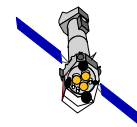


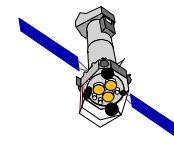
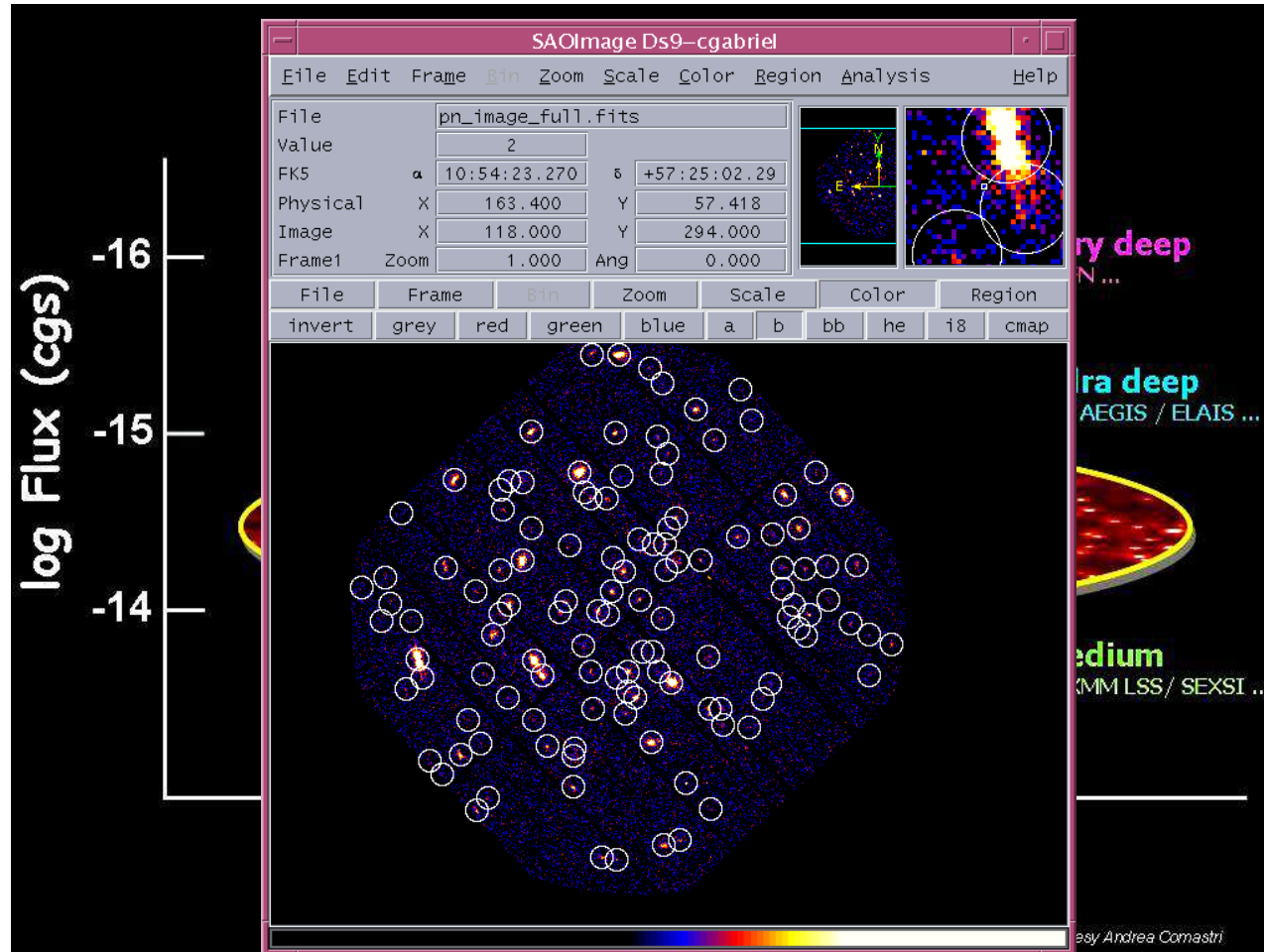
# EPIC source catalogues

Richard Saxton

June 2013



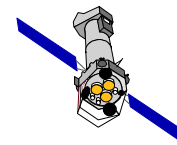
# 2XMM – serendipitous sources cat



# 2XMM: Creation process

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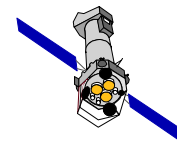
- Uniform pipeline processing of all public observations
- Combine detection of sources in all EPIC cameras simultaneously with ML method to maximise sensitivity
- Visual screening to remove obvious spurious sources
- Cross-correlation with standard catalogues (USNO, Rosat 2mass etc.)
- Merge all observations into one catalogue
- First released in August 2007 (increments every year, currently DR3)
- Source-specific products (spectra, lightcurves) produced for brighter sources (>500 counts in combined image)



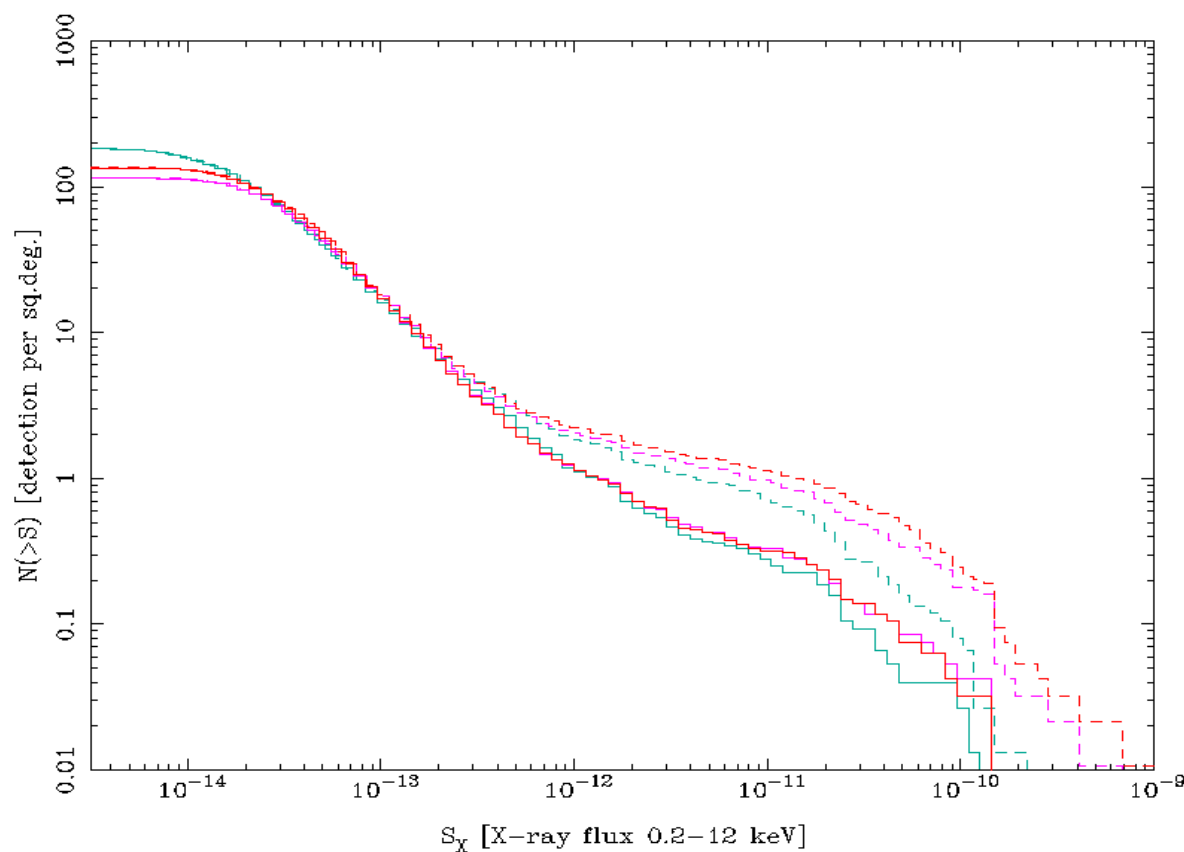
# 2XMMi-DR3: statistics

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- ④ 4953 observations.
- ④ ~353000 detections in total.
- ④ ~263000 unique sources
- ④ ~30500 X-ray sources appear extended
- ④ ~median flux is  $F_{2-10} = 1.4 \times 10^{-14}$  ergs s<sup>-1</sup> cm<sup>-2</sup>
- ④ 20% have  $F_{0.2-12} < 1 \times 10^{-14}$  ergs s<sup>-1</sup> cm<sup>-2</sup>
- ④ Minimum flux  $\sim 1.0 \times 10^{-15}$  ergs s<sup>-1</sup> cm<sup>-2</sup>
- ④ Total area independently covered = 504 deg<sup>2</sup>
- ④ Astrometry generally good to  $\sim 1$  arcsec
- ④ 56000 sources have spectral products extracted

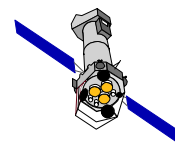


# Source flux distribution

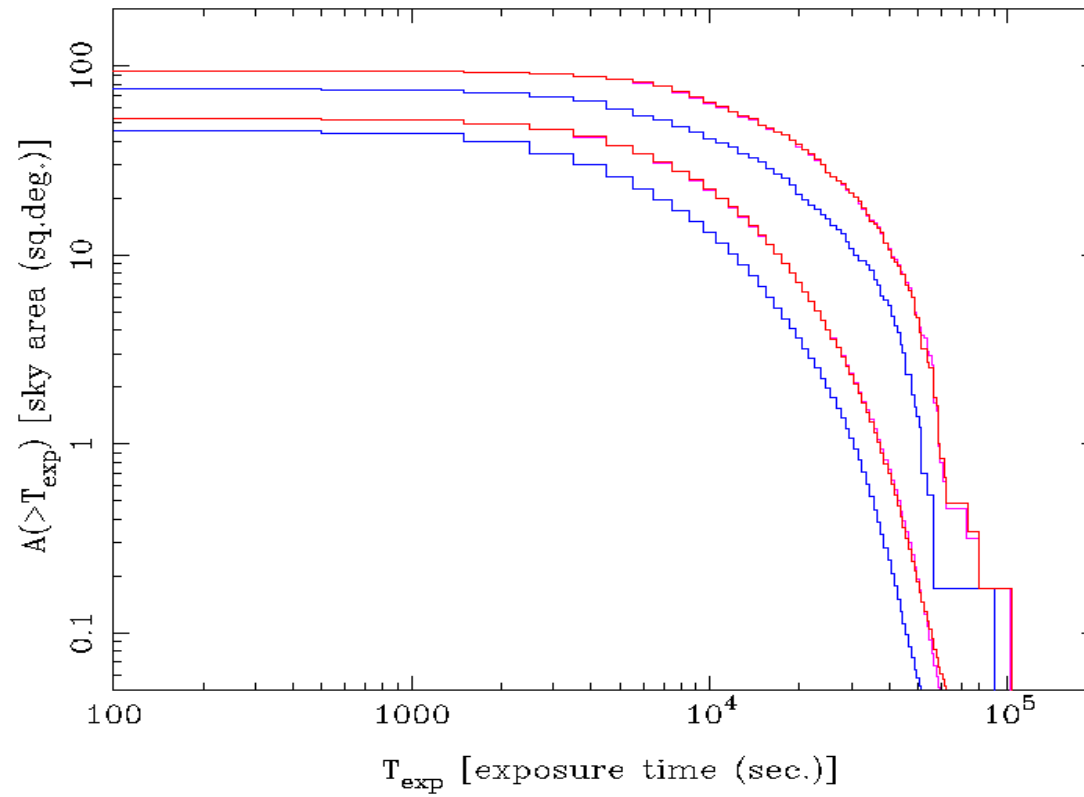


Log n - Log s curves for  
pn (red), Mos-1 (purple)  
and Mos-2 (grey).

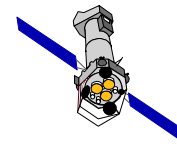
Dashed curves include  
the observation targets.



# Sky Area



Area covered by catalogue:  
upper curves are the nominal  
values for MOS and EPIC-pn;  
lower curves correct for field  
overlaps and vignetting.

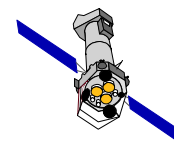


# Important columns

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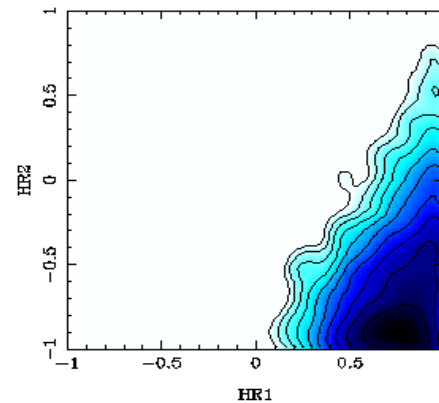
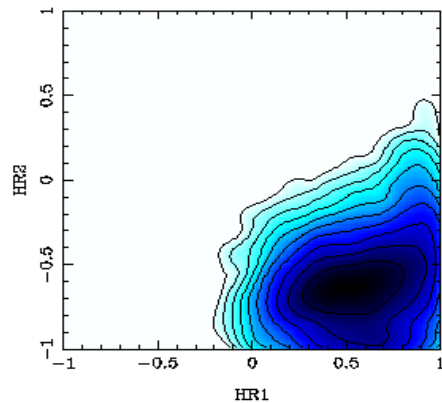
2XMM 010230+640102 - IAU source name  
RA\_CORR, DEC\_CORR, LII,BII - standard coords.  
EP\_DET\_ML - maximum likelihood for source  
EP\_FLUX, EP\_FLUX\_ERR - 0.2-12 keV flux  
M1\_n, M2\_n, PN\_n - count rate in band 'n' in each camera  
CAT\_NAME\_1 - cross-correlation results

Band	Energy (keV)
1	0.2 – 0.5
2	0.5 – 1.0
3	1.0 – 2.0
4	2.0 – 4.5
5	4.5 – 12.0



**XMM-Newton**  
Richard Saxton

# Hardness ratios

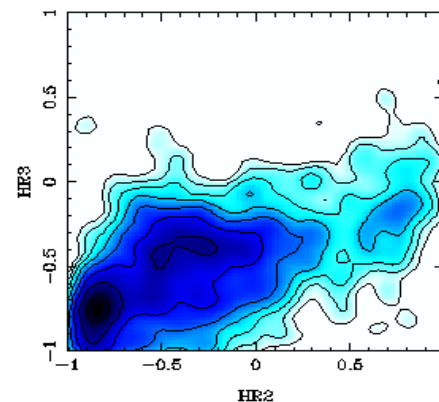
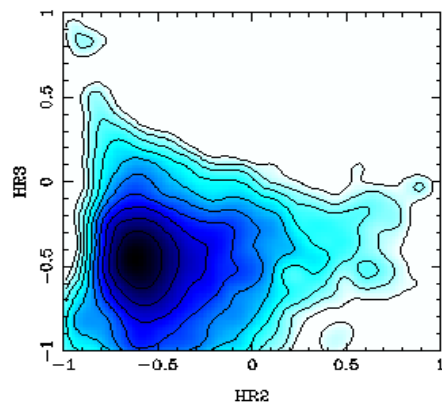


The bulk spectral properties of the EPIC\_pn catalogue detections.

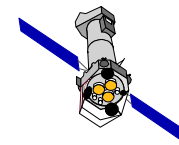
$$\text{HR1} = (F2 - F1) / (F2 + F1)$$

$$\text{HR2} = (F3 - F2) / (F3 + F2)$$

$$\text{HR3} = (F4 - F3) / (F4 + F3)$$

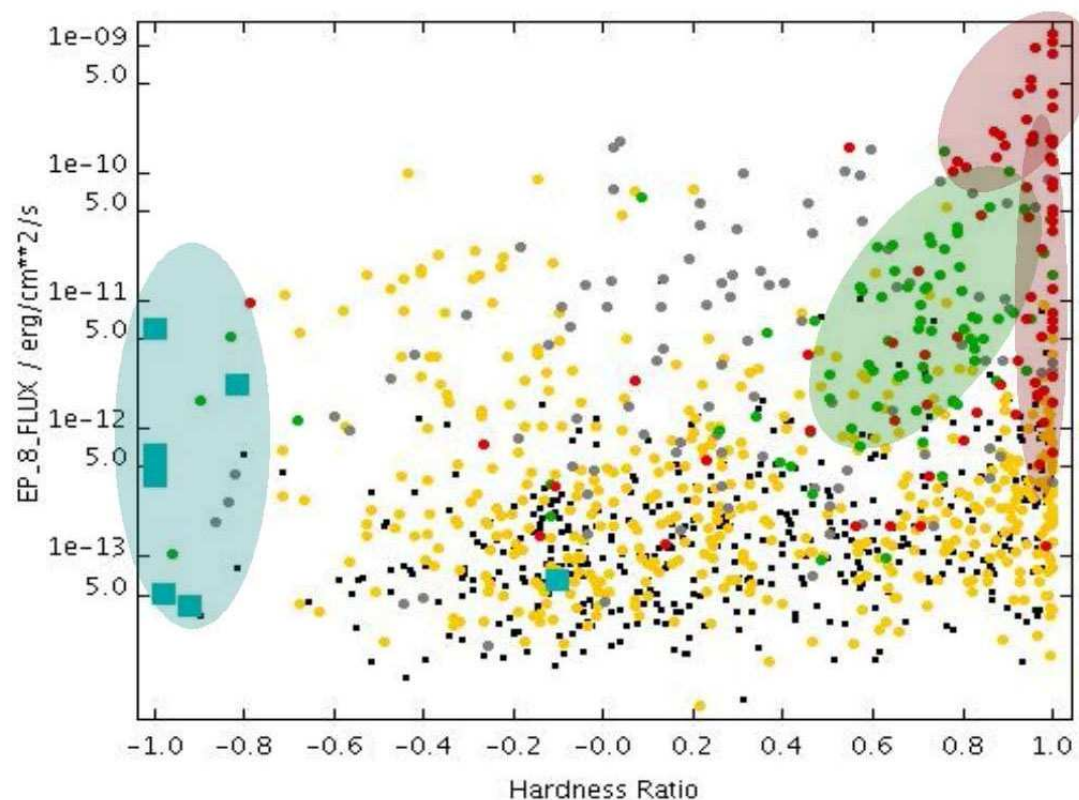


Left panels are for high galactic latitude, right panels are for low galactic latitude.





# Hardness ratios of variable sources in 2XMM



$$HR = (F2 - F1) / (F2 + F1)$$

F1 = 0.2 – 1 keV flux

F2 = 1 – 12 keV flux

EP\_8\_FLUX is 0.2-12 keV

Red = X-ray binaries

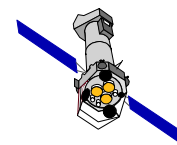
Green = CVs

Grey = AGN

Yellow = Stars

Turquoise = SSS

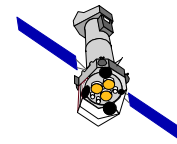
*Gosling et al. 2008*



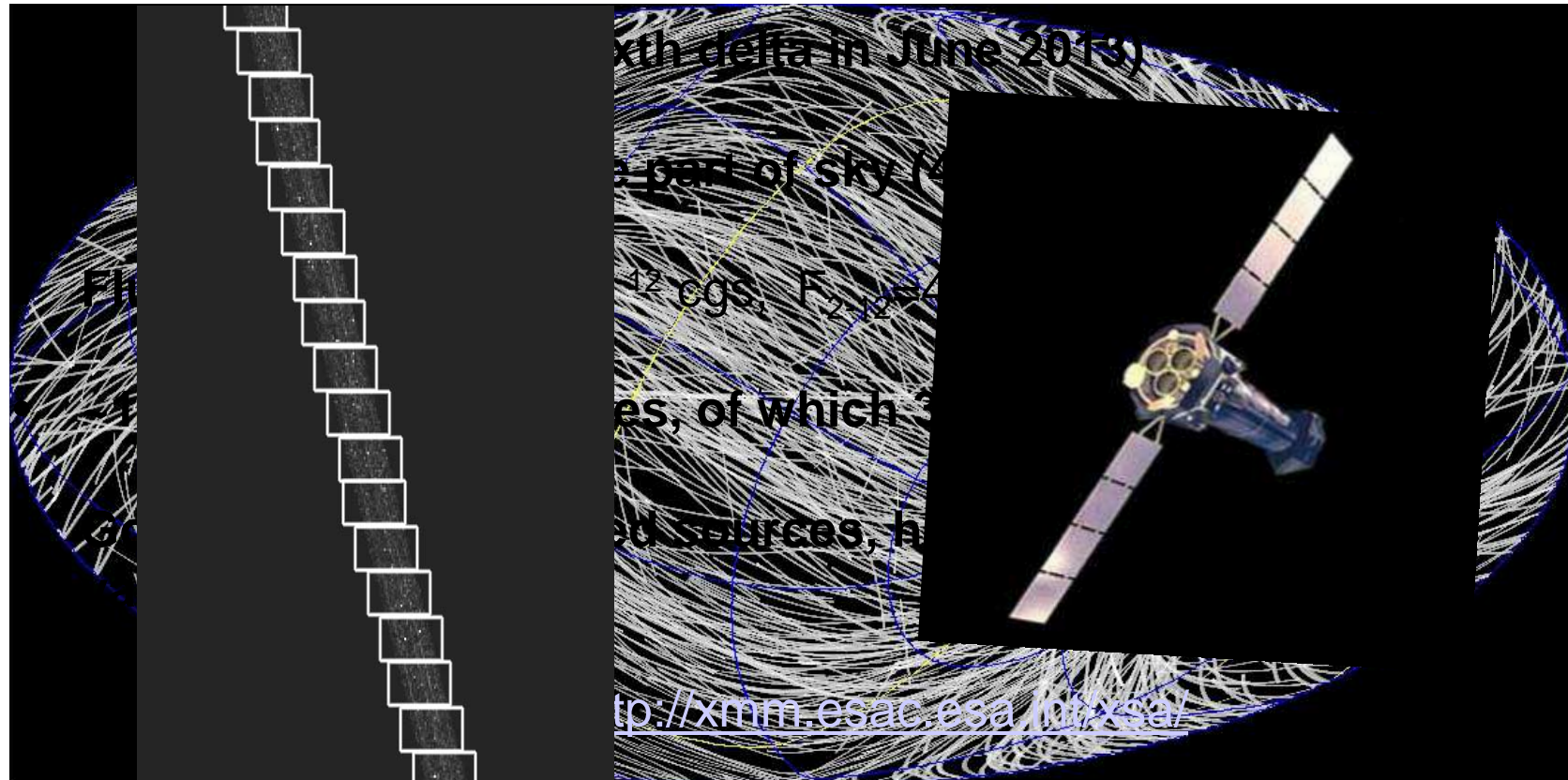
# 3XMM: an imminent update

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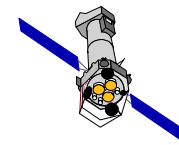
- ② 7433 observations.
- ② ~531000 detections in total.
- ② ~372000 unique sources
- ② ~8500 definite extended sources
- ② ~median flux is  $F_{2-10}=1.4 \times 10^{-14}$  ergs s<sup>-1</sup> cm<sup>-2</sup>
- ② 20% have  $F_{0.2-12} < 1 \times 10^{-14}$  ergs s<sup>-1</sup> cm<sup>-2</sup>
- ② Minimum flux  $\sim 1.0 \times 10^{-15}$  ergs s<sup>-1</sup> cm<sup>-2</sup>
- ② Total area independently covered = 800 deg<sup>2</sup>
- ② Improvements in astrometry
- ② 248000 sources have spectral products extracted



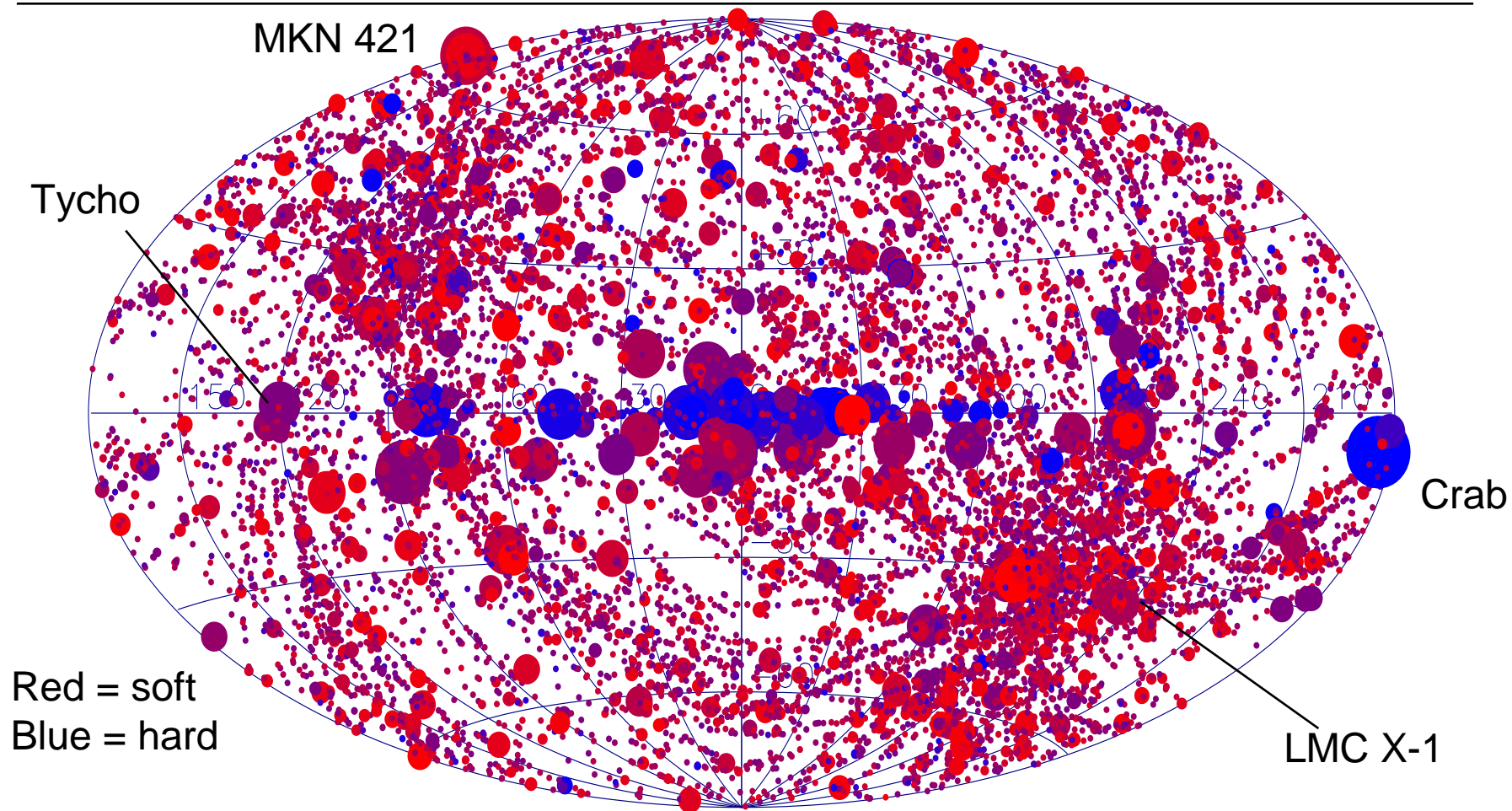
# XMM slew survey: XMMSL1 (Delta-6)



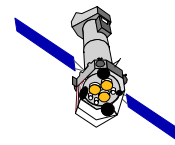
- **Archived images, exposure maps and event files**  
Slew paths in Galactic coordinates



# Slew sources



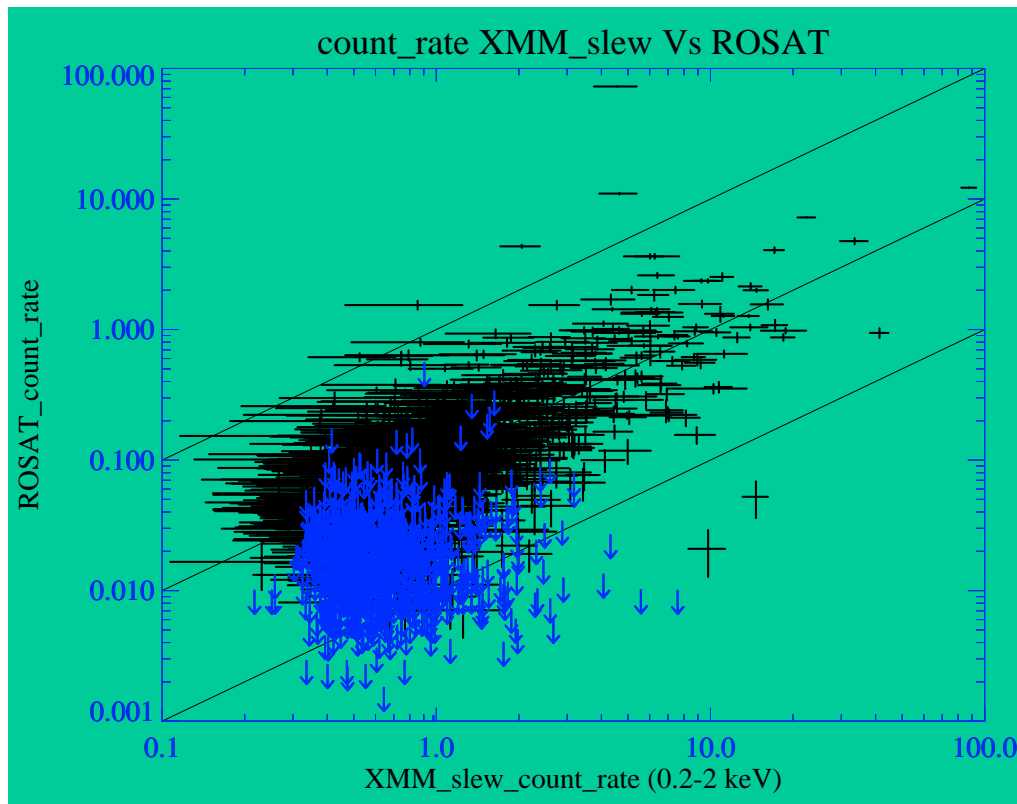
Richard Saxton



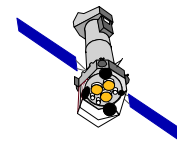
***XMM-Newton***

# Correlations with ROSAT

- 55% of sources correlate with ROSAT (non-extended, DET\_ML>10)
- 1% show variability by > factor of ten (5% of AGN)

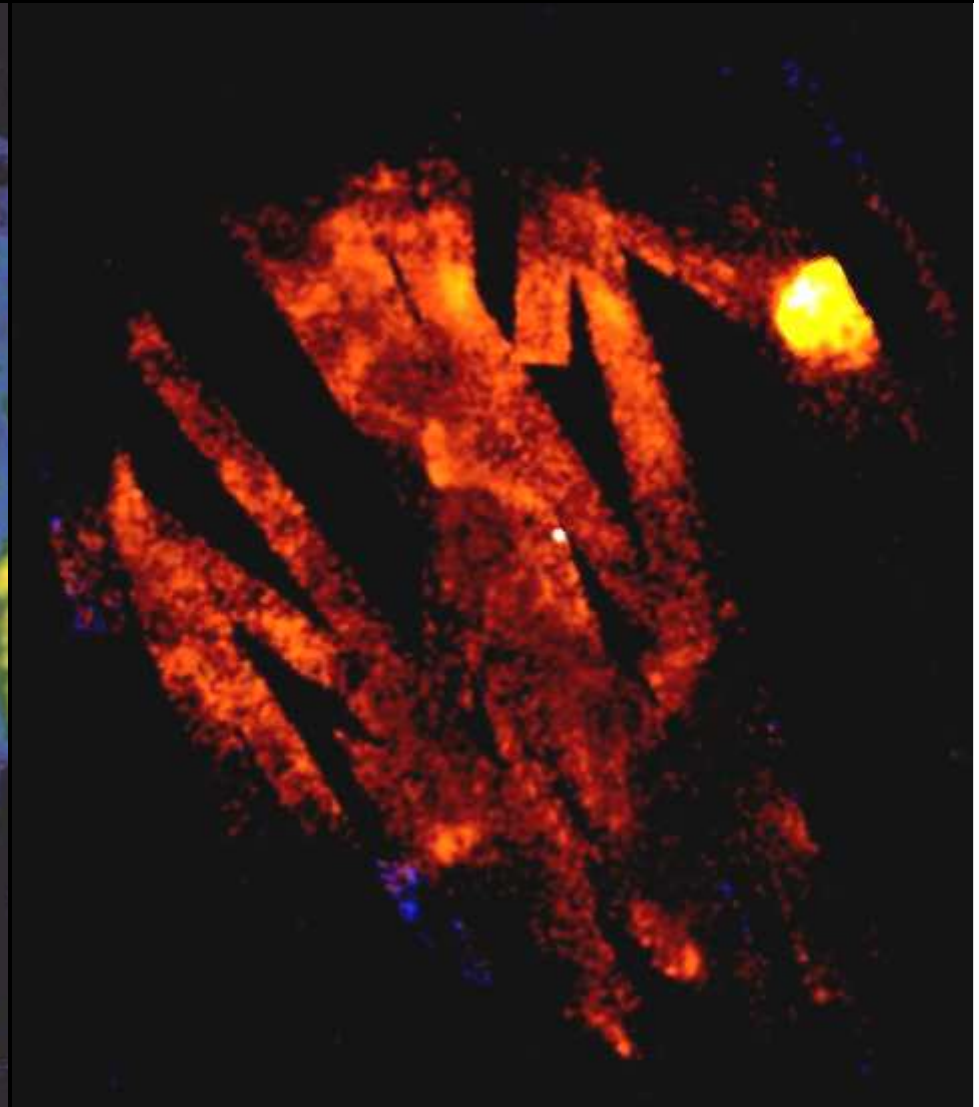
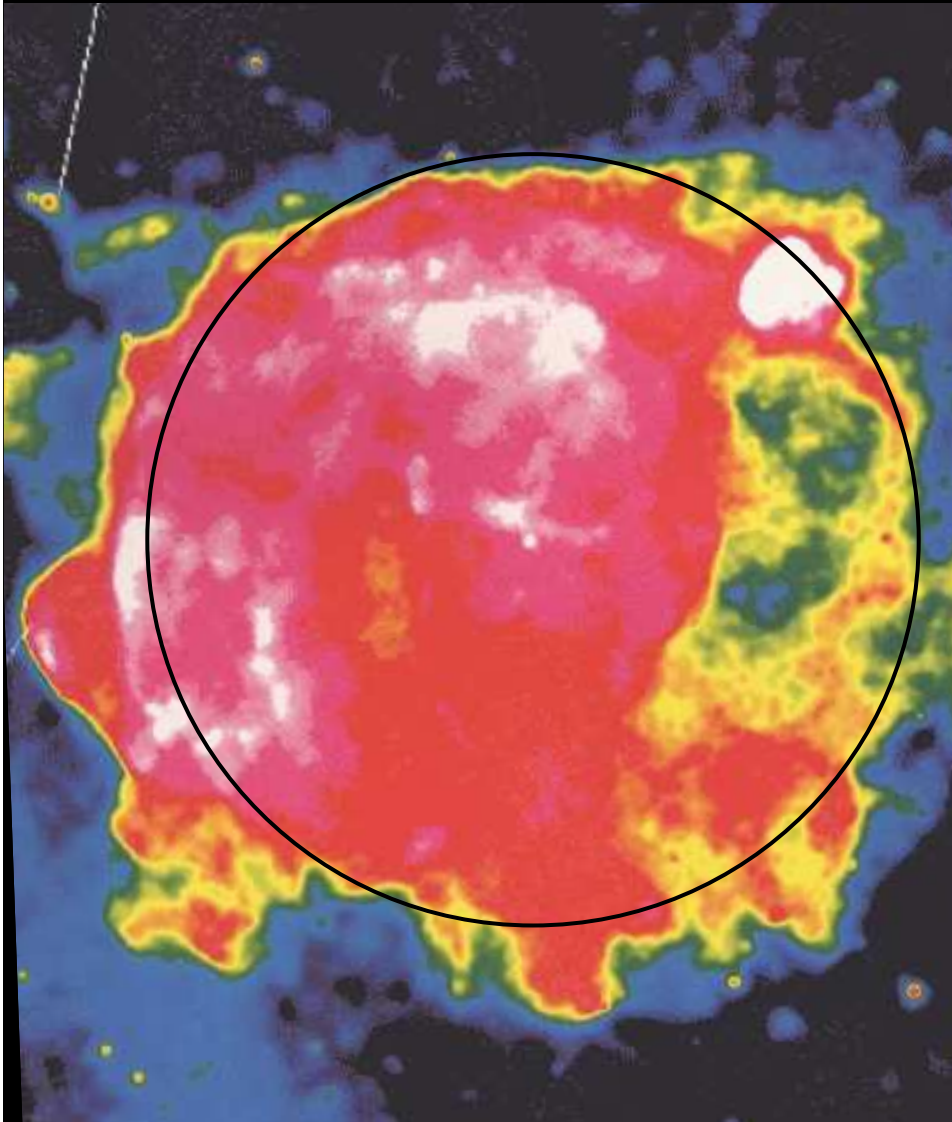


Mean rate :  
 $\text{XMM-slew}/\text{ROSAT} \sim 7$





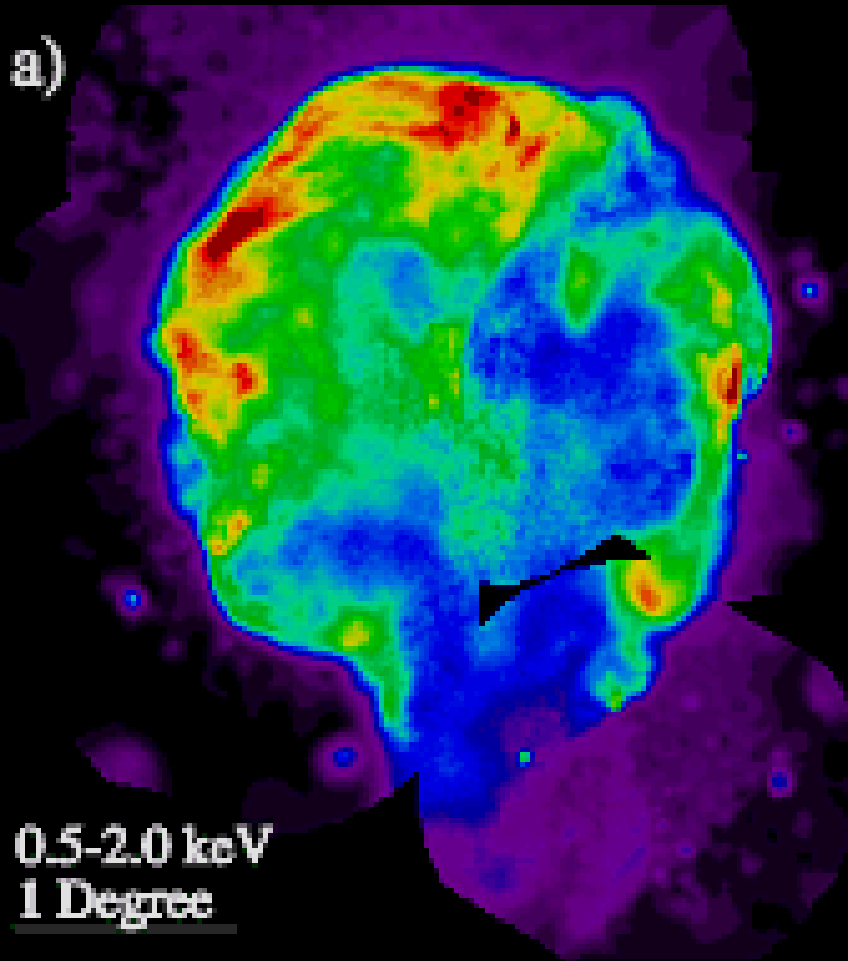
# Vela Supernova Remnant



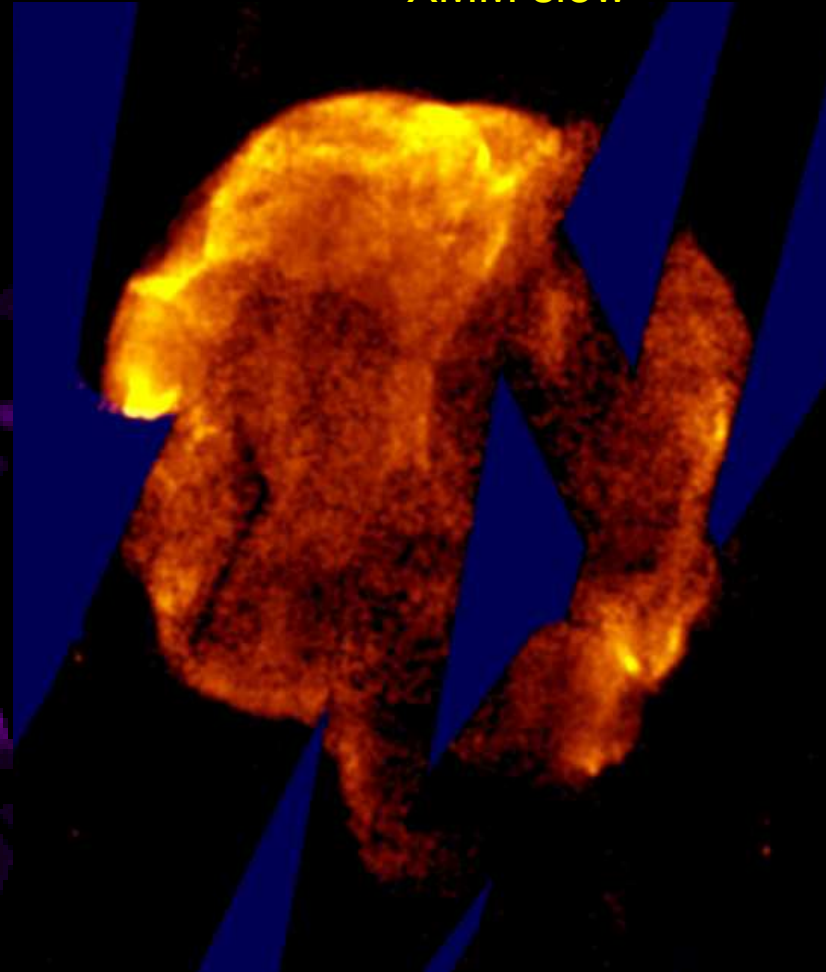
# Cygnus Loop

ROSAT

a)

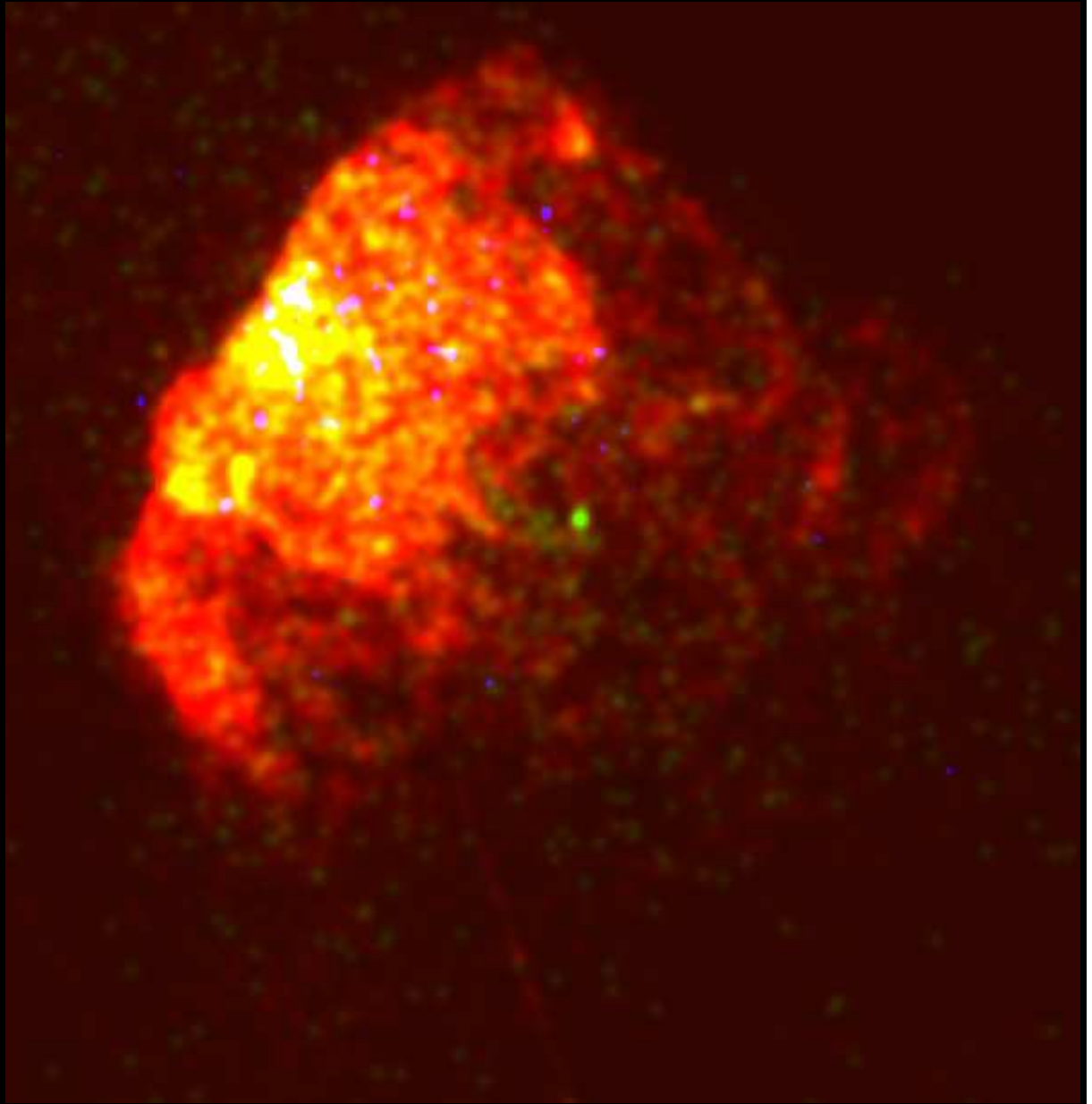


XMM slew

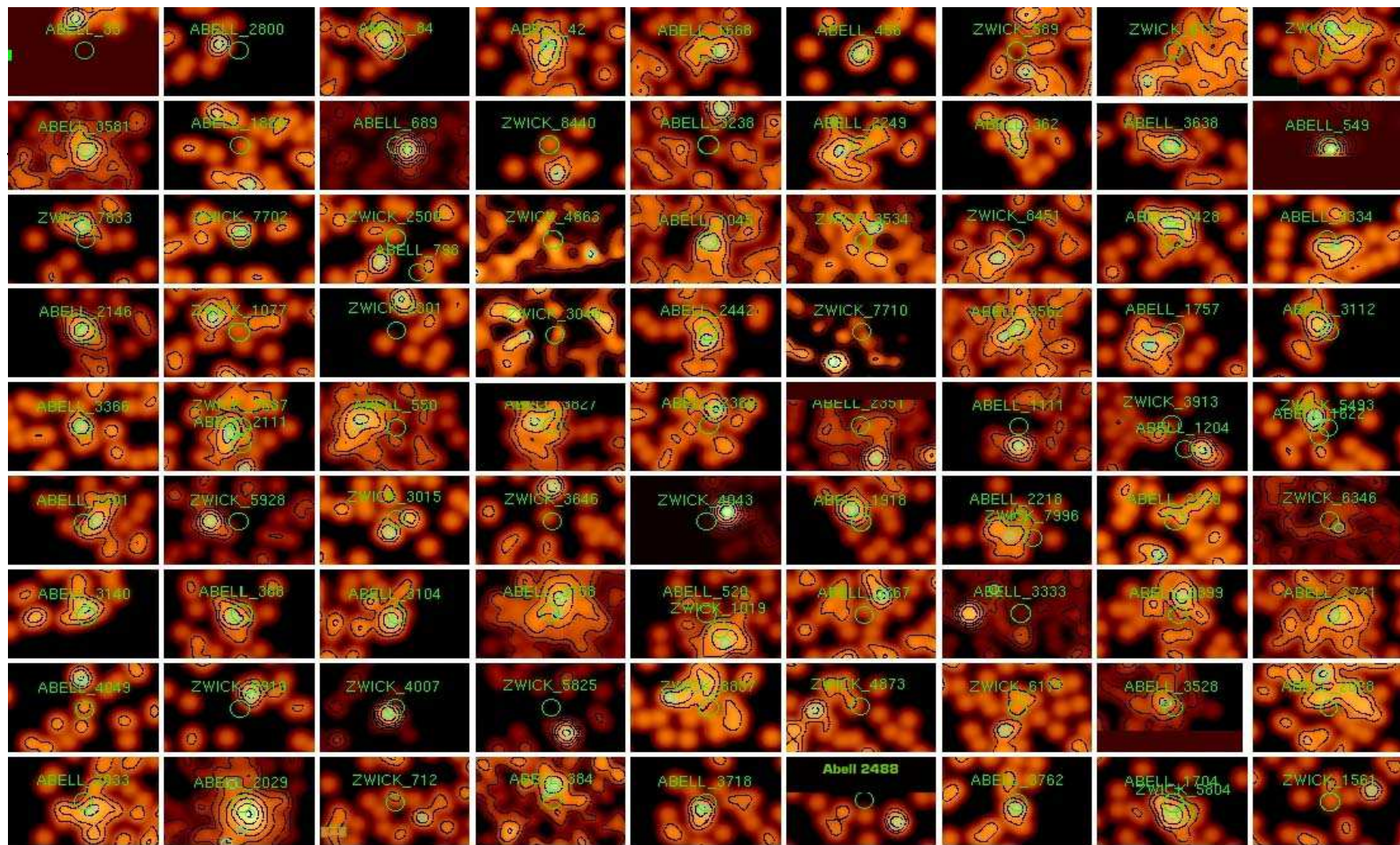


# Analysing extended structures- Puppis SNR

XSA contains slew images, exposure maps and event files. Can perform spectral analysis of extended structures.

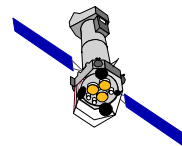






›200 clusters of galaxies detected

Richard Saxton

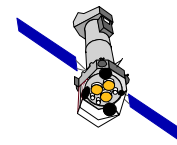


**XMM-Newton**

# Summary

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- **2XMM, XMMSL1 relatively unexplored at present.**
- **Data are public**
- **2XMM will be superceded by 3XMM in Summer of 2013.**
- **Slew survey currently covers 65% of sky. Addition of 4000 deg<sup>2</sup> per year.**



# How to access the catalogue

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- o Fits file from <http://xmmssc-www.star.le.ac.uk/>
- o The XSA <http://xmm.esac.esa.int/xsa/>
- o SCI-DB <http://xcatdb.u-strasbg.fr/xcat-db/>
- o User documentation: [http://xmmssc-www.star.le.ac.uk/Catalogue/UserGuide\\_xmmcat.html](http://xmmssc-www.star.le.ac.uk/Catalogue/UserGuide_xmmcat.html)
- o LEDAS <http://ledas-www.star.le.ac.uk>

Current ref: *Watson et al. 2008, A&A 493, 339-373 (2XMM)*  
*Saxton et al. 2008, A&A 480, 611 (XMM slew)*

