A Novel Approach to model EPIC variable background

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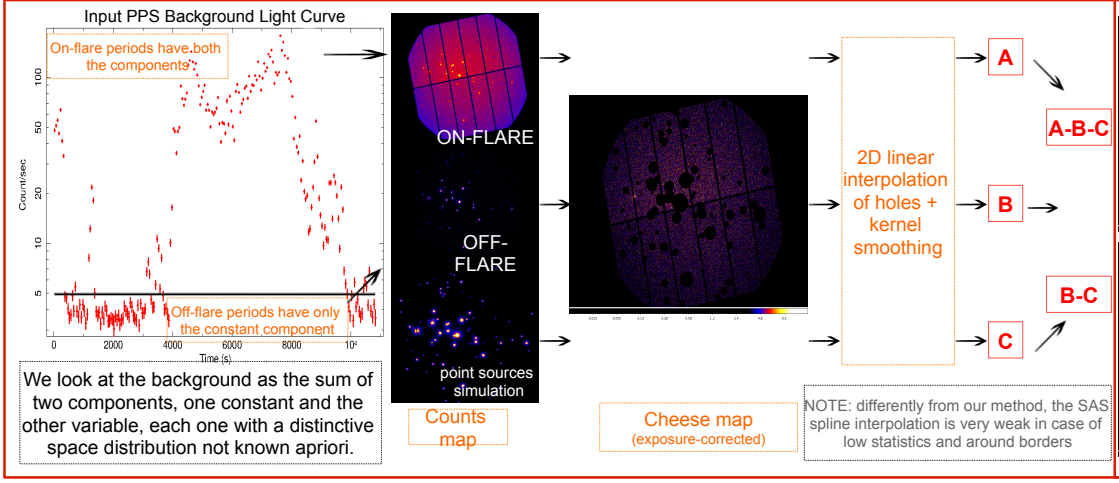
The problem of the EPIC background

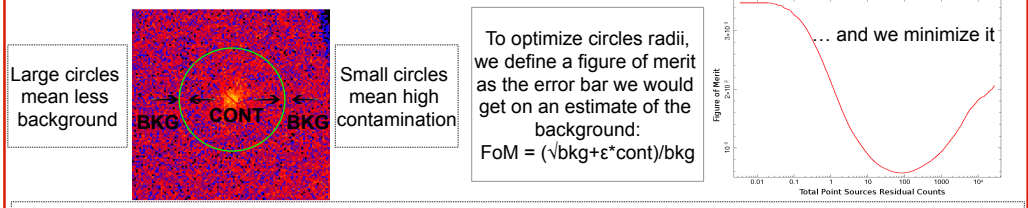
One of the main aim of the EXTraS (Exploring the X-ray Transient and variable Sky) project is to characterise the variability of serendipitous XMM-Newton sources within each single observation. Unfortunately, 164 Ms out of the 774 Ms of cumulative exposure considered by the 3XMM-DR4 catalog (21%) are badly affected by soft proton flares, with background increasing by orders of magnitudes hampering any classical analysis of field sources. De facto, the latest releases of the 3XMM catalog, as well as most of the analysis in literature, simply exclude these 'high background' periods from analysis.
We implemented a novel SAS-indipendent approach to produce background-subtracted light curves, which allows to treat the case of very faint sources and very bright proton flares. EXTraS light curves of 3XMM-DR5 sources will be soon released to the community, together with new tools we are developing.

Background maps extraction

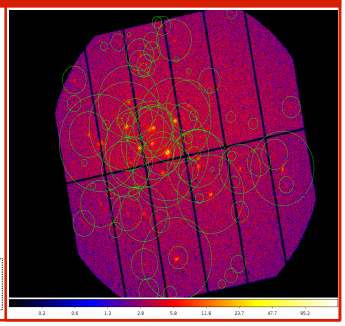


Background region extraction

We define as global background region - the same for each source – the entire FoV from which we cut out circles around point-like sources



Among 3XMM observations, we get a minimum number of considered background counts as 15% of the total and a maximum point source contamination of 5% of the considered background

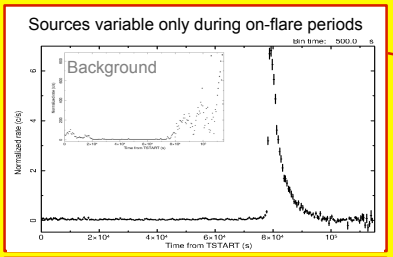


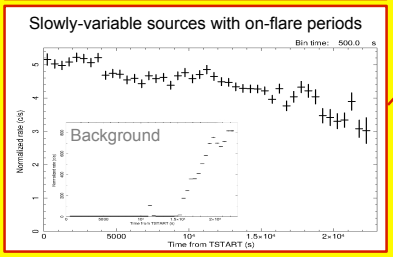
Light curves extraction

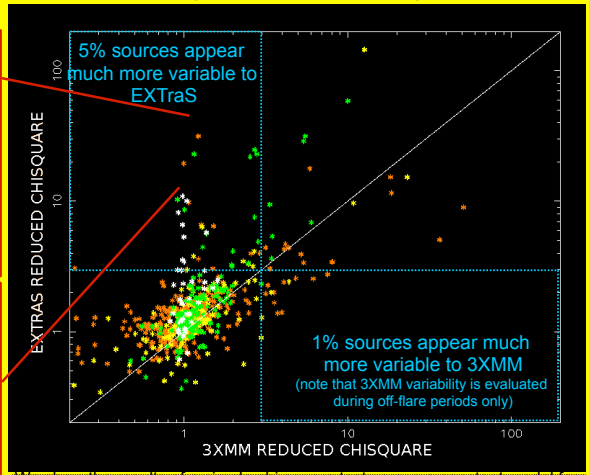
To create a source light curve, events are extracted from a circular region. First, we extract the gti-corrected background curve, then we exploit our knowledge of spatial (bkg maps) and temporal (bkg light curves) background distributions to predict the constant and variable background contributions inside the source region. All the components' counts are corrected for CCD gtis. Source counts are corrected for the PSF tails outside the considered region and spatial effects.

Tests and preliminary results

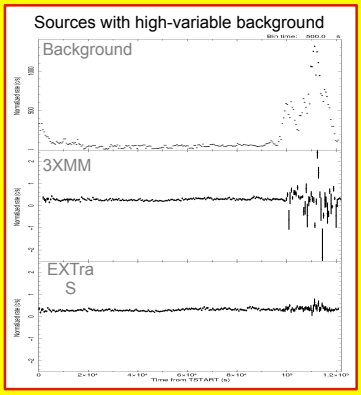
Preliminary tests on thousands sources revealed significant differences between 3XMM and EXTraS uniform-bin light curves, even for bright sources.
The 3XMM light curves show a much stronger correlation with background than the EXTraS light curves







We show the results of a simple chi square test versus a constant model for a small sample of bright sources (>0.01 c/s), with colours reddening for decreasing count rate. Overall, EXTraS sees sources more variable than 3XMM.



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