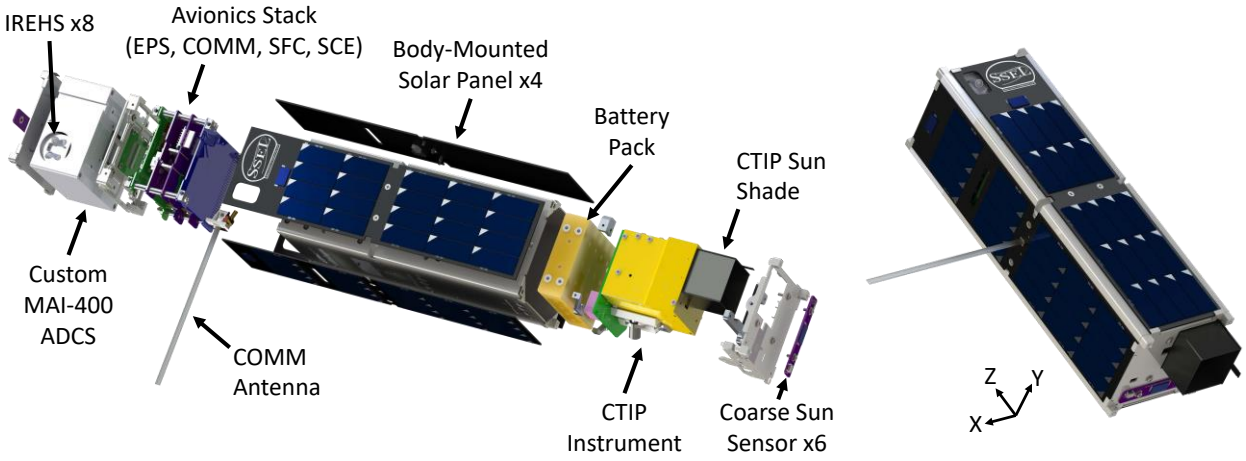
IT-SPINS Satellite Technical Description

The overall science goal of the IT-SPINS CubeSat mission, is to provide the first two-dimensional (2D) tomographic ionospheric imaging from a research CubeSat, addressing the basic nature of the nocturnal ionosphere. This has broader impacts as a space weather investigation, with significant additional goals directed at experiential learning in science, technology, engineering, and mathematics (STEM) education. The motivation is to improve space weather forecasting by increasing understanding of the drivers for variation in the mass species distribution in the near-Earth plasma environment.

The satellite will be carried to Low Earth Orbit on the NG-14 ISS commercial resupply mission, launched from Wallops Flight Facility, in September 2020. Aboard the ISS, IT-SPINS will be externally mounted to a panel on the Cygnus Service Module and deployed from the Cygnus spacecraft into an orbit 50 to 100 km above ISS following its departure from ISS. It will be deployed from Cygnus into an approximately circular orbit at about 500 km at an inclination from the equator of 51.6 degrees, some time in Q4 2020 or Q1 2021. Transmission will begin 60 minutes after deploy, and cease at the end of the mission two years later. Atmospheric friction will slow the satellite and reduce the altitude of the orbit, until de-orbiting occurs about 2.5 years after launch. See the Orbital Debris Assessment Report for details.

The spacecraft is a single unit with the dimensions of 3 stacked CubeSat modules (giving an overall dimension of 343 mm x 108 mm x 105 mm.) The total mass is about 3.3 Kg.

Figure 1 IT-SPINS Overview



IT-SPINS Satellite Technical Description

The satellite contains the following systems:

Guidance, Navigation and Control (GNC) Subsystem: IT-SPINS uses an MAI-400 ADCS system. It is programmed to null out the rates in all three axis then transition into a 2 RPM cartwheel spin along the orbit path with the axis of rotation perpendicular to the orbit plane.

Command and Data Handling (CDH) Subsystem: The CDH system is an MSU designed and built board based on a PIC-24 processor. It is similar to the CDH system that has been operating for 5 years on our FIREBIRD cubeSats

Communications Subsystem (COMMS): The satellite will communicate with MSU Mission operations via a Lithium-2 radio operating on UHF up and down. The CubeSat uses a simple monopole. MSU Mission Operations will use an M2 436CP30 Yagi antenna, and an Icom 910 radio for communications.

Electrical Power Subsystem (EPS): The EPS is a direct energy transfer system using a solar array producing up to 7W of orbit average power to charge the 1.8 A-hr battery system. The solar arrays utilize SolAero photovoltaic cells; the batteries are COTS Panasonic 18650B cells. The CDH sends commands to the EPS to manage the loads and power switching. The EPS also contains a watch dog timer that power cycles the CDH each 12 Hours.

Thermal Control Subsystem (TCS): IT-SPINS uses passive thermal control

Structure Subsystem: The structure is a Pumpkin unit made of 6061 aluminum.

Propulsion Subsystem: No propulsion subsystem is included.

Payload Subsystem: The fundamental measurement of IT-SPINS is the line-of-sight observation of 135.6-nm nightglow produced by the recombination of O^+ with electrons in the ionosphere. In the nighttime F-region ionosphere, the optically thin 135.6-nm emission doublet arises from the recombination of atomic oxygen ions. This measurement is accomplished via observations by a single instrument, the CubeSat Tiny Ionospheric Photometer (CTIP) viewing out along the long axis of the 3U CubeSat as the satellite rotates at 2 revolutions per minute about an axis perpendicular to the orbit plane. Line-of-sight measurements of emission intensity made by CTIP every 0.5 seconds are subsequently collected together to provide for tomographic reconstruction of the ionospheric plasma density as a function of altitude through the nightside ionosphere..