MICROGRAVITY SCIENCES AND PROCESSES (A2)
Microgravity Processes onboard the International Space Station and Beyond (7)

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# HUMAN-TENDED SUBORBITAL MICROGRAVITY PAYLOAD FLIGHT OPPORTUNITIES IN THE XP SPACEPLANE

**Abstract**

The XP spaceplane now being developed by Rocketplane Global (RGI) is a fully reusable suborbital vehicle about the size of a mid-sized business jet. It takes off and lands from conventional runways using J-85 afterburning turbojets and ascends to a 13 km altitude under airbreathing thrust before igniting its LOX / kerosene rocket engine for the ascent to space. After a 70 second main engine burn the XP has accelerated to Mach 3.5 and climbed to about 50 km altitude at rocket engine cut-off. Thereafter a ballistic coast carries the vehicle to its 104 km apogee and back to atmospheric re-encounter at 50 km again. The coast phase lasts about three to four minutes, and it is during this time that the XP is in the microgravity environment.

While the primary market for this suborbital flight service is space tourism, the same flight profile can also be used to fly microgravity research payloads. The flight profile is slightly modified to orient the vehicle to the proper reentry attitude immediately after main engine cutoff. Thereafter, the entire ballistic coast is free from RCS thruster disturbances and the maximum quality microgravity can be achieved.

Internal payloads are expected to be predominantly made up of standard ISS Express Rack locker modules – either single or double locker configuration. The NASA FASTRACK system now in development will provide a standard modular interface that can be installed in place of a passenger seat. Smaller CubeSat modular payloads will be accommodated in the NANORACKS system installed inside a standard ISS locker. This flexible configuration also permits researchers to actually fly with their payloads in a shirtsleeve environment and operate their experiments in real-time conditions. Telemetry and data / video links will also permit tele-operation of payloads from Mission Control. Astronomy and upper atmospheric research and sampling missions would use external payload attach points.

A recent NASA sponsored suborbital payload users conference drew over 300 people from a wide variety of disciplines all interested in this new class of spaceflight service. The overwhelming consensus was that "human-in-the-loop" payload architectures actually reduce cost and improve performance. Moreover, having experiment developers on board with their payloads dramatically increases the value of the flights for STEM and other space-related outreach activities

This paper will describe the development and operation of microgravity racks and support equipment for the XP spaceplane and the business model for suborbital microgravity research flights.