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Nuclear-reactor spacecraft poor for astronomy

Spacecraft powered by nuclear fission reactors are of limited use to astronomers, the US National Research Council panel has concluded. The report calls into question NASA's multi-billion-dollar Prometheus project, which aims to develop such spacecraft for future missions to the Moon, Mars, and the outer solar system.

Early reactor technology was used in space once by the US in 1965 and a couple of dozen times by the Soviet Union from 1967 to 1988. Now, NASA hopes to improve on the technology, which releases heat by splitting uranium.

The "nuclear electric propulsion" NASA is focusing on could provide up to a million watts of electricity to power instruments and propel spacecraft using a stream of ions. This could support many more scientific instruments, beam back more data, and allow spacecraft to visit more targets than current technologies.

But the NRC report finds that the reactors would be virtually useless for – and could even hamper – observations of astrophysical phenomena beyond our solar system.

"Reactors are messy things," says NRC panel member Gary Bernstein, an astronomer at the University of Pennsylvania in Philadelphia, US. "They generate huge numbers of radiation particles and gamma rays."

He says these by-products of fission could effectively "blind" space telescopes such as Hubble, Spitzer, and Swift if the reactors operated near the Earth, as they did in the past. "We didn't see a benefit of this technology for any kind of pure science that peers outside the solar system or does fundamental physics tests," he says.

Hot hydrogen

Nor did the panel find that NASA's nuclear programme would support its planned human missions. The NRC acknowledged that fission reactors would be useful for both space travel and long-term human bases on the Moon or Mars. But it said it is not clear whether the nuclear electric propulsion NASA is pursuing is "adequate for either application".

Another reactor technology that uses fission to heat hydrogen so it can be forcefully expelled to provide rocket thrust might get astronauts to Mars more quickly, the panel

The NRC did identify several robotic missions where nuclear electric propulsion could be beneficial, including one to send probes and landers to Neptune and its largest moon, Triton.

But the NRC cautioned that significant hurdles remain for the technology to actually be practical. These include the ability to operate continuously – without repairs – for the decade or so that it would take to reach Neptune. In fact, earlier in 2005, NASA admitted that its first plan to use the technology – in a huge spacecraft called the Jupiter Icy Moons Orbiter – was too ambitious. It is now considering testing the reactor around Earth's Moon instead.

Trunk full of batteries

"There's an awful lot of technological development that's going to take a very long time," says Louise Prockter, a member of the NRC's solar system panel at Johns Hopkins University in Laurel, Maryland, US.

"There's still a lot we can do with the technology we have," she adds, referring to the radioisotope thermoelectric generators (RTGs) that "passively" produce electricity using heat released by the radioactive decay of plutonium-238. RTGs have been used to power dozens of space science missions, from the Voyager probes now at the edge of the solar system to the Cassini spacecraft around Saturn.

But Anthony Hyder, a physicist at the University of Notre Dame University in Indiana, US, points out that RTGs can only generate a few hundred watts of electricity. He says any missions requiring more than that would have to use many more RTGs – the equivalent of using a "trunk full" of flashlight batteries to start a car. "It's much easier at that point to graduate from radioisotopes to fission reactors," he says.

Death knell

However one scientist, who wished to remain anonymous, told **New Scientist** that public concern over the safety of nuclear reactors resulted in a Catch-22 situation: "You're not going to develop it until someone says they need it and no one is going to say they need it because they know it's a death knell for their programme."

Space researchers generally believe spacecraft reactors can be used safely, for example by launching the reactor in pieces before assembling and starting it in space.

While reactors would definitely boost a mission's power level, the technology does come at a heavy financial cost. NASA projects Prometheus will cost $3 billion between now and 2010. In the agency's 2006 budget request, the money was scheduled to come from "exploration systems" – and not the science budget.

But Bernstein says he is worried about the effect of the cost on NASA's other missions. "If

By **Maggie McKee**

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