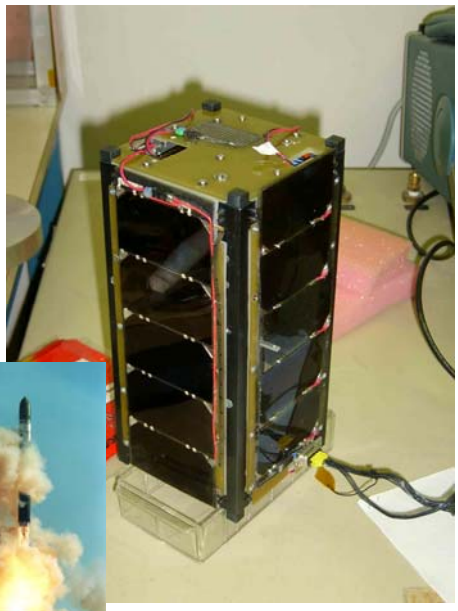
ION CubeSat Information Sheet

The University of Illinois' first student developed satellite is ready for launch!



The Illinois Observing Nanosatellite (ION) project comprises an ambitious double CubeSat that will form the first student-developed satellite at the University of Illinois at Urbana-Champaign. We have been developing ION for three and half years and expect it to ***launch in May of 2005***. Three CubeSats fit into launchers called PPODs and then multiple PPODs mount onto a launch vehicle as secondary payloads. We will participate on the next launch utilizing the DNEPR launch vehicle from Kosmotras in Russia.

ION has ***five science and technology mission objectives*** including measurement of Oxygen intensity in the Earth's Ionosphere. This will help scientists understand how energy transfers across large regions contributing to our knowledge of atmospheric dynamics including global warming. Second, ION will test a new MicroVacuum Arc Thruster (μVAT) with high dynamic range advancing a key enabling technology for small satellites. This serves as a stepping-stone towards a versatile low mass satellite propulsion system capable of lateral movement and finely controlling attitude. Such a capability might allow greater interaction with other spacecraft. Third, ION will test a new SID processor board designed specifically for small satellites in Low Earth Orbits (LEO). By utilizing a Commercial Off the Shelf (COTS) processor that is radiation hardened through system design techniques, it allows small satellites to take advantage of the latest in small, low power, high performance processor technology with increased reliability. Fourth, ION will test a small CMOS camera for Earth imaging on this and future spacecraft. Finally, ION will perform active attitude stabilization demonstrating an important capability for the future growth of CubeSats. ION's design includes solar cell power point tracking, dual redundant batteries, a custom communications protocol, a custom file system, automatic telemetry publication to the Web, and future support for distributed ground stations.

About the Illinois Tiny Satellite Initiative (ITSI)

ITSI exists primarily as an ***interdisciplinary senior design educational initiative***. Satellite development provides an exciting, challenging, and very hands-on engineering educational experience. Furthermore, some employers value the experience as much as internship experience. Over the past three and a half years, over ***70 students across seven majors*** have participated. The course's educational goals include teaching the elements of a large, interdisciplinary engineering project through experience. Students ***develop leadership and teamwork skills*** as part of a large ongoing multi-team project. They must often continue the work of others and train replacements while finding ways to make unique contributions of their own. Some students stay involved with the organization in some capacity for one to two years and provide invaluable veteran mentorship to their newer counterparts. In addition to the primary educational objectives of the organization, ITSI launches ***research payloads*** including instruments that perform measurements in support of Earth science research. We also test experimental technologies such as MicroVacuum Arc Thrusters for use in future spacecraft. Finally, we wish to explore and advance the capabilities of small satellites in general. This includes advancing overall systems design as well as specific on-board systems such as operating system, communication systems, and fault tolerance techniques.

ION Mission Objectives

- Perform Oxygen intensity measurements in the Ionosphere
- Test MicroVacuum Arc Thruster (μVAT) in space
- Test SID processor in space
- Test CMOS camera in space and provide Earth imaging capability
- Demonstrate attitude stabilization on a CubeSat

Status

- Fully integrated and functionally tested
- Fully environmentally tested including thermal-vacuum and vibration
- Undergoing various upgrades while waiting for launch
- Ground Station operational

System Specifications

- **Physical Characteristics:** 10cm x 10cm x 21.5cm (double CubeSat), 2 kg mass
- **Orbit:** 650km altitude, 98° inclination, 98 min period, max 35 min eclipse
- **Expected Lifetime:** Six months
- **Processor:** Hitachi 7045, 1MB external RAM, 8MB flash storage

Payload

- **Photometer:** Measures Oxygen Intensity at 100km altitude
- **MicroVacuum Arc Thrusters (μVAT):** Four thrusters allow translation & 2 axis rotation
- **CMOS Camera:** 640 x 480 pixel, black and white

Communications

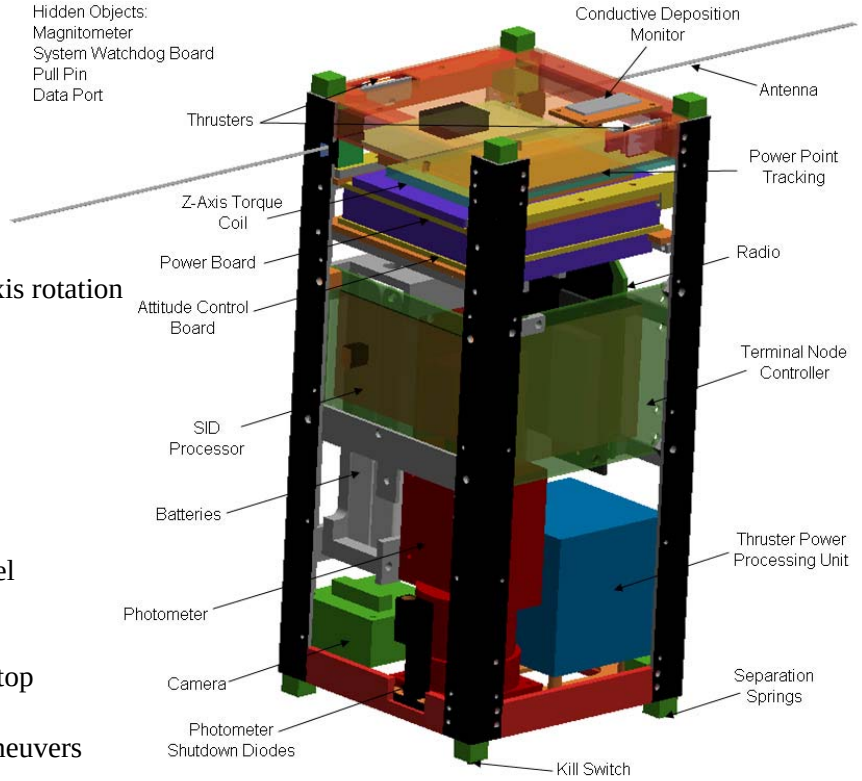
- **Transmission:** 1200 baud AFSK @ 437.505 MHz
- **Packet Format:** Half Duplex, custom protocol over AX.25
- **Ground Station:** Satellite tracking, Doppler adjustments, Web data publication

Power

- **Batteries:** Two Li-Ion batteries (12.6V, 1950mA-h each)
- **Solar Panels:** Four side panels, 26% high efficiency, 4.7W peak power per panel
- **Ave Power Consumption:** 1.2W with 30% margin

Attitude Control

- **Sensors:** 3-axis Magnetometer, solar panel current on four sides, sun sensor on top
- **Actuators:** Three torque coils with one on each axis
- **Method:** Ground based simulator receives sensor data and uploads actuator maneuvers



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