NASA SBIR/STTR Technologies

High-Performance Methane Thrust Chamber (HPMTC)
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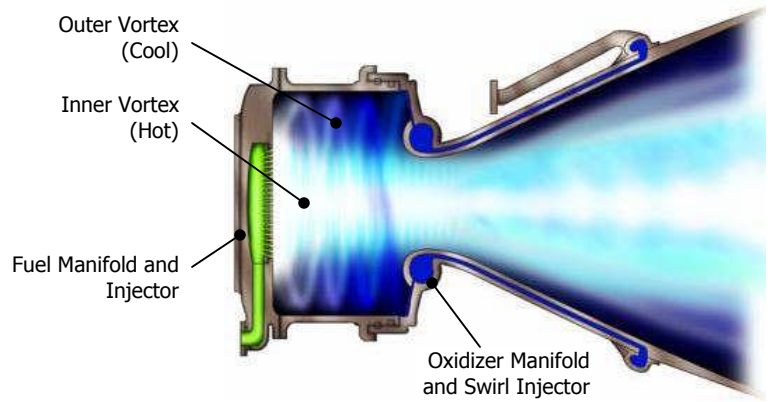
Identification and Significance of Innovation

ORBITEC proposes to develop a high-performance, methane thrust chamber (HPMTC) for Space Science propulsion systems. The HPMTC uses oxygen and methane, as well as ORBITEC's patented vortex combustion process. Confined to the inner vortex, the combustion products do not contact the wall, and the outer vortex provides convective cooling to counter the effects of thermal radiation. Oxygen - methane combustion produces about 380 s I_{sp} (vacuum) at a mixture ratio of 3.5 and 500 psia with a nozzle area ratio of 100:1. The HPMTC offers several advantages over conventional liquid rocket engine designs:

- No severe thermal cycling of the chamber, extends engine lifetime
- Simple, lightweight chamber designs
- Vortex mixing produces high combustion efficiencies



Technical Objectives

1) Perform systematic trade analyses to quantify the operation, performance, cost, advantages of mature HPMTC-based propulsion systems relative to other engines

2) Design and fabricate modifications to existing thrust chamber hardware for testing methane with both GOX and LOX at 100 lb_f, 250 psia

3) Conduct hot-fire tests to evaluate thrust chamber performance with methane

4) Analyze and interpret the behavior of the specific impulse efficiency and chamber temperatures with respect to the operating conditions and engine geometry

5) Consider what type of physical phenomena associated with the vortex injection, mixing, and combustion processes may lead to important scaling effects

6) Develop preliminary plans for a Phase II HPMTC, including igniter.

Work Plan

Task 1. HPMTC System Studies
Task 2. Thrust Chamber Hardware Modifications
Task 3. Hot-Fire Test Programs
Task 4. Data Analysis
Task 5. Scaling Effects Analysis
Task 6. Phase II HPMTC Design and Plans
Task 7. Reporting

NASA Applications

Propulsion systems using the HPMTC chambers will exhibit lower initial cost, longer service life, and lower life cycle cost than any existing known or projected competing technologies for the same thrust level. In addition to deep space chemical propulsion applications, which demand very high reliability and long life, NASA applications include the current propulsion systems for ELV's, service life extension versions for the SSME, and opportunities to apply the technology to CEV propulsion system development programs. The HPMTC is suited to upper stage needs. They can employ the technology beneficially, to save weight and extend in-space service life of current designs and to save costs.

Non-NASA Applications

The HPMTC chambers are ideal for commercial applications where economics are more stringent in justifying pursuit of new technology. For such cases, the low initial cost of the HPMTC main chamber, and the low cost of qualifying such hardware in a new size can be key. New commercial users seeking to develop reusable launch systems will be prime candidates to seek this new, higher-performance low cost approach to reliable, long life, low cost liquid rocket engines. We have been approached by several such private venture firms seeking this technology. Once it is developed, a ready market in the private sector is known to exist.

Firm Contacts

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