SphinX NG X - ray spectrophotometer.
The Polish American nanosatellite experiment.

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Science Objectives:

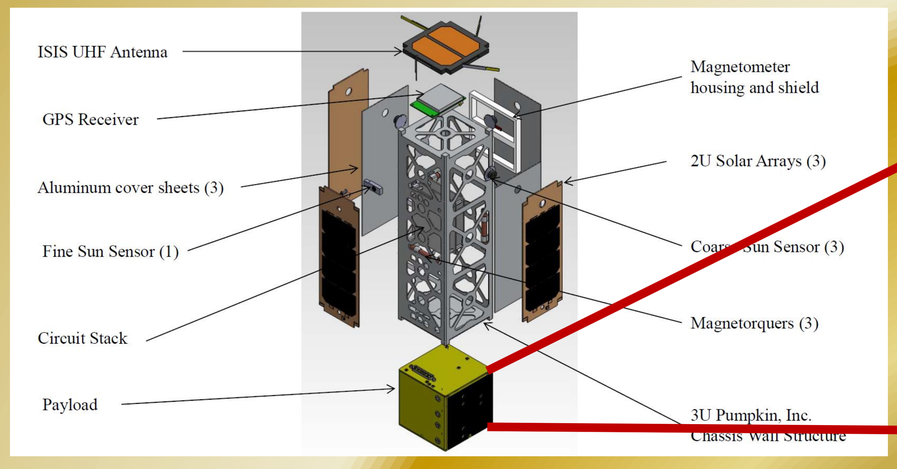
Solar X-ray monitoring:

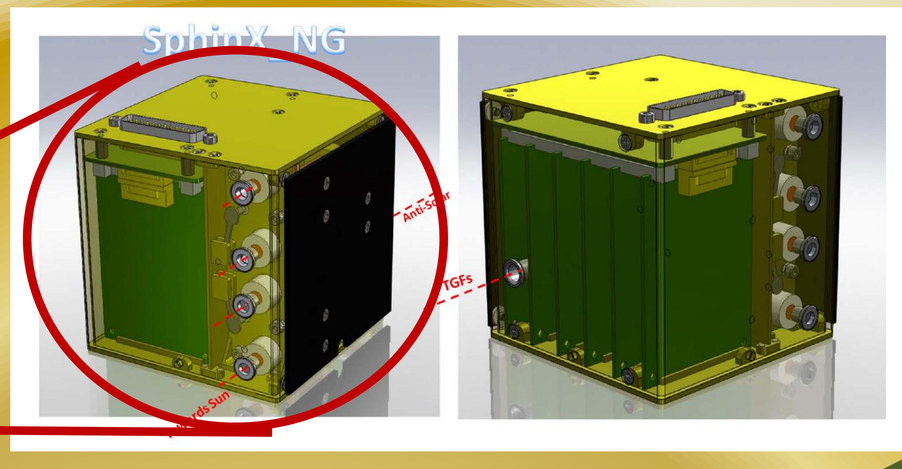
- **Temperature and differential emission measure studies**
- **Long-term flux variability**
- **Non-active corona**
- **Active regions**
- **Solar flares**
- **Plasma abundances**

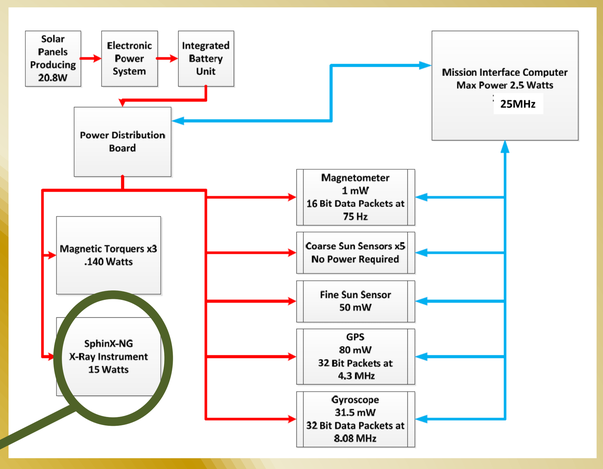
Terrestrial X-ray and particle observations:

- **X-ray signatures of Terrestrial Gamma Flashes (TGFs)**
- **Auroral X-ray spectra**
- **Orbital particle fluctuations**

Construction





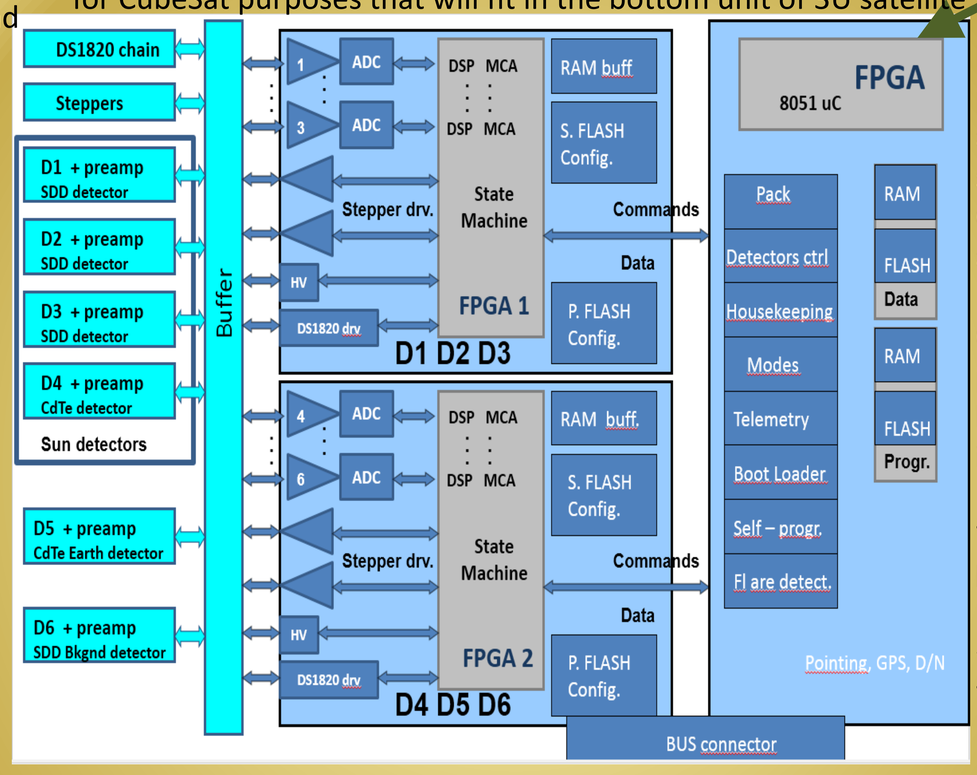


SphinX-NG will be equipped with six, 256 energy channels, X-ray detectors for the soft (0.8-15 keV) and harder (5-150keV) energy domains. A new type of high-sensitivity silicon drift detectors (SDD) and Schottky diode detectors CdTe sensitive to radiation in the soft and hard X-rays from Amptek.

Configuration:

- Four detectors will look towards the Sun;
- The fifth detector will look in the anti-solar direction, taking measurements of particle back-ground and ambient soft X-ray emission arising within Earth ionosphere (auroral X-ray emission) or atmosphere (solar X-ray induced Air fluorescence).
- The sixth spectrophotometer will be directed towards the Earth to search for Xray signatures of terrestrial gamma-ray flashes (TGF) that have been recently observed from powerful thunderstorms.
- Below are presented example of spectra measured in SRC laboratory.

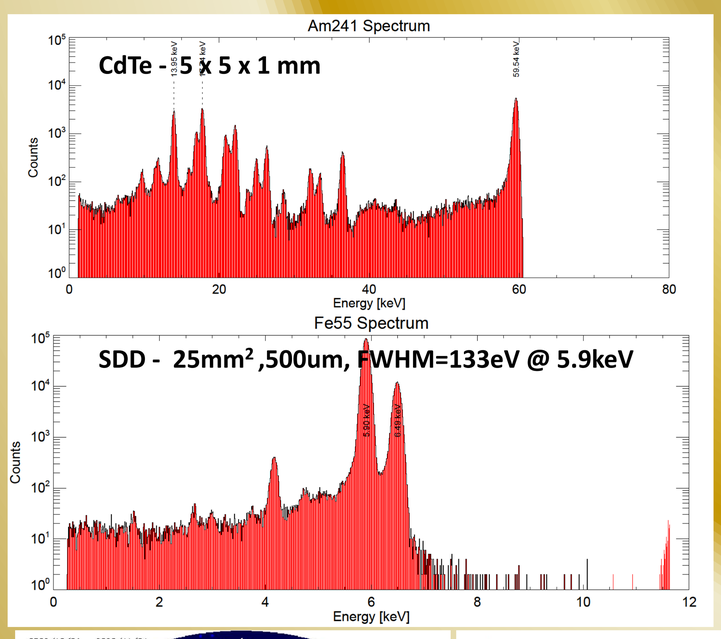
The SphinX-NG has been miniaturized to a 10x10x10cm cube for CubeSat purposes that will fit in the bottom unit of 3U satellite



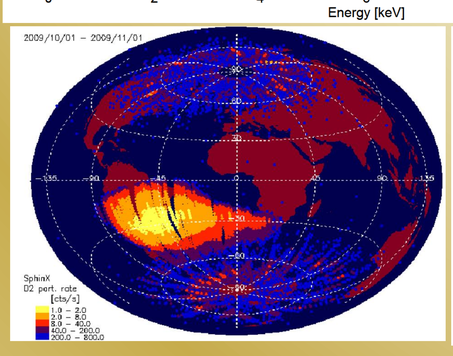
The **above** diagram describes the number and type of each sensor, actuator, and computation board. As shown in the diagram system includes solar panels, an EPS with integrated battery unit, a PDM board, and OBC board, three magnetic torquers, five coarse sun sensors, a magnetometer, one fine sun sensor, a GPS, and Gyroscope. Each of these devices has a specific function and is vital to the ADC system.

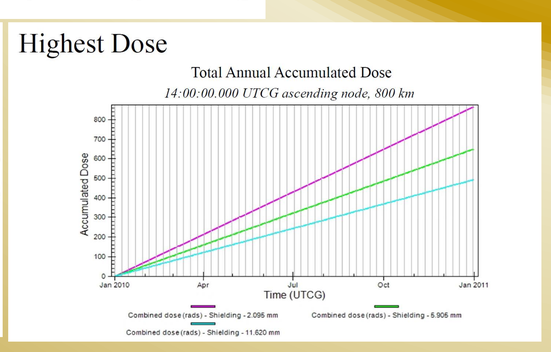
On the **left** block diagram of of SphinX NG electronics is presented. The analogue measurement chain is replaced by **Digital Signal Processing**. Also discrete microcontroller is replaced by VHDL component .

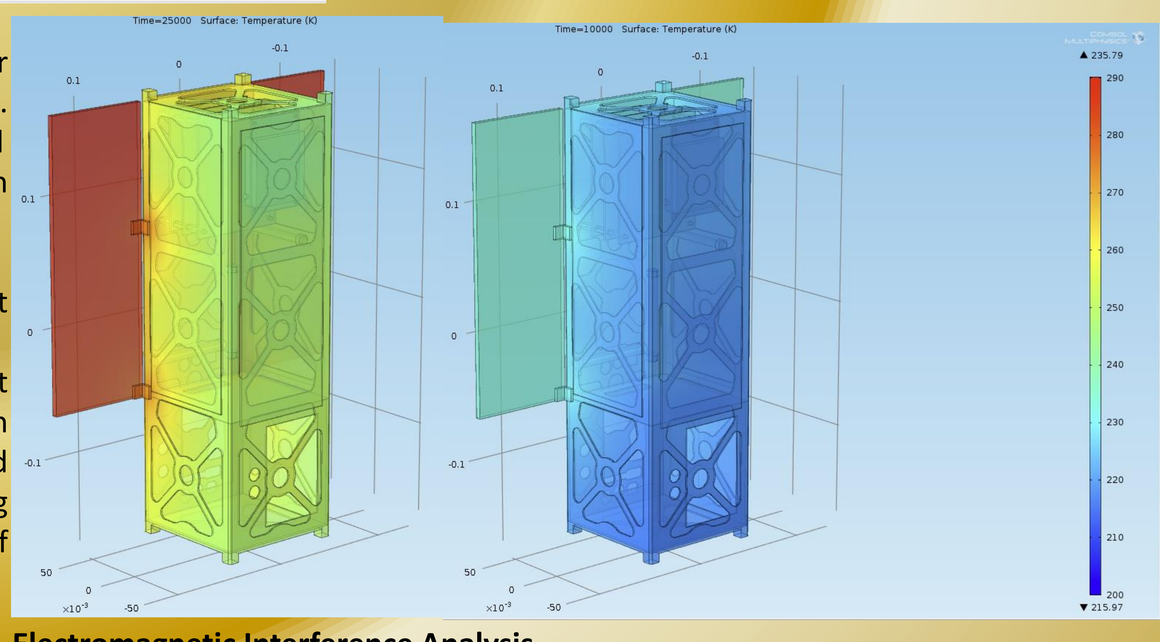
The the results of the thermal simulation are presented **below**.
It was used COMSOL Multiphysics to simulate heat transfer, and Solidworks to model the satellite.
The analysis was performed for multiple orbits.



3U **Cubesat** will be on a **Sunsynchronus** polar orbit at an altitude between 500 to 800 km. During the mission on-board instrumentation and electronic devices located inside a satellite on such orbit are exposed to **the space radiation environment**. The radiation propagates through the satellite structure and poses a serious threat to the internal electronic components.
There are three primary radiation sources that constitute the radiation environment in Low Earth Orbit: solar variation, the Van Allen Belts, and galactic cosmic rays. The monthly map showing the location of regions with increased rates of charged particles observed by previous SphinX is presented on bottom left.
The left diagram presents total annual accumulated radiation dose for different thickness shielding.







Electromagnetic Interference Analysis.
The potential magnetic interference generated by the magnetic torquers used for attitude determination and control (ADC) of CubeSat were simulated using Comsol software.

The following Structural Analysis were performed:

- Virtual static load and random vibration tests.
- Test for Von Mises stresses and displacement.
- Simulation of typical launch environment where highest static and vibrational loads will occur.

Grant application to NCN passed to the second round of review.

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