Sun CubE OnE:
A Multi-wavelength Synoptic Solar Micro Satellite

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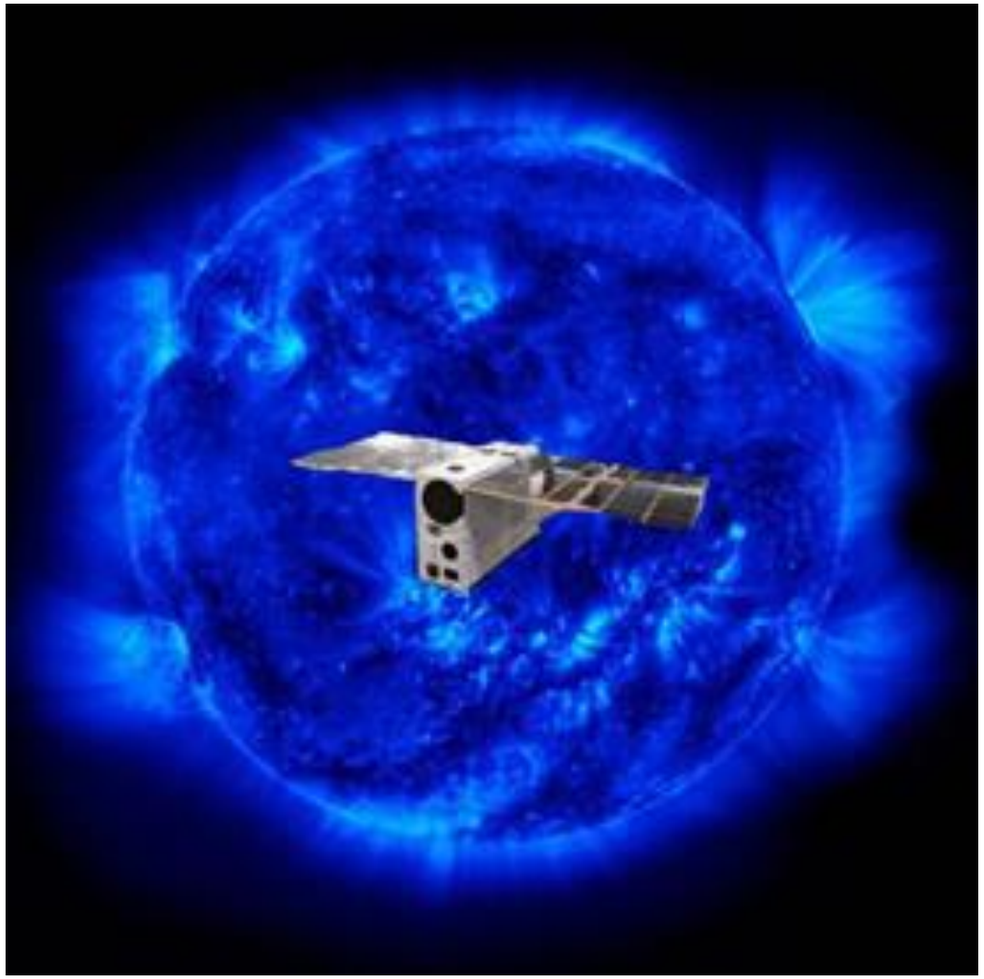
SEE mission

Sun CubE OnE (SEE) is a micro satellite for multispectral synoptic observation of the Sun.

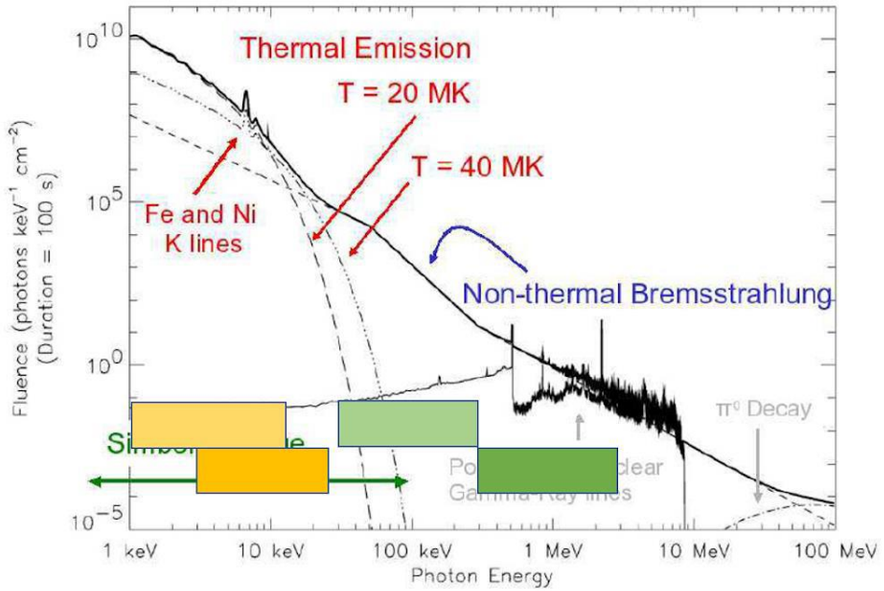
The SEE mission has been proposed in the "Future missions for Cubesat" call of the Italian Space Agency (ASI), under the General Support Technology Programme (GSTP) ESA.



Mission goals

- Monitor the emission from **soft-X** to **Gamma ray** energy range
- Monitor solar activity using **full disk** images in the **Mg II doublet** at 280 nm

SEE X and Gamma Channels: energy bands



8: channels, 2 for each band (redundancy and wider energy range)

- 3 KeV (GOES-B band: 1.5-12 keV)
- 6 KeV (GOES-A band: 3-25 keV)
- 30-300 keV (non-thermal up to the knee)
- 300-3000 keV (emission lines)

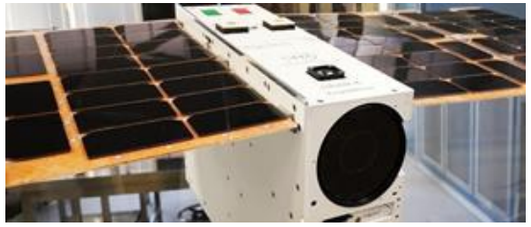
SEE science will impact on:

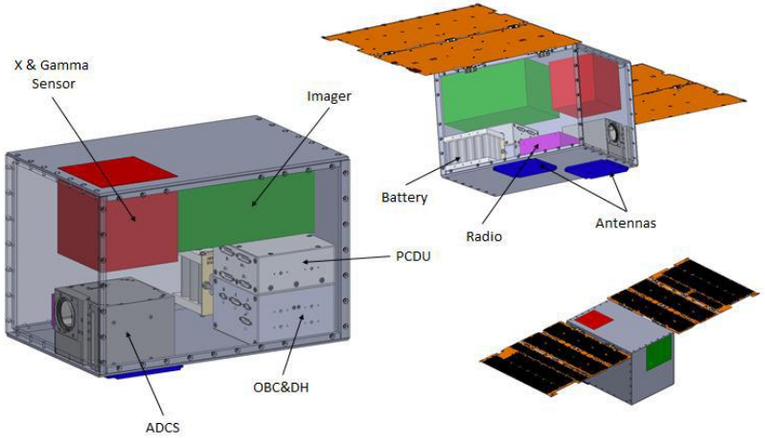
- Solar activity relation with the upper layers of the Earth's atmosphere (UV/ozone)
- multi-instrument/multi-wavelength/multi-messenger approach to space weather
- Space safety and human exploration

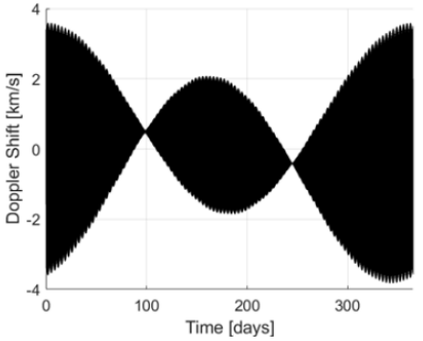
The high energy spectrum will be explored **from the KeV to the MeV** with unprecedent cadence (up to 10 kHz) to investigate the spectral variability connected to SW events (e.g. flares).

Mission profile

- SEE is a 12U CubeSat (up to 24 kg) based on the ARGOTEC HAWK platform, currently used in LICIACube.
- The HAWK platform provides: Attitude Determination and Control, Data Handling, Telemetry Tracking & Command and Thermal Control.
- The mission will last for 1 year + 1 year of possible extension.
- The orbit chosen for the SEE is a circular Sun Synchronous Orbit (SSO) that allows low eclipse time.
- The maximum Doppler Shift due to the orbit has been preliminary evaluated to be 3.85 km/s .







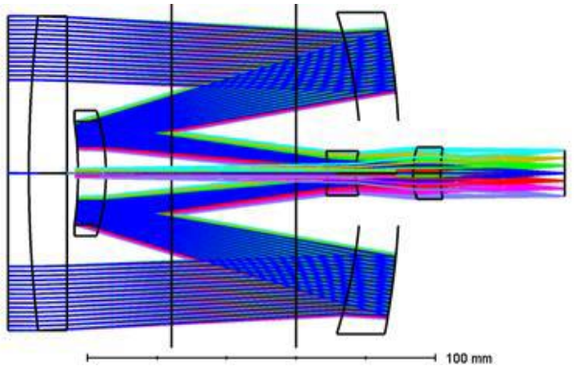
UV Mg II payload

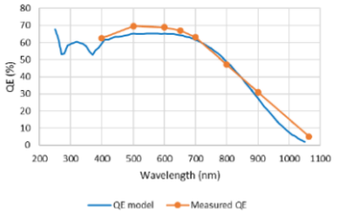
The Mg II full disk imager proposed for this mission allows to map the radiative emission of the Sun at 280.0 nm, with a passband of 2 nm and a 9 cm aperture

The telescope is composed of 2 spherical mirrors and 3 spherical lenses. The compact design allows to fit the UV imager payload in less than 2U volume.

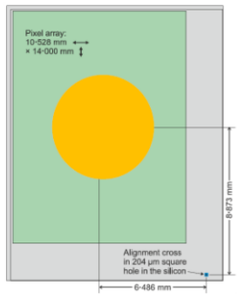
The distortion is less than 1% and the field curvature (*i.e.* the difference in best focus position from optical axis and marginal FOV) is less than the depth of focus of the instrument, causing negligible variation in terms of performances.

A possible sensor is the Teledyne e2v CIS115, TRL 9, (TBC).





Typical spectral response of M48 variant at 293°K of Teledyne e2v - SIRIUS – CIS115 Back Illuminated CMOS Image Sensor (TBC)



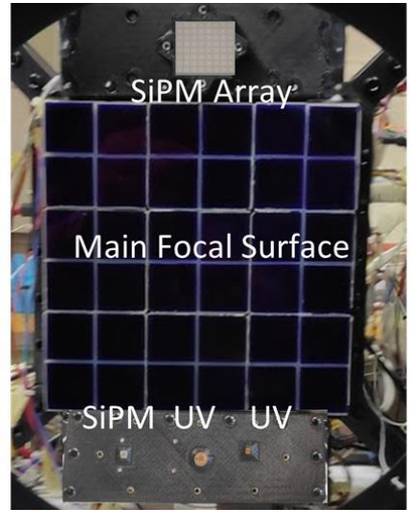
Diam. Sole ~ 900 pixels

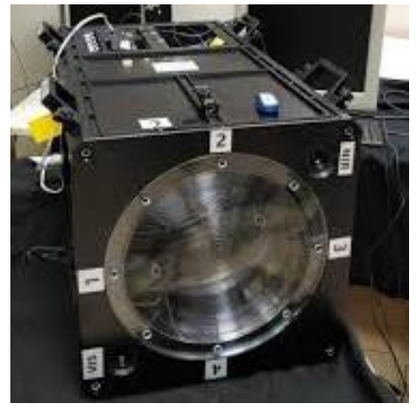
~ 2 arcsec/pixel

FoV sCMOS 1.1°

Gamma and X-ray payload

- The gamma and X-ray instrument is based on four (for redundancy and wider energy range) Silicon Photomultiplier (SiPM)-Scintillator detectors.
- The system is the evolution of similar ones already flown on previous/current missions on the International Space Station in (ISS): 2002 (**Lazio-Sirad**, employing for the first time SiPMs in space) and subsequently in 2019- (**Mini-EUSO** as part of the Vita Mission, employing multi-pixel SiPM arrays).
- As detector the instrument uses Hamamatsu MPPC (SiPM), as scintillator, it is planned to use CsI(Tl) or Lyso(Ce) crystals.





Mini-EUSO experiment to study UV emission of terrestrial and astrophysical origin onboard of the International Space Station.

Conclusions

- The proposal passed ASI's technical and cost congruence analysis.
- The TOTAL price for phase A and B is about 700 k€.
- SEE is currently on the final ASI shortlist: https://www.asi.it/wp-content/uploads/2020/08/Graduatoria.pdf