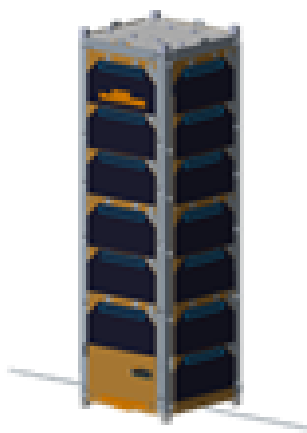
SpaceIce Satellite Technical Description

The overall goal of the SpaceICE mission is to investigate freeze-casting in the microgravity environment of low Earth orbit. Freeze-casting is a directional solidification technique that is used to fabricate porous materials with anisotropic, aligned pore structures. The SpaceICE mission aims to improve terrestrial fabrication of these materials by conducting experiments that allow us to develop an improved understanding of the role of gravity during the microstructural templating process.

The satellite will be launched as a secondary payload aboard NG-16 or later resupply mission as cargo to the ISS. It will be deployed from the ISS into a circular orbit at 400 km altitude, 51.6 degrees elevation no earlier than Q2 2021. Transmission will begin upon deploy. Atmospheric friction will slow the satellite and reduce the altitude of the orbit, until de-orbiting occurs about 1.101 years after deploy. See the Orbital Debris Assessment Report (ODAR) for details.

The spacecraft is an integrated unit with the dimensions of three stacked 10 cm X 10 cm X 10 cm CubeSat modules (giving an overall dimension of 10 cm X 10 cm X 30 cm). The total mass is approximately 2.9 kg. See the ODAR for details.

Figure 1 SpaceIce Overview



The satellite contains the following systems:

Attitude Determination and Control System (ADCS) Subsystem: The ADCS includes magnetic torque coils built into the solar panel structures to de-tumble the satellite and then cancel environmental torques. This is the primary means of providing attitude control device onboard SpaceICE. A tri-axis magnetometer determines earth field strength that, along with ground supplied orbital information and on-board gyroscopes, allows the satellite to determine its attitude and location around the earth. Redundancy is incorporated for all control and attitude sensors/devices.

Command and Data Handling (CDH) Subsystem: The CDH system includes a flight computer running the Linux operating system executing flight software and with memory sufficient to accept and execute commands received from the ground and to store flight system telemetry for transmission to the ground upon request.

Communications Subsystem (COMMS): The communications package on board SpaceICE is a GOMSpace NanoCom AX100 UHF radio. The radio interfaces to the flight computer via a UART serial link. It receives data for downlink from the flight computer and packetizes it according to the AX.25 protocol. For uplink it receives AX.25 encoded data and returns the unpacked data to the flight computer. Uplink carrier frequency is 402.675 Mhz; downlink carrier frequency is 401.175 Mhz.

Electrical Power Subsystem (EPS): The EPS is a direct energy transfer system using a solar array producing approximately 24W of orbit average power to charge the 56 AHr battery pack. The solar arrays utilize triple-junction gallium arsenide photovoltaic cells manufactured by AZURSpace of Germany. The batteries are COTS LG Li cobalt-ion with ID MJ1 R219, purchased from Liion Wholesale in Pennsylvania.

Thermal Control Subsystem (TCS): SpaceICE does not have active TCS systems. The mission is designed around natural radiative effects associated with low Earth orbit.

Structure Subsystem: SpaceICE utilizes an indigenous structural design fabricated of Aluminum 6061. The structure is anodized with an approximate thickness of 0.3 mm.

Propulsion Subsystem: No propulsion subsystem is included.

Payload Subsystem: The Scientific payload consists of two (2) aqueous particle suspension samples and one (1) saltwater solution sample; these samples will be repeatedly solidified (and melted) over the course of the mission. Scientific instrumentation includes: (i) three (3) camera sensors and corresponding lenses that will be used to image the solidification process and (ii) ninety (90) thermistors that will be used to obtain *in-situ* temperature measurements during solidification. The primary structure of the payload consists of five 6061-T6 aluminum plates (2.5 mm thickness); four of these plates interface directly with the bus rail system.