

Here's why scientists haven't invented an impossible space engine – despite what you may have read

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From Earth to the Moon in four hours? Still impossible. Shutterstock

What if I told you that recent experiments have revealed a revolutionary new method of propulsion that threatens to overthrow the laws of physics as we know them? That its inventor claims it could allow us to travel to the Moon in four hours without the use of fuel? What if I then told you we cannot explain exactly how it works and, in fact, there are some very good reasons why it shouldn't work at all?

I wouldn't blame you for being sceptical. The somewhat fantastical EMDrive (short for Electromagnetic Drive) recently returned to the public eye after an academic claimed to have recorded the drive producing measurable thrust. The experiments from Professor Martin Tajmar's group at the Dresden University of Technology have [spawned numerous overexcited headlines](#) making claims that -- let's be very clear here -- are not supported by the science. The idea for the EMDrive was [first proposed](#) by Roger Shawyer in 1999 but, tellingly, he has only recently published

[any work](#) on it in a peer-reviewed scientific journal, and a rather obscure one at that. Shawyer claims his device works by bouncing microwaves around inside a conical cavity. According to him, the taper of the cavity creates a change in the group velocity of the microwaves as they move from one end to the other, which leads to an unbalanced force, which then translates into a thrust. If it worked, the EMDrive would be a propulsion method unlike any other, requiring no propellant to produce thrust.

Fundamental problems

There is, of course, a flaw in this idea. The design instantly violates the principle of [conservation of momentum](#). This states the total momentum (mass x velocity) of objects in a system must remain the same and is linked to Newton's Third Law. Essentially, for an object to accelerate in one direction, there must be an equal force directed the opposite way. In the case of engines, this usually means firing out particles (such as propellant) or radiation. The EMDrive is designed to be a closed system that doesn't emit any particles or radiation. It cannot possibly generate any thrust without breaking some seriously fundamental laws of physics. To put it bluntly, it's like trying to pull yourself up by your shoelaces and hoping you'll levitate. From Earth to the Moon in four hours? Still impossible. Shutterstock Nonetheless, a few open-minded experimental groups have built prototype EMDrives and all seem to see it generate some form of thrust. This has led to a lot of excitement. Maybe the laws of physics as we know them are wrong? Eagleworks, a NASA-based group, built a prototype and [last year reported](#) 30-50 micronewtons of thrust that could not be explained by any conventional theory. This work was not peer-reviewed. Now, Tajmar's group in Dresden say they have built a new version of the EMDrive [and detected](#) 20 micronewtons of thrust. This is a much

smaller value, but still significant if it really is generated by some new principle.

Experimental problems

Straightaway, there are problems with this experiment. The abstract states: "Our test campaign cannot confirm or refute the claims of the EMDrive." Then, a careful reading of the paper reveals this observation: "The control experiment actually gave the biggest thrust ... We were really puzzled by this large thrust from our control experiment where we expected to measure zero." Yes, the control experiment designed not to generate any thrust still measures a thrust. Then there's the peculiar gradual way the thrust seems to turn on and off that looks suspiciously like a thermal effect, and then there are acknowledged heating problems. All this leads to the conclusion stated in the paper that "such a set-up does not seem to be able to adequately measure precise thrusts." Similar problems were seen by the Eagleworks group, with thrust also mysteriously appearing in their control test. Taken together, these results strongly suggest that the measured signatures of thrust are subtle experimental errors. Possible sources include thermal effects, problems with magnetic shielding or even a non-uniform gravitational field in the laboratory leading to erroneous force measurements. As a comparison, the force measured in this latest experiment is roughly comparable to the gravitational attraction between two average-sized people (100kg) standing about 15cm apart. It is an extremely small force. That the experiments detect a measurable thrust is undeniable. Where the [thrust](#) comes from, whether it is real or erroneous, is inconclusive. That the experiments in any way confirm the EMDrive works is a falsehood. This was noted by Tajmar himself, who told the [International Business Times](#) "I believe there is no real news here yet." The experimental scientists involved have done their jobs to the best of their ability, having tested a hypothesis – albeit a spectacularly unlikely one – and reported their results. These scientists aren't actually claiming to have invented a warp drive or to have broken the laws of physics. All they're saying at the moment is that they've found something odd and unexplained that might be something new but is likely an experimental artefact

that needs further study. The panoply of clickbait headlines and poorly researched articles on the topic are doing something of a disservice to their scientific integrity by claiming otherwise.

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