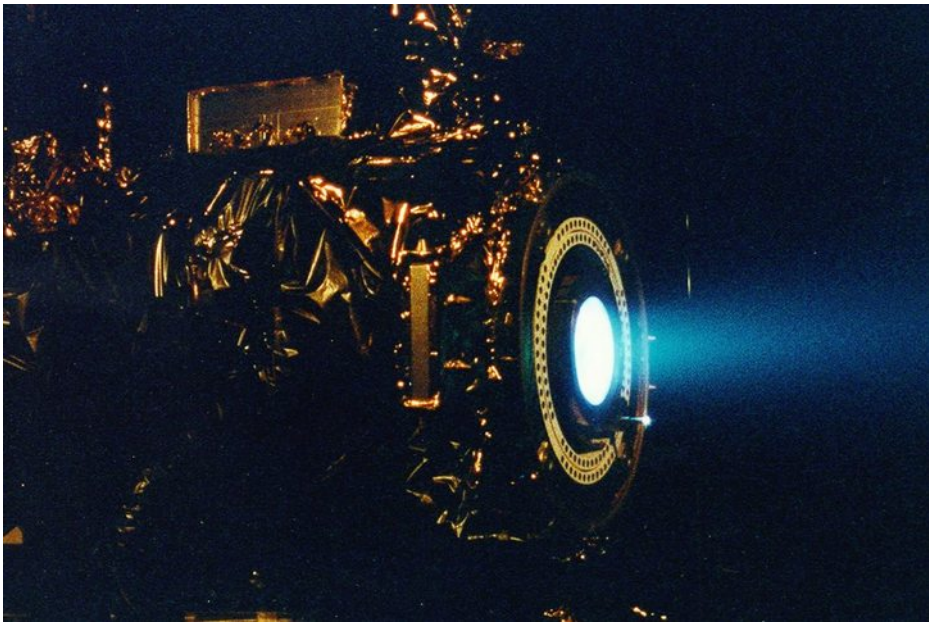
# Final NASA Eagleworks Paper Confirms Promising EmDrive Results, Proposes Theoretical Model



by Giulio PriscoNovember 18, 2016



**Earlier this month *Hacked* reported that a draft version of the much expected EmDrive paper by the NASA Eagleworks team, had been leaked. Now, the final version of the paper has been published.**

The NASA Eagleworks paper, titled "Measurement of Impulsive Thrust from a Closed Radio-Frequency Cavity in Vacuum," has been published online as an open access "article in advance" in the American Institute of Aeronautics and Astronautics (AIAA)'s *Journal of Propulsion and Power*, a prestigious peer-reviewed journal. The paper will appear in the December print issue of the journal.

The final version of the paper is very similar to the leaked draft. In particular, the NASA scientists confirm the promising experimental results:

> "Thrust data from forward, reverse, and null suggested that the system was consistently performing at 1.2 ± 0.1 mN⁄kW, which was very close to the average impulsive performance measured in air. A number of error sources were considered and discussed."

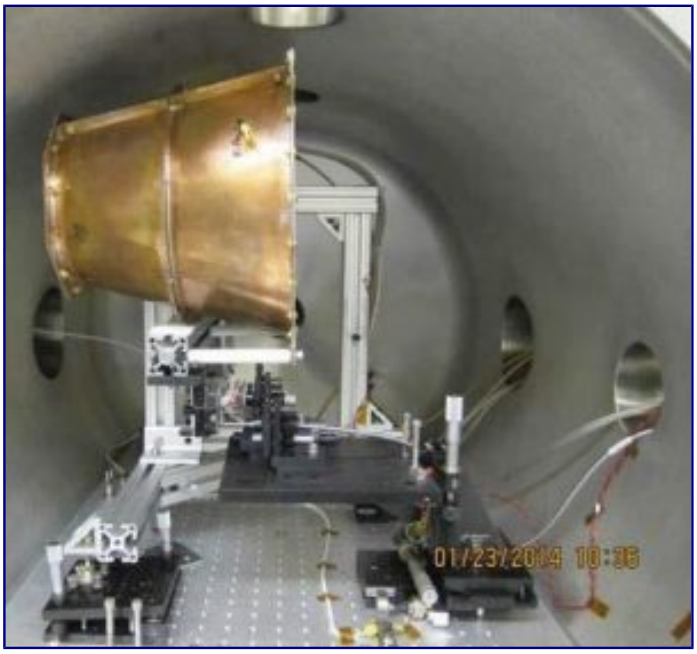
The scientists add that, though the test campaign was not focused on optimizing performance and was more an exercise in existence proof, it is still useful to put the observed thrust-to-power figure of 1.2 mN⁄kW in context.

> "[For] missions with very large delta-v requirements, having a propellant consumption rate of zero could offset the higher power requirements. The 1.2 mN⁄kW performance parameter is over two orders of magnitude higher than other forms of 'zero propellant' propulsion, such as light sails, laser propulsion, and photon rockets having thrust-to-power levels in the 3.33–6.67 μN⁄kW (or 0.0033–0.0067 mN⁄kW) range."

In other words, a modest thrust without having to carry fuel can be better, especially for long-distance space missions, than a higher thrust at the cost of having to carry bulky and heavy propellant reserves, and the EmDrive performs much better than the other "zero propellant" propulsion systems studied to date.

The EmDrive results are often dismissed because they appear to violate the fundamental conservation laws of physics, but possible models for the anomalous thrust effect have been proposed that, while belonging to highly imaginative areas of theoretical physics, could explain the controversial results without violating fundamental conservation laws.

# Can Nonlocal Hidden-Variable Theories Explain the Anomalous EmDrive Thrust?




EmDrive built by Eagleworks inside the test chamber.

Though the NASA Eagleworks paper is mainly focused on experimental test results, the scientists discuss some possible theoretical models:

> "[The] supporting physics model used to derive a force based on operating conditions in the test article can be categorized as a nonlocal hidden-variable theory, or pilot-wave theory for short."

While pilot-wave interpretations and re-formulations of quantum physics have been proposed by leading scientists, notably including David Bohm, most physicists remain unpersuaded. However, pilot-wave theories are becoming fashionable again with the development of pilot-wave models for classical (non-quantum) hydrodynamic systems that can reproduce quantum-mechanical phenomena. The NASA researchers note that, to date, hydrodynamic pilot-wave analog systems have been able to duplicate the double slit experiment findings, tunneling, quantized orbits, and numerous other quantum phenomena.

The scientists note that, in supporting theoretical models, the zero point field (ZPF) plays the role of the guiding wave in a similar manner to the vacuum-based pilot-wave theories, and suggest that the idea of treating the quantum vacuum as a dynamic medium capable of supporting oscillations might be valid. "If a medium is capable of supporting acoustic oscillations, this means that the internal constituents were capable of interacting and exchanging momentum."

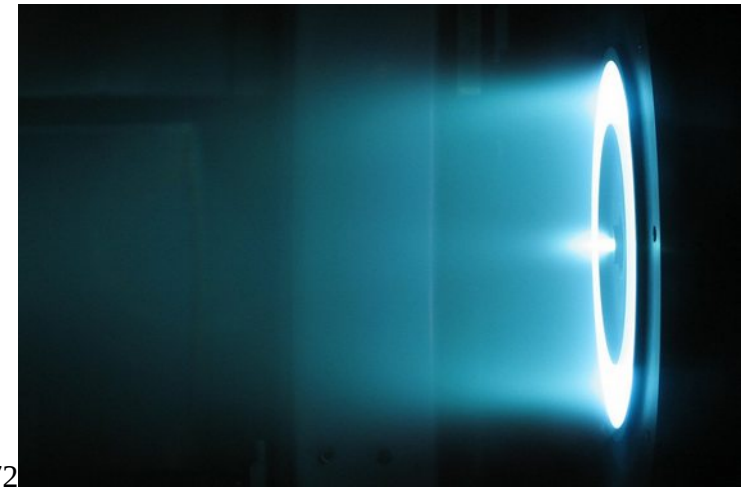
> "If the vacuum is indeed mutable and degradable as was explored, then it might be possible to do/extract work on/from the vacuum, and thereby be possible to push off of the quantum vacuum and preserve the laws of conservation of energy and conservation of momentum."

The experimental results achieved by the NASA Eagleworks scientists and validated by independent reviewers, and the developing theoretical frameworks that could explain the mysterious thrust measured in the lab, put EmDrive research firmly on the map. But of course many people will keep their pre-conceived skepticism. A recent *Motherboard* EmDrive article was deleted yesterday by the moderators of the popular subreddit r/Physics because they "consider the EM-Drive to be unscientific."

One wonders what will be required to persuade the professional skeptics that EmDrive research is science. Perhaps a Nobel Prize? Or not even that?

*Images from NASA and Wikimedia Commons.*

EMDrive, NASA, NASA Eagleworks

2772 

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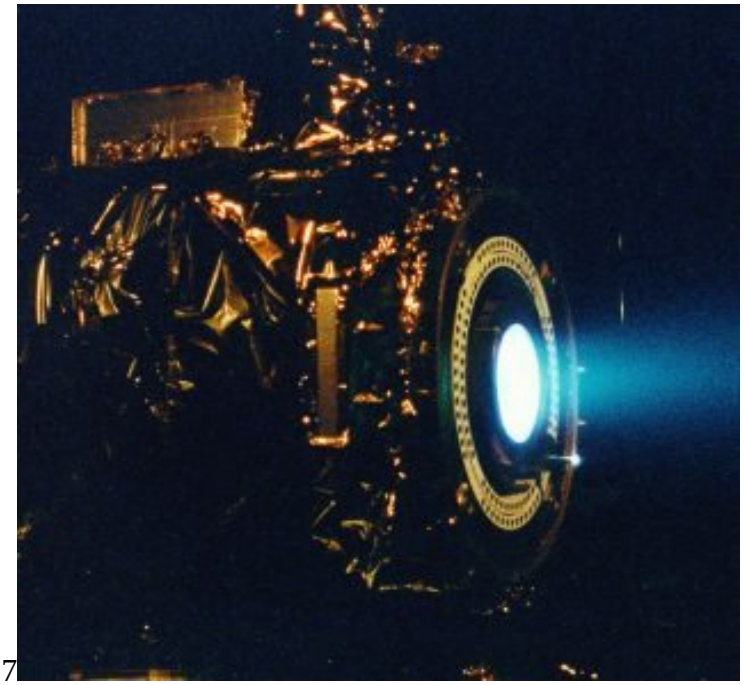
3517 

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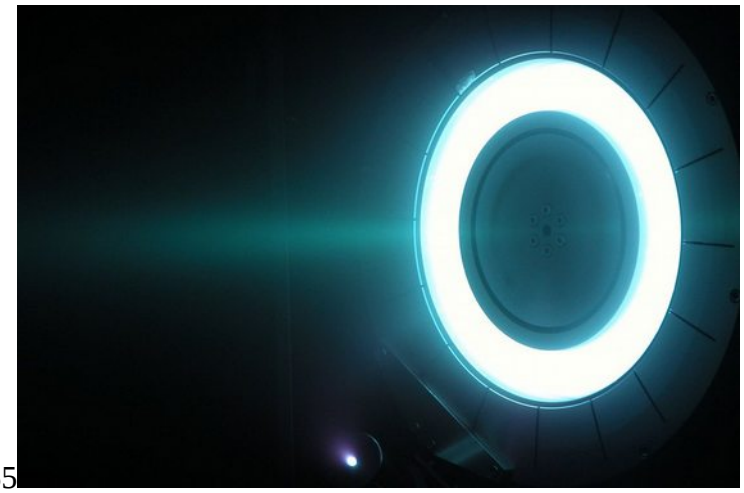
22255 

New Published Results on the ‘Impossible’ EmDrive Propulsion Expected Soon

New NASA Tests Confirm Anomalous EmDrive Thrust