Using the Enhanced XMM-Newton Catalogue to identify extremely variable AGN

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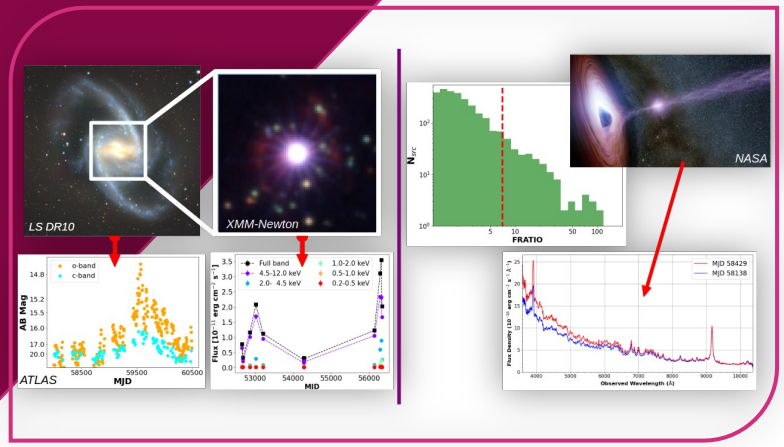

Left: NGC 1365, or the Fornax Pinwheel Galaxy. The strongest X-ray emission is associated with the galactic nucleus. The split over energy bands shows us that the large X-ray flare was largely driven by hard X-rays. ATLAS data show that the galaxy also shows optical outbursts. Right: An overview of one of the catalogue variability parameters (FRATIO) for the XMM sources matched to AGN candidates (before filtering). The sample above the red cut-off line still contains e.g. variable X-ray binaries. However, all confirmed AGN with spectra available are NLSy1s, as intended.

The Enhanced Stacked Catalogue of XMM-*Newton* sources, developed as part of XMM2Athena, provides overview information on all sources detected in XMM observations, using a more refined detection algorithm than previous versions. Here we focus on a small subsection of the available information: the catalogue includes parameters that quantify the level of X-ray variability in a source. The catalogue therefore provides a treasure trove for identifying variable sources among the archival data. This is in addition to the work done as part of XMM2Athena (WP5) on the development and refinement of detection algorithms for transients and other variables. The following is an example of how the Enhanced XMM-*Newton* catalogue can be used to identify highly variable sources. The science case is the detection of extreme variability in Active Galactic Nuclei. AGN are powered by supermassive black holes in the centres of galaxies that draw in surrounding matter and they are known to be variable over time: the matter flow to the black hole is not smooth and the emission 'flickers'. A subset of AGN, referred to as type Narrow-Line Seyfert 1 (NLSy1), is particularly variable in X-rays. We will use the timing data in the catalogue (usually on timescales of months-years) to identify NLSy1 candidates in the XMM-*Newton* catalogue, focussing on the most extreme cases of variability. To limit the variability search to likely AGN and to combine our X-ray insight with optical information, we crossmatch the enhanced catalogue with a sample of Gaia AGN candidates. We are able to find counterparts for 7466 XMM sources. Limiting to objects with at least three observations and with a high probability of being variable (VAR_PROB<10^{-7}), we are left with 236 objects. A good example from this dataset is shown in the left side of the accompanying figure: the nucleus of NGC 1365. Finally, we filter down to the cases of very large variability, requiring FLUX_VAR>3 and FRATIO>7; making cuts in the size of the largest change and the largest fractional flux change, respectively. Using Simbad to verify the classification of the remaining 27 objects, we find 12 confirmed AGN. For 6 of these AGN optical spectra are available and, interestingly, all of these AGN are NLSy1s. The catalogue's variability parameters allowed us to filter out the most extreme objects and with a more rigorous filtering of the QSO candidates, there is a great potential for further statistical analysis.

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