

# WFI Surveys with Athena: results from SIXTE simulations

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



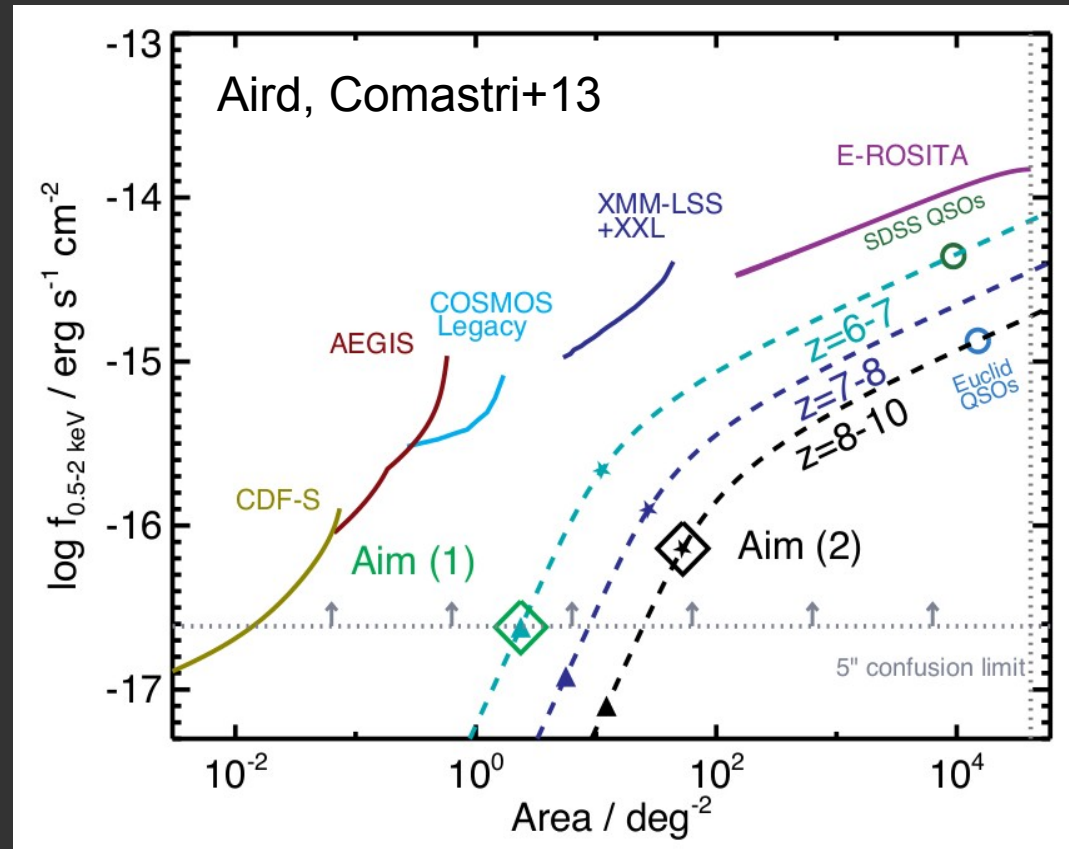
# High z AGN science

Detect at least:

10 AGN at  $z=6-7$   $\text{Log}L_x=43-43.5$  erg/s and 10 AGN at  $z=8-10$   $\text{Log}L_x=44-44.5$  erg/s

**Aim 1:** flux limit  $2.4 \times 10^{-17}$  erg s $^{-1}$  cm $^{-2}$  over 2.4 deg $^2$

**Aim 2:** flux limit  $7.2 \times 10^{-17}$  erg s $^{-1}$  cm $^{-2}$  over 52.7 deg $^2$



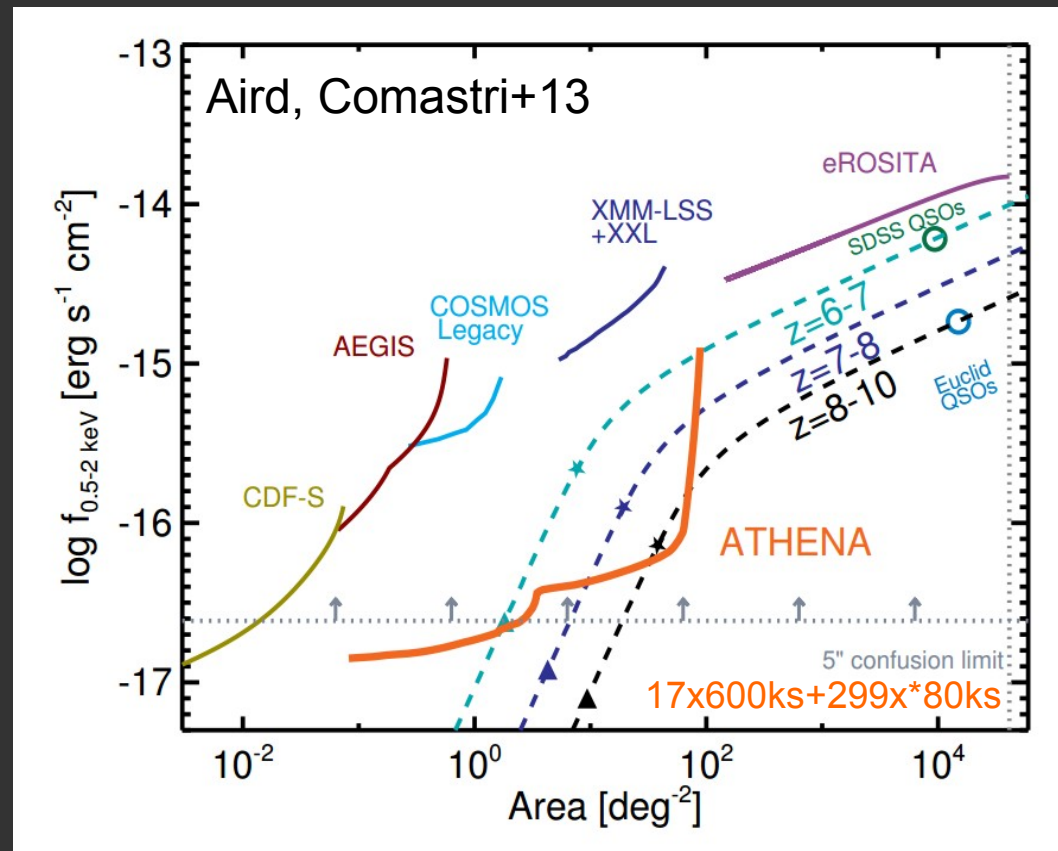
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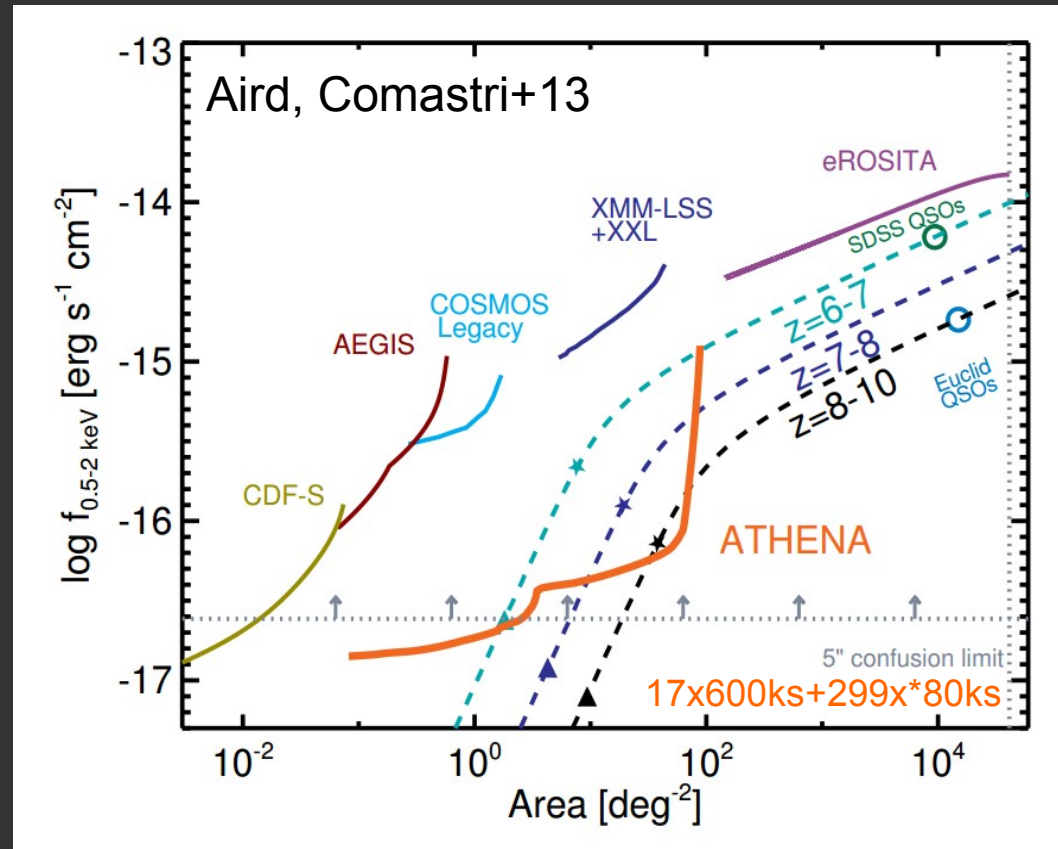
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WFI survey  $>20\%$  of MOP  
(to address 5 Sci-OBJ  
+Legacy value)

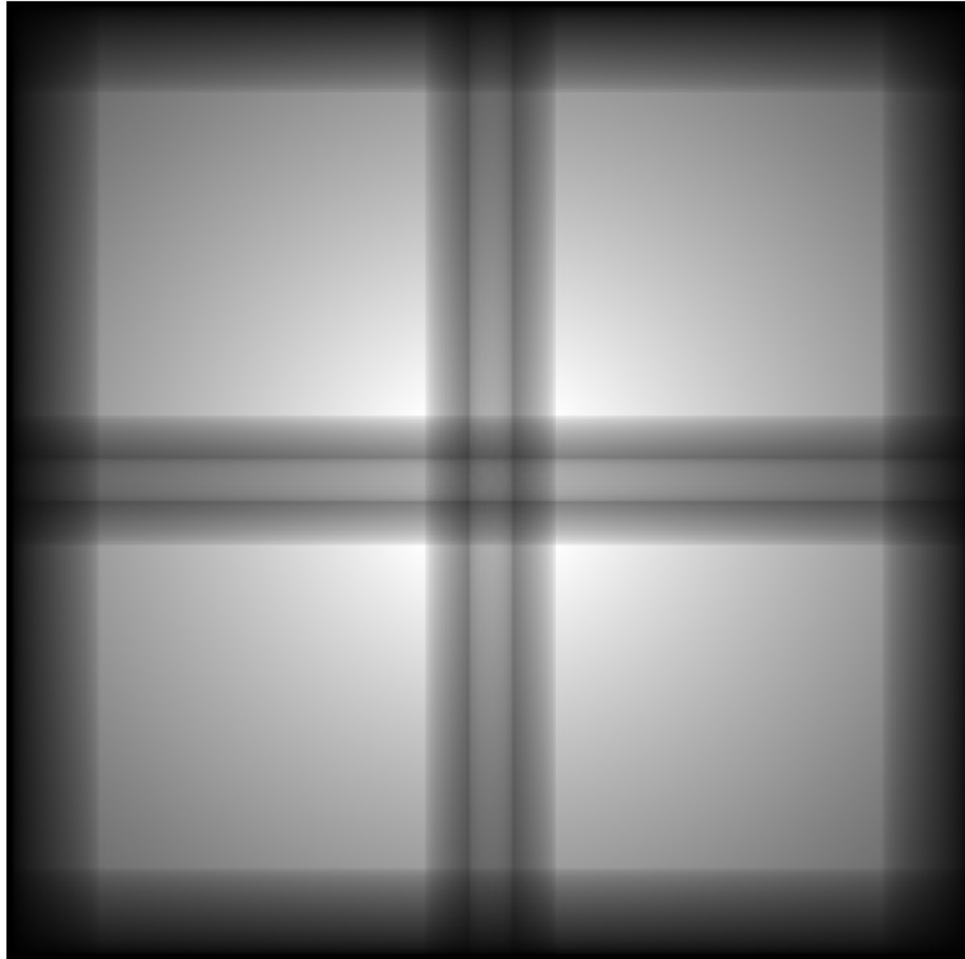
Test impact of dithering, survey  
configurations, different WFI  
geometry, stray light...



# Effect of dithering

From SIXTE, with dithering

100ks

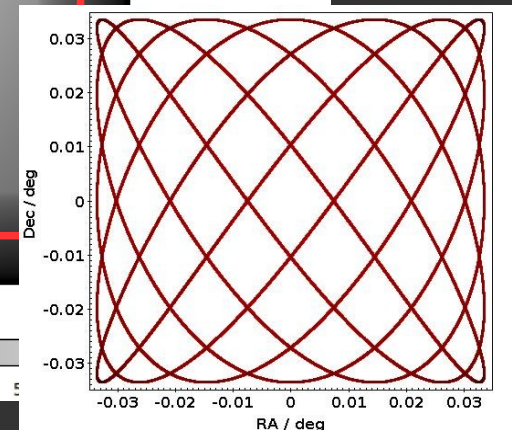
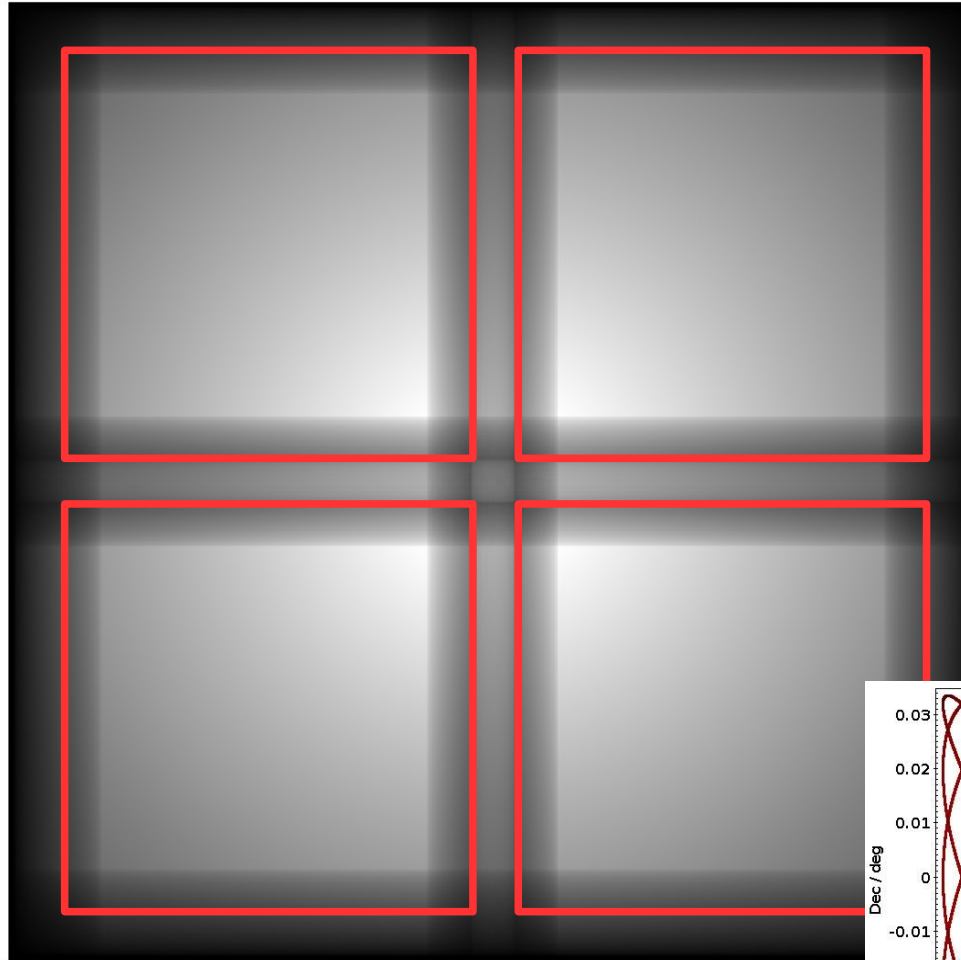


6.28e+04 1.26e+05 1.89e+05 2.52e+05 3.15e+05 3.78e+05 4.41e+05 5.04e+05 5.67e+05

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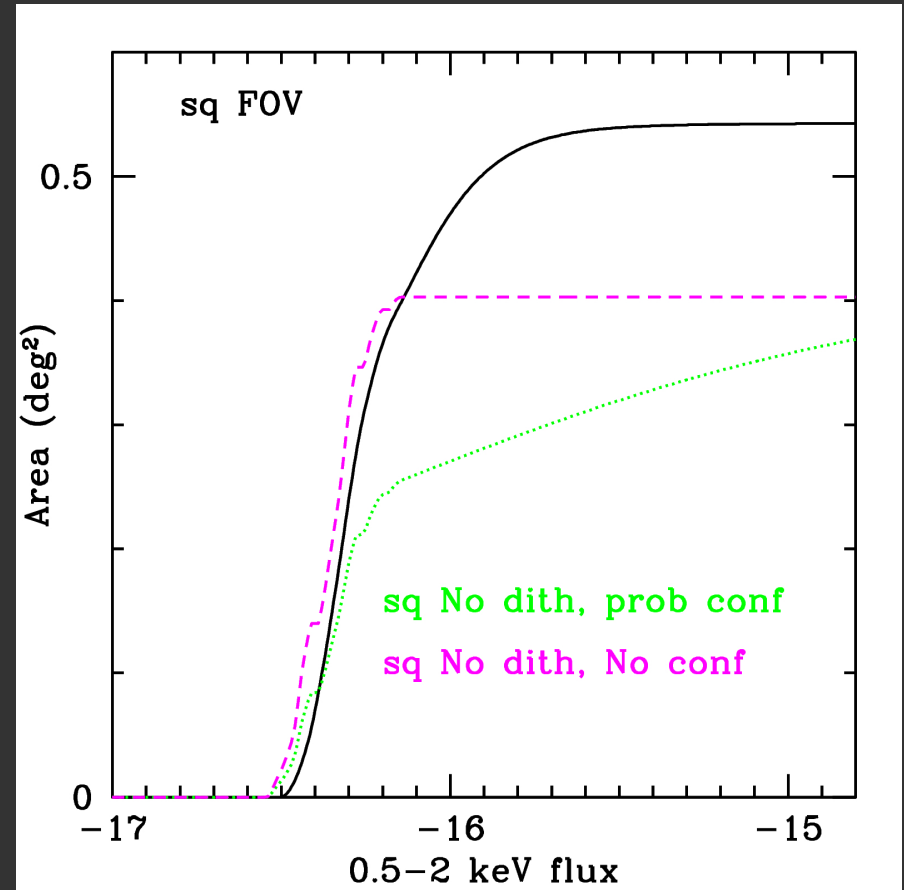
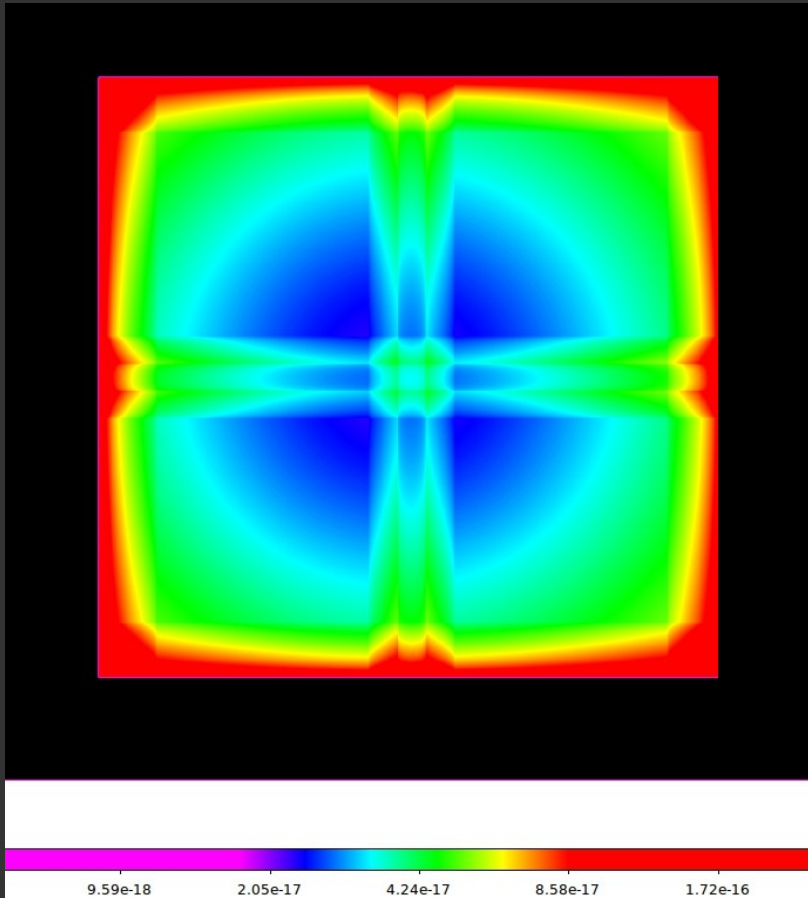
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# Sensitivity Map



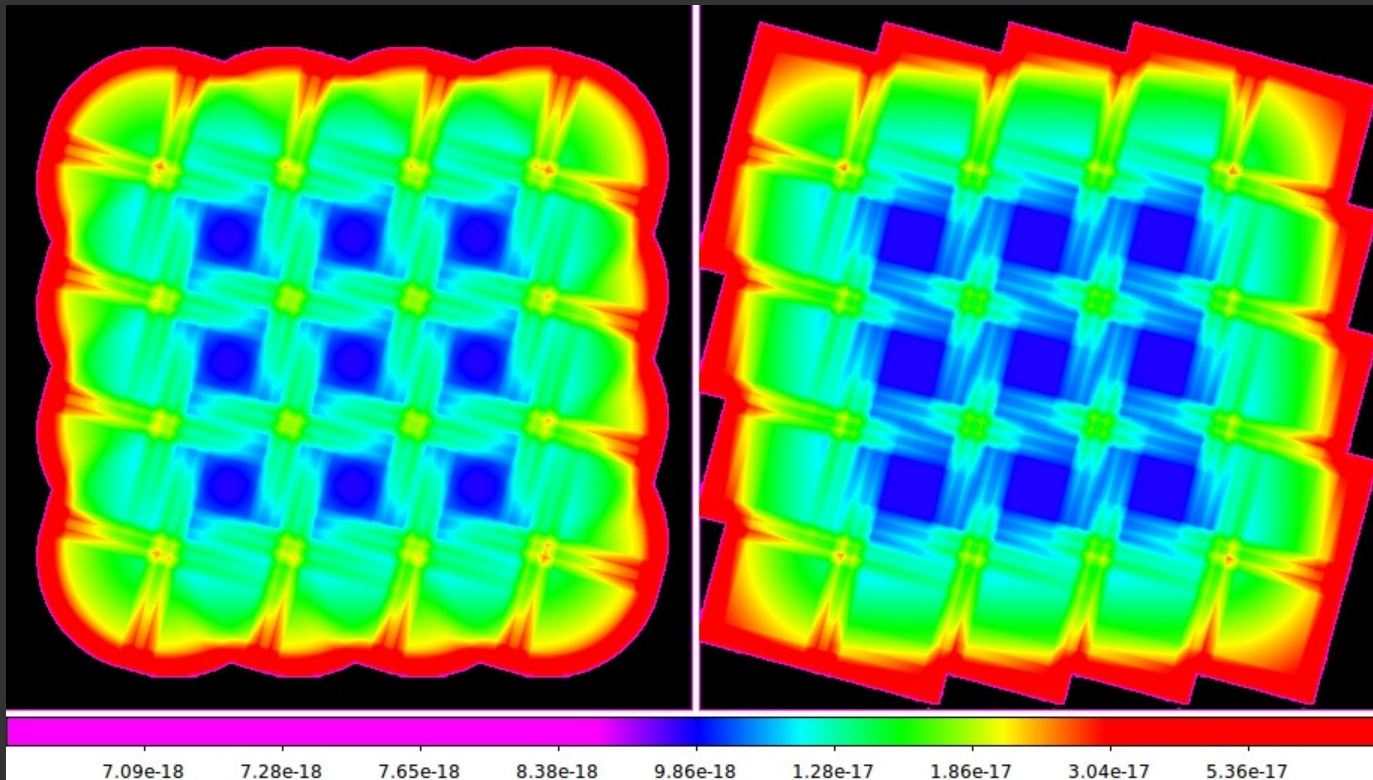
The dithering decrease the effective expo in the deepest part by  $\sim 15\%$   
The total area is  $0.54 \text{ deg}^2$  vs.  $0.4 \text{ deg}^2$

# Survey strategy

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

COSMOS-like tiling (half FOV shift for each pointing)

→ Optimizes the PSF over the FOV



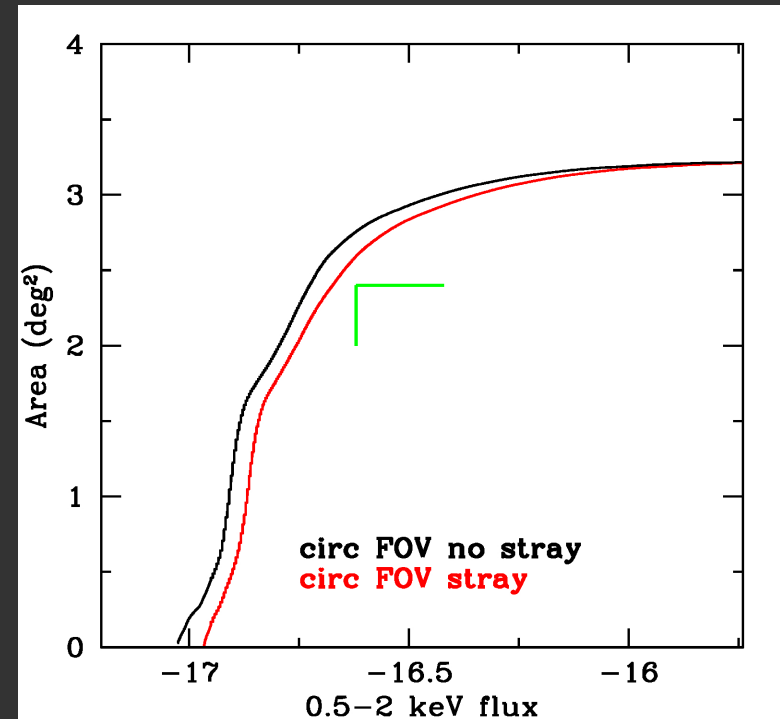
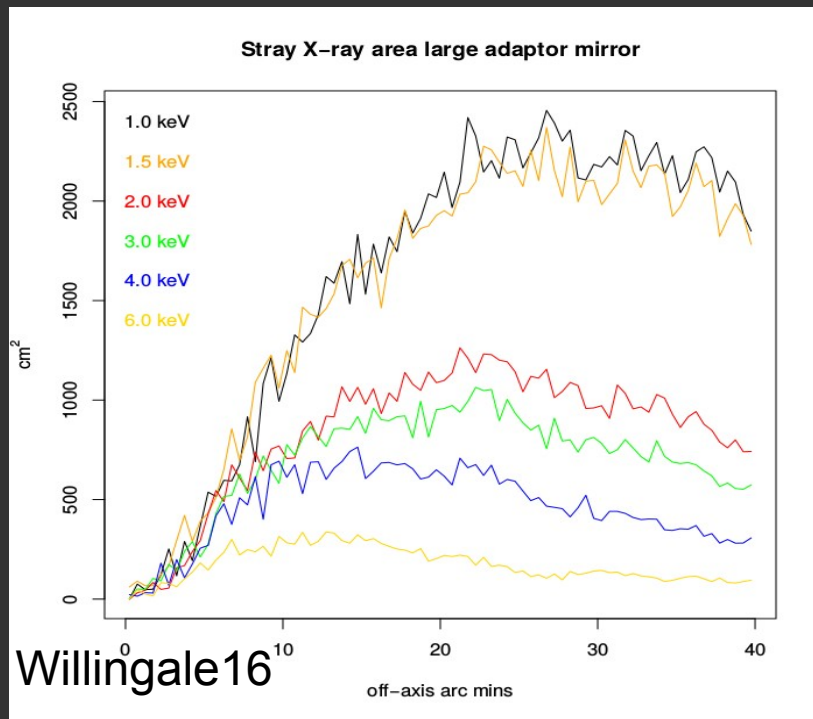


# Stray-light impact

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

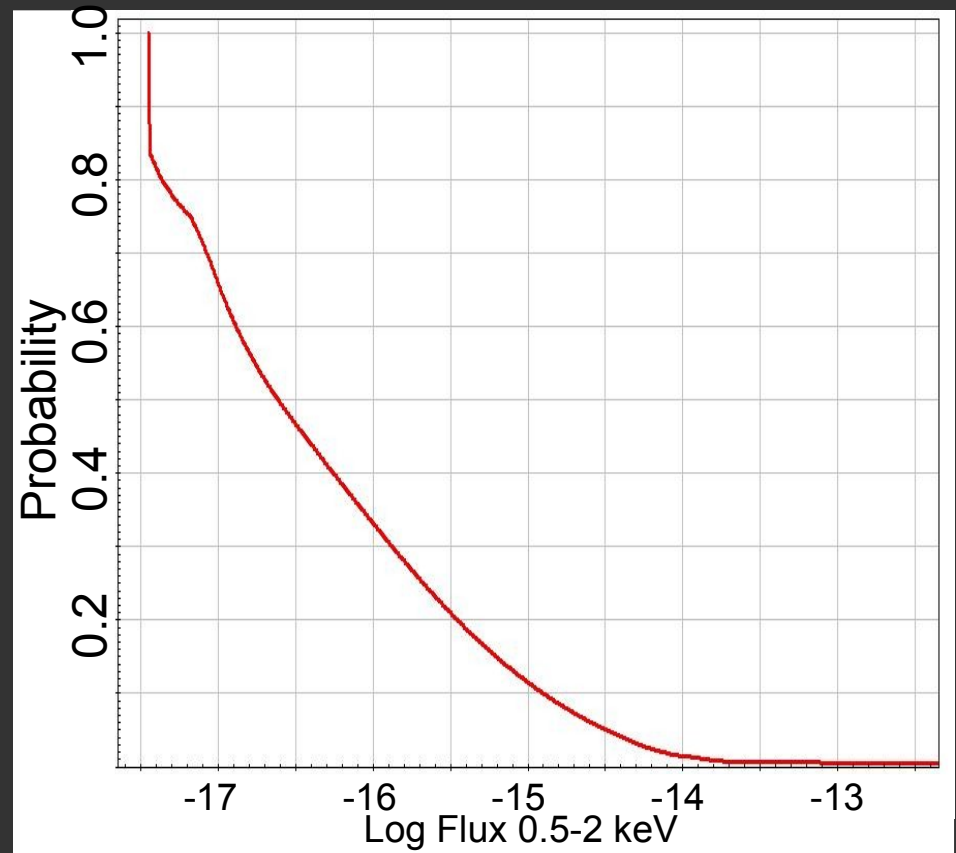
Flux-limit increase of **1.15** → expo time by **~30%** needed for Aim1 and Aim2



# Confusion

There is **no confusion effect** included

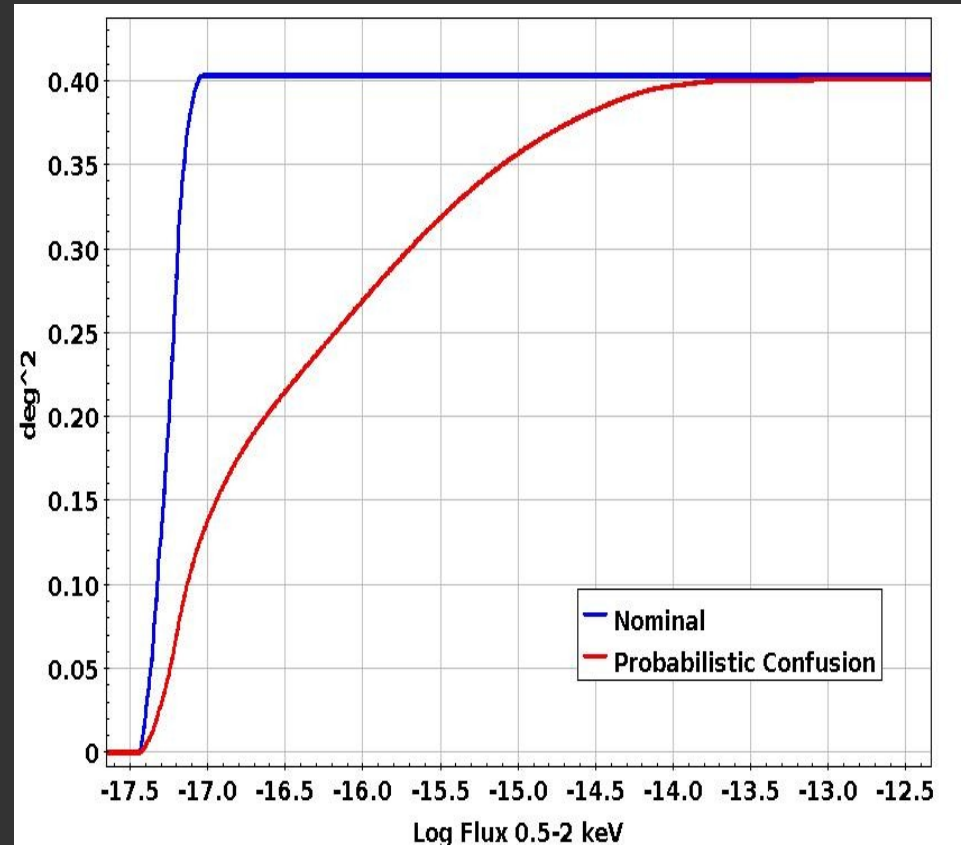
Probabilistic confusion limit adopted in Aird+13: a source is not confused if isolated in a **20xBeam area (HEW=5")**



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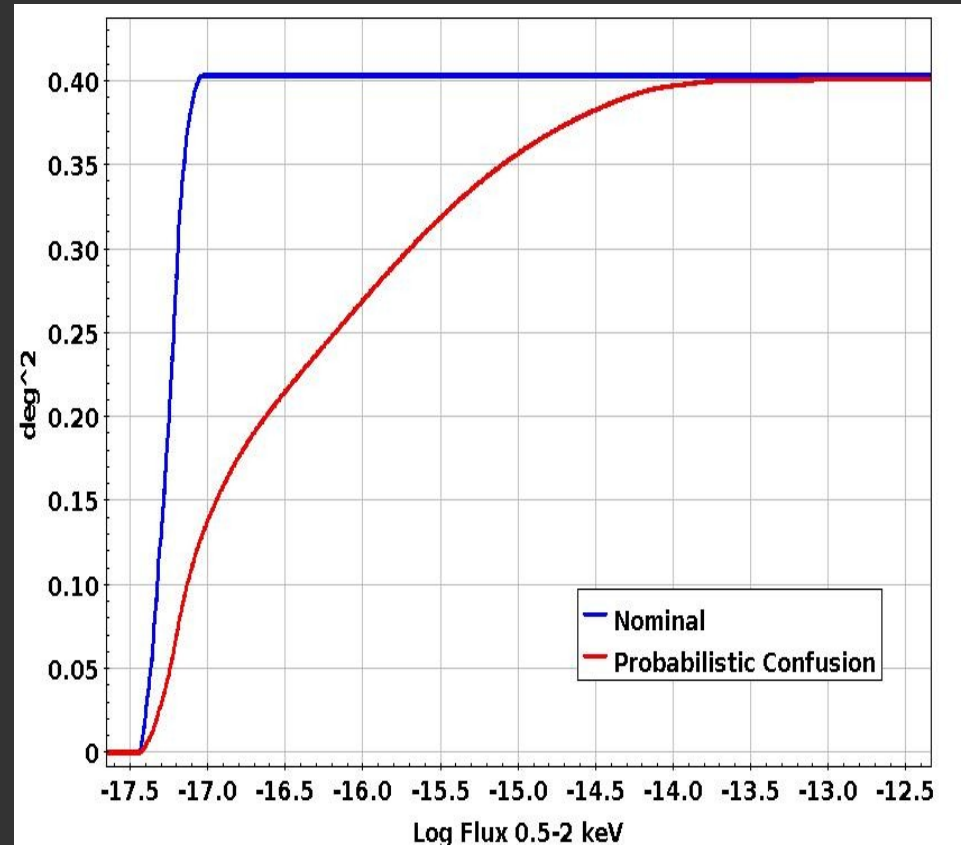
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Too conservative approach?

In XMM-CDFS survey (Ranalli+13), a deep field with  $\langle \text{FWHM} \rangle \sim 8.5''$

Detected:

- As 2 sources, 50% of the pairs separated by  $>2 \times \text{FWHM}$
- As 1 source between 50 and 90% of the pairs separated by  $<2 \times \text{FWHM}$

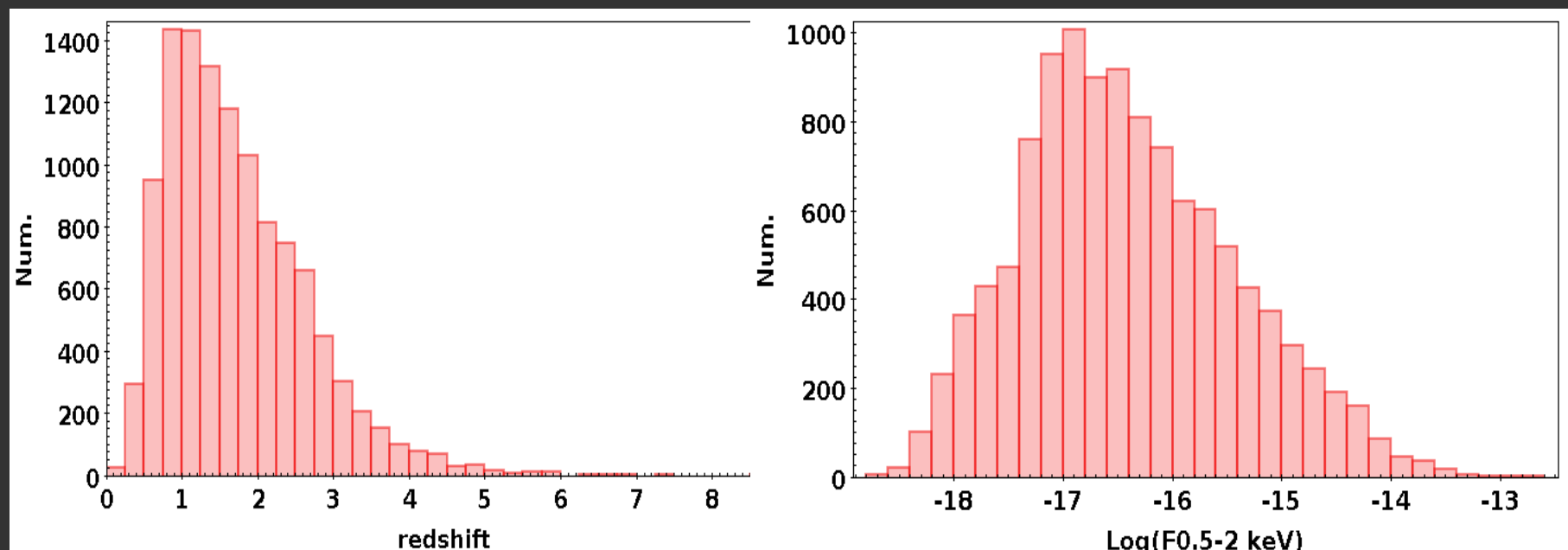


# Full SIXTE simulation of a Deep Field

Input: **Mock catalogs from Gilli+07 (no clustering)**

~11000 sources in 1 deg<sup>2</sup>, up to z=8, and with F0.5-2 down to -18.5

Each source has a value of  $N_H$  and z

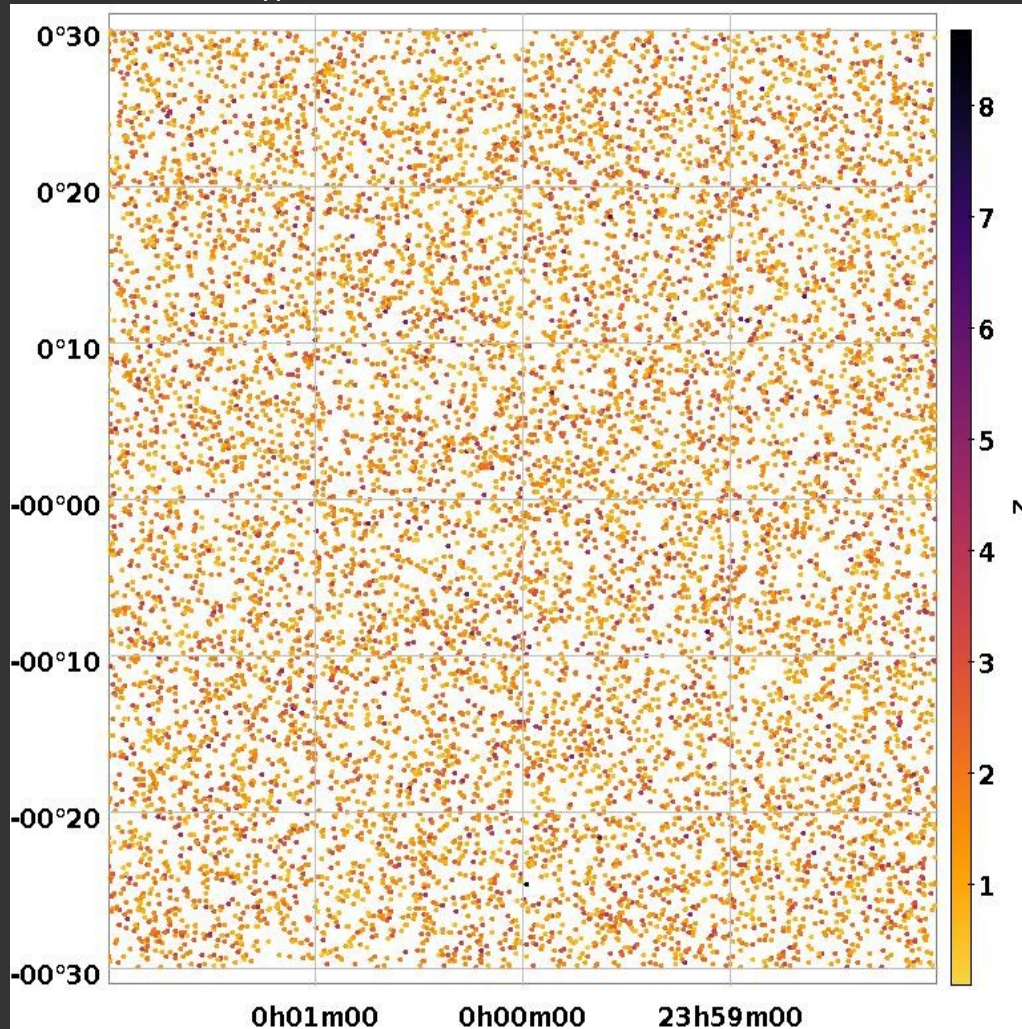


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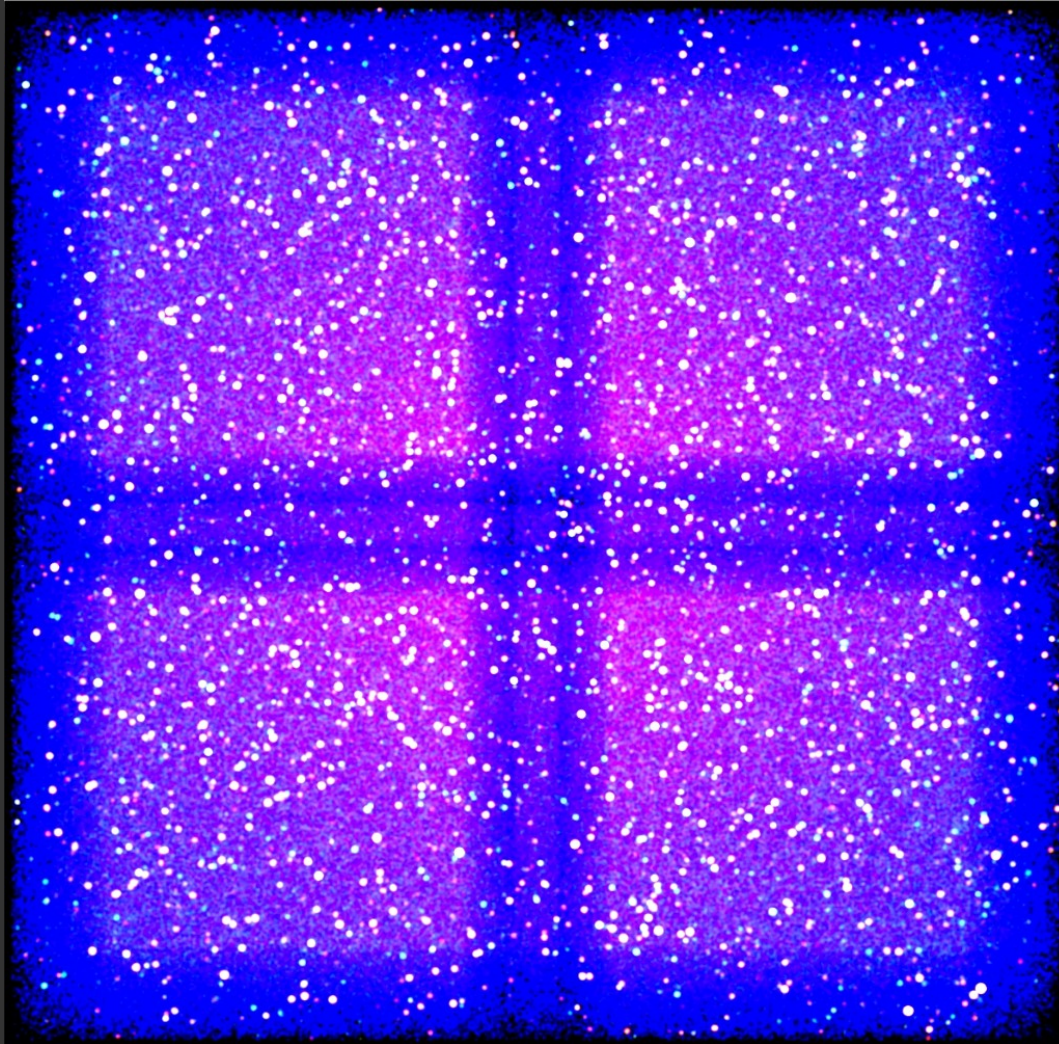
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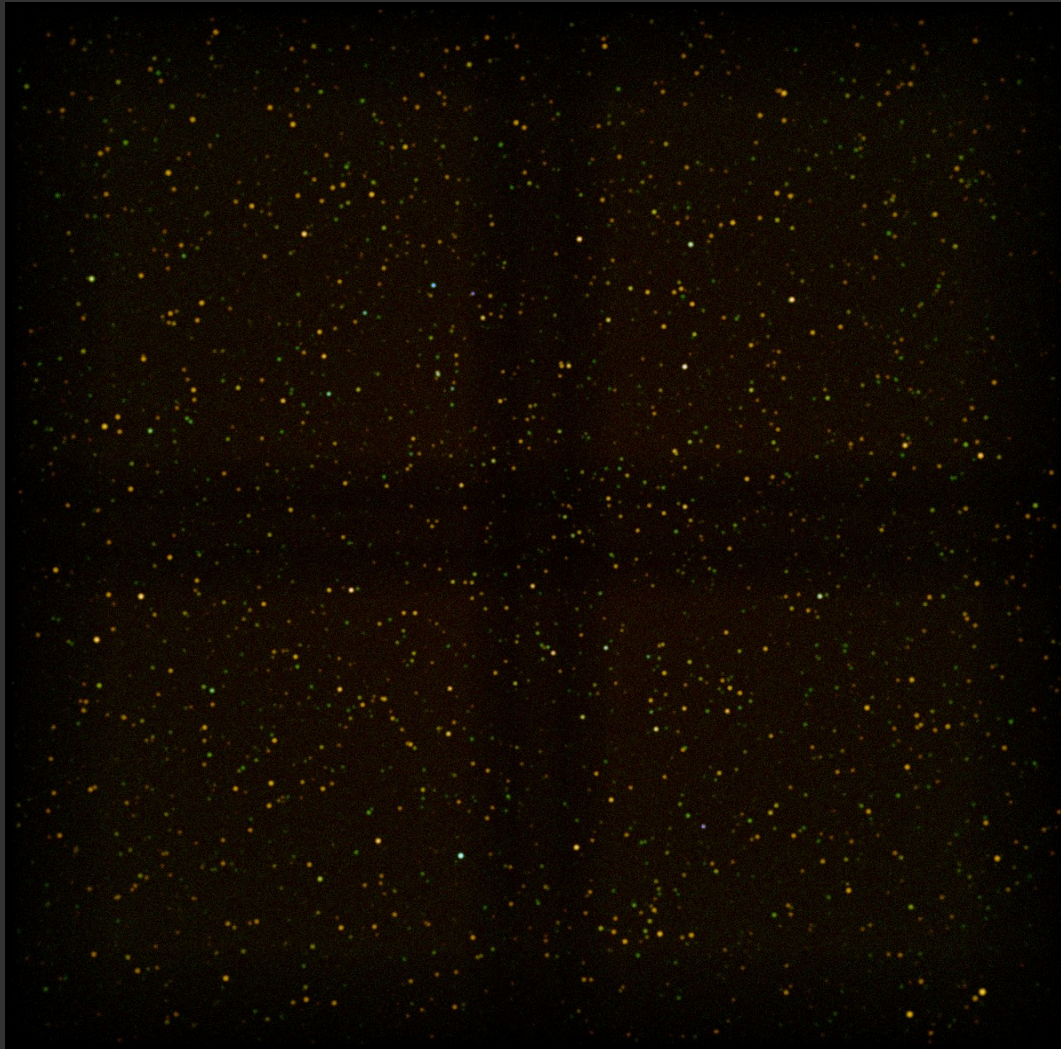
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Result for a 600ks exposure (red 0.5-2, green 2-4.5 blue 4.5-10 keV)



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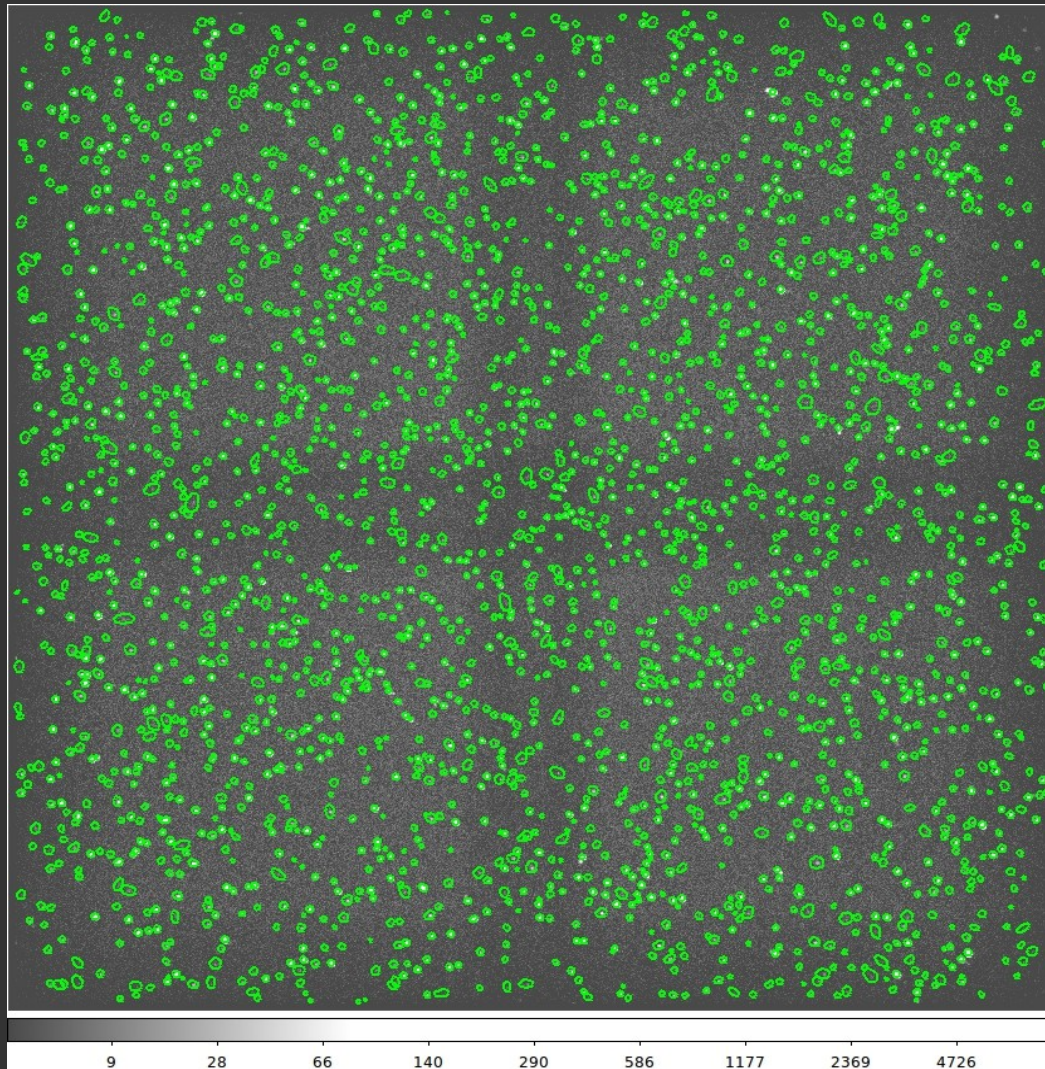
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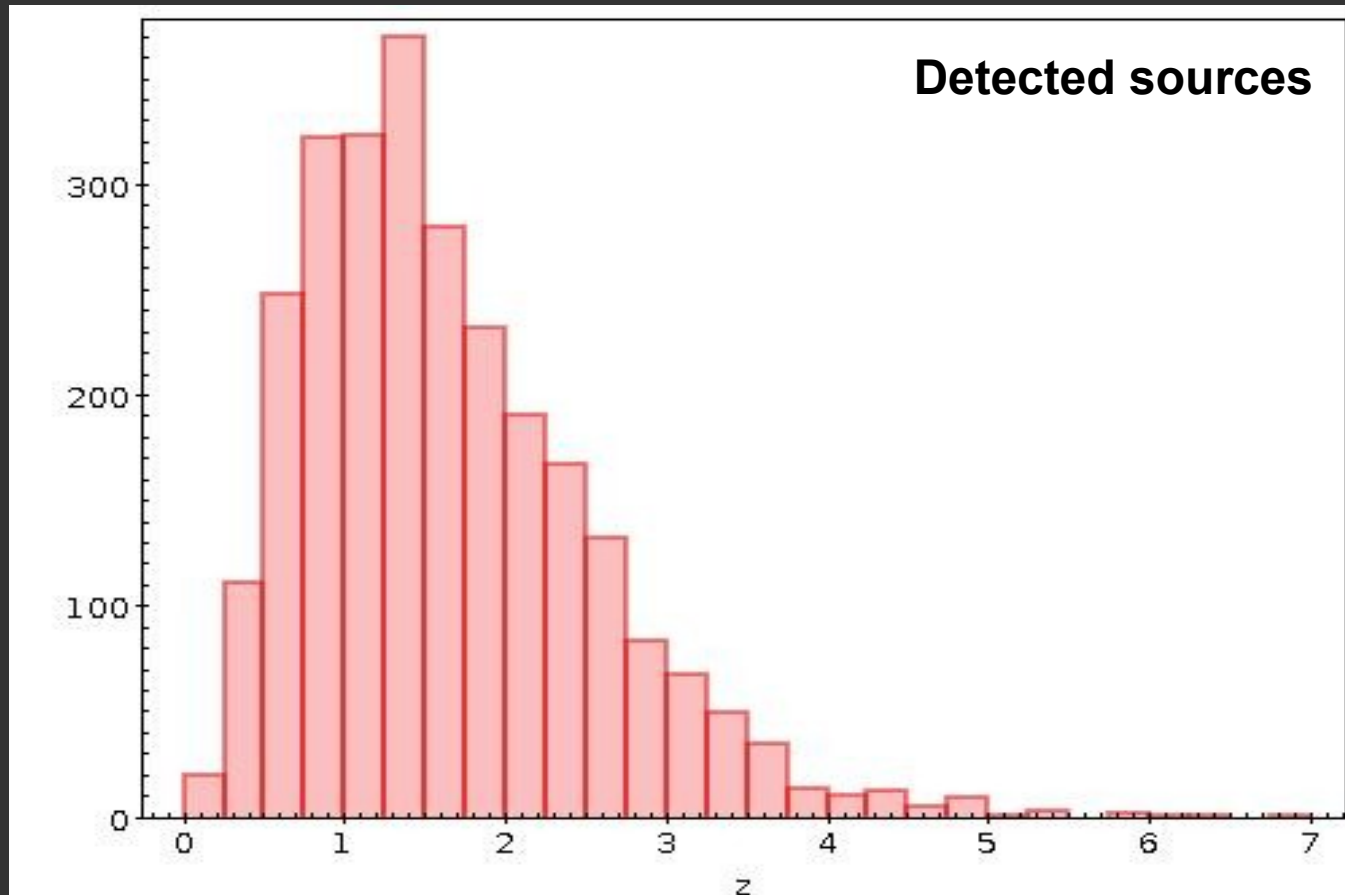
# Source Detection

Run `wavdetect` on the 0.7-2 keV image  $\rightarrow$   $\sim$ 2800 sources detected

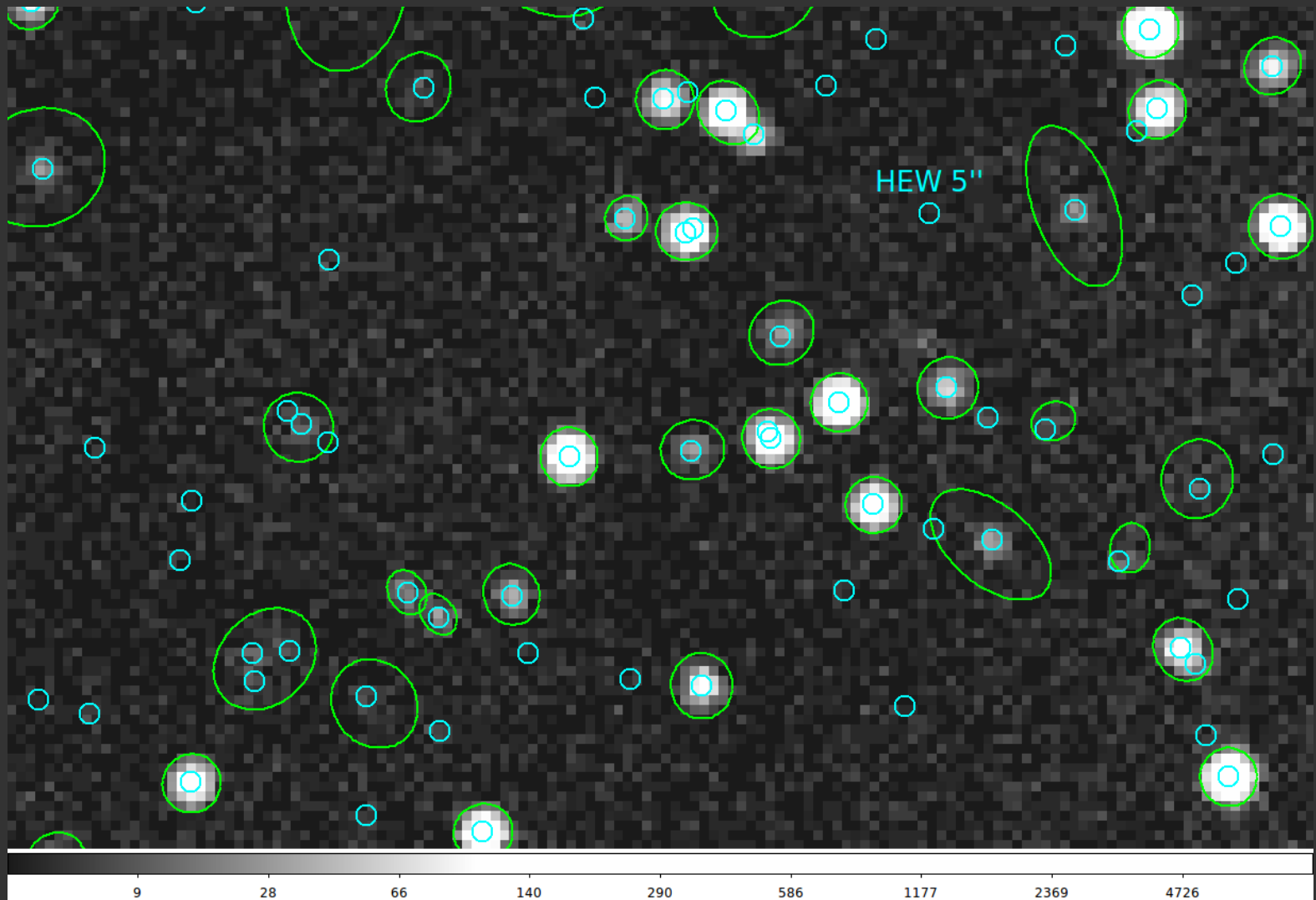


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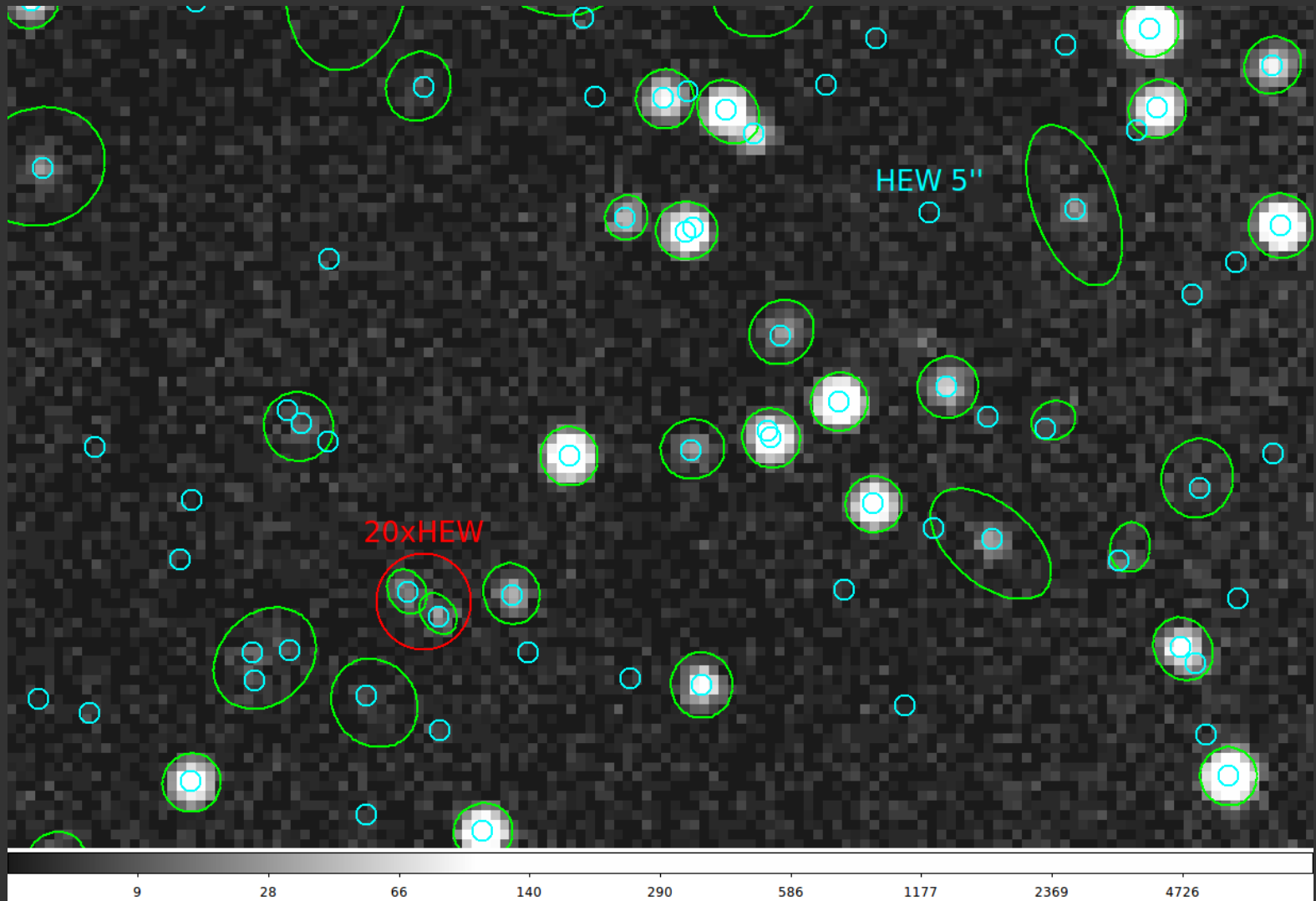
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# Zoom in...

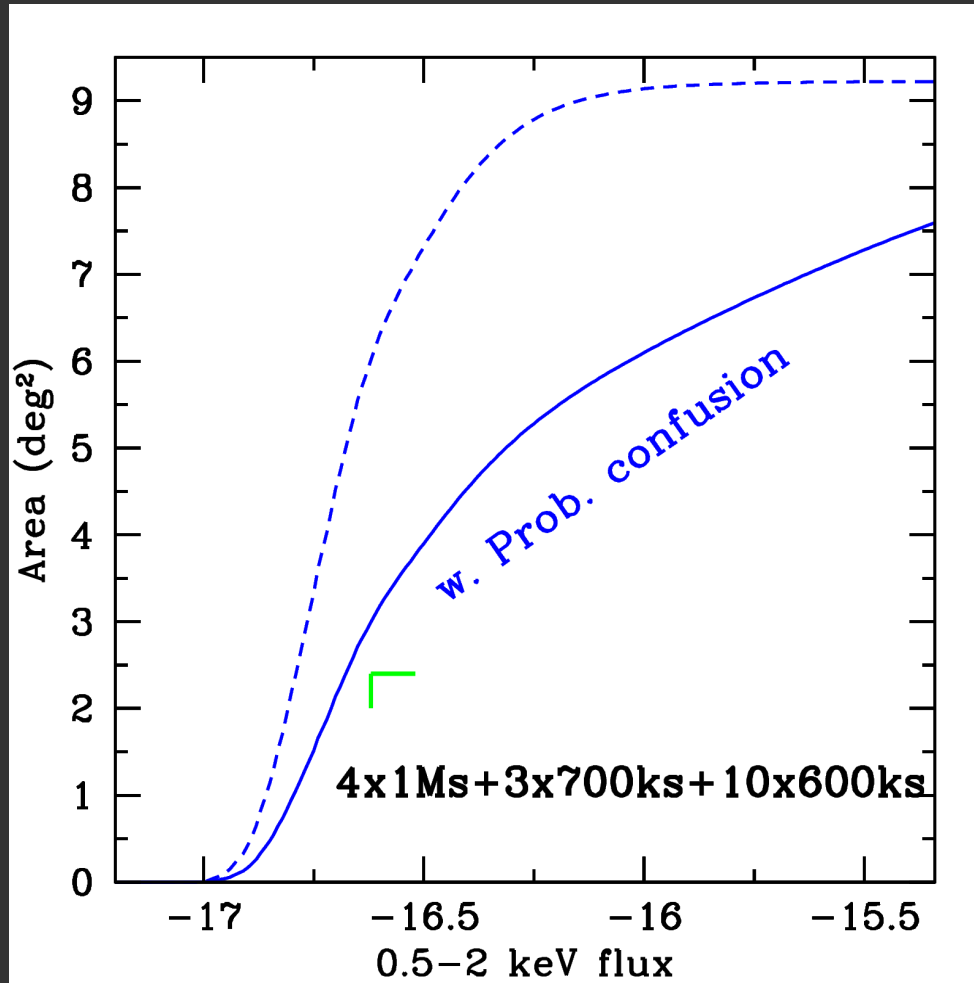


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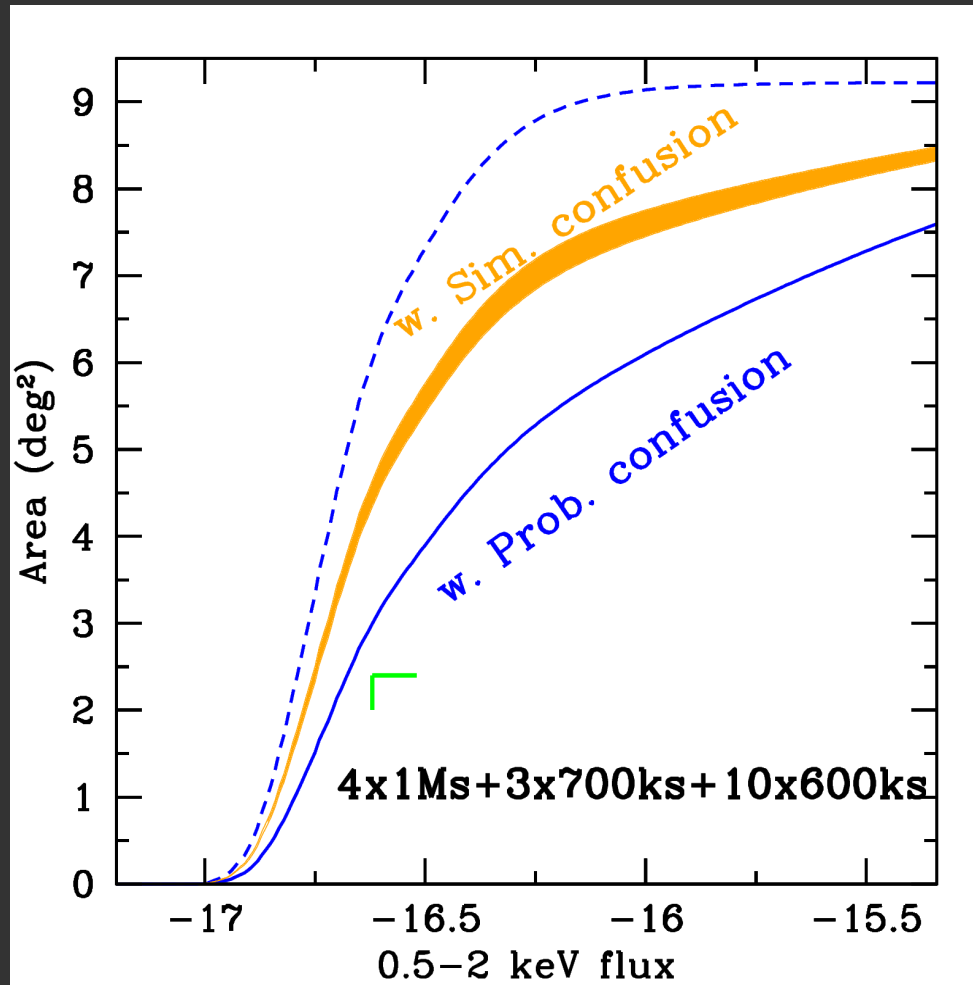
# Modify confusion prescriptions?

Reduce the area to e.g.  $\sim 10 \times \text{Beam}$ ?



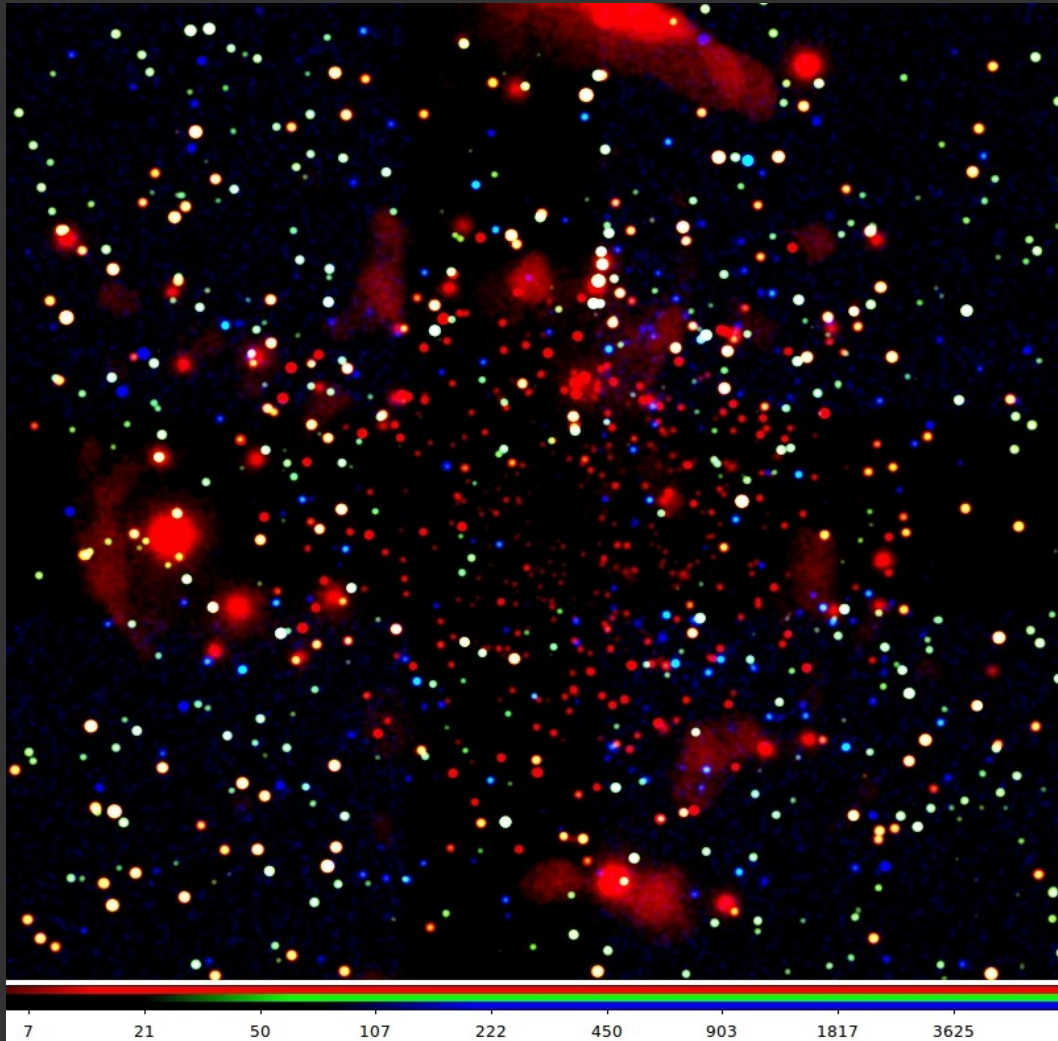
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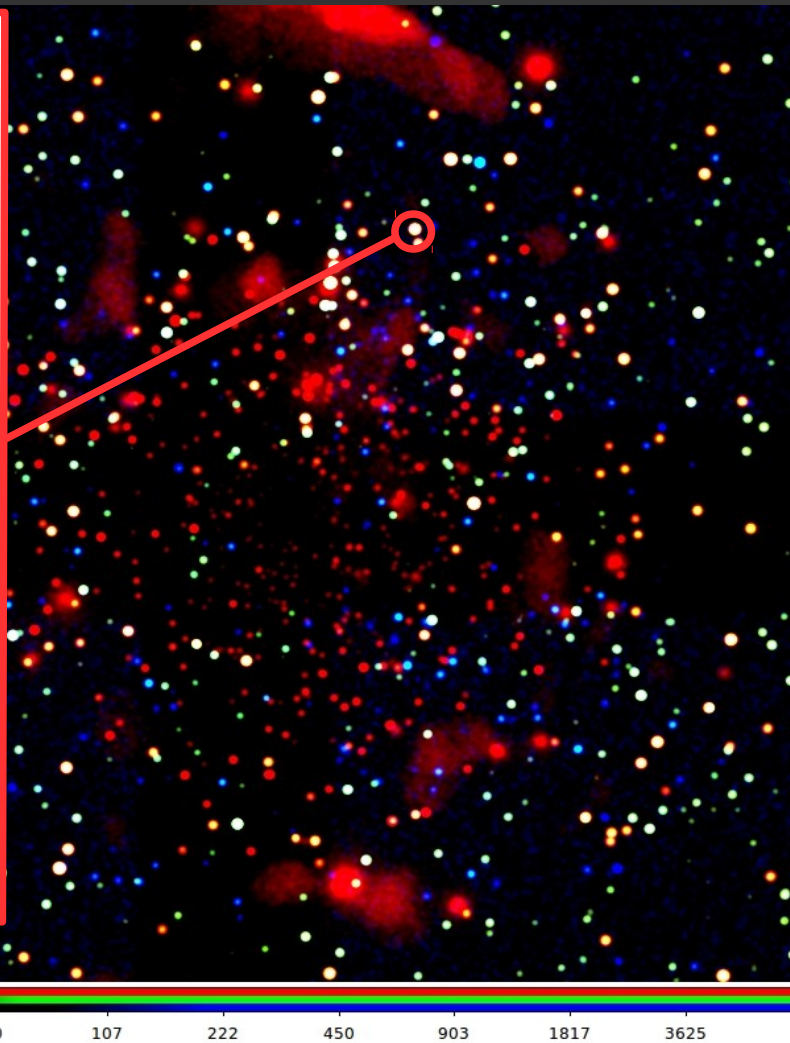
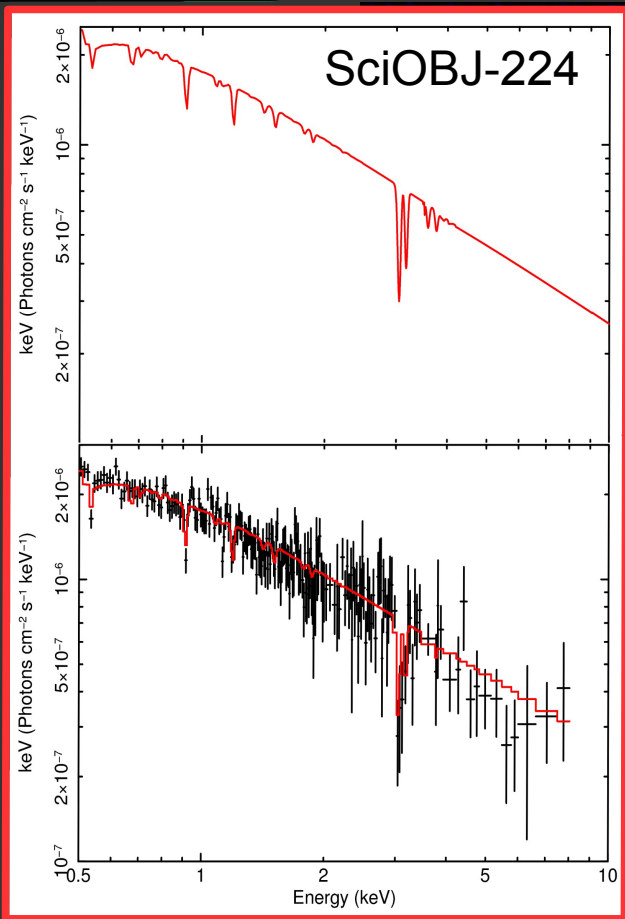
# Modify confusion prescriptions?

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



# Play with input spectra...

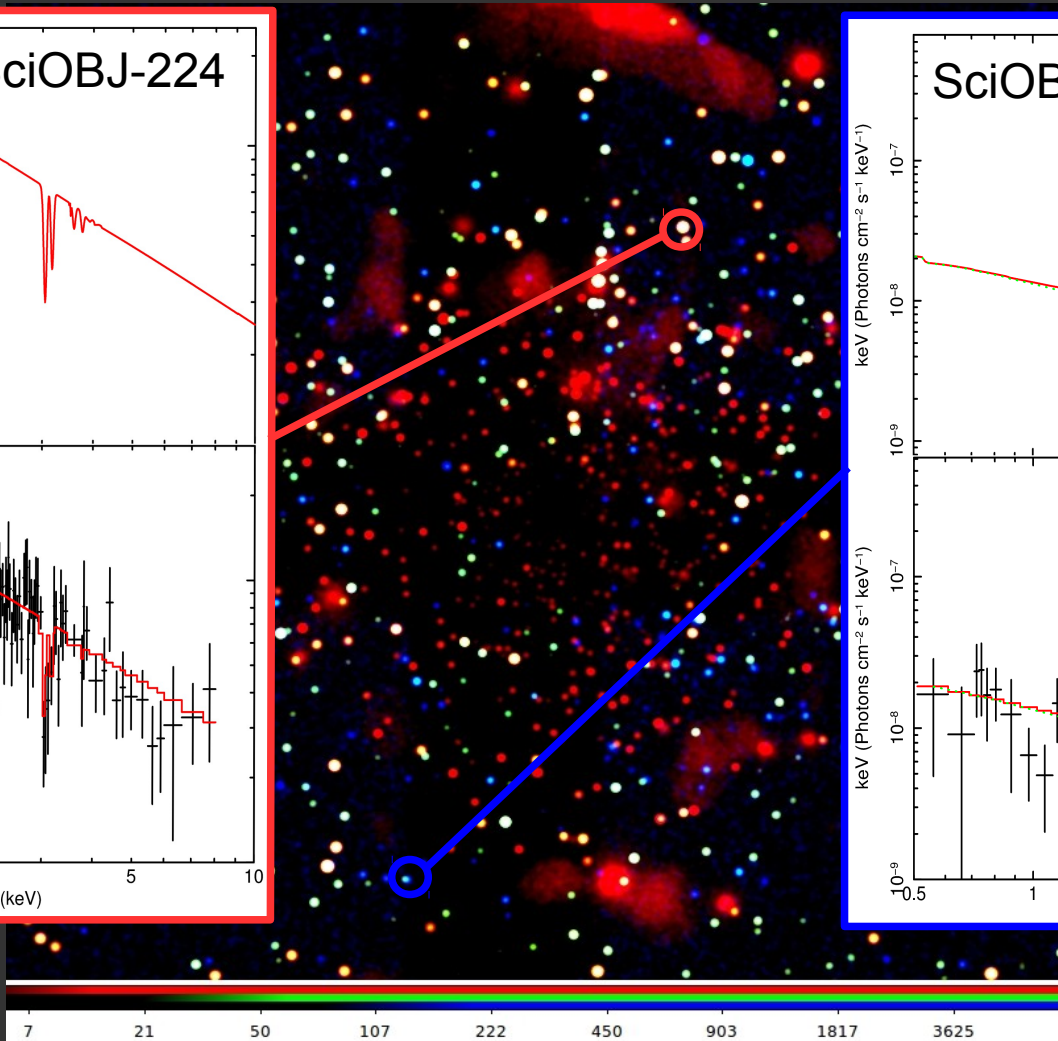
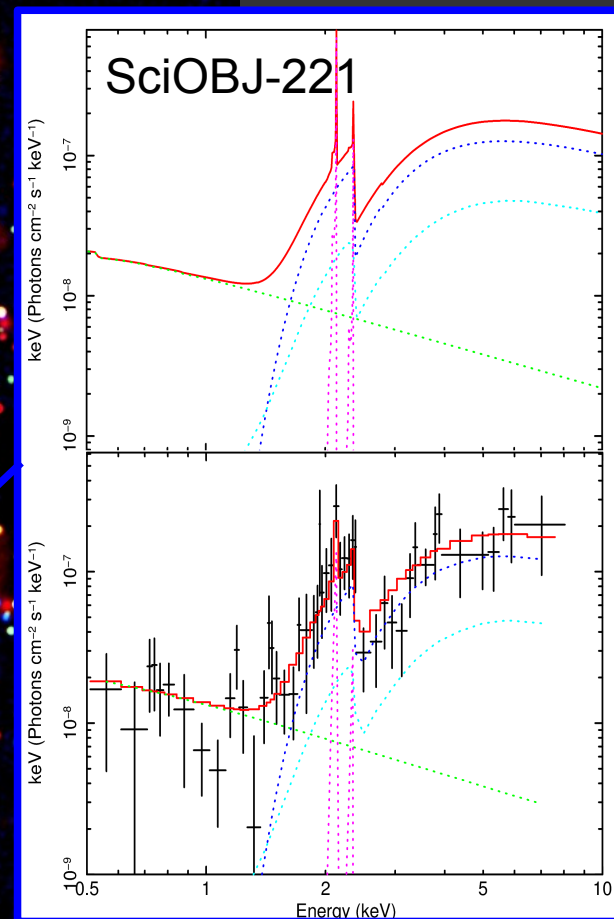
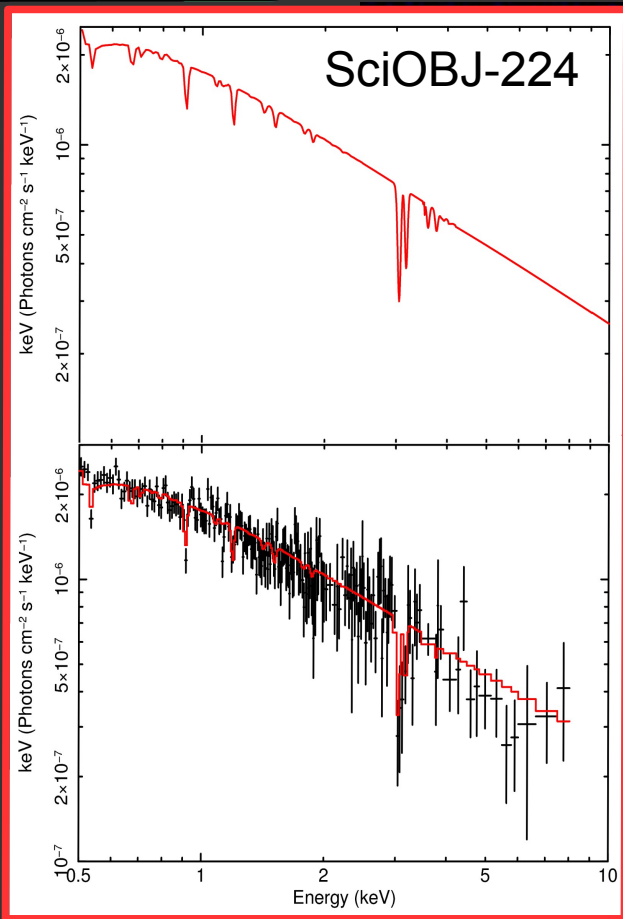
Try to recover spectral properties on input sources





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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**)