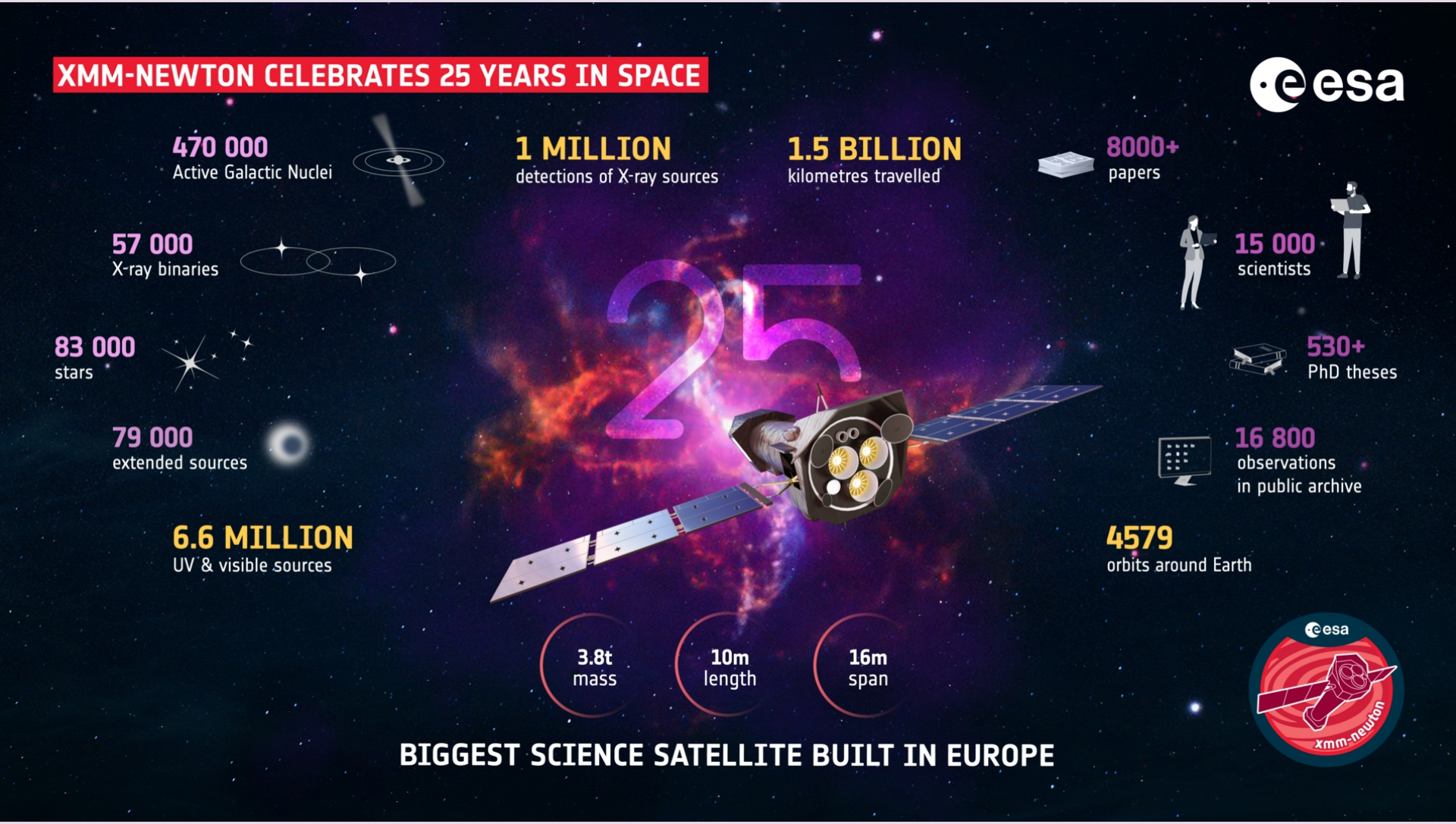
XMM-Newton catalogues & products in the years to come

Natalie Webb, IRAP, Toulouse, France

For the XMM-SSC and XMM2ATHENA

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101004168



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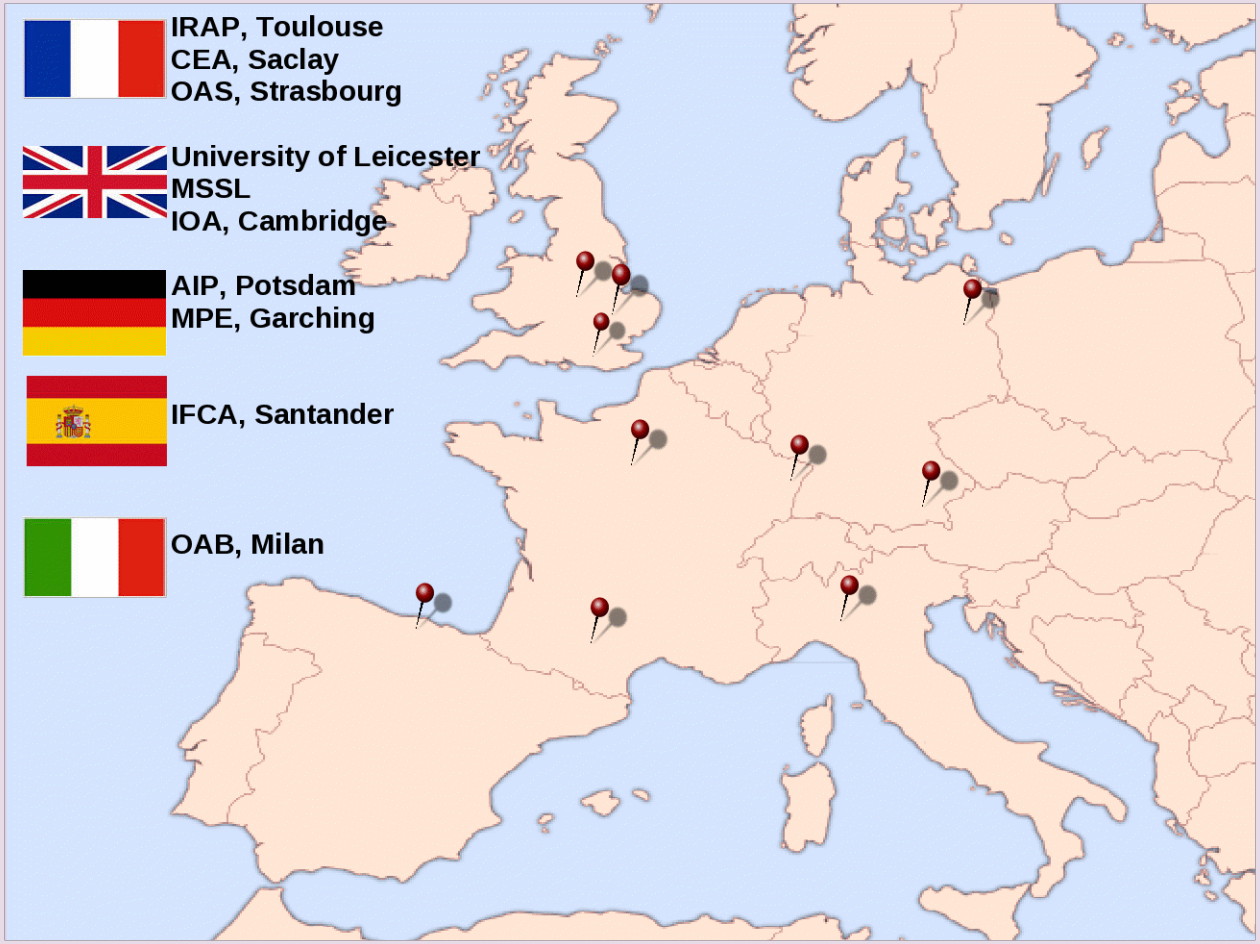
WHAT IS THE XMM-NEWTON SURVEY SCIENCE CENTRE & XMM2ATHENA ?

- **The XMM-Newton Survey Science Centre was selected by ESA in 1995 to ensure the scientific community can exploit XMM-Newton data**
- **Development of science analysis system (SAS)**
- **Pipeline processing of XMM-Newton obs.**
- **Identification of XMM serendipitous sources**
- **Compilation of the Serendipitous Source Catalogue**
- **XMM2ATHENA was a Horizon 2020 project (Apr. 2021-Sep. 2024) to improve and publicise XMM catalogues & prepare for Athena**



http://xmmssc.irap.omp.eu

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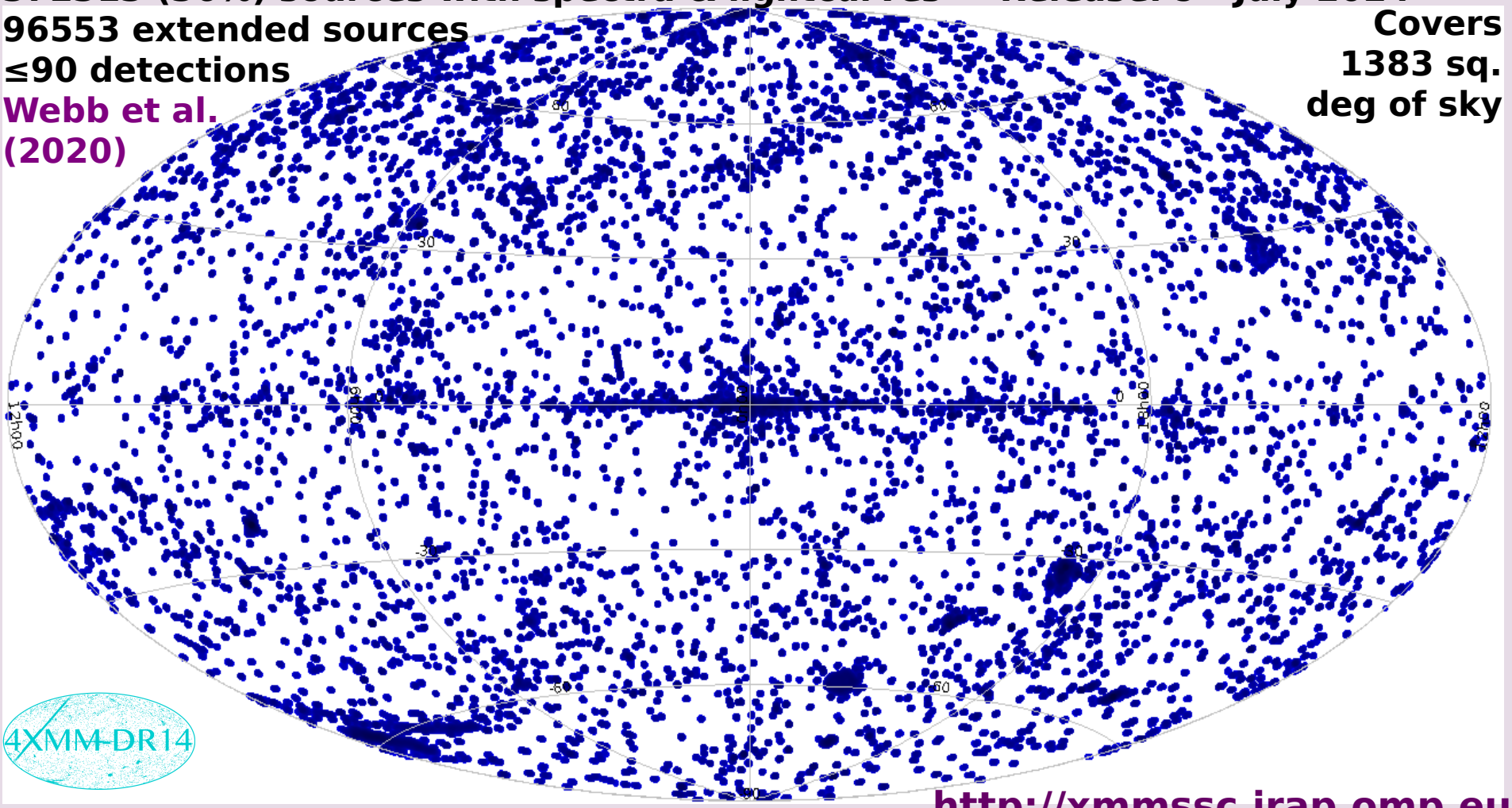
4XMM-DR14

1035832 detections, 692109 unique sources
372313 (36%) sources with spectra & lightcurves **Release: 9th July 2024**
96553 extended sources
≤90 detections
Webb et al. (2020)

Covers 1383 sq. deg of sky



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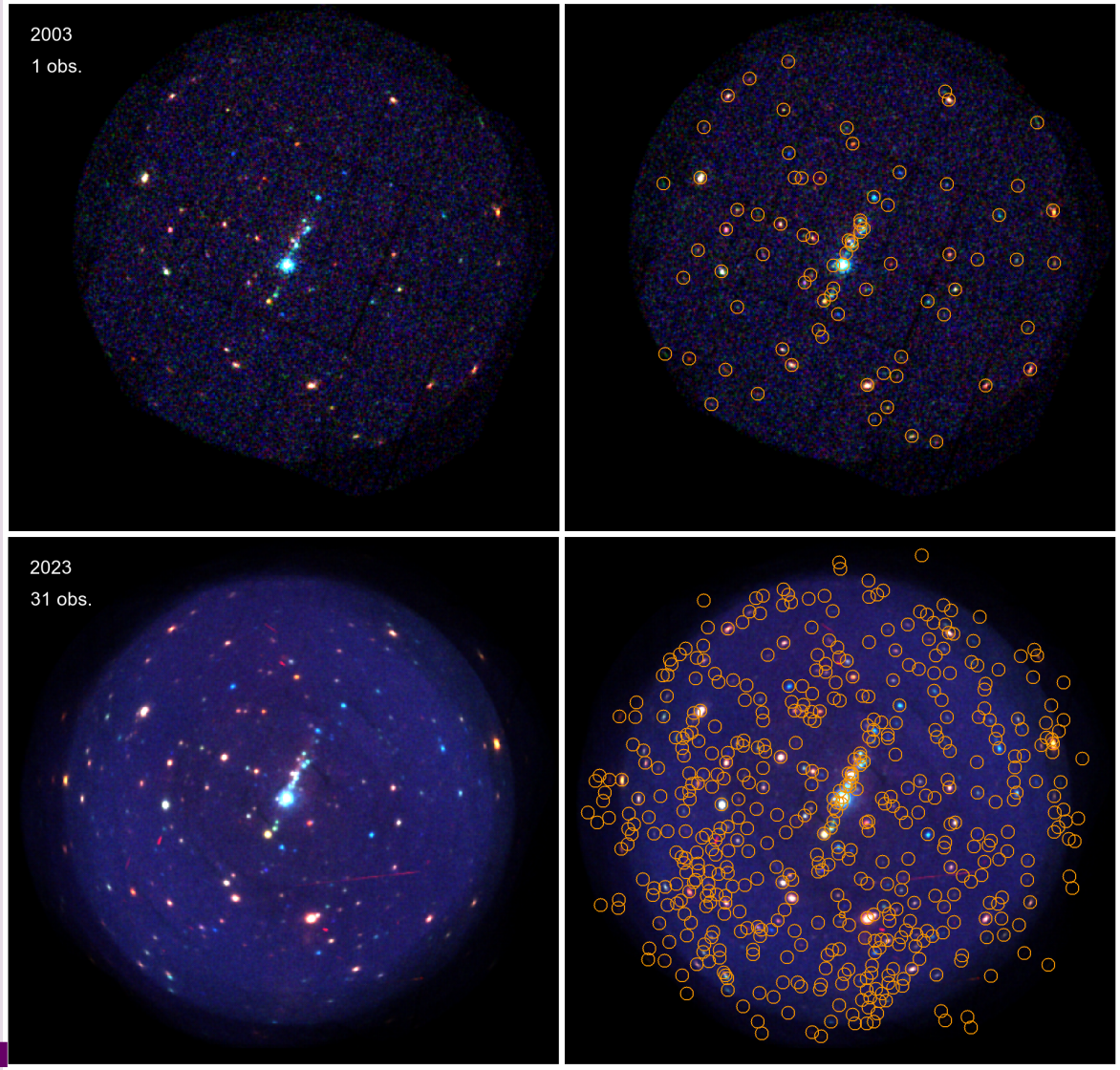
4XMM-DR14S

- 4XMM-DR14s
- 1751 stacks
- 10336 observations
- 427524 sources
- ~20% new sources with respect to 4XMM-DR14
- Released 9th July 2024
- With both catalogues, a similar number of sources to eRosita

Traulsen et al. (2020)



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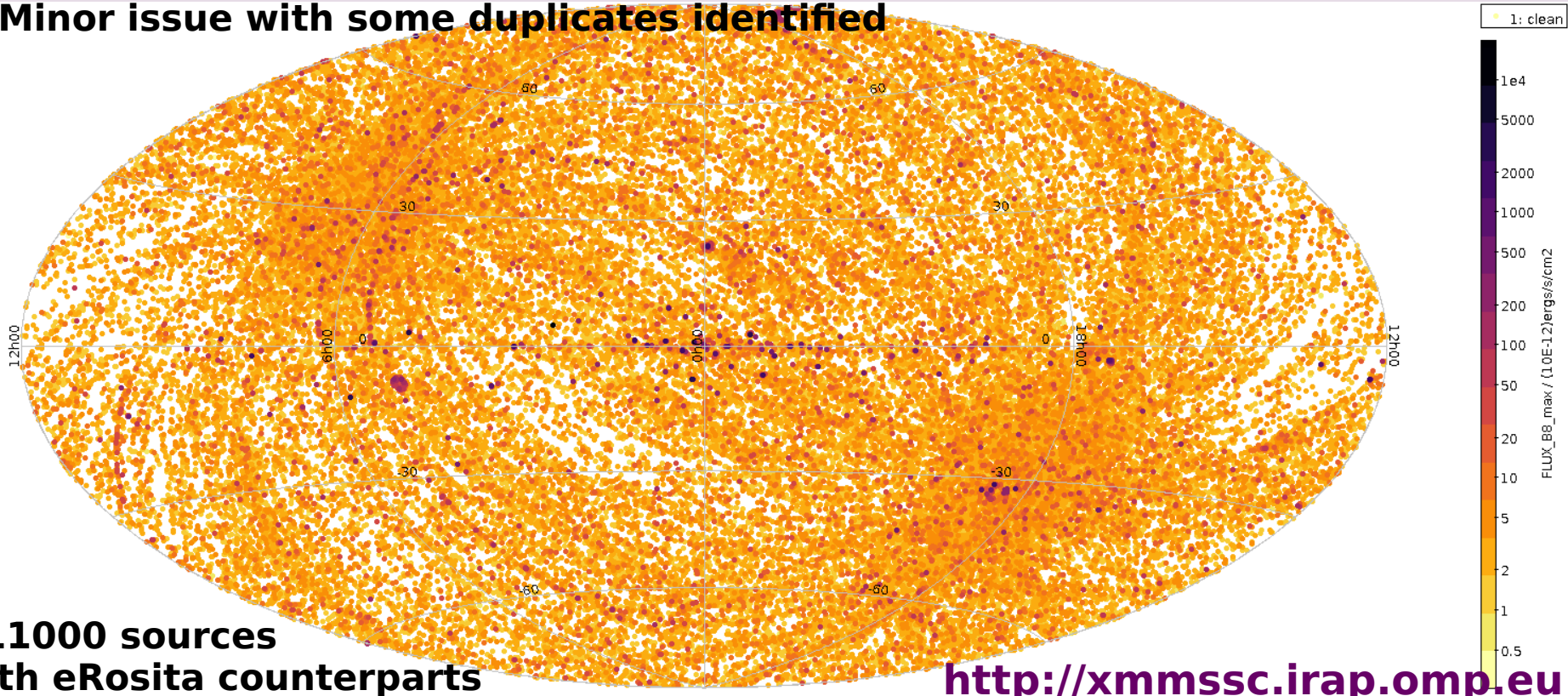
SLEW CATALOGUE, XMMSL3

- **Period : August 2001-August 2023 – almost 10 yr extra data**
- **140735 detections (68383 new detections), 116598 unique sources**
- **Source detections up to 78 times**
- **Covers 93.7 % of sky. Median flux (0.2-12.0 keV) : 2.7 × 10^{-12} erg cm^{-2} s^{-1}**
- **Release : 19th February 2025**
- **Minor issue with some duplicates identified**



~11000 sources with eRosita counterparts

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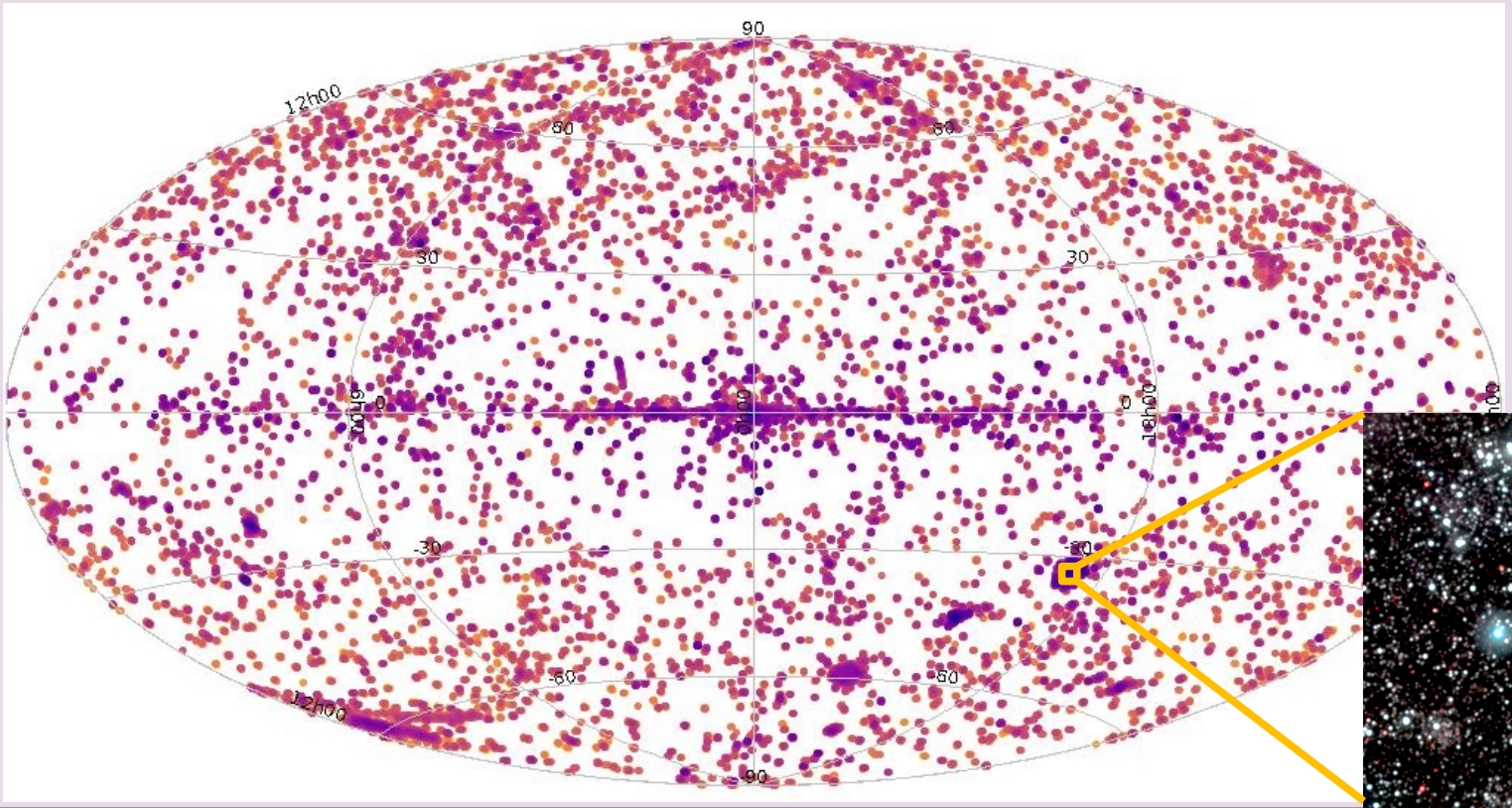
OM CATALOGUE SUSS 6.2

- **Period : February 2000 - November 2022**
- **9.9 million detections, 6.7 million sources, 1.2 million with multiple entries**
- **80 % sources in Gaia**
- **UVW2, UVM1, UVW1, U, B, V (down to ~23rd magnitude)**



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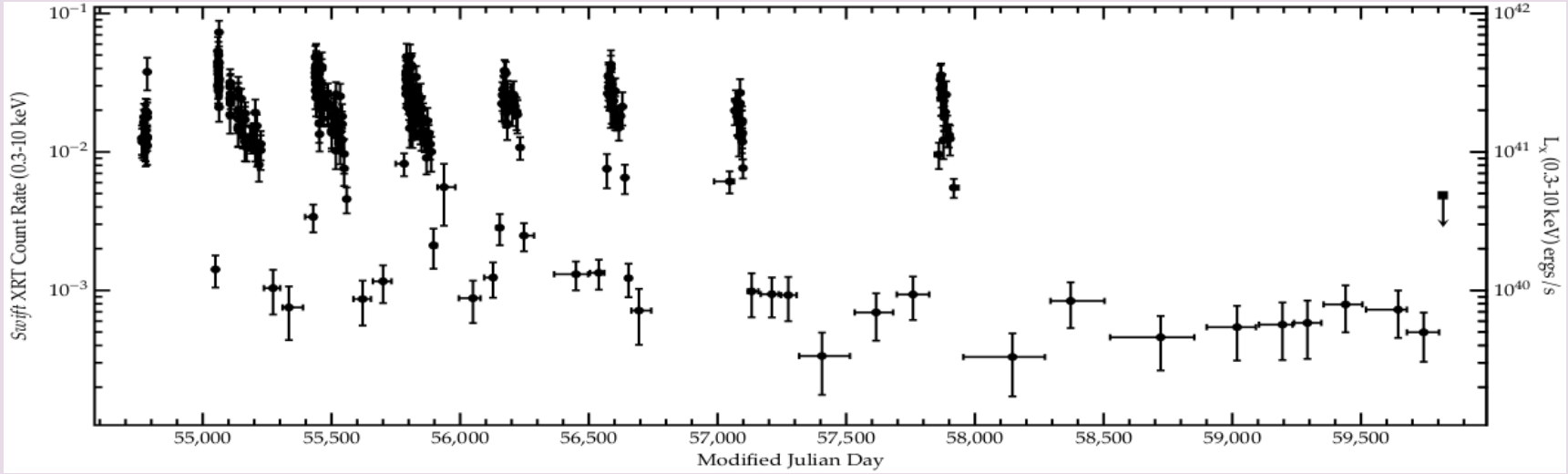
DISCOVERIES IN THE CATALOGUES

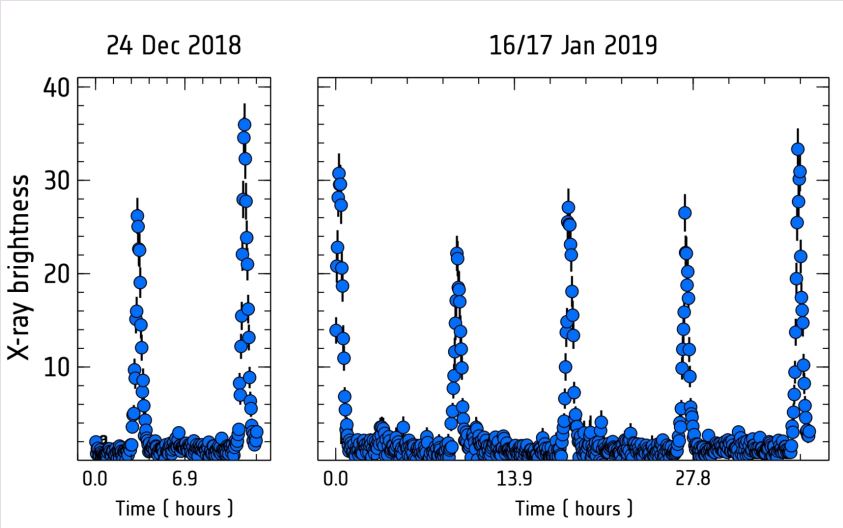
ESO 243-49 HLX-1, Partial tidal disruption event (Farrell, Webb et al. 2009)



GSN 069

Quasi Periodic Eruptions

(Miniutti et al. 2019)



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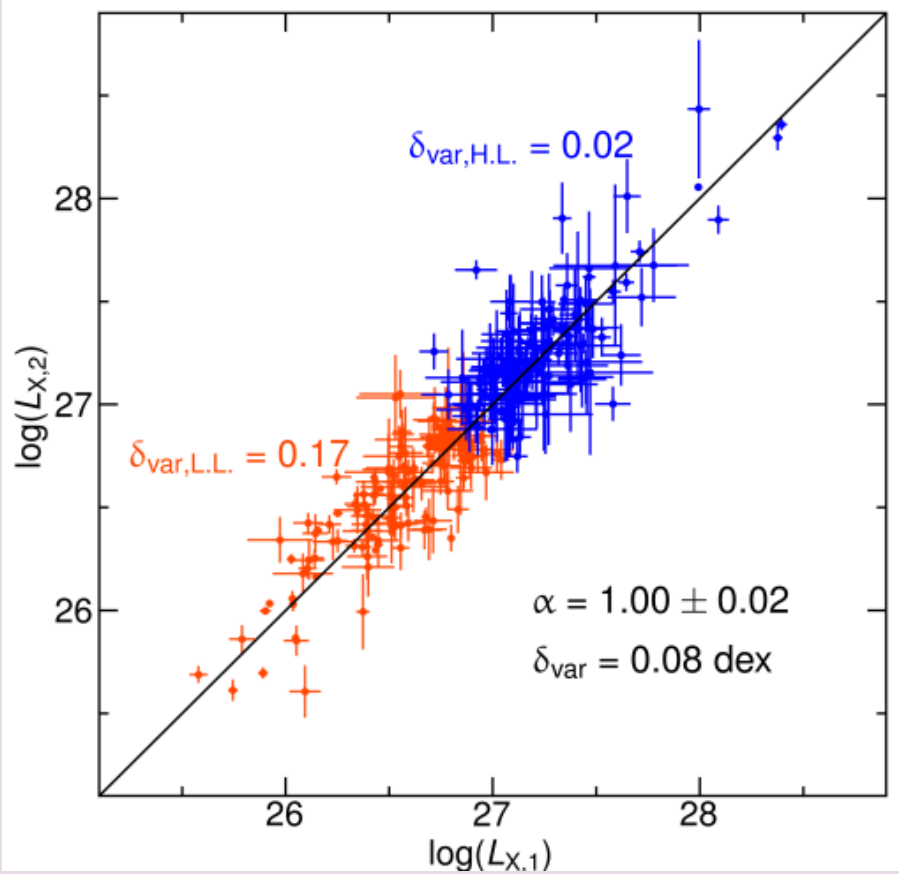
USES OF THE CATALOGUES

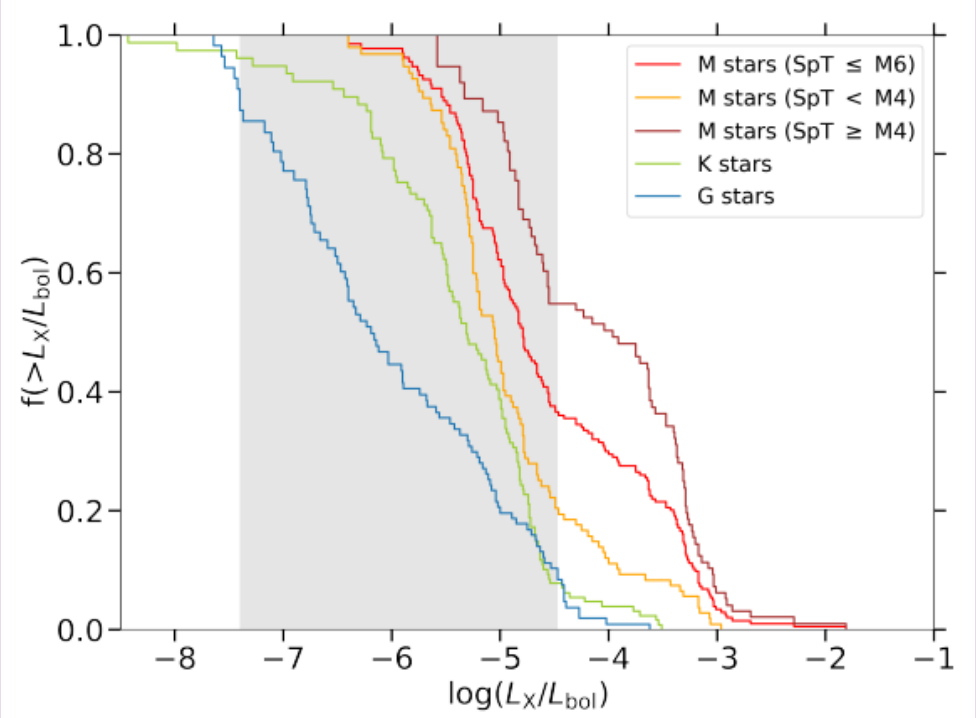
Using quasars as standard candles

(Signorini et al. 2024)



Evaluating stellar activity to determine exoplant habitability

(Zhu & Preibisch 2025)



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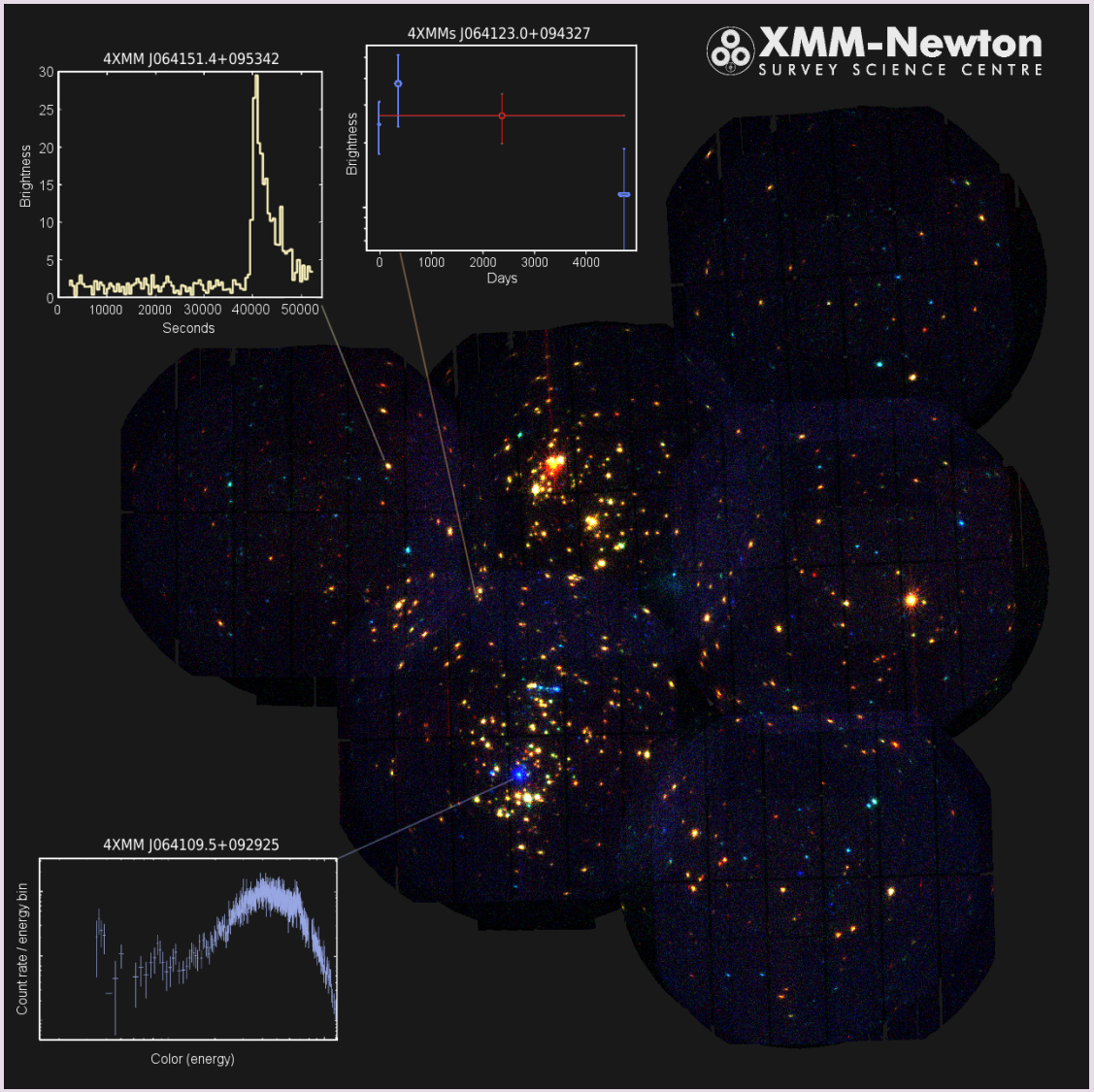
WHAT CAN WE DO BETTER ?



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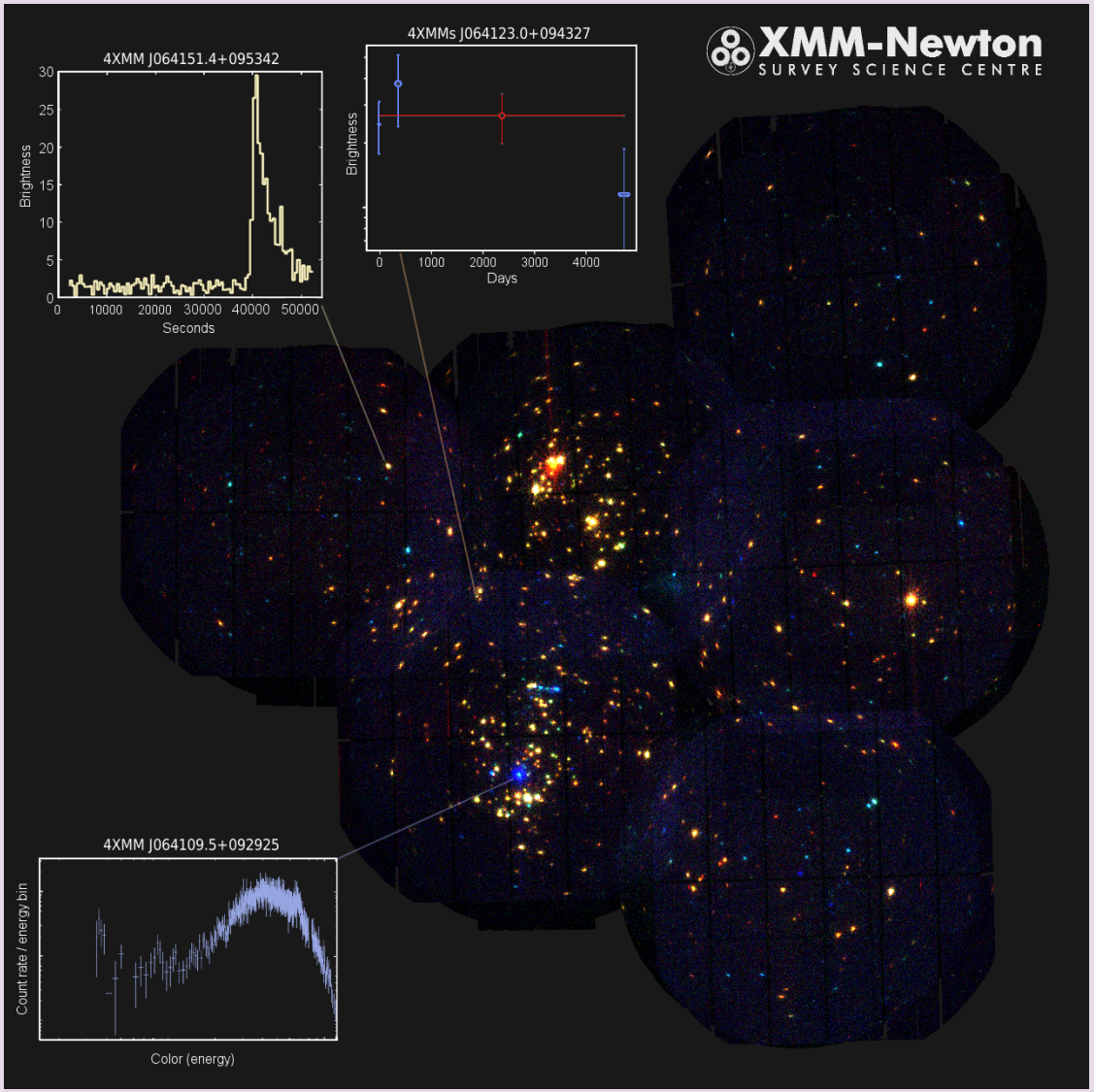
What is this source ?



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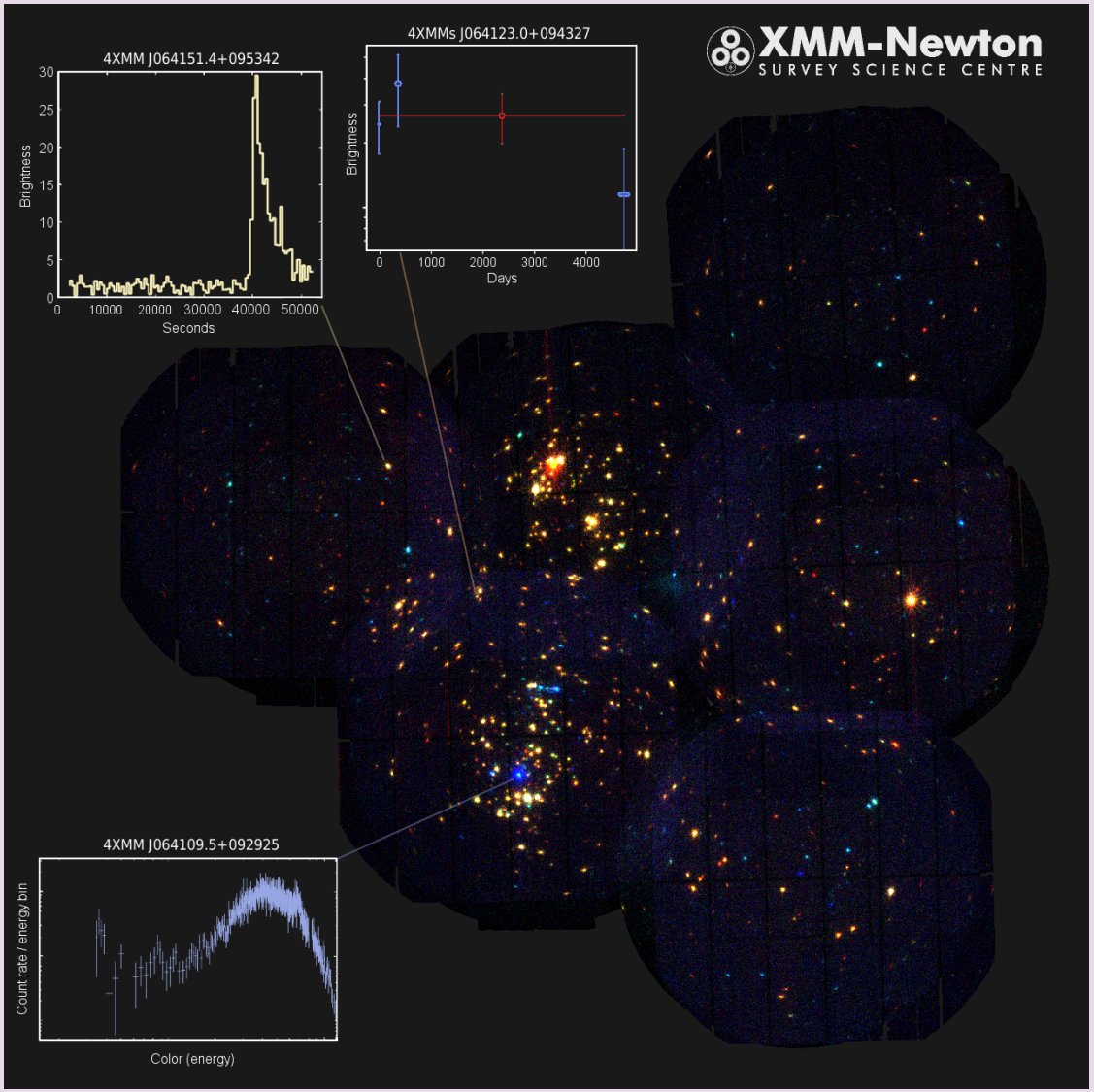

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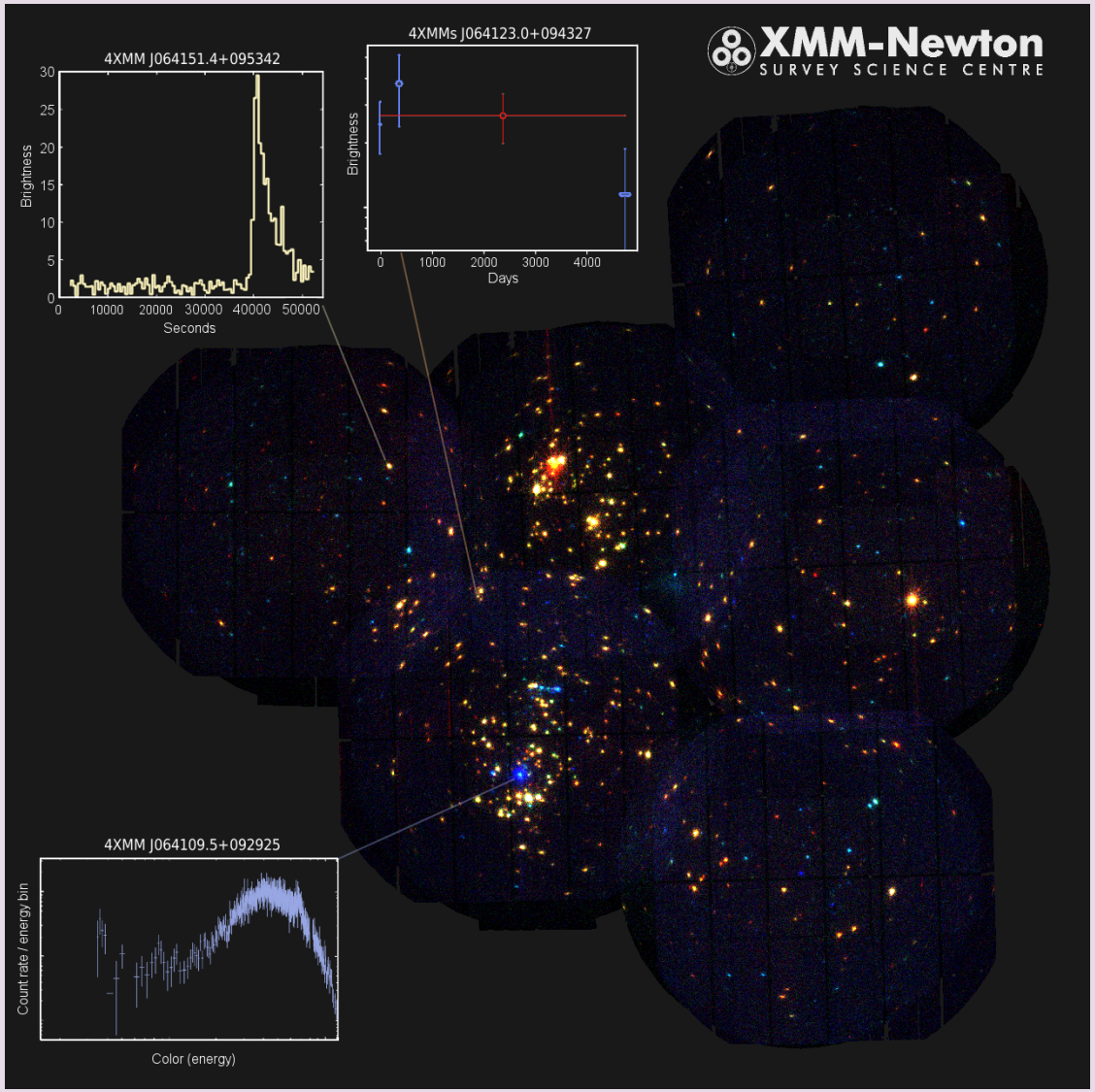

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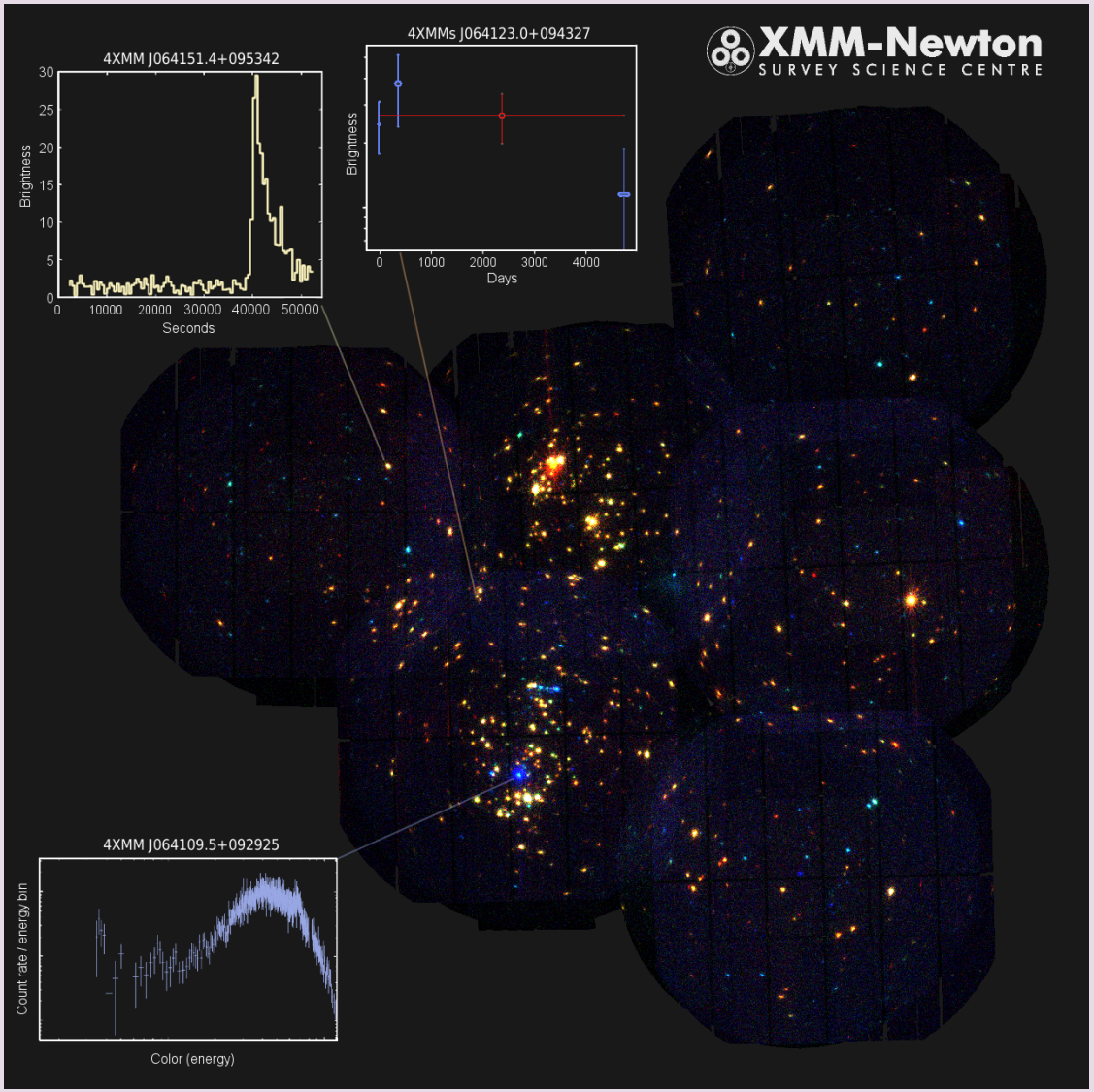

What does the X-ray spectrum look like ?

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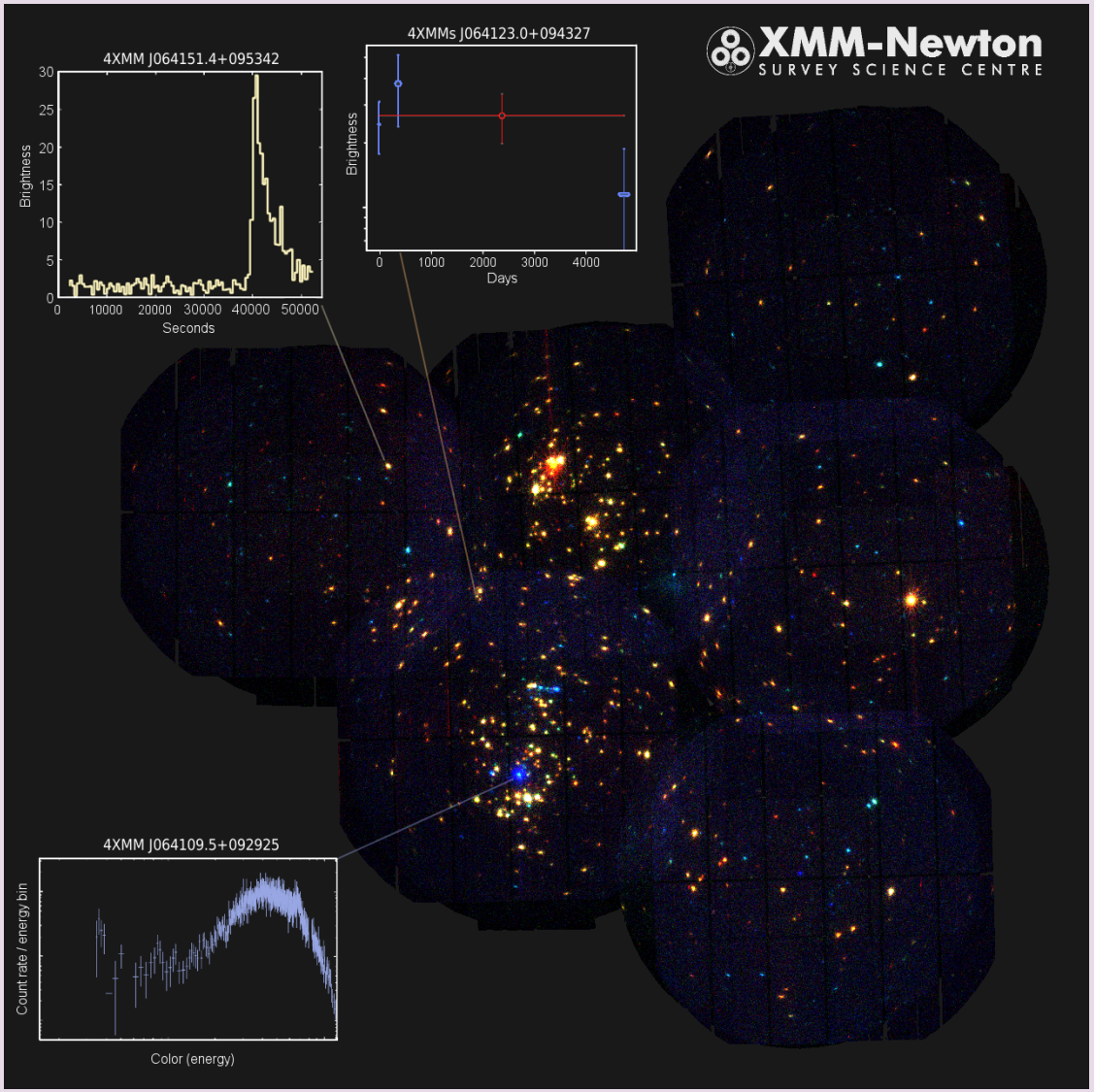

What does the X-ray spectrum look like ?

How far away is it ?

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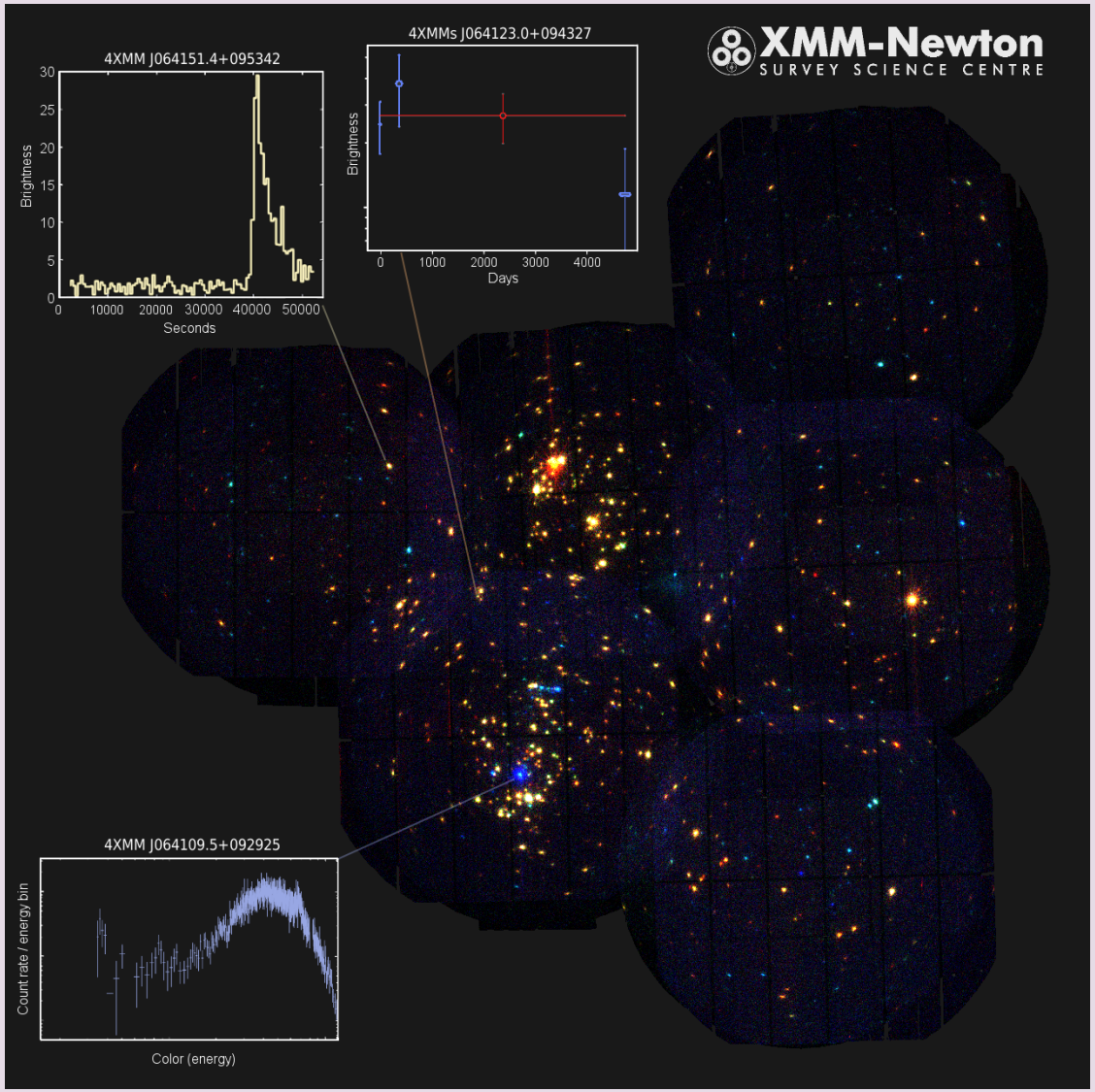

What does the X-ray spectrum look like ?

How far away is it ?

Can we detect new fainter sources ?

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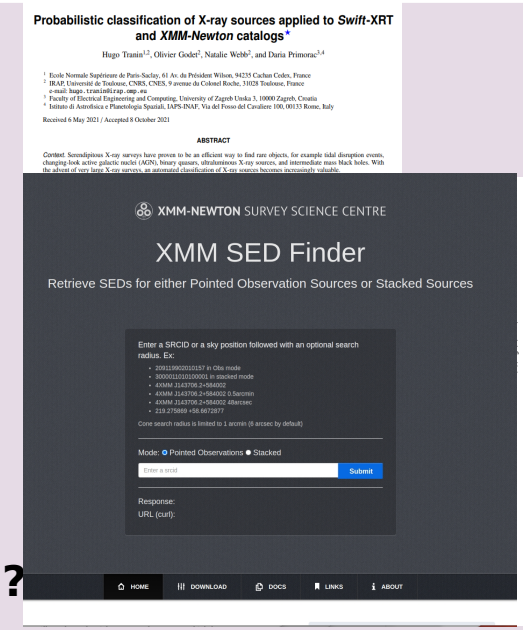
WHAT CAN WE DO BETTER ?

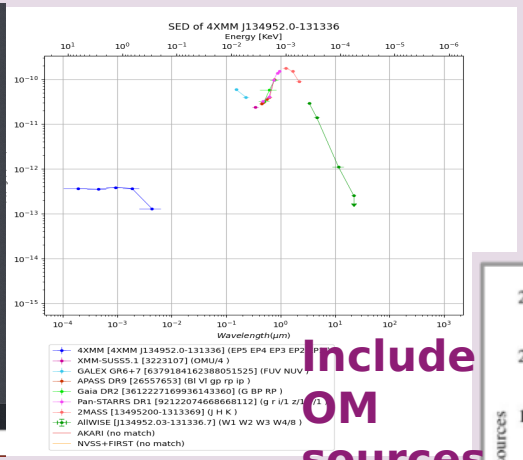
What is this source ? ✓
Classification (Tranin et al. 2022)


Probabilistic classification of X-ray sources applied to *Swift*-XRT and *XMM-Newton* catalogs*

Hugo Tranin[1,2], Olivier Godet[2], Natalie Webb[2], and Daria Primorac[3,4]

ABSTRACT

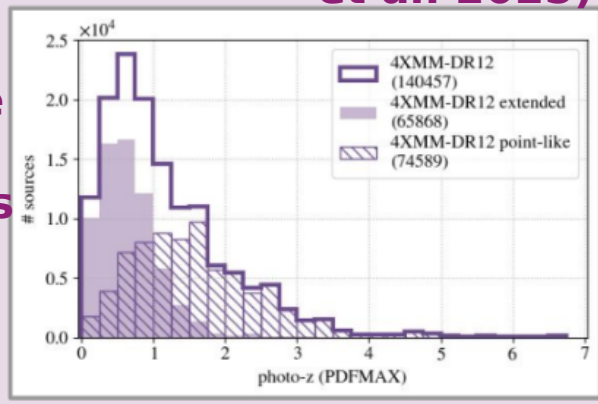
What does it look like at other wavelengths ? ✓



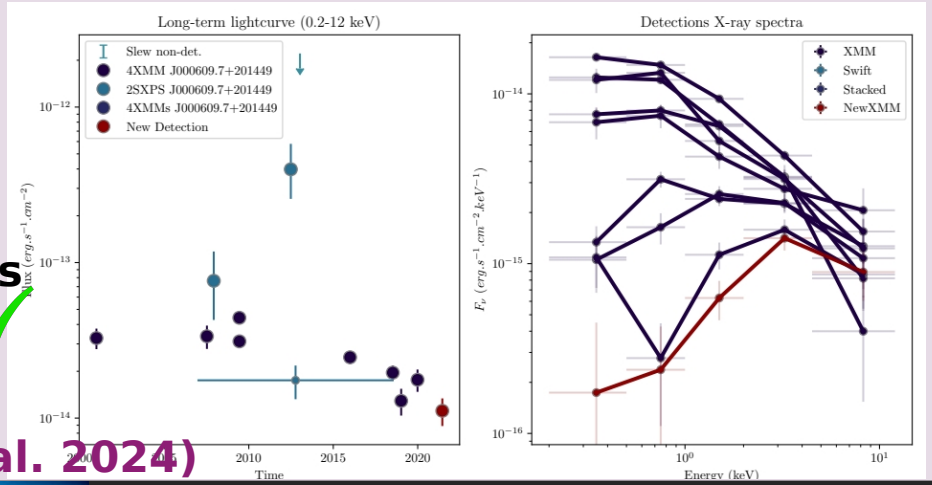
Include OM sources

What does the X-ray spectrum look like ? ✓
Spectral fitting (Mountrichas et al. 2022)

How far away is it ? ✓
(Pouliasis et al. 2025)



Has it always looked this way or does it change ? ✓
(Quintin et al. 2024)



Can we detect new fainter sources ? ✓
Improved stacking (Pires et al. 2024) & search for faint bursts (Khan et al. 2025)

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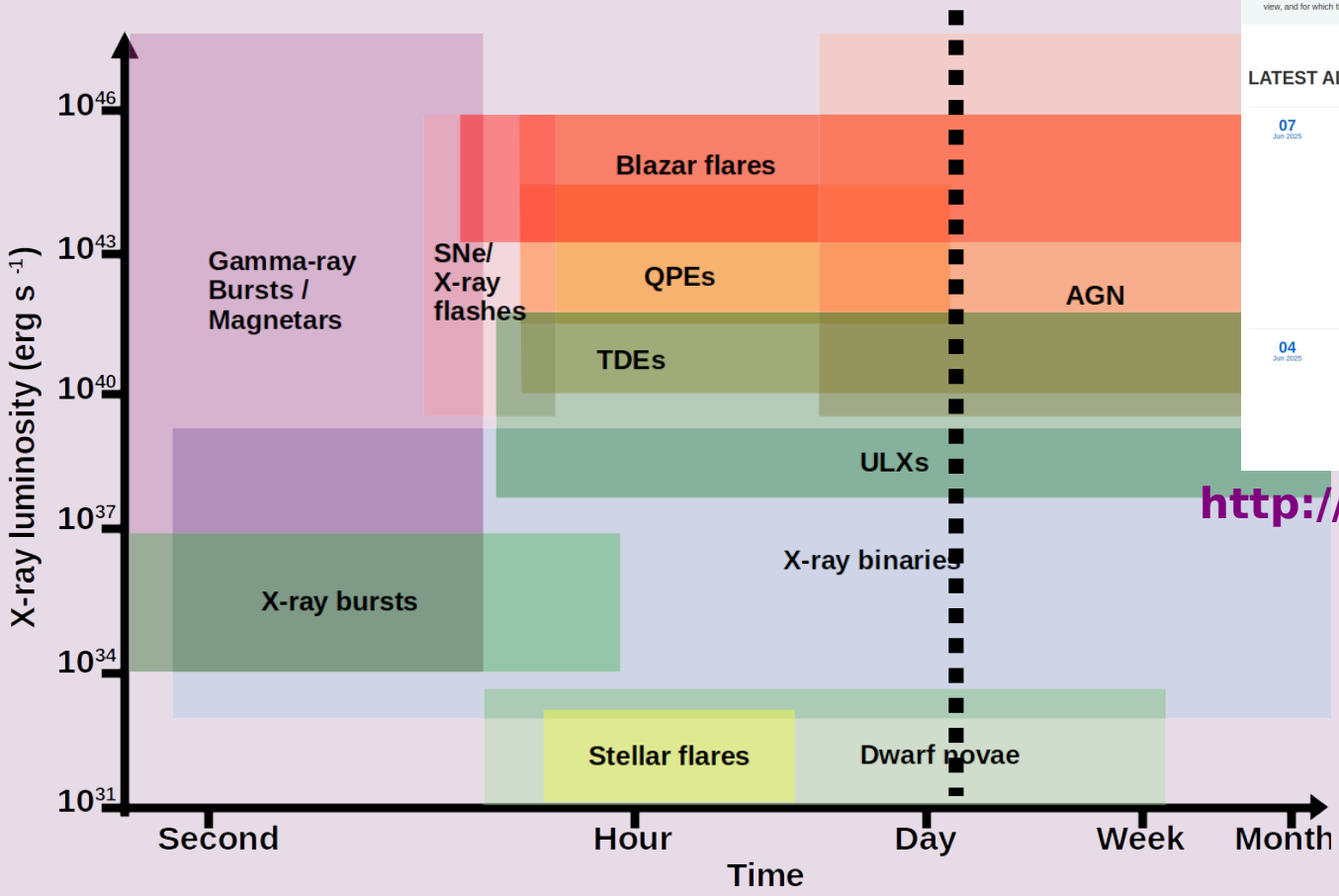
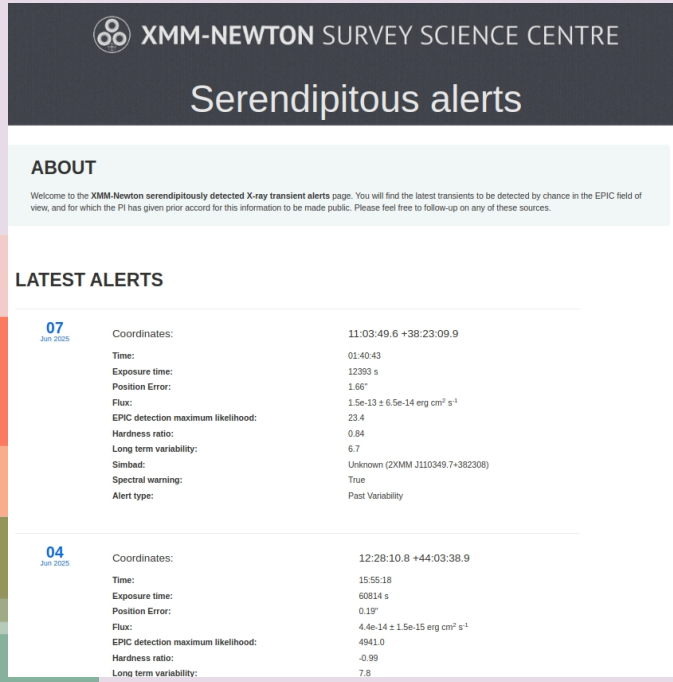
QUASI REAL-TIME ALERTS
IF PRIOR PERMISSION FROM PI





http://flix.irap.omp.eu/stonks

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5XMM

- **Significant development to prepare for reprocessing**
- **SOC re-reprocessed all 17199 observations ready for production of 5XMM**
- **Catalogue simplified, one single stacked catalogue, with ~450 columns**
- **To include :**
  - **OM + multi-wavelength counterparts**
  - **upper limits**
  - **long-term variability information + OM variability**
  - **spectral fits**
  - **classifications**
  - **photometric redshifts**
- **Expected for early 2026**

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CONCLUSIONS

- **25 years of XMM-Newton has provided a plethora of data and great tools**
- **Results from stars, planets, X-ray binaries, galaxies+clusters, supernovae, …**
- **New software and tools available & 5XMM coming in 2026**
- **Alerts now available for long-term transients**

Here's to many more years of XMM-Newton !

…and looking forward to NewAthena !

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BACK UP SLIDES

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IMPORTANCE OF DATA EXPLOITATION

Estimate of the carbon footprint of astronomical research infrastructures

2022, Nature Astronomy, Volume 6, p. 503-513

Jürgen Knödlseder[1], Sylvie Brau-Nogué[1], Mickael Coriat[1], Philippe Garnier[1], Annie Hughes[1], Pierrick Martin[1] & Luigi Tibaldo[1]

worldwide active astronomical research infrastructures currently have a carbon footprint of 20.3±3.3 $MtCO_2$ equivalent (CO_2e) and an annual emission of 1,169±249 $ktCO_2e\ yr^{-1}$ corresponding to a footprint of 36.6±14.0 tCO_2e per year per astronomer. Compared with contributions from other aspects of astronomy research activity, our results suggest that research infrastructures make the single largest contribution to the carbon footprint of an as-

Note : average carbon footprint / European / year : ~8 tCO_2

Findings include :

- Operations are ~1-2 % of carbon footprint of typical space based mission

- More comprehensive exploitation of data limits carbon footprint

=> Longevity of XMM-Newton coupled with intense archive exploitation reduces carbon footprint of X-ray astronomy in Europe ☺

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