

IAF MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Life and Physical Sciences under reduced Gravity (7)

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VGM – A NOVEL CENTRIFUGE FOR PARTIAL GRAVITY EXPERIMENTS AND CELL SEEDING
IN MICROGRAVITY**Abstract**

The Variable Gravity Module (VGM) is a new microgravity research centrifuge developed by BioServe Space Technologies for use within the Space Automated Bioproduct Lab (SABL) incubator onboard the International Space Station (ISS). VGM was developed to allow variable gravity experiments in the range from 0.01 to 7.4g while in a microgravity environment. This simulated gravity range covers both partial gravity studies to simulate Lunar and Martian gravity levels but also allows 1g gravity levels for on-orbit comparison studies against terrestrial ground controls. Additionally, VGM can provide gravity levels up to 7.4g to allow seeding of attached cell cultures from frozen vials into BioServe's BioCell cell culture plates. VGM is compatible with most of BioServe's gas-permeable BioCell variants specifically designed for operation in microgravity. In addition, VGM is also compatible with commercial multiwell cell culture plates in various configurations from one to 96 wells. VGM features a modular design to accommodate up to 6 cartridges. Cartridges have the option to be powered by individually switchable 28V or 5V lines and can communicate via a USB 2.0 connection for commanding and telemetry. The fleet of SABL incubators, which have been in continuous operation onboard the ISS since 2015, can provide precision temperature control in the range of -5 to +43C. Combined with carbon dioxide control from BioServe's Atmospheric Control Module (ACM), which is fully compatible with VGM, the centrifuge can be used for mammalian cell cultures under an actively controlled 5% CO₂ environment. Other than the crew intervention needed for manual loading and unloading, VGM can be commanded fully remotely through SABL's command interfaces including functions such as speed, direction, and power switch changes to active cartridges. Individual cartridges can be powered on and off and commanded via the USB interface.

For live experiment support, VGM provides temperature, acceleration, and power data as part of its telemetry stream in addition to environmental data from SABL (Temperature, CO₂). Custom cartridge-specific telemetry can be added on an individual experiment basis. VGM is scheduled to launch in 2024 and remain on orbit as a permanent research facility for use with the SABL incubator.