

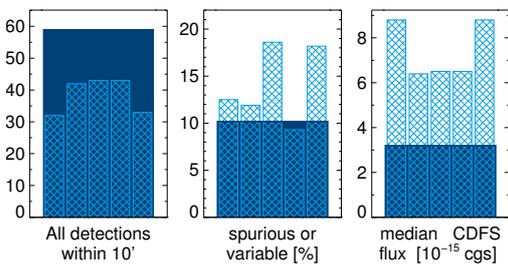
# The serendipitous source catalogue from overlapping XMM-Newton observations

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on behalf of the XMM-Newton  
Survey Science Centre consortium

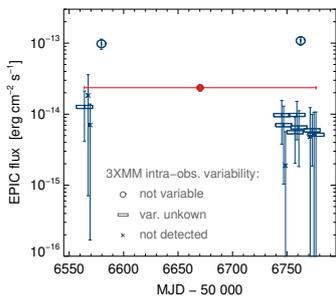
## The first catalogue 3XMM-DR7s

20 years after its launch, XMM-Newton has performed about 13,000 pointed observations which cover a total of more than 1,100 square degrees of the X-ray sky. From all public data, the XMM-Newton Survey Science Centre consortium (SSC) generates serendipitous source catalogues listing positions, source parameters such as fluxes, hardness ratios, extent, and a quality assessment.



Higher sensitivity in stacks (dark blue, solid) compared to single observations (light blue, cross-hatched): five XMM-Newton exposures in the Chandra Deep Field South (CDFS). From left to right: Number of XMM-Newton detections, fraction without a counterpart in the CDFS 7Ms catalogue, and median fluxes.

Last year, we have published for the first time a catalogue from simultaneous source detection in a selection of 1,789 overlapping observations. It is based on a new standardized procedure for multiply observed sky areas and includes almost 72,000 sources with their stacked and observation-level parameters and information on their inter-observation variability. The longer effective exposure time and the combined fit result in more faint detections, more precisely determined source parameters, and lower spurious source content than in single observations.

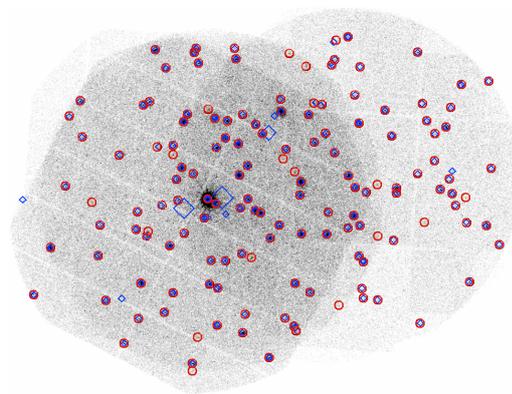


Long-term variability information directly from source detection: light curve of a 3XMM-DR7s source that was newly found to be variable. Each blue symbol represents one XMM-Newton observation. The stacked all-EPIC flux is shown as red filled circle with a black flux error bar. Flux light curves are provided together with the catalogue in ESA's XSA.

Catalogue paper: Traulsen et al. 2019, A&A 624, A77, "The XMM-Newton serendipitous survey. VIII: The first XMM-Newton serendipitous source catalogue from overlapping observations"

## The next generation: 4XMM

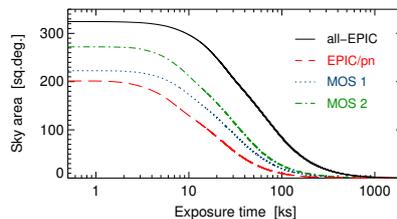
Celebrating XMM-Newton's 20th anniversary, the SSC currently compiles new, fully reprocessed catalogues. The next catalogue of sources in overlapping observations 4XMM-DR9s is made from 1,340 stacks comprising more than 7,500 individual observations with moderate background. Its sources are observed up to 65 times with a cumulated exposure time between about 1 ks and 2 Ms.



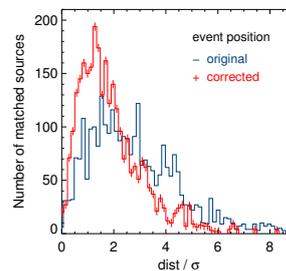
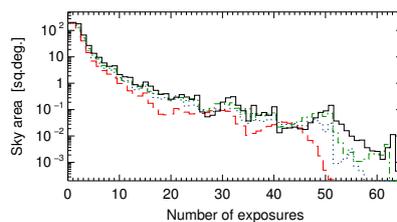
Digging deeper and reducing the spurious content: Results of stacked source detection (red circles) and of the individual runs (blue squares) in a group of five observations around CM Dra.

## New in 4XMM-DR9s

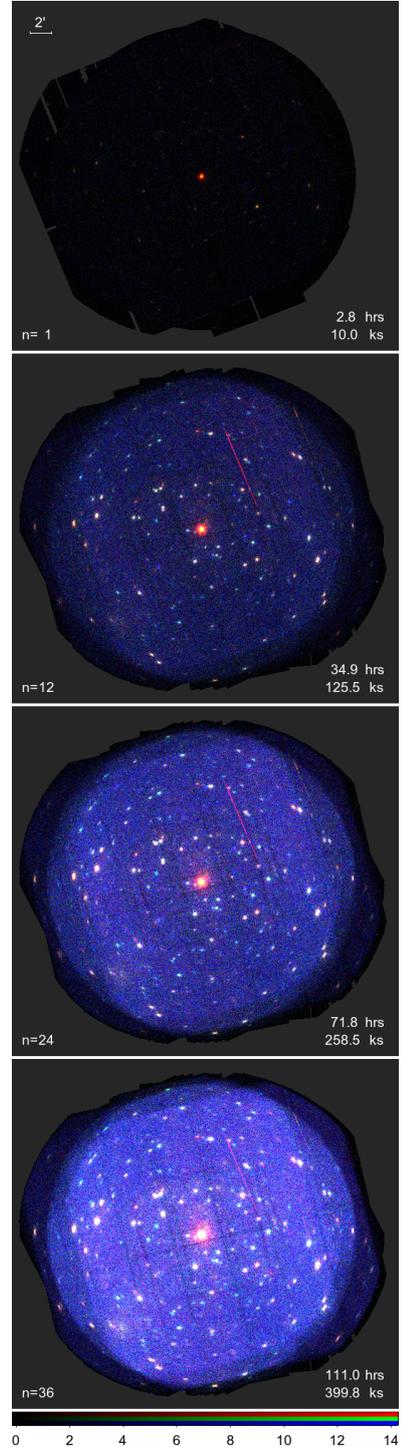
- \* all EPIC exposures with moderate background level
- \* different observing modes
- \* improved background determination
- \* event-based field rectification before source detection
- \* more than 3 times the sky area of the first catalogue



The next edition: Cumulative repeatedly observed sky area over exposure time and total area per number of observations in 4XMM-DR9s.



Improved position determination: Histogram of the error-normalized position offsets between X-ray detections in 25 stacks and their SDSS counterparts before (blue) and after (red) event-based astrometric correction. Each stack includes two to six observations. Ideal positions would follow a Rayleigh distribution peaking at 1.



Stacking XMM-Newton observations: False-colour images showing repeated observations of HD 81809. Red band: 0.2—1.0 keV, green: 1.0—2.0 keV, blue: 2.0—12.0 keV.