

Mitigating X-ray Obscuration Biases with Isotropic AGN Selection

Peter Boorman

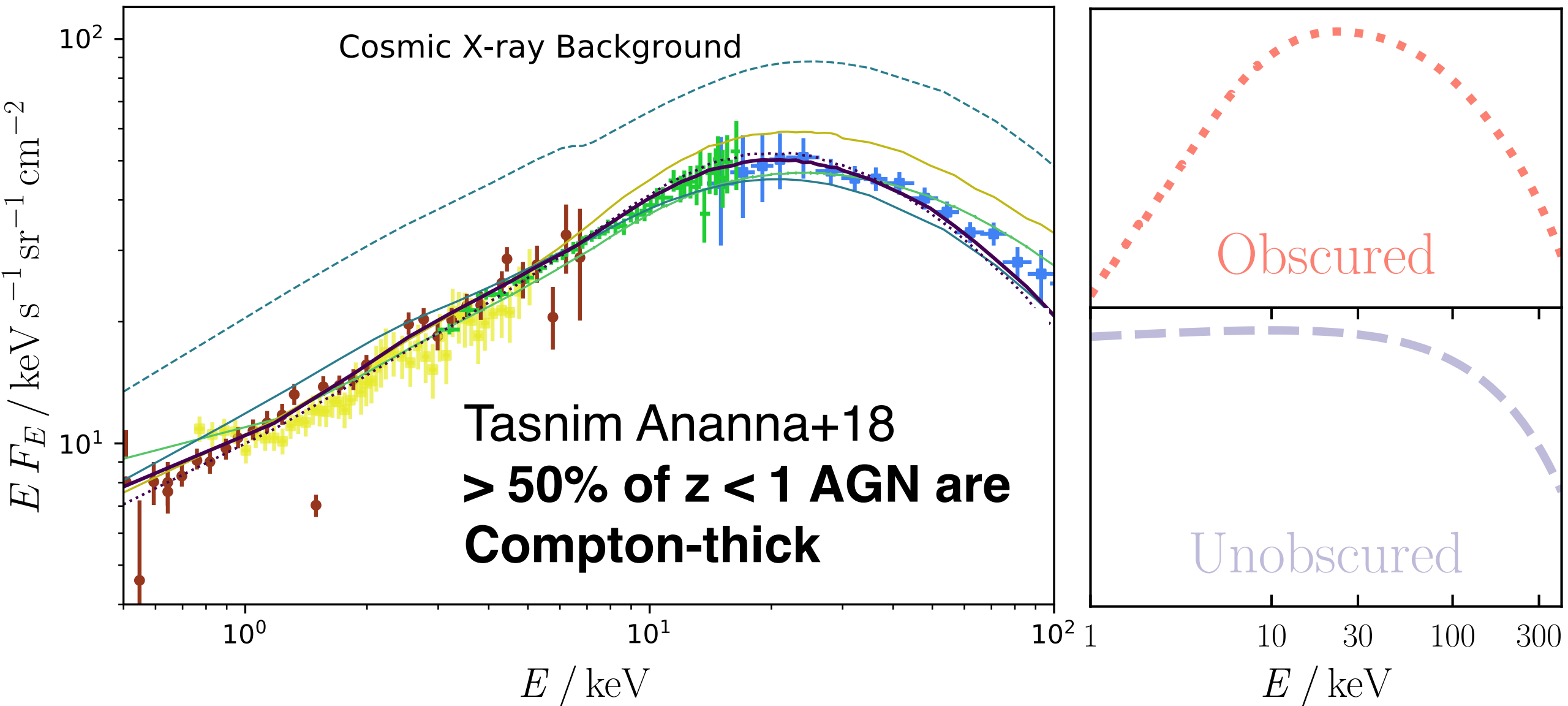
PhD Student - University of Southampton

With Poshak Gandhi (Southampton), Seb Hönig (Southampton), Dan Stern (JPL), Fiona Harrison (Caltech), Mislav Baloković (BHI), Claudio Ricci (UDP), Franz Bauer (PUC), Daniel Asmus (Southampton), Lauranne Lanz (Dartmouth) & the *NuSTAR* AGN Team

Key Questions

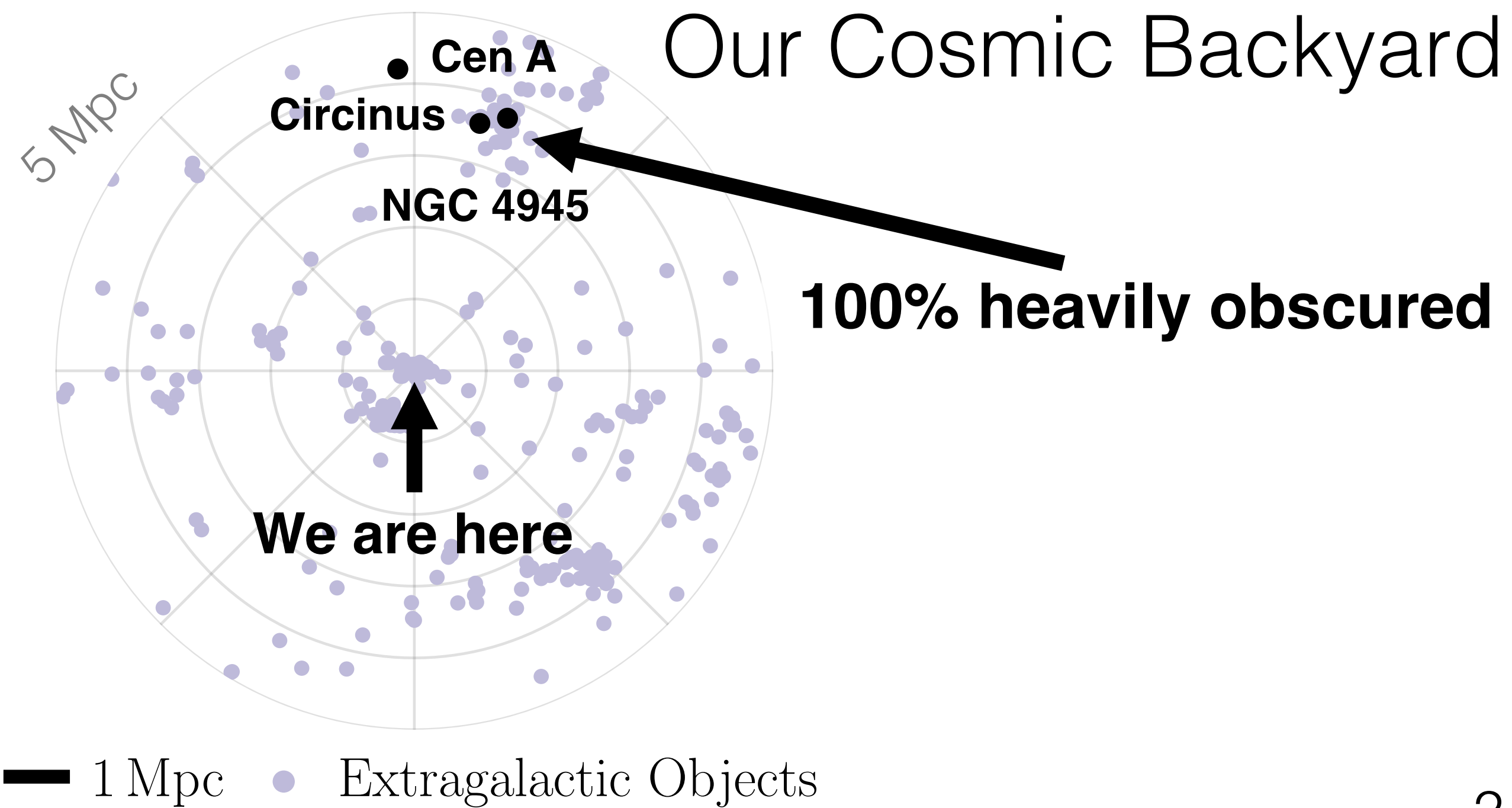
1. How **prevalent** are the most obscured AGN?
2. How can we construct a **representative census** of the most obscured AGN?

Predicted Prevalence of Obscuration

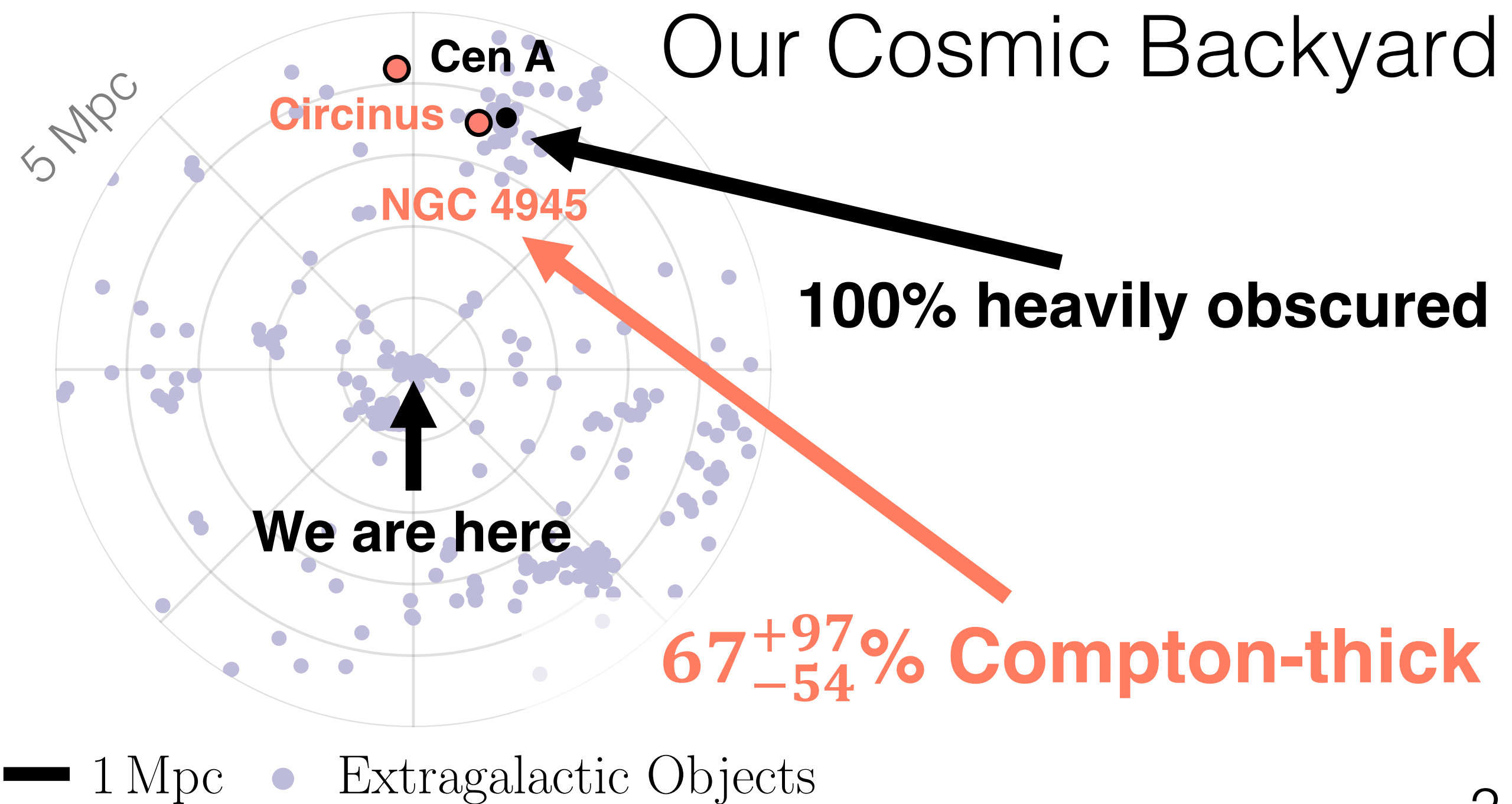


(Also Comastri+95, Mushtozky+00, Gandhi+03, Gilli+07, Treister+09, Aird+15) **1**

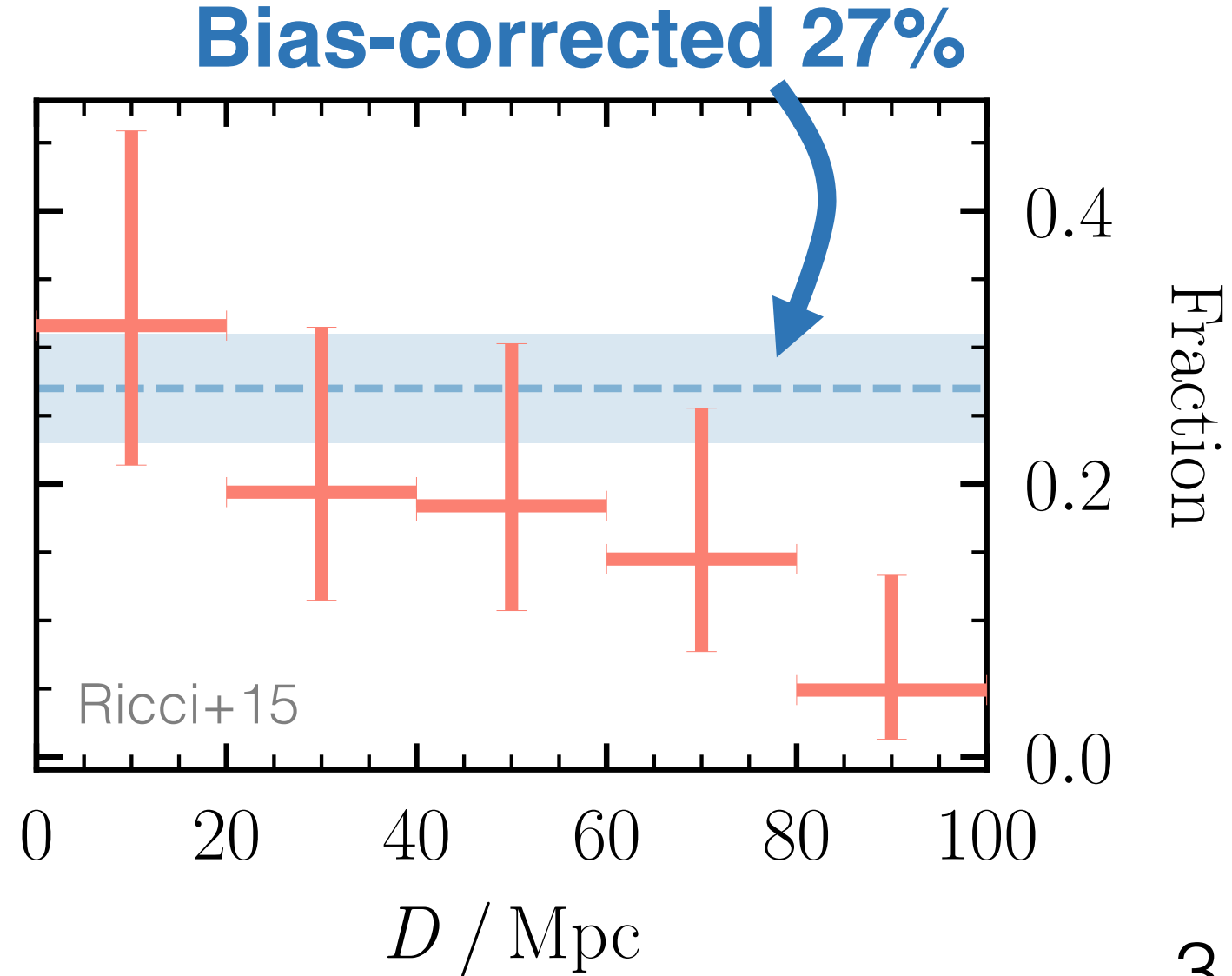
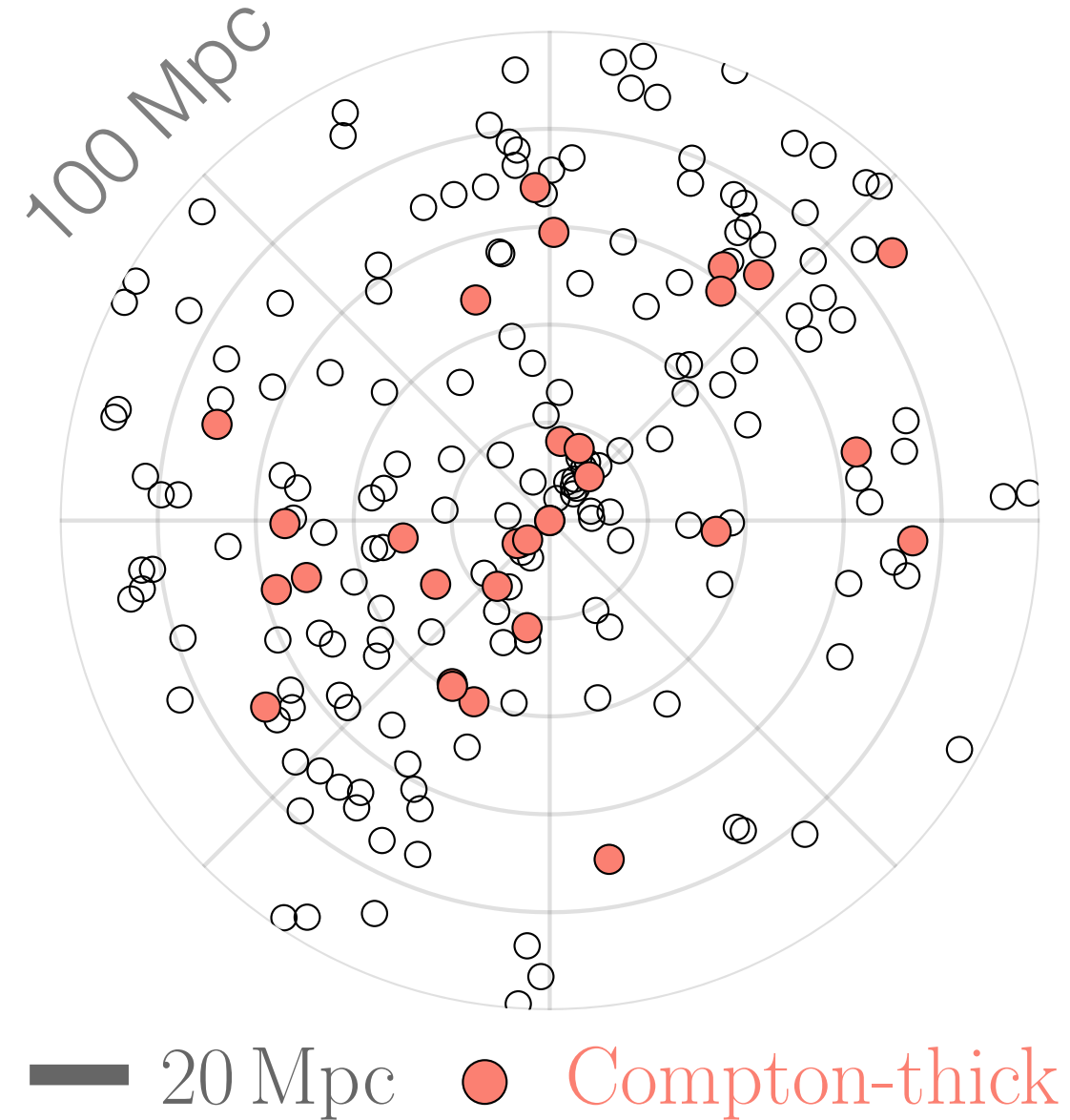
Our Cosmic Backyard



Our Cosmic Backyard

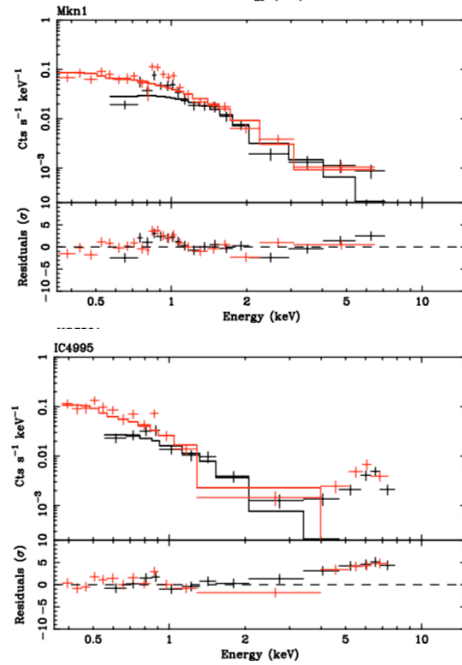
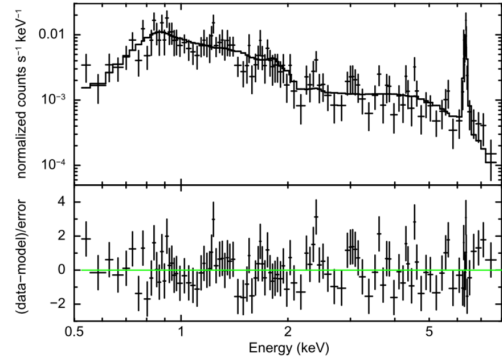


Swift/BAT Compton-thick AGN

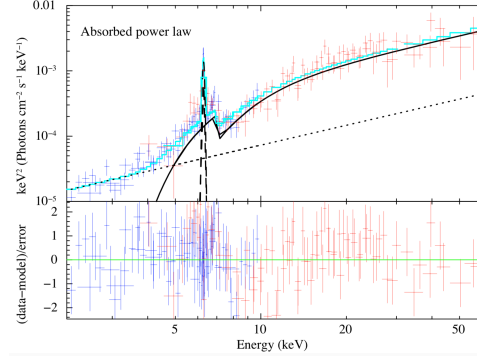


Missed Compton-thick AGN

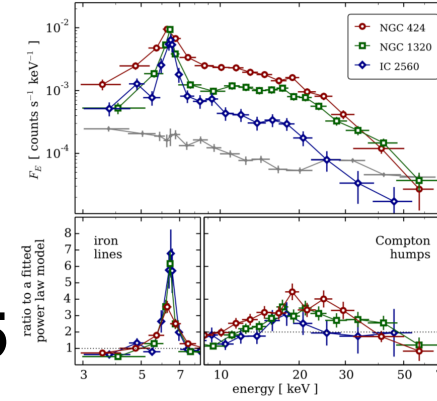
NGC 4968
Lamassa+17
+in prep.



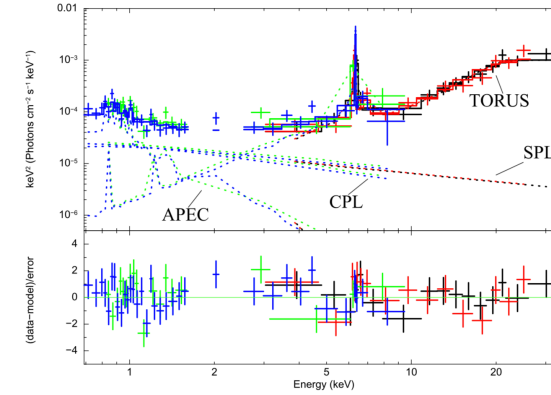
ESO 116-18
Zhao+18



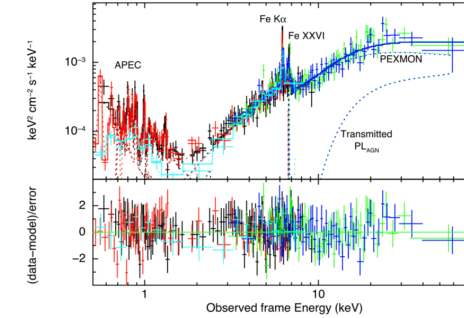
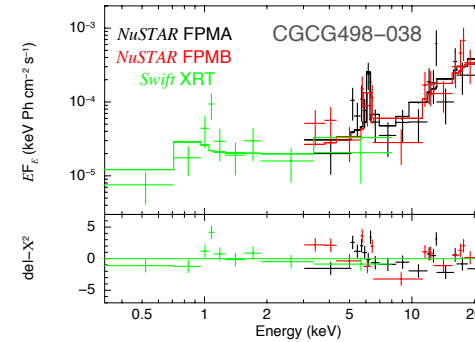
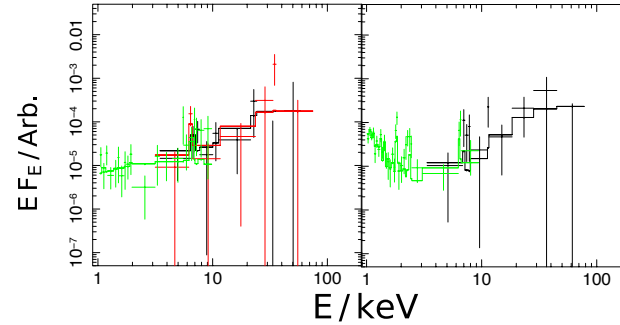
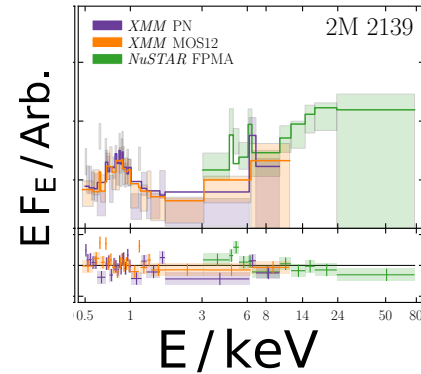
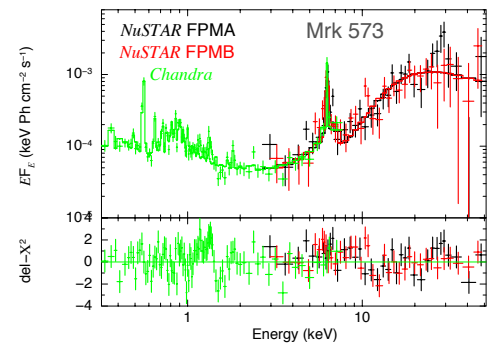
NGC 1320
Baloković+14



IC 3639
Boorman+16.



NGC 449, IC 4995
Guianazzi+05



Mrk 573

2M 2139

ESO 18-9

UGC 9944

2M 2355

NGC 7674

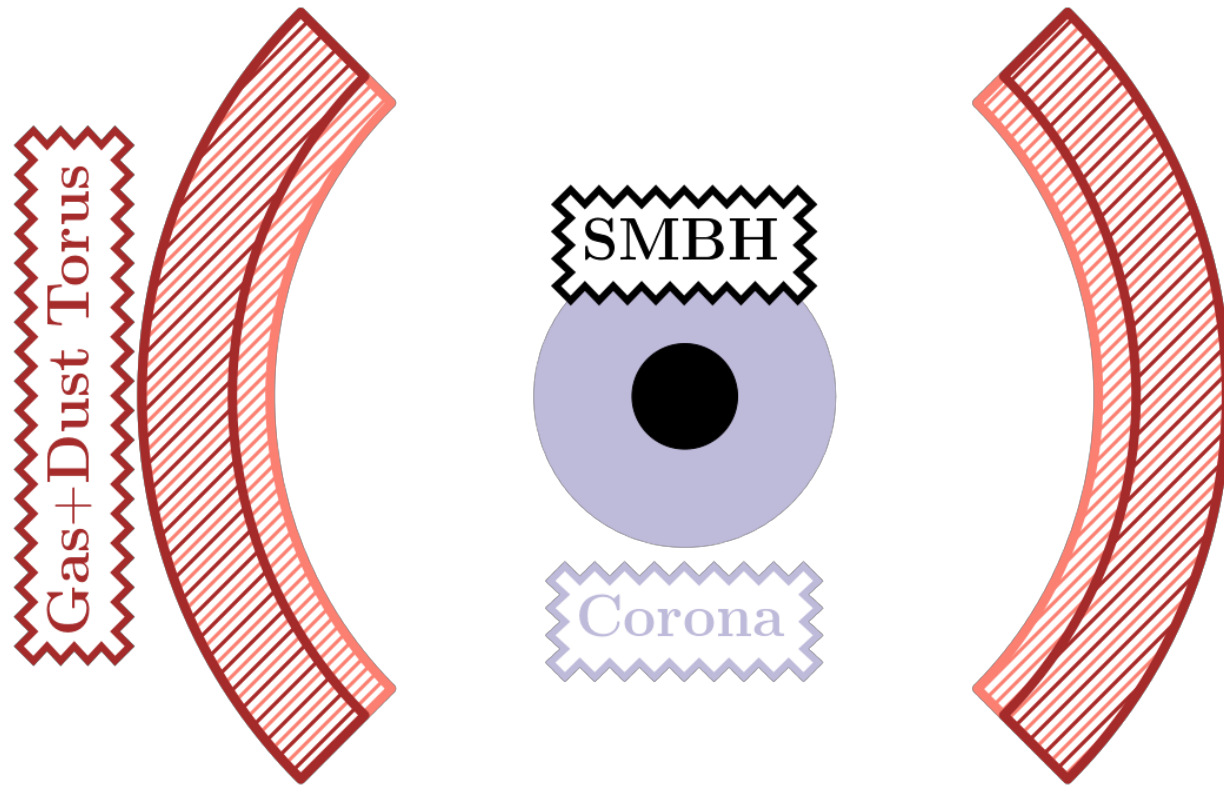
Boorman+, in prep.

Gandhi+17

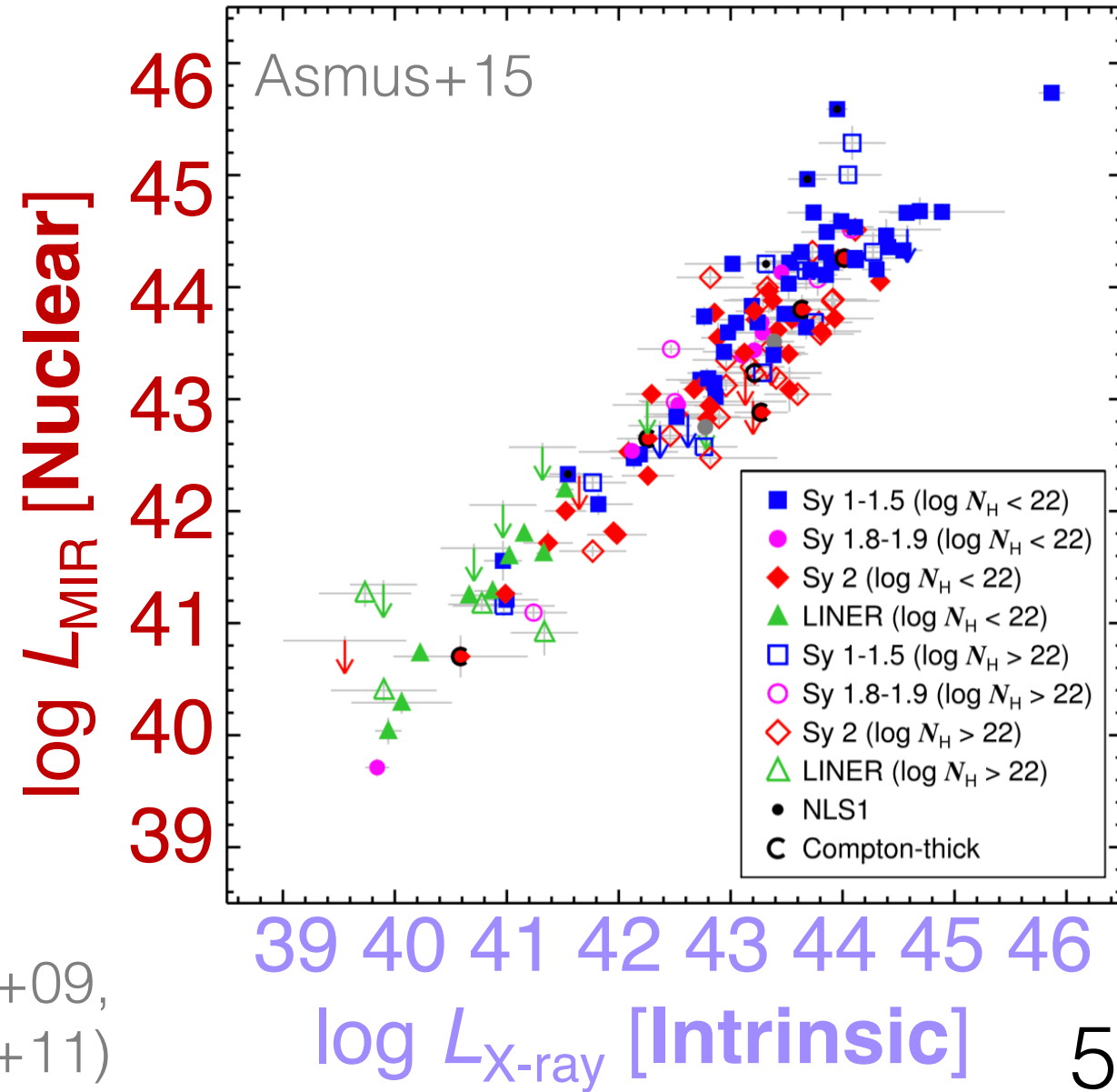
Key Questions

1. How **prevalent** are the most obscured AGN?
2. How can we construct a **representative census** of the most obscured AGN?

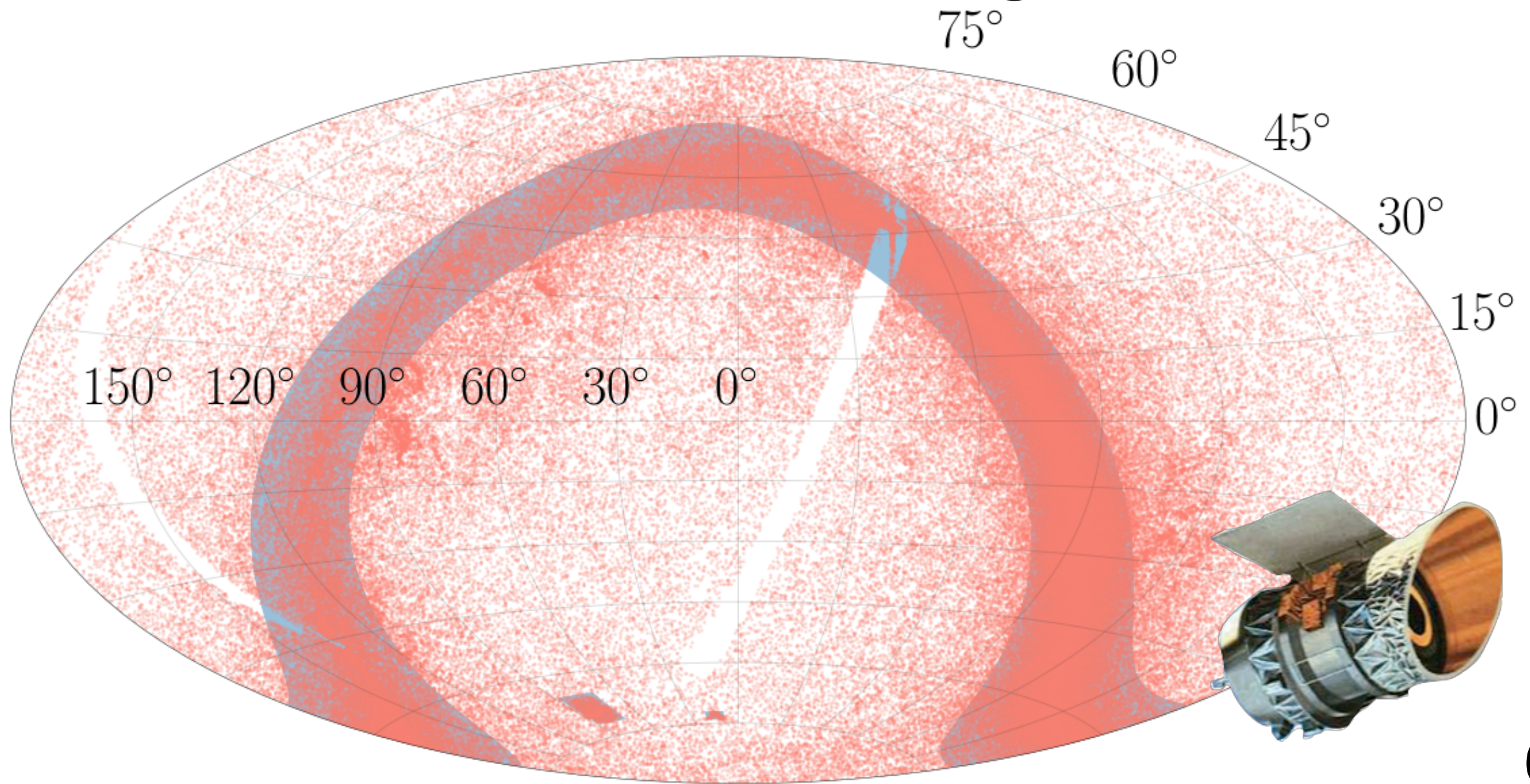
Mid-infrared Isotropy



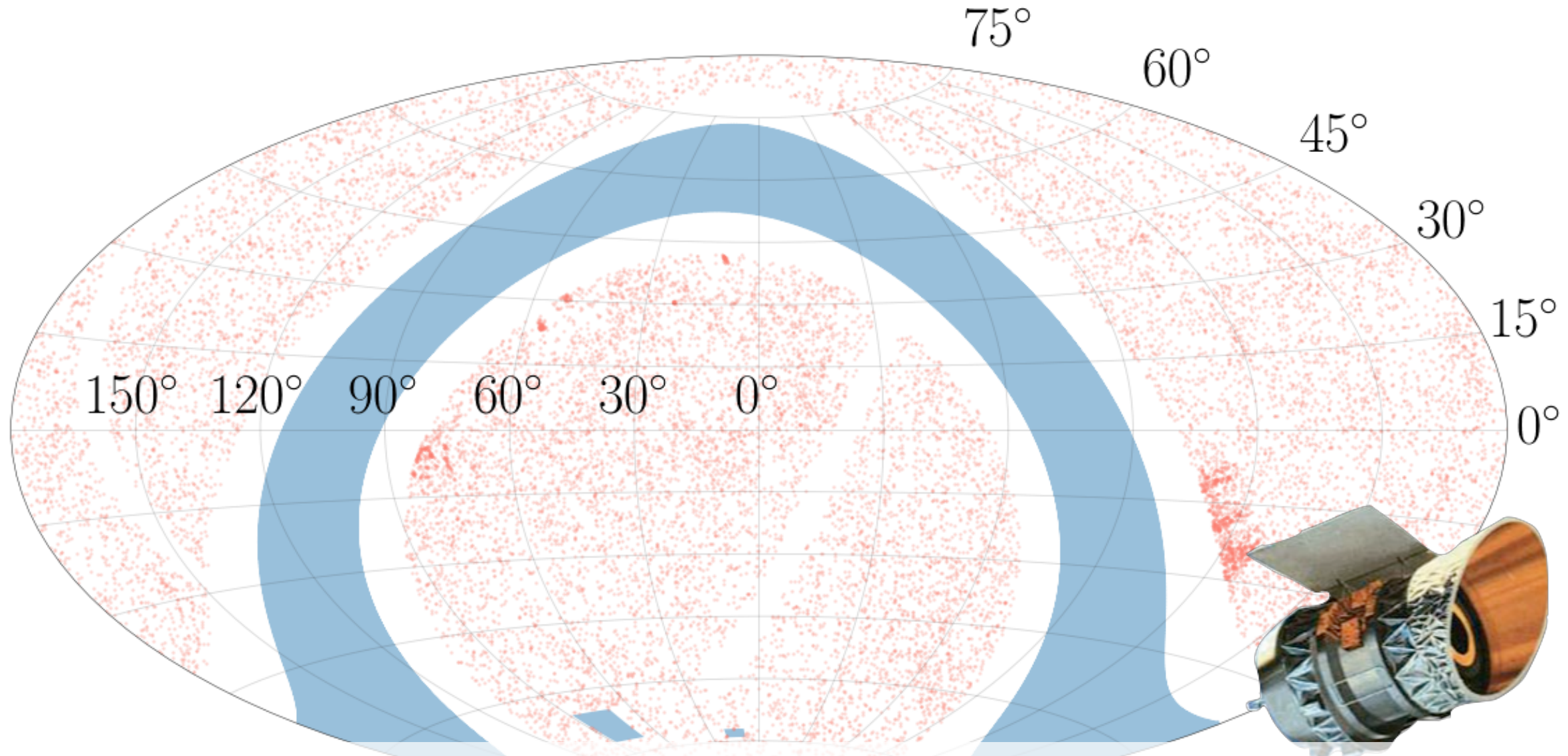
(Also Buchanan+06, Horst+08, Levenson+09, Gandhi+09, Lawrence & Elvis 10, Hönig+11)



IRAS Point Source Catalog

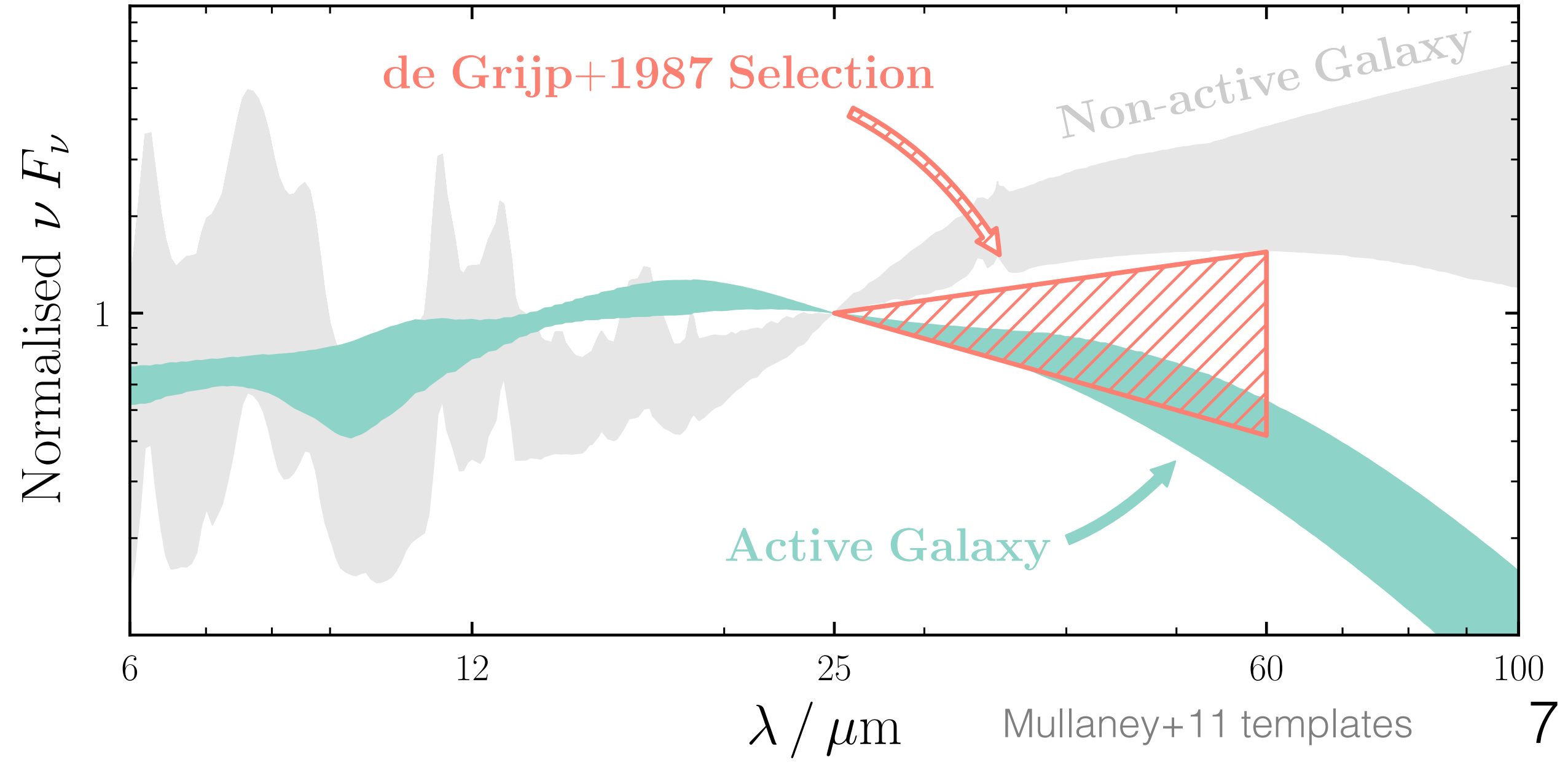


Isotropic Selection – *IRAS* Flux Cut



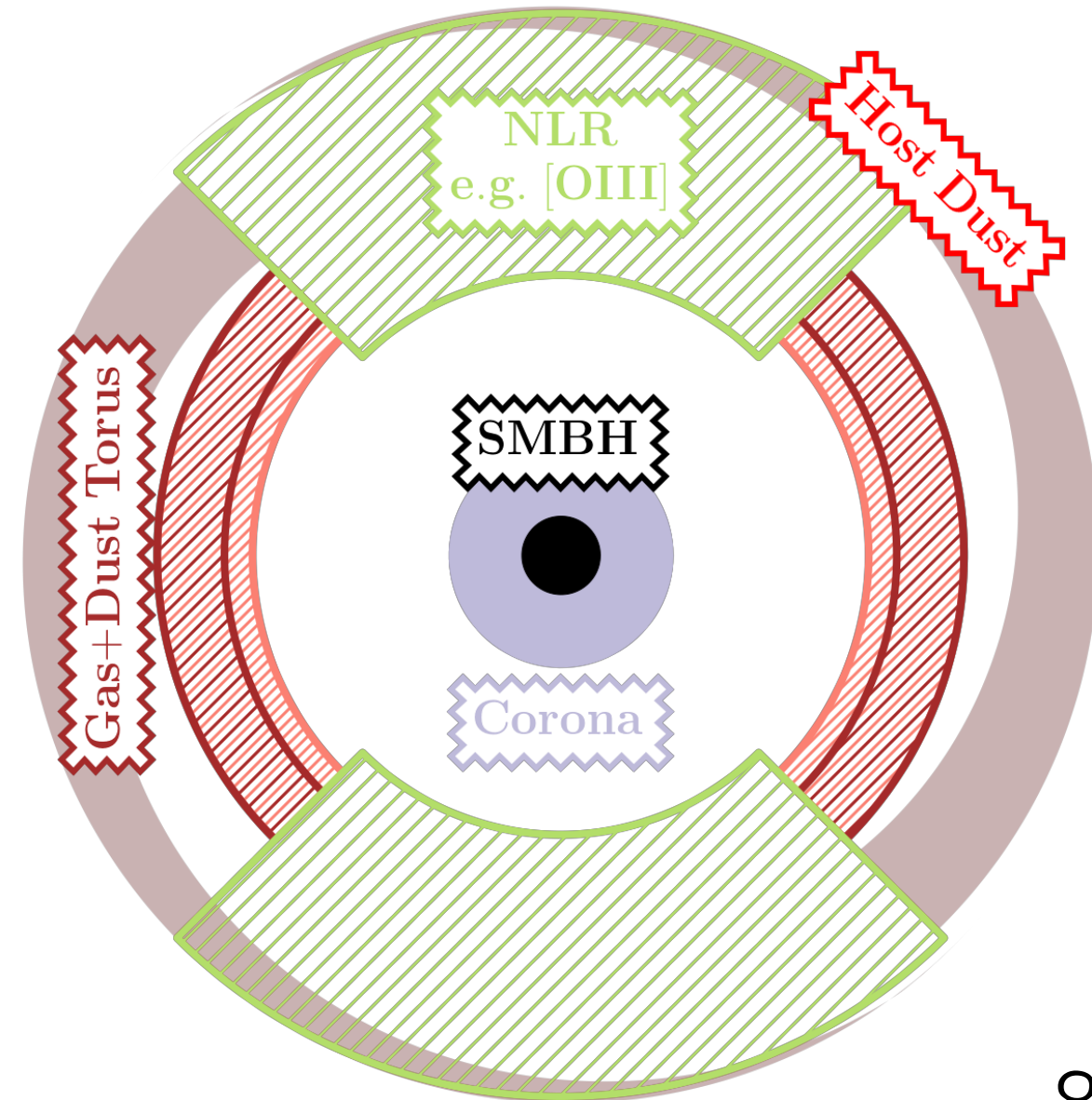
Inherent prevalence of Type 1 & 2 AGN

Infrared Classification - Warm Colours



Optical Classification

- Line ratio diagnostics - Keel+94
- May miss AGN with **large scale host dust** (e.g., Goulding+09, Buchner+17)
- Would lead to **lower limit on obscured fraction**



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

Boorman+, in prep.

75°

60°

45°

30°

15°

0°

150°

120°

90°

60°

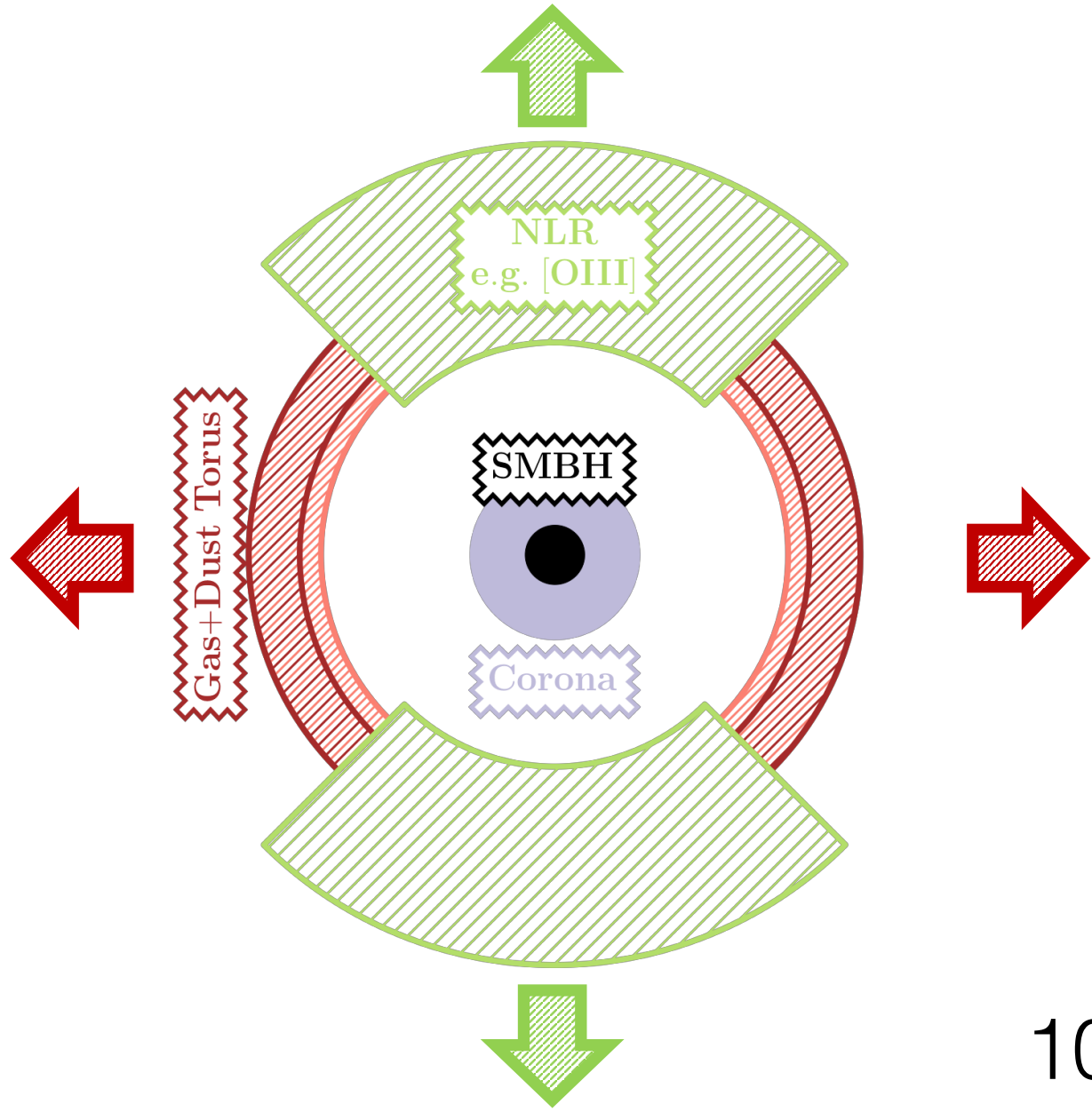
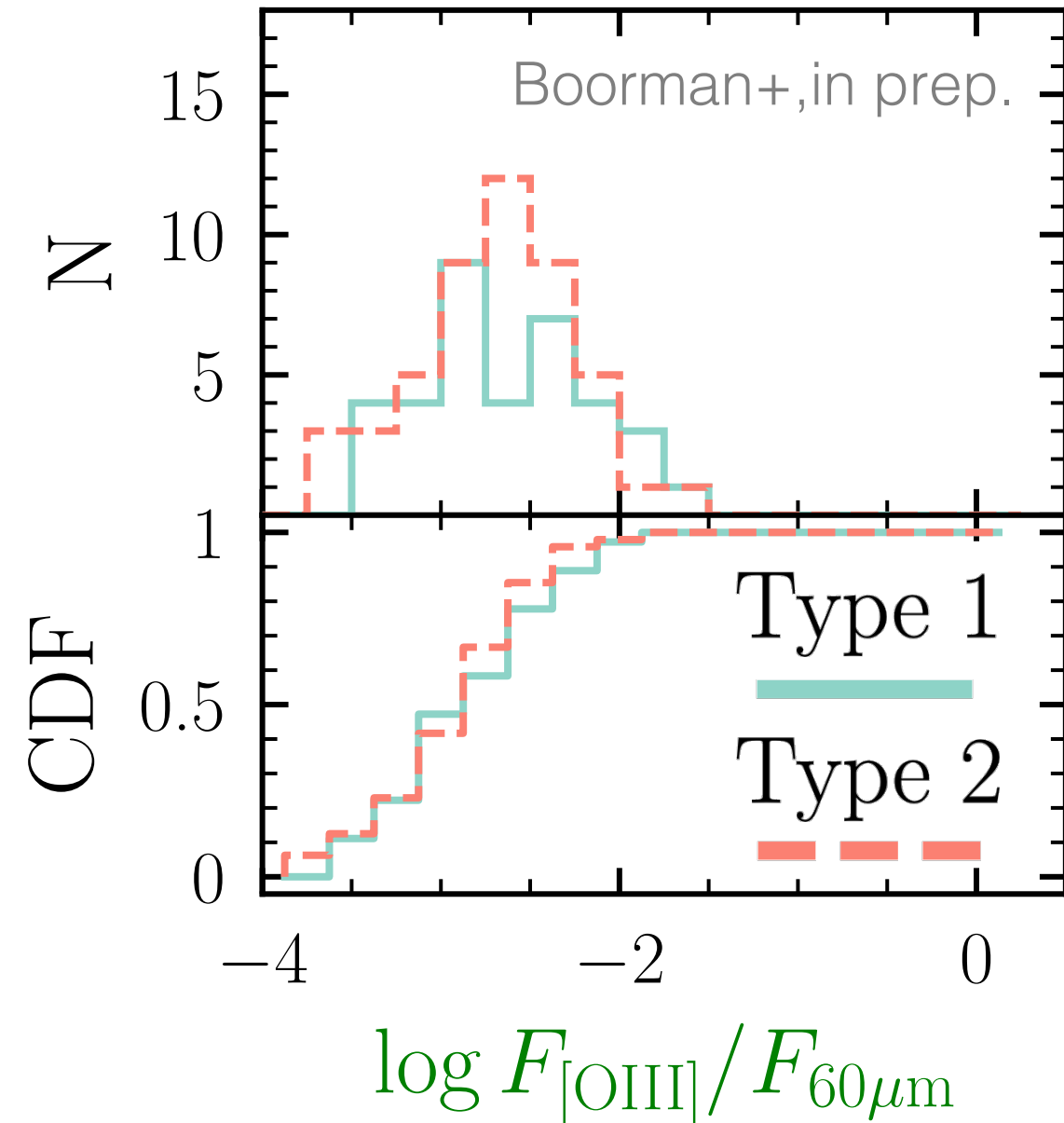
30°

0°

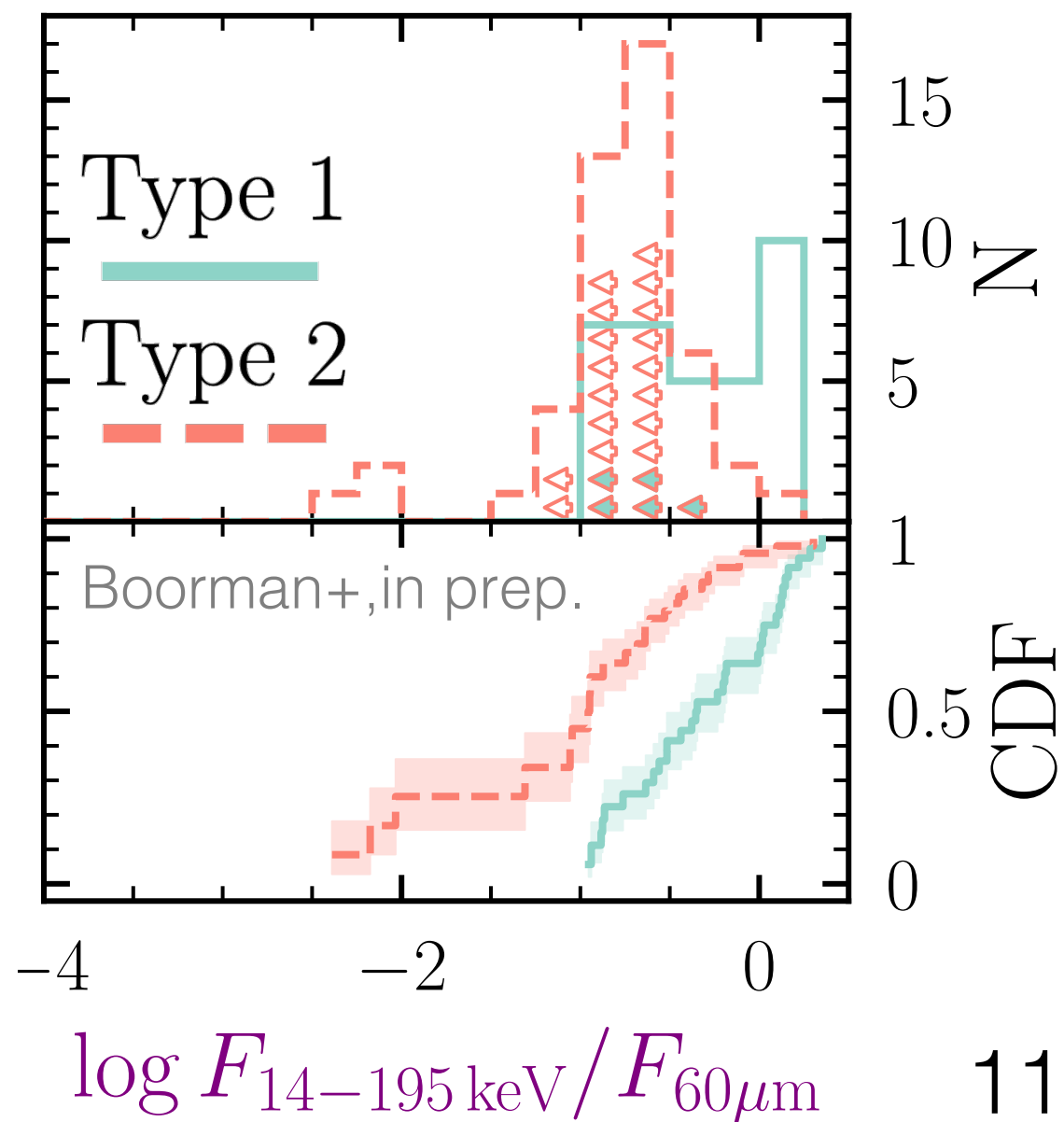
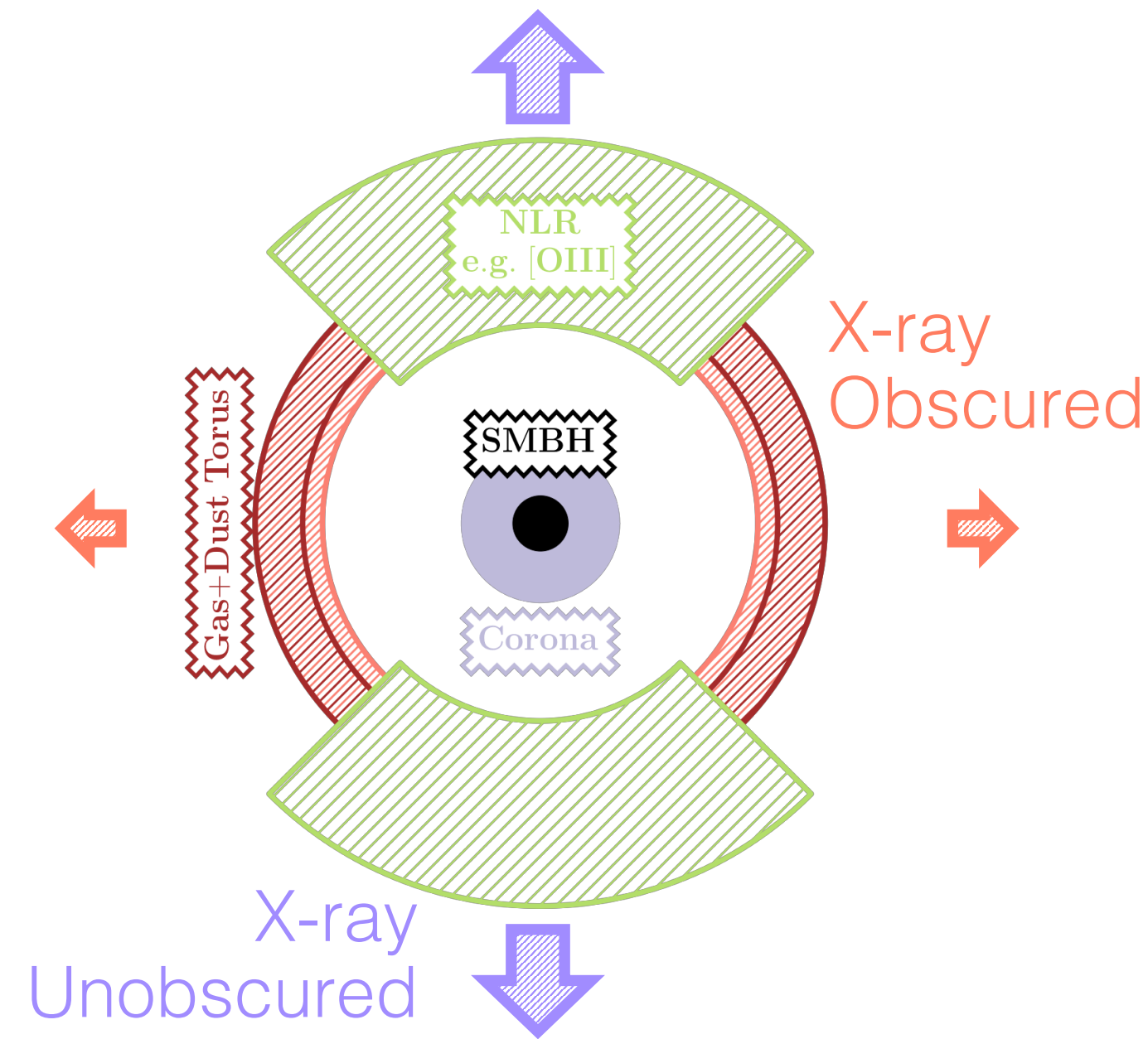


uLANDS = **Nu**_{STAR} **L**_{LOCAL} **A**_{GN} **N**_H **D**_{ISTRIBUTION} **S**_{URVEY}

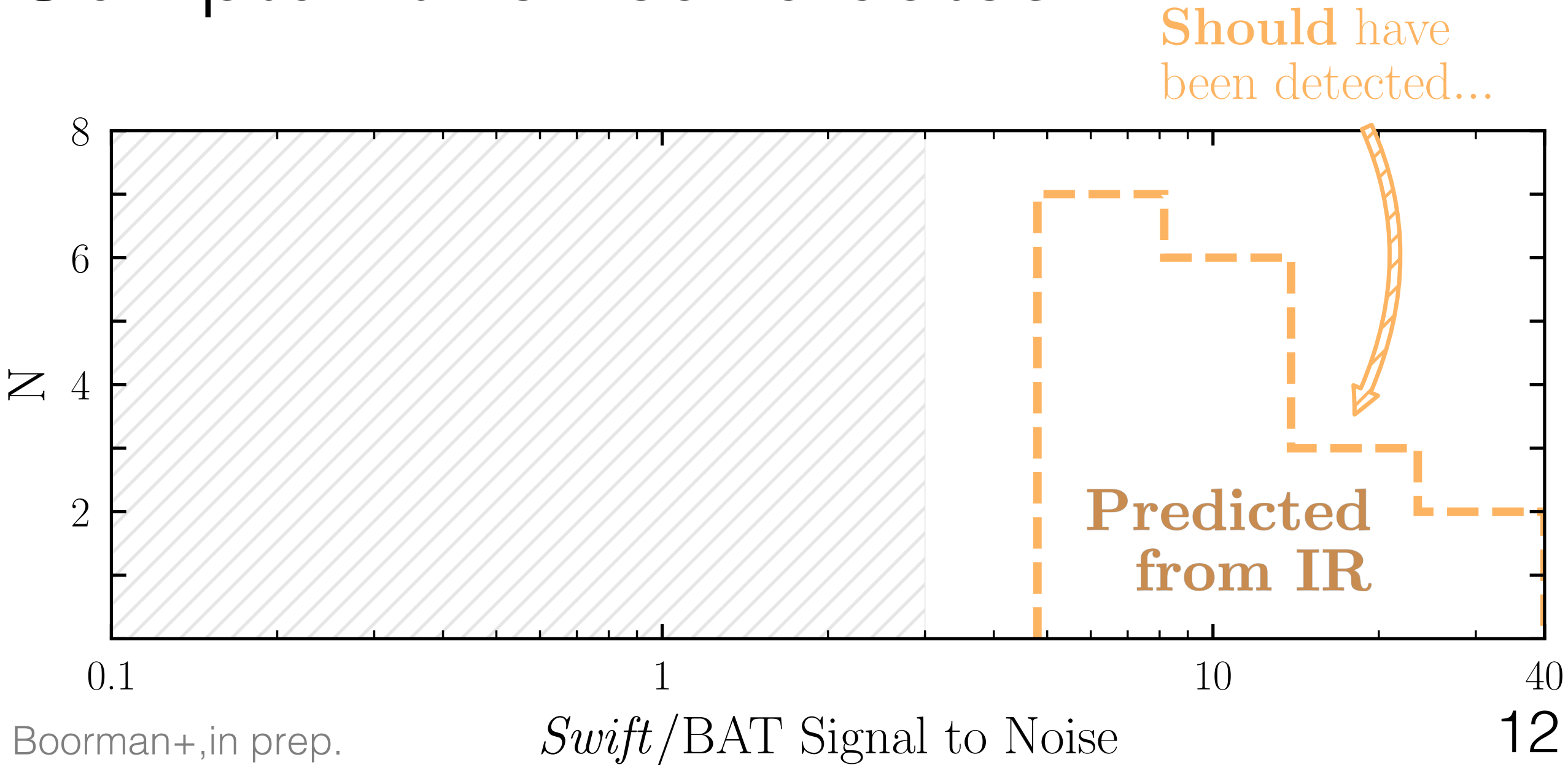
Representative? Optical traces infrared



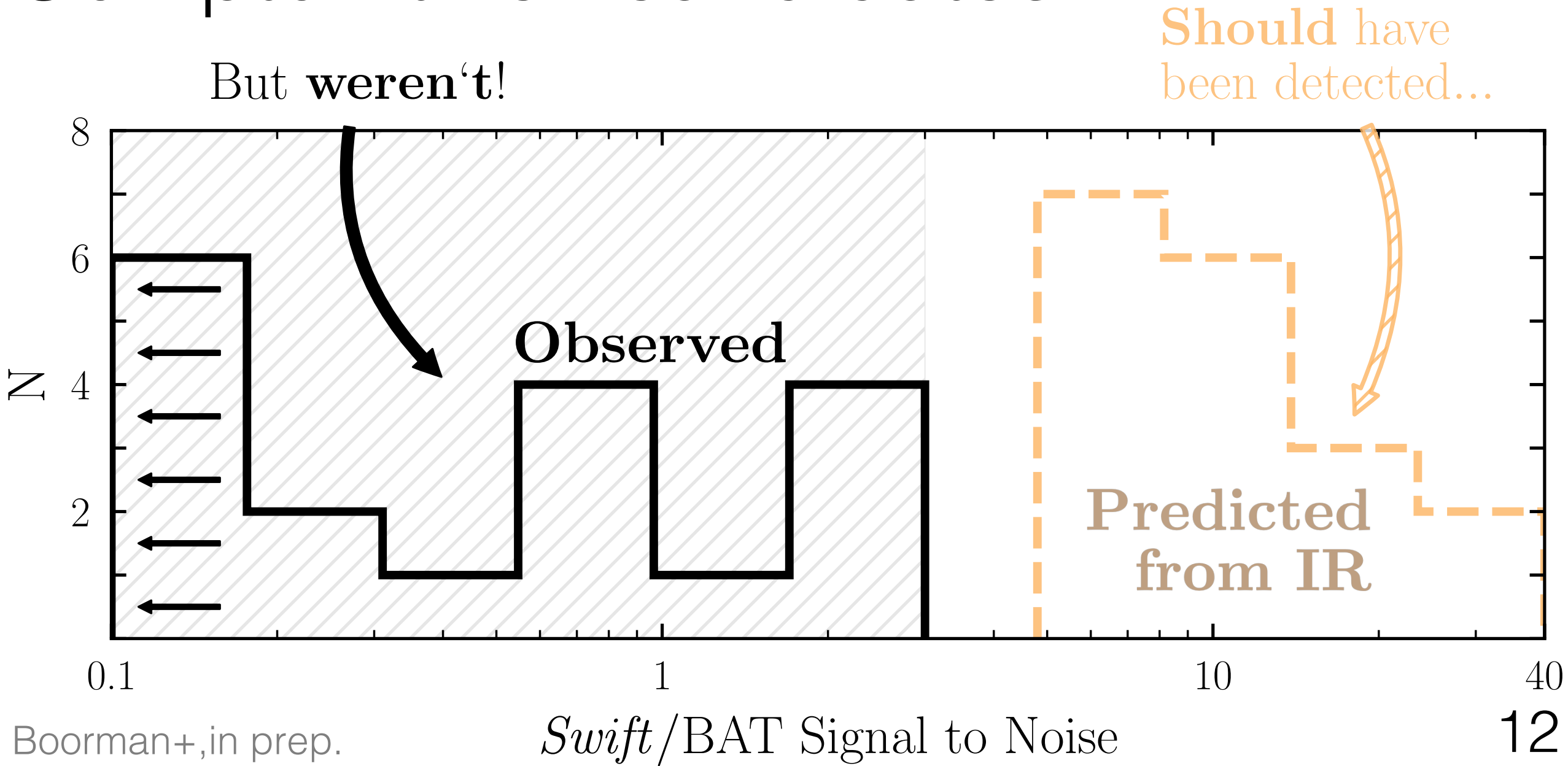
Representative? X-ray does not trace infrared



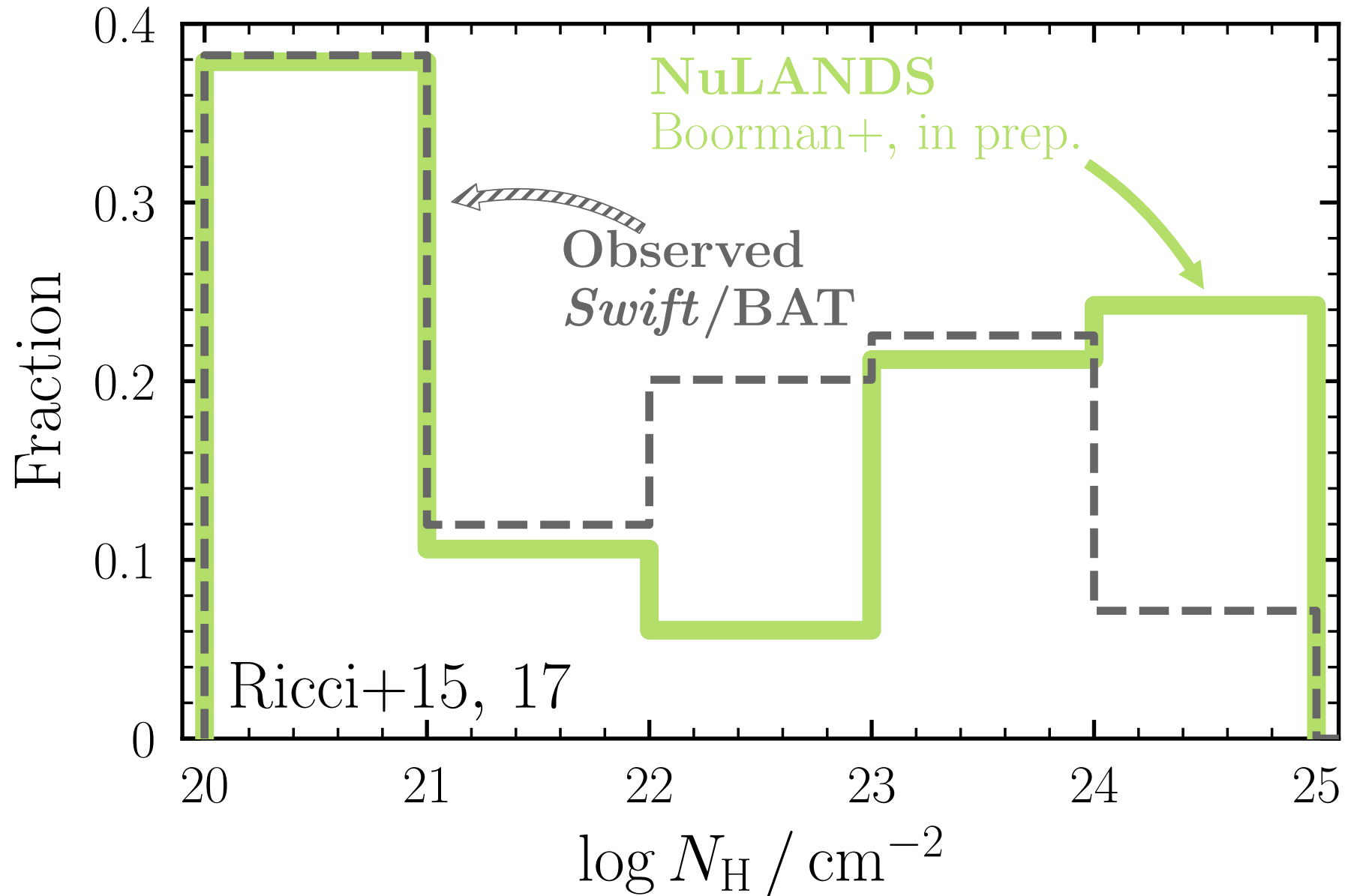
Compton-thick candidates



Compton-thick candidates



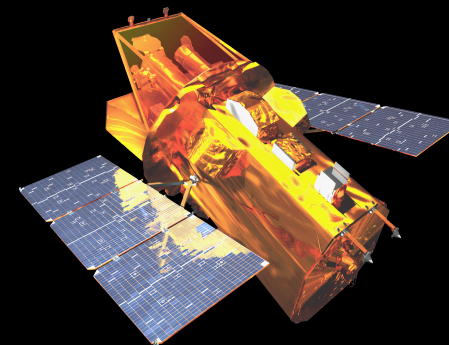
Directly Observed N_{H} Distribution (so far)



How can we construct a **representative census** of the most obscured AGN?

- NuLANDS is N_{H} - **unbiased selection**
- We find many **Compton-thick AGN missed by BAT - complementary**
- Obscured fraction may still be **lower limit** due to **classifications**

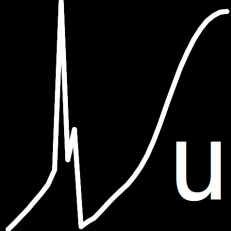
NuLANDS



BAT

¡Muchas gracias!

soton.ac.uk/~pgb2g11

 NuLANDS