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DEVELOPMENT OF A LOW COST REUSABLE AIR-LAUNCHED SOUNDING ROCKET FOR MICROGRAVITY SCIENCE EXPERIMENTS

Abstract

The NASA Flight Opportunities Program is now opening a new round for proposals by suborbital vehicle developers and operators for providing 100 km suborbital research flight to NASA and university payloads. Rocketplane Global LLC (RGL) is developing a low cost and responsive air-launched sound rocket flight system which utilizes the highly capable Mach 2 F-104 Starfighter as the carrier aircraft and a reusable upper stage rocket to conduct the suborbital sounding flight missions.

The under wing pylons of the F-104 are used as the external hard points for carrying the upper stage. These pylons were originally used to launch the AIM-7 Sparrow air to air missile. The initial capability of the RGL air launch sounding rocket will closely emulate the Sparrow, using the same 20 cm diameter solid rocket motor used in the weapons system but substituting the warhead and guidance system with a payload carrier and GPS guided parafoil for recovery of the upper stage and payload assembly. The upper stage is released from the Starfighter in a supersonic zoom climb and can reach apogees of over 100 km. Once the upper stage has completed re-entry an small drogue chute is deployed, then a steerable GPS guided parafoil is deployed at a 7 km altitude for return to the launch site. For sensitive payloads that cannot tolerate landing shocks a mid-air helicopter recovery of the upper stage and payload assembly can be done. The flight operations are planned to be conducted at the NASA Kennedy Space Center Shuttle Landing Facility, with launch activity over the ocean in the Cape Canaveral restricted air space.

The total weight of the initial system is about 300 kg, with payload capability of 30 kg. Upgrades planned to the system include mote size increases to 25 cm and 40 cm diameter motor cases with higher fuel loads and larger diameter payload bays. Higher altitude payload release point up to 25 km are also possible with the Starfighter when the pilot is wearing a supplemental pressure suit. The ultimate performance configuration of this air-launch system can reach 700 km apogee, with almost 10 minutes of high quality microgravity and a re-entry velocity of about Mach 10.

This paper will describe the systems engineering for the upper sage and payload accommodations as well as the flight operations and payload recovery procedures necessary to provide an affordable and responsive sounding flight system to end users.