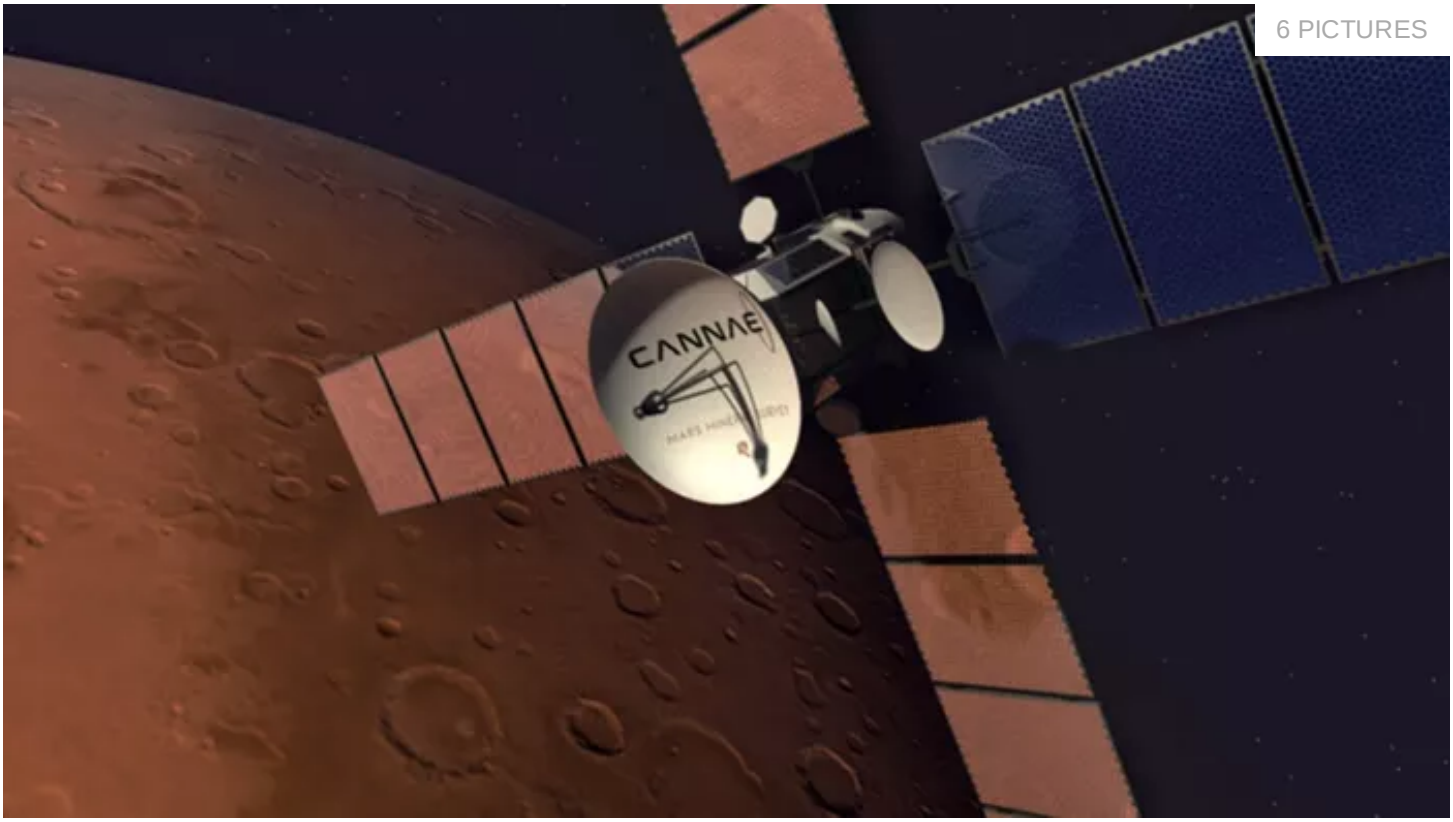
NASA says puzzling new space drive can generate thrust without propellant

Dario Borghino August 2, 2014

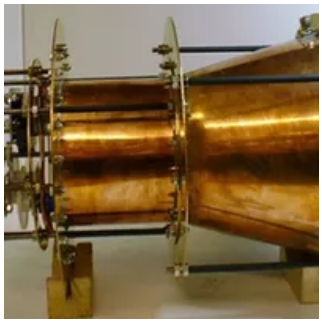
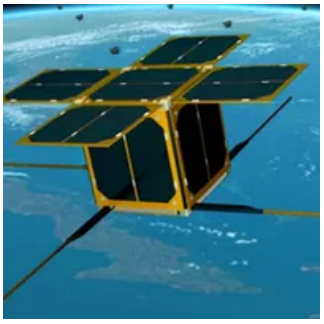
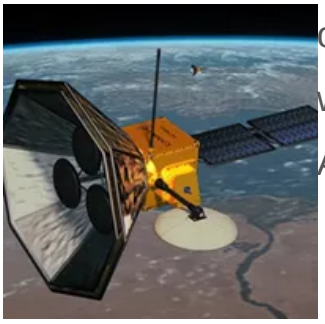


6 PICTURES

According to a puzzling report, a new thruster design appears to be able to accelerate a craft without the use of propellant (Image: Cannae). View gallery (6 images)

A NASA study has recently concluded that the "Cannae Drive," a disruptive new method of space propulsion, can produce small amounts of thrust without the use of propellant, in apparent discordance with Newton's third law. According to its inventor, the device can harness microwave radiation inside a resonator, turning electricity into a net thrust. If further verified and perfected, the advance could revolutionize the space industry, dramatically cutting costs for both missions in deep space and satellites in Earth orbit.

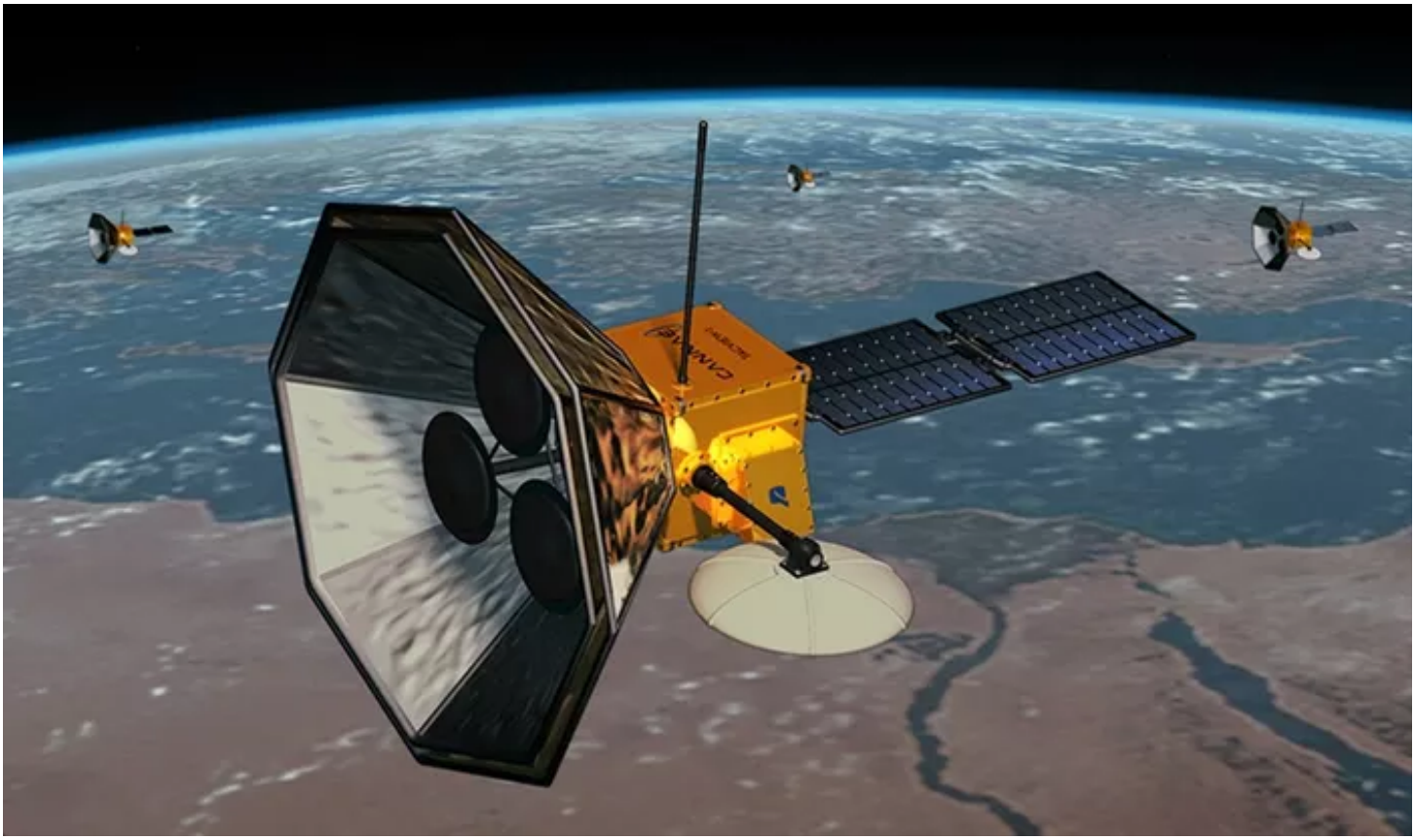
The basic principle behind space propulsion is very simple: for every action, there is an equal and opposite reaction. Use a rocket engine to throw mass one way, get propelled the

other way. And according to the law of conservation of momentum, the more mass you throw behind you and the faster you throw it, the stronger your forward thrust will be.

One consequence for space travel is that, to counter Earth's gravity and reach orbital velocity, rockets need to carry a very large amount of propellant: For instance, in the now-retired Space Shuttle, the mass of the fuel was almost twenty times greater than the payload itself. In satellites the impact is smaller, but still very significant: for geostationary satellites, fuel can make up as much as half the launch weight, and that makes them more expensive to launch and operate.

But now, a NASA study has concluded that a new type of spacecraft propulsion is able to generate thrust without propellant. This appears to violate the law of conservation of momentum: in other words, if no mass (fuel or otherwise) is being ejected from the system, where is the thrust coming from? Where is the equal and opposite reaction?



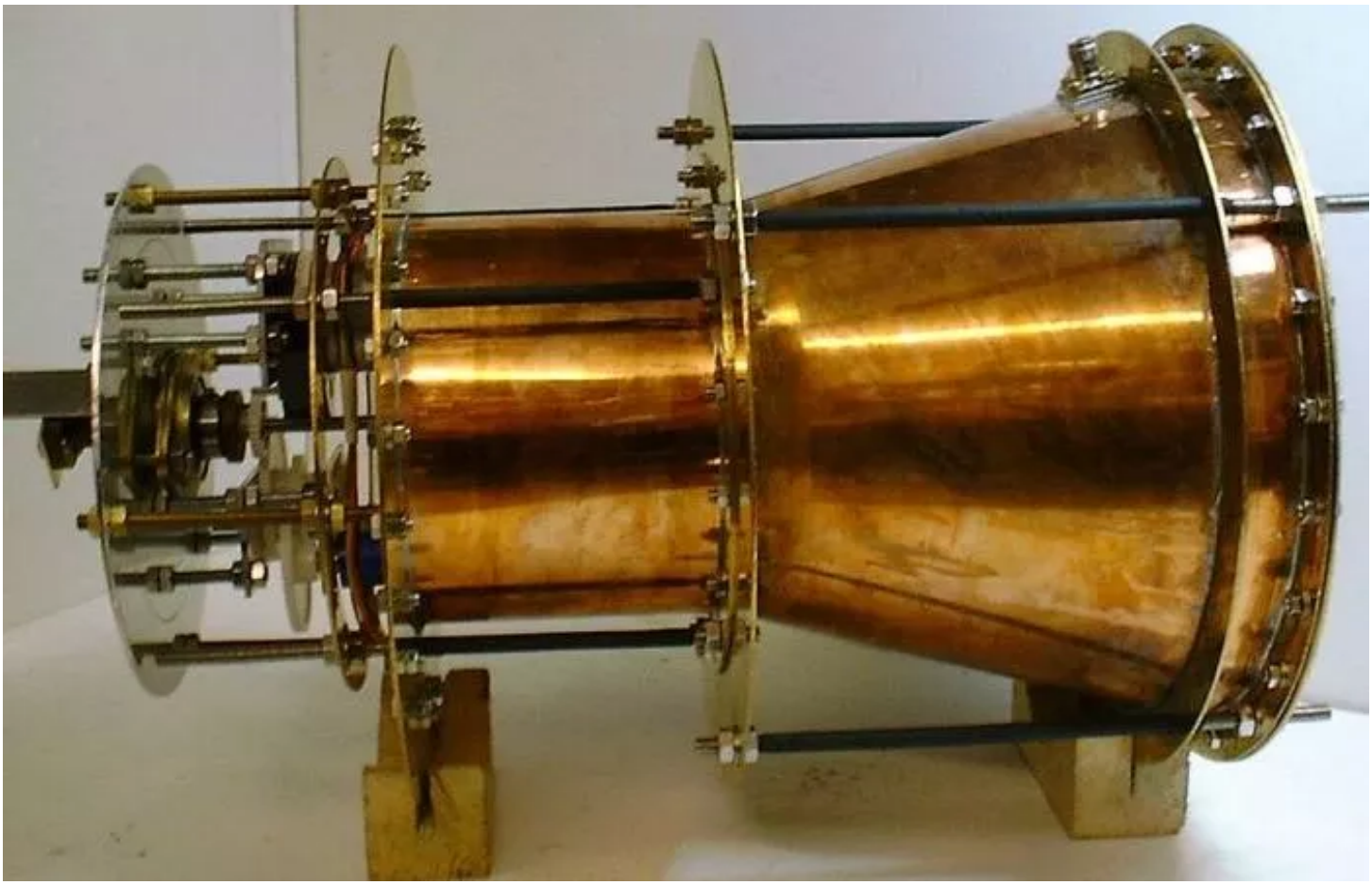
According to its inventor, US scientist Guido Fetta, the thruster works as a resonating cavity for microwave radiation. The cavity redirects the radiation pressure to create an unbalanced force, and that force produces a net thrust.

In its study NASA didn't attempt to explain the phenomenon, and instead contented itself with verifying that the system did indeed generate a small amount of thrust, between 30 and 50 micro-Newtons. This is a tiny amount, only enough to levitate a mass of three to five milligrams (a few eyelashes) here on Earth; but, astonishingly, it is a net thrust nonetheless.

"Test results indicate that the RF resonant cavity thruster design, which is unique as an electric propulsion device, is producing a force that is not attributable to any classical electromagnetic phenomenon and therefore is potentially demonstrating an interaction with the quantum vacuum virtual plasma," the study concludes.

The system has many striking similarities with the EmDrive, designed by British aerospace engineer Roger Shawyer, although the explanation that Shawyer provides for the working

mechanism is quite different from Fetta's or NASA's.



According to one peer-reviewed paper, the EmDrive thruster was able to produce 720 mN of thrust from an electricity input of 2.5 kW (Photo: EmDrive)

"At first sight the idea of propulsion without propellant seems impossible," says Shawyer. "However, the technology is firmly anchored in the basic laws of physics and following an extensive review process, no transgressions of these laws have been identified."

According to Shawyer, the thruster works because of relativistic effects: the microwaves are moving at a significant fraction of the speed of light at both ends of the resonator, and so, he claims, the resonator and the microwaves have two separate frames of reference, with the two forming an open system that ultimately doesn't violate the laws of physics, conservation of momentum included.

The interesting thing about EmDrive is that, back in 2009, a Chinese peer-reviewed journal

tested Shawyer's thruster design, registering 720 mN of thrust at an input power of 2.5 kW. That's enough to make a tennis ball hover, and then some; in fact, if the results are confirmed, such levels of thrust would already be practical for satellitar applications.

Performance Parameter	Current Ion Propulsion System	Proposed Microwave Propulsion System
DC power (Watts)	700	700
Thrust (mN)	23	88
Thrust period (Years)	1.6	15
System Mass (kg)	94	9

Salient characteristics of the EmDrive compared to a more conventional ion propulsion system (Image: EmDrive)

The system could generate electricity from solar panels, and because it is much lighter than current thrusters, it could more than halve the weight launch of satellites, leading to very significant reductions in launch costs. A practical microwave thruster could also meaningfully extend the lifetime of satellites and pave the way for deep space robotic missions.

Even beyond that, Shawyer claims that the second generation of his fuel-less thrusters, based on superconductor technology, will be capable of producing an impressive specific thrust of 30 kN per kW of input energy. "Thus for 1 kilowatt (typical of the power in a microwave oven) a static thrust of 3 tonnes (3.3 tons) can be obtained, which is enough to support a large car. This is clearly adequate for terrestrial transport applications."

But before we start talking Sun-powered flying cars and weekend trips to Pluto, the scientific community will undoubtedly need to dissect the experiment with great care and independently verify whether the tiny net thrust reported by NASA could after all be attributed to some external cause that the researchers didn't account for.