

IAF SPACE PROPULSION SYMPOSIUM (C4)
Hypersonic Air-breathing and Combined Cycle Propulsion, and Hypersonic Vehicle (7)

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DEVELOPMENT STATUS OF THE AIR TURBO ROCKET ENGINE "ATRIUM"

Abstract

JAXA is currently conducting research and development of the Air Turbo Rocket engine "ATRIUM" as a hypersonic engine for reusable space vehicles. The ATRIUM engine is the successor to the ATREX engine, which was developed in the 1990s, the expander cycle and air precooler were demonstrated through ground combustion tests. In 2000s a flight demonstration plan for the ATREX engine was proposed, but the plan was not approved due to funding constraints in JAXA. In the late 2010s, with the growing momentum for the commercialization of reusable rockets and hypersonic aircraft in Japan, the research and development of the ATREX engine was resumed. A new ATR engine was designed with a higher compression fan to improve engine thrust to weight ratio. The fan tip speed is increased to 1,400 ft/sec and the design pressure ratio exceeds 1.8. Because of the insufficient heat gained in the expander cycle for the high compression fan, the cycle was changed to a gas generator and expander combination cycle. The added LH₂/LOX gas generator can supply approximately 1,000 K hydrogen-rich combustion gas to the turbine at 2 MPa. This engine is to be further evolved into the "ATRIUM," an Air Turbo Rocket engine that combines the air turbo and a LH₂/LOX rocket engine. In 2021 and 2022 the ATRIUM engine was tested in a jet engine firing test facility constructed for the ATREX engine. These experiments were successful such as stable rated fan rotational operation with the LH₂/LOX gas generator, secondary air-hydrogen combustion, and 0-100