

Mitigating X-ray Obscuration Biases with Isotropic AGN Selection

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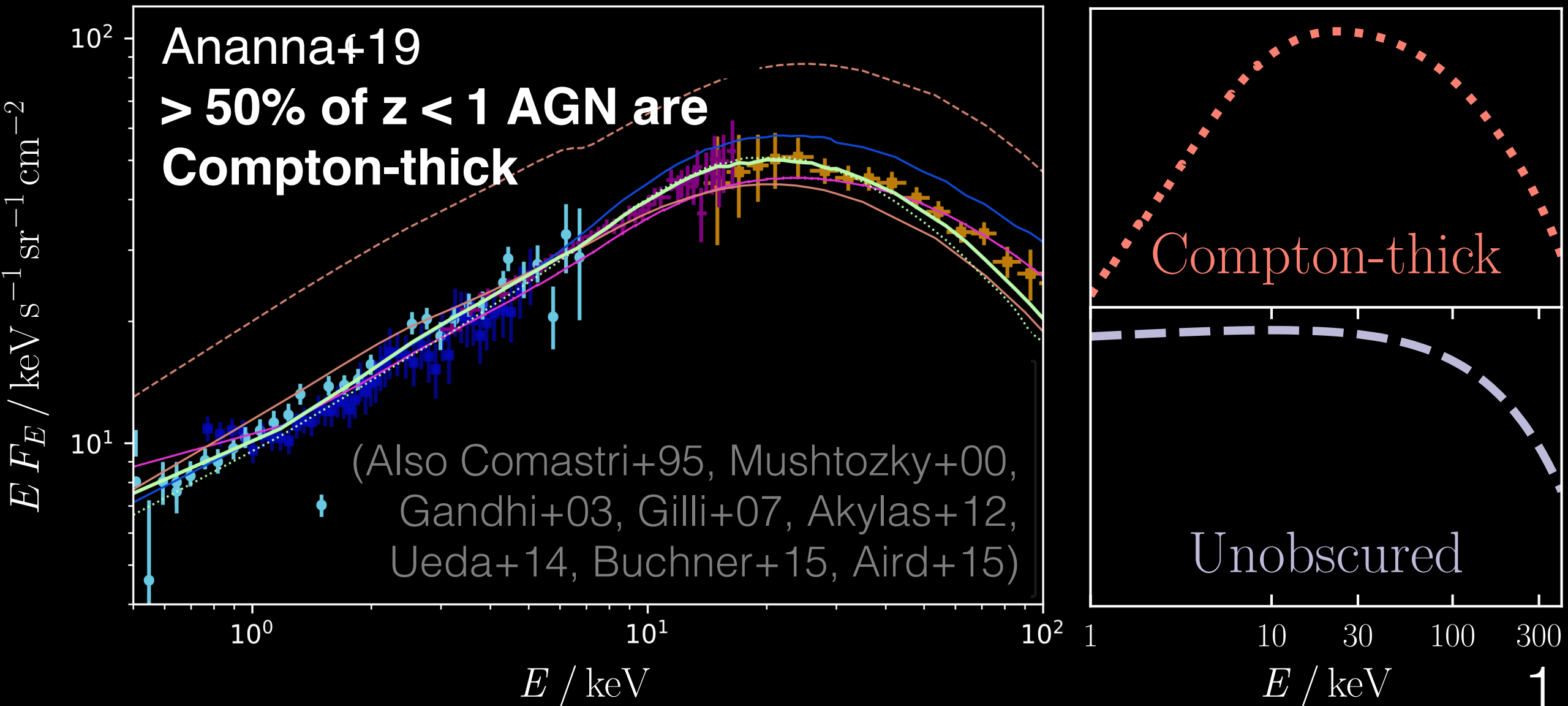
With Poshak Gandhi, Claudio Ricci, Dan Stern, Mislav Baloković, Dave Alexander, Fiona Harrison & the NuSTAR Team

X-ray Astronomy 2019 • Sep 12 • soton.ac.uk/~pgb2g11 •  @boorm

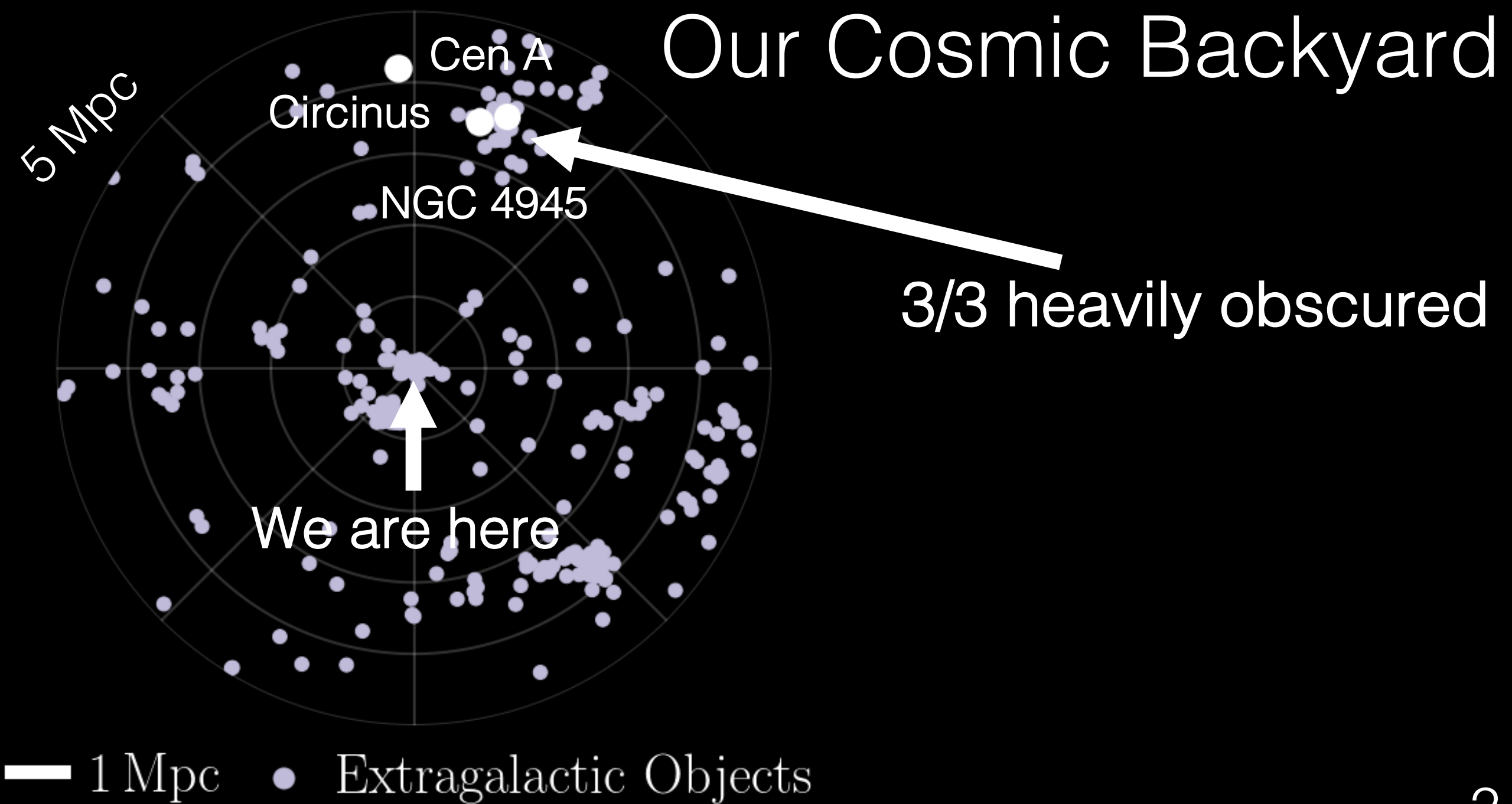
Key Questions

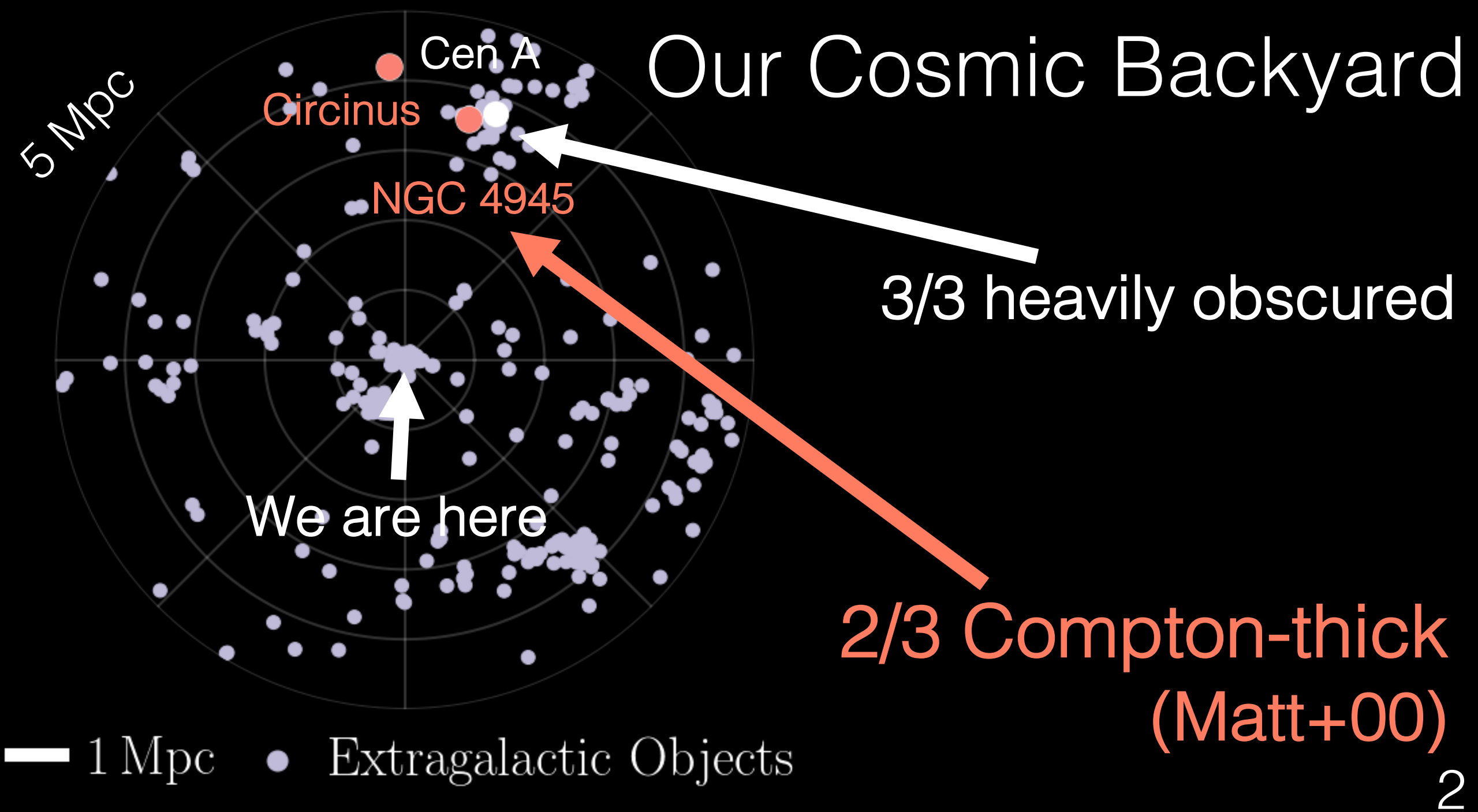
1. How **prevalent** are the most obscured AGN?
2. How can we construct a census of AGN, **unbiased to heavy obscuration**?

Predicted Prevalence of Obscuration

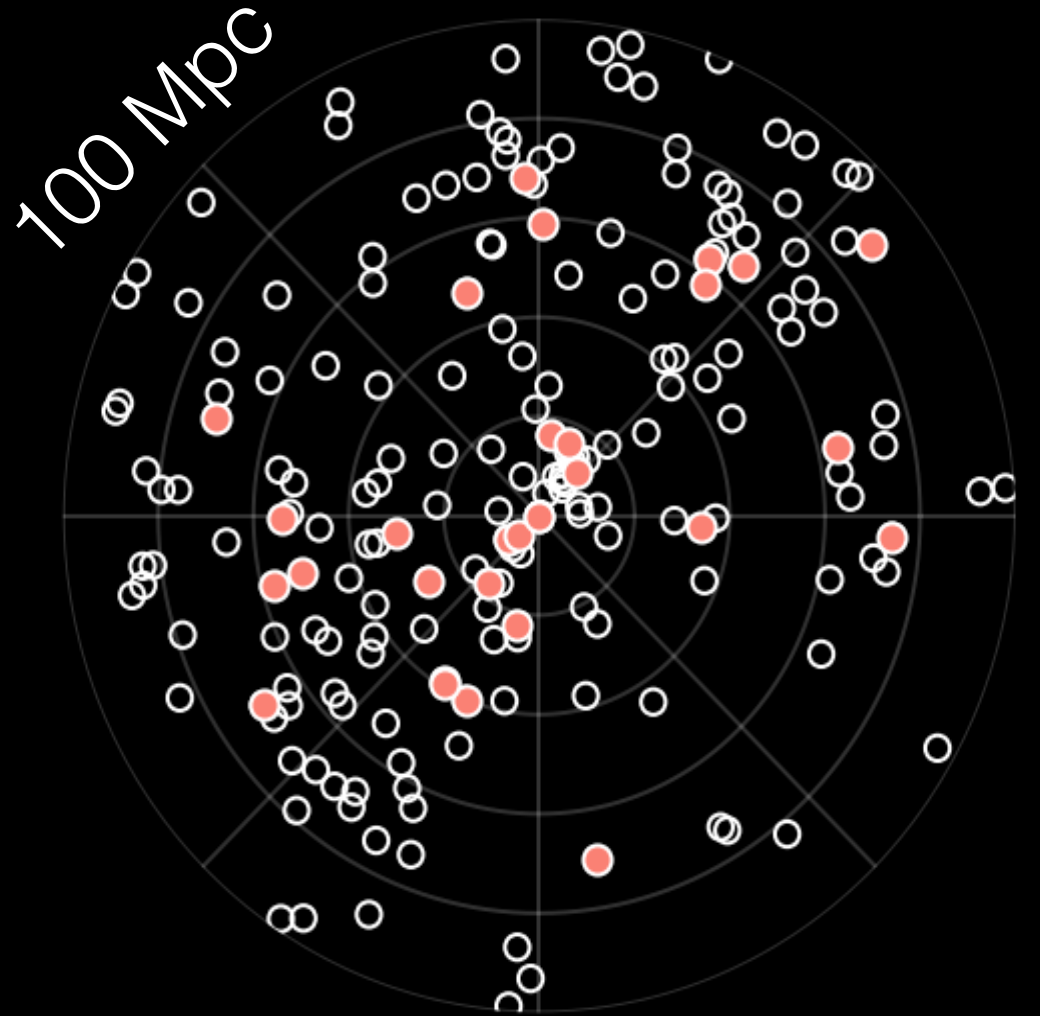


Our Cosmic Backyard

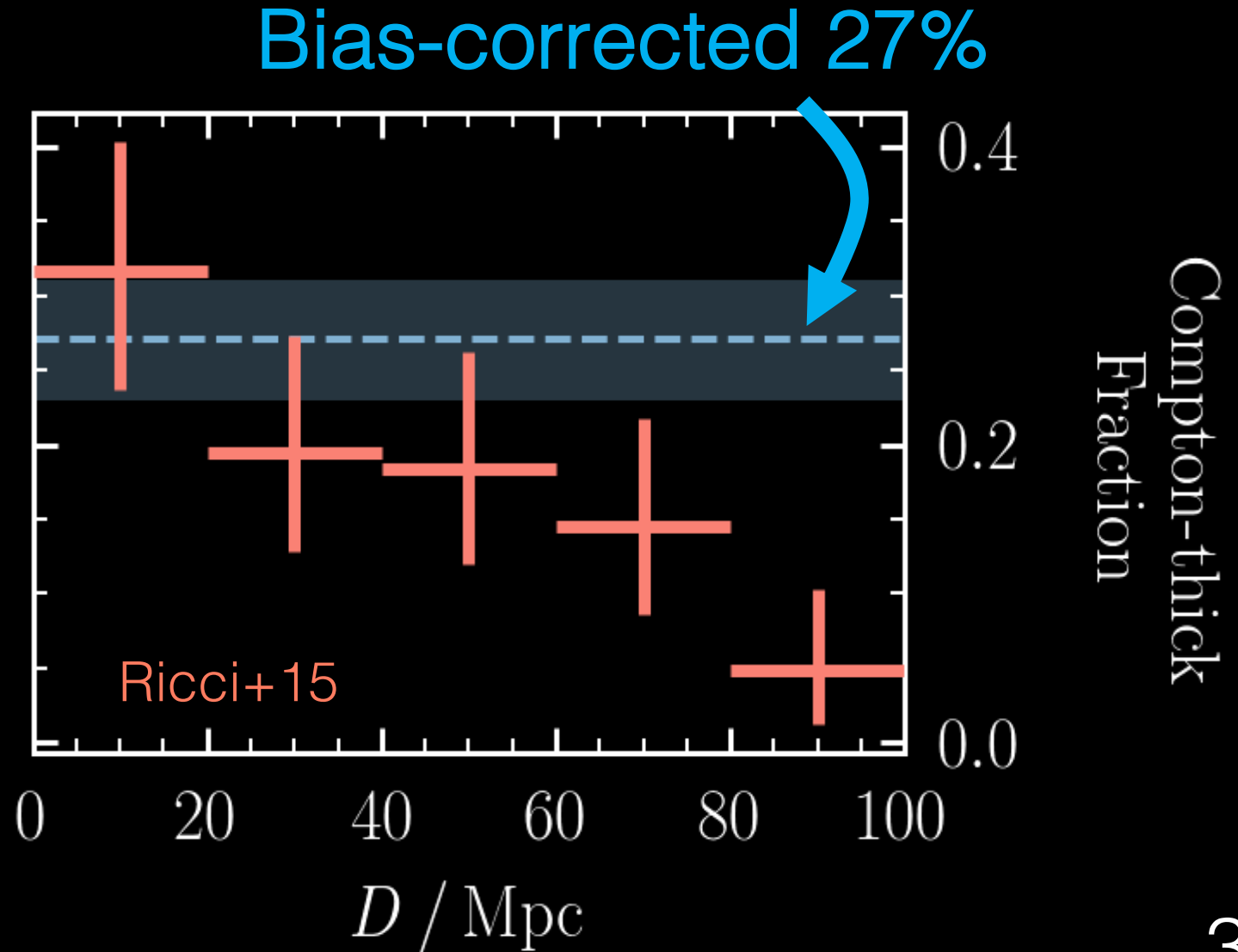




Swift/BAT Compton-thick AGN



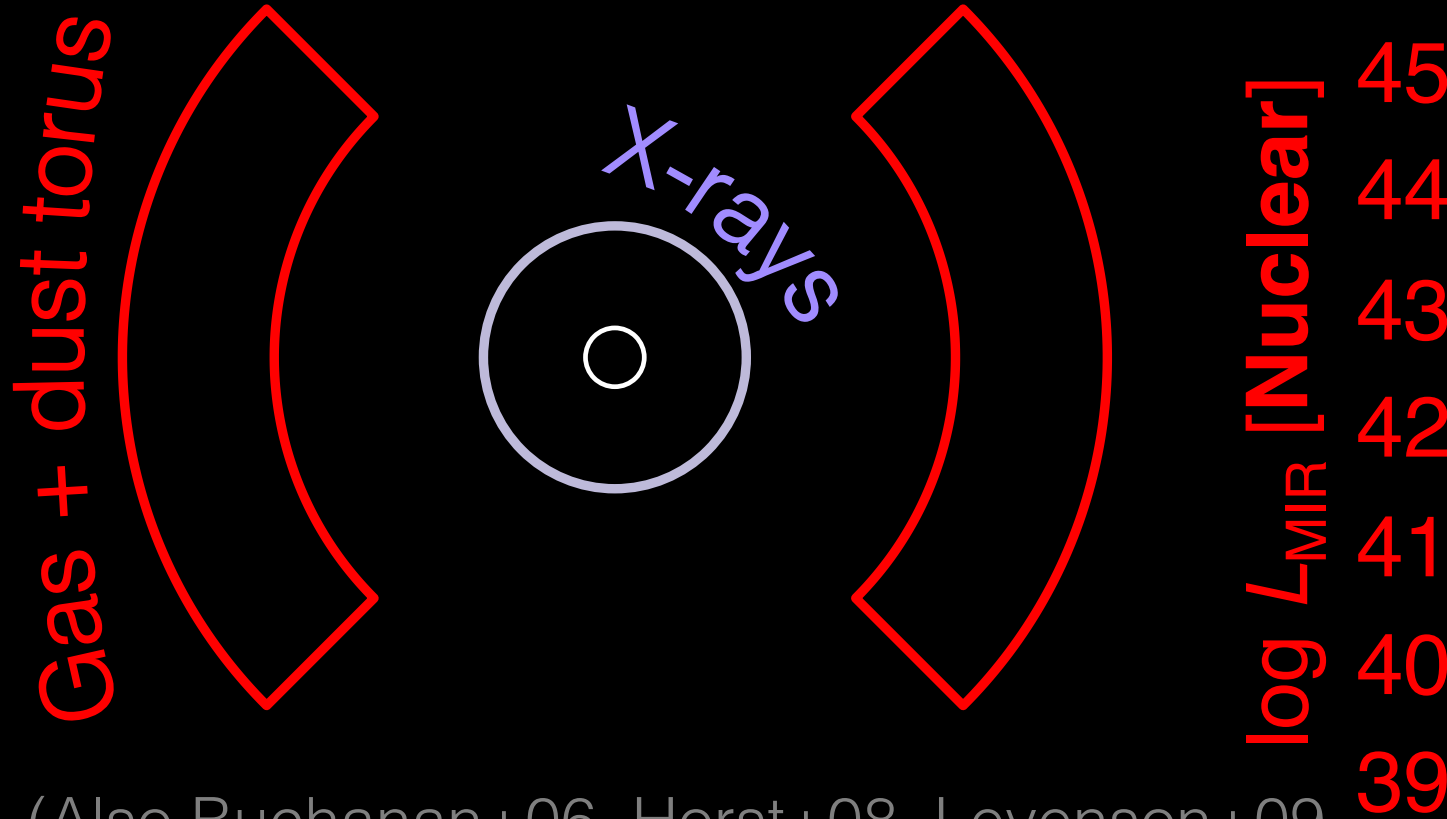
— 20 Mpc ● Compton-thick



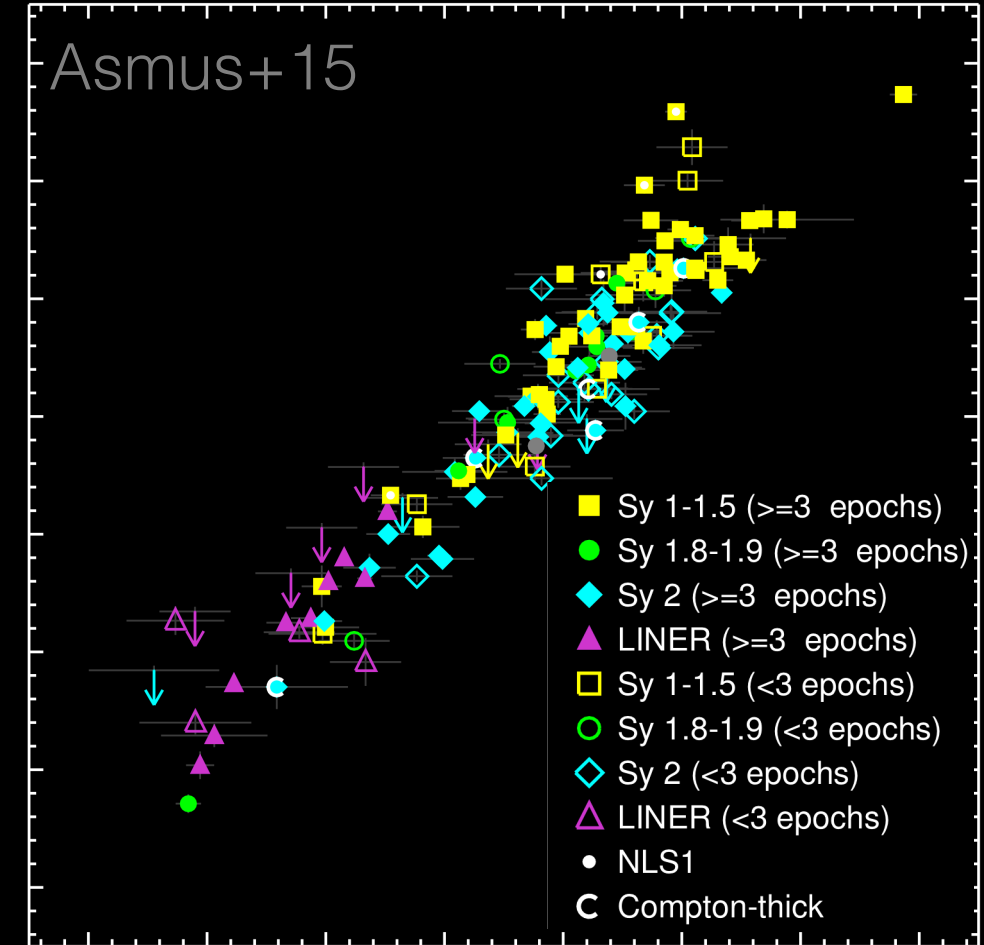
Key Questions

1. How prevalent are the most obscured AGN?
2. How can we construct a census of AGN, unbiased to heavy obscuration?

Infrared Isotropy – AGN unification



(Also Buchanan+06, Horst+08, Levenson+09, Gandhi+09, Lawrence & Elvis 10, Hönig+11, Mullaney+11, Matsuta+12, Ichikawa+12)



39 40 41 42 43 44 45 46
 $\log L_{\text{X-ray}} [\text{Intrinsic}]$

Our Survey Strategy

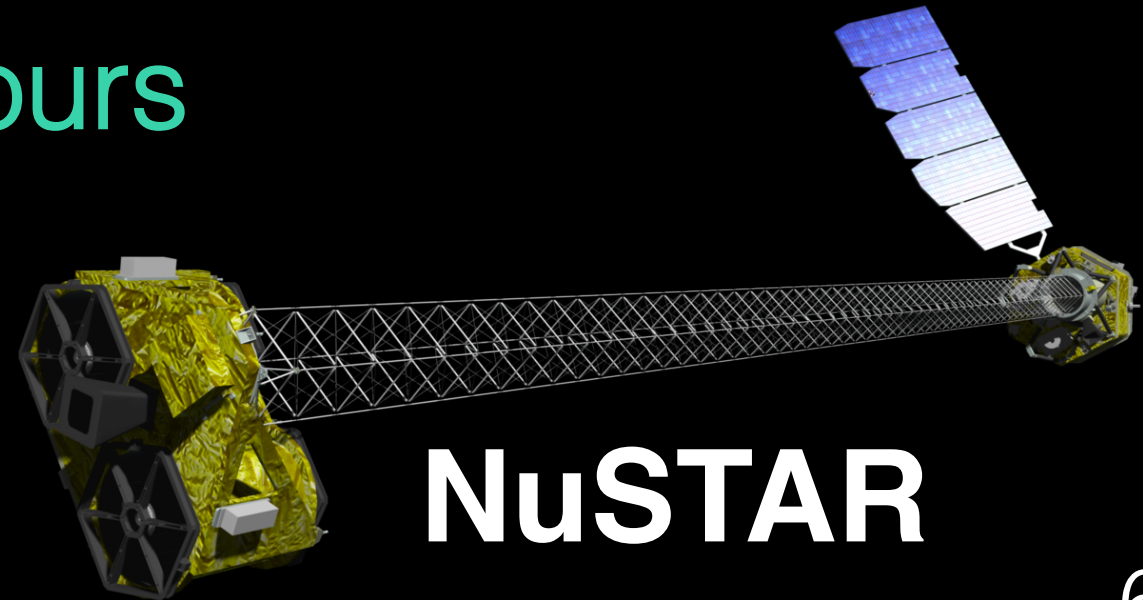
1. Isotropic infrared selection

2. Classification:

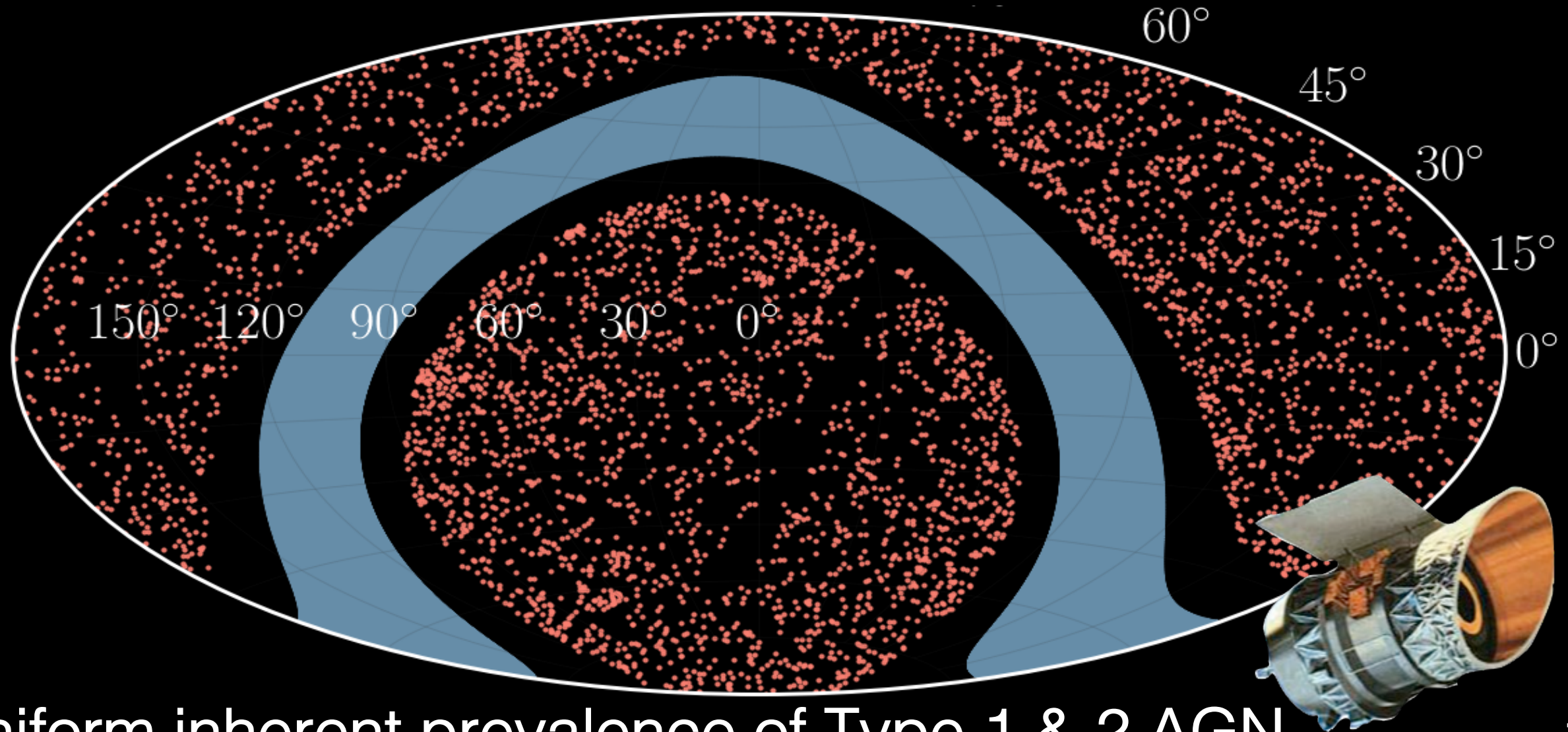
▷ Infrared warm colours

▷ Optical AGN lines

▷ X-ray spectra

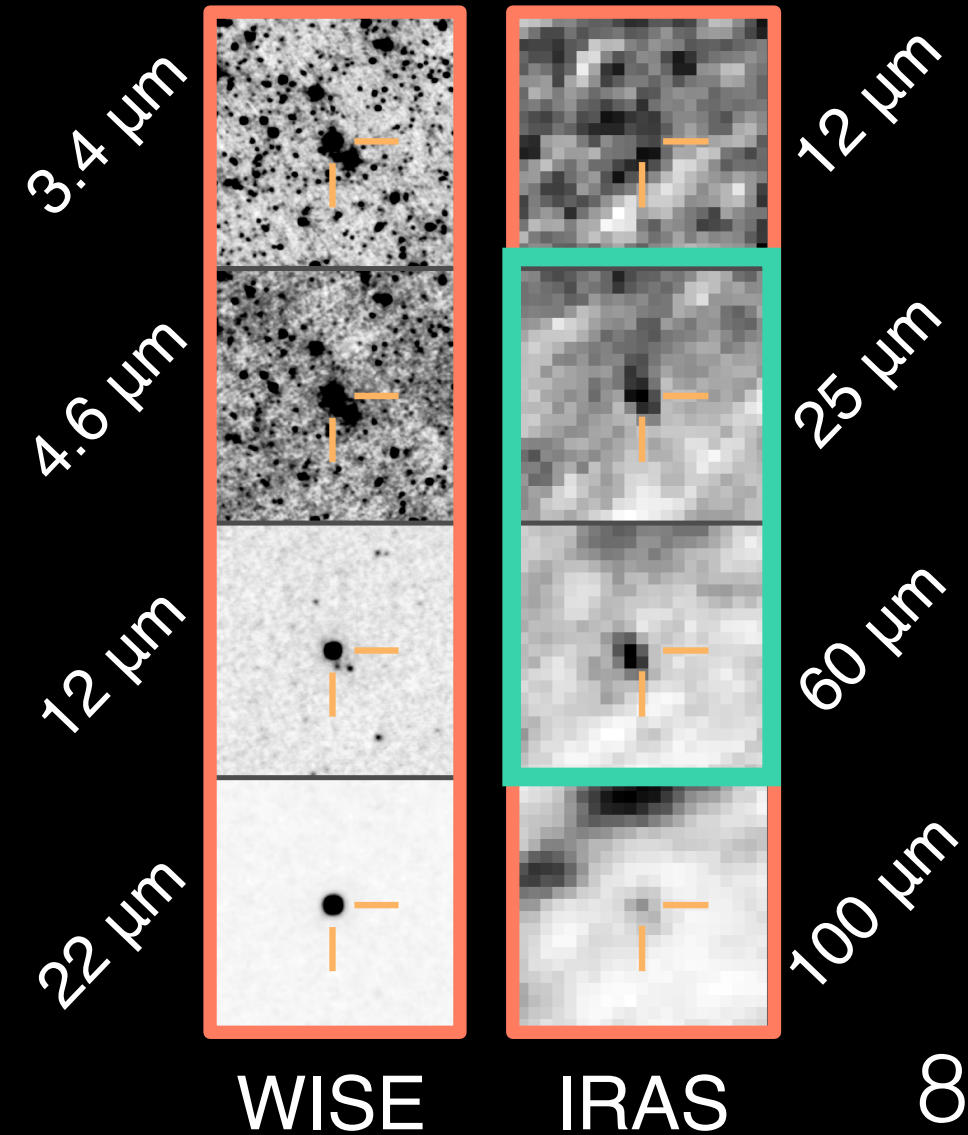
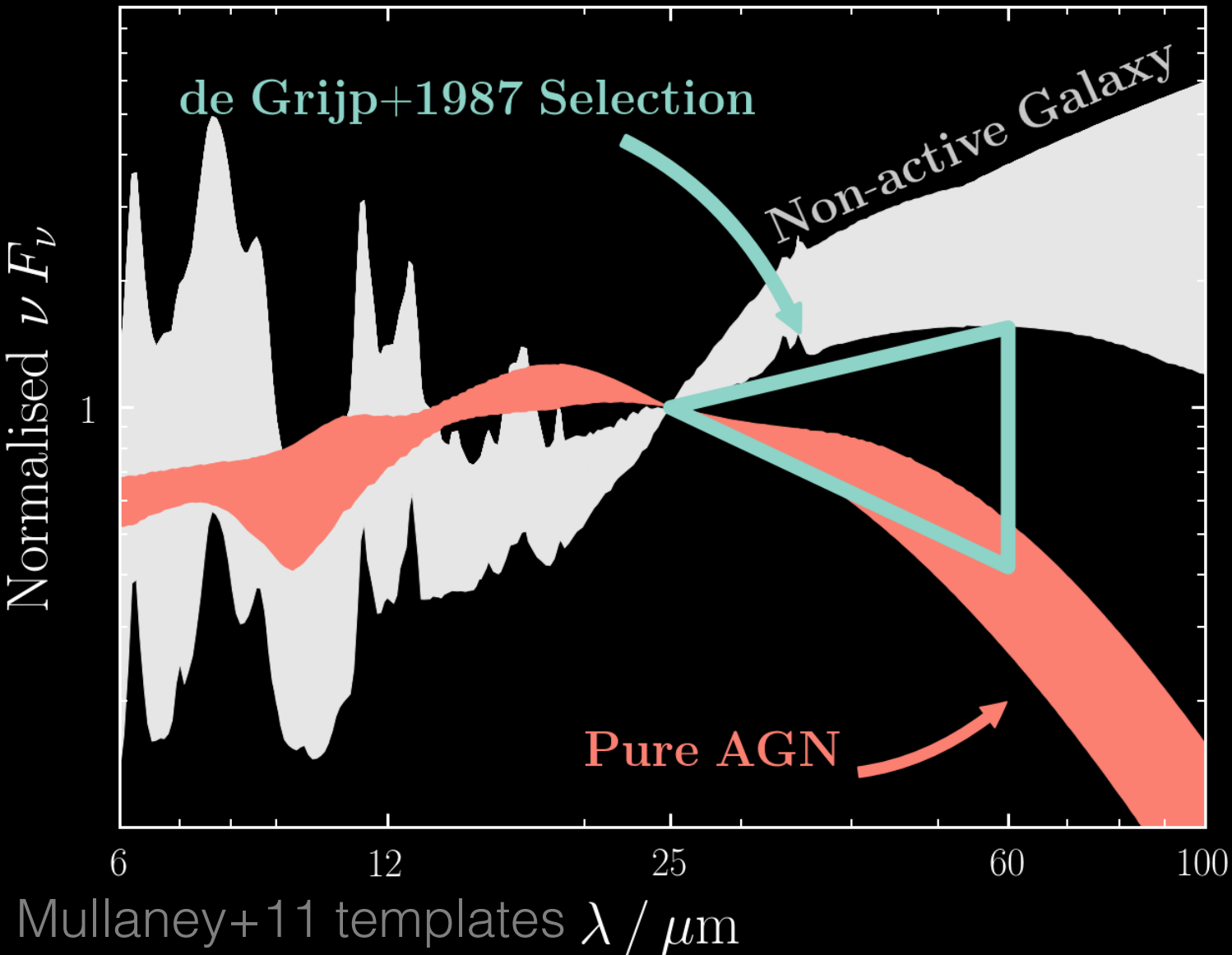


Isotropic Selection – IRAS Flux Cut

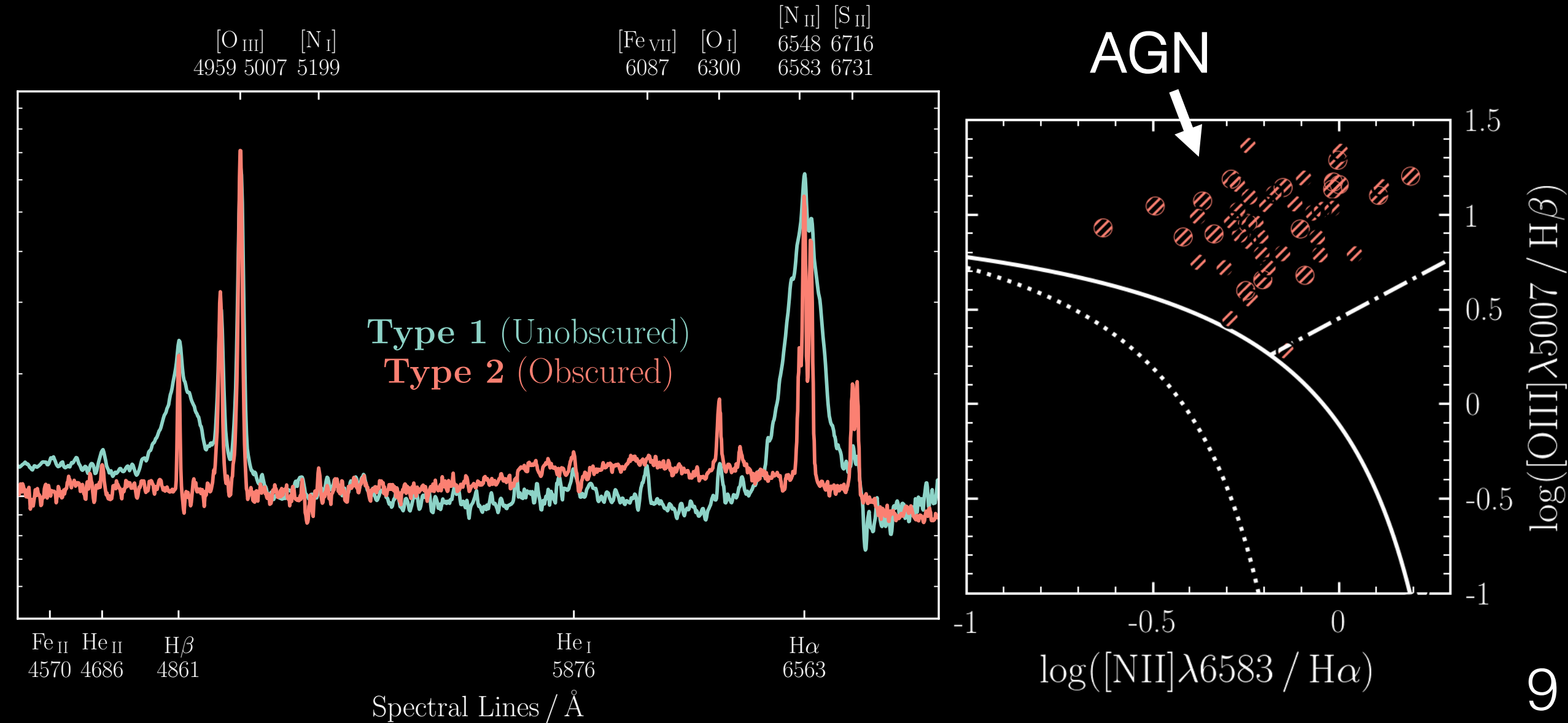


Uniform inherent prevalence of Type 1 & 2 AGN

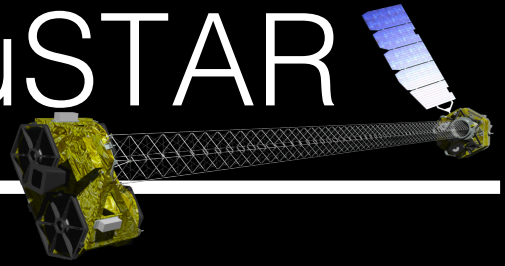
Infrared Classification - Warm Colours



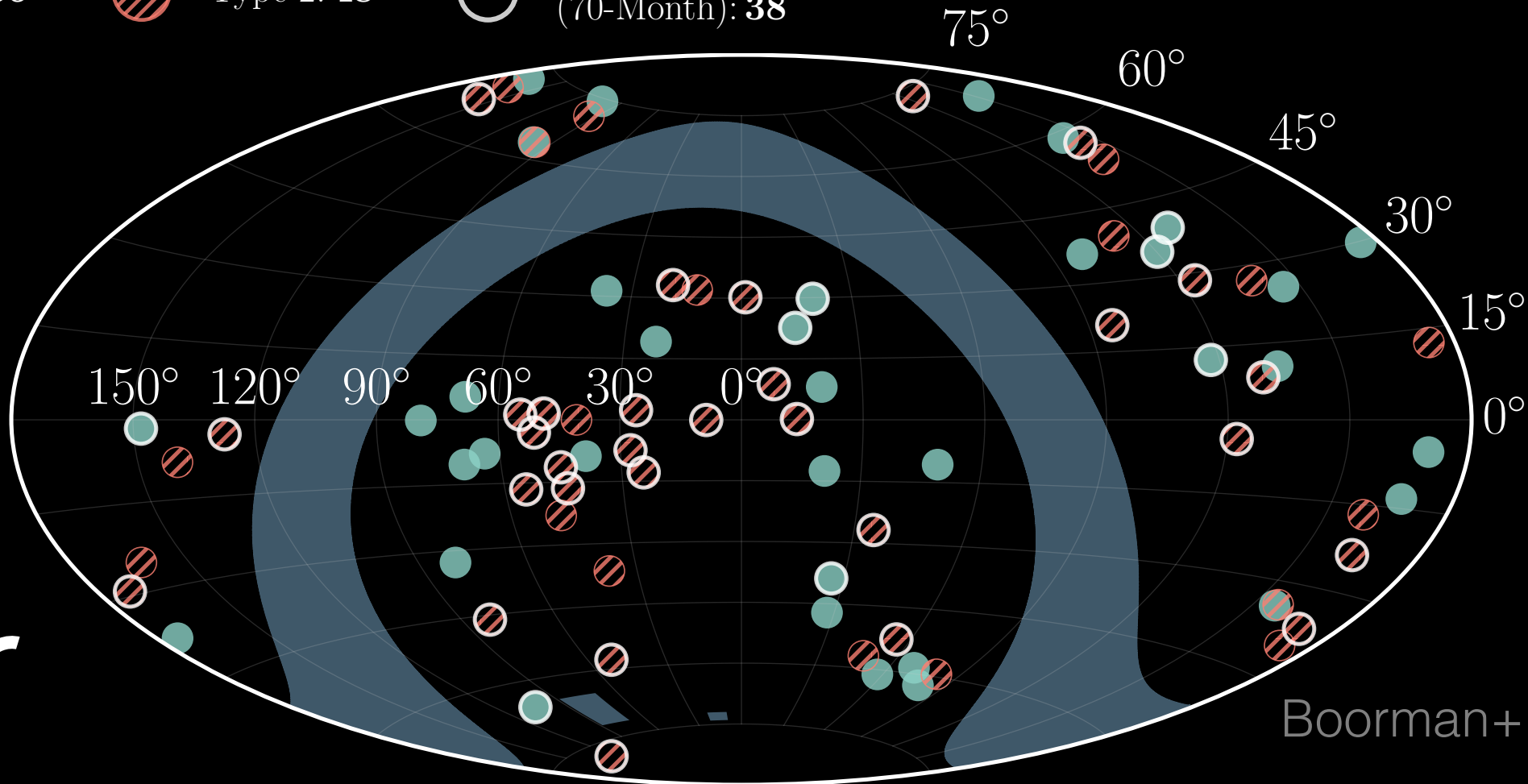
Optical Classification – Line Ratios



X-ray Classification – 1 Ms with NuSTAR



● Type 1: 36 ● Type 2: 48 ○ *Swift*/BAT-Undetected (70-Month): 38

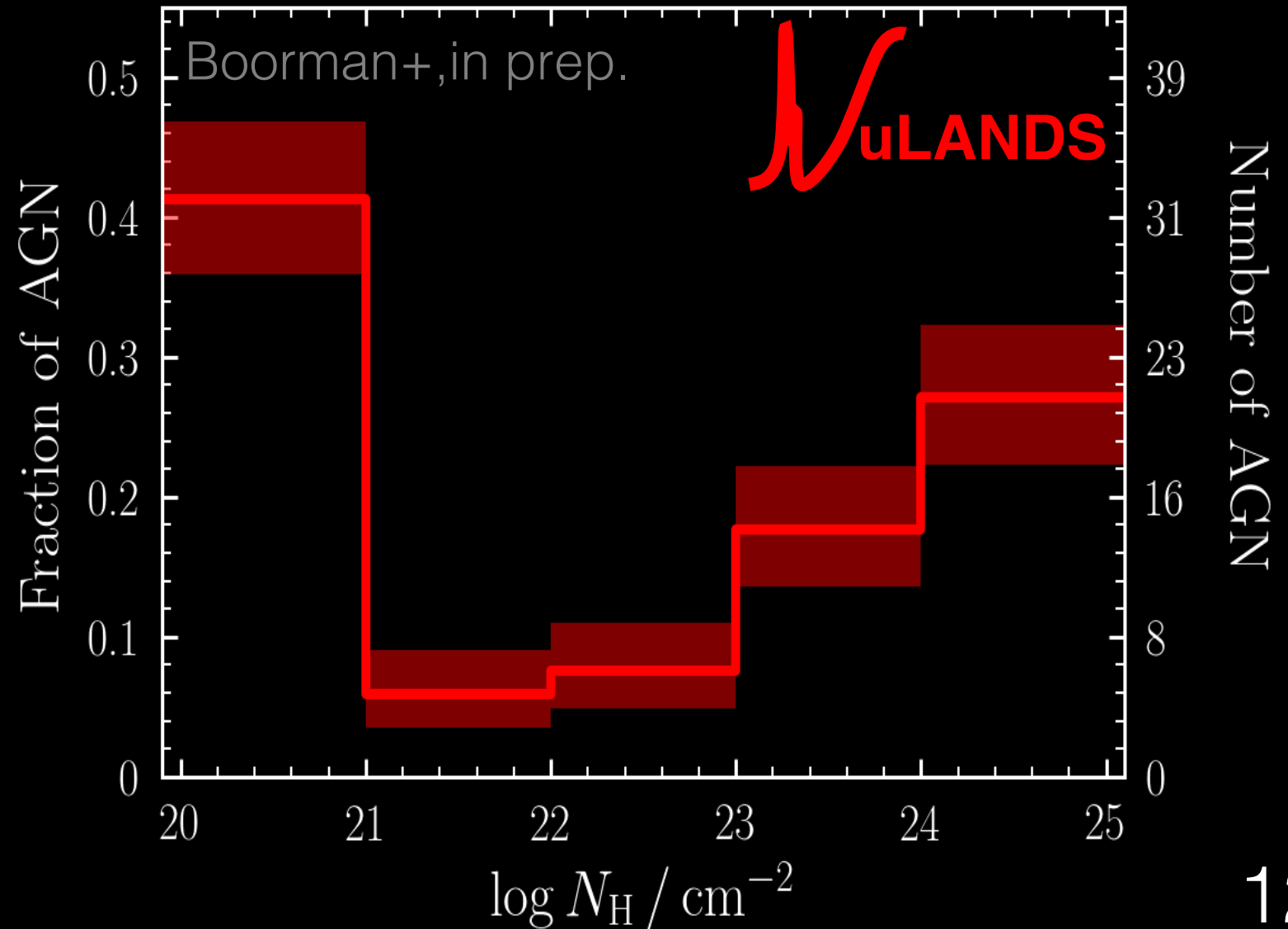


Boorman+, in prep.

NuLANDS = NuSTAR LOCAL AGN N_H DISTRIBUTION SURVEY

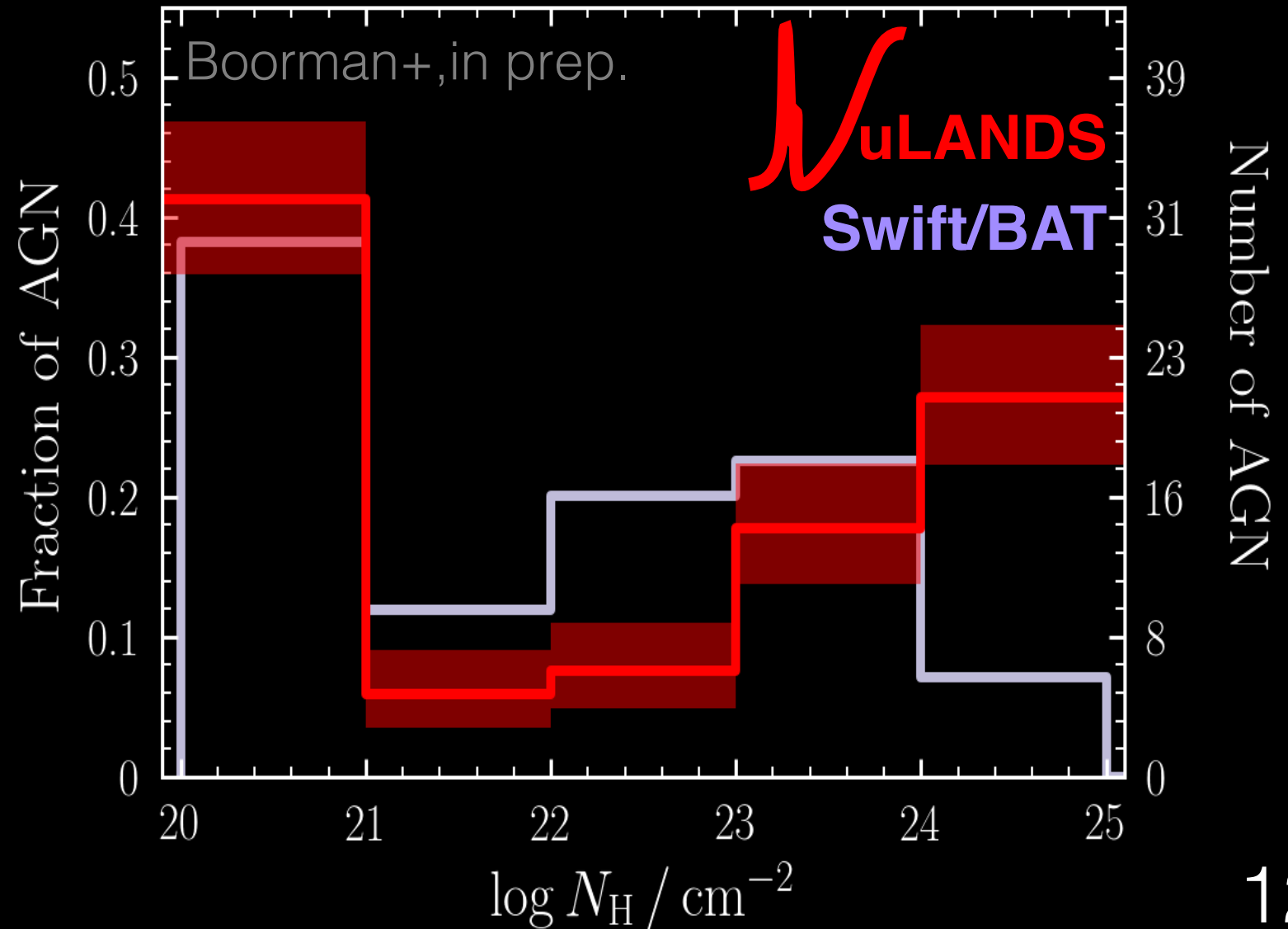
Directly Observed N_{H} Distribution (so far)

- 84 sources total
- Compton-thick fraction ~26-40%



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Possible biases...

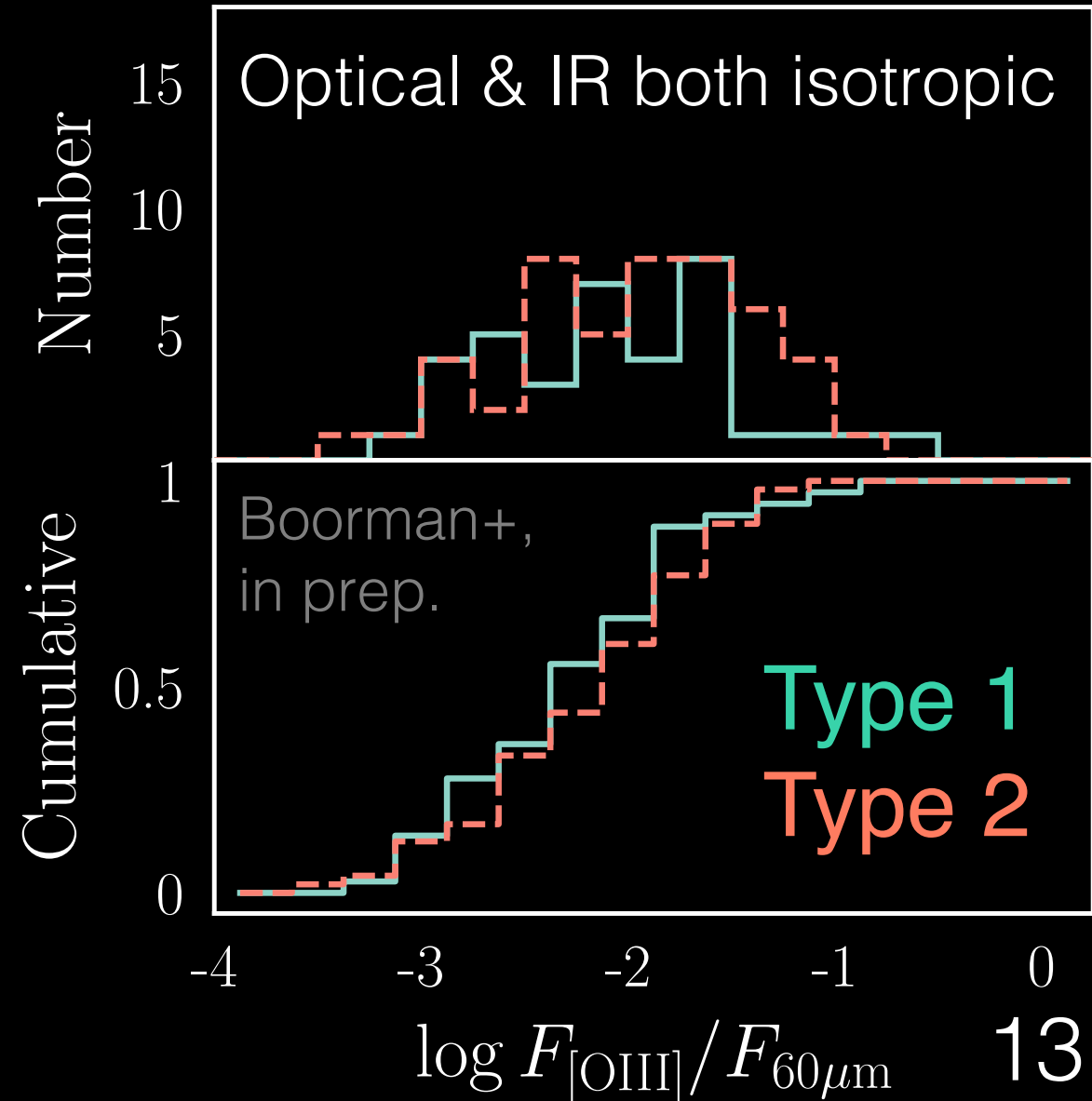
1. Infrared selection/classification:

- Missing Infrared-faint AGN?
- Missing Infrared-cool AGN?

2. Optical classification:

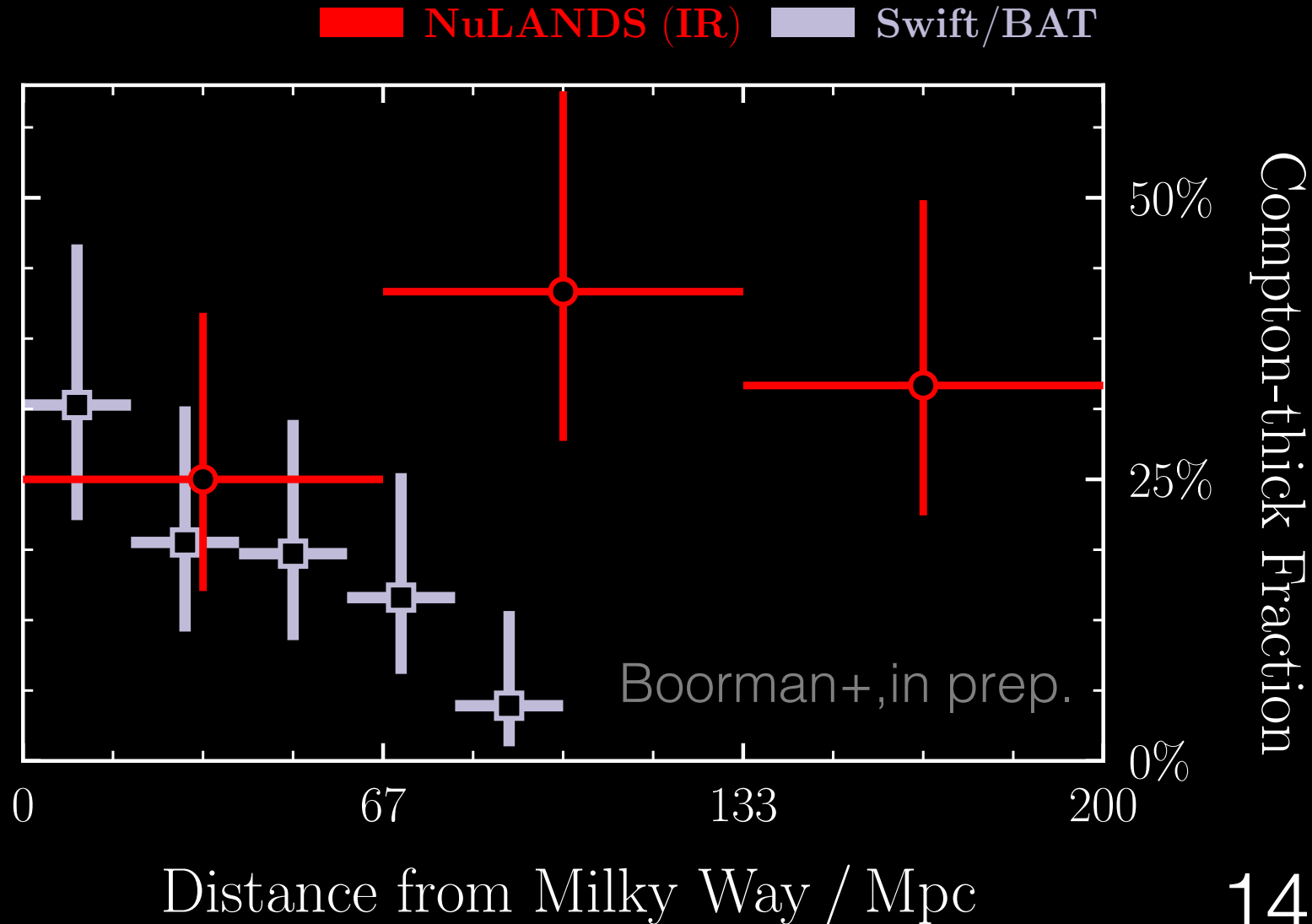
- Missing AGN in host-dominated galaxies?

(e.g., Goulding+09, Hao+10, Buchner+17)



Compton-thick AGN with distance

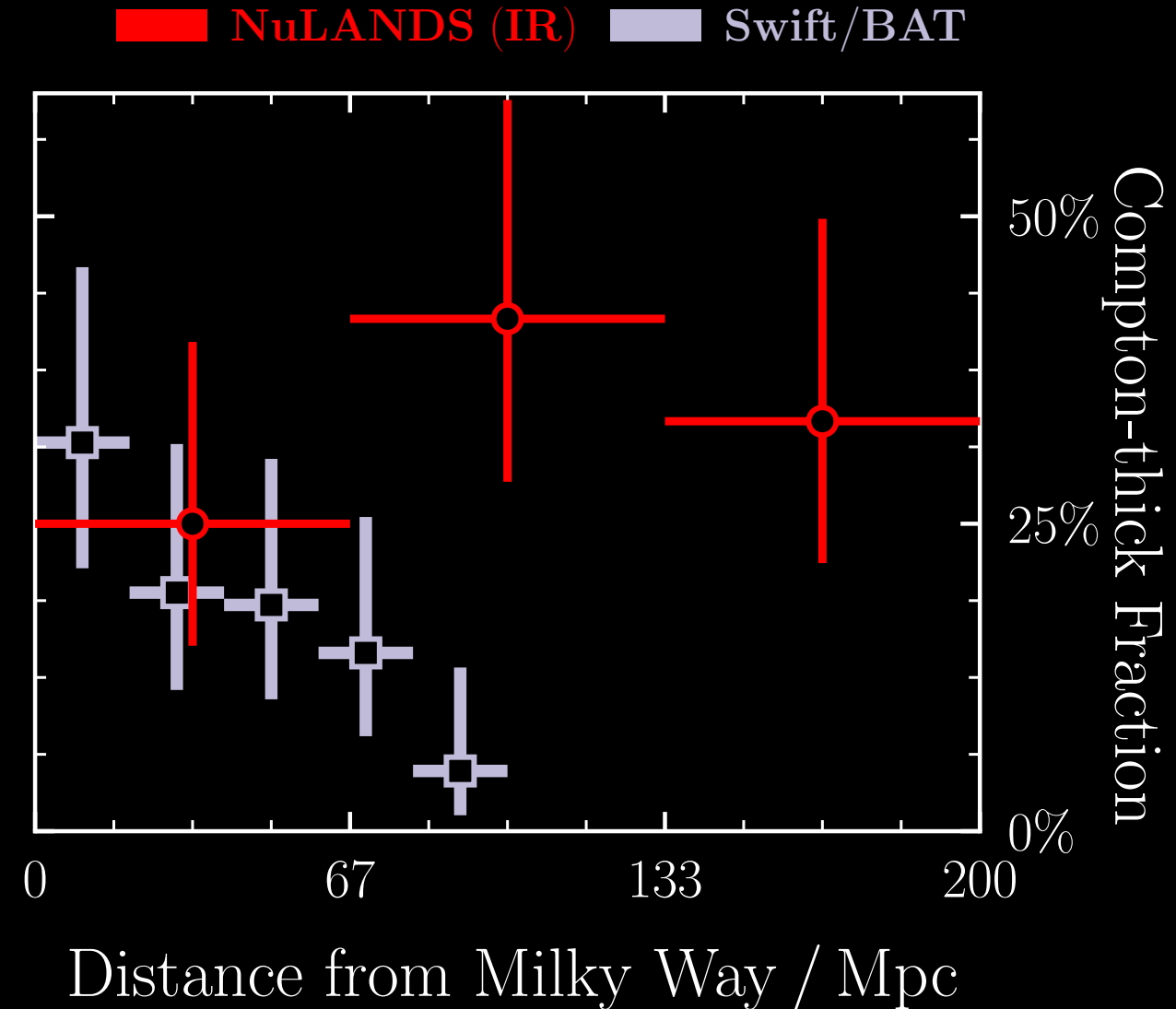
- Compton-thick fraction $\sim 26\text{-}40\%$
- Uniform with distance



Summary

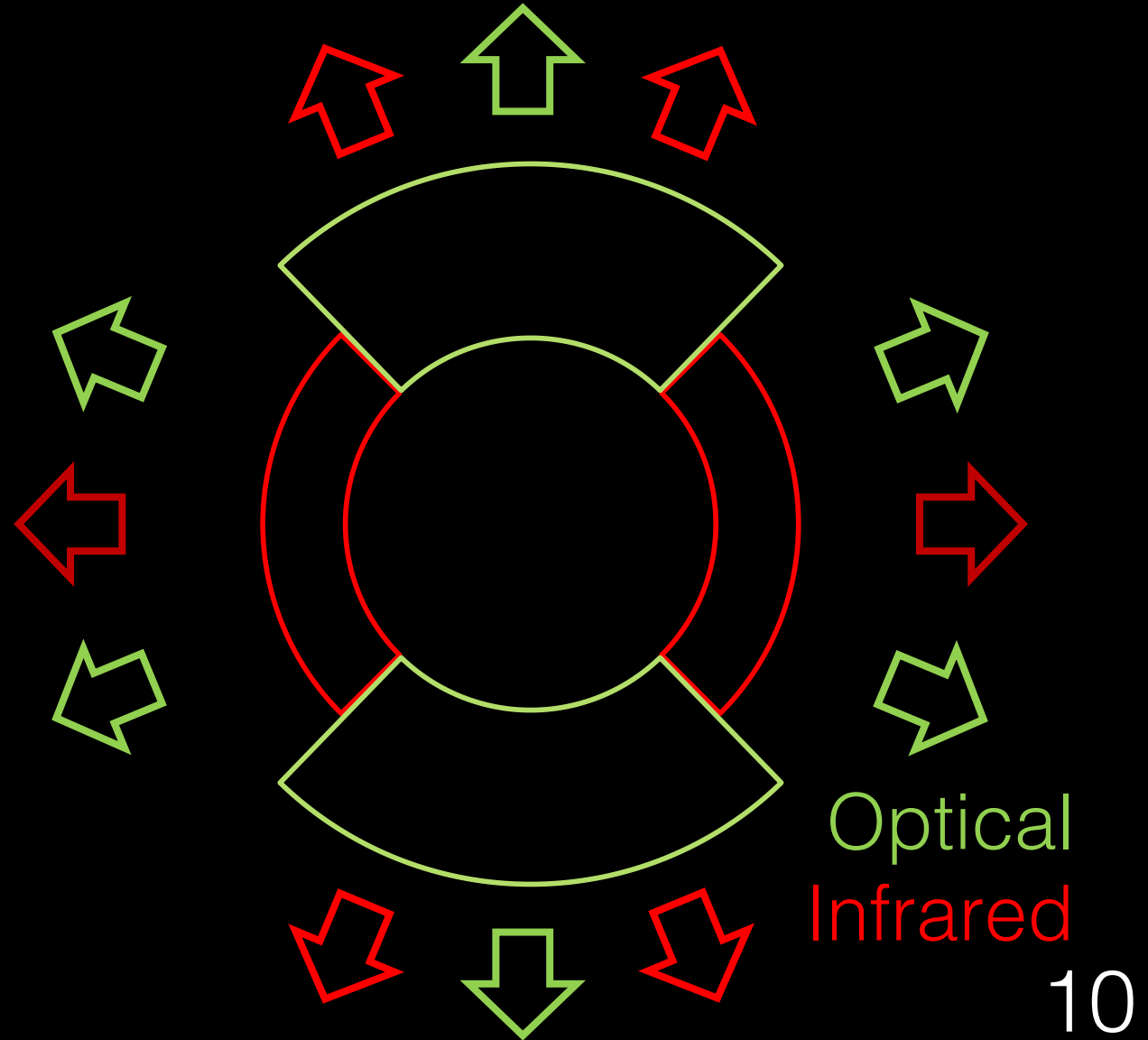
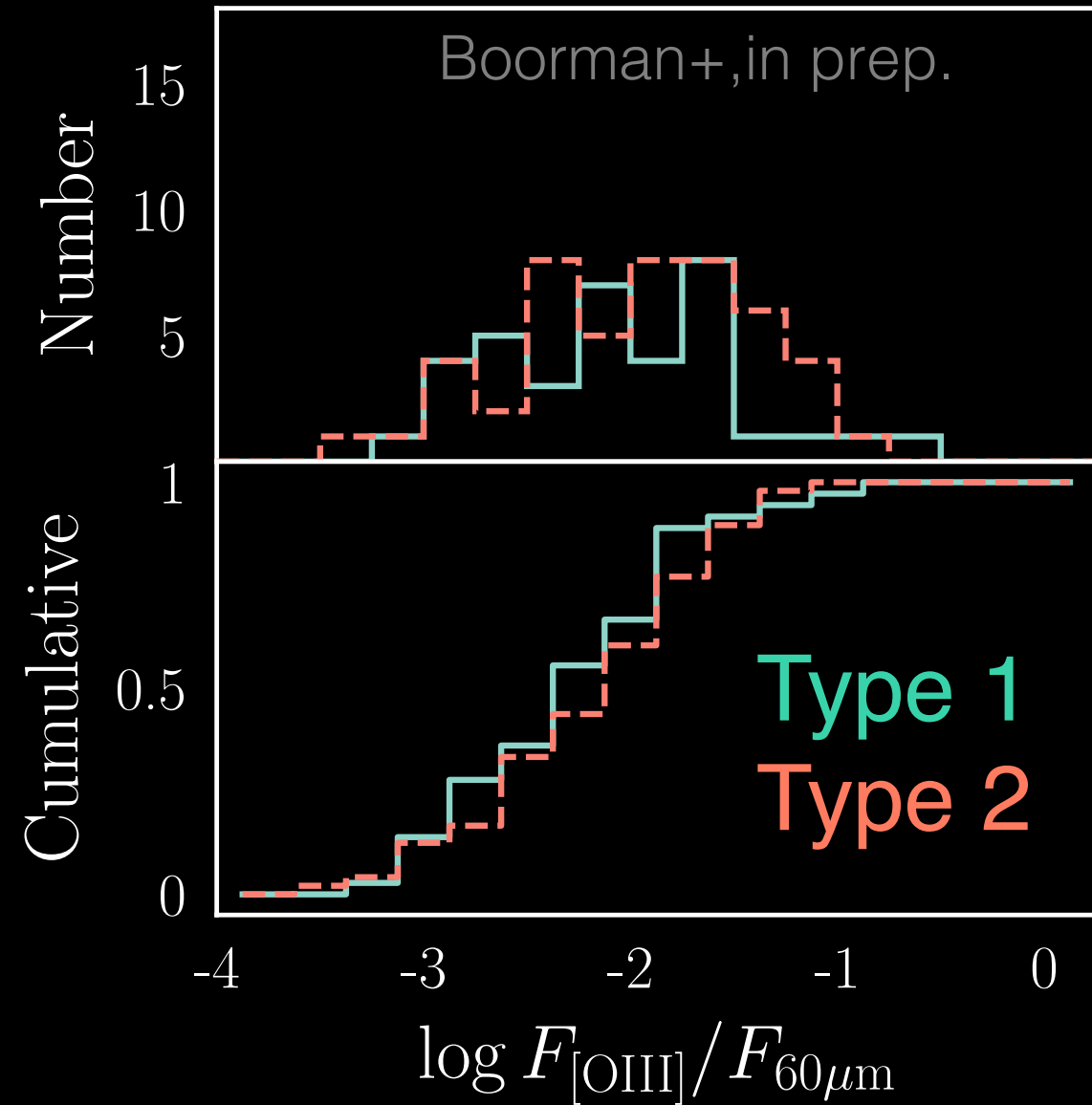
soton.ac.uk/~pgb2g11

- NuLANDS is AGN X-ray flux-limited unbiased
- Uniform fraction of Compton-thick AGN with distance (without bias corrections)
- Obscured fraction may still be lower limit

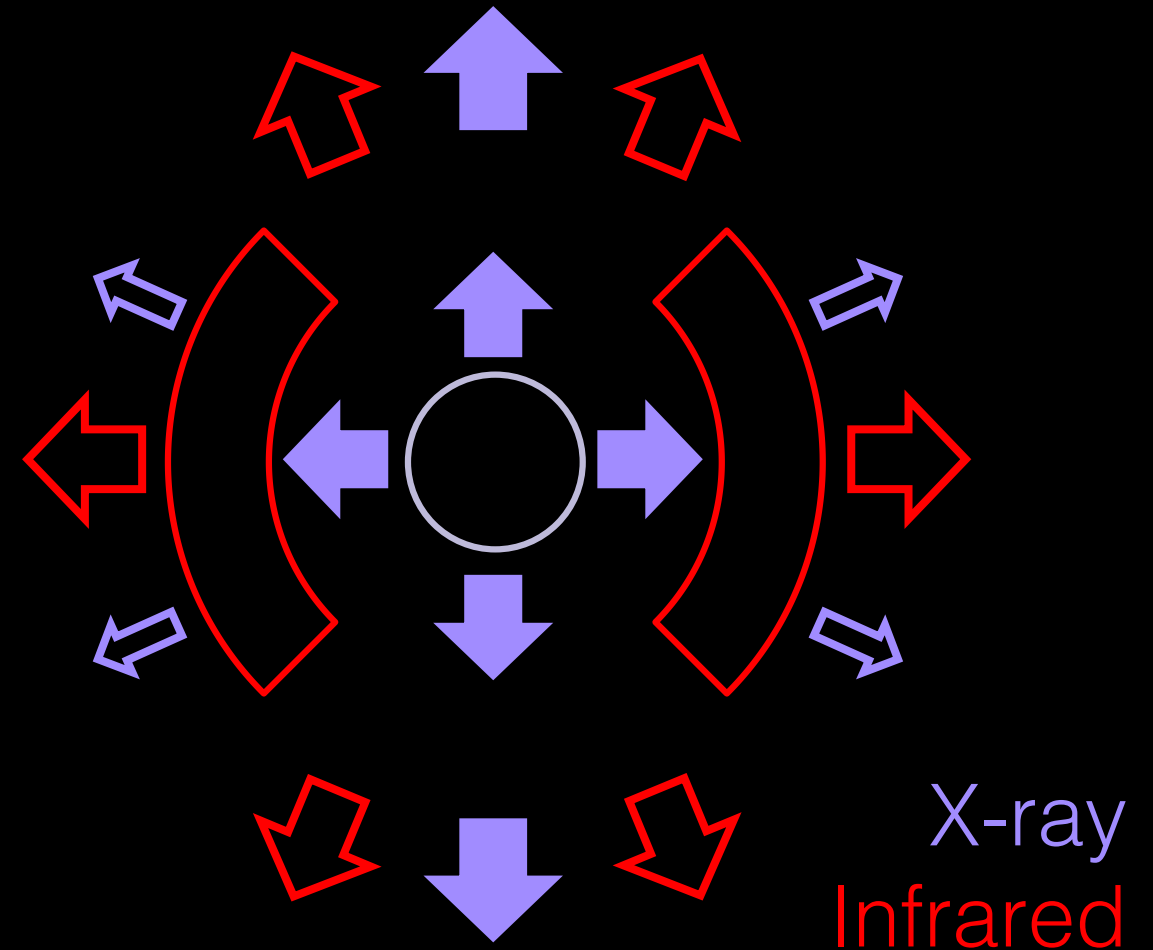
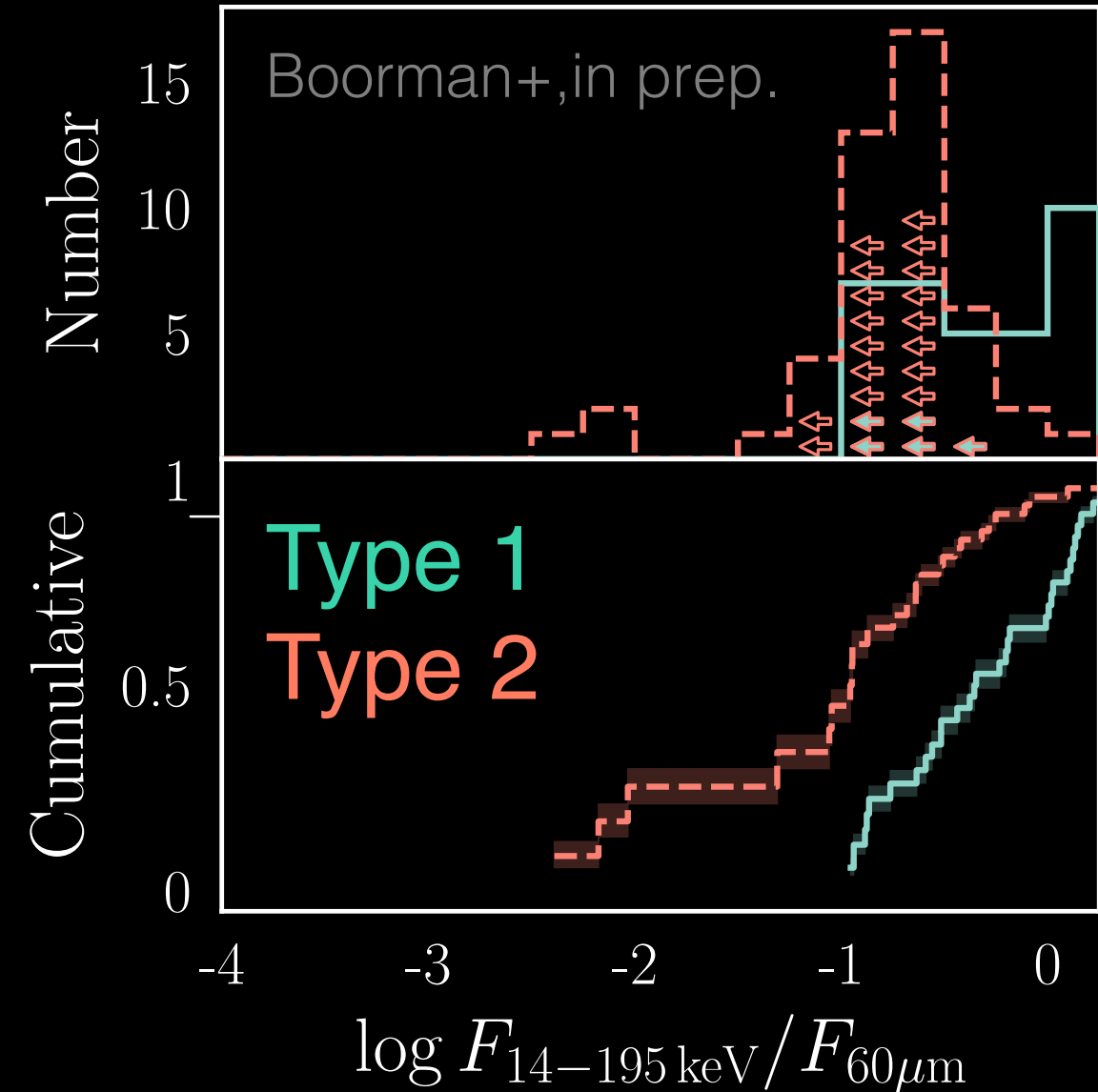


Appendix

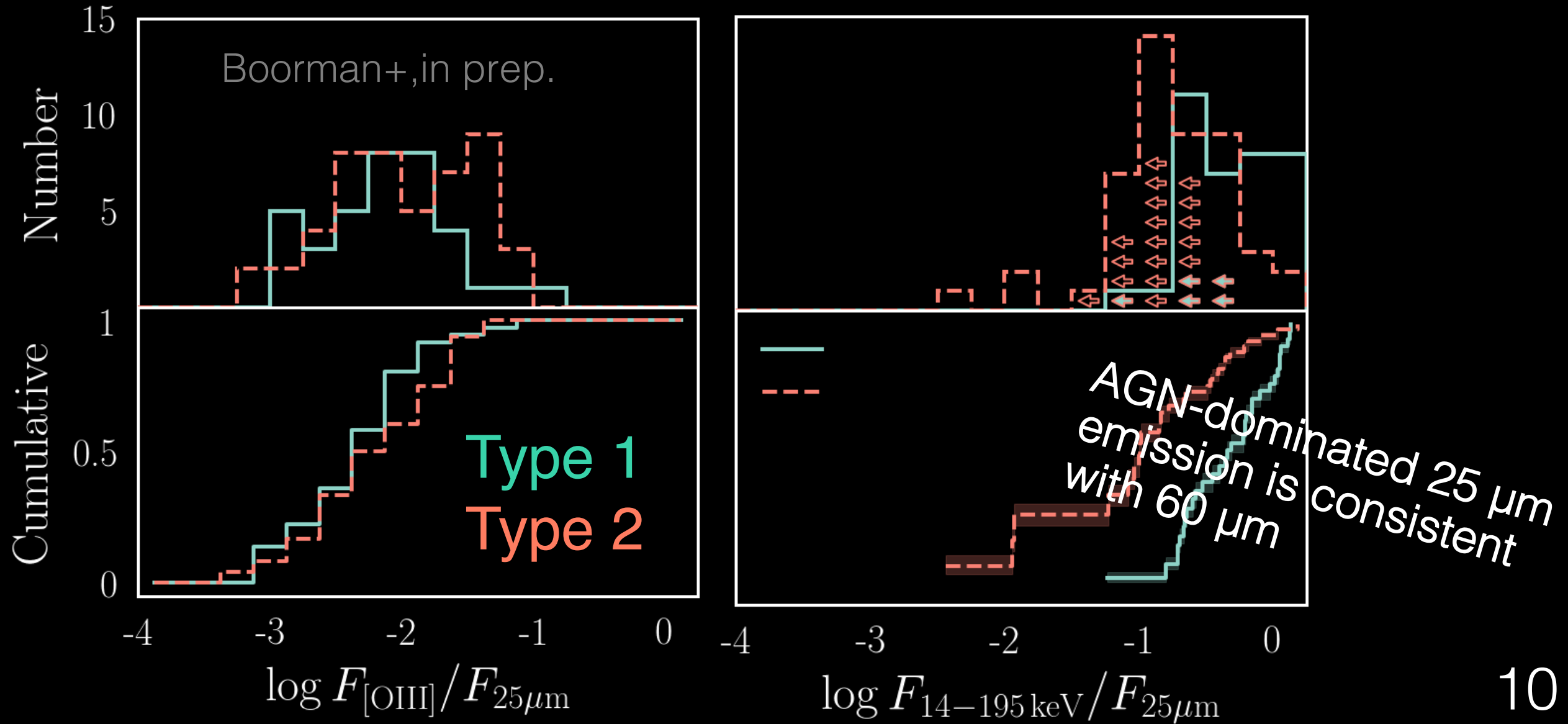
Optical and infrared are both isotropic



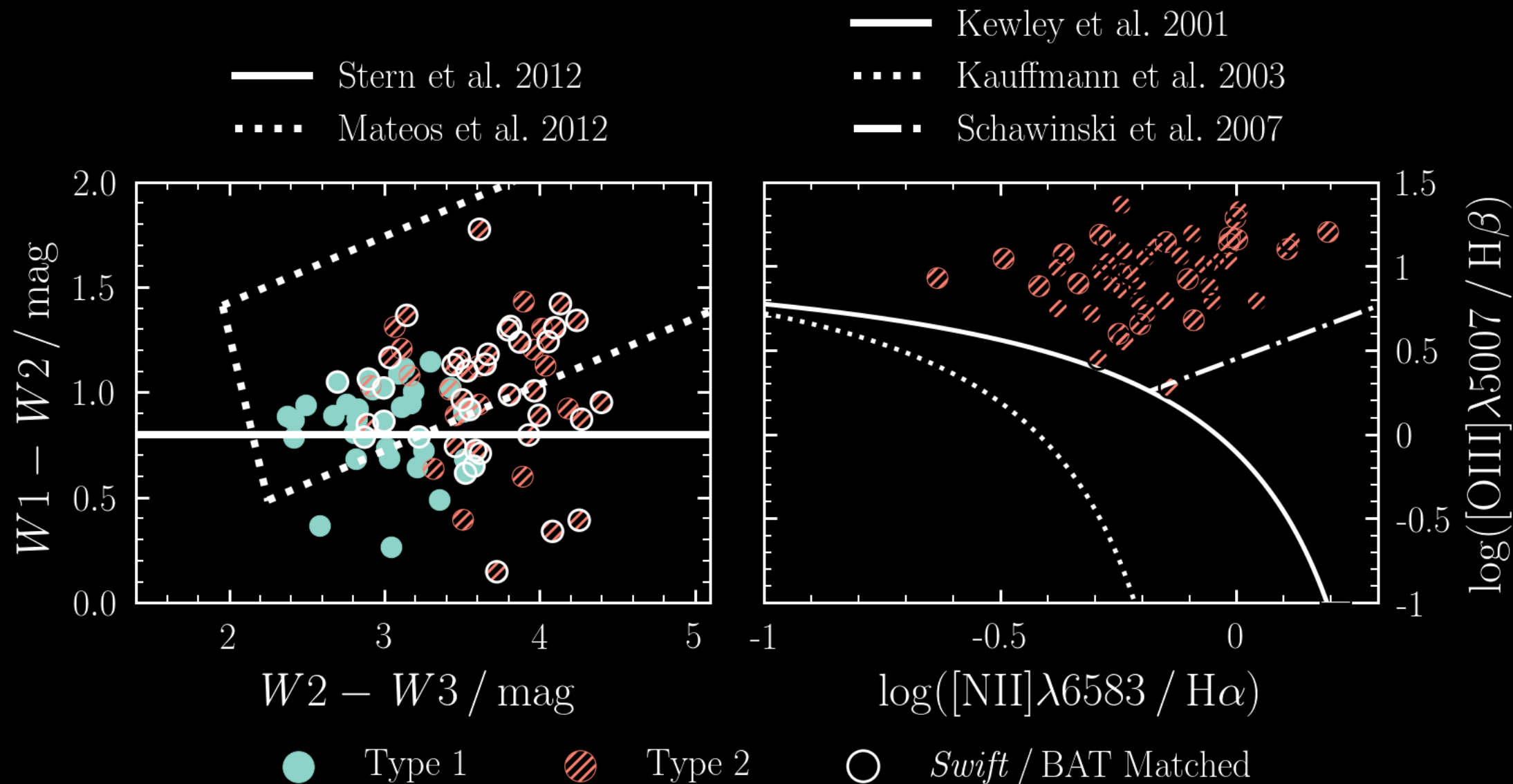
Representative? X-ray does not trace infrared



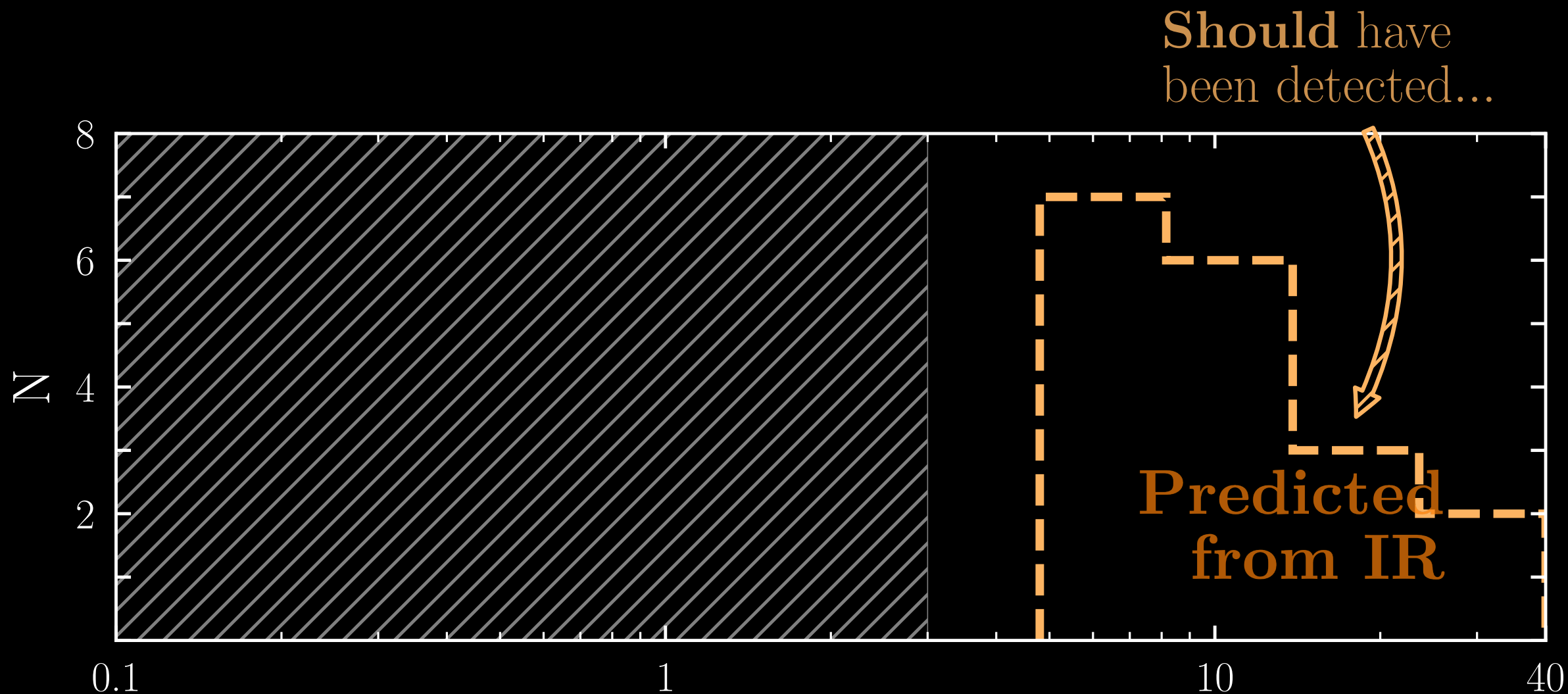
Is NuLANDS dominated by mergers?



Multi-wavelength checks



Compton-thick candidates



Compton-thick candidates

But weren't!

Should have
been detected...

