Detection of X-ray sources with MXT telescope onboard of SVOM satellite

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SVOM (Space Variable Object Monitor) mission

- A Sino-French space mission to be launched at 2023.
- Complementary set of ground and space based instruments with energy range: few keV - few MeV
- 3 scientific programmes:
  - Core program
  - General program
  - Target of opportunity program

Gamma ray bursts
AGN, Accreting objects, Flaring objects
Unplanned observations of transient sources.

Main feature:
- Triggered by ECLAIR
- 1.1° x 1.1°.
- ∼35 kg & ∼1.2 m.

Scientific requirements:
- Localize the source precisely and rapidly
- X-ray photometry and spectroscopy

MXT camera: PnCCD detector, 256x256 pixels
MXT optics: Micropore optics arranged in a lobster-eye configuration

Simulation tool for MXT:

Main feature:
- Simulate camera images
- Simulate an astrophysical source: spectrum, light curve, ra & dec.
- Simulate an observation sequence for MXT

Objectives:
Characterize MXT onboard scientific algorithm mainly the localization

X-ray sources onboard localization algorithm

1. Requirements: Localization accuracy < 2' in few minutes.
2. Why:
   - Important for multi-messenger astronomy
   - Better understanding of the source, ex: the redshift, host galaxy .. etc.
3. Algorithm constraint: have to be a combination of speed, optimization, precision and robustness in all space conditions.

4. Algorithm:
   i. Camera images processing and photon identification
   ii. Build photon map
   iii. Cross-correlate with the optics point spread function
   iv. \((y_p, z_p) \rightarrow (\theta, \phi)\)

5. Algorithm characterisation:
   - Simulate different sources intensities and noise levels
   - 1000 different simulated location for each intensity
   - Compute sources location with onboard algorithm \(\rightarrow\) compare to the simulated locations
   - Estimate the algorithm accuracy given by the 90th percentile \((r_{90})\) of the \(dr\) distribution

N photons to match MXT scientific requirements:
- ∼ 175 photons at high noise level
- ∼ 100 photons at low noise level

Conclusion

SVOM is a Sino-French space mission, dedicated to study mainly the Gamma-Ray Bursts and other high energy objects. Onboard, MXT will observe the sources in the soft X-ray range aiming at localize them to better than 2' in few minutes. I presented the method that I developed for MXT to localize the source in fly precisely and rapidly, as this algorithm is implement onboard, it is highly constrained and have to be a combination of speed, optimization, precision and robustness in all space conditions.

References