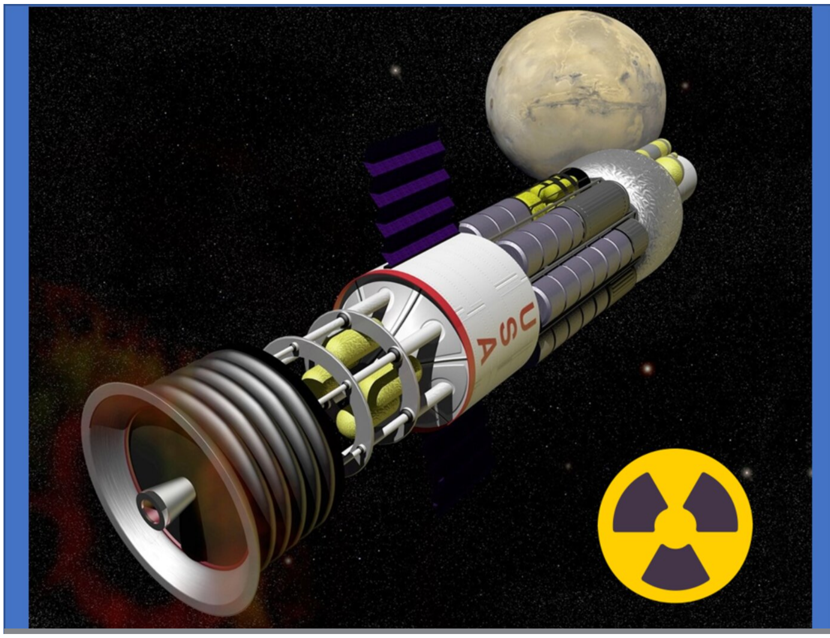


National Aeronautics and
Space Administration

TECHNOLOGY SOLUTION

Propulsion

Improved Efficiency in Nuclear Propulsion

NTAC Harvests Waste Energy to Improve Propulsion Capability

Innovators at Langley Research Center (LaRC) have developed a design and method to improve efficiency in nuclear propulsion technology for long-distance space missions. The nuclear thermionic avalanche cell (NTAC) Augmented Nuclear Electric Propulsion and/or Nuclear Thermal Propulsion design surrounds the rocket chamber and reactor core with an NTAC and safely converts gamma ray radiation expelled during nuclear fission processes, which would otherwise be lost to radiation shielding, into electric power to support additional propulsion. Compared to current radiation-shielded propulsion systems, this design is more efficient and lower weight, enabling faster nuclear propulsion travel. This technology potentially has a wide range of applications including nuclear power generation applications on Earth, and for unmanned vehicles, and commercial space exploration.

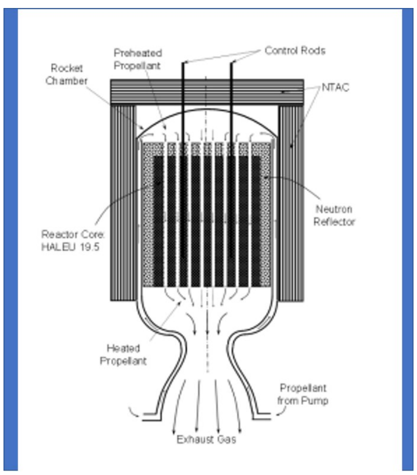
BENEFITS

- Higher efficiency by capturing lost energy: an additional 6.5% (13.3 MeV) of radiation energy typically lost to radiation shielding
- Faster nuclear propulsion travel enabling long-distance missions to other planets and reducing astronaut risk related to long-term radiation and low-gravity conditions
- Lower weight, more efficient, and reduced complexity compared to current radiation-shielded propulsion systems
- Low-profile radar signature compared to solar panels, enabling use for stealth systems

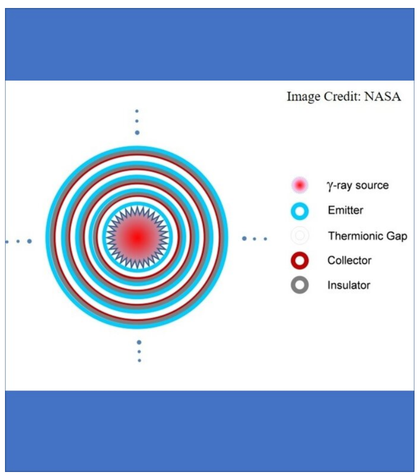
THE TECHNOLOGY

Current nuclear propulsion technologies do not utilize the additional energy expelled as gamma ray radiation during nuclear fission. This results in the loss of 6.5% of the total fission energy, which could be used to improve propulsion capabilities. The NTAC Augmented Nuclear Electric Propulsion and/or Nuclear Thermal Propulsion design is more efficient than existing technology and captures an additional 6.5% (13.3 MeV) of radiation energy that is currently lost to radiation shielding. In this design the NTAC cell structure surrounds the TRISO (TRi-structural ISOtropic particle fuel) bead-filled rocket chamber, covering all sides and the top of the chamber, therefore capturing additional energy. This structure allows one-way energy flow to then be expelled through the bottom cavity as exhaust gas

This technology is lower weight and less elaborate than current radiation shielded-propulsion systems. Equipping nuclear spacecraft systems with the NTAC Augmented Nuclear Electric Propulsion and/or Nuclear Thermal Propulsion design could reduce travel time to Mars by 50%. It has lower radar signatures compared to solar panels and could be used for systems that need to fly undetected, such as Earth observing satellites. Additionally, it has a lower noise output, which could have applications in reducing noise from submarine and aircraft carrier power systems.



Shown is the design for NTAC Augmented Nuclear Electric Propulsion and/or Nuclear Thermal Propulsion. The NTAC surrounds the rocket chamber on all sides and the topmost portion.



An example of a typical NTAC device similar to the one that could be used in the NTAC Augmented Nuclear Electric Propulsion and/or Nuclear Thermal Propulsion design.

APPLICATIONS

The technology has several potential applications:

- Defense/Security: enables stealth and unmanned vehicles
- Electric Vehicles: allows contactless charging at future nuclear charging stations
- Space: exploration for long-distance missions
- Energy: remote mining, nuclear power stations

PUBLICATIONS

Patent No: 11,581,104

Patent Pending

technology.nasa.gov

More Information

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