mission to return to Titan after Cassini-Huygens and conduct thorough remote and in situ exploration. Recent Cassini-Huygens discoveries have indeed revolutionized our understanding of the Titan system, rich in organics, possibly containing a vast subsurface ocean of liquid water, a surface repositories of organic compounds, and having the energy sources necessary to drive chemical evolution. With these recent discoveries, interest in Titan as the next scientific target in the outer Solar System is strongly reinforced. Cassini's discovery of active geysers on Enceladus adds an important second target in the Saturn system.

TSSM integrates results from the TandEM proposal within ESA's Cosmic Vision 2015-2025 Plan [1] and the 2007 Flagship Titan Explorer Study [2]. In the 50 years since space exploration began, the Titan Saturn System Mission (TSSM) would be the first in situ exploration of active organic chemistry and climate on the land, on the sea, and in the air of another world. TSSM is planned as a collaborative NASA-ESA mission that includes a full complement of NASA and ESA exploration elements.The mission concept consists of a NASA-provided orbiter and an ESA-provided probe/lander and a Montgolfiere. The mission would launch on an Atlas 551 in the 2018 to 2020 time frame, travelling to Saturn on an SEP gravity assist trajectory, and arriving at Saturn about 9.0 years later. The flight system would go into orbit around Saturn for a 2-year tour. During the first Titan flyby, the orbiter would release the lander to target a large northern polar sea, Kraken Mare, and the montgolfière system would be released on the second Titan flyby to arrive at a mid latitude region.

During the tour phase, TSSM [3,4] will perform Saturn system and Enceladus science, with at least 7 close Enceladus flybys. Instruments aboard the orbiter will produce a global map of Titan's surface at 50 m resolution in the 5 micron window, provide a global data set of topography and sound the immediate subsurface, sample complex organics, provide detailed observations of the atmosphere, and quantify the interaction of Titan with Saturn's magnetosphere. A subset of the instruments would provide spectra, imaging, plume sampling, subsurface measurements and particles and fields data on Enceladus.

Instruments aboard the montgolfière will acquire high resolution imagery of the surface of Titan as it cruises at 10 km altitude, as well as make compositional measurements of the surface, detailed sounding of crustal layering, and chemical measurements of aerosols. A magnetometer, will permit sensitive detection of induced or intrinsic fields.

The probe/lander will splash into a large northern sea and spend several hours floating on the surface during which time direct chemical and physical sampling of the liquid would be undertaken. During its descent the probe would provide the first in situ profiling of the winter northern hemispheric atmosphere, distinctly different from the equatorial atmosphere where Huygens descended and the balloon will arrive. Radio science experiments should be capable of providing detailed information on Titan's tidal response, and hence its crustal rigidity and thickness.

This poster will present the NASA-ESA approach to achieving comprehensive focused exploration of Titan and Enceladus.

References:

[1] Coustenis et al. (2008). Experimental Astronomy, DOI: 10.1007/s10686-008-9103-z.

[2] J. Leary, R. Strain, R. Lorenz, J. H. Waite, 2008. Titan Explorer Flagship Mission Study, Public Report, Jan. 2008, http://www.lpi.usra.edu/opag/Titan_Explorer_Public_Report.pdf.

[3] http://www.lesia.obspm.fr/cosmicvision/tssm/tssm-public/

[4]<http://www.lpi.usra.edu/opag/>http://www.lpi.usra.edu/opag/