OPTIONS FOR A TITAN ORBITER AND MULTI-PROBE MISSION

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ABSTRACT

The Cassini spacecraft to be launched this October will arrive at Saturn in July 2004 and drop the Huygens probe into Titan in November. Then, for the next three years, the orbiting spacecraft will gather science data of Saturn and her many satellites, using what is called a satellite tour.

A follow-on mission option would be to concentrate on Titan as the prime objective, considering that it is similar to Earth, and may have organic compounds in its atmosphere and on the surface. With this objective in mind, a multi-probe mission direct to Titan is an interesting option, and is the subject of this paper.

First, it is interesting to compare conditions for a multi-probe mission at Venus, proposed in 1994 and in 1996 as a Discovery mission, with a Titan multi-probe mission. This is shown in the following table:

Body	Atmos	Temp (°K)	Pressure (bar)	surface-g (earth-g)	V-entry (km/s)	Scale Ht. (km)
Venus	CO_2	730	90.00	0.91	10-12	5-10
Titan	N2	94	1.50	0.14	6-8	20-40

Here, it is seen that conditions for probe entry and survival upon landing are more favorable for Titan than for Venus. For Titan, for example, surface pressure is Earth-like, and surface temperature is manageable using radioisotope heater units (RHU's). Also, surface gravity is quite low, and entry velocities are almost half of those for Venus, and Titan scale height is almost four times as large. The paper will discuss the impact that each of these characteristics have on the mission design.

The problem remains as to the best trajectory and propulsion method to be used to get to the Saturn system. The paper will compare the use of ballistic trajectories with the use of solar electric propulsion, both of which can include Earth, Venus, and/or Jupiter gravity assist. This comparison will be made for the first decade of the 21st century. Since only a Saturn flyby is required (and no orbit insertion) fast flight times may be used, with corresponding increases in entry speeds at Titan. But these speeds are manageable. The paper will conclude with a specific example mission, taken from launch to specified Titan landing sites. A short discussion of aerobraking the probe carrier into a Titan orbit will also be given.

'To be presented at the AAS/AIAA Astrodynamics Conference in Sun Valley, Idaho, August 4-7, 1997. This research performed by the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.