WFI Surveys with Athena: results from SIXTE simulations

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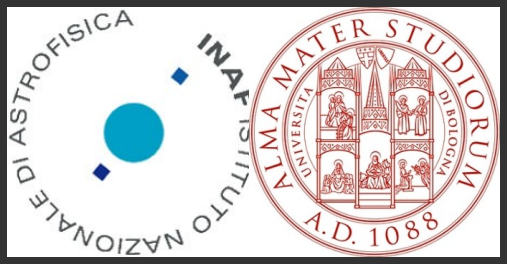
A. Comastri, J. Aird, M. Brusa, N. Cappelluti, R. Gilli, I. Matute...

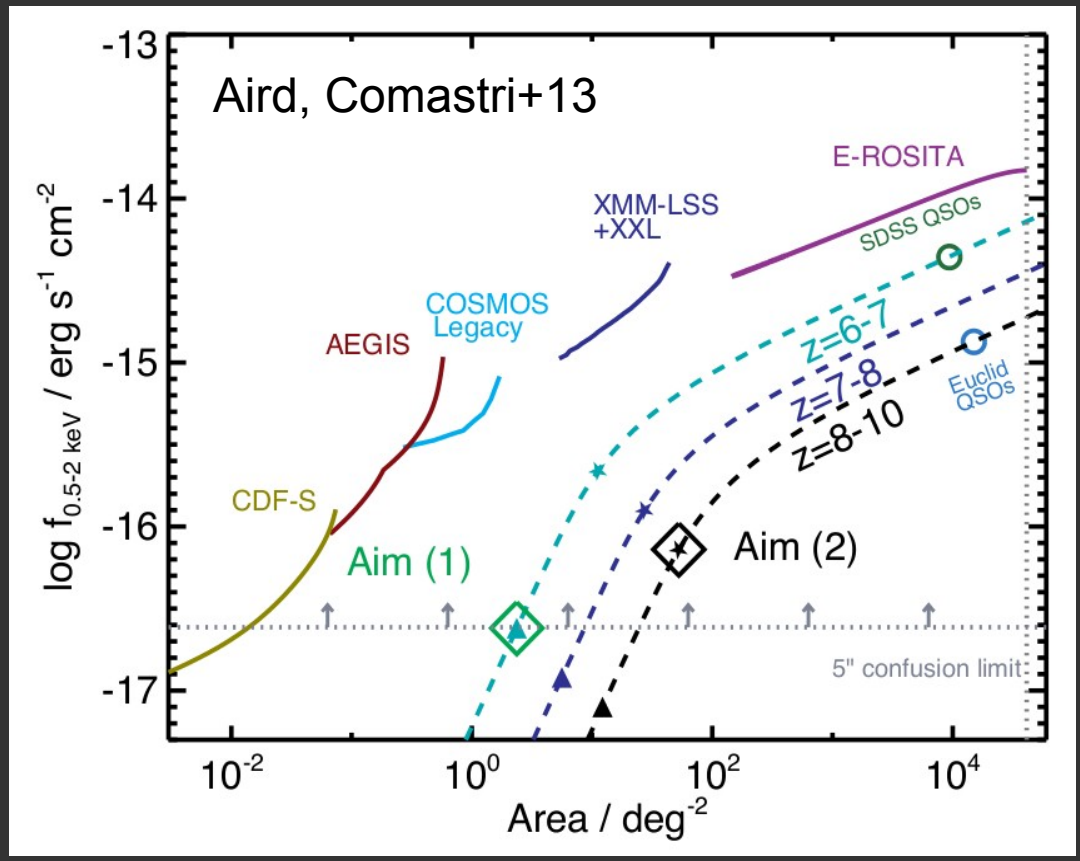


The X-ray Universe, Rome, 2017

High z AGN science

Detectet at least:
10 AGN at z=6-7 LogL_X=43-43.5 erg/s and 10 AGN at z=8-10 LogL_X=44-44.5 erg/s

Aim 1: flux limit 2.4×10^{-17} erg s^{-1} cm^{-2} over 2.4 deg^2
Aim 2: flux limit 7.2×10^{-17} erg s^{-1} cm^{-2} over 52.7 deg^2



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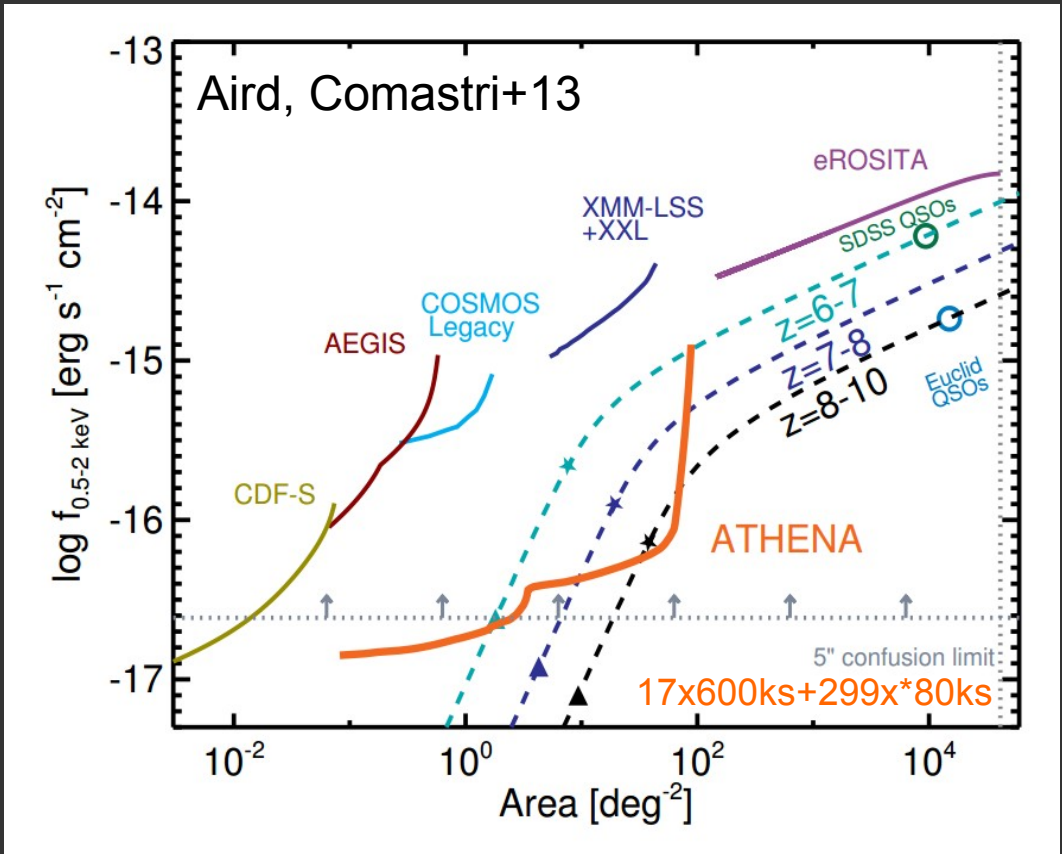

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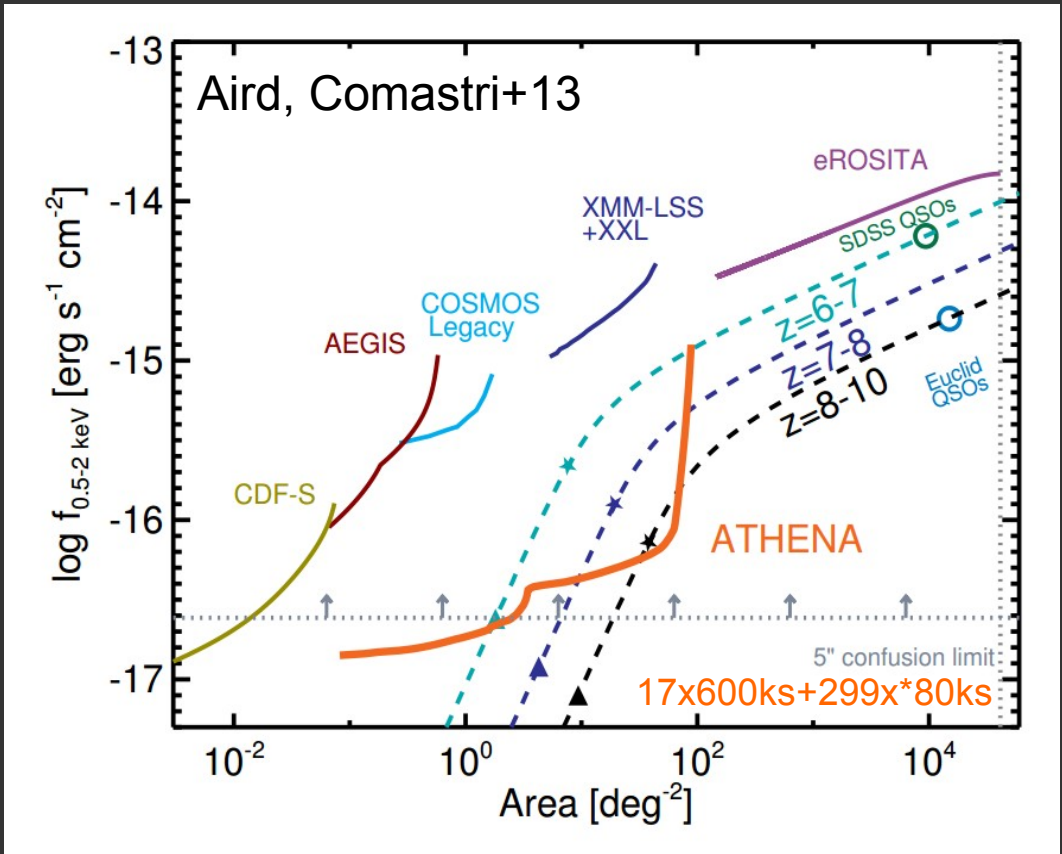
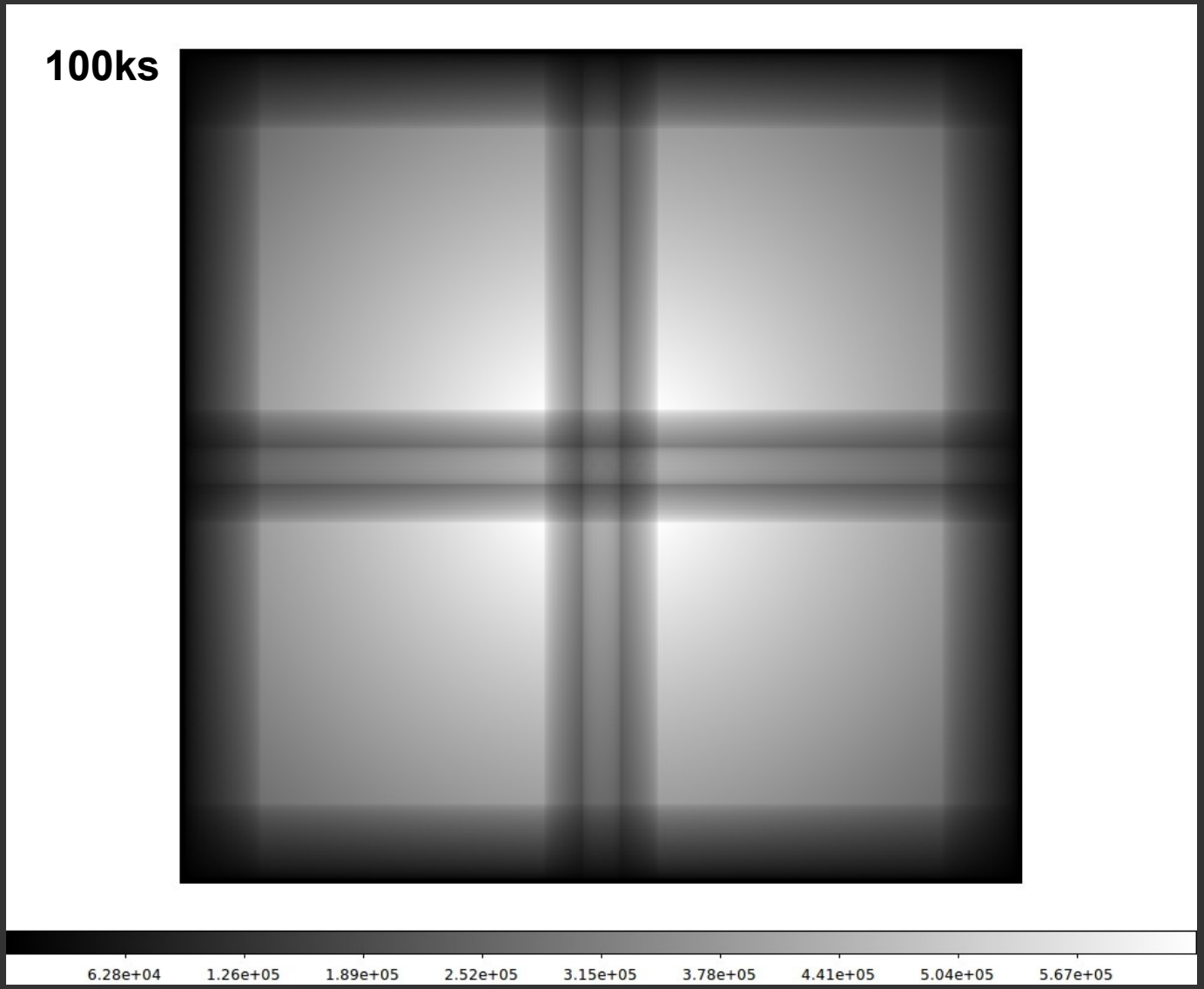
WFI survey >20% of MOP
(to address 5 Sci-OBJ
+Legacy value)

Test impact of dithering, survey configurations, different WFI geometry, stray light...



Effect of dithering

From SIXTE, with dithering



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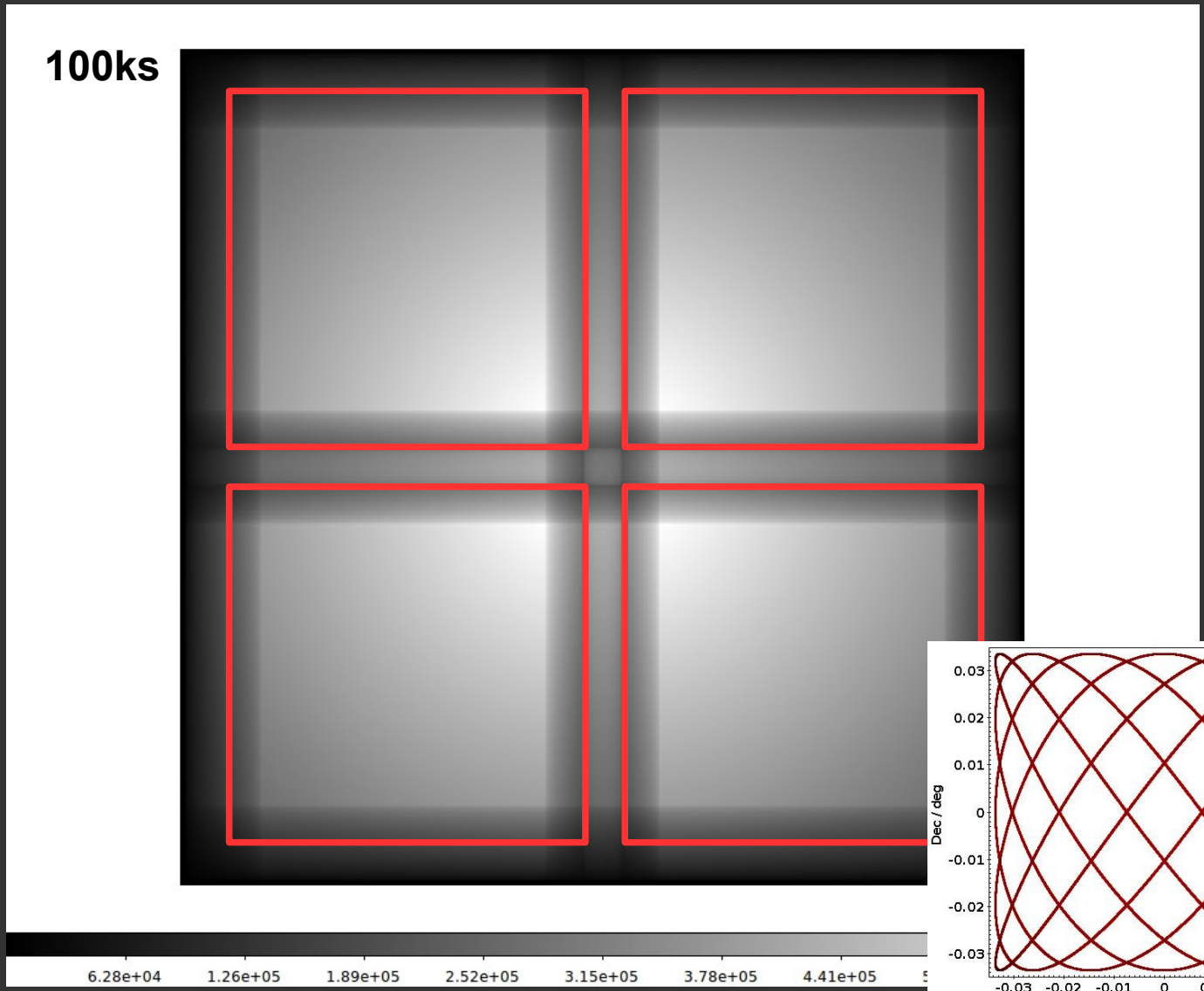
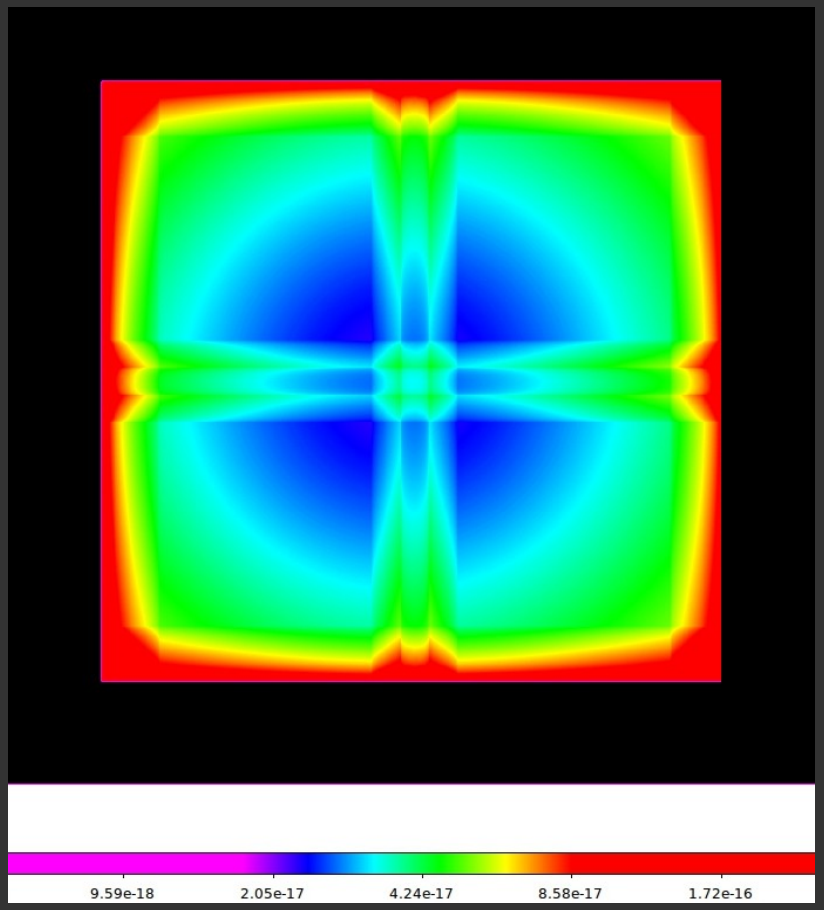
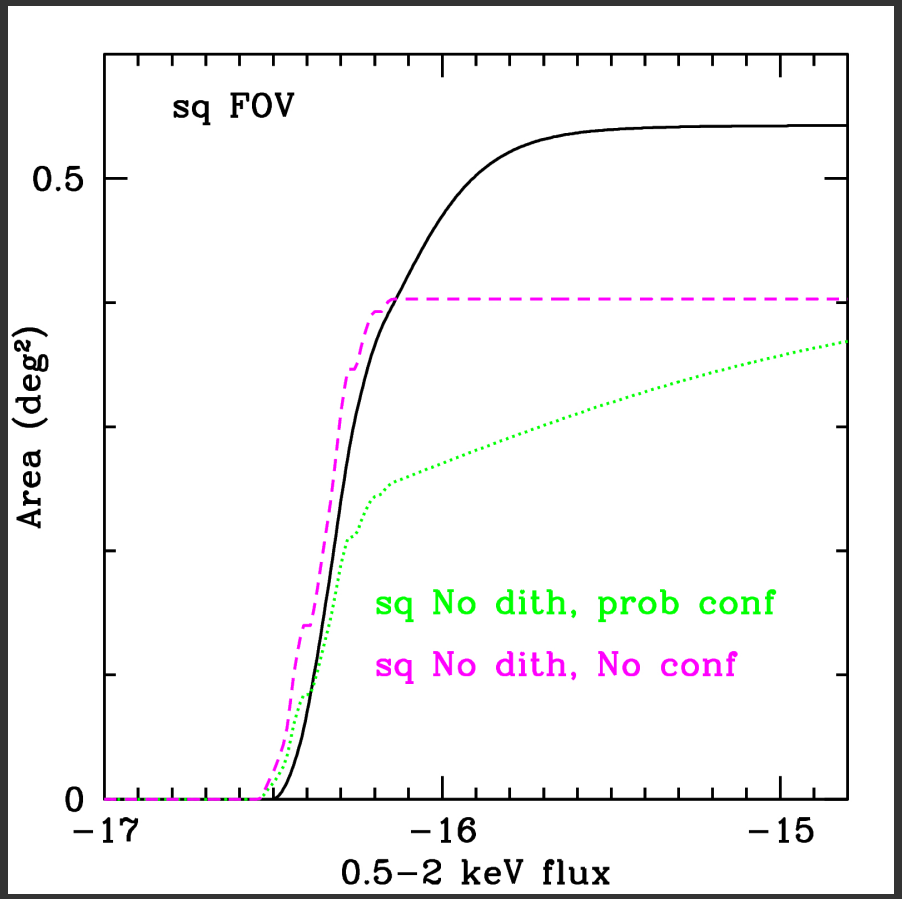


Senstivity Map



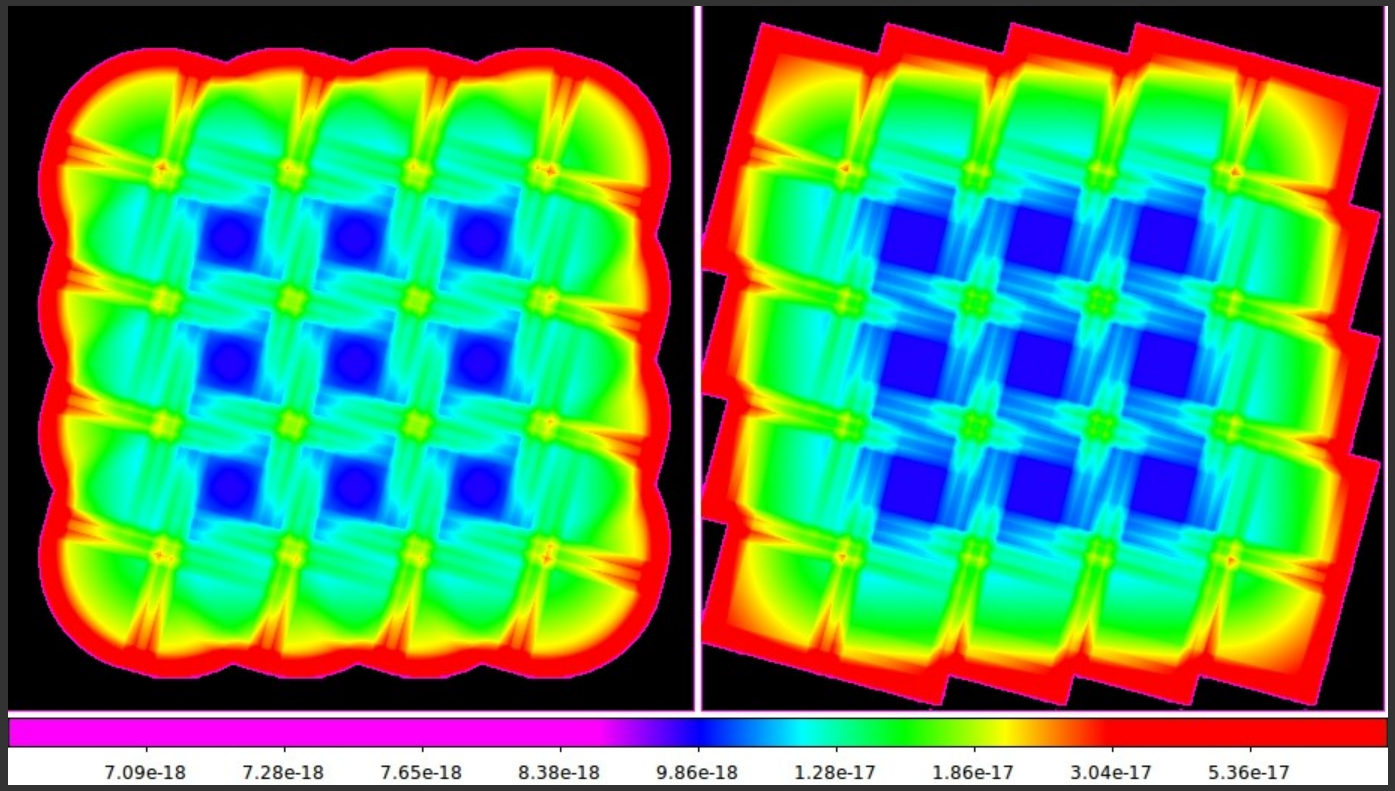


The dithering decrease the effective expo in the deepest part by ~15%
The total area is 0.54 deg^2 vs. 0.4 deg^2

Survey strategy

Aim 1= F_{Lim} 2.4×10^{-17} erg/s/cm^2 over 2.4 deg^2 in 7.2 Msec

COSMOS-like tiling (half FOV shift for each pointing)
→ Optimizes the PSF over the FOV

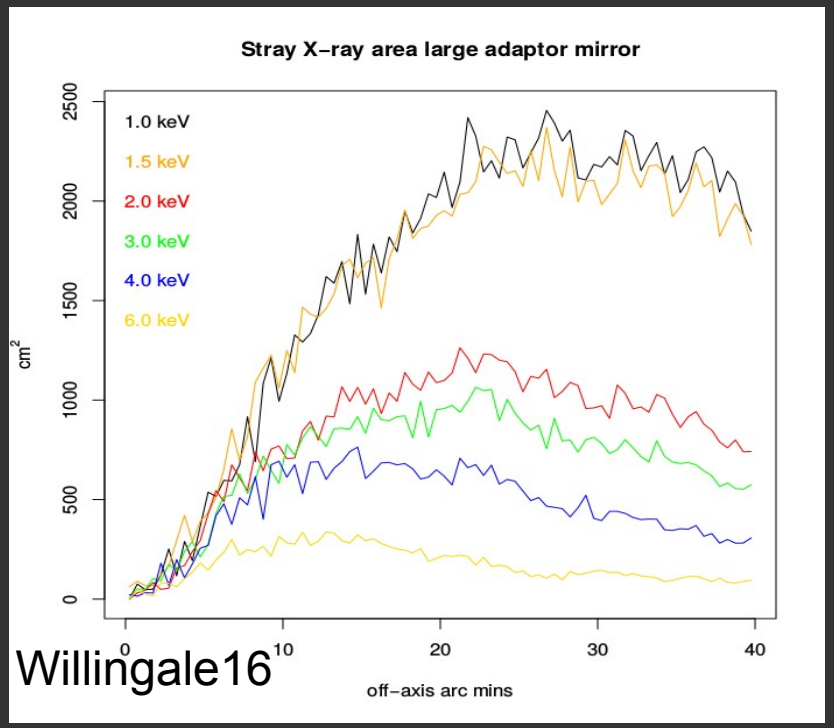


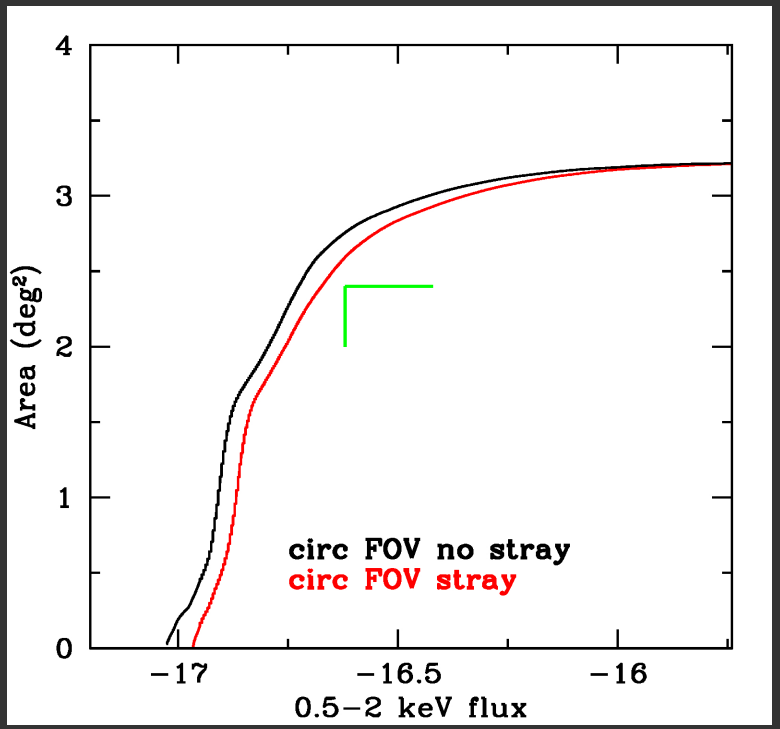
Stray-light impact

Test the effect of stray light, in the form of a stray-light “effective area”.

Thermal emission from Galactic foreground and contribution from extragalactic point sources

Flux-limit increase of **1.15** → expo time by **~30%** needed for Aim1 and Aim2

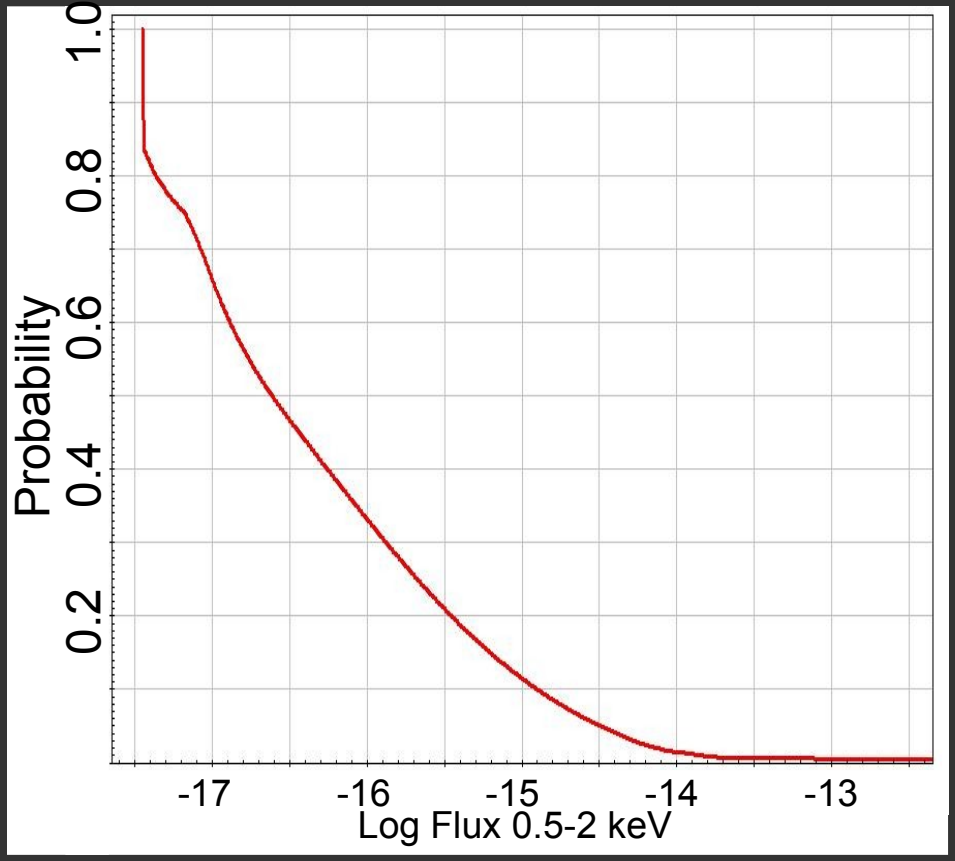




Confusion

There is no confusion effect included

Probabilistic confusion limit adopted in Aird+13: a source is not confused if isolated in a 20xBeam area (HEW=5")



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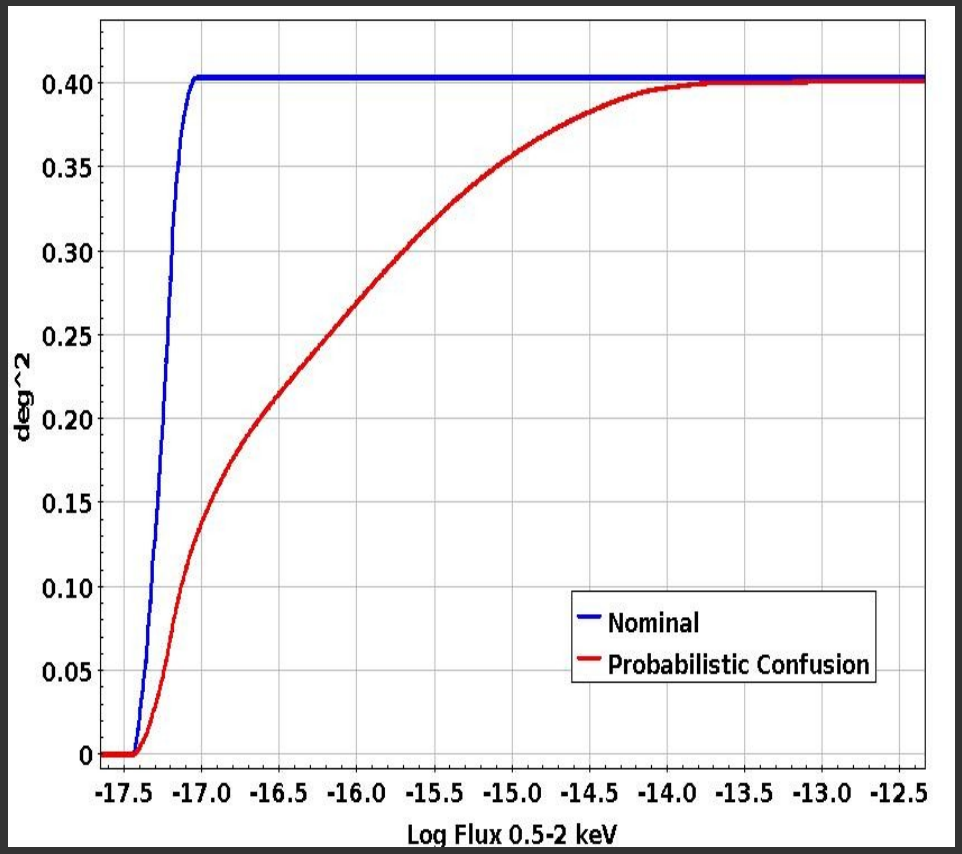

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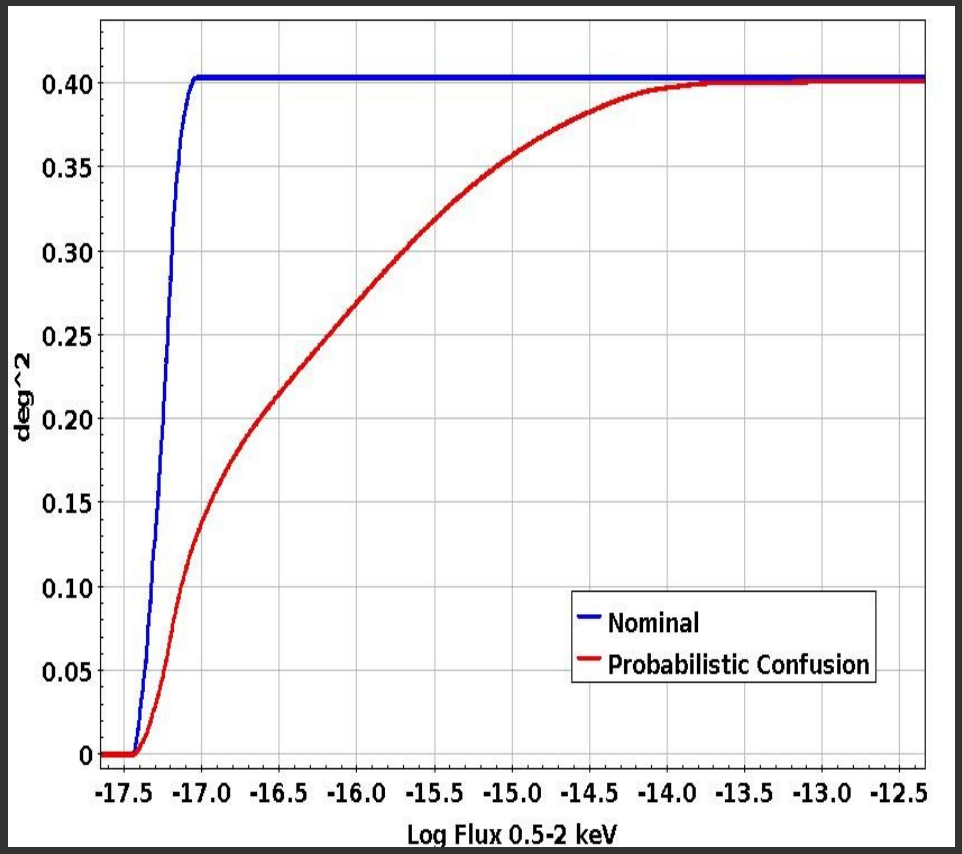
Too conservative approach?

In XMM-CDFS survey (Ranalli+13), a deep field with <FWHM>~8.5"

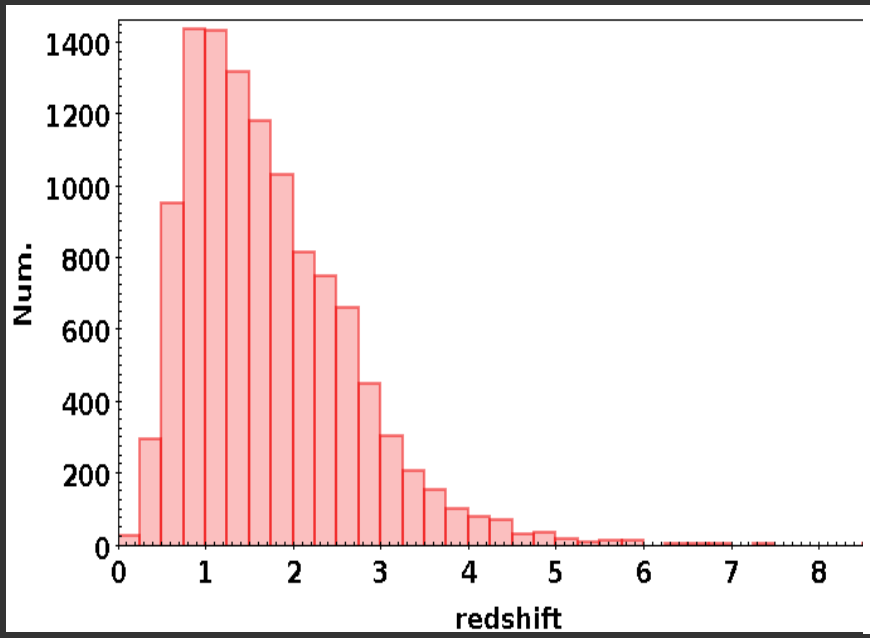
Detected:
- As 2 sources, 50% of the pairs separated by >2xFWHM

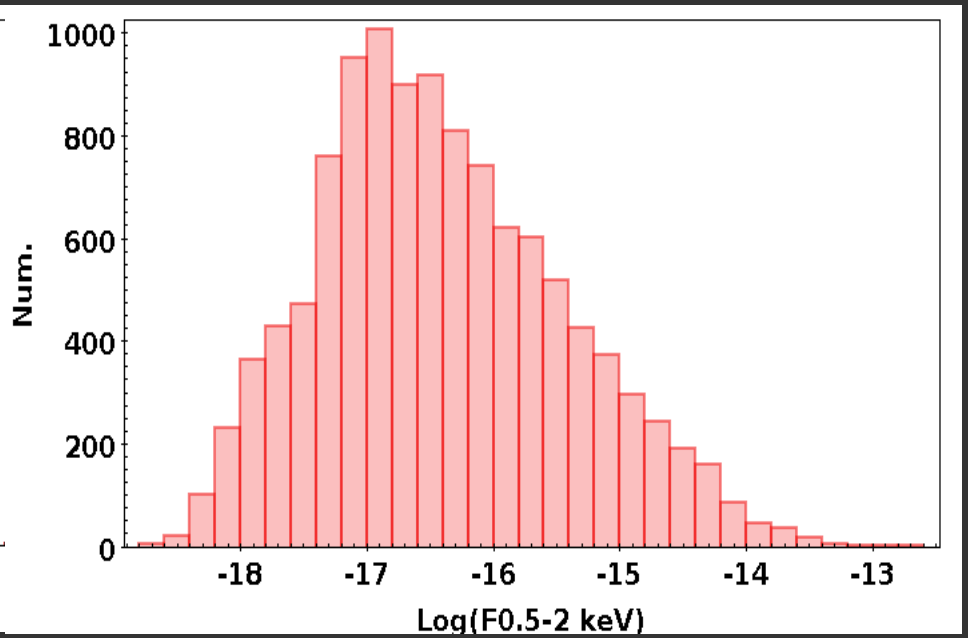
- As 1 source between 50 and 90% of the pairs separated by <2xFWHM



Full SIXTE simulation of a Deep Field

Input: Mock catalogs from Gilli+07 (no clustering)
~11000 sources in 1 deg^2, up to z=8, and with F0.5-2 down to -18.5
Each source has a value of N_H and z





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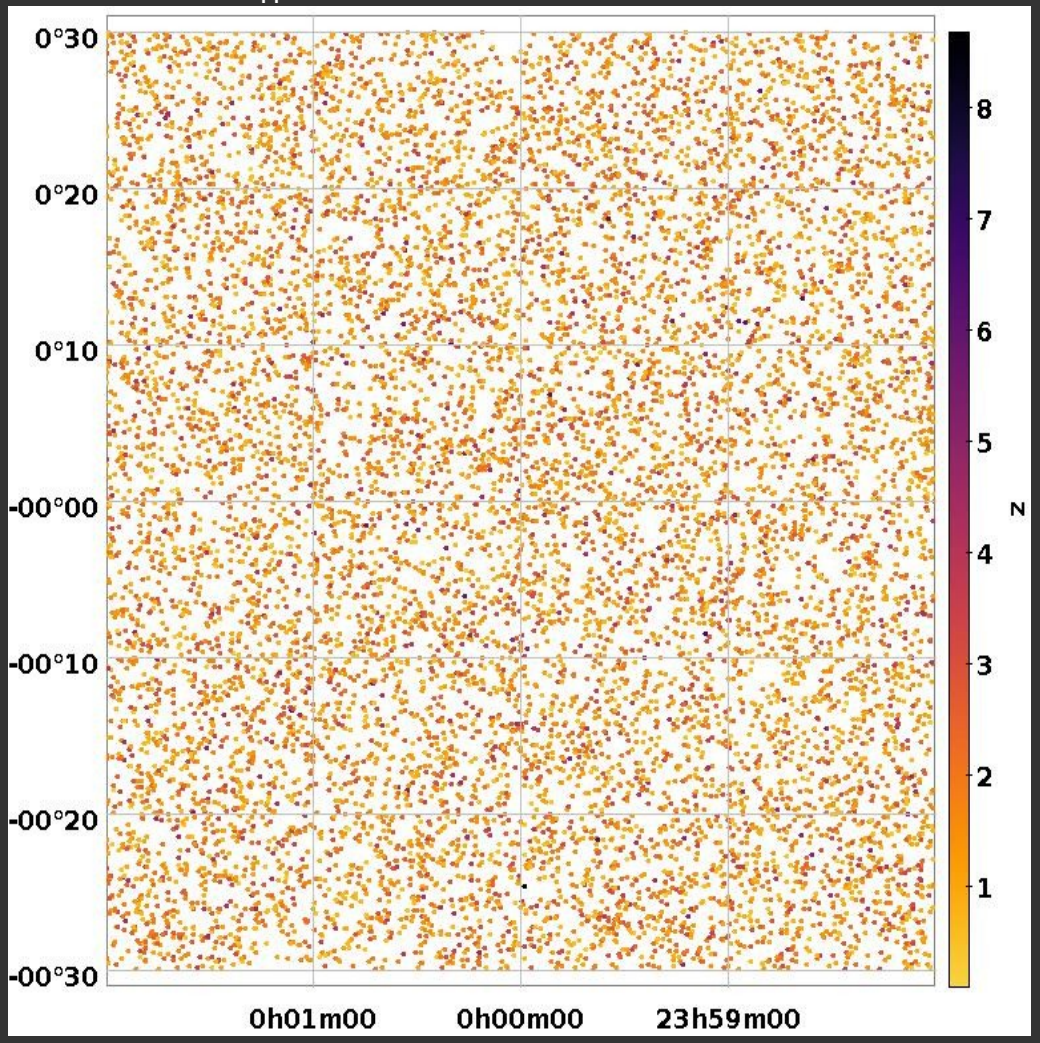
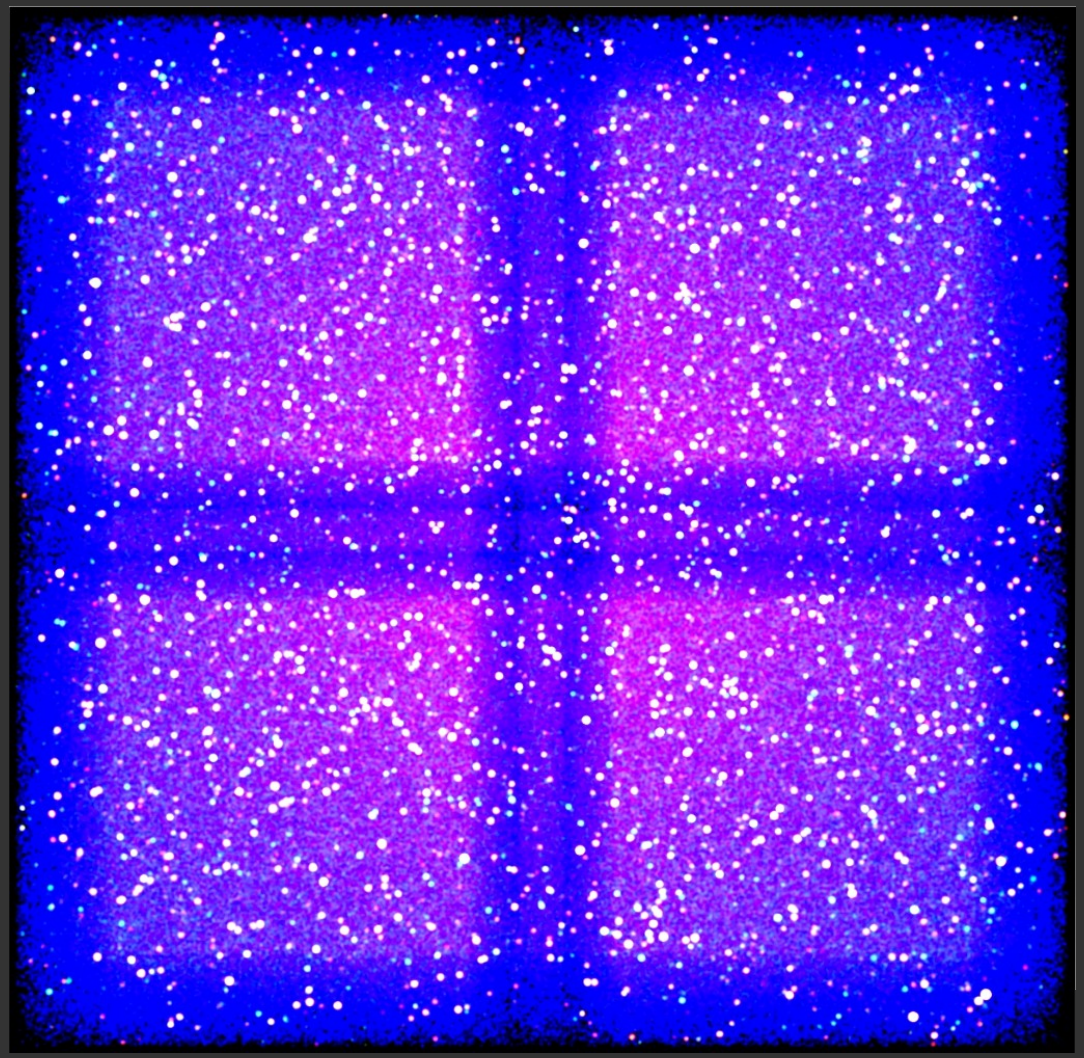


Full SIXTE simulation of a Deep Field

Result for a 600ks exposure (red 0.5-2, green 2-4.5 blue 4.5-10 keV)



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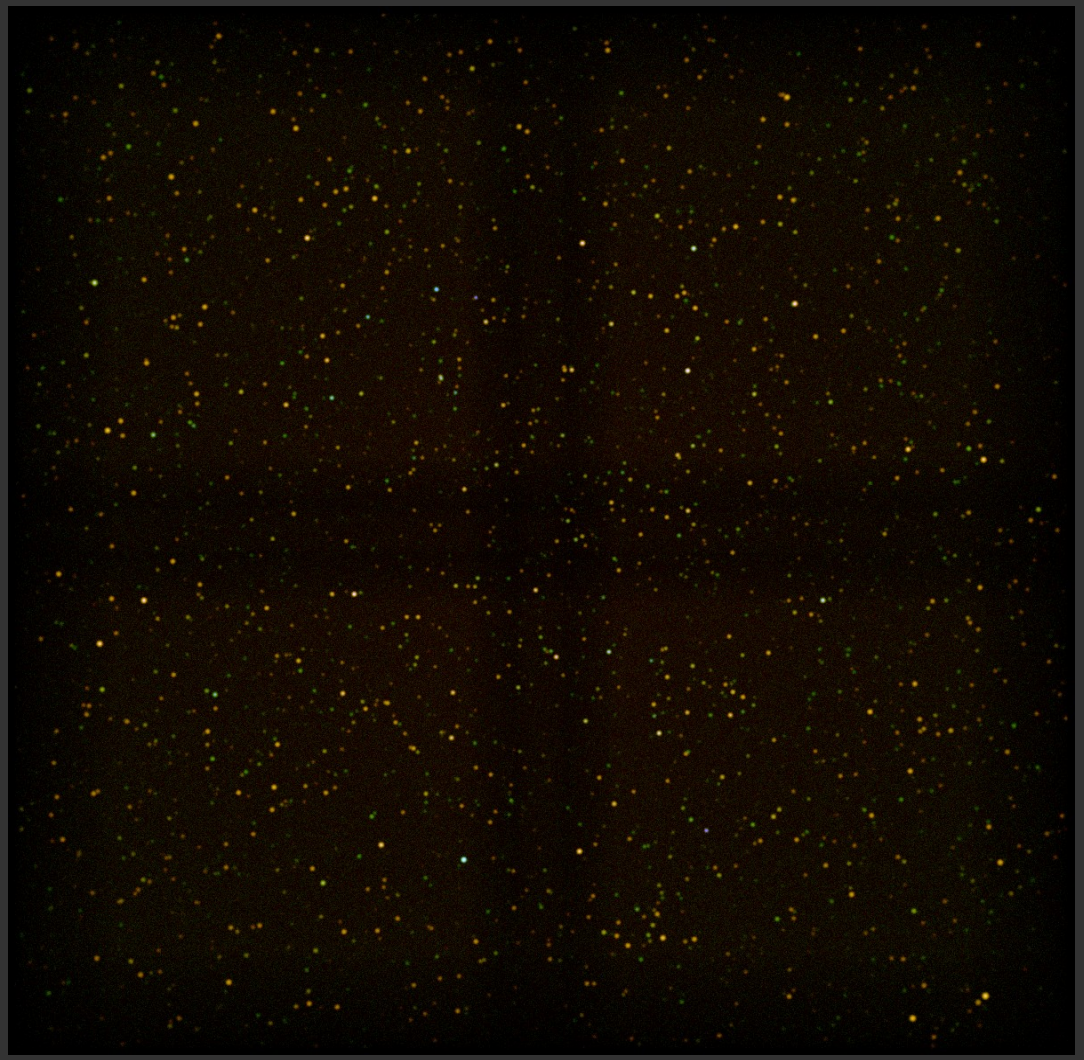
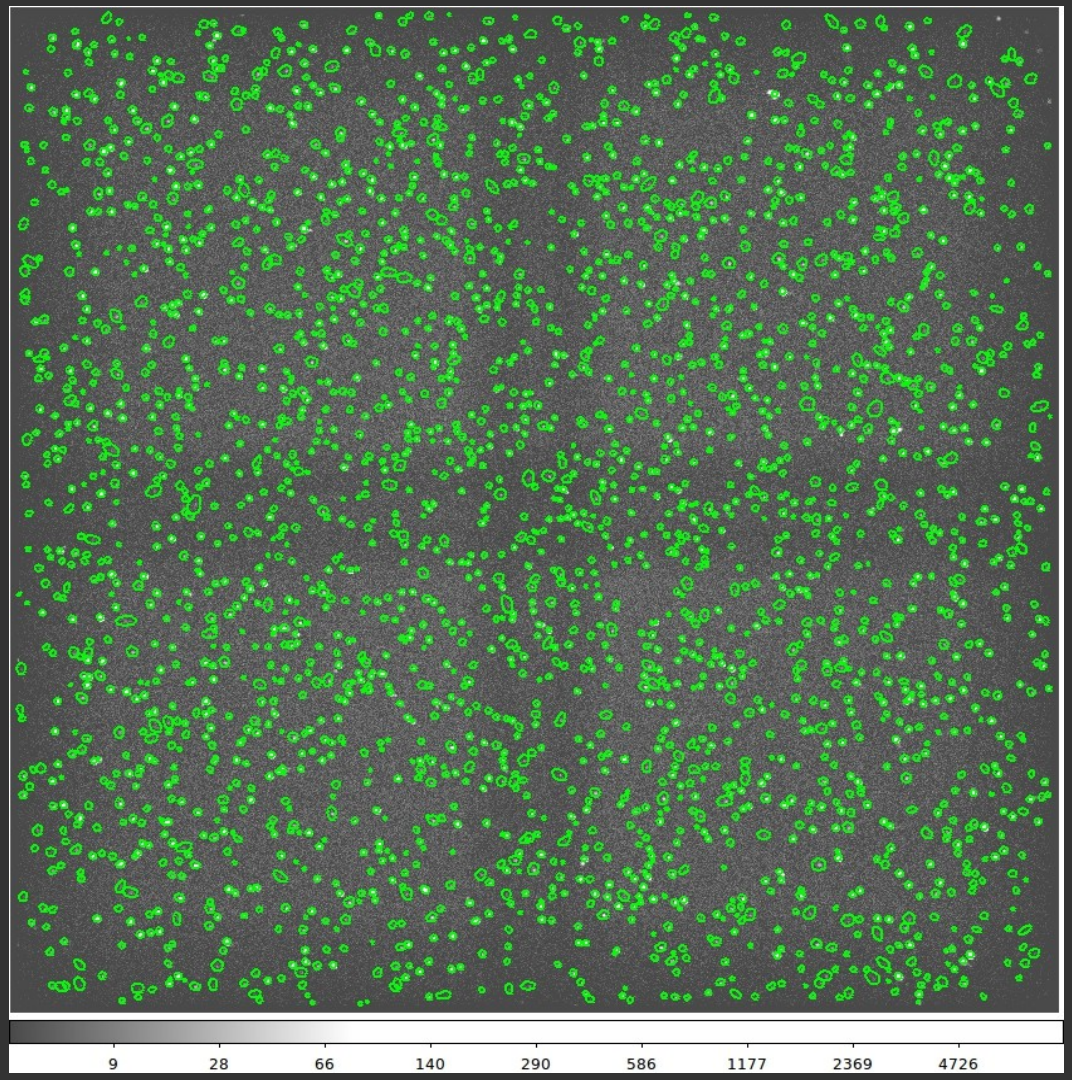


Source Detection

Run **wavdetect** on the 0.7-2 keV image → ~2800 sources detected



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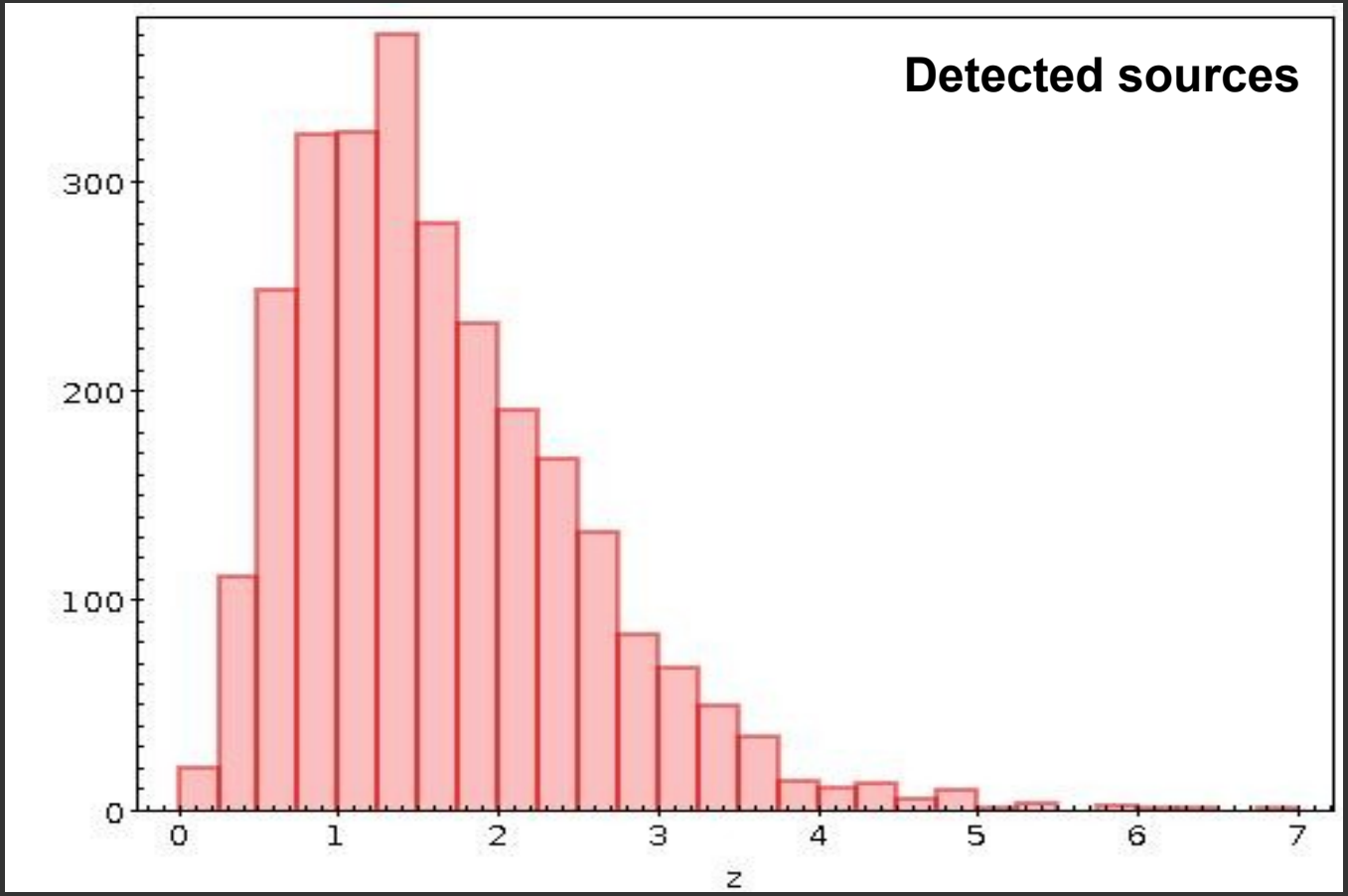
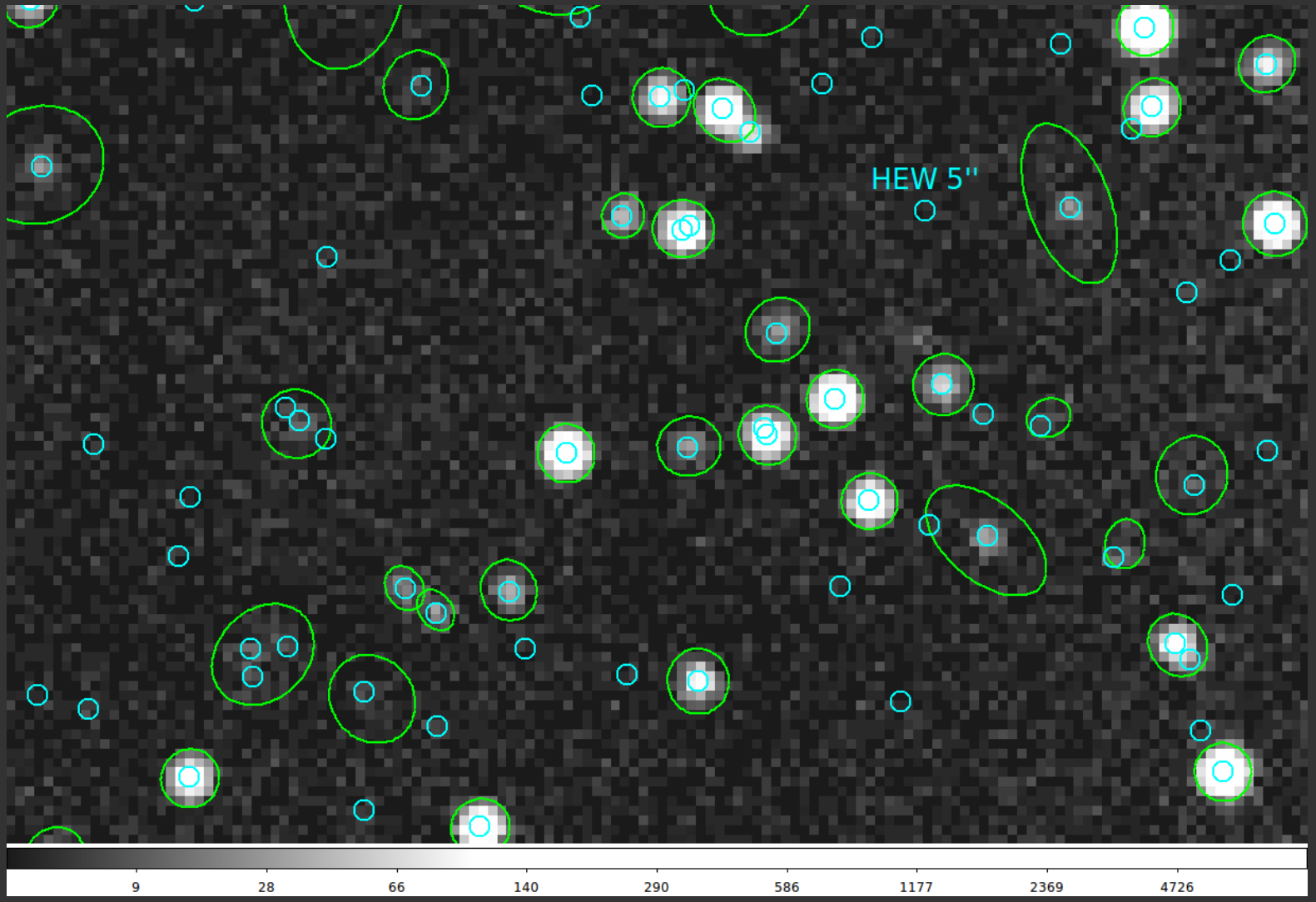


Zoom in...



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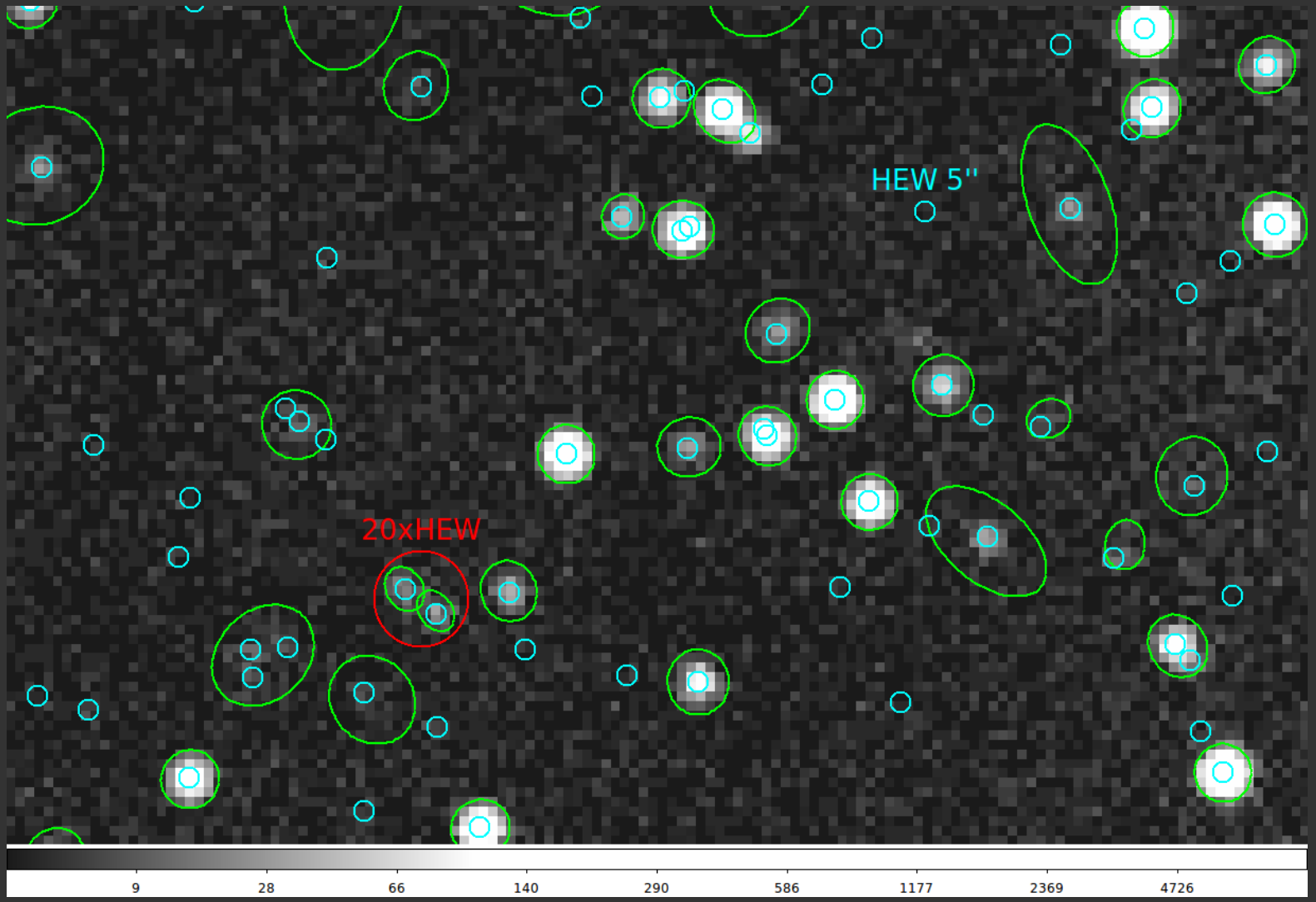
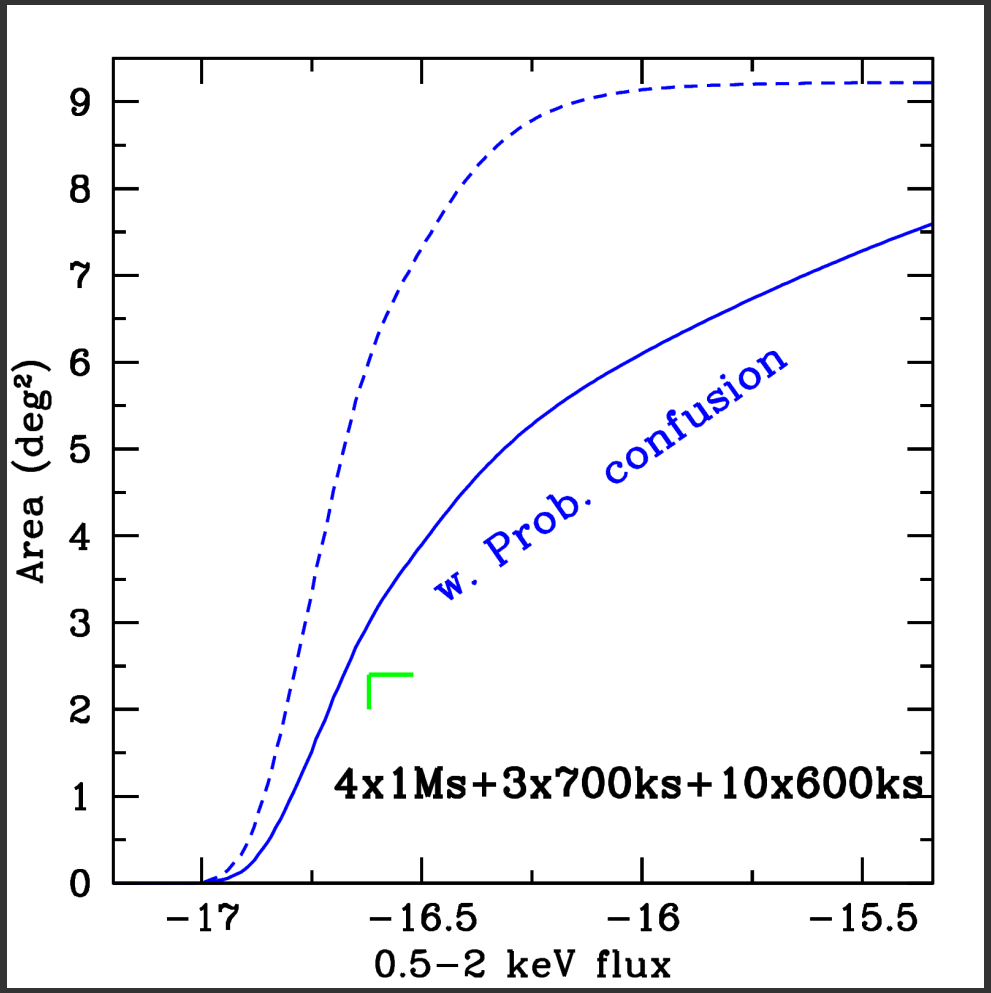


Modify confusion prescriptions?

Reduce the area to e.g. ~10xBeam?



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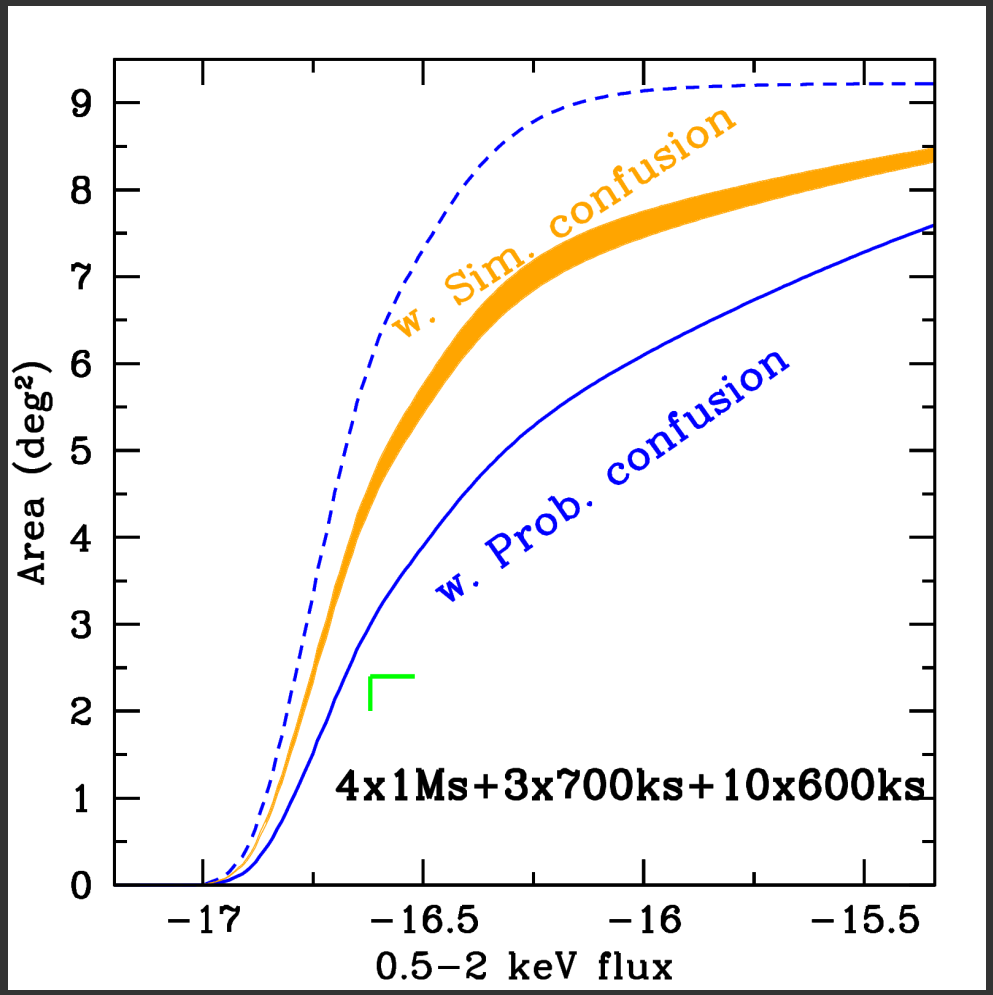
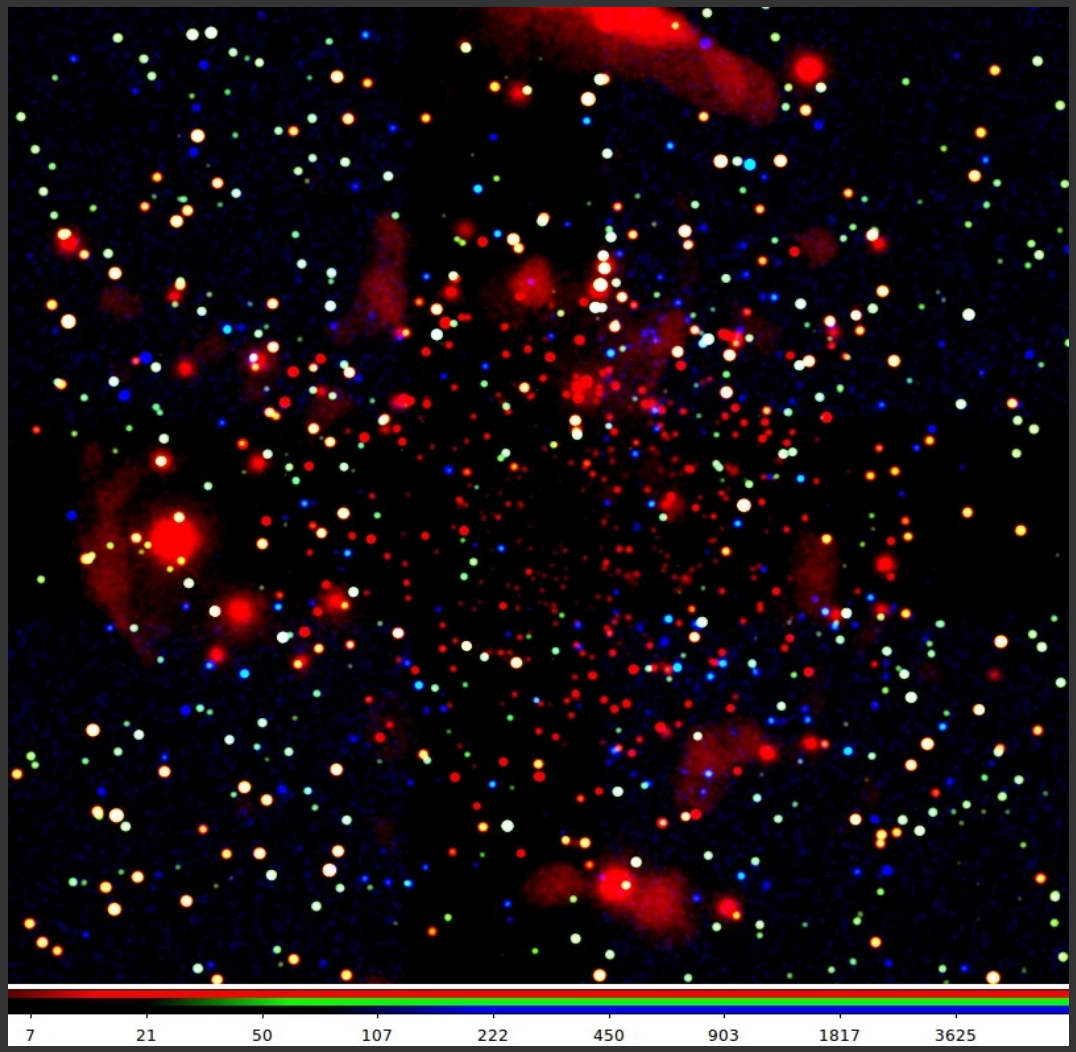


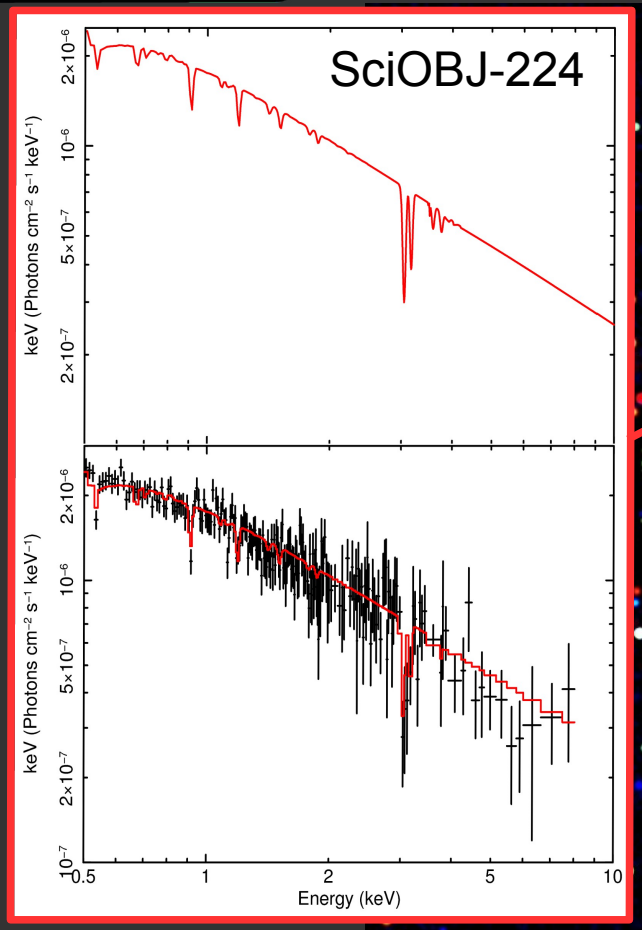
Modify confusion prescriptions?

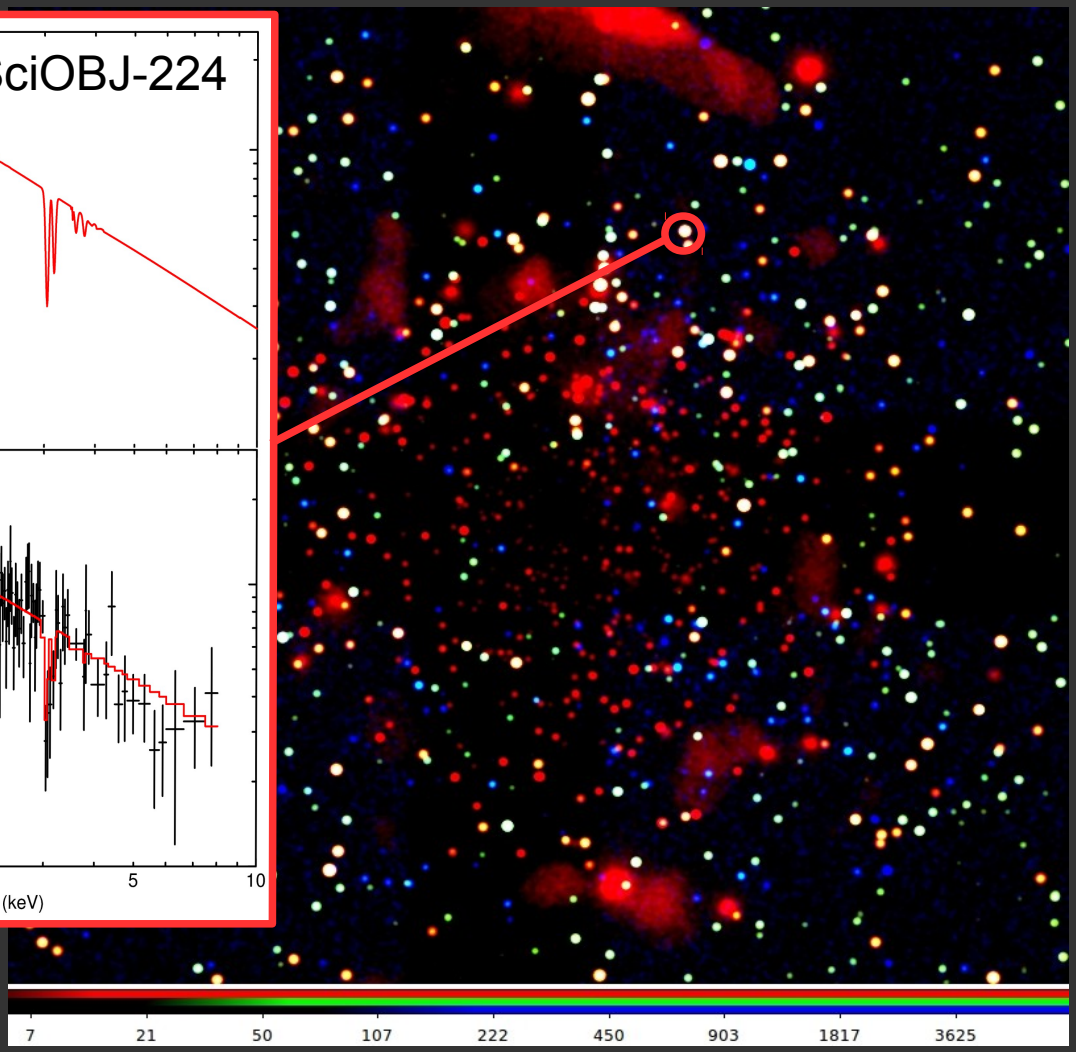
Adding clusters/galaxies and extended emission, the detection of high-z sources is less efficient...



Play with input spectra...

Try to recover spectral properties on input sources





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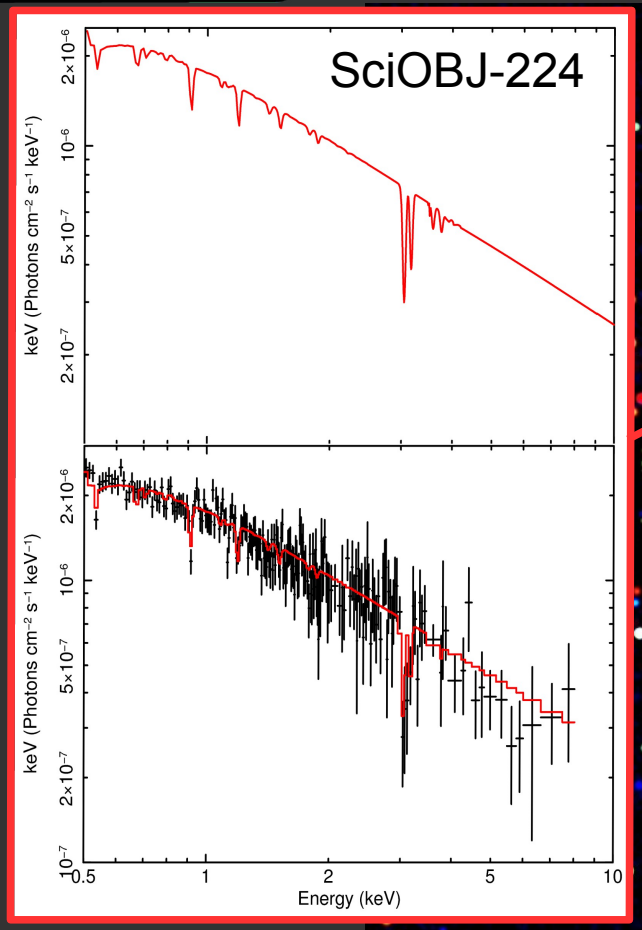
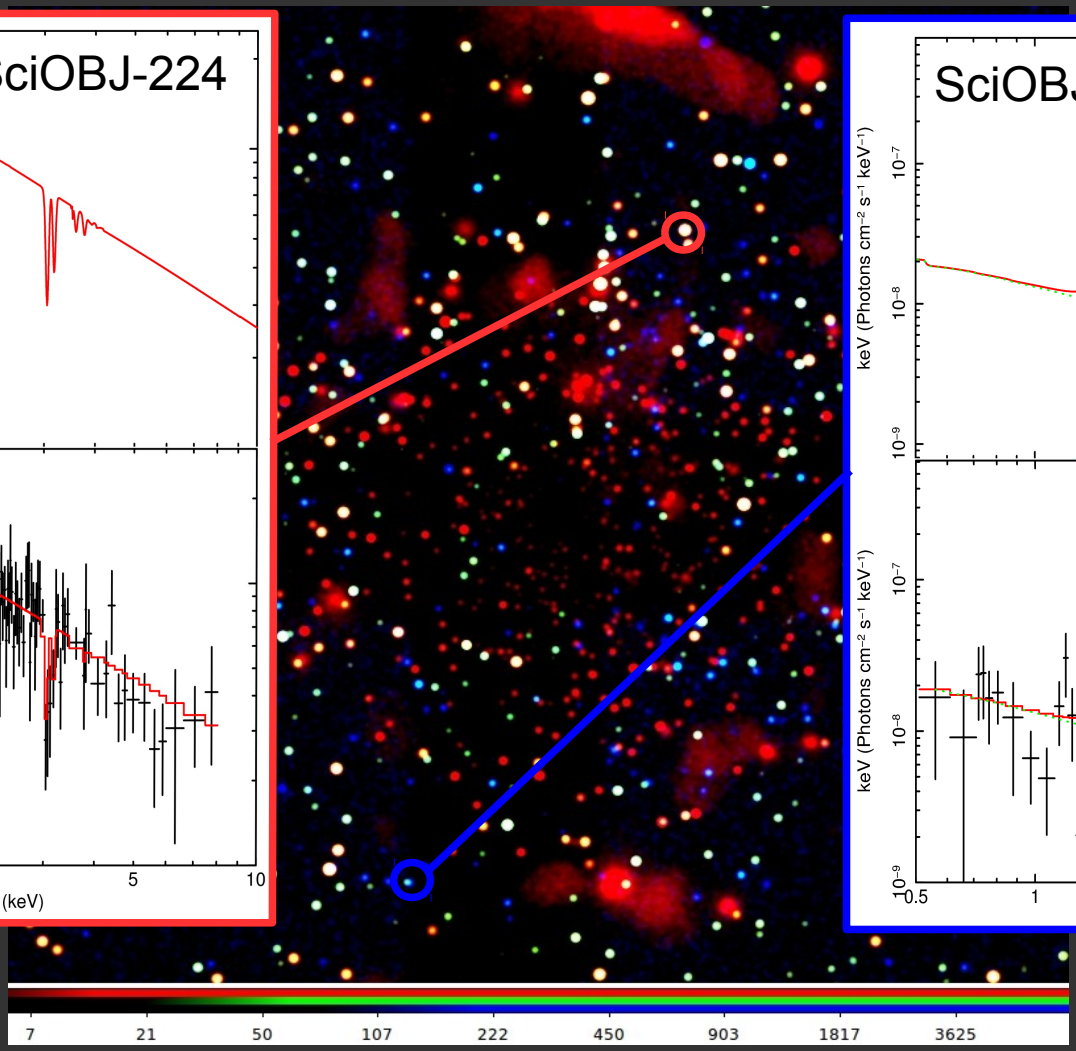
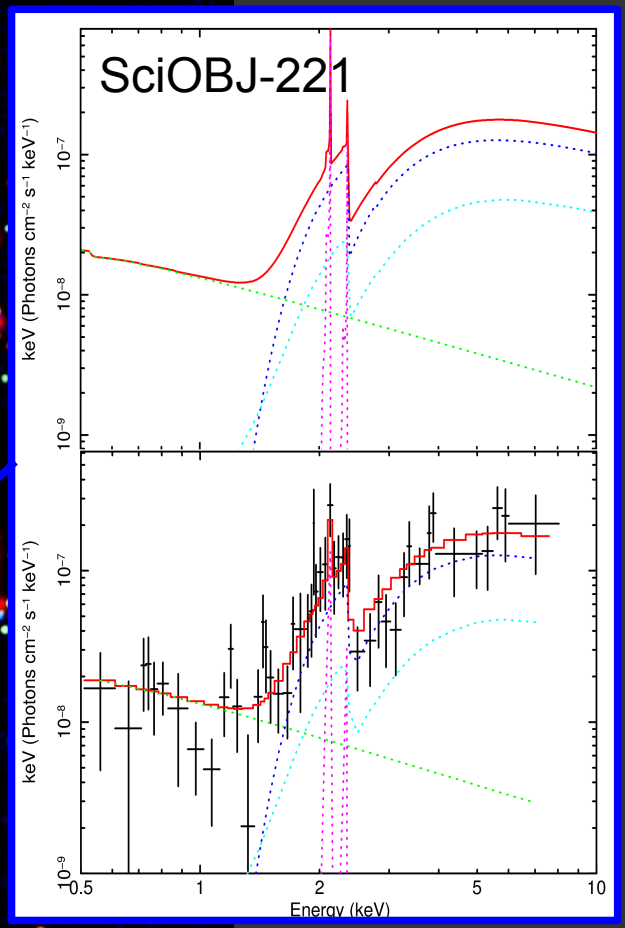




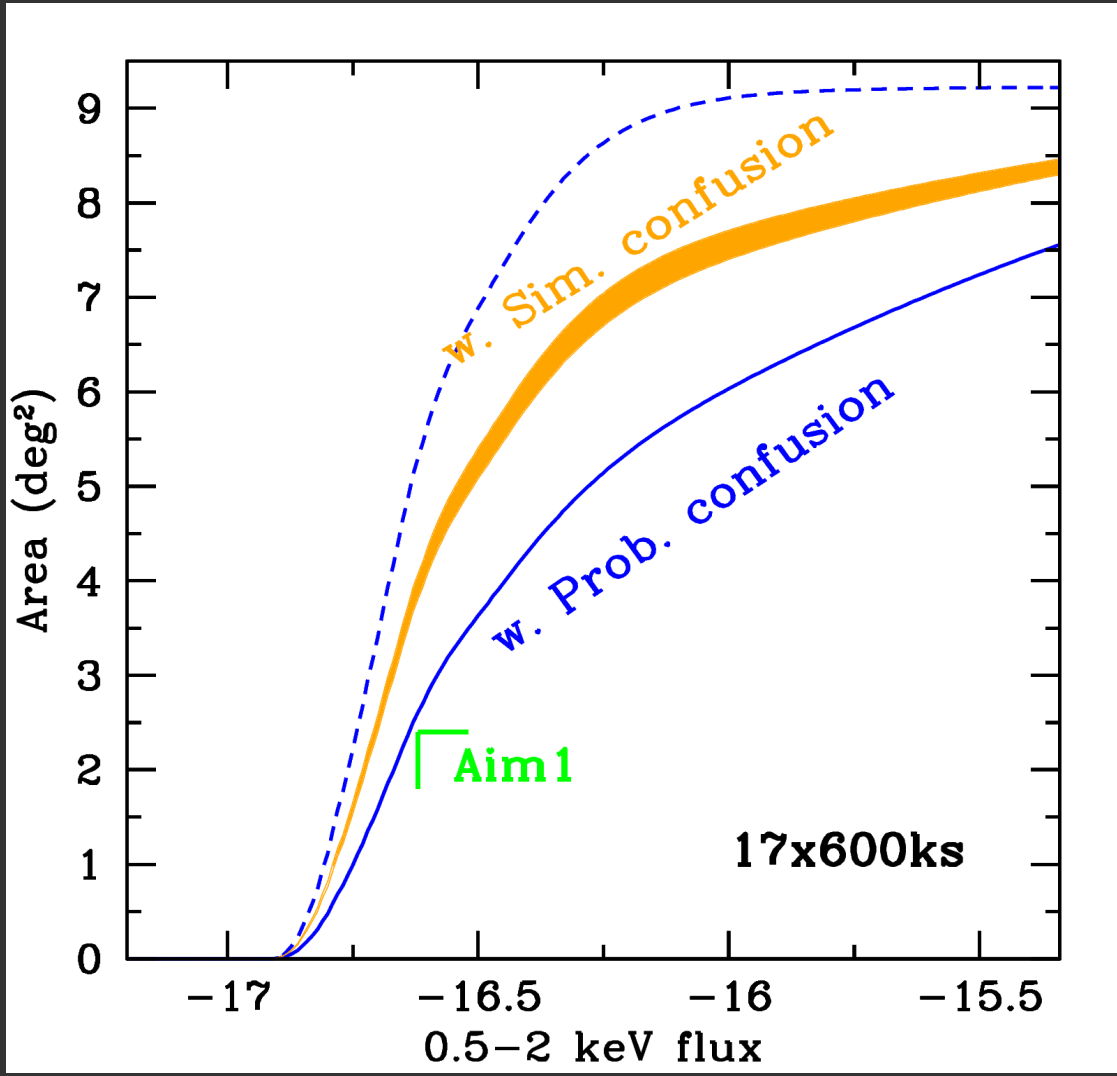


Conclusions

- Detailed simulations with SIXTE to test different instrumental setup effects, for fixed scientific objectives...
- We can get some more margin from a different treatment of the confusion...(still to be quantified!)
- This margin may be required when adding clustering, extended emission, etc...
- Use the Simulator(s)! (SIXTE, SIMX)

Extra Slides

Aim1 only


w. Sim. confusion
w. Prob. confusion
Aim1
17x600ks
Area (deg²)
0.5–2 keV flux
0
1
2
3
4
5
6
7
8
9
−17
−16.5
−16
−15.5

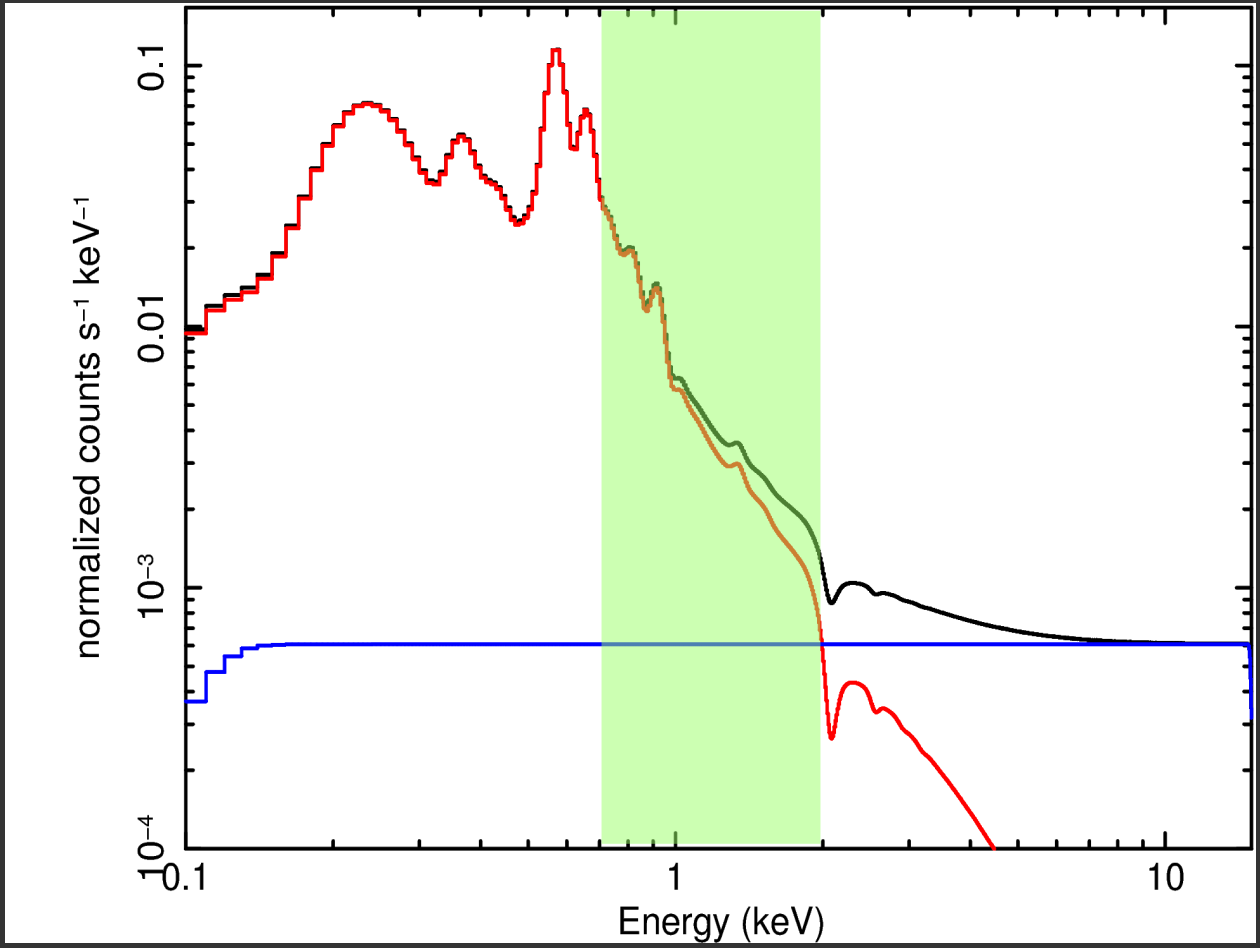
BKG counts maps

- Diffuse galactic foreground
- CXB (80% resolved)

} Vignetted

- particle background

0.7-2 keV
optimized to reduce bkg contribution



Source detection

- Effective Area

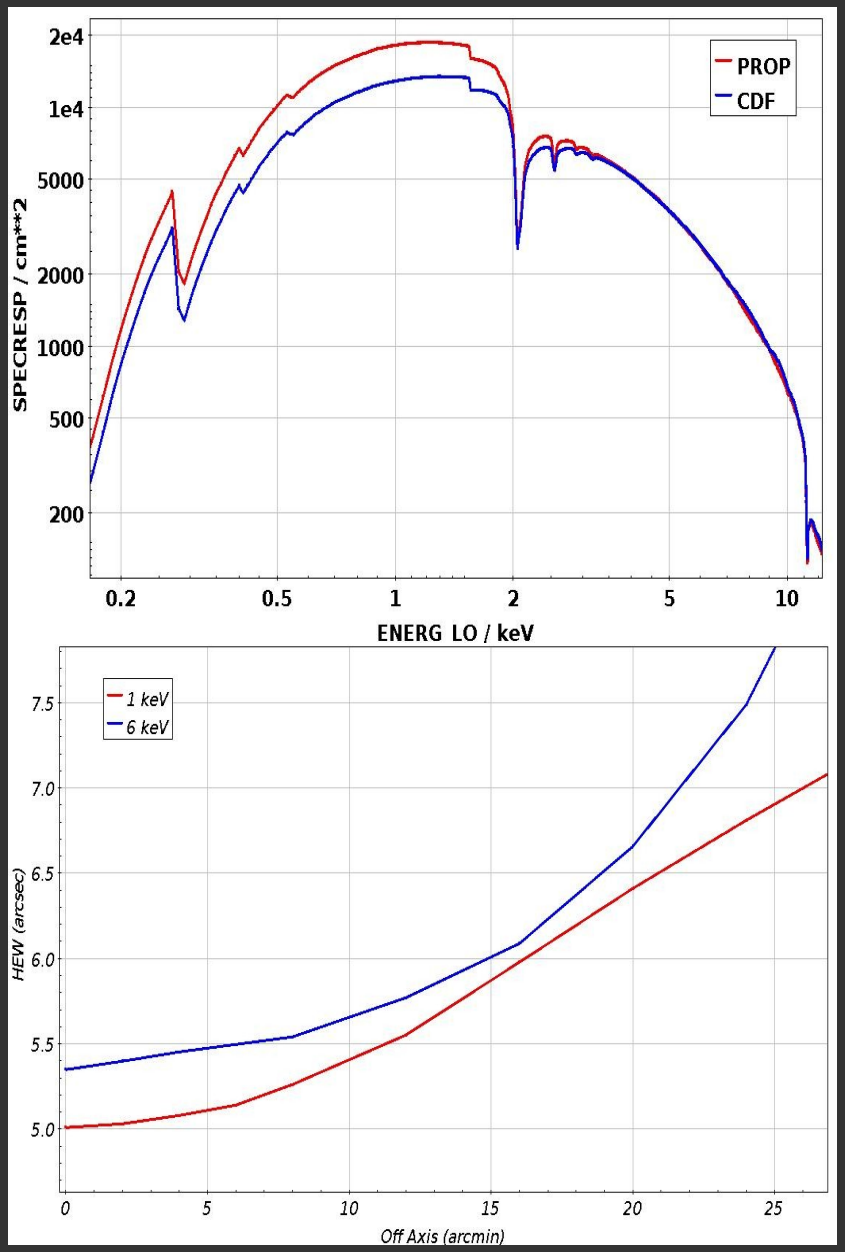
- PSF map

- Aperture photometry:

  Detection on a source area with radius 0.67xHEW

  10^{-6} probability of being bkg fluctuation

  ECF (0.7-2 keV counts to 0.5-2 keV flux) = 1.13×10^{-13}



Survey strategy

Aim 1= F_{Lim} 2.4×10^{-17} erg/s/cm^2 over 2.4 deg^2 in 7.2 Msec

7.2 Msec total exposure time fixed to Aird's value

No confusion

Aim1 can be reached with a 4x4x450s strategy with both sq. and circ. FOV

The deepest parts have an expo of 1.1Msec and F_{Lim} ~9×10^{-18} erg /s/cm^2