CAN THE CASSINI PAYLOAD CONDUCT PLUTO FLYBY SCIENCE ? by Kevin J. Cole, Science Applications International Corporation, Schaumburg, Illinois.

With the completion of the Voyager 2 encounter at Neptune and Triton, Pluto/Charon remains the only outer planet system that has not been visited by a planetary probe. The purpose of this study is to assess the capability of the Cassini science payload to conduct flyby investigations at Pluto and Charon using a modified Mariner Mark II (a Cassini clone) spacecraft.

An assessment of the Cassini science payload (TABLE 1) on an instrument by instrument basis indicates that 9 out of the 13 instruments could be used at Pluto. Cassini carries one instrument designed to observe Saturn and Titan in the far and mid-IR regions (Composite IR Spectrometer (CIRS)). This instrument measures the thermal character of the surface and atmosphere from absorbed thermal radiation. However, the low temperatures expected at Pluto (50-55 K) would provide little or no thermal signature of the planet. These low temperatures result in a low signal-to-noise ratio at the detector and would yield very little meaningful data. To obtain even low-resolution data with these instruments would require integration times of an hour or more in duration (V. Kunde, GSFC, personal communication). Consequently, the CIRS would not be suitable for this type of mission.

The Titan radar mapper would not be required since there is no obscuring atmosphere at Pluto. However, it would be highly desirable to carry along an altimeter (either laser or radar) to obtain data on surface topography. The imaging system on Cassini should perform quite well at Pluto despite the lower light levels (nine times lower than at Saturn) with the only modifications being to the filters used to conduct Pluto specific science (M. Davies, personal communication). In general, images would require exposure durations nine times longer than at Saturn. The ultraviolet imaging spectrograph (UVIS) and visual and IR mapping spectrometer (VIMS) could also be used as configured for Cassini. As with the imaging system, the UVIS would require longer exposure times to obtain data on Pluto's atmospheric composition and its ionosphere. Data return from VIMS, however, would be minimal due to the low light levels. Since it is highly desirable to carry such an instrument to Pluto to obtain surface composition data, the VIMS detector system could be reconfigured (e.g. changing the detector from a linear CCD array to a planar CCD array) to allow for the low light levels (R.H. Brown, personal communication). This is a problem that should be addressed in greater detail by the project science team.

Each of the giant outer planets contains a magnetic field and thus, a magnetosphere which interacts with the incoming solar wind. This interaction will produce radio emissions, concentrated hot plasmas, auroras, and other phenomena when charged particles interact with a magnetic field. Pluto, on the other hand, is not a giant gas planet. In fact, its a small, solid body of low density and mass composed primarily of rock and ice. With such a composition, it is unlikely that Pluto possesses any intrinsic magnetic field and, therefore, no magnetosphere. Exactly how Pluto interacts with the solar wind (which at these distances is very tenuous and cold) and interplanetary magnetic field (also very weak at 30 AU from the sun) is unknown, however, it is speculated that any interaction may be either comet-like or Venus-like (1). This interaction can be characterized with the Cassini plasma spectrometer (CAPS) and radio plasma wave spectrometer (RPWS). With no magnetosphere to generate radio waves, the radio wave capability of the RPWS may not be required at Pluto. This capability may be desirable, however, at Jupiter to obtain more data on its magnetosphere during the Jupiter gravity assist stage of the mission. The magnetospheric imaging instrument (MIMI) is designed to measure the composition, charge-state, and

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energy distribution of energetic ions and electrons; detect fast neutral species within Saturn's magnetosphere; and conduct remote imaging of Saturn's magnetosphere. Again, this capability would be desirable at Jupiter but may not be necessary at Pluto.

Although it is not expected to find a ring system encircling Pluto and thus no dust particle population of any consequence, it would still be useful to include the Cassini cosmic dust analyzer (CDA) for a Pluto mission. Since Galileo and Cassini will provide a characterization of the interplanetary dust population only out to the orbits of Jupiter and Saturn, respectively, a dust analyzer will be valuable in providing data on the interplanetary dust population out to the orbit of Pluto. This data will be important in determining the relation of dust particles to comets, asteroids and the outer planets. Also, in order to gain a better understanding of the dynamical processes of the outer planets, the flux, size, and orbital distribution of interplanetary dust particles is needed. These measurements will compliment those of Galileo, Ulysses, Cassini, and CRAF.

The Cassini payload also includes an ion mass spectrometer (INMS) for conducting upper atmosphere aeronomy investigations at Titan. Since Pluto does contain an atmosphere, it would be desirable to obtain aeronomy data on the upper atmosphere. To obtain this data, however, would require a flyby to within 3000 km of Pluto. Such a trajectory might sacrifice important remote sensing observations of Pluto's surface as well as losing occultation data at Charon. An alternative would be to include the INMS, along with a retarding potential analyzer/langmuir probe (RPA/LP), on a detachable probe that would skim Pluto's atmosphere conducting upper atmosphere aeronomy investigations.

References. 1) Bagenal and McNutt, Jr. (1989), Geophys. Res. Lett., vol. 16, pp 1229-1232.

TABLE 1
CASSINI ORBITER VS PLUTO FLYBY PAYLOADS

INSTRUMENT	MASS, kg	CASSINI PAYLOAD	PLUTO FLYBY
ISS	36.3	x	x
UVIS	8.0	x	x
VIMS	18.5	x	x
CIRS	22.9	x	
RADAR	18.0	x	x (Altimeter only)
RS	6.3	x	x
CDA	5.0	x	x
RPWS	6.8	x	x
CAPS	12.5	x	x
MIMI	16.0	x	x*
MAG	3.0	x	x
INMS	6.0	x	x**
RPA/LP	3.4		x**
Atmos Probe	192.3	x (Titan)	

* The MIMI would be used at Jupiter only.
** Might include these instruments on a detachable aeronomy probe.