Arctic Flight: MINIS North

Instrumentation:

X-ray Instrument

Objective: To learn more about the energy, spatial, and temporal extent of relativistic electron precipitation. To do this, the instrument measures the energy spectrum and flux of bremsstrahlung x-rays over time.

How it Works: The x-ray instrument consists of a cylindrical three inch diameter by three inch height scintillator NaI crystal, a PMT, and a peak detect board. It has an energy response from 10keV to 10MeV with a spectral resolution of 5keV. When x-rays from precipitating electrons enter the crystal, visible light photons are generated. The number of photons produced in the scintillator is proportional to the incident x-ray energy. These photons are detected by a photomultiplier tube which converts the light pulse into charge pulses. The amplitude of each charge pulse is then determined by a pulse height analyzer. The charge pulse amplitudes can be plotted to show the x-ray spectrum, which can then be used to study the energies of the precipitating electrons.

Optical Photometer (H_β)

Objective: To detect the flux of visible light at wavelengths near 486.1 nm during a relativistic electron precipitation event. This will determine whether there are protons accompanying the precipitating electrons. (emissions near 486.1 nm are a signature of precipitating protons.) Correlated proton and relativistic electron precipitation would support scattering by EMIC (electromagnetic ion cyclotron) waves at the precipitation mechanism.

How it works: The photons are collected through a collimator tube that restricts the field of view to a cone approximately five degrees full width angle, tilted at 35 degrees from the zenith. A 2.5 nm wide H_β filter is mounted near the base of the collimator. Each photon incident on the two inch diameter photomultiplier tube results in the generation of a charge pulse. These pulses then go into a charge-sensitive pre-amplifier, discriminator, and shaping electronics, producing a TTL pulse for each incident photon. By counting the number of pulses, the flux of the precipitating protons can be determined.

Magnetometer

Objective: To sense changes in the Earth's magnetic field, such as the very strong ULF (Ultra Low Frequency) waves that might be modulating electron precipitation events.

How it Works: PNI Corp. TCM2-20 axis. The magnetometer uses three orthogonal magneto-inductive sensors and measures the three components of B with 10nT resolution. Serial data is transferred to the flight computer, COM3. In addition, the TCM2 provides pitch & roll information.

Flight Computer:

Objective: The Winsystems PC104 single board flight computer with a custom interface board developed at U.C. Berkeley, acquires measurements from the instruments, adds in timing, housekeeping and position data, then emits data to a satellite modem at an average rate of 256 bytes/s.

Iridium Modem:

Objective: Provides the real time data link between the payload and our ground station during all stages of the flight at 19.2K baud. Commands can also be sent through the Iridium link in order to terminate the balloon flight.

Global Positioning Satellite Hardware:

Objective: The Lassen SQ by Trimble is used to locate global position of payload package and provide accurate timing for correlation with MINIS South.