

OUTER PLANETS/SOLAR PROBE PROJECT: PLUTO KUIPER EXPRESS. R. J. Terrile¹, K. P. Klaasen¹, J. Lunine² and T. V. Johnson¹, ¹Jet Propulsion Laboratory, 4800 Oak Grove Dr., Pasadena, CA, 91109, rich.terrire@jpl.nasa.gov, ²Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ, 85721.

Introduction: As part of the exploration strategy laid out in the Solar System Exploration Roadmap, NASA plans to start the Outer Planets/Solar Probe Project in FY '00. The first three missions address key issues in both planetary exploration and the Sun-Earth connection disciplines. They are Europa Orbiter (EO), Pluto-Kuiper Express (PKE) and Solar Probe (SP). All require challenging new technologies and the ability to operate in deep space and at Jupiter (gravity assists from Jupiter are part of the PKE and SP missions). Use of common management and design approaches, avionics, and mission software is planned to reduce the costs of the three missions.

Mission Overview: The Pluto-Kuiper Express mission is designed to provide the first reconnaissance of the Solar System's most distant planet, Pluto, and its moon Charon. Recent progress in understanding Pluto and Charon enabled a well-focused set of questions to be developed that can be addressed by a first spacecraft reconnaissance of the system. Fundamental questions regarding the physical and chemical processes in protoplanetary disks and their relationship with the surrounding nascent molecular cloud will be addressed through study of Pluto and Charon. Analysis of cratering and tectonic records of these bodies will enable an investigation of the environment of the outer Solar System during its early history. The physics of the unique evolution of Pluto's atmosphere as the planet moves away from the Sun will also be a focus of study on this mission.

The reference mission calls for a single spacecraft on a flyby trajectory of the Pluto/Charon system. The spacecraft will carry an integrated array of scientific sensors, including radio science, which will satisfy at least the Category 1a science objectives developed by the Outer Planets Science Working Group and described below. Radio science provides an essential complement to fulfill these goals, and the required PI-provided hardware will be incorporated as part of the spacecraft subsystems. Two science investigation teams will be competitively selected: one for optical remote sensing science and one for radio science. The selected teams will be expected to work closely with spacecraft designers and each other to produce an integrated spacecraft within the stringent cost, mass, power and mission design constraints of the mission.

The recent discovery of dozens of objects, from comet-sized up to hundreds of kilometers, orbiting in the predicted Edgeworth-Kuiper Belt region just beyond the known planets[1,2,3], has raised the exciting possibility of an extended mission to fly close to

one or two such bodies. If remaining spacecraft resources permit, the mission may be extended to explore the Edgeworth-Kuiper Belt. If implemented, this extended mission would allow comparison of the properties of Pluto and Charon with the smaller bodies from which they (and the larger planets) were likely assembled.

Science Objectives: The Outer Planets Science Working Group and later the Pluto Science Definition Team (SDT) carefully considered the range of science objectives appropriate to a first reconnaissance mission to Pluto. These were then prioritized, and their final ranking was endorsed by the Solar System Exploration Subcommittee. Listed below are the Category 1a objectives which are considered absolutely essential to the first-science reconnaissance mission.

- Characterize global geology and morphology of Pluto and Charon
- Map surface composition
- Characterize the neutral atmosphere and its escape rate

Investigations: In assessing experiments that could meet these objectives, the SDT suggested a strawman payload consisting of an integrated ultraviolet, visible and infrared remote sensing package plus a radio science experiment. The SDT also noted that other experiments or groups of experiments could well be proposed that would address the 1a objectives.

Mission Schedule: A draft NASA Announcement of Opportunity was released in January 1999 for comments, and selection of investigations for PKE is expected at the beginning of calendar year 2000. The current planned launches are EO in 2003, PKE in 2004 and SP in 2007, although the launch order will be evaluated again in the next year and changed if critical technology milestones for EO cannot be met for the 2003 opportunity. A 2004 launch for PKE would arrive at Pluto about 9 years later.

References: [1] Jewett, D., Luu, J. and Trujillo C. D. (1998) *AJ*, 115, 2125-2135. [2] Luu, J. X. and Jewett, D. C. (1998) *APJ*, 502, L91. [3] Jewett, D. (1999) *An Rev Earth & Space Sci.*, in press.

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