Could NASA Get To Pluto Faster? Space Expert Says Yes - By Thinking Nuclear

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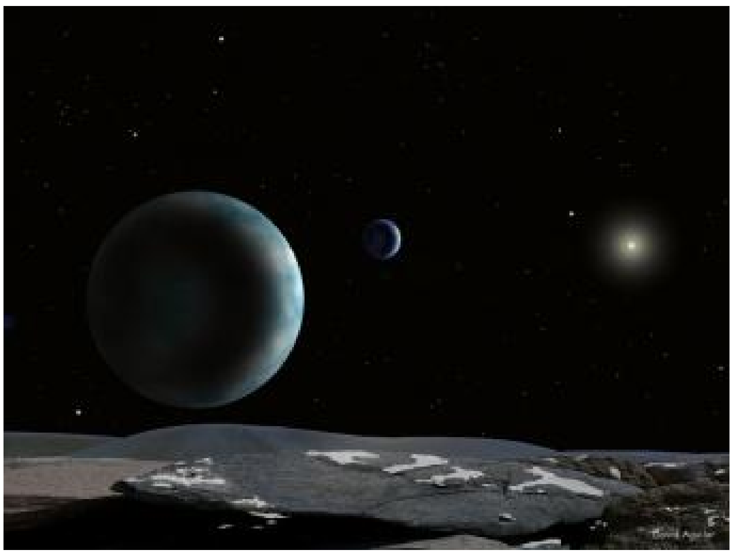

Image: In this artist&acutes concept, Pluto and its moon Charon are seen from the surface of one of Pluto&acutes newly discovered candidate satellites. Credit: David A. Aguilar (Harvard-Smithsonian Center for Astrophysics).

As NASA's New Horizons spacecraft winds its way on a nine-year journey toward Pluto and the outer solar system, at least one expert wonders why such missions need to take so long.

Paul A. Czysz, a 30-year veteran of the industry, continuing consultant to the U.S. military and professor emeritus of aerospace engineering at St. Louis University, thinks NASA can curb the travel time to the outer planets from nearly a decade to a matter of weeks - something he considers critical for the human exploration of the solar system. What's required, he said, is a renewed commitment to nuclear propulsion.

Czysz, who with Claudio Bruno has just published the book, "Future Spacecraft Propulsion Systems" (Springer-Verlag Telos) explored this possibility recently in an interview with SpaceDaily.com.

SpaceDaily: What's wrong with existing propulsion concepts to take astronauts to Mars and beyond?

Paul Czysz: You have to look at the Russian data on microgravity (compiled over the years by long-term missions aboard the Mir space station). Anything after two years and there's an extremely significant re-adaptation of the human physiology to a zero-gravity world. It's not just that the calcium goes out of your bones. The Russian data show that the human body very quickly wants to get rid of processes that cost it energy to maintain all of this bone strength when there's no load on the bones and the heart doesn't have to pump against gravity. The one guy who stayed up well over a year was so badly deteriorated that after the Russians tried to get some of his processes to restart, they realized they had to put him back up into space for the rest of his life - but then about a week before he was going to go up, his body finally responded, but his health has never fully recovered.

SD: And he was only up on Mir for a year?

PC: He was up for 462 days. The problem is that even the Moon's gravity isn't significantly strong enough to elicit a gravity response by the human body. It has to be at least one-fourth of a G.

SD: And the Moon is one-sixth.

PC: Yes, the Moon is one-sixth G. It's marginal, and no one's been up there long enough to test it. You have to be up at least six months to tell if the processes that deal with gravity keep going or whether they start shutting down.

SD: What about introducing artificial gravity?

PC: It's not artificial. If you can produce a 1G environment - and probably half a G - you're going to have the human body respond to the gravity load and it will keep all the calcium processes going between the electrolytes and your calcium storage device, which is your skeleton, and keep all of the blood-circulation systems going. So somewhere between one-half of a G and 1G should be sufficient.

You have to look at crewed missions to deep space differently than you look at robotic missions. The New Horizons spacecraft will take eight and a half or nine years to reach Pluto, and that is too long for human spaceflight.

SD: You've said that a mission to Neptune could be accomplished in 15-and-a-half days?

PC: Yes, at 1G acceleration all the way. You're accelerating at 1G all the time, and then when you get halfway, you turn the engine around and you decelerate at 1G.

SD: Can you describe the powerplant that produces this?

PC: The Russians have said that by 2050 they will have a highly efficient system that uses an extremely small amount of propellant. It's almost a massless propulsion system. It interacts with the space energy structure, producing extremely high-velocity particles that come out of the engine.

SD: Like a stellar ramjet?

PC: No. It's a fusion device that produces extremely high-velocity particles, as much as a tenth of the speed of light.

SD: But this is only theoretical, this has not been tested, yes?

PC: It is possible to build such a thing if you can contain the reaction. A guy I know at the Keldysh Institute (for Applied Mathematics, in Moscow) who is working on this claims that by 2050 there will be such as device. The Russians are at least 35 years ahead of us on nuclear propulsion. They have nine different propulsion systems that they have used. They have been working on this ever since nuclear propulsion systems came about, and their first systems went into space in the sixties. We also had those back then. We called them Rover and Pluto. We actually ran them and they worked very well. In fact, we even blew one up, when the nozzle got clogged up with some ceramic pellets, and although some pellets flew all over the place, the next day it was cleaned up and there was no residual radiation.

SD: But as far as anything on the shelf right now …

PC: It would be Russian.

SD: So, basically what you're saying is if we want to go further than the Moon, then we've got to do it faster because we can't just pack astronauts on these one- or two- or three-year, or longer, missions and expect that their bodies won't deteriorate.

PC: Yes, and if you do robotic missions, you want those missions to be over in a reasonable amount of time. Ten years is a long time to keep a tracking crew together. You may not have to go at 1G, but you would like to be able to get there in a year or under. You could get to Pluto in less than a month, for example.

SD: You could cut 95 percent off, or more, of the flight time by switching propulsion systems?

PC: Yes, we're at the limit of our chemical systems. We're using Jupiter for a gravity assist (with New Horizons), but it would be much better if you had the right propulsion system to begin with, and that system would be nuclear.

SD: But you can't get off the surface with nuclear.

PC: No. Nuclear works best when it's in a vacuum. Then you can get the maximum thrust, and the exhaust from nuclear will always have something in it that you don't want to get into the atmosphere. But you also have to work on reducing costs - achieved, say, by not having to throw the rocket away each time, or if you establish an infrastructure in space.

When I was at Wright Paterson (Air Force Base), and when I was at McDonnell(-Douglas), with the system to supply the Manned Orbiting Laboratory, we developed a hypersonic glider that carried 7 metric tons of cargo, or 12 people - that was half a station load. The MOL required 988,000 lbs. of resources per year - about 45,000 lbs. per person - to keep the crew on the station - oxygen, water, food and everything else. This was a complement of 21 people. We calculated the cost of a fleet of 14 vehicles, including 11 operational and three spares that flew 100 times a year for 15 years. The cost per pound was about $500. When I was still teaching, TWA gave us some cost figures on the Boeing 747. We took four 747s, with one in overhaul and three operational, and flew each three times per year - nine flights per year, just like the shuttle, each carrying 32,000 pounds of cargo. The price was the same as the shuttle: $55,000 per pound.

The concept we had for the MOL was flying 11 vehicles a total of 100 times a year. That's what it took to keep that station going, with crew rotation, experiments, and getting the 988,000 lbs. of stuff up there for them to live on. The shuttle only flew (a maximum of) nine times per year, but if you were to fly the shuttle 100 times a year, the cost per pound would drop to about $800. It has nothing to do with technology. It has to do with the flight rate. If the flight rate is the same as the shuttle, even a 747 is expensive.

SD: So, if you rework your system to get payload off the ground and into orbit, that's where you can fire your nuclear propulsion, and you've got a concept of propulsion that could work continuously and supply the 1G acceleration?

PC: Yes, you supply the 1G for the whole flight.

SD: And how do you get that?

PC: You have to have an extremely high thrust ratio to keep the weight down, and you get that through nuclear propulsion - not the nuclear propulsion we know of today, but the system the Russians are projecting for 2060.

SD: What is the propulsion medium?

PC: It's almost always hydrogen, because it has the smallest molecular weight, and in some of the highest performance nuclear systems what comes out is atomic hydrogen, because the temperature is so high the hydrogen molecules disassemble themselves.

SD: What would this system look like?

PC: There would be no exhaust stream, only a blue glow. When we tested Rover, and the others, you could not see the hydrogen exhaust. On the other hand, some of the systems they're proposing today have thrust levels that are too low. The ability to generate high thrust levels is a necessity. I don't know if (such spacecraft) are going to look like big truss structures. If the mass ratio comes down, they're going to look very different.

SD: What do we do now?

PC: It's about time NASA said, "We're not going to spend all this money to go back to the Moon," and then in three years walk away from it. A Moon base is an orbital station that requires no orbital maintenance. You can hide under the ground so you don't have to worry about solar flares. It has enough atomic oxygen in the soil that you can make oxygen for a breathable system. You can put up a greenhouse and grow your own food. And it might have water.

The point is we have to find out if we can live on the Moon for a year without dying. If we can't do that, how are we going to live on Mars without dying?

SD: Isn't the trick to get up there and exploit the resources to build the materials that you need not only to stay up there, but to go on from there, without having to rely on the heavy lifting from Earth's surface?

PC: That's exactly right. If you make oxygen on the Moon and liquefy it and let it fall back to Earth orbit, that's cheaper than lifting it up from the surface of the Earth.

SD: So all you need is to get above low Earth orbit. Once you're on the Moon, you can supply the mid-range facilities from the Moon instead of from Earth.

PC: Yes.

SD: But nuclear propulsion must come from Earth. There's nothing on the Moon that can help you with that.

PC: Right. There might be some residual material there, but nothing substantial. In terms of nuclear propulsion, that has to come from here.

SD: It would be a quantum leap in our propulsion technology - a couple of weeks to Neptune and a couple of weeks back would be fantastic.

PC: Yes, it would be fantastic. If you're really going to explore our solar system, you're going to have propulsion systems with high accelerations, and in order to do that you're going to have to use either a fission or a fusion propulsion system.