Paddy Neumann: Rocket man

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Australian rocket scientist Dr Paddy Neumann has invented technology that could revolutionise space travel: his rocket drive recycles space junk for fuel and is set to be tested on the International Space Station.

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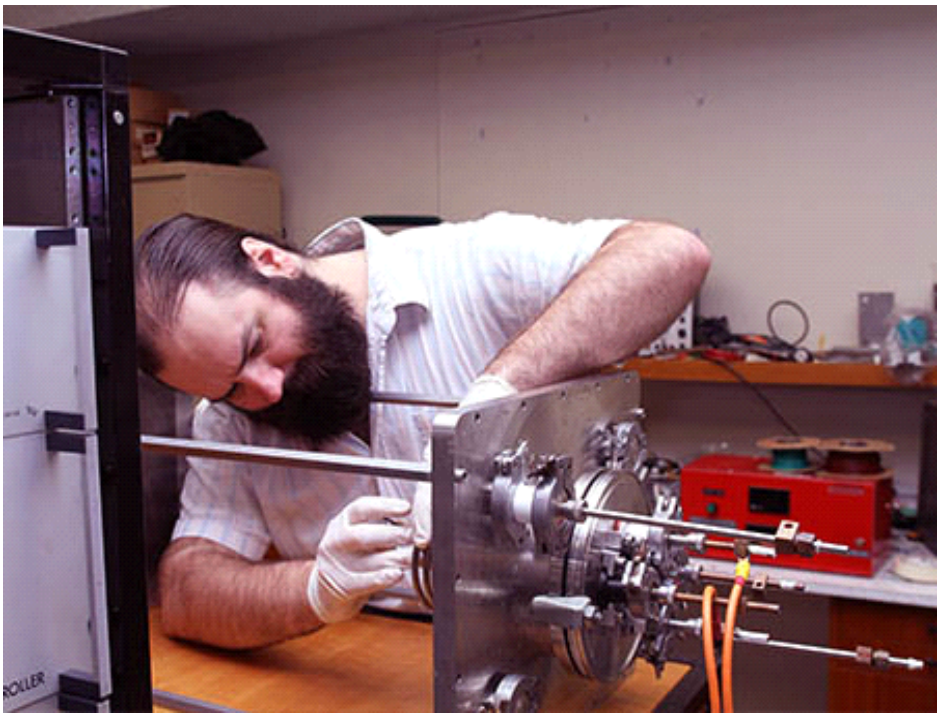


Like many kids, Dr Paddy Neumann wanted to be an astronaut when he grew up. Like most kids, his childhood space travel dreams didn't quite work out the way he planned. Still, Neumann's consolation prize is close to the next best thing. The Australian rocket scientist has developed technology that could change the way we travel in space.

Alongside Professors Marcela Bilek and David McKenzie from his alma mater the University of Sydney, Neumann has designed a rocket propulsion system that will be tested on the International Space Station in a year-long experiment. Neumann's idea is for spacecraft to use an ion thruster that recycles space junk for fuel – technology that could efficiently power a return trip to Mars without refuelling.

"You can get to Mars in a few different ways depending on what technology you use and how much money you want to spend," says Neumann. "A traditional chemical rocket is going to burn a lot of fuel to get to where you want to go and would require several large rockets to bring back a few kilograms of rock from the

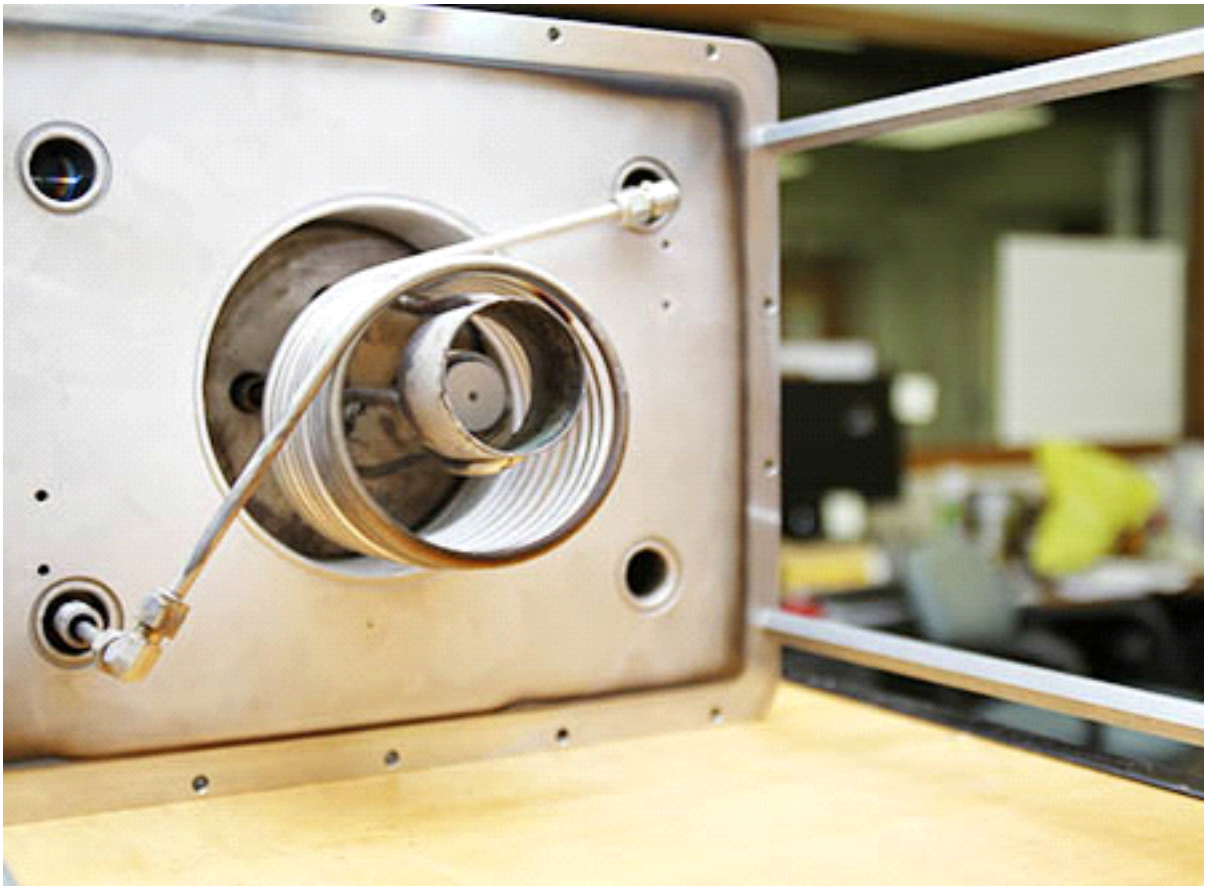
surface of Mars.

> "With our system, we reckon we can get a payload from lower Earth orbit to Mars and back without needing to be refuelled."

Named the Neumann Drive, the innovative rocket engine heats solid metal that turns into plasma to propel the space vehicle. While ion thrusters have previously been used on space missions, they employed Xenon gas atoms as propellant – expensive, of limited supply, and cumbersome to deploy. The Neumann Drive's use of widely available metals could be a breakthrough for space travel.

"Just like an arc welder creates a plasma from the iron and carbon in its welding rod, we create aluminium plasma from an aluminium cathode or titanium from a titanium cathode," explains Neumann.

"The plasma comes streaming away from the cathode and moves very fast – maybe 110 kilometres per second. As it moves away from the cathode you get a reaction force just like when you are firing a bullet out of a gun. That's basically how a rocket works – you shoot stuff out one end really fast and get a push in the other direction."



The Neumann Drive cathode. Credit: Neumann Space.

Turning space junk into rocket fuel

The Neumann Drive has several potential advantages over traditional chemical rocket propulsion. While not capable of launching a spaceship into orbit from Earth (powerful rockets are still required to counter gravity), reduced fuel payloads and the ability to refuel in space opens up a whole new world of reusable spacecraft to undertake long missions across the solar system.

"With our system, you can change the economics of how a space tow truck or tugboat can be used, as well as satellite maintenance and delivery," Neumann says.

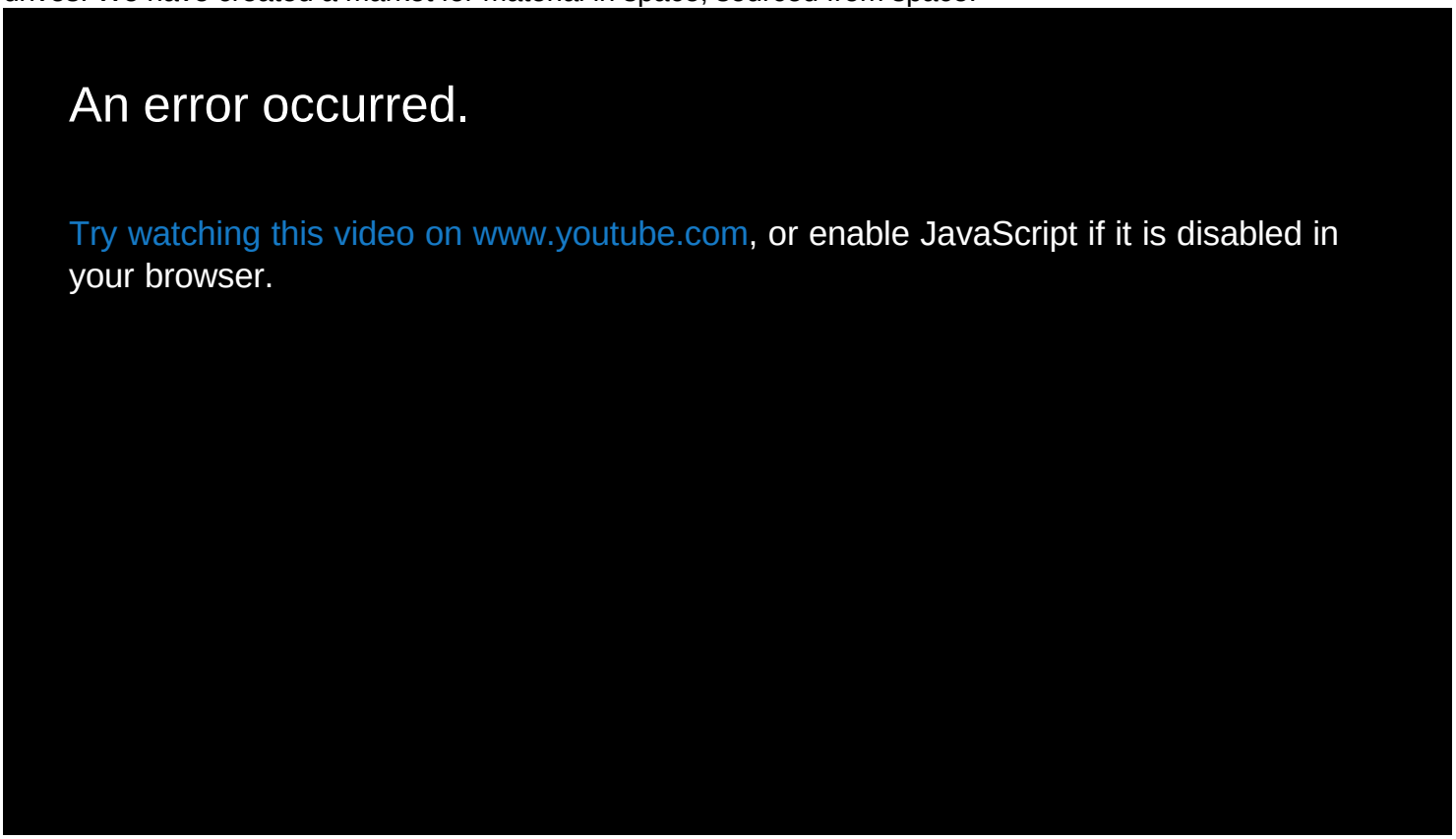
> Metals as fuel is a key element of the Neumann Drive – an approach that has also created an opportunity to pioneer a use for recycled

space junk.

As Neumann explains, the Earth's lower orbit is littered with dead satellites and floating debris that are dangerous to functioning satellites and spacecraft. Much of that junk is made from aluminium, titanium or magnesium.

"Our drive system runs on what are called 'aerospace metals'," Neumann says. "You can put anything solid in our drive to run on the cathode, turn it into short sharp blasts of plasma, and get thrust out of it. It doesn't matter what metal we use.

"If we were to recycle space junk, we would be actively removing debris from the near-Earth environment, lowering rates of collision, increasing the lifespan of valuable assets in orbit, and processing it for fuel for the drives. We have created a market for material in space, sourced from space."



From the City of Light to outer space

Neumann grew up and attended school in Perth, Western Australia, a city made famous in 1962 when residents turned on house lights to be visible to astronaut John Glenn – the first American to orbit the Earth – as he passed overhead in the Friendship 7 spacecraft. The event marked Perth as 'The City of Light'.

It was during high school, while attending a winter science camp, International Science School, at the University of Sydney that Neumann's fascination with physics was confirmed. A scholarship to study at the University of Sydney followed and the door opened to double undergraduate degrees – a Bachelor of Aerospace Engineering (graduating with Honours) and a Bachelor of Science specialising in Physics.

The common theme in Neumann's academic career is the development of thruster technology for aerospace use. Neumann's PhD project focused on specific fuel options for the drive.

"I tested 11 different materials," he says of his research project. "Some were pretty solid contenders for consideration and others you wouldn't use in a million years as rocket fuel. But the way they failed told us a lot about what was happening in the plasma. Sometimes you learn more from what you fail at."

Dr Paddy Neumann with the Neumann Drive. Credit Neumann Space.

Lift off to the International Space Station

The next step for Neumann was to translate his academic achievements into a commercial startup (his university professors assigned their rights as co-inventors of the technology to Neumann). He chose the South Australian city of Adelaide as headquarters – a location that offered a competitive economic environment for a new business supported by venture capital and grants. Neumann Space now has six employees.

The latest landmark for the Neumann Drive was formalised in late 2016, when Neumann Space agreed to a deal for European company Airbus Defence & Space to transport a drive to the International Space Station (ISS) in 2018 for a 12-month test program. Tests will take place on the Bartolomeo platform, a commercial research platform attached to the European Columbus module of the ISS. The aim is to demonstrate how the drive performs in a real out-of-world environment for an extended period.

“We need to take our drive up to space, turn it on, and fire off a bunch of plasma,” Neumann says. “We need to go through all the operations to prove the drive does work in space.”

Demonstrating its owner’s entrepreneurial smarts, Neumann Space also plans to sublease additional space it has rented on the Bartolomeo platform to other research projects. Another long-term objective: Neumann intends to show Australians can contribute to global space technology research and development from their home base.

> “Australia is not known for its space and rocketry but there is definitely an Australian space diaspora,” Neumann says.

“There are a lot of Australians working on cutting-edge research in satellite dynamics and ground-based observations, mostly working overseas with NASA, the European Space Agency or private companies like Airbus, Boeing or Lockheed. Neumann Space hopes to be an Australian company that manufactures components for spacecraft in Australia that people are willing to pay for and help give Australia more of a civil space industry.”

Find out more about the Neumann Drive.
