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New insights on the distant AGN population

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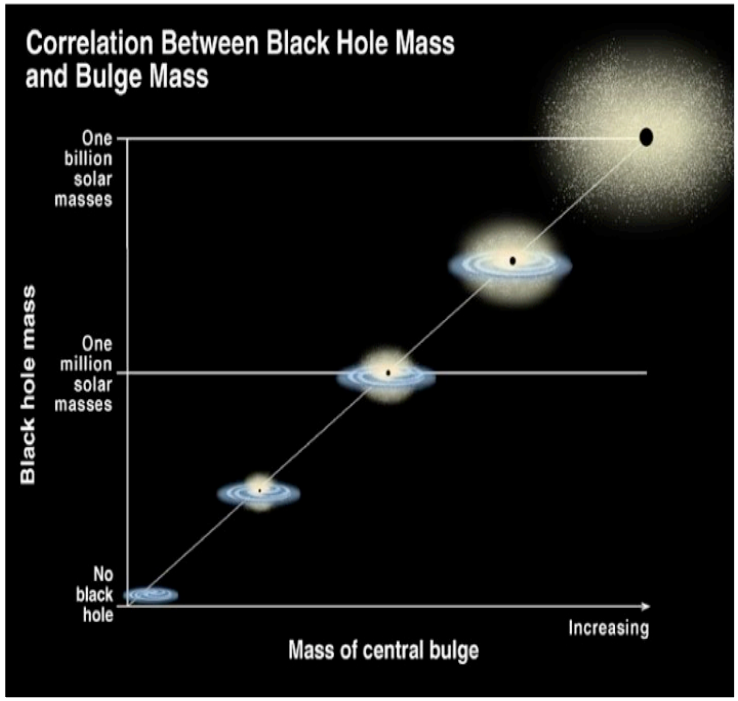
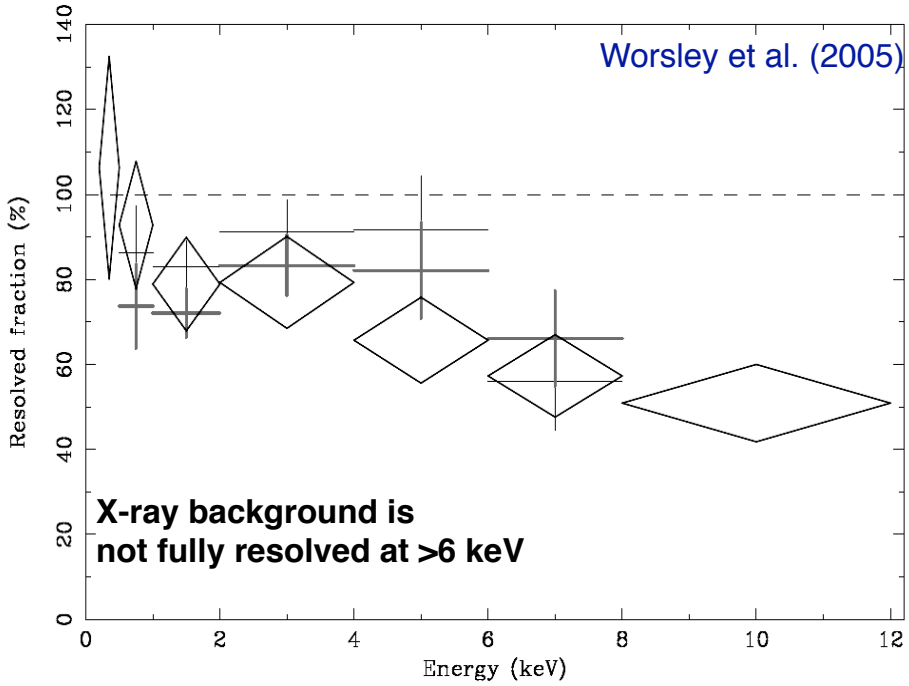
Why looking for missing AGN?

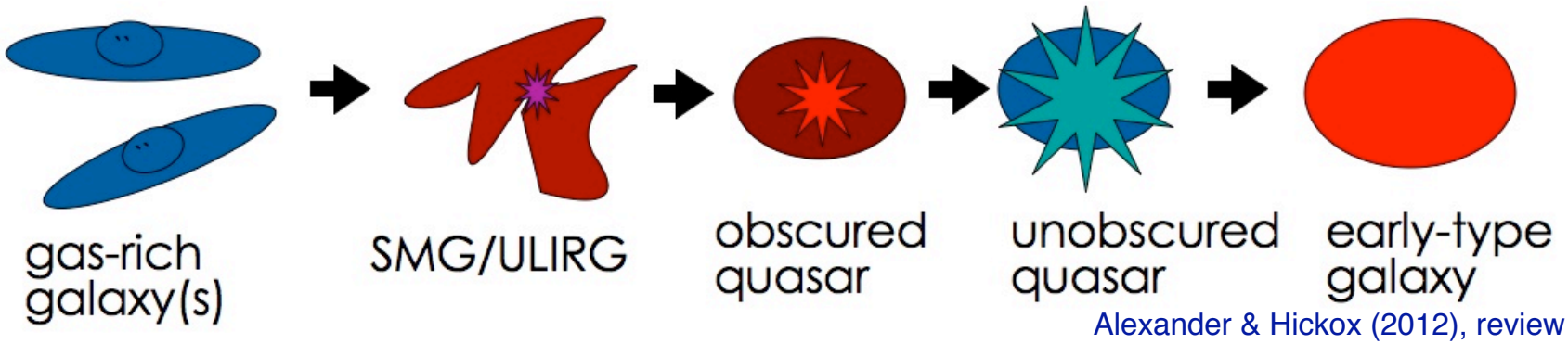
BH-spheroid growth connection



Missing AGN population

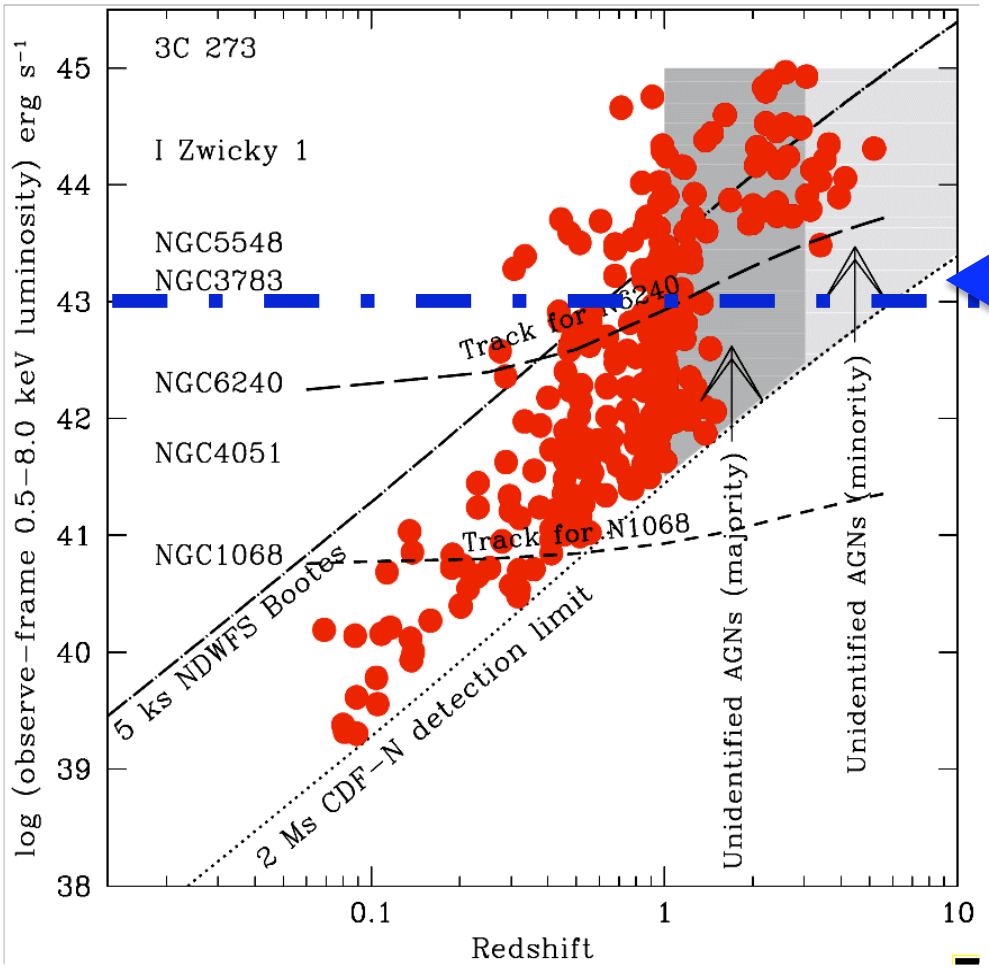


Major-merger evolution scenarios



Alexander & Hickox (2012), review

Deep X-ray surveys are great to detect distant AGN…
… but still not complete



Brandt & Hasinger (2005) for a review

Deep X-ray surveys are great to detect distant AGN…
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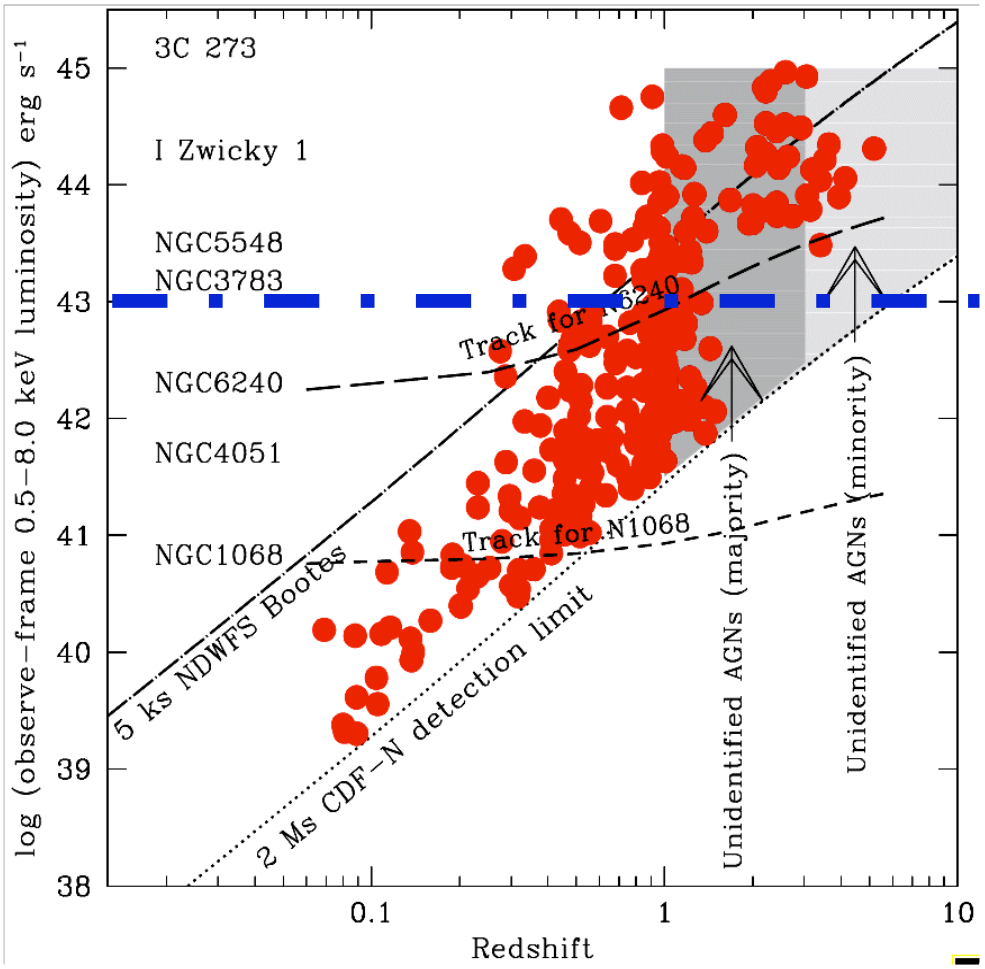
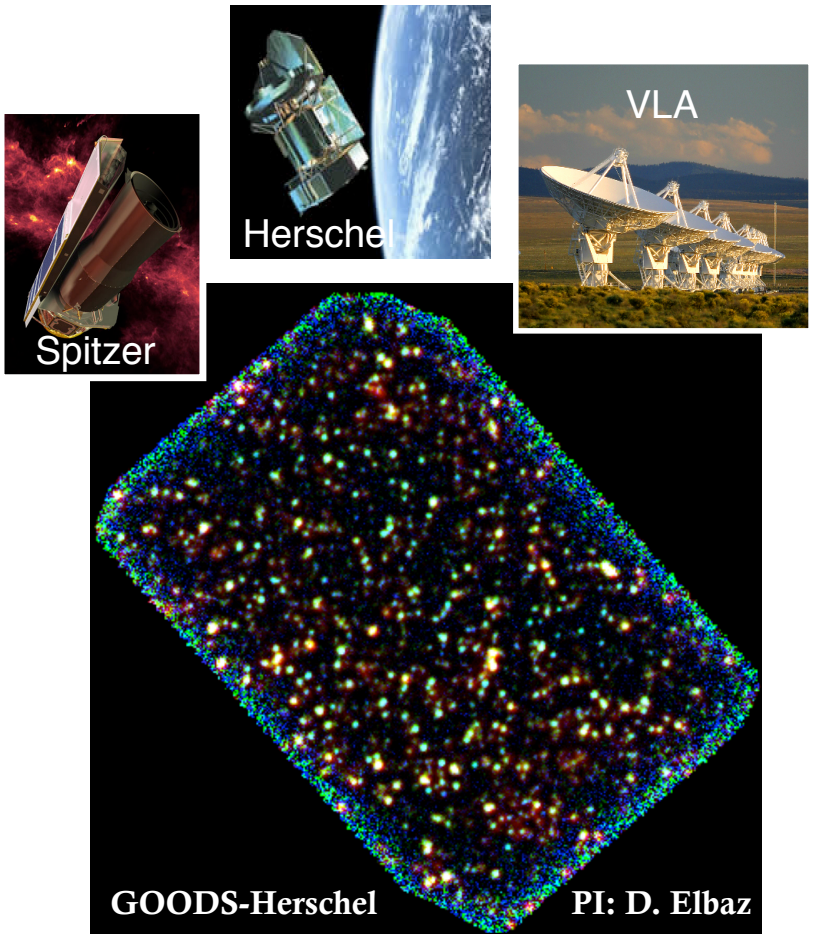
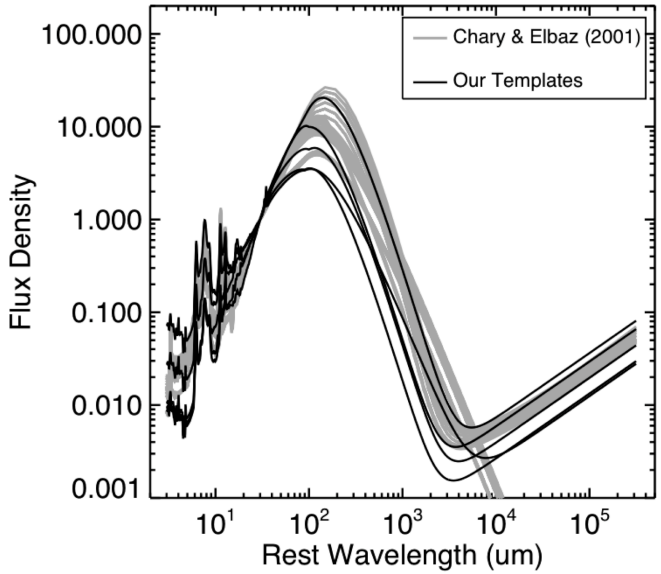


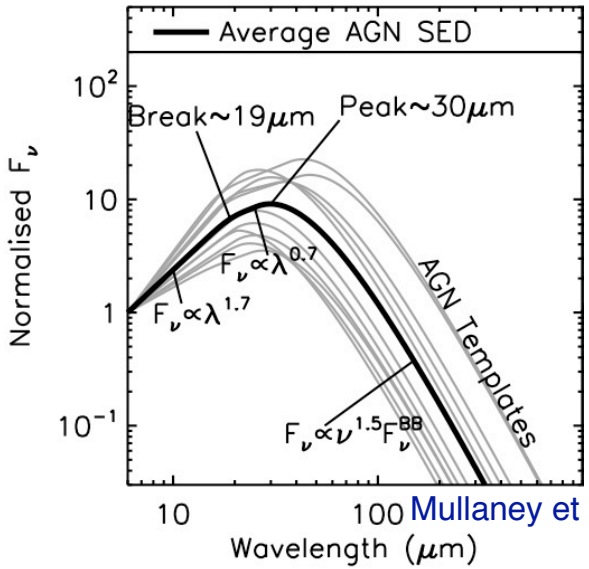
Brandt & Hasinger (2005) for a review

Go multiwavelengths!



AGN-galaxy SED decomposition





Mullaney et al. (2011)

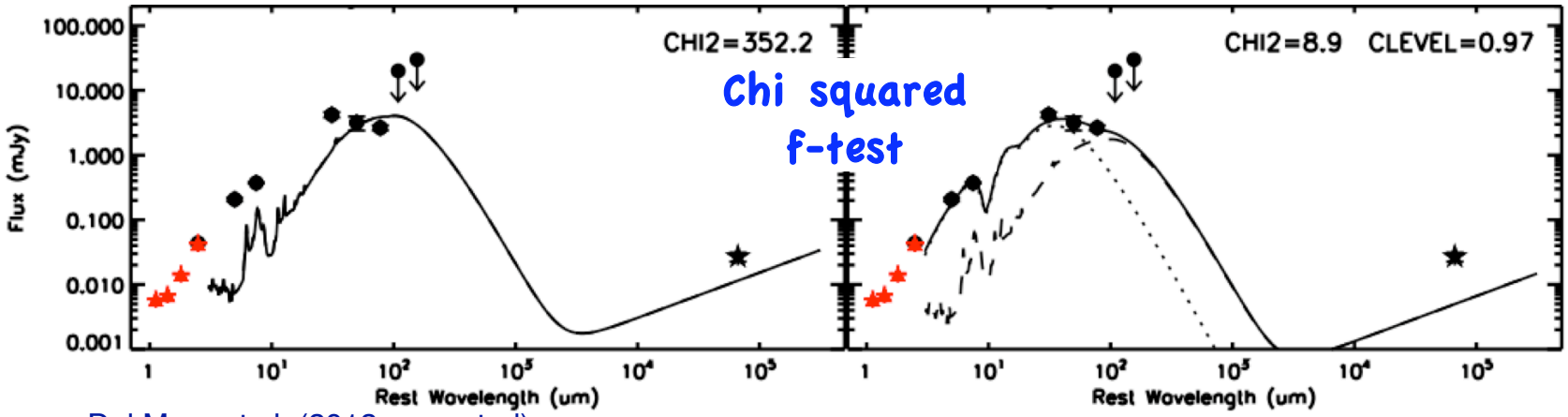
5 host galaxy templates (Mullaney+2011)

Extended to:

- 3 um using average SB SED (Dale+2001)
- radio band ($f_\nu = \nu^{-0.7}$), FIR/radio ratio ~2.2 (Helou+1985)

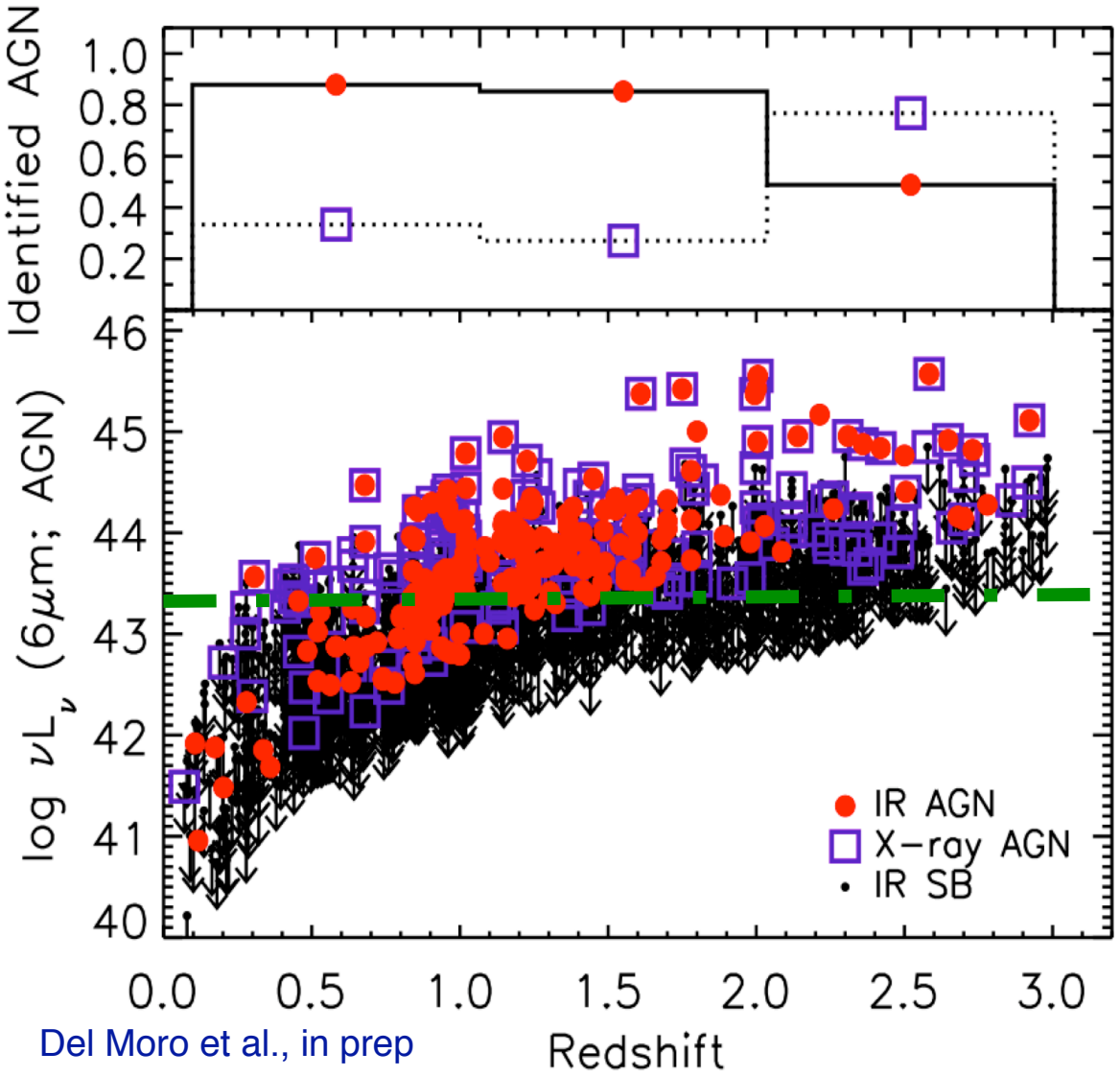
Empirically defined AGN template (Mullaney+2011)

+ Extinction



Del Moro et al. (2012, accepted)

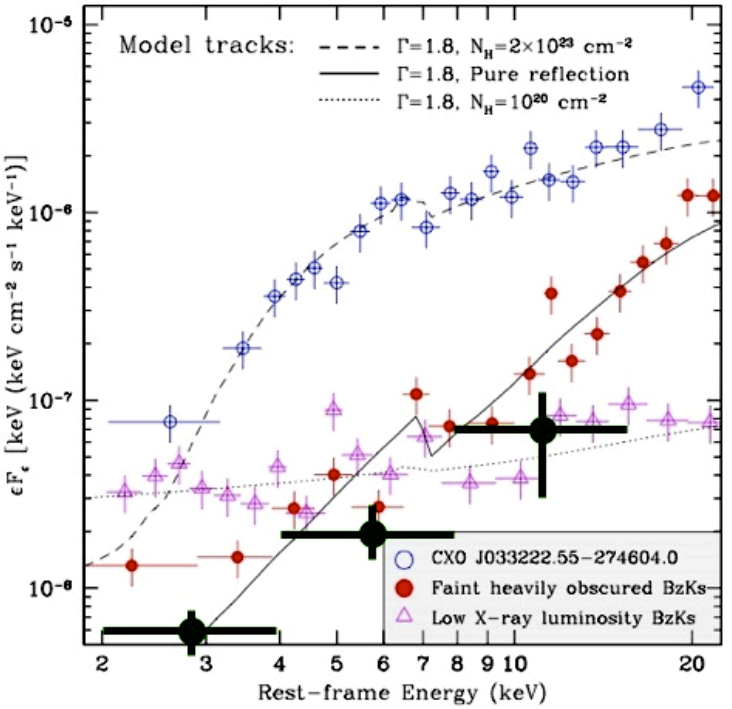
Identifying the AGN dominating the cosmic BH growth



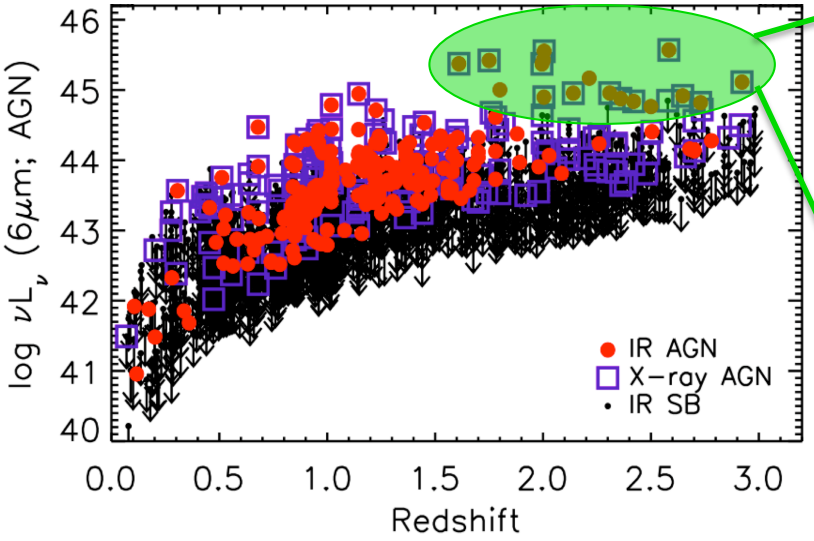
Del Moro et al., in prep

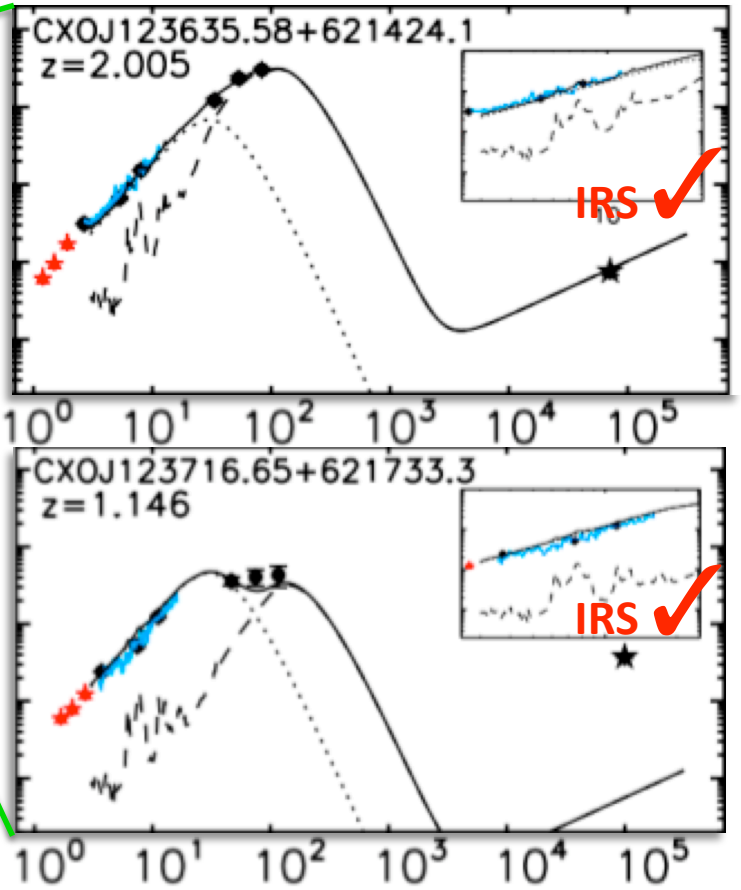
-Large population of X-ray undetected AGN are identified in IR at z<2

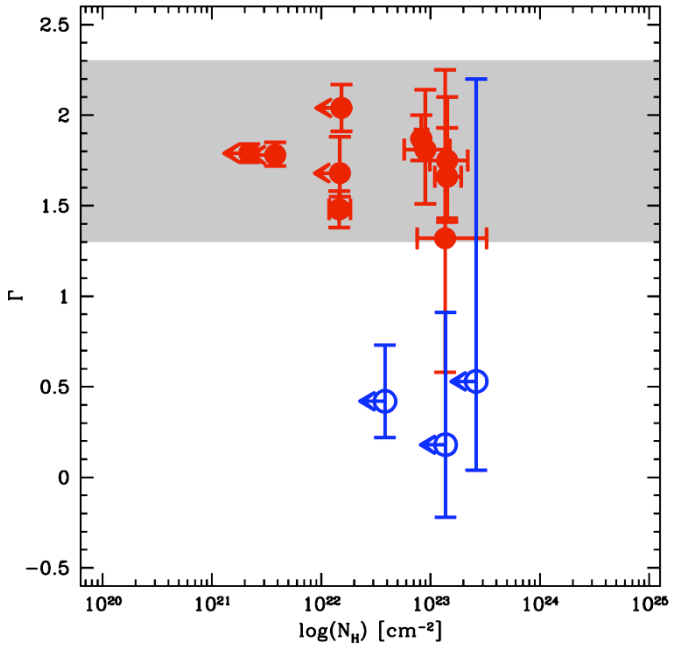
- Stacking of X-ray undetected IR AGN at z<1 consistent with reflection dominated spectrum



Population of obscured quasars at z~2







Alexander et al. (2012, in prep)

- MIR luminosity log L_{6um}> 44.8 → Lx>10^{44} erg/s, z=1-3

- ≈25% are BL AGN

- ≈25% are X-ray undetected

2.5 times more obscured AGN than unobscured AGN

much higher than in previous studies (<1; e.g. Ueda+2003; La Franca+2005; Hasinger 2008; Assef+2012)

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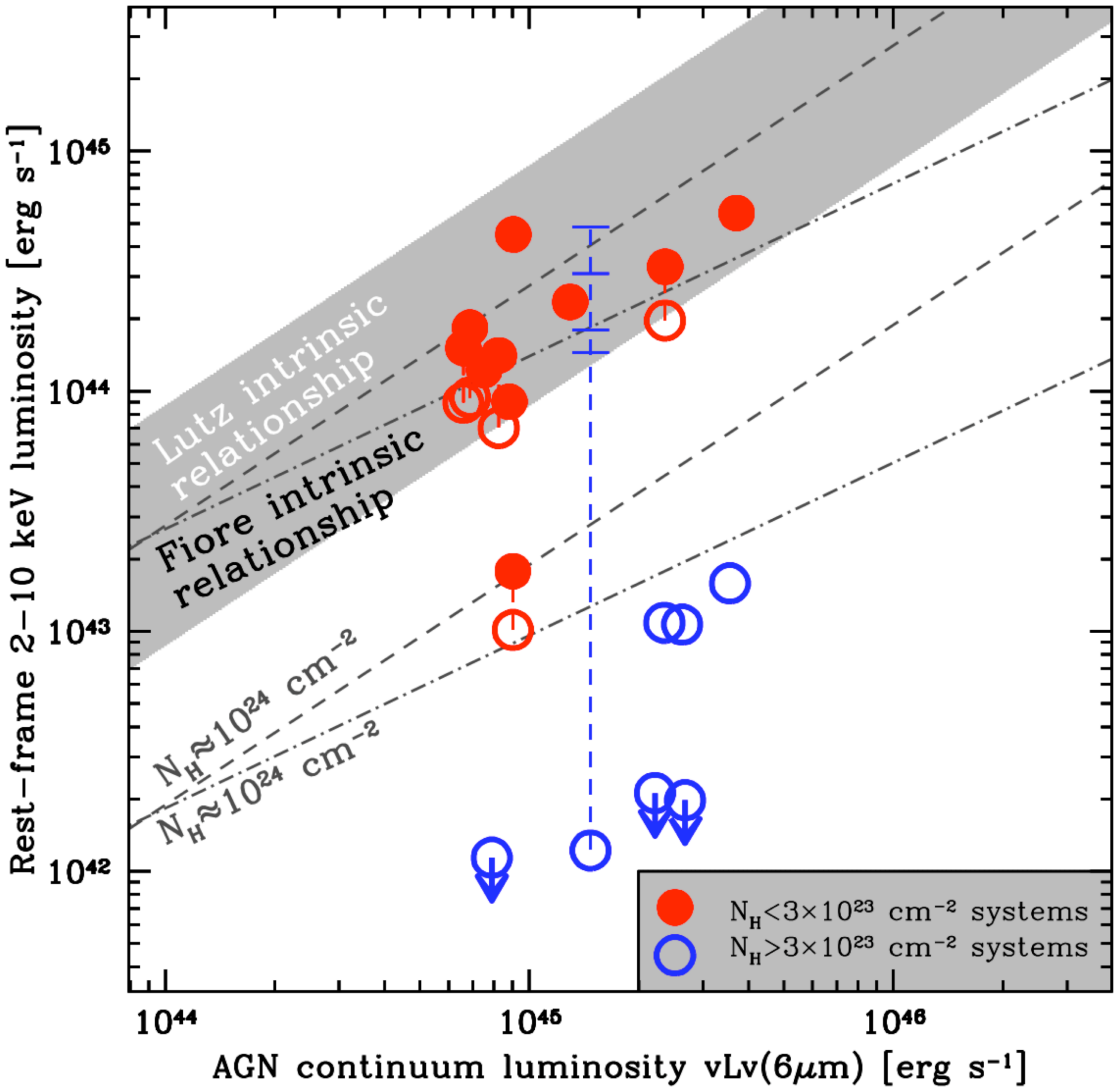
Population of obscured quasars at z~2

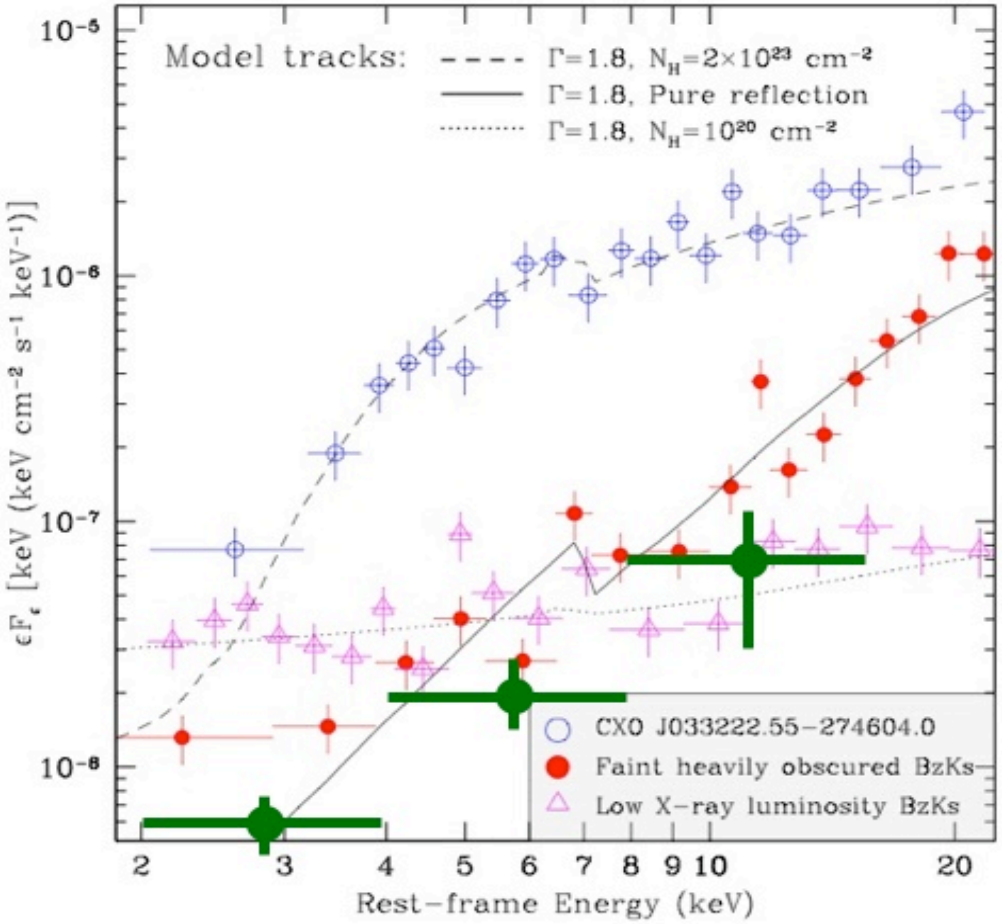


Alexander et al. (2012, in prep)

- Unobscured/moderately obscured high-z AGN seem to follow the intrinsic L_X-L_{6um} relation

- ≈ 25-50% are likely to be heavily obscured Compton-thick AGN

z~1 IR AGNs: the unresolved X-ray background?



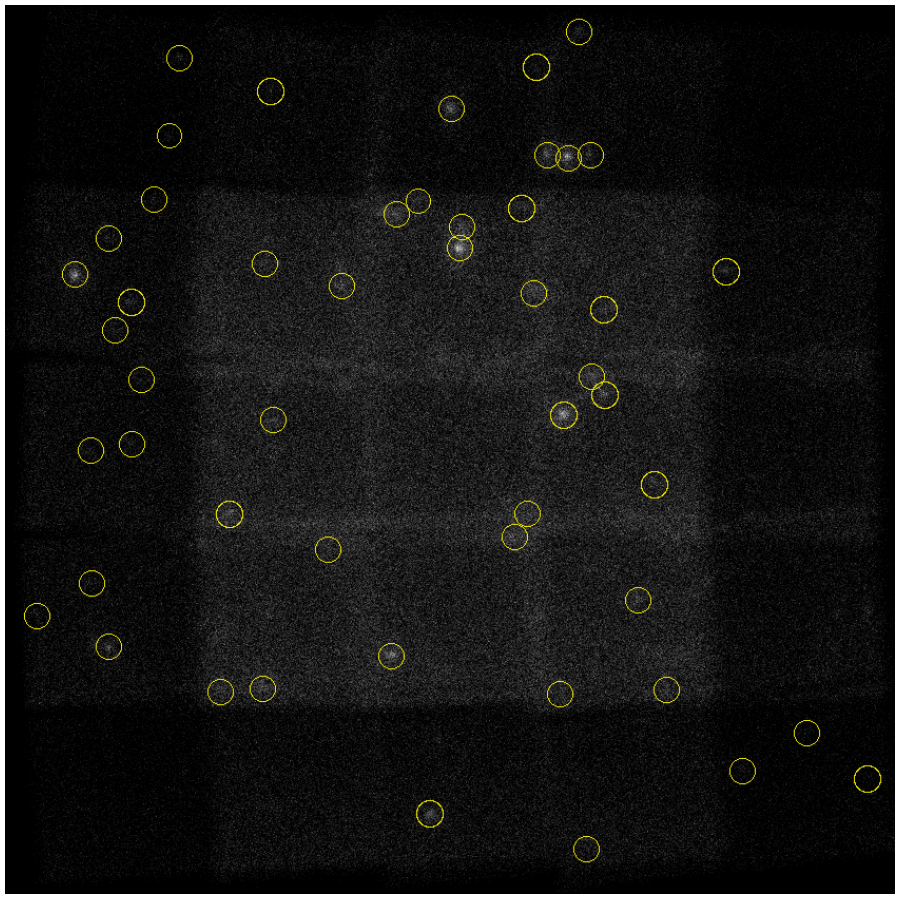
Stacked X-ray data of the X-ray undetected IR AGNs: consistent with reflection dominated: heavily obscured/ Compton thick

Properties consistent with producing the unresolved X-ray background at 30 keV:

z~1, intrinsic $L_X \sim 10^{43}$ erg/s and heavily obscured

NuSTAR extragalactic survey: simulations

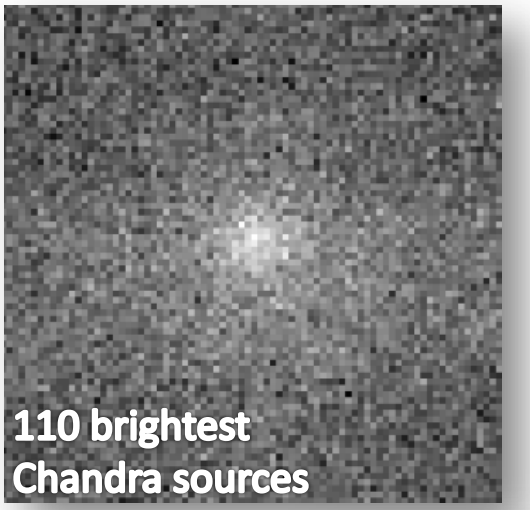
Deep survey simulation (E-CDF-S)
3-30 keV band image

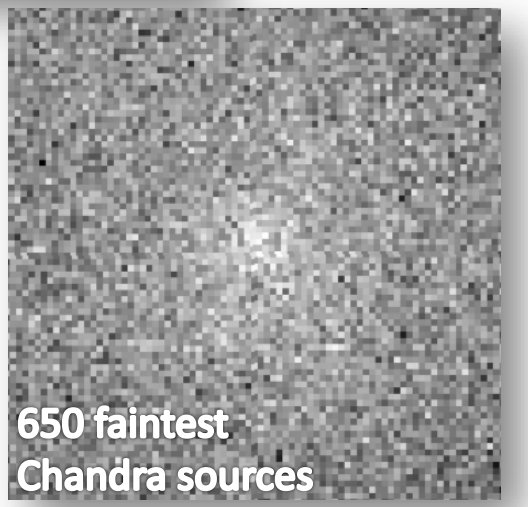


NuSTAR exposure/pixel ranges from ~200-800 ks across the image

~50 of the ~760 Chandra sources are detected

NuSTAR stacking at 10-30 keV





Summary

- IR SED analysis very effective in identifying AGN out to z≈2
- Stacked X-ray data of X-ray undetected IR AGN at z<1 consistent with reflection dominated spectrum → heavily obscured/CT AGN
- Population of IR bright quasars at z≈2 from IR SED analysis

→ 2.5 times more obscured AGN than unobscured AGN

- ≈25-50% are likely to be Compton-thick AGN at z≈2
- NuSTAR will provide information at E>10 keV for these heavily obscured AGN
- Directly resolve ~25-50% of the X-ray background at peak
- Indirectly resolve (via stacking analysis of Chandra/XMM sources) most of the remaining X-ray background