The stellar population in the XMM-Newton slew survey

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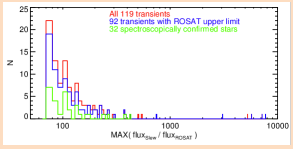
ABSTRACT:

We search for stars among XMM-Newton slew transients. The source identification process comprises a systematic search for multi-wavelength photometry using VO tools and dedicated spectroscopic follow-up.

Sample selection from XMMSL1 DR3 catalog:

1.) count rate in XMM slew
> 70 times ROSAT count rate
2.) during slew >6 counts in soft band (0.2-2 keV)
3.) remove obvious extragalactic sources
→ 119 X-ray transients



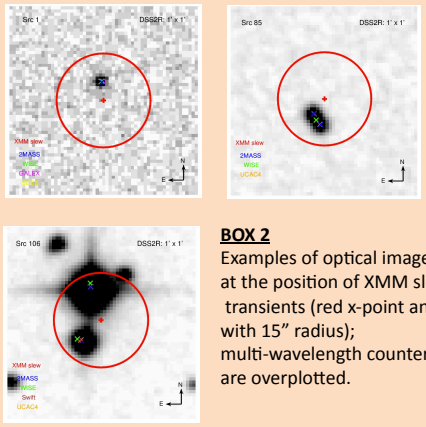
BOX 1
Maximum of flux ratio between XMM slew soft band and ROSAT; most objects have only an upper limit in ROSAT. Green is the distribution for confirmed stars from our spectroscopic follow-up (see BOX 3).

Photometric multi-wavelength counterparts:

• search in 2MASS, WISE, GALEX, Swift, SDSS, UCAC4, Tycho2 and NVSS using TOPCAT with match radius of 15"

--> 72 X-ray sources have a single counterpart,
42 X-ray sources have more than one counterpart,
5 X-ray sources have no counterpart

• selection of unique counterpart to the X-ray source aided by visual inspection of images and catalogued positions in ALADIN (see BOX 2)



BOX 2
Examples of optical images at the position of XMM slew transients (red x-point and error box with 15" radius); multi-wavelength counterparts are overplotted.

In cases with more than one possible identification we selected the one with a Swift or GALEX counterpart, if there is no such counterpart then we selected the brightest 2MASS or WISE object.

Optical spectroscopy:

• 34 slew transients observed with the R1000B grism of OSIRIS@GTC (wavelength range ~ 3600-7500Å, R~1000) (see BOX 3)

• deriving spectral types by comparison to templates from the "MILES library" (http://miles.iac.es)

Analysis:

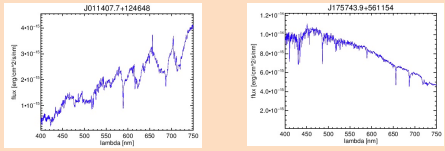
• photometric distance from V, J mags for 61 transients and spectroscopic distance for 32 transients (with calibrations from "Allen's Astrophysical Quantities", Cox 2000); photometric spectral type from V-J for 41 transients (see BOX 3)

• spectral energy distribution with VOSA yields T_{eff} and L_{bol} for stellar counterparts (see BOX 4)

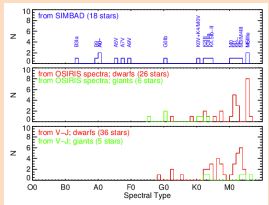
• color-color and color-magnitude diagrams separate stars from other astronomical objects (see BOX 5)

• X-ray flux from different satellites compared in BOX 6

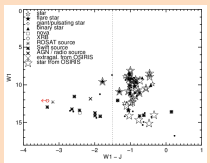
BOX 3
Examples of OSIRIS spectra



Spectral type distribution:



Spectroscopically we find 19 M-stars, 9 K-stars, 4 FG-stars, and 2 extragalactic objects. 16 of these have no entry in SIMBAD, 7 were only known as "1RXS J" source. We discriminate between dwarfs and giants for objects without spectroscopy using the distance and log L_x derived from the V-J color.



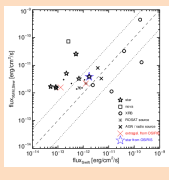
BOX 5
Color-magnitude and color-color diagrams from WISE and 2MASS photometry

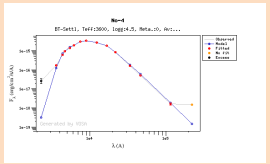
Late-type stars confirmed with OSIRIS spectroscopy are highlighted (large star symbols), extragal. objects identified with OSIRIS are large crosses; other source info from SIMBAD. Upper limits in W4 = red, upper limits in W3 = yellow

- W1-J separates stars from "other objects"
- 3 confirmed stars have WISE excess (disks)

BOX 6
X-ray flux measured in the XMM slew and with Swift

The flux limit of the slew is ~ 10^{-12} erg/cm²/s
Most transients were caught during a flare in the slew.





BOX 4
Example of SED fit with VOSA.

Data points indicated as "excess" (black) and upper limits (yellow) are not considered in the fitting process.
Y-axis shows flux observed at Earth.

SED fits yield T_{eff} but are insensitive to gravity and metallicity.

Poster presented at `The X-ray Universe 2014', 16-19 Jun 2014, Dublin, Ireland

Background image: XMM-Newton X-ray slew tracks (courtesy A.Read)

ACKNOWLEDGMENT: *This publication makes use of Virtual Observatory tools.*
• TOPCAT (Taylor M.B. 2005, ASPC 347, 29)
• ALADIN (Bonnarel et al. 2000, A&AS 143, 33)
• VOSA (Bayo et al. 2008, A&A 492, 277; Rodriguez et al. 2014, 485, 321)