Caliste SO X-ray micro-camera for the STIX instrument on-board Solar Orbiter mission


The Spectrometer Telescope for Imaging X-rays (STIX)

Spectrometer requirements

Each spectrometer unit should provide photon counting information and energy measurement of one of the spatial Fourier component, with the following performance:

- 4 keV low-level threshold
- 1 keV FWHM @ 6 keV, 15 keV FWHM @ 150 keV
- 50% efficiency at 100 keV
- 20000 photons/s count capability (goal 100)

Front-end characterization

Set-up: one IDE-F X HD channel connected to one Shottky CdZnTe monopixel crystal, 2 mm × 2 mm pixel size, 2 mm thickness, 1000 V bias voltage, –10°C.

Spectroscopic characterization

![Graph showing spectroscopic characterization](image)

Modeling of Caliste-SO response

- Input spectrum: solar flare (July 23, 2002), 0.25 g/cm² Be window, 0.2 g/cm² Al.
- Monte Carlo simulation of interactions in 1 mm-thick CdZnTe detector (G4Event4).
- Event time tagging and grid attenuation.
- Readout generator: event list (trigger time, pixel number, energy).
- Performance analysis:
  - Counting capability: pile-up, dead time...
  - Imaging: Moire coefficients.
  - Spectroscopy: individual histograms.

Sensor characterization

- Dark current measurement of individual pixels
- Voltage bias and current measurement with picoammeter Keithley 2410
- Metal etch technique
- Lift-off technique

Conclusions

32 Caliste-SO spectrometer units will be used in STIX to observe solar flares in X-rays on board Solar Orbiter. They should combine high energy resolution and high count rate capability in hostile radiation environment.

- IDE-F X HD ASIC has been tested up to 25000 cts/s/channel.
- Proper count rate evaluation after dead time correction.
- Spectral performance compatible with STIX requirements.
- First pixel sensor prototypes have been realized and are being characterized (dark current).
- A first design of Caliste-SO prototype is available.
- A behavioral model of Caliste-SO has been successfully implemented and will be used for scientific performance evaluation and engineering ground support equipment development.