

# VIEWPOINT



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**P**luto is a complex world and a wonderland of exotic planetary physics. Its attributes include dramatic seasonal cycles, an atmosphere that escapes into space as fast as that of a typical comet, a complex melange of icy and organic (perhaps even including biotic precursors) surface constituents and the most variegated surface markings seen by telescope on any known planet except Earth. Pluto's moon Charon is fully half of Pluto's size, and strangely, far different in terms of surface appearance and composition. Together, Pluto-Charon comprise the only known binary planet system, and the only known example of a planet-satellite system thought to be formed via a giant impact as was the Earth-Moon system. Why the two worlds in this double planet system should be so different is a mystery.

The campaign by scientists wanting NASA to stage a Pluto-Kuiper Belt (PKB) mission was born in the late 1980s and accelerated through the 1990s. During that time, such a mission received endorsement at every stage of NASA's scientific review process.

Although several incarnations of previous Pluto mission studies (Pluto Mariner Mark II, Pluto Fast Flyby, Pluto Kuiper Express) failed to gain new start status during the mid and late 1990s—largely owing to mission cost issues—the current round of PKB proposals fit within NASA's self-imposed \$500-million cap. Such a total mission cost (including all design, development, launch, flight operations, science data analysis, reserves, everything) is just about 50% above typical moderate-cost Discovery missions to far closer and easier-to-reach planets, and requires just 1% of the NASA budget for about three years in order to reach the launch pad. This is a dramatic improvement over outer solar system missions costing billions.

Traveling at about 100 times the speed of a typical jetliner, it will take PKB about 10 years to cross the entirety of our vast solar system and reach the frontier where Pluto-Charon lies. When it arrives, PKB's sophisticated instrument suite is expected to conduct a stunningly rich exploration that will include detailed mapping, composition studies and detailed studies of Pluto's atmosphere. In doing so, NASA will have at long last completed the reconnaissance of the planets.

After its flyby of Pluto-Charon, PKB will continue on to explore objects in the Kuiper Belt. The Kuiper Belt, discovered in the early 1990s, is a vast, disk-like reservoir beyond Neptune containing billions of comets, planetesimals and miniature planets; it is the single most fundamental element of the deep solar

system's architecture, and arguably will be the highest-value treasure trove of information about the era of planet formation in the outer solar system.

PKB also offers a mix of compelling motivations far beyond its exciting science. One is the return to first-time exploration of planets never visited before by spacecraft. Another is the affectionate connection so many school children feel for the planet Pluto. Yet another is the fact that PKB will be the first outer solar system mission for which NASA has opened the competitive bidding to an outside scientist/industry team. As a result of this competition, NASA has brilliantly opened new avenues

that can only serve to reduce cost and enhance flexibility to program managers; in this respect, PKB may be a pathfinder for all future outer planet missions.

Yet PKB's launch window is time critical. PKB requires a special alignment of Jupiter in 2004 to reach Pluto by gravity assist; without gravity assist, the mission cost would be far higher, and the arrival date of the spacecraft much delayed. Owing to the orbital mechanics required to reach Jupiter for a gravity assist, a deferment by just one year beyond 2004 would increase the flight time to 13 years from

8.5 years. And if PKB's launch is delayed further, beyond 2006, then it must wait until 2012 for Jupiter to be in position again for launch.

Each year's delay also will increase the distance PKB must fly to reach Pluto and the distance over which PKB must transmit home its data set. With each passing year, Pluto's deepening (seasonal) polar night enshrouds another 200,000 sq. km. of the planet in near interstellar darkness. And because Pluto is also moving farther from the Sun and cooling, delays will increase the risk that when PKB does arrive, its fascinatingly complex nitrogen-methane atmosphere will have frozen onto its surface as a gentle snow, denying us the opportunity to study it until Pluto returns to its next perihelion, in the mid-23rd century.

Now it is up to the Congress and President Bush to choose whether we will explore Pluto. If Congress and the President do not endorse PKB this year, the opportunity to undertake this exploration will be lost for many years at the very least. Congress can exercise leadership by appropriating funds in the forthcoming markup of the Fiscal 2002 bills. The cost will not be high, yet the rewards will be great—scientifically, programmatically and to all of those who believe in the frontier ethic and the power of exploration to spark the imaginations of all Americans. ➔

## 2004: Key Year For Pluto Mission