**Abstract**

Modern X-ray observatories can yield unique insights into time domain astrophysics. Indeed, a huge amount of information is already stored - and largely unexploited - in data archives. The EXTraS project harvests the hitherto unexplored temporal domain information buried in the serendipitous data collected by the European Photon Imaging Camera (EPIC) onboard the ESA XMM-Newton mission since its launch. This includes a search for fast transients, missed by standard image analysis, and a search and characterization of variability (both periodic, aperiodic and long-term) in hundreds of thousands of sources spanning more than nine orders of magnitude in time scale (from $\leq 1$ s to $\geq 10^{15}$ yr) and six orders of magnitude in flux (from $10^{-9}$ to $\geq 10^{-15}$ erg cm$^{-2}$ s$^{-1}$ in 0.2–12 keV). X-ray results are to be complemented by multiwavelength characterization of new discoveries. Phenomenological classification of variable sources will also be performed. Our final catalogue and results will be made available to the community, together with new analysis tools, at the end of the project (end of 2016).

**EXTraS aims and objectives**

The aim of EXTraS is the exploration and characterization of the temporal behaviour of the largest ever sample of objects in the soft X-ray (0.1–10 keV) range with a complex, systematic and consistent analysis of the whole XMM-Newton/EPIC database (Serendipitous Source Catalogue, 3XMM-DR4, and Slew Survey, XSS).

**XMN-Newton EPIC databases**

<table>
<thead>
<tr>
<th>3XMM-DR4</th>
<th>XSS</th>
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</thead>
<tbody>
<tr>
<td>Number of sources (unique)*</td>
<td>531,261 (373,268)</td>
</tr>
<tr>
<td>Sources with detections** $\geq 1$</td>
<td>66,728</td>
</tr>
<tr>
<td>Sky coverage</td>
<td>794 deg$^2$</td>
</tr>
<tr>
<td>Sensitivity 0.5–2 keV</td>
<td>$3 \times 10^{-15}$ erg cm$^{-2}$ s$^{-1}$</td>
</tr>
<tr>
<td>Sensitivity 2–10 keV</td>
<td>$1.5 \times 10^{-14}$ erg cm$^{-2}$ s$^{-1}$</td>
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* Final numbers of sources may increase.  ** Final sky coverage of the XSS will be increased.

**Exploring the data**

- **Aperiodic Variability of 3XMM Sources**
  - systematic study of aperiodic, short-term variability
  - characterizing the bulk of 3XMM sources on all possible time scales,
  - generates power spectra based on Fourier analysis, or optimally biased light curves based on Bayesian Blocks analysis,
  - extraction of synthetic parameters for each source to quantify variability

- **Search for Periodicity in 3XMM Sources**
  - first systematic search for periodicity ever performed on the EPIC database
  - performing state-of-the-art timing analysis techniques to unbinned photon times of arrival

- **Search for Transients and Highly Variable Sources**
  - large number of overlapping observations performed at different epochs (repeated pointings or less)
  - provide photometric snapshots that sample long-term light curves (up to 15 yrs)

- **Long-Term Variability of 3XMM and XSS Sources**
  - phenomenological characterization (hardness ratio) and spectral fitting of the X-ray spectrum
  - search for positional counterparts at other wavelengths using public source catalogues
  - automated classification based on the broad band spectrum and timing properties

- **Phenomenological Classification**
  - phenomenological classification of all variable sources
  - use of an automated statistical classification approach, based on a full set of source “features”, describing all X-ray temporal and spectral properties
  - use of all available information in multiwavelength catalogues and databases
  - test of different classification algorithms

- **Multiwavelength Characterization of NewTransient Sources**
  - phenomenological characterization (hardness ratio) and spectral fitting of the X-ray spectrum
  - search for positional counterparts at other wavelengths using public source catalogues
  - automated classification based on the broad band spectrum and timing properties

**EXTras Public Product Release (end of 2016)**

- All results and products will be included in a public Catalogue, the most important product of the project for the community, helping to address a wide range of unsolved problems in almost all fields of astrophysics.
- All the software tools developed and/or customized in the project will be made available to the scientific community.
- As a very specific contribution, the project includes an experimental didactic program that is aimed at directly involving students in our research program, allowing them to participate in the scientific activities.

**Contact**

For more information, visit [www.extras-fp7.eu](http://www.extras-fp7.eu)

**EXTras Consortium**