

SCintillation and IONosphere eXtended (SCION-X)

A 12U CubeSat for Ionospheric and Atmospheric Science

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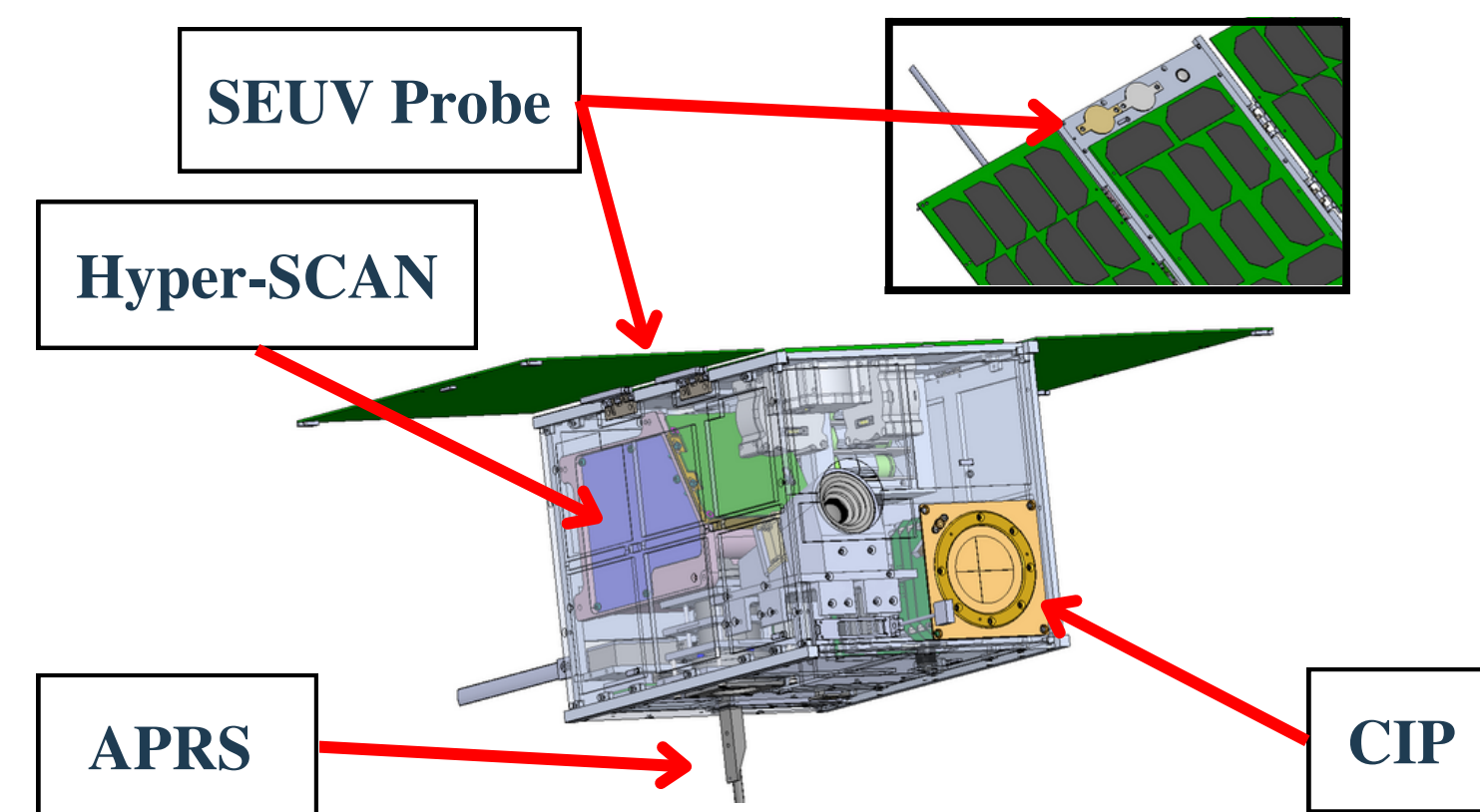
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SCION-X

SCION-X (SCintillation and IONosphere eXtended) is a 12U CubeSat that is being designed and developed by Upper Air Dynamics Laboratory, National Central University (NCU). SCION-X is the second funded CubeSat project being developed by NCU and is the largest self-developed spacecraft to date.

This mission will help to further understand the variation of ionospheric irregularities, remote sensing methods for PM2.5 pollution distribution, and thermospheric photochemistry while serving as a relay station for amateur radio. Furthermore, it will help increase the communication and cooperation between universities in developing spaceflight capacity.



Mission Objective

Science Objectives

Measurement Requirements

Science - CIP

- S1. Provide in-situ measurements of ionospheric composition and plasma drift in the F-region.
- S2. Provide plasma bubbles and the associated vertical ion drifts measurements.
- S3. Infer the electric fields driving horizontal plasma drift, and their relation to the F-region wind dynamo.

- Ionospheric parameters in the F-region 20 km (100 km) horizontal sampling resolution.
- Latitude $\geq \pm 25^\circ$
- Observations for at least 24 months above 400 km.

Science-SEUV Probe

- S4. Provide in-situ measurements of SEUV flux during sunlight and eclipse transition.

- Sampling rate 240 sps and reconfigurable.

Science-Hyper-SCAN

- S5. Perform instrument calibration for remote sensing of PM 2.5 aerosol pollution from above and below 400 km altitude to identify composition of air pollutants.

- Spectrum from 450 – 850 nm in daylight, not obscured by clouds with view angle of 30° or less.
- Measurement over NCU ground station. Coincident PM 2.5 concentration measurements from ground.

Service - APRS/AX.25 Data Packet Digipeater

- S6. Provide APRS/AX.25 packet data digipeater as APRS transponder for radio amateur service.
- S7. Provide onboard APRS position and flight telemetry reporting.

- APRS/AX.25 Data Packet Digipeater for radio amateur service.
- The APRS beacon shall contain satellite position data in latitude & longitude.

Payloads

CIP - Space Weather Monitoring

The CIP is an in-situ plasma probe derived from the Advanced Ionospheric Probe (AIP) onboard FormoSat-5 developed by the NCU Space Payload Laboratory. This probe contains a Retarding Potential Analyzer, Ion Trap, Ion Drift Meter, and Planar Langmuir Probe measuring with a timeshare data rate of up to 2k bytes per second.

Hyper-SCAN - PM2.5 Observation

Hyper-SCAN performs remote sensing of aerosol distribution (such as PM 2.5 pollution) and provides hyperspectral images for calibration and qualification of the AEROSOL ROBOTIC NETWORK (AERONET).

SEUV Probe - Thermospheric Photochemistry Monitoring

The SEUV Probe includes a pair of metal electrodes and a signal processing PCB. The electrodes are made of tin and gold, which are mounted on the chassis of the spacecraft to measure the solar EUV flux and acquire the voltage by the photoelectric effect.

APRS - APRS/AX.25 Data Packet Digipeater

The APRS is a transponder that works at 145.825 MHz, which frequency is the same as the APRS on International Space Station (ISS). APRS allows SCION-X to serve as an amateur radio relay station that repeats messages in AX.25 format. This format is also commonly used by Internet of Things (IoT) sensors.

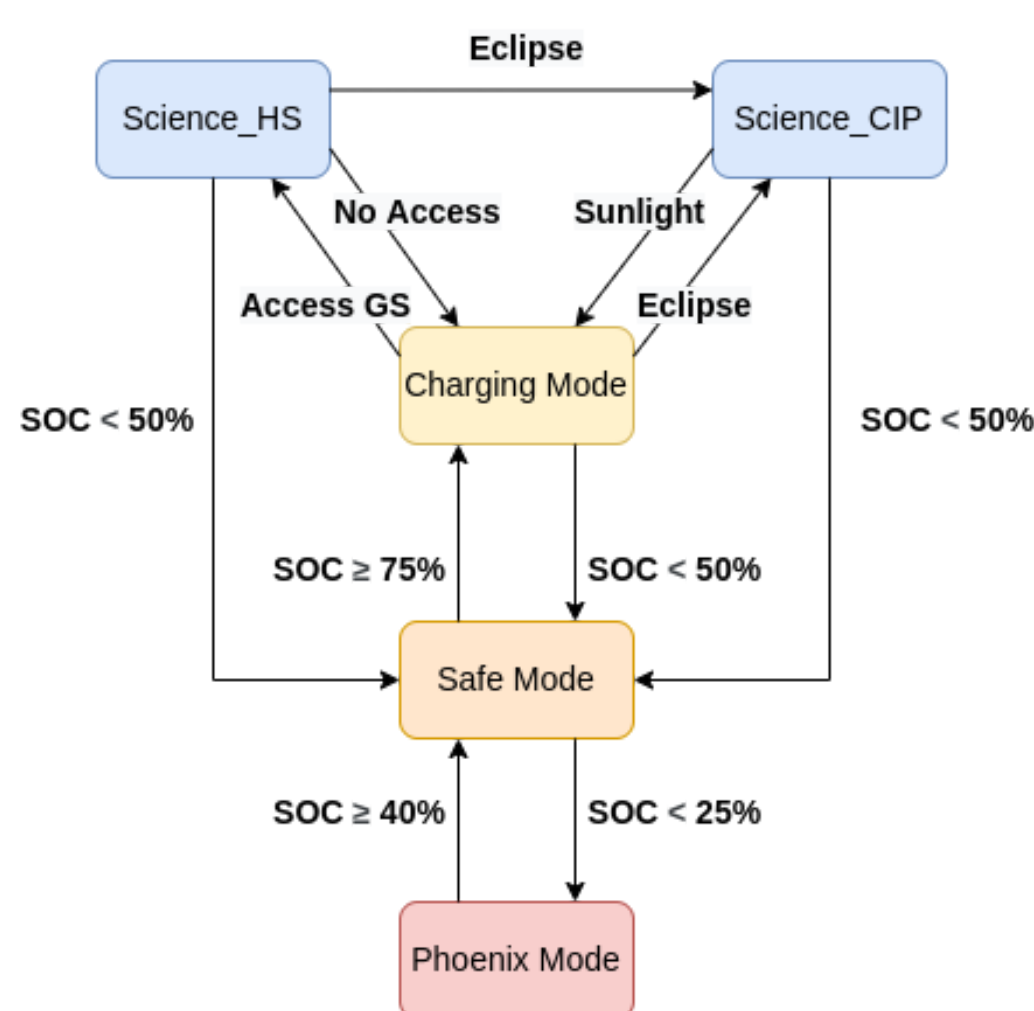
Orbit Definition

Circular Sun-Synchronous Orbit (CirSSO) in 500km

Considering orbit requirements of CIP and Hyper-Scan, as well as mission lifetime, communication time, and Taiwan daytime line of sight duration for Hyper-SCAN. The CirSSO in 500 km is an ideal orbit for SCION-X.

CirSSO_500 km	
Altitude	500 km
Inclination	97.41°
RAAN	130.32°
Argument of periapsis	0°

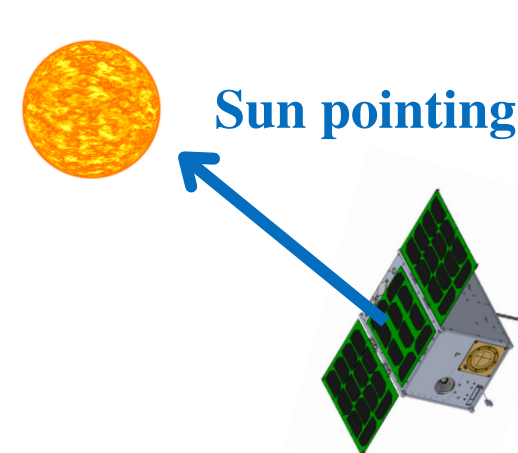
Concept of Operation



- Turn on the SEUV Probe during daylight and transition between daylight and eclipse.
- Turn on the APRS digipeater as required on command.

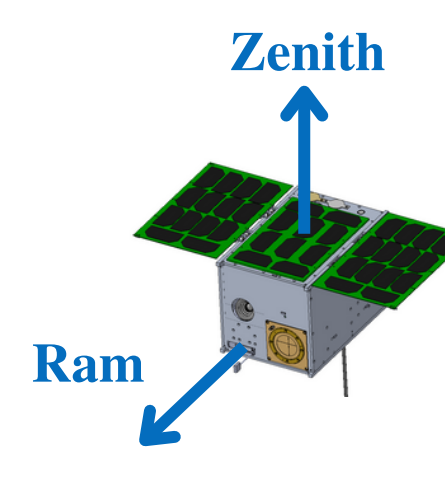
Charging

Start charging with solar panels during daytime.



Science-CIP

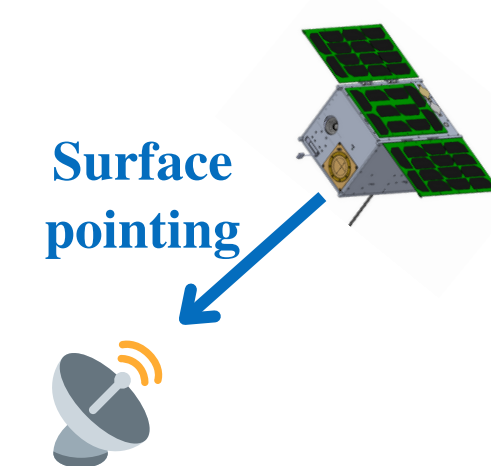
Turn on CIP during eclipse.



Science-HS

When passing over NCU:

- Turn on Hyper-SCAN as required on command.
- Communicate with NCU ground station.



Conclusions

SCION-X is a 12 U CubeSat that carries 3 science payloads and 1 service payload. It has been through the phase of Preliminary Design Review (PDR) and is currently in the Phase C Final Design and Fabrication stage, with construction of a flat sat for testing in progress. Integration and test is scheduled to be completed by Q4 2023, with launch in 2024.

Acknowledgements

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