Geophysical Research Abstracts
Vol. 13, EGU2011-9531, 2011
EGU General Assembly 2011

Titan Aerial Explorer Mission Proposal to ESA's Cosmic Vision Programme.

Jonathan I. Lunine (1), Kim Reh (2), Christophe Sotin (2), Patrice Couzin (3), and Andre Vargas (4)

(1) Università degli Studi di Roma "Tor Vergata", Dipartimento di Fisica, Roma, Italy (jlunine@roma2.infn.it), (2) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, (3) Thales Alenia Space, Cannes, France, (4) CNES, Toulouse, France

Introduction: The Cassini-Huygens mission revealed Titan to be a body with an active hydrological cycle involving methane, ethane and a variety of other organic molecules. The variety of surface features and atmospheric phenomena seen only at moderate and low resolution by the orbiter tease us, because we know from nature of the one site visited in situ by the Huygens probe that hidden among the dunes and channels, the mountains and lake shores, is a complex history of climate change and chemical evolution tied to methane and its prodigious variety of organic products. We seek to understand this history by deploying at Titan the one type of vehicle that combines the mobility and coverage of the orbiter with the capability for high resolution and in situ observations demonstrated by the Huygens lander, and does so in an aerodynamically stable and low-risk fashion—an aerostat (balloon plus gondola). Concept: The Titan Aerial Explorer mission has been proposed for study under the ESA Cosmic Visions 2010 opportunity. The baseline mission begins with a Soyuz-Fregat launch followed by the interplanetary cruise of the combined Carrier and Descent Modules. The Descent Module includes the aerostat encased in an entry and descent system. At Titan arrival the Descent Module is released onto the pre-determined trajectory. It enters Titan's atmosphere south of the equator, deploys a parachute, releases the heat shields, initiates the balloon inflation and establishes neutral buoyancy at $\sim$8 km altitude. It utilizes a helium-filled super-pressure (or "pressurized") balloon, rather than a hot air (montgolfière) design, as in many previous studies. Strict limitations on technology readiness level, relative robustness of the inflation scenario and mission lifetime were factors that weighed in this decision. Its development leverages decades of previous experience as well as recent planetary balloon development advances of the French Space Agency (CNES) and Jet Propulsion Laboratory California Institute of Technology (JPL) inspired by the Titan Saturn System Mission (TSSM) study. The proposed design satisfies the Cosmic Vision call requirement specifying that technologies are to be at a technical readiness level 5 or greater. The Advanced Stirling Radioisotope Generator (ASRG), assumed to be provided by NASA, would enable electrical power for all phases of the mission. The aerostat gondola would carry the six instruments proposed to perform the measurements. The baseline communication scheme would be a direct-to-earth link using the aerostat's inertial stabilized 0.75-meter high gain antenna. TAE would be compatible with Saturn orbiting relay if one were in the Saturn system at that time.
Science: TAE science is organized around two themes, which emphasize the special nature of Titan and at the same time its important connections to studies of other planets and the Earth. These are (1) The presence of an atmosphere and liquid volatile "hydrologic" cycle, which implies climate evolution through time and (2) organic chemistry, which is pervasive through its atmosphere, surface, and probably interior. A camera, near-infrared spectrometer, radar sounder, cloud analyzer, meteorology package and electromagnetic field instruments would conduct measurements over at least a 3 month period.