Running the Science Analysis Software on any Region of the XMM-Newton sky with Amora

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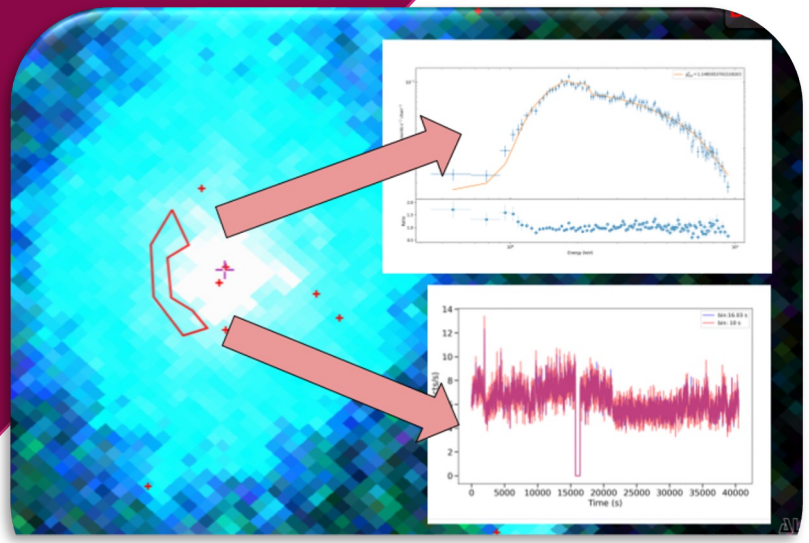

Example of a spectrum, fitted with a power law, and a light curve both generated online by Amora from a region of the SNR G021.5-00.9 nebulae. The region was drawn by the user who also chose one observation (0804250201/PN) among those overlapping with it. Amora ran the data analysis software on the subset of events that are enclosed in that region. Results are made available as both previews (shown here) and FITS files.

Many astrophysical objects emit photons in the X-ray energy band; these photons can travel millions of light-years in straight lines and eventually reach our solar system. However, these highly energetic photons are absorbed by the Earth's atmosphere, thus in order to study these objects we build space observatories like XMM-*Newton*. The main detector of these photons is in fact a CCD camera that takes 'photos' at a very fast speed, enabling us to collect the electric charge deposited in the pixels by single photons, in what we call an event. An event contains information about the position, time of arrival, and energy of the incident photon. The processing of such event lists is quite complicated because the signal count rate is often low and on top of a background containing many events that do not come from the source of interest or are not even due to X-ray photons. In addition to this, the interaction of X-ray photons with CCD pixels is complex: a photon can create signal in more than just one pixel, or multiple photons can hit the same pixels in the same frame.

Retrieving science data from event lists requires advanced statistical processing that is run on ground. In a nutshell, the workflow consists in first filtering the events (no solar flare, no unexpected noise, electronic working well…) and then building images. The images are processed to detect areas with photon excess and thus detect source candidates that will be studied later on. The photons issued from these sources are then processed to evaluate source brightness and to build spectra or time series which are ready for further analysis. These science products are made available to the community through different interfaces among those the XCatDB, operated by the Observatory of Strasbourg. This tool is able to plot the almost 630000 different sources detected by XMM upon any of the ~1100 available image surveys across the whole electromagnetic spectrum and to combine them with data from more than 22000 catalogues.

A new XCatDB feature, named Amora for "Asynchronous Multi-Observation Region-based Analysis", allows users to access all the events/photons that were collected by the XMM-*Newton* mission in the region of interest and to process them interactively.

Users can draw a polygon or a circle isolating that region; they can also define another area that will be used as a background region. Once the region is validated, Amora lists observations that cover it along with their properties, allowing the user to choose which observations to use for further analysis. On these selected data, the user has just to select the processing tasks (e.g. building spectra) that will run on the server. The processing output is displayed in real time on the screen, allowing an efficient monitoring of the task progress. Results are provided as both previews for a quick look and as science products that can be downloaded for further analysis (https://xcatdb.unistra.fr/xsasdb, green button).

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