Possible EXTraS contribution to EPIC calibration

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EXTraS: Exploring the X-ray TRAnsient and variable Sky

**FP7 project** funded by the European Union with 2.5 M€ for 3 years (2014-2016)

EXTraS aims at exploring the serendipitous content of the **EPIC** database in the time domain and to make it available and easy to use to the whole community.
EXTraS consortium

- INAF, Italy (PI: Andrea De Luca)
- IUSS Pavia, Italy
- CNR – IMATI Genova, Italy
- MPG – MPE, Germany
- University of Leicester (UK)
- FAU – ECAP, Germany
EXTraS goals

Systematic analysis of EPIC archival data (3XMM-DR4) aimed at:

- Detection of new X-ray transients
- Detection of new X-ray pulsators
- Detection and characterization of variability in all sources
- Detection and characterization of long-term variability for sources with multiepoch observations (including slews)
- Multi-wavelength characterization of all new EXTraS sources
- Phenomenological classification of all variable sources
- Compilation and public release of a variable source catalogue including all results and metadata
Transient search (IUSS)

We search for weak transients that are above the detection threshold for short time intervals but in the whole observation

⇒ For each observation, source detection on images integrated on short time intervals (either fixed or selected by a Bayesian Block analysis)

⇒ transient if source detected in snapshot and not in whole observation

Example:

Three ~100 s flares discovered from Young Stellar Object in PN observation of Ophiuchi
CR afterglows/noisy pixels?

From preliminary tests, <10 s PN transients with soft spectrum (<0.5 keV) and counts in single pixel (or column). Decaying energies suggest dissipation of large charge deposited by energetic particle or a noisy pixel.

• How frequent?
• Recurrent pixels?
• Can be automatically identified?

⇒ Possible impact on soft image cleaning
Pulsation search \textit{(INAF, OA Roma)}

Instrumental periodicities might be discovered during the EXTraS systematic search for pulsators.

In a similar analysis of \textit{Chandra} data (CATS@BAR) a series of \textbf{systematic effects} (mainly related to dithering) were identified.
Long-term variability \textit{(Leicester)}

Software tools to compare different observations of \textit{calibration targets} (and other objects with multiple observations) will be useful for monitoring EPIC stability and calibration.

3XMM sources:
- \~67,000 with > 1 detection
- \~28,000 with > 2 detections
- Max 44 repeat observations
- Excess in 30-35 range (\textit{calibration targets}, M31)
Calibration target: AB Dor

A

Factor ~4

Count Rate

50 ks

Factor ~2

Hardness Ratio

~11 yr

B

Factor ~3

Hardness Ratio

50 ks

Count Rate
The variable source catalogue

The final EXTraS catalogue might be useful for:

- Searching for instrumental **anomalies**: periods of enhanced (or reduced) variability, long-term trends in source fluxes, identification of detector regions with reduced sensitivity...

- Selection of **stable sources** as new calibration sources (also for cross-calibration with non-simultaneous observations)

- Evaluating the quality of **calibration observations** (additional data products, information on source variability)

- Involving the broadest **scientific community** in the analysis of *XMM-Newton* data
Conclusions (I)

The **EXTraS** project can give an important support to **XMM-Newton** and contribute to EPIC monitoring and calibration activities:

- Identification of EPIC **anomalies** and **systematic effects**: CR afterglows, noisy pixels, spurious periodicities, long-term trends in performances...

- Support to **calibration**: tools for quick-look analysis, selection of best calibration sources and observations...
Conclusions (II)

On the other hand, the whole EPIC team might give important contributions to EXTraS:

• Link to [http://www.extras-fp7.eu](http://www.extras-fp7.eu) (still under construction) from ESAC website and possible integration of EXTraS catalogue with official XMM archive

• Possible modification of SAS tools and/or integration of EXtraS tools in SAS

• Support on technical/calibration issues

• Anyone’s contribution is welcome: contact us!