
Transient sources in the XMM-Newton catalogue

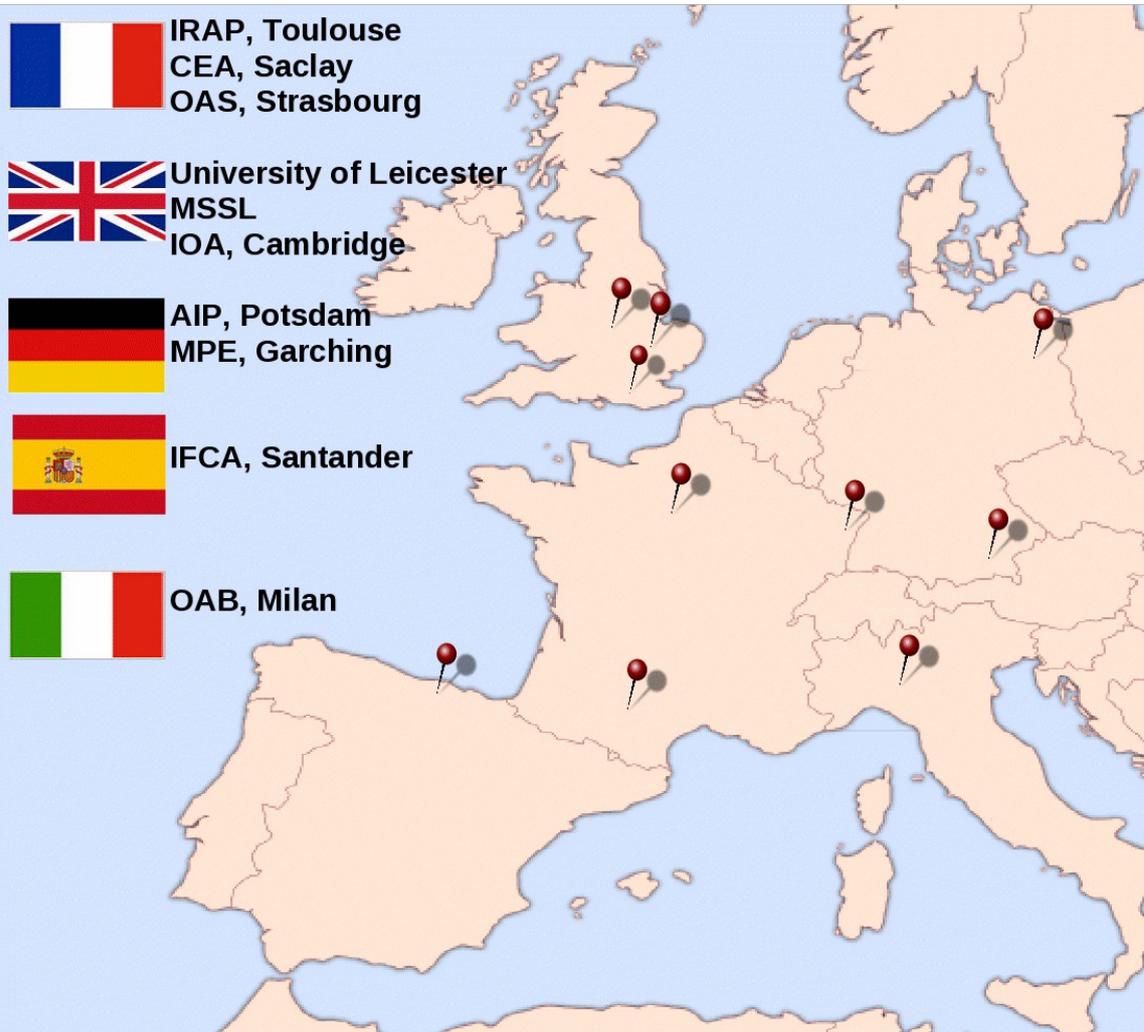
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Institut de Recherche en Astrophysique et Planétologie,
Toulouse, France



XMM-Newton Survey Science Centre (SSC)

The XMM-Newton Survey Science Centre was selected by ESA to ensure that the scientific community can exploit XMM-Newton data



Responsibilities :

Development of science analysis system (SAS)

Pipeline processing of all XMM-Newton observations.

Follow-up/identification of the XMM-Newton serendipitous sky - the XID Programme

Compilation of the Serendipitous Source Catalogue.

3XMM-DR8



3 February 2000 – 30 November 2017 – made public 16th May 2018

775153 detections, some sources up to 59 times

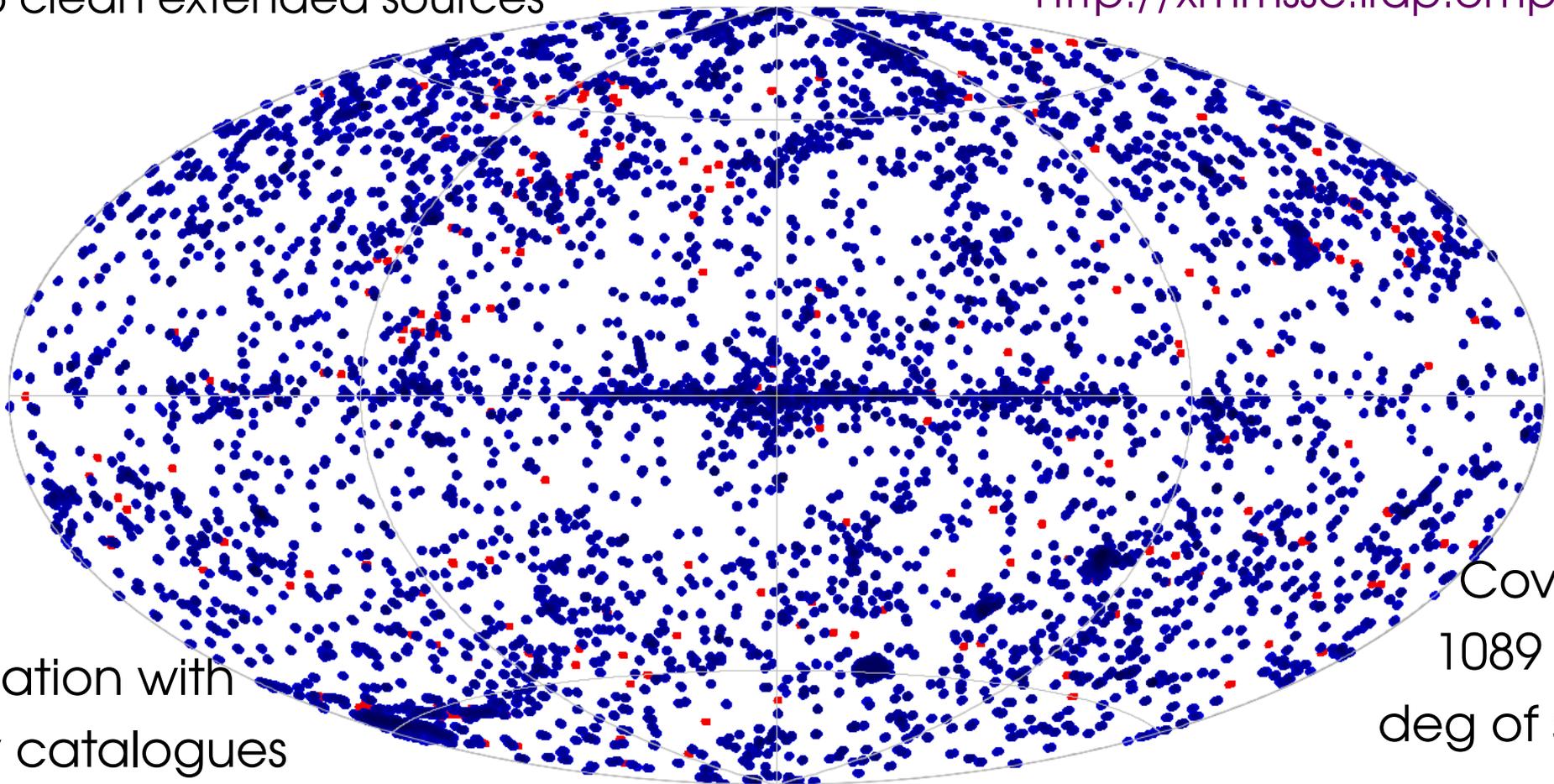
531454 unique sources

173208 sources with spectra and lightcurves

12256 clean extended sources

Rosen, Webb,
et al. (2016)

<http://xmmssc.irap.omp.eu>



Cross
correlation with
many catalogues

Covers
1089 sq.
deg of sky



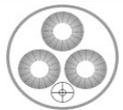
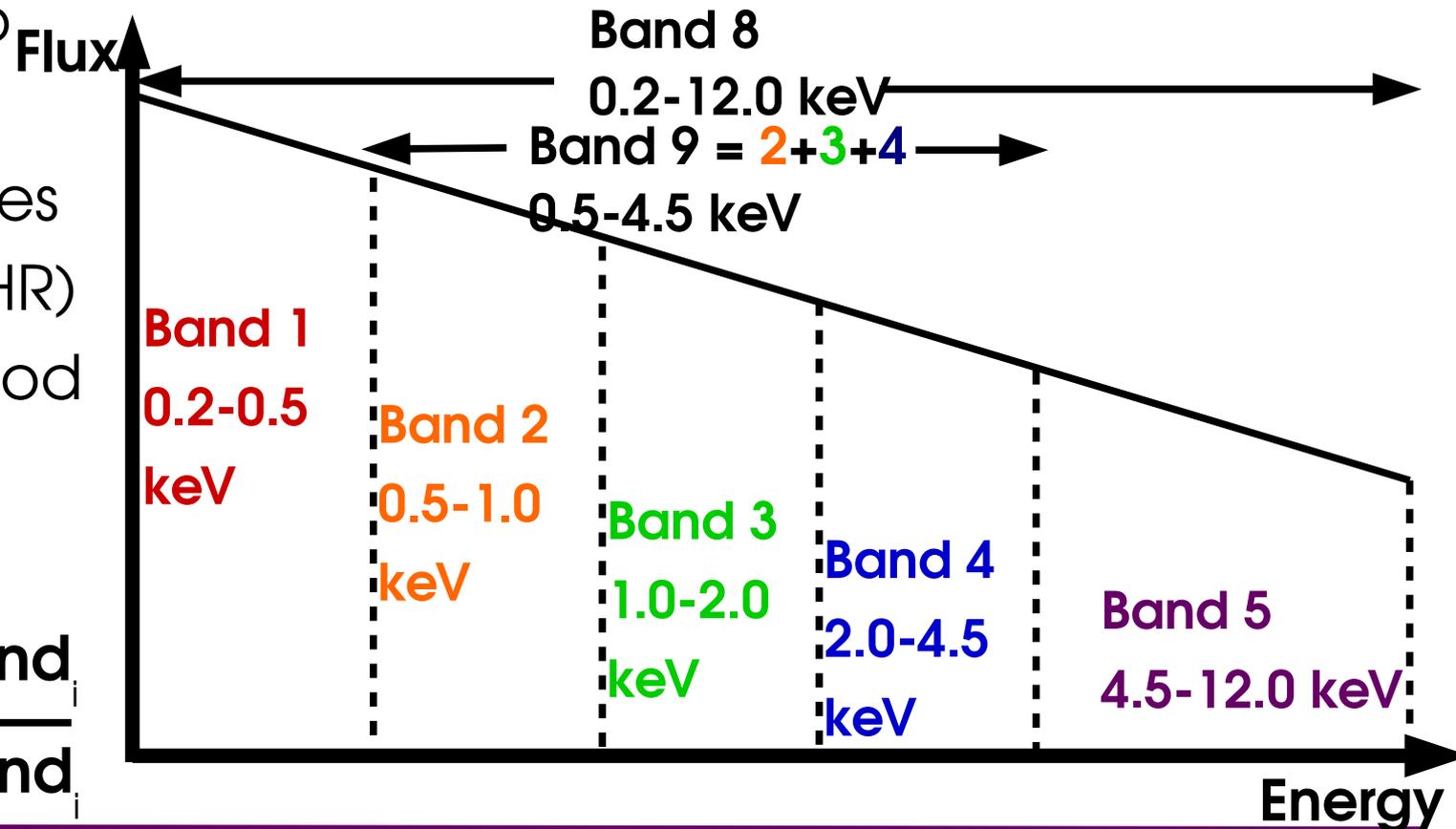
332 columns of information including :

- Identifiers/coordinates
- Observation date/time and observing mode
- Exposure

/background info

- Extent
- Counts/fluxes/rates
- Hardness ratios (HR)
- Maximum likelihood
- Quality flags
- Variability

$$HR_i = \frac{\text{Band}_{i+1} - \text{Band}_i}{\text{Band}_{i+1} + \text{Band}_i}$$

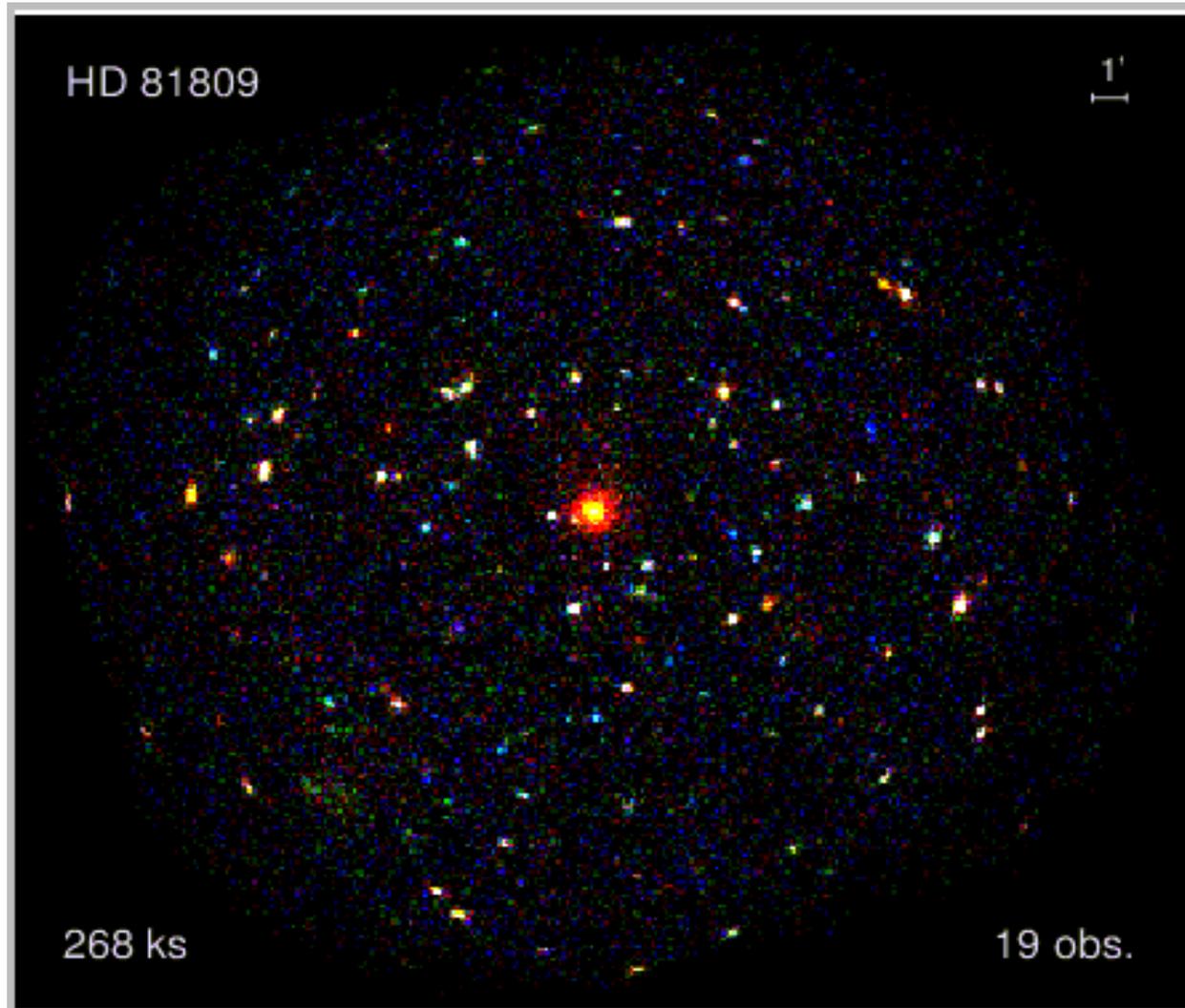


1789
observations

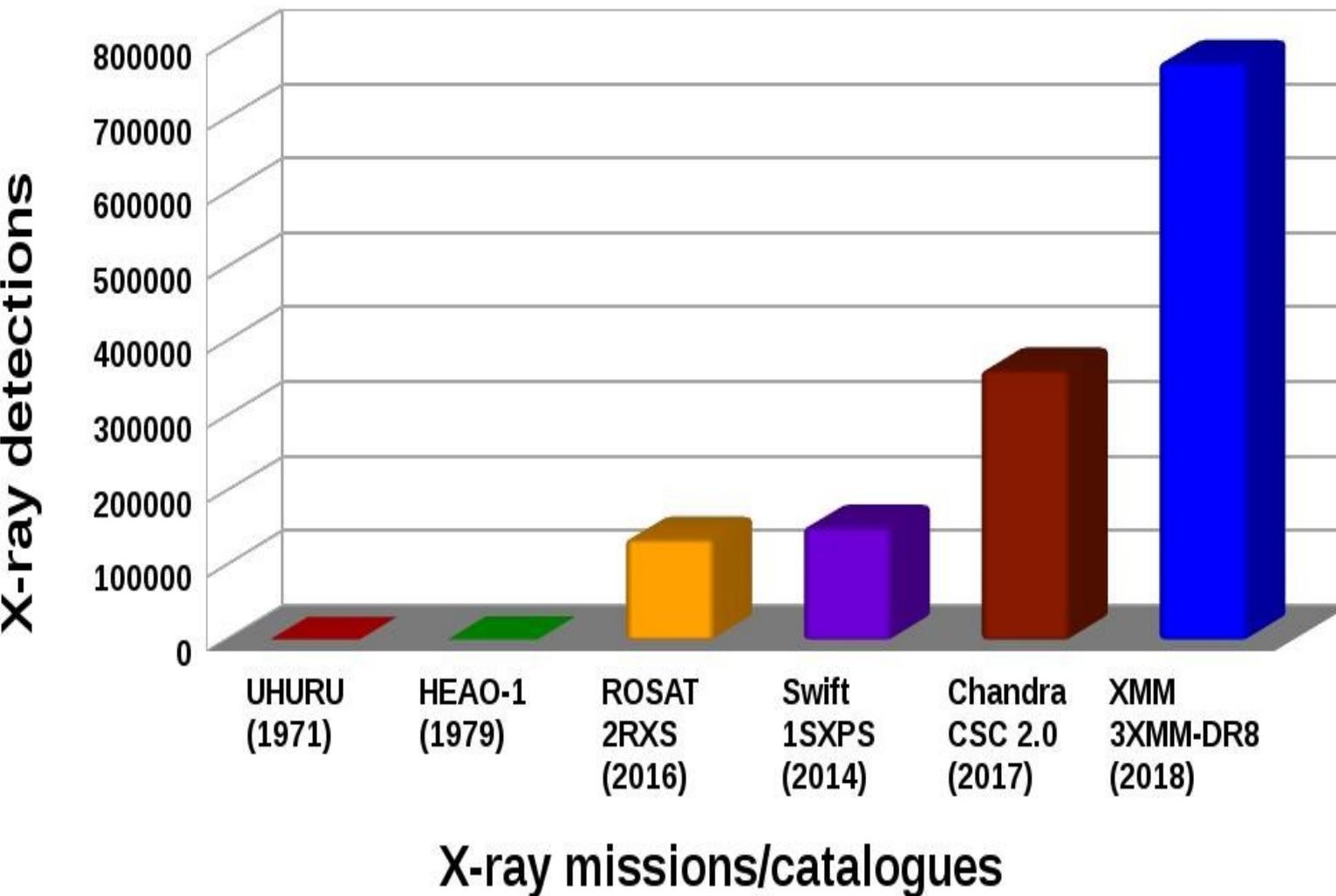
71951
unique
sources

11043 new
sources w.r.t.
DR7

Traulsen et
al. 2019



Excellent to
search for
faint sources
or long term
variability



The catalogue is excellent for :

- Quick access to data products (fluxes, spectra, images, etc)

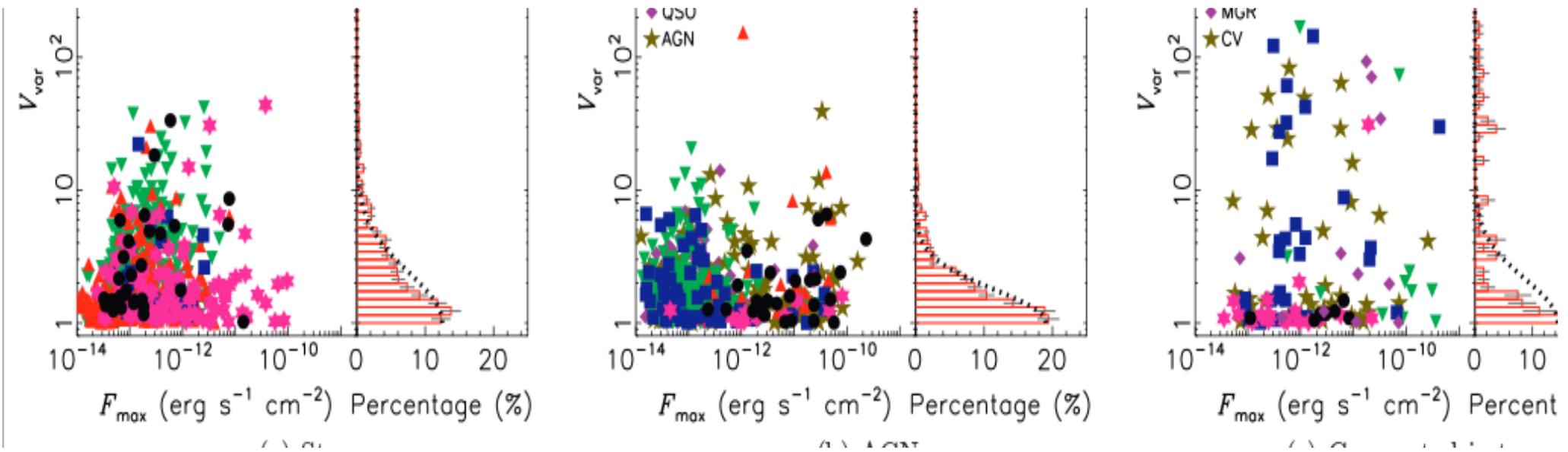
- Finding new objects

- Population studies

- Cross correlation for multi- λ studies

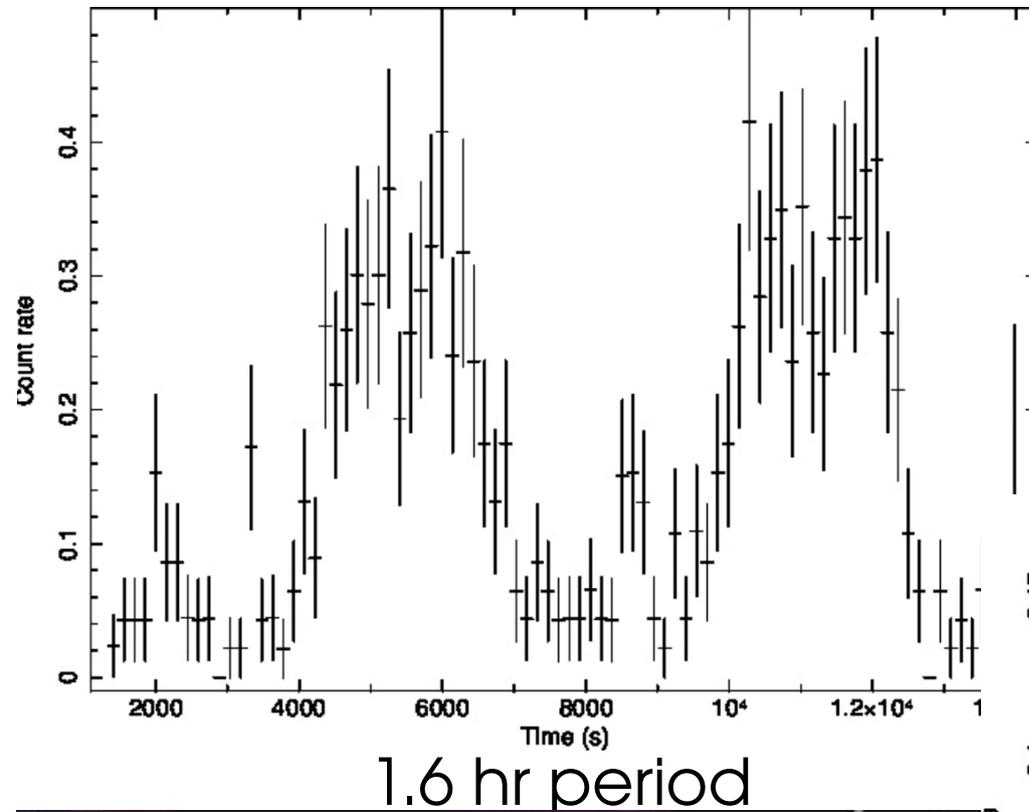
Variable sources

Investigation of 4330 point-like, good signal to noise sources with multiple pointings in 2XMM (Lin, Webb & Barret 2012)



Variable sources are therefore a good way to identify compact objects

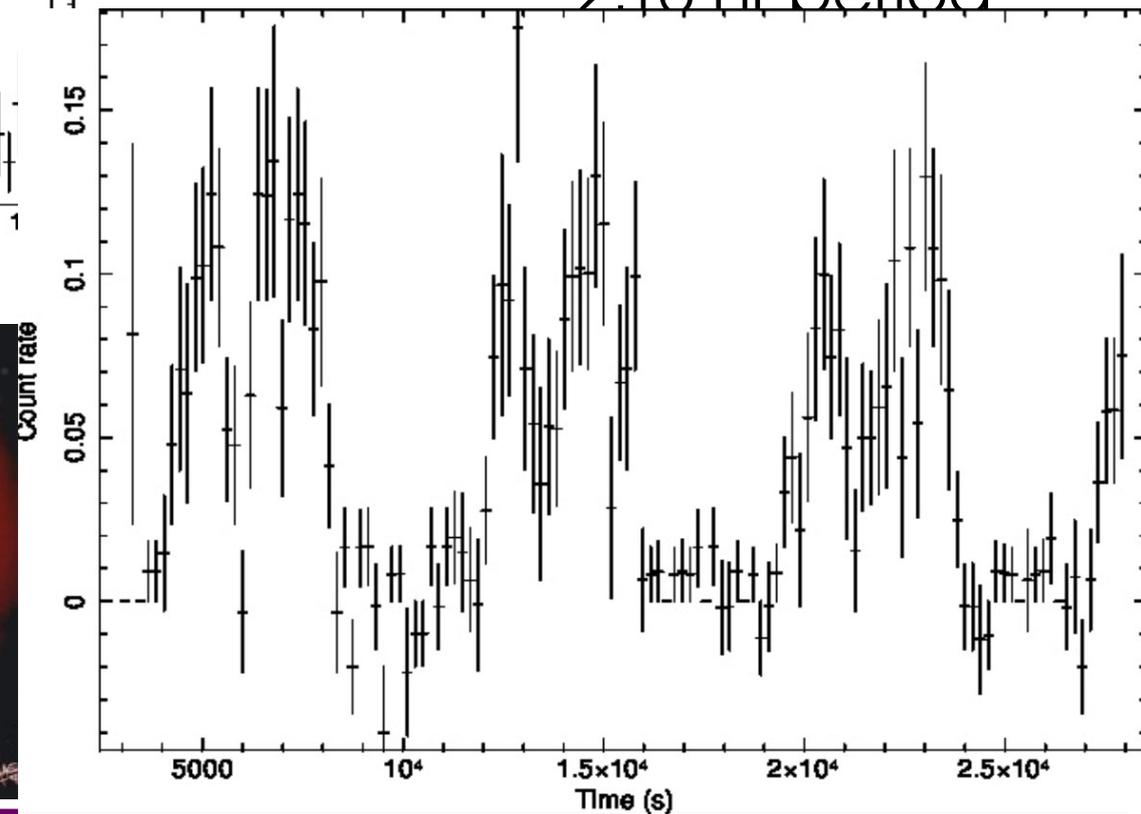
Variable sources



2 magnetic cataclysmic variables (CVs)

(Webb et al., 2018)

2.15 hr period

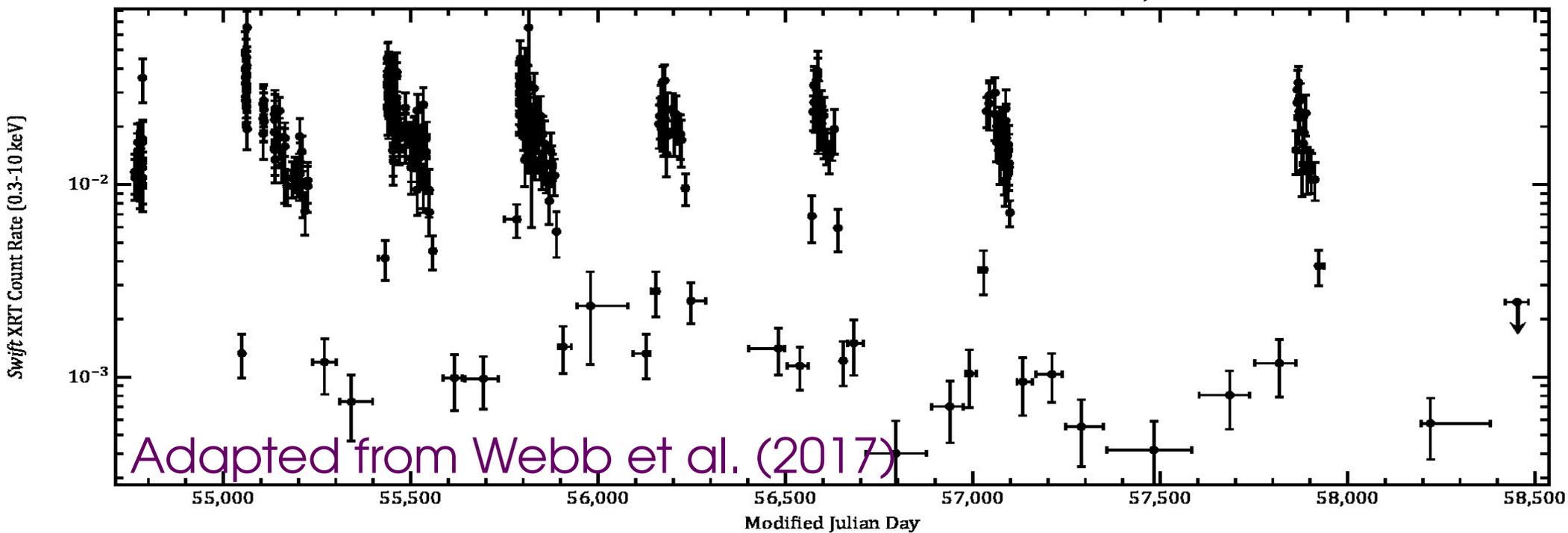


An intermediate mass black hole (HLX-1)



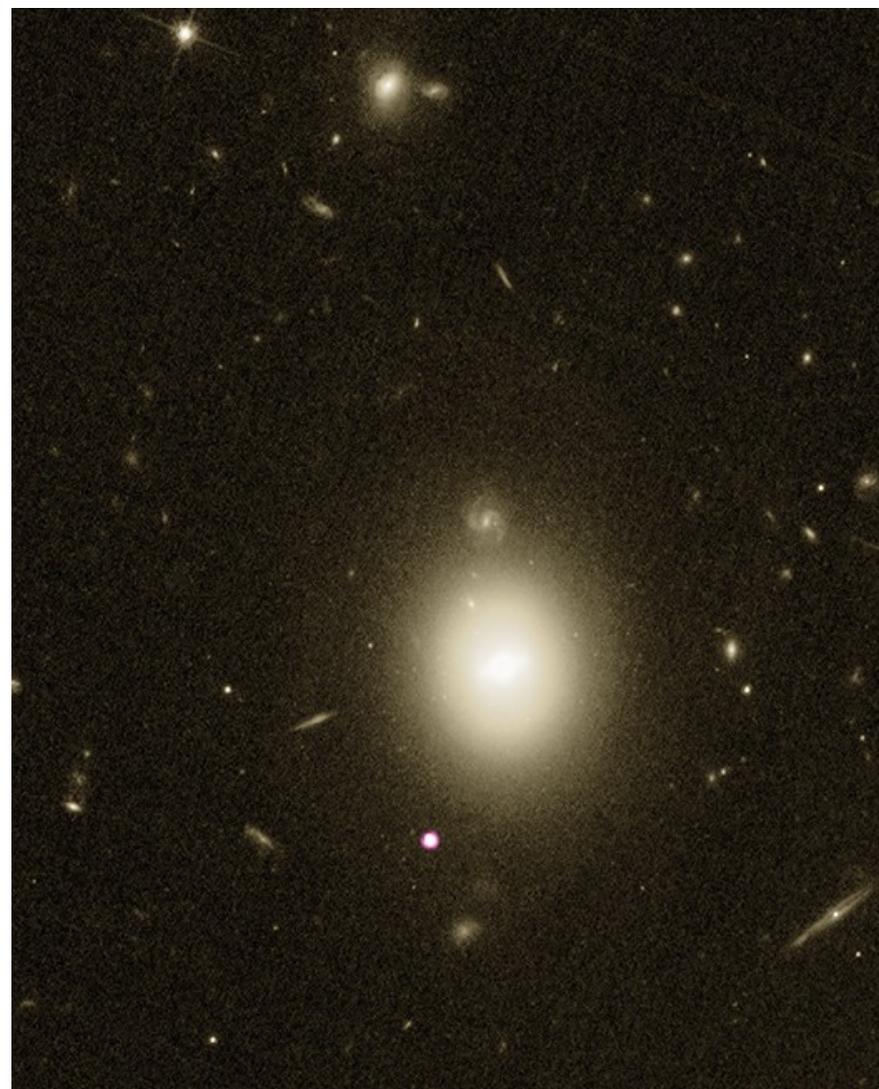
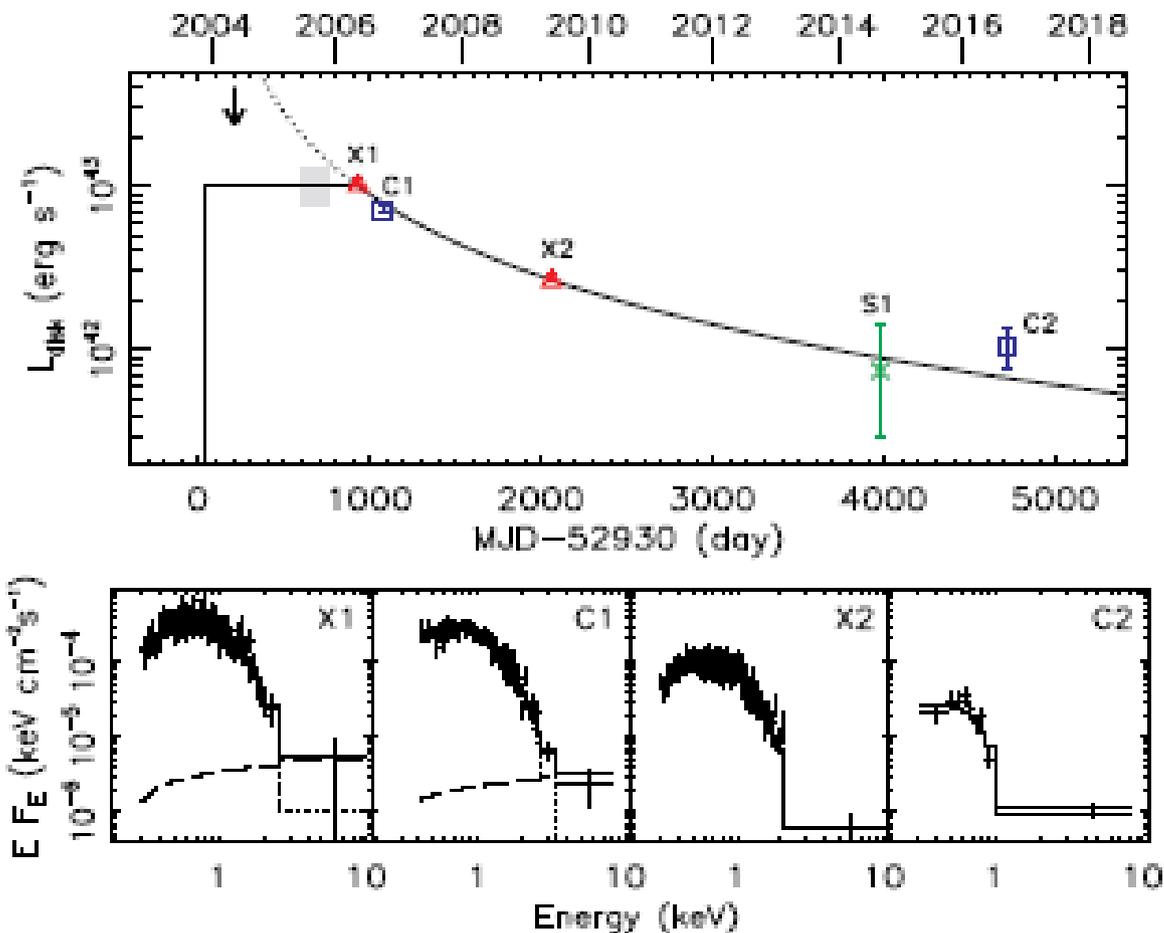
HLX-1 associated with ESO 243-49 at 95 Mpc (Farrell, Webb et al. 2009, Nature; Wiersema, Farrell, Webb et al. 2010)

$L_{x(\text{max})} = 1.2 \times 10^{42} \text{ erg s}^{-1}$ (Godet, Barret, Webb et al. 2009)



Long term variability : Low mass tidal disruption events

Lin et al. Nature Astronomy (2018)



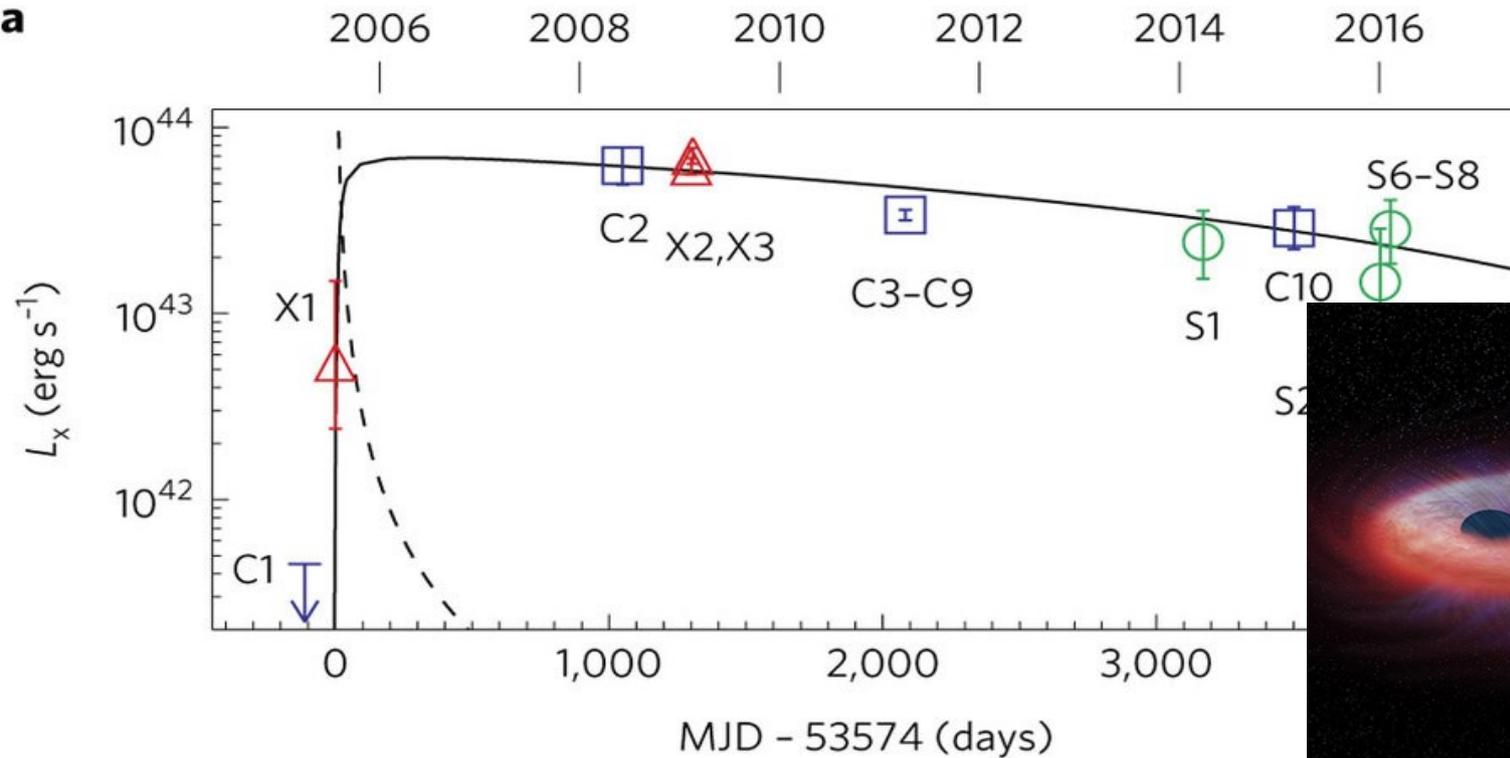
Modelling with *optxagnf* :

$$0.92 < a_* \text{ (spin)} < 1.0 \quad (D_L = 247 \text{ Mpc})$$

$$5.3 \times 10^4 M_{\odot} < \text{mass} < 1.2 \times 10^5 M_{\odot}$$

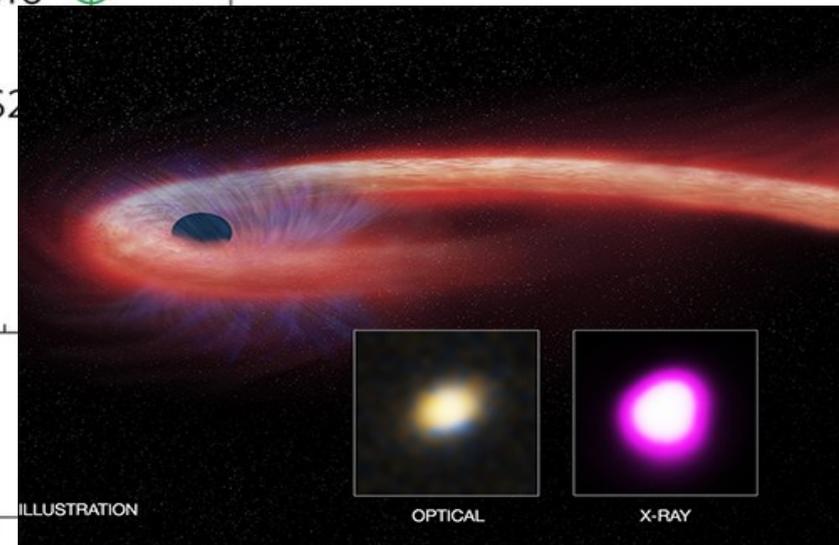
Extreme tidal disruption event

a

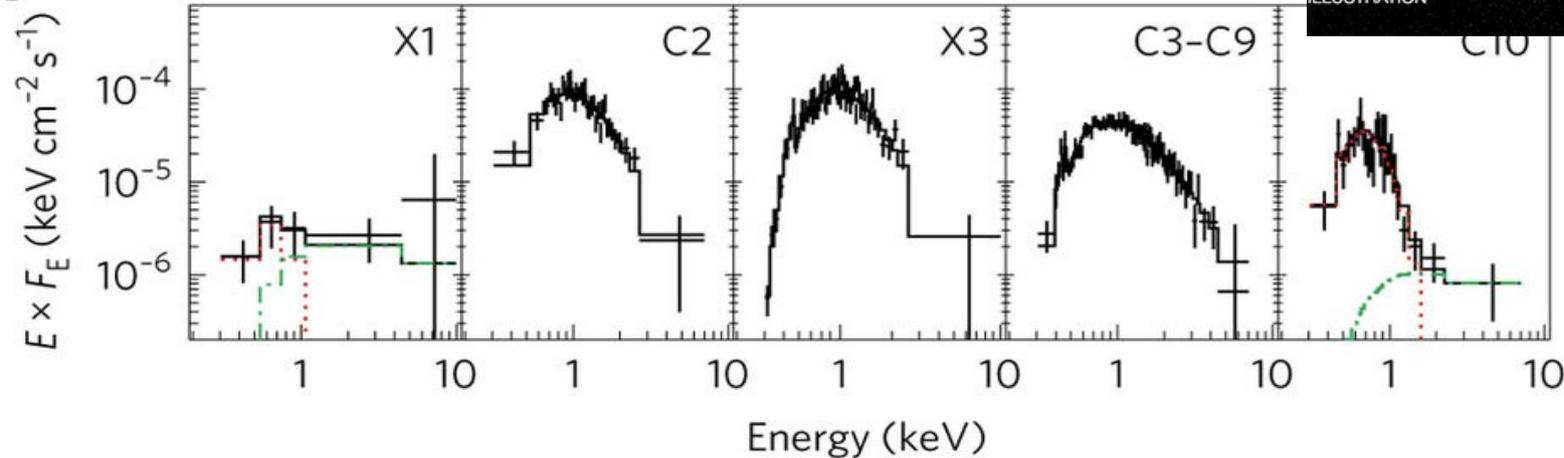


Lin et al.

Nature Astronomy
(2017)



b



New software
coming online to
search for long term
variability in real
time

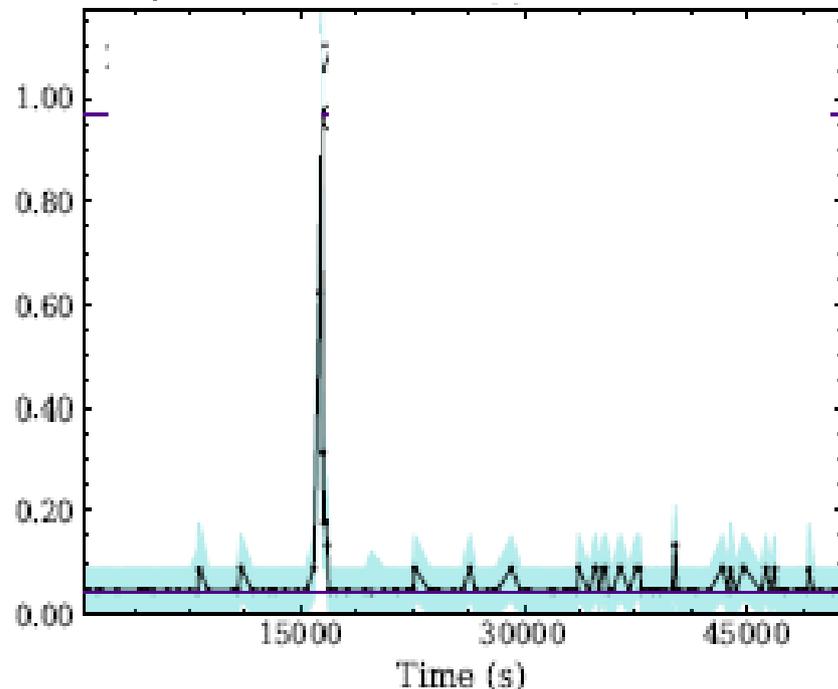
Short term variability

χ^2 & frac. variability tests on **detected** sources with > 100 counts

Some sources vary very rapidly (short γ -ray bursts/gravitational wave events, type I X-ray bursts, possible counterparts FRBs etc)

Distant (faint) sources may have few counts, all concentrated over a few seconds and not detected in a long observation

To exploit all data, search whole FOV on seconds timescales



2849 variable sources

New : Short stellar flares

Type I X-ray bursters

Magnetar candidates

AGN flares

(Pastor-Marazuela, Webb et al. sub)

Summary

Wide range of rare objects found in the 3XMM catalogue

New techniques to search for short and long term variability

New major version, 4XMM-DR9 and 4XMM-DR9s for 2019

Access the catalogue:

XMM-SSC webpages : <http://xmmssc.irap.omp.eu>

XSA at ESA's XMM-Newton SOC : <https://nxsa.esac.esa.int/>

XCAT-DB at : <http://xcatdb.unistra.fr/3xmmdr8>

LEDAS at : <http://www.ledas.ac.uk/>

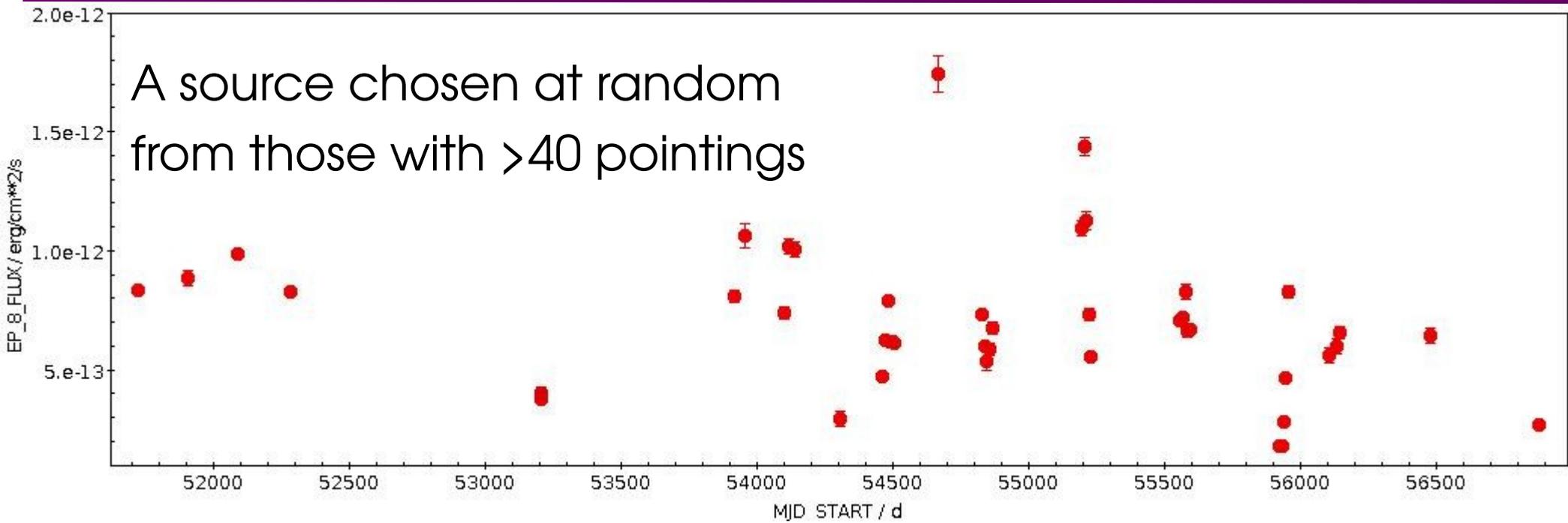
Browse at HEASARC NASA GSFC :

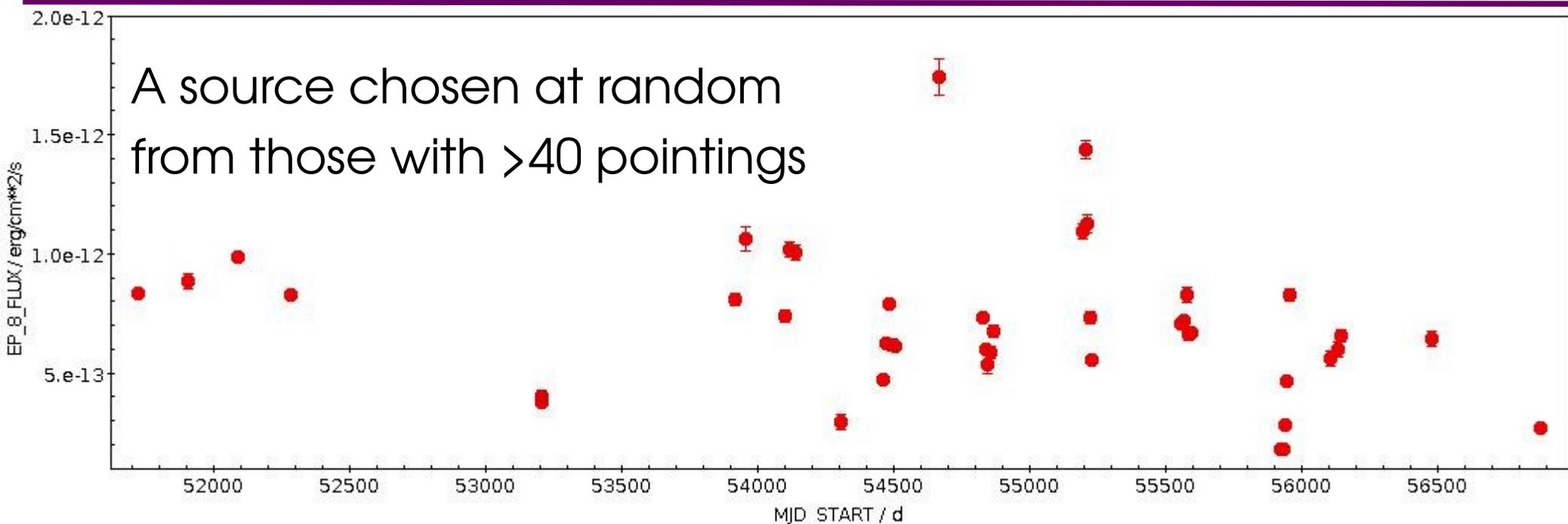
<http://heasarc.gsfc.nasa.gov/db-perl/W3Browse/w3browse.pl>

The IRAP catalogue server XSA : <http://xmm-catalog.irap.omp.eu/>

Backup slides

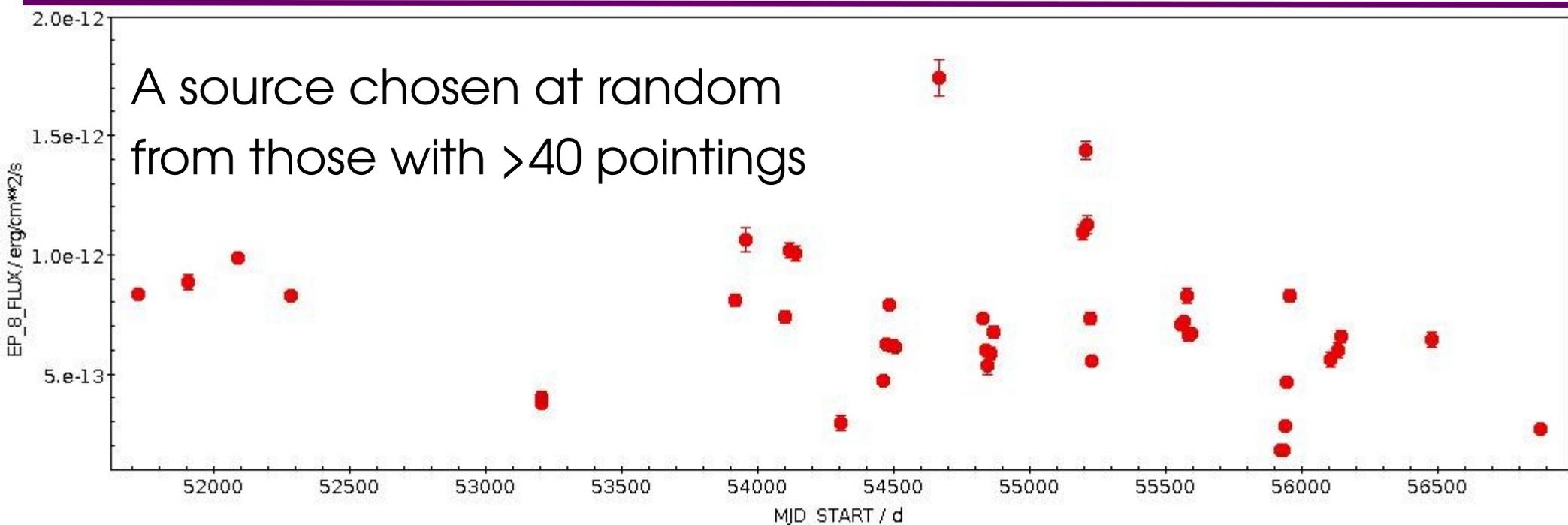
Backup slides





New XMM-Newton stacked catalogue for July (Traulsen et al. 2018)

- Improved signal to noise for stacked sources
- 71951 sources with up to 66 pointings per field, 7543 new sources
- a long-term light curve in all standard XMM-bands

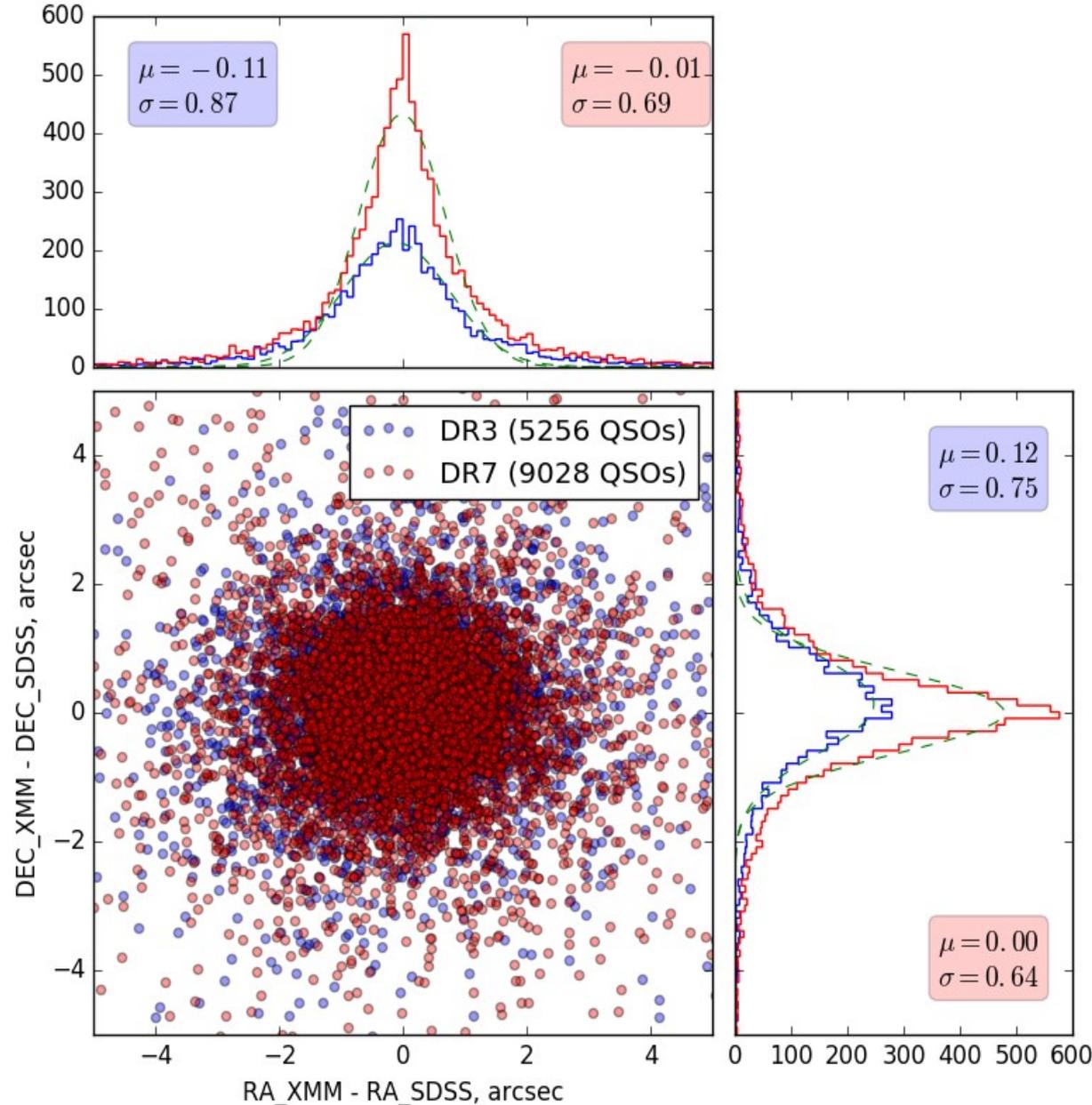


New XMM-Newton stacked catalogue for July (Traulsen et al. 2018)

- Improved signal to noise for stacked sources
 - 71951 sources with up to 66 pointings per field, 7543 new sources
 - a long-term light curve in all standard XMM-bands
- Highly variable sources may be :

- gravitational wave events
- γ -ray bursts
- cataclysmic variables
- tidal disruption events
- supernovae
-
- X-ray binary outbursts
- magnetars

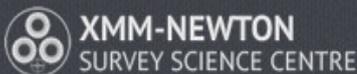




Astrometry

- Cross-match with latest version of SDSS quasars catalogue
- Comparison between 2XMM-DR3 and 3XMM-DR7

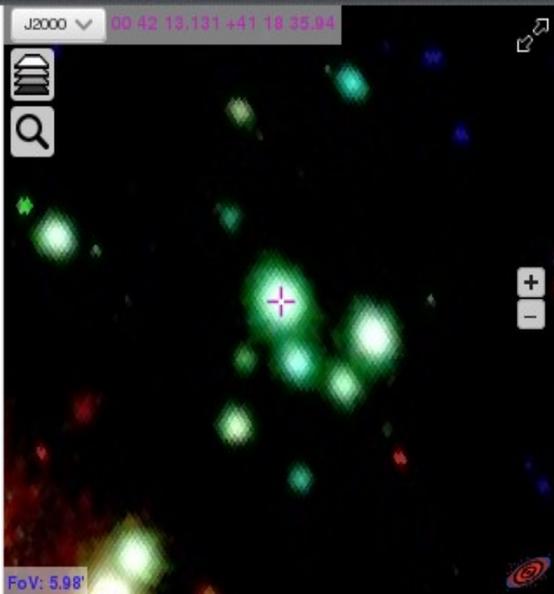
IRAP catalogue server



cone('00 41 41.4','+41 19 17','0.2deg')

SEARCH

Show query language



sc_ep_1_flux	2.83214e-15 ± 8.93324e-17	sc_ep_2_flux	4.15314e-14 ± 3.17139e-16
mjd_first	51720.4884491	sc_ep_3_flux	1.94199e-13 ± 7.02137e-16
mjd_last	56479.4418866	sc_ep_4_flux	2.50582e-13 ± 1.3788e-15
sc_chi2prob	0.00323261	sc_ep_5_flux	8.57917e-14 ± 2.47017e-15
sc_ra	10.5547131248	sc_ep_8_flux	5.55128e-13 ± 3.0474e-15
sc_dec	41.3099819881	sc_ep_8_fmax	1.74306e-12 ± 7.50653e-14
sc_poserr	0.0484553	sc_ep_8_fmin	1.77926e-13 ± 1.00496e-14
sc_det_ml	47769.8	sc_ep_9_flux	4.01314e-13 ± 1.18207e-15
sc_ext_ml	0.0	sc_extent	0.0
sc_fvar	0.252154 ± 0.0542623	sc_hr1	0.86285 ± 0.00386822
sc_hr2	0.629318 ± 0.00244231	sc_hr3	-0.341634 ± 0.00264739
sc_hr4	-0.808007 ± 0.00395566	sc_sum_flag	1
sc_var_flag	False	confused	False

This source in external databases: [XCatDB](#), [Chandra CSC 20" VO Table](#), [Swift 1SXPS 20"](#), [RCSED](#), [Simbad 2'](#), [VizieR 20"](#), [NED 2'](#)

Detections (observations of this source at different epochs)

detid	revolut	obs_id	src_num	poserr	ep_8_flux	utc_start	exptime	ep_offax	spectrum
101125704010012	0100	0112570401	12	0.329335	8.36703e-13	2000-06-25 11:43:22.000	31232	5.27103	True (Fit spectrum)
101125706010013	0193	0112570601	13	0.327963	8.83526e-13	2000-12-28 00:51:02.000	9849	5.96841	True (Fit spectrum)
101092701010011	0285	0109270101	11	0.223599	9.89186e-13	2001-06-29 06:59:13.000	52508	5.30718	True (Fit spectrum)
101125701010013	0381	0112570101	13	0.33079	8.2724e-13	2002-01-06 18:44:42.000	61198	6.07995	True (Fit spectrum)
102022302010031	0843	0202230201	31	0.266496	4.0448e-13	2004-07-16 16:40:09.000	18335	4.27041	True (Fit spectrum)
102022303010030	0843	0202230301	30	0.276143	4.00074e-13	2004-07-17 12:30:57.000	23196	4.26273	True (Fit spectrum)

SUSS 3.0

Field of view coincides with 3XMM FOV

6,880,116 detections

4,751,899 unique sources

867,022 have multiple entries

Visible (U, B and V) and UV (UVW1, UVM2 and UVW2)

Detections down to AB magnitude:	FWHM (")
UVW2~ 23.0	1.98
UVM2~ 24.1	1.8
UVW1~ 24.8	2.0
U ~ 25.2	1.55
B ~ 24.0	1.39
V ~ 23.4	1.38