

Beyond Cassini

The triumph of the spacecraft's arrival in orbit around Saturn last week heralds four years of outstanding research. But the longer-term ambitions of NASA and planetary researchers signal trouble ahead.

Few fields of science require more patience than planetary exploration. The scientists who built instruments for the Cassini-Huygens spacecraft now orbiting Saturn began planning for the mission in the 1980s. They worked feverishly to meet a 1997 launch date, then waited seven long years for the first results.

Early signs suggest that the pictures and data now streaming back from Saturn will be worth the wait. Cassini's powerful instruments have already shown new detail in the planet's ring system and revealed the icy satellite Phoebe to be a remnant from the first days of the Solar System. The large moon Titan is proving more mysterious than ever, strangely devoid of the large oceans that many suspected would lie underneath its clouds. For planetary scientists, it looks to be an exciting and surprising four years.

Several of the Cassini investigators are veterans of pioneering missions in the 1980s and 1990s, and can rightly be called the first generation of planetary explorers. What's the outlook for the next generation? Mostly sunny, but with clouds gathering on the horizon.

In recent years, NASA has created a balanced, healthy planetary-exploration programme, at least on paper. Ever more sophisticated Mars probes launch every two years and are producing results. The Discovery programme — modest-sized missions proposed by the research community — has been a scientific and budgetary success. The next spacecraft in the series, MESSENGER, will lift off this month to study the Solar System's innermost planet, Mercury.

As for the outer Solar System, New Horizons will launch in 2006 to the last unexplored planet, Pluto. And NASA is in the early stages of planning its Jupiter Icy Moons Orbiter (JIMO), which will use a nuclear-powered rocket to orbit several of the giant planet's satellites in the course of one mission — impossible using conventional rockets.

All this would be wonderful, but here's where the storm clouds

gather. JIMO is likely to far exceed Cassini's \$3.2-billion cost. Its nuclear power plant has yet to be built. It relies on a heavy-lifter launch vehicle that doesn't yet exist. Nuclear power offers shorter trip times to the outer planets and enough onboard electricity to power instruments far more advanced than any previously sent into deep space, but any new technology is likely to suffer cost overruns and delays. The expected launch date has already slipped from 2011 to 2015.

Add to this uncertainty NASA's plan to send astronauts to the Moon and Mars, a shift in direction that — if it survives this year's US presidential election — will affect every other programme at the agency. Nuclear rockets would be useful for human expeditions as well, and optimists say that having two customers makes the programme stronger than if JIMO were its only purpose. Pessimists worry that this expensive planetary mission will be easy to cut if NASA runs into money trouble with its Moon–Mars plans.

International cooperation is another unknown. Cassini is the historic high point of collaboration between European and US planetary scientists. The Huygens probe was built in Europe, which also footed nearly a quarter of the overall project's bill. But such collaboration seems to be on the wane. The Mars programme, once envisaged as truly international, ended up being mostly American. The JIMO mission is, at this point, NASA-only. If European and US space scientists continue to go it alone, exploration of the Solar System will be more expensive for each side.

After the successful Voyager fly-bys of the 1980s, planetary scientists entered the doldrums, with no new science results for nearly a decade. NASA has a plan to avoid such a hiatus in the future. But it depends on following through with key projects such as JIMO, whose political fortunes bear watching even as we sit back and enjoy the spectacular Cassini images of Saturn, its rings and moons. ■

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