

A Nuclear Ramjet Flyer for Exploration of Jovian Atmosphere

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We investigated the design, operation, and data gathering possibilities of a nuclear-powered ramjet flyer in the Jovian atmosphere. The MITEE nuclear rocket engine can be modified to operate as a ramjet in planetary atmospheres. (Note: MITEE is a compact, ultra-light-weight thermal nuclear rocket which uses hydrogen as the propellant.) To operate as a ramjet, MITEE requires a suitable inlet and diffuser to substitute for the propellant that is pumped from the supply tanks in a nuclear rocket engine. Such a ramjet would fly in the upper Jovian atmosphere, mapping in detail temperatures, pressures, compositions, lightning activity, and wind speeds, e.g., in the highly turbulent equatorial zone and the Great Red Spot. The nuclear ramjet could operate for months because: 1) the Jovian atmosphere has unlimited propellant, 2) the MITEE nuclear reactor is a (nearly) unlimited power source, and 3) with few moving parts, mechanical wear should be minimal. This paper presents a conceptual design of a ramjet flyer and its nuclear engine. The flyer incorporates a swept-wing design with instruments located in the twin wing-tip pods (away from the radiation source and readily shielded, if necessary). The vehicle is 2 meters long with a 2 meter wingspan. Its mass is 220 kg, and its nominal flight Mach number is 1.5. Based on combined neutronic and thermal/hydraulic analyses, we calculated that the ambient pressure range over which the flyer can operate to be from about 0.04 to 4 (terrestrial) atmospheres. This altitude range encompasses the three uppermost cloud layers in the Jovian atmosphere: 1) the entire uppermost visible NH_3 ice cloud layer [where lightning has been observed], 2) the entire NH_4HS ice cloud layer, and 3) the upper portion of the H_2O ice cloud layer.