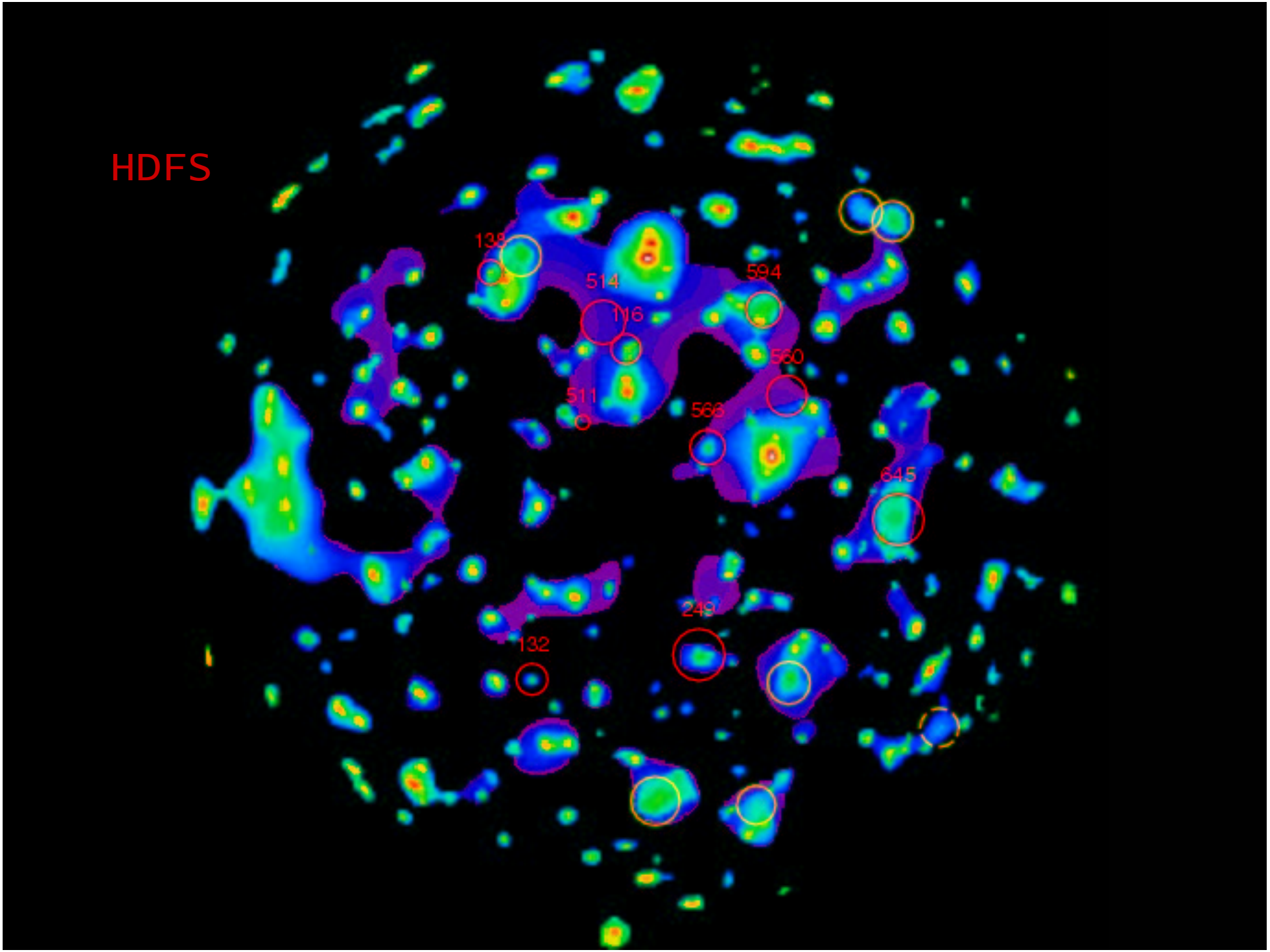
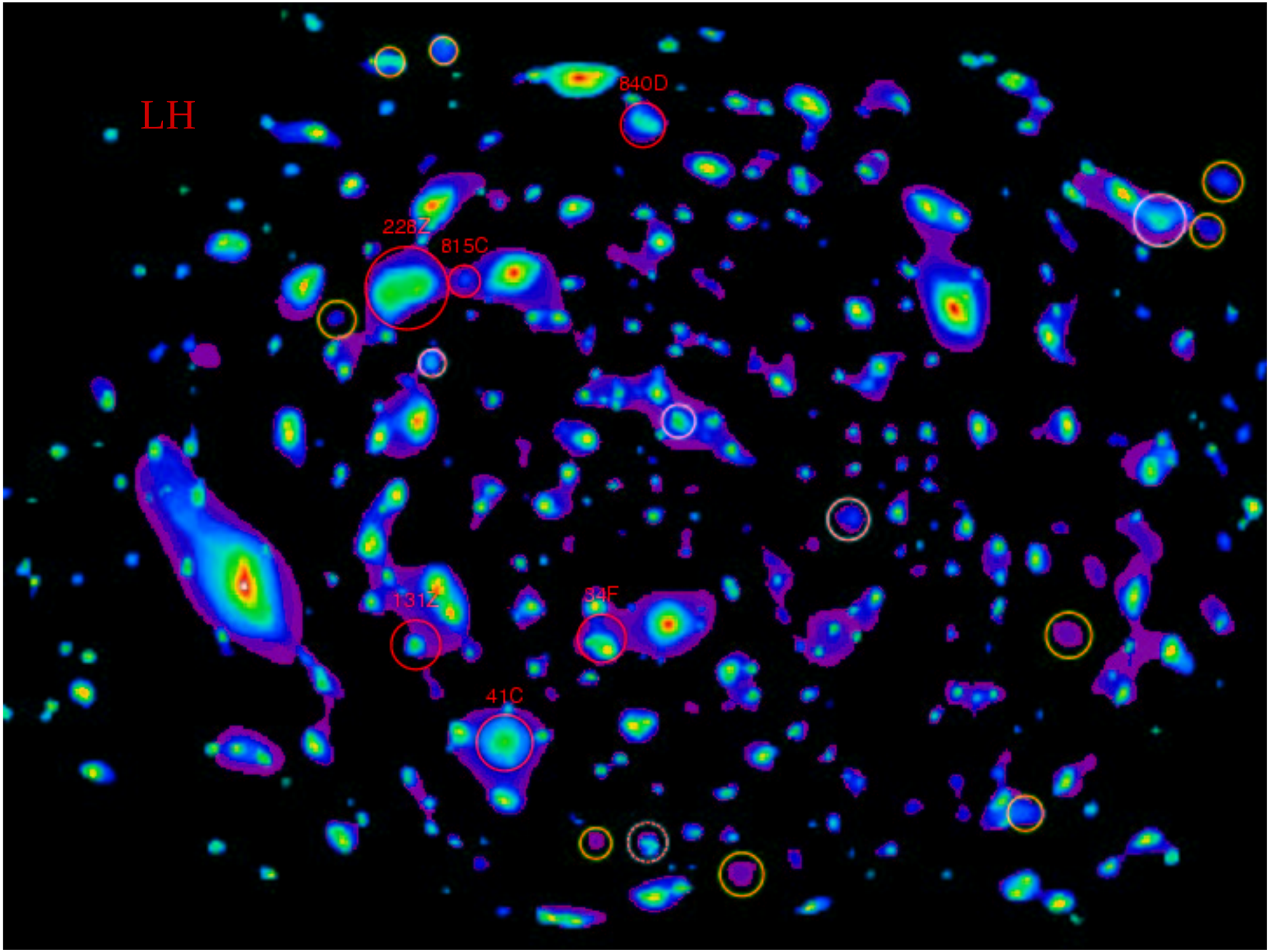
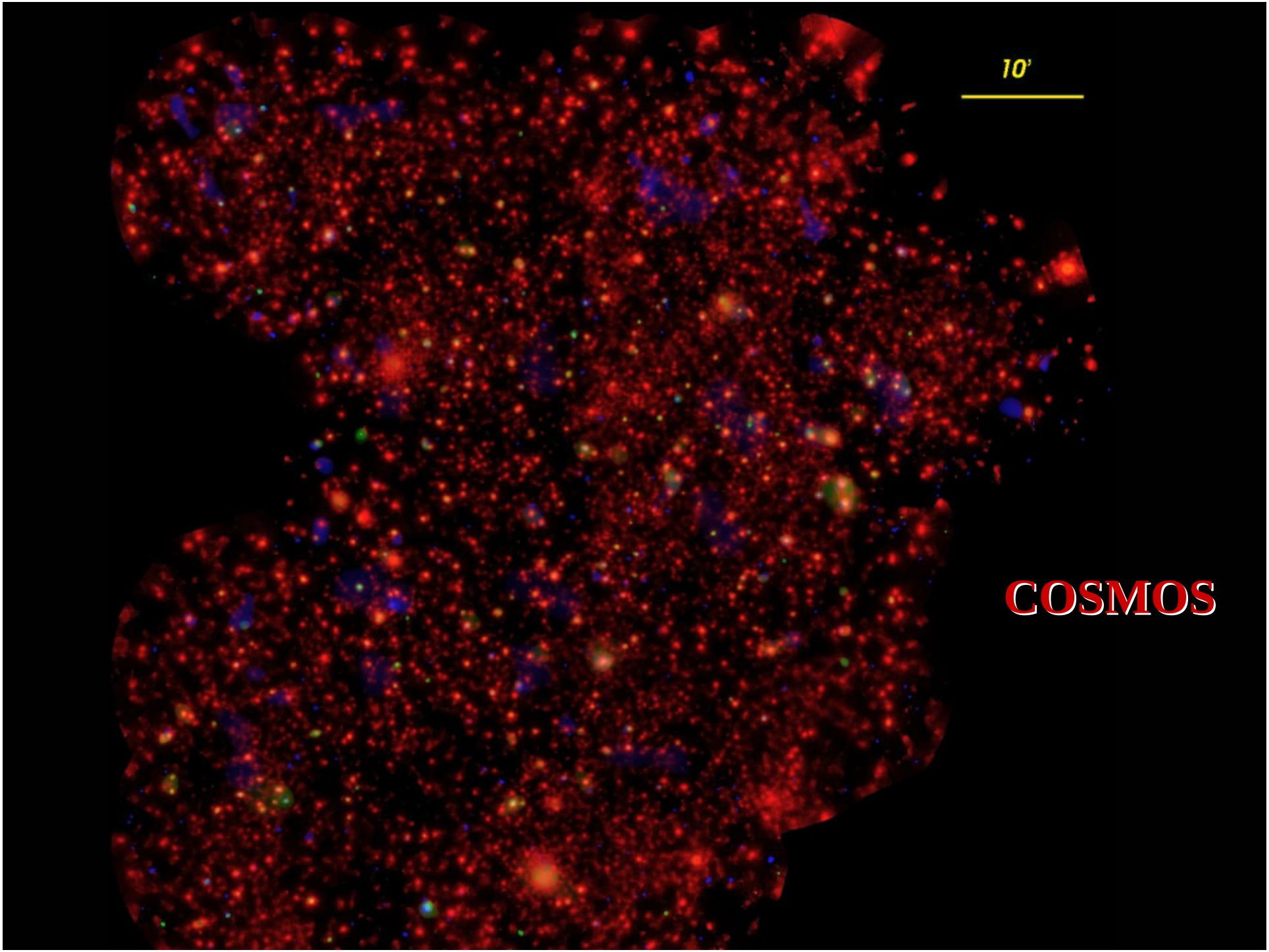
EPIC-pn background in deep fields – taking a deep breath before diving

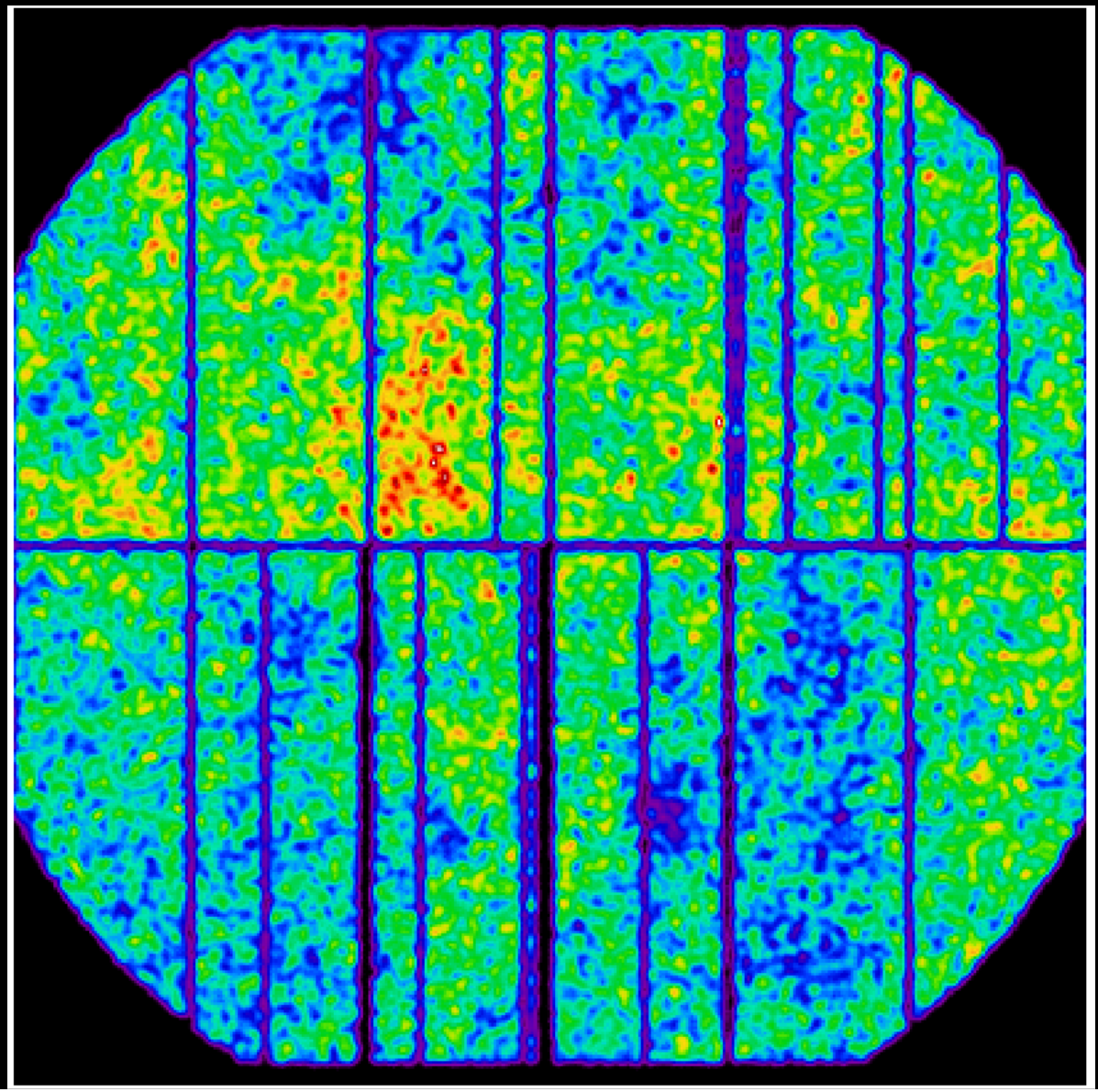
Finoguenov Alexis


HDFS
514
594
116
560
511
566
645
249
132

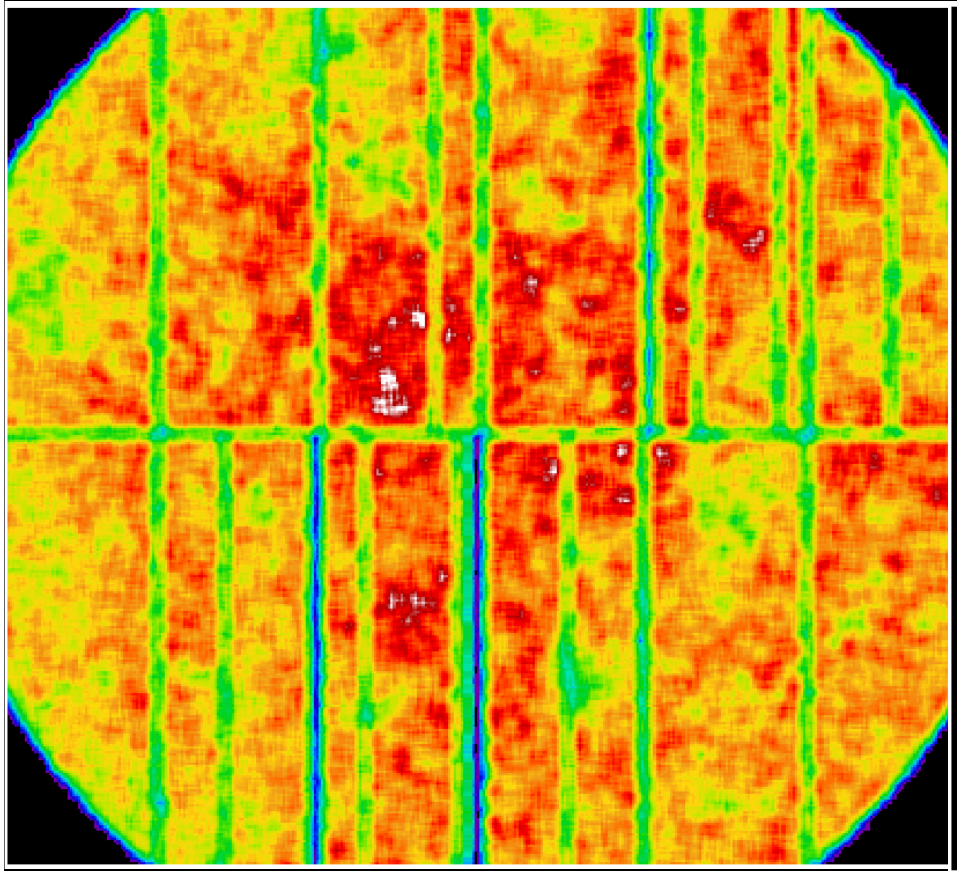

LH
840D
228Z
815C
131Z
84F
41C

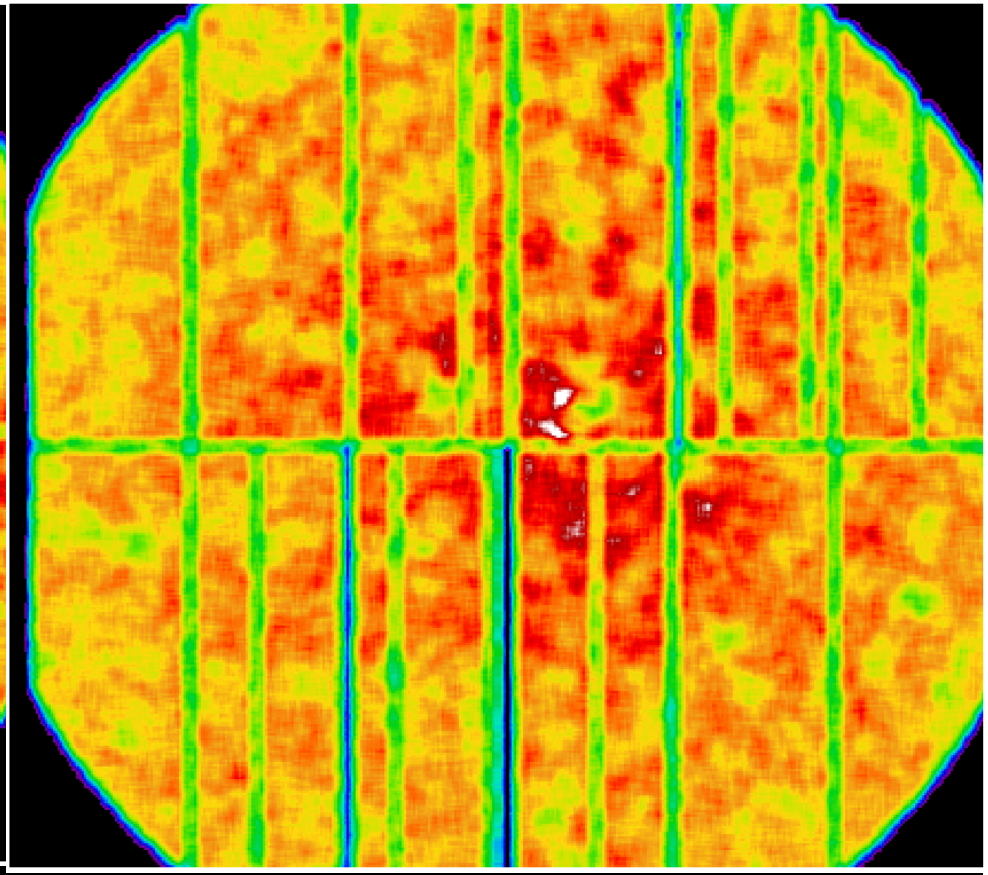

10'
COSMOS

COSMOS 9.5-12 keV



0.5-2 keV

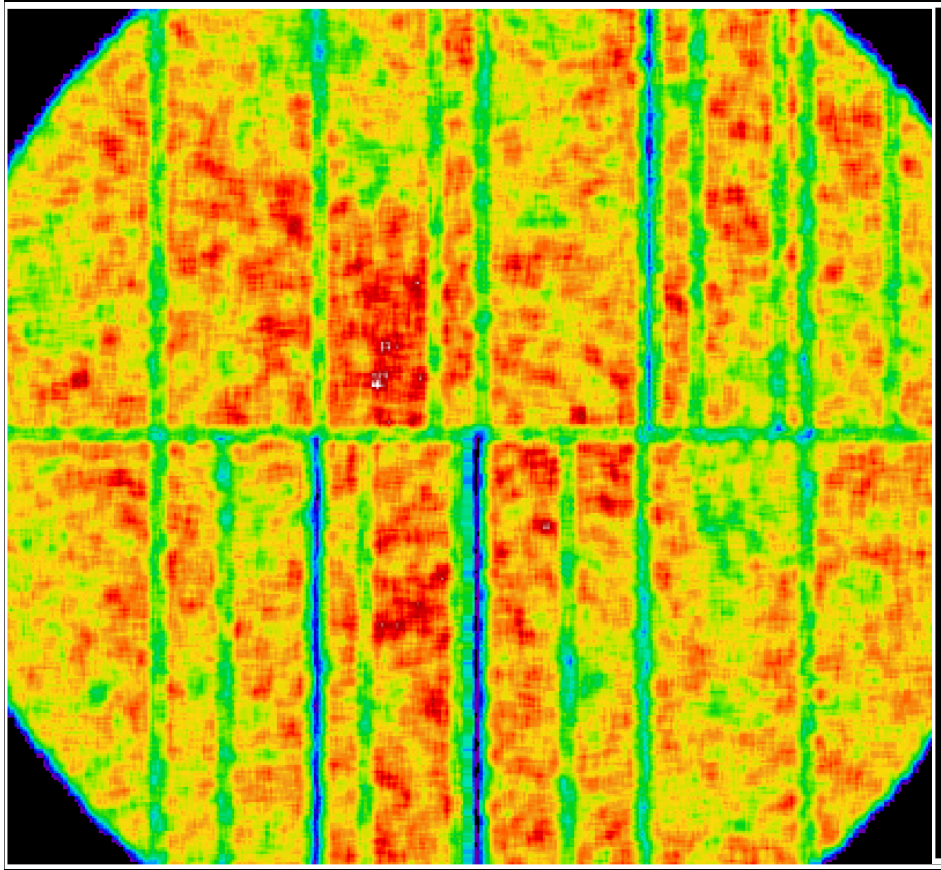


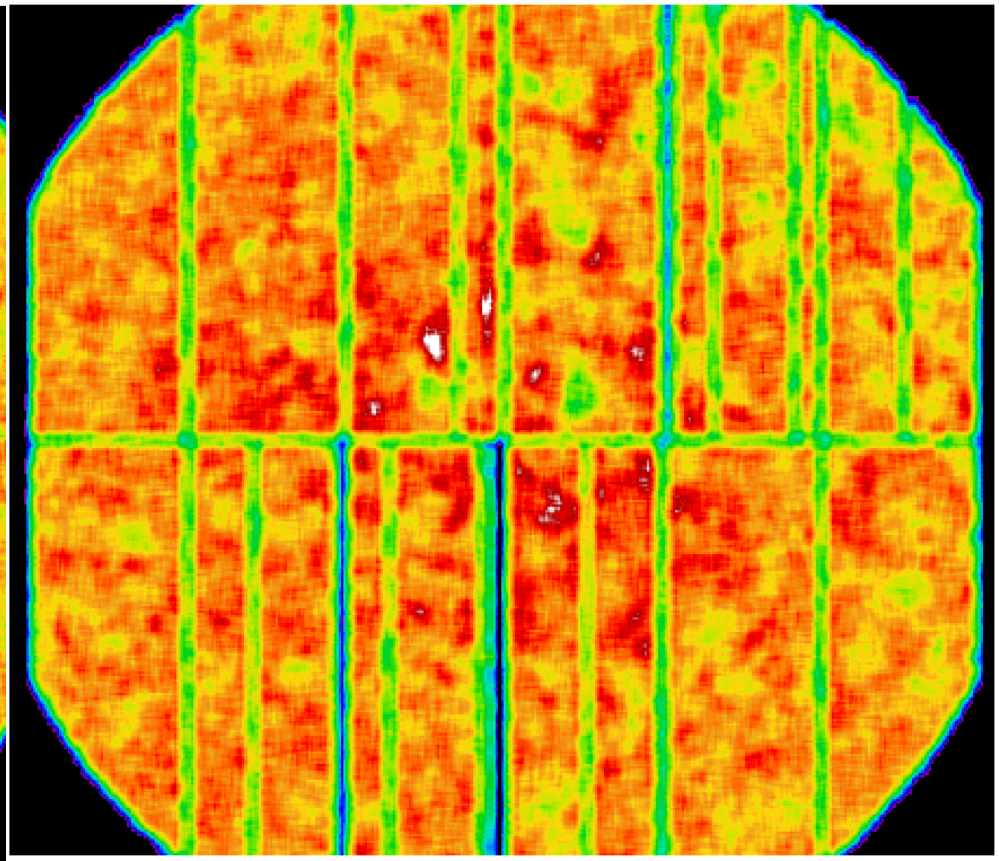


COSMOS

Andy Read

2-4.5 keV

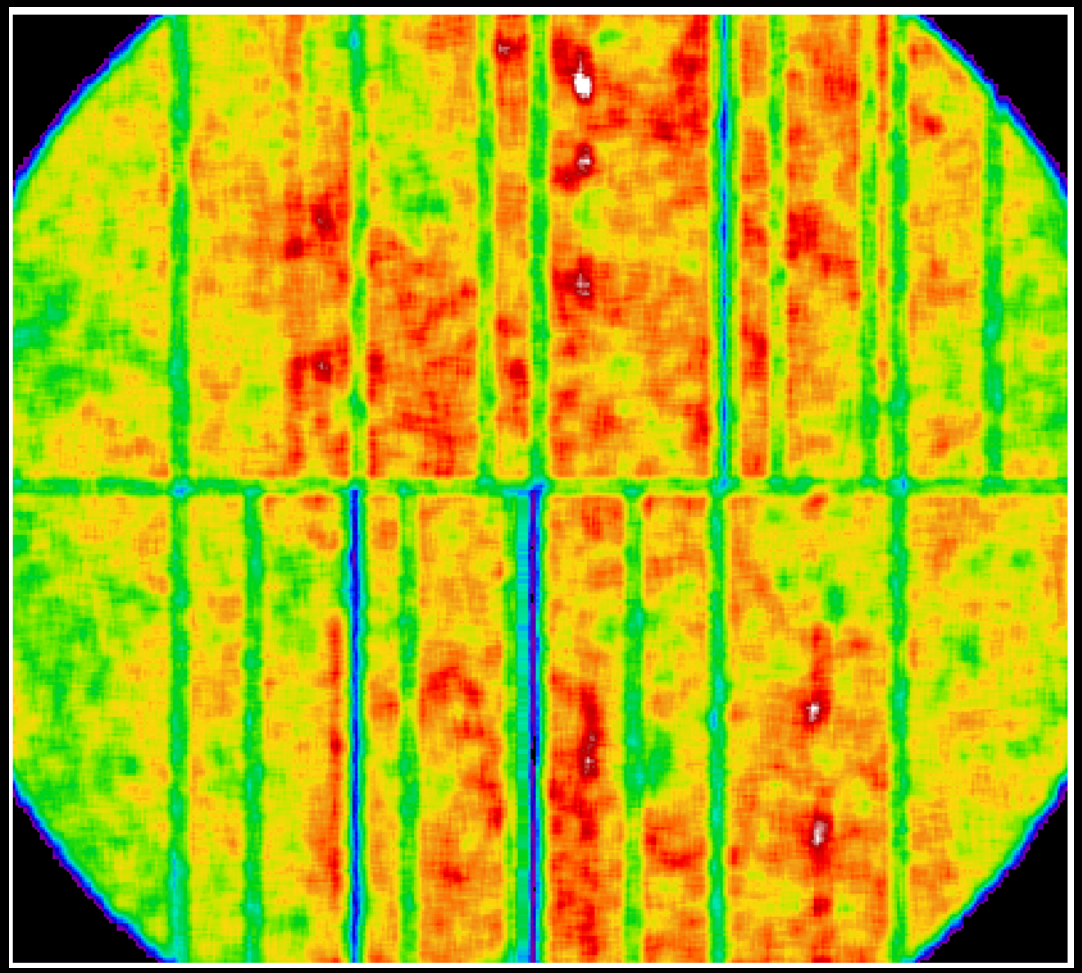




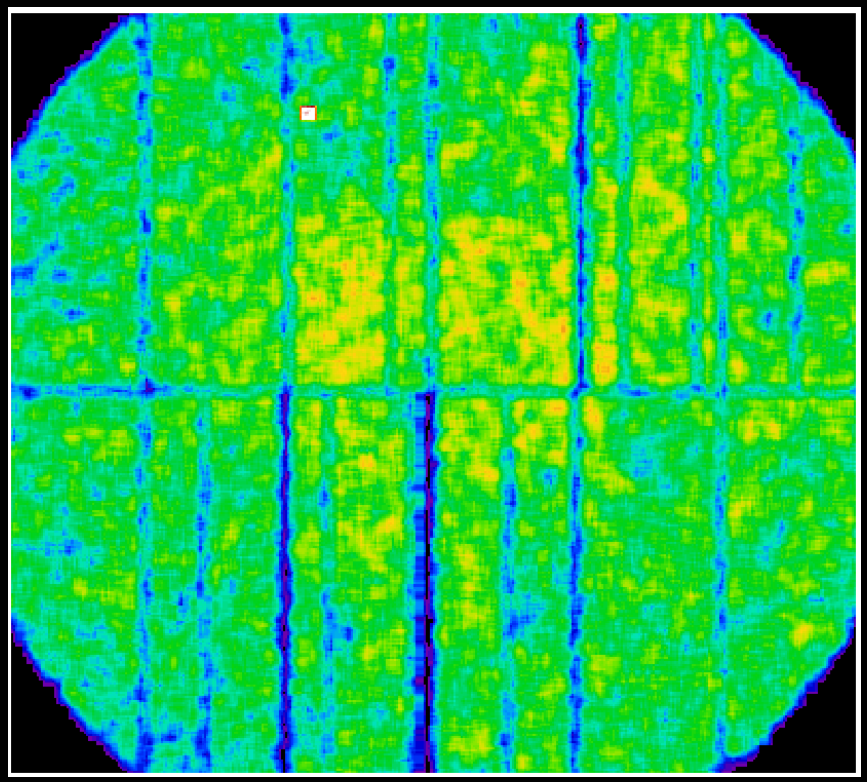
COSMOS

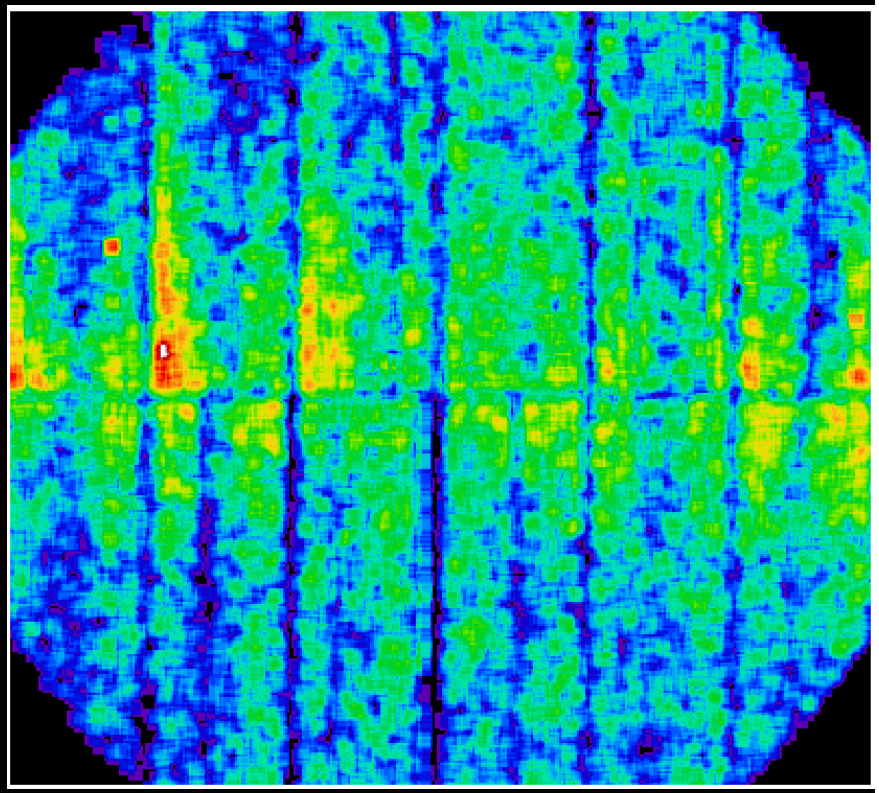
Andy Read

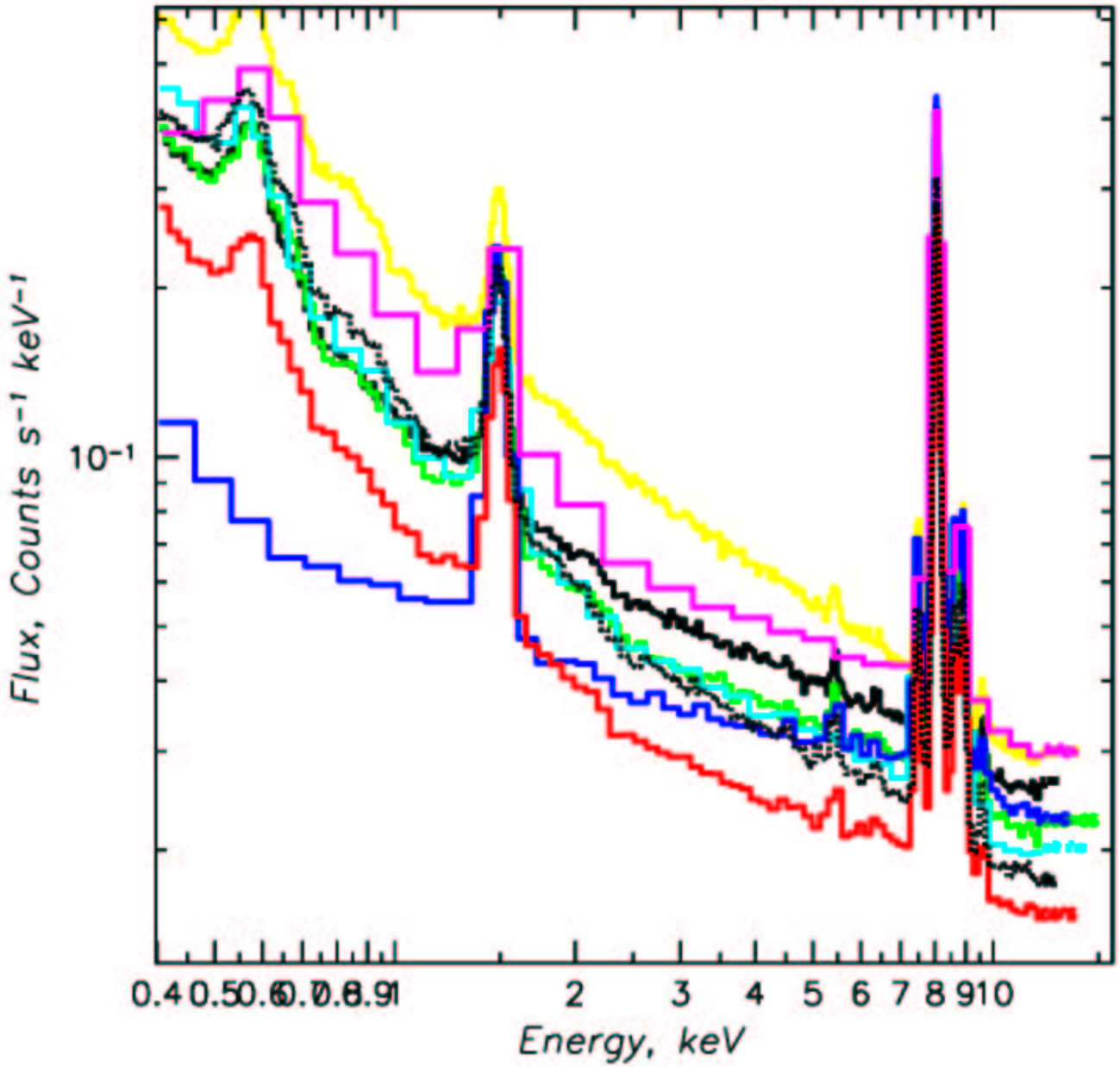
OOTE



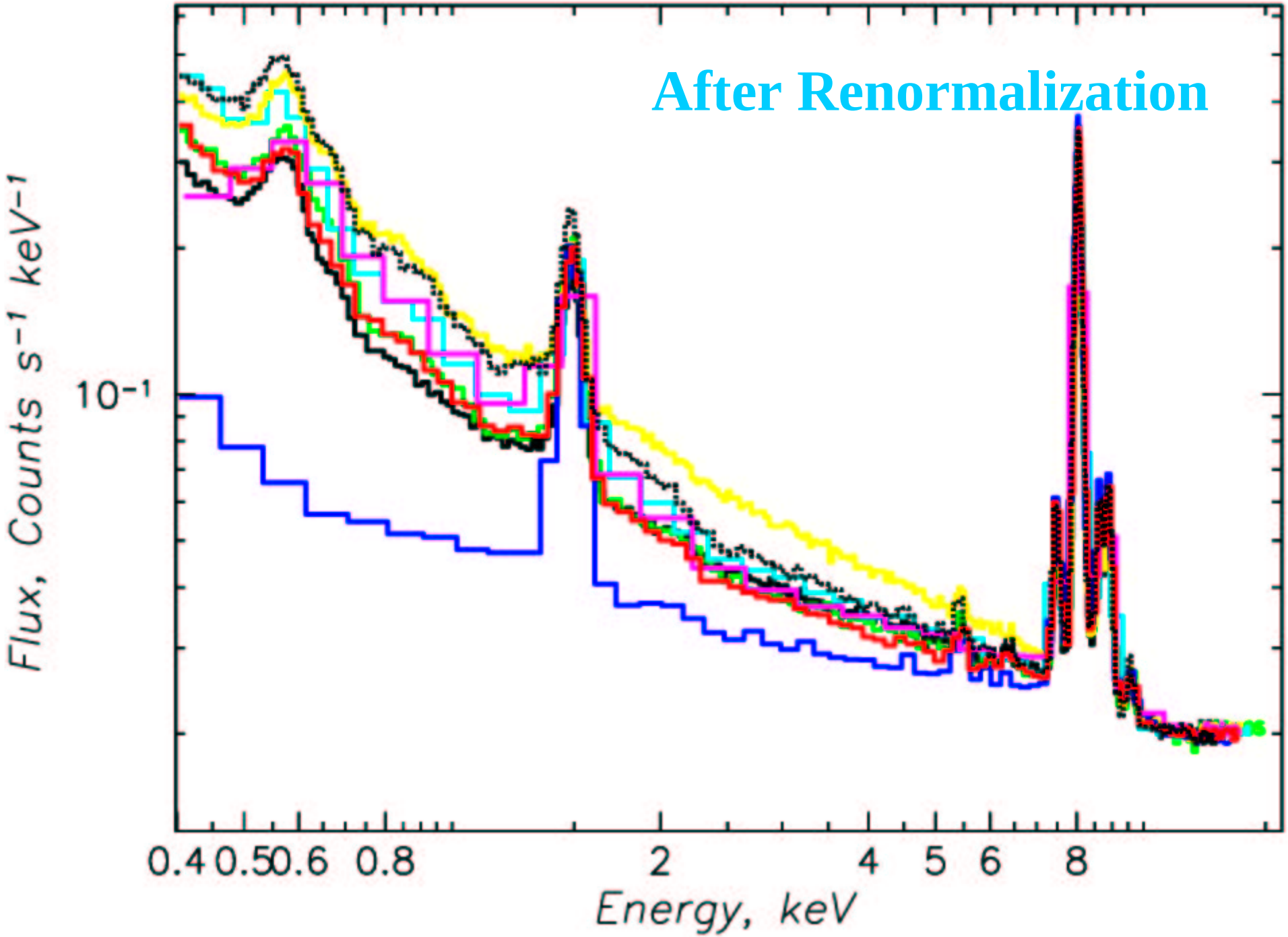
Singles vs doubles

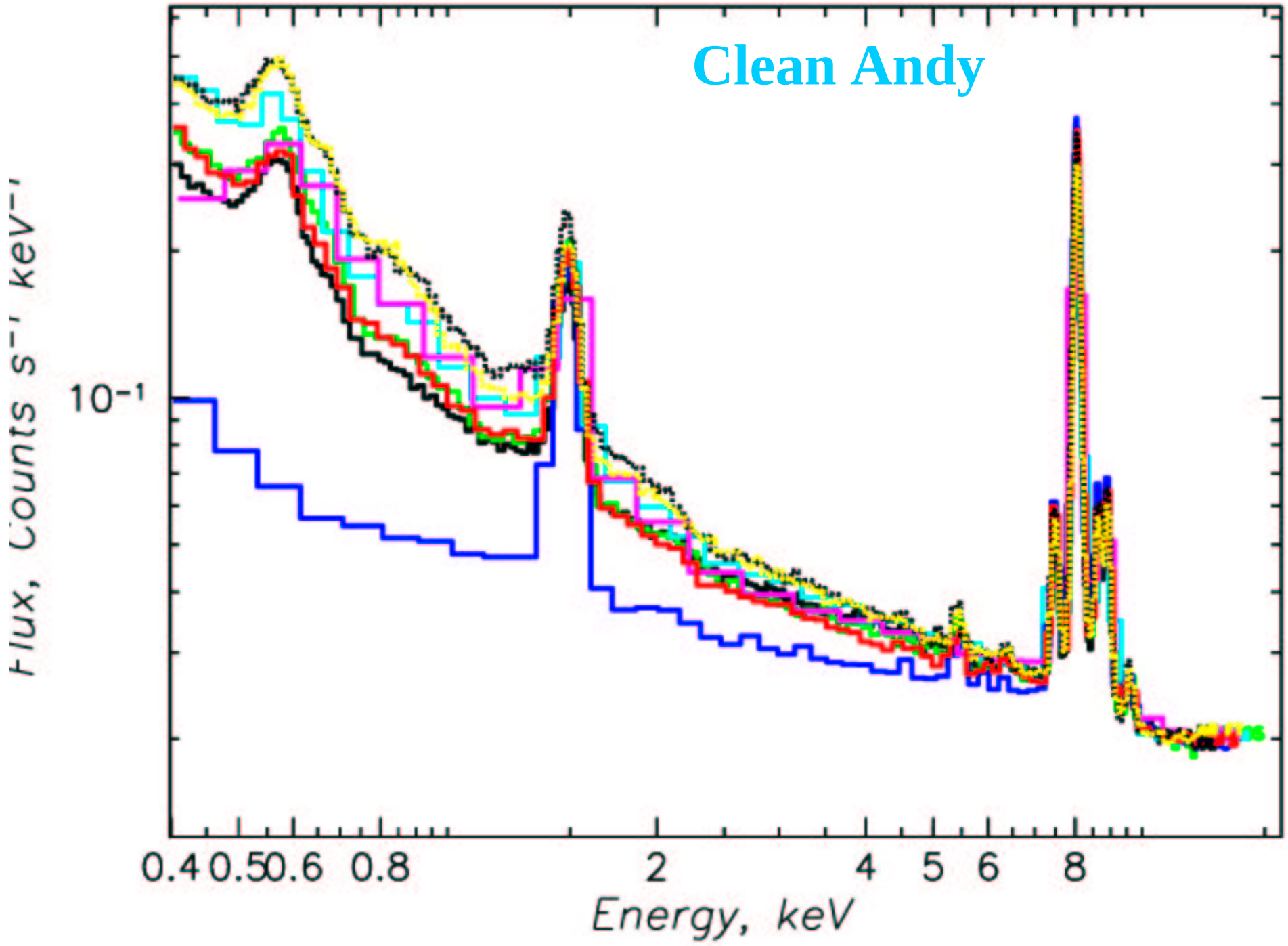


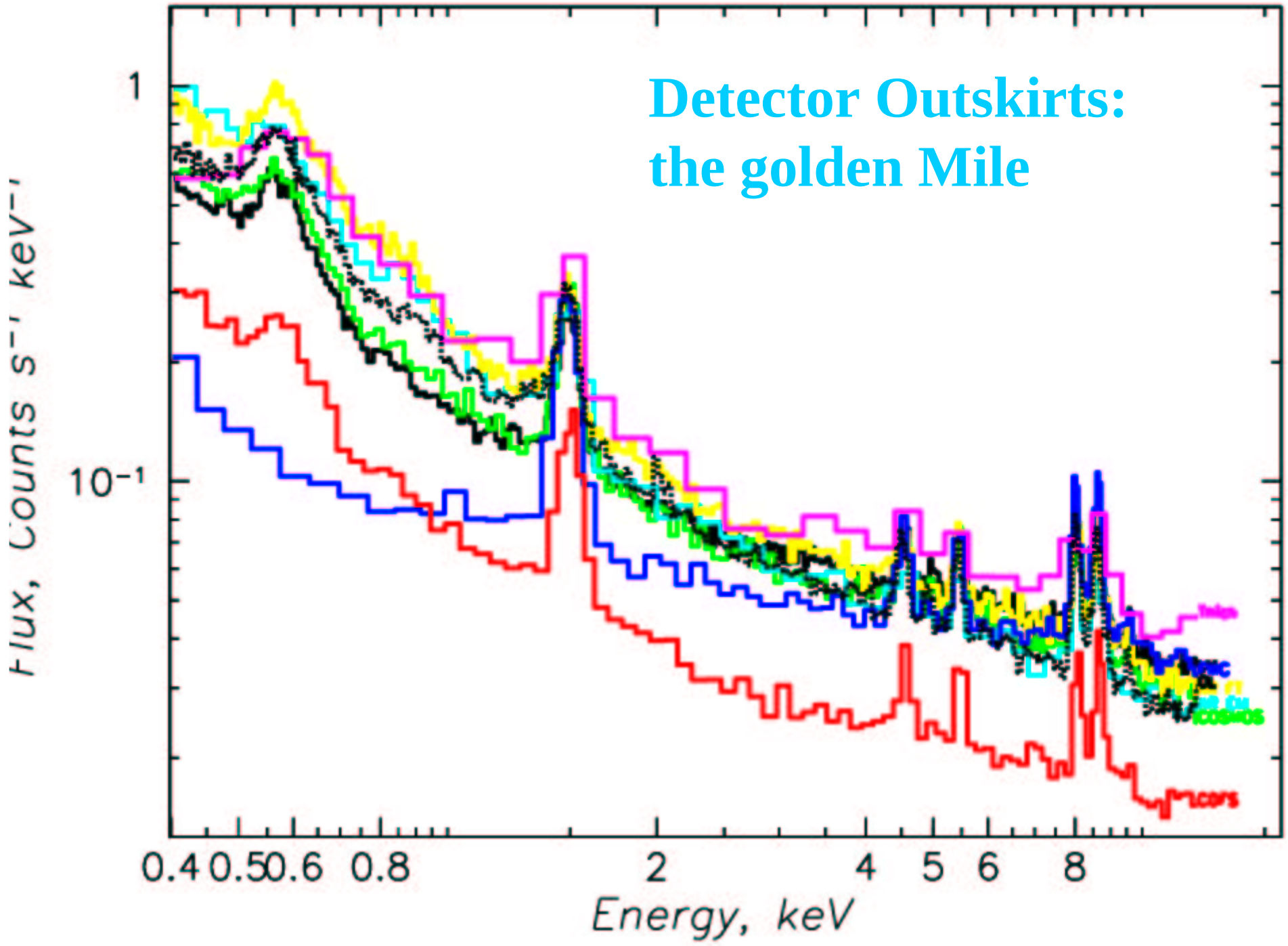


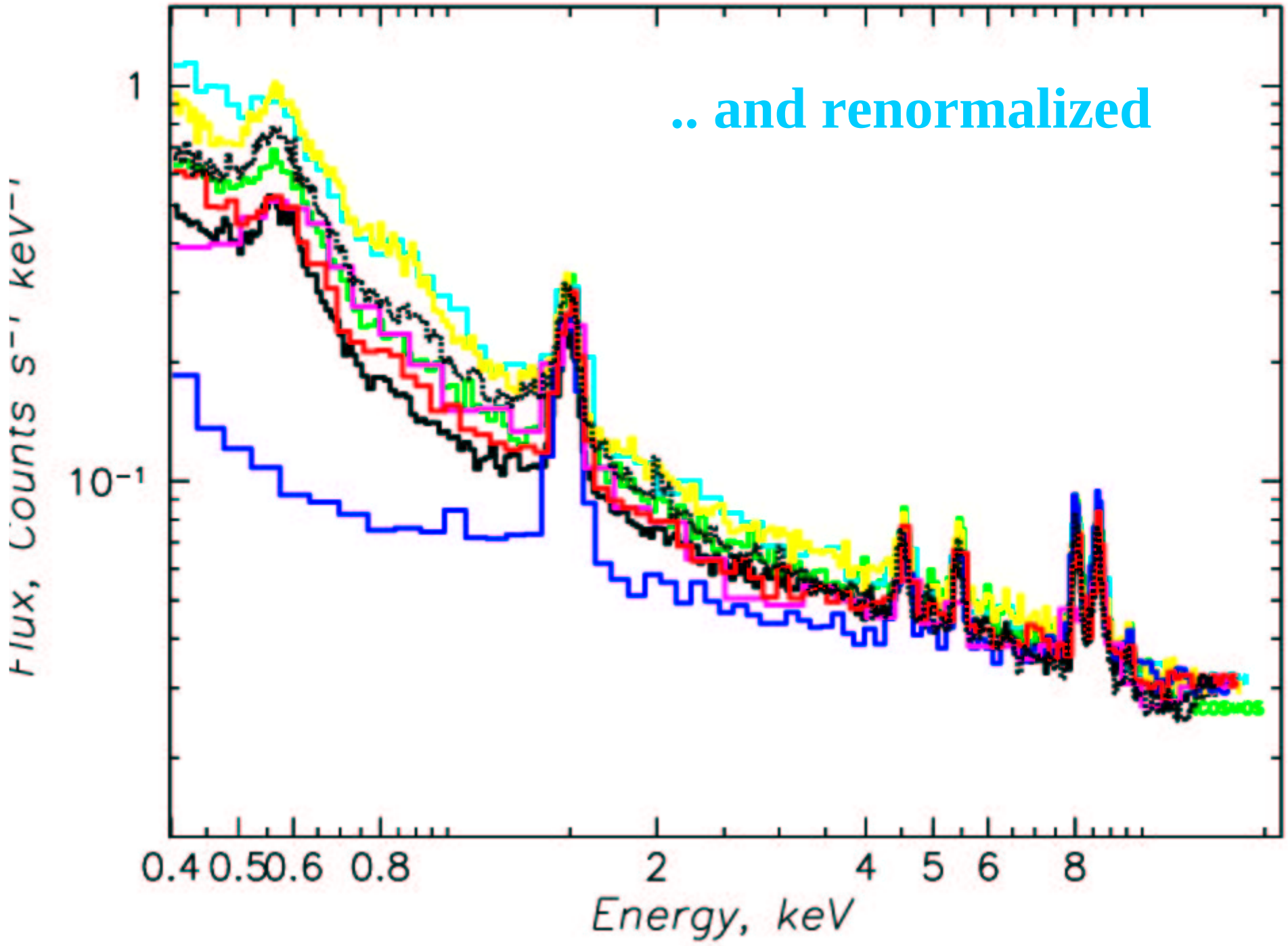


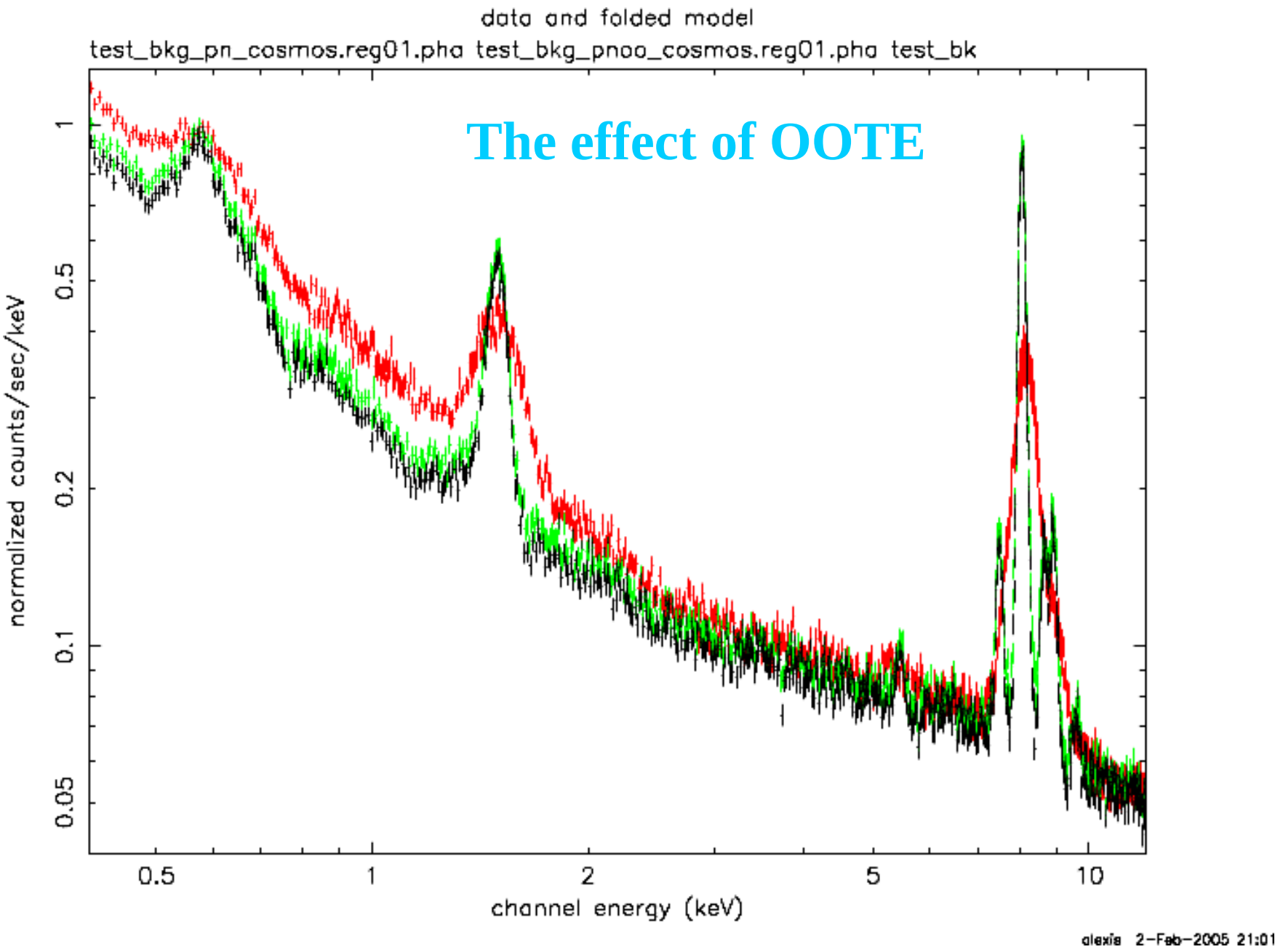
Spectral comparison


After Renormalization
Flux, Counts s⁻¹ keV⁻¹
10⁻¹
0.4 0.5 0.6 0.8 2 4 5 6 8
Energy, keV


Clean Andy
Flux, Counts s⁻¹ keV⁻¹
10⁻¹
0.4 0.5 0.6 0.8 2 4 5 6 8
Energy, keV


Detector Outskirts:
the golden Mile
1
10⁻¹
Flux, Counts s⁻¹ keV⁻¹
0.4 0.5 0.6 0.8 2 4 5 6 8
Energy, keV
COSMOS


.. and renormalized
1
10^{-1}
Flux, Counts s^{-1} keV^{-1}
0.4 0.5 0.6 0.8 2 4 5 6 8
Energy, keV


data and folded model
test_bkg_pn_cosmos.reg01.pha test_bkg_pnoo_cosmos.reg01.pha test_bk
The effect of OOTE
normalized counts/sec/keV
0.05
0.1
0.2
0.5
1
0.5
1
2
5
10
channel energy (keV)
alexis 2-Feb-2005 21:01

Is there some sky background in there?

A msg from Andy Fabian

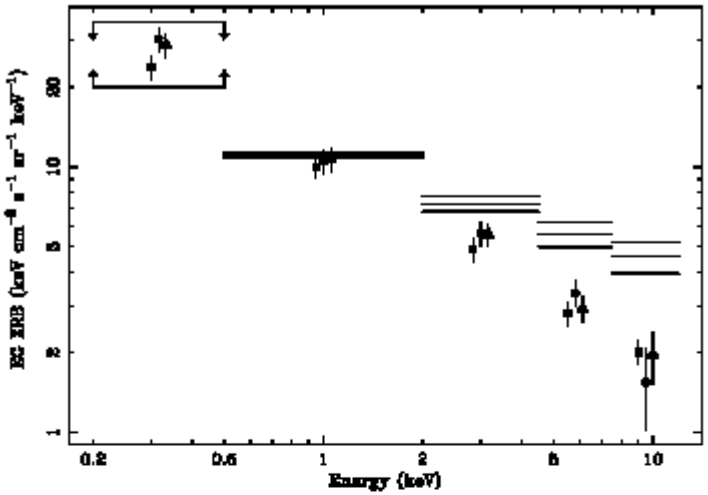


Figure 2. The extragalactic XRB intensity resolved from detected sources in the energy bands ($0.2-0.5$, $0.5-2$, $2-4.5$, $4.5-7.5$ and $7.5-12$ keV). The values from the three instruments are plotted, for clarity, as points in the centre of each band and offset horizontally with respect to each other. Squares, circles and triangles represent the PN, MOS-1 and MOS-2 instruments respectively. Errors are one sigma. The bars represent the measured values of the total extragalactic XRB intensity; the $0.5-2$, $2-4.5$, $4.5-7.5$ and $7.5-12$ keV values from De Luca & Molendi (2003) with the grey bars indicating estimated one sigma error, the $0.2-0.5$ keV data is from Warwick & Roberts (1998) and shows the upper and lower bounds of their estimate.

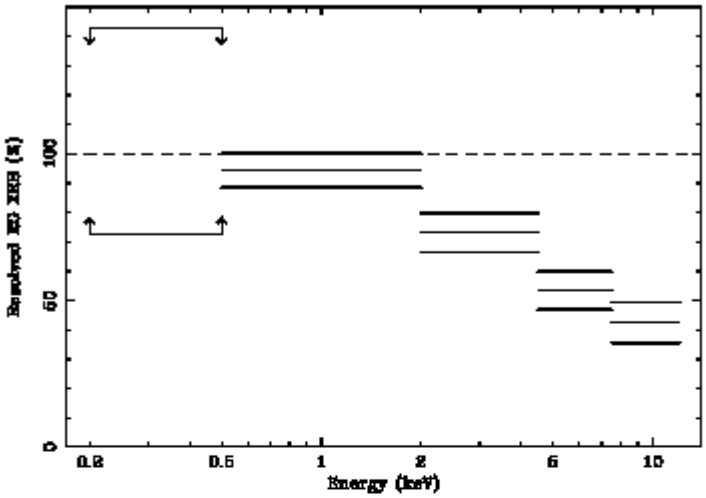


Figure 3. The fraction of the total extragalactic XRB intensity resolved from detected sources. The combined result from all three instruments is shown, the grey bars indicate one sigma errors for each fraction.

each band so even negative fluxes are included in the sum (if negative values are ignored the resolved fraction is artificially higher although the same trend is seen in the results). The flux errors are added appropriately and combined with the estimated error in the RCF values. A correction is then made for Galactic absorption. This is ~ 15 per cent in the $0.2-0.5$ keV band and insignificant in the harder bands (< 1 per cent). The apparent resolved flux is then converted to the resolved XRB intensity over the relevant 10′ source-inclusion circle.

3 RESULTS

The resolved XRB intensity for each energy band and instrument is shown in Fig. 2. In comparison, the most recent total extragalac-

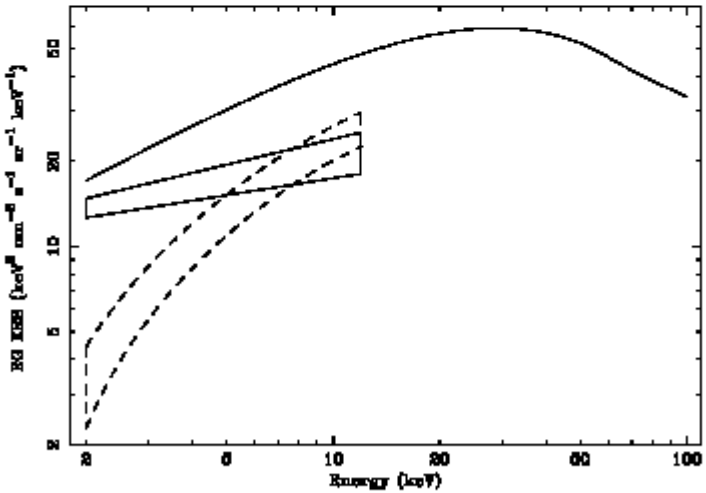
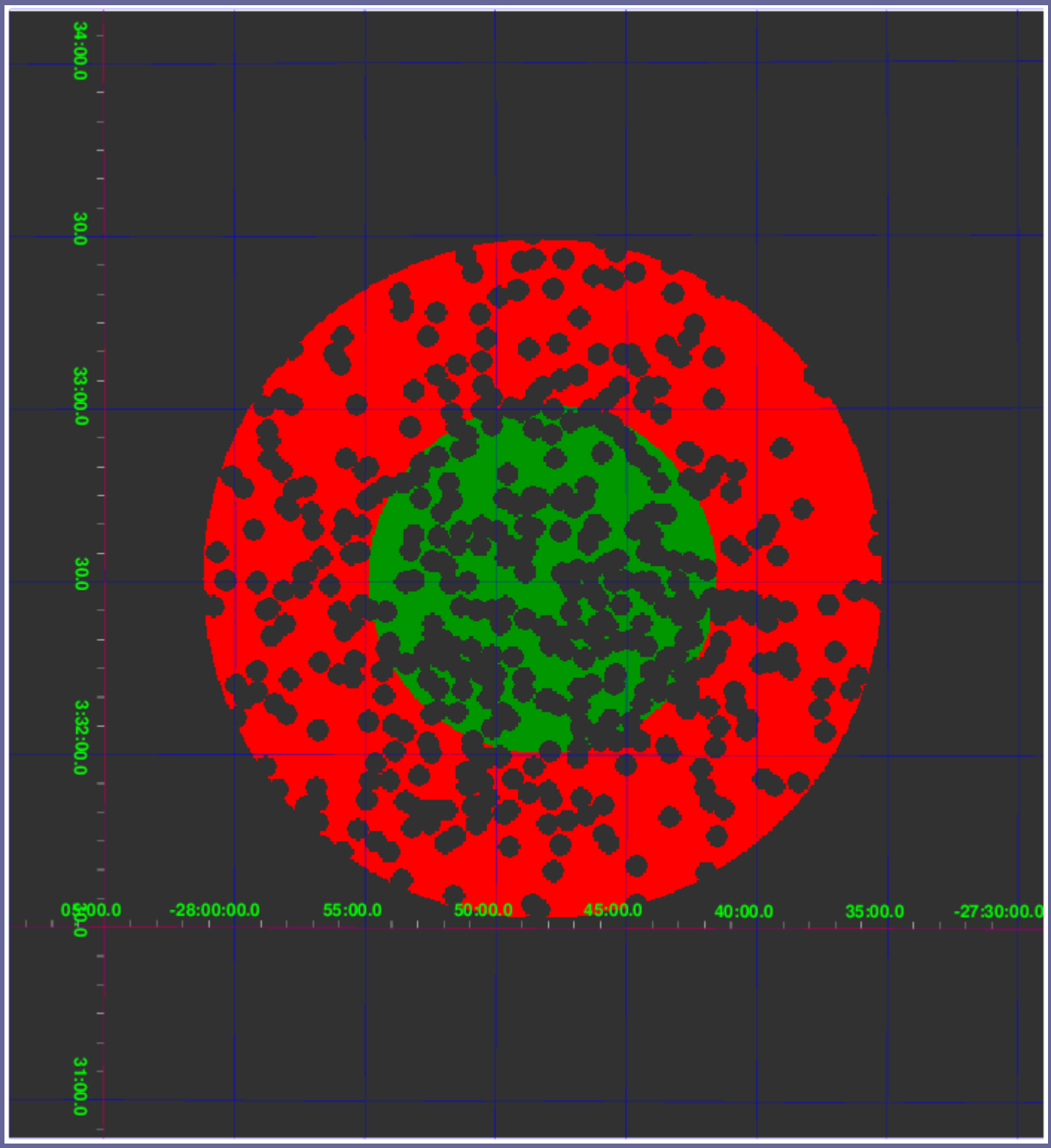
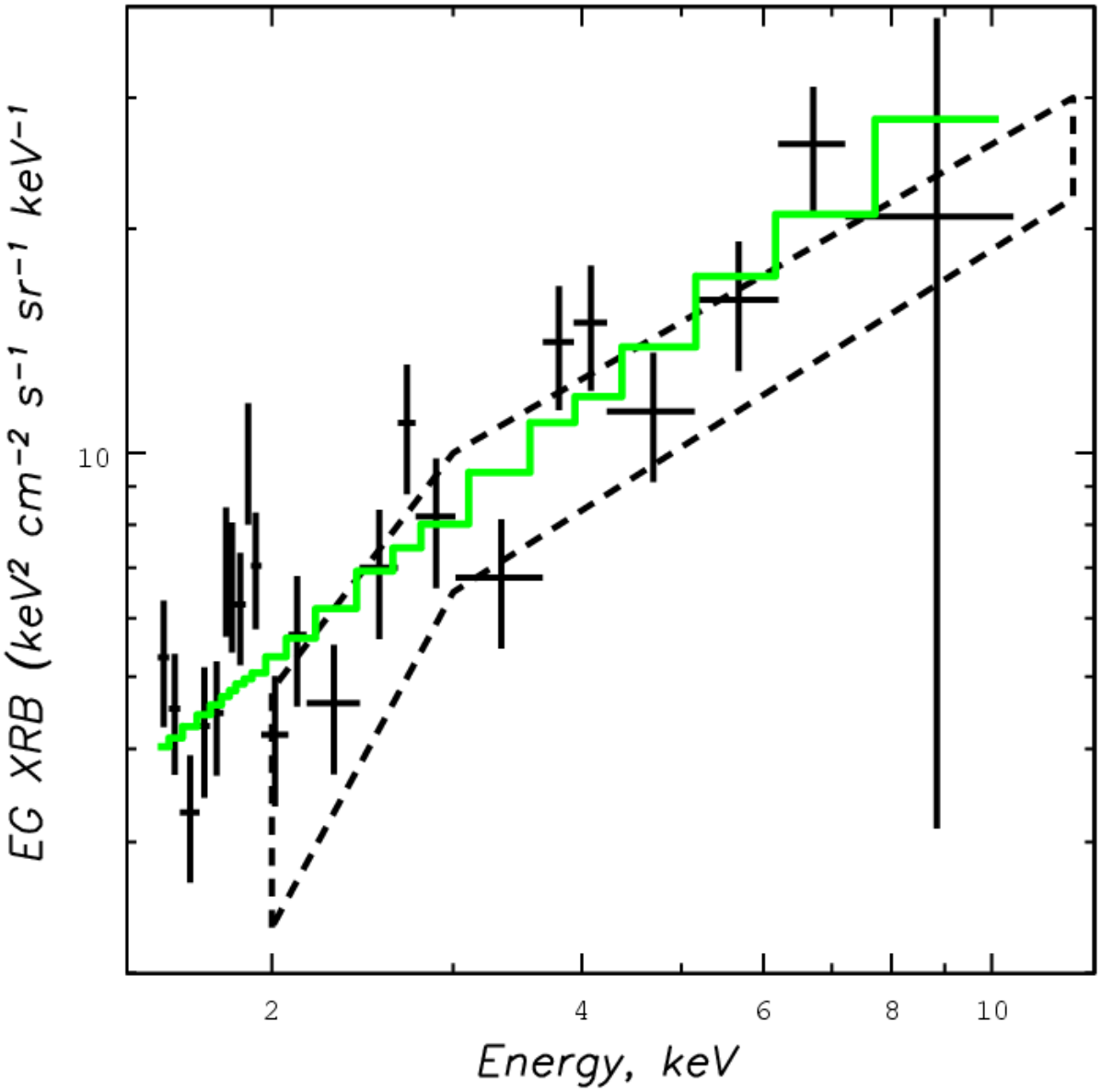


Figure 4. The total XRB as measured by the HEAO-1 missions (Gruber et al. 1999) but renormalised to the $2-8$ keV intensity observed by De Luca & Molendi (2003) (a scaling factor of ~ 1.4). The solid region indicates the $\Gamma = 1.75$, $N = 11 \pm 0.5$ keV cm^{-2} s^{-1} sr^{-1} keV^{-1} resolved spectrum and uncertainty. The dashed region indicates the residual unresolved component and uncertainty.

Strategy for background subtraction

- Observation is filtered for flares
- We use the Filter wheel closed accumulation of Michael Freyberg for pn
- The above is similar to De Luca & Molendi
- We remove the sources identified by both Chandra and XMM (5-10% residual contamination)
- Two regions are used to test the in-field background


34:00.0
30.0
33:00.0
30.0
3:32:00.0
30.0
31:00.0
-28:00:00.0
55:00.0
50:00.0
45:00.0
40:00.0
35:00.0
-27:30:00.0


EG XRB (keV² cm⁻² s⁻¹ sr⁻¹ keV⁻¹
10
2
4
6
8
10
Energy, keV

Components of the residual spectrum

- Hard X-ray background: 0.9-1.0 slope
- Galactic emission of 0.1 and 0.2 keV
- Intrumental background: quiescent soft protons

background slope 3

Flux is similar to total CXB

Conclusions

- Background in deep fields appears to be similar
- Initial problems with use of Andy Read‘s or David Lumb‘s background seems to resolve in difference in the cleaning
- A consistent answer to 2-10 keV Cosmoc background with De Luca&Molendi
- Quiescent soft proton flux is not evolving during 2002-2004