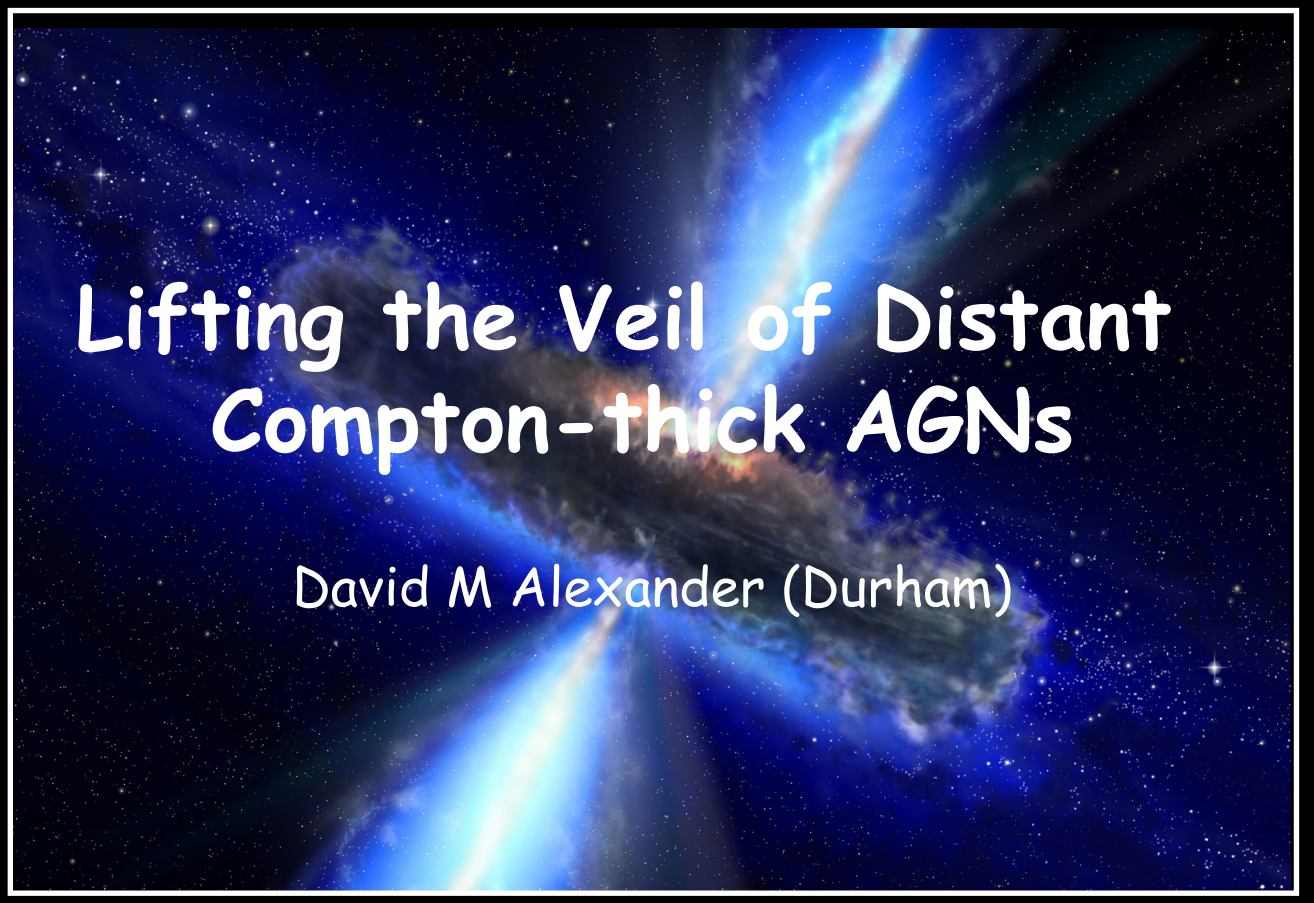
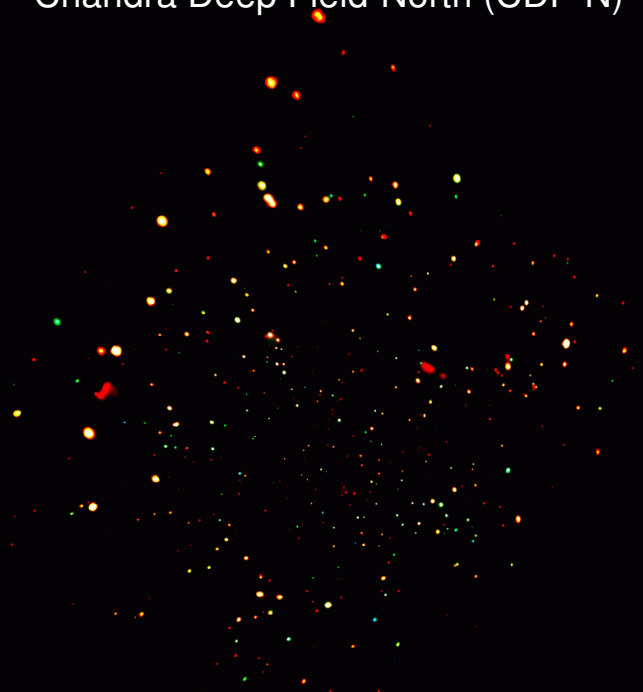

Lifting the Veil of Distant Compton-thick AGNs
David M Alexander (Durham)

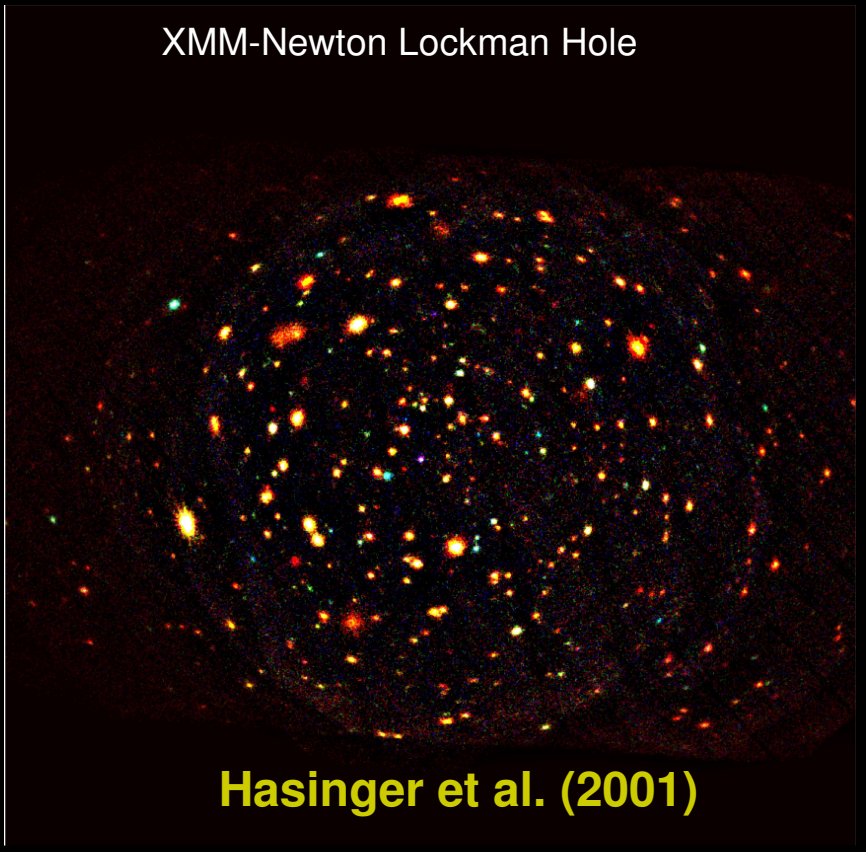
The Deepest X-ray Surveys

Chandra Deep Field-North (CDF-N)



Alexander et al. (2003)

XMM-Newton Lockman Hole



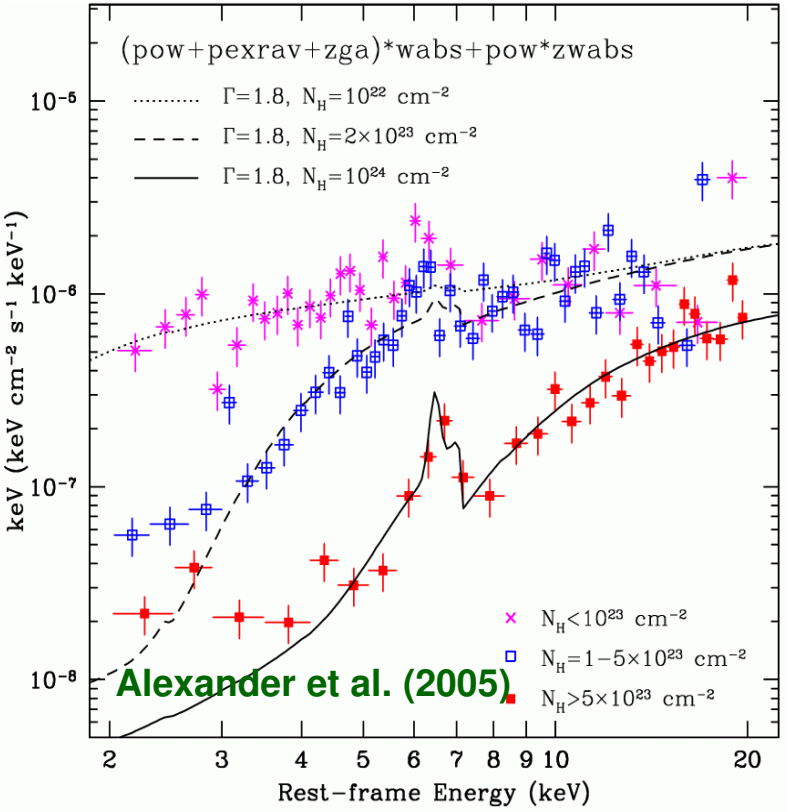
Hasinger et al. (2001)

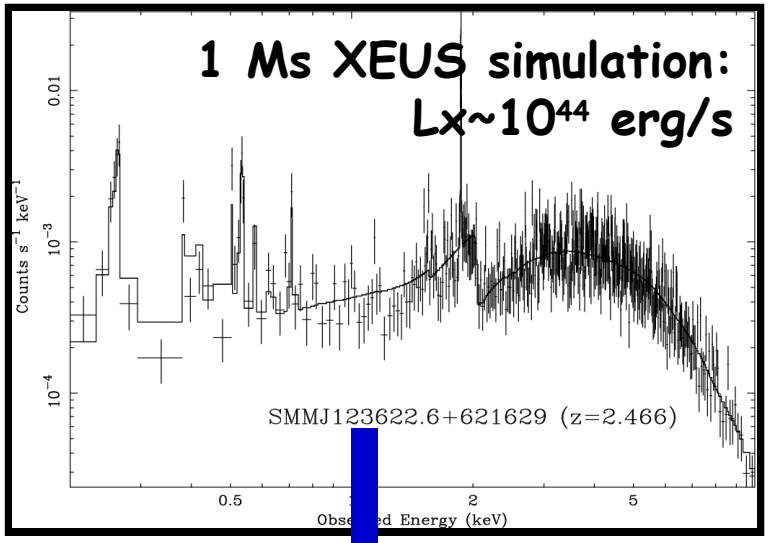
Deepest X-ray observations ever taken, can detect moderate luminosity AGNs out to z~6-10 and starburst galaxies out to z~1-2

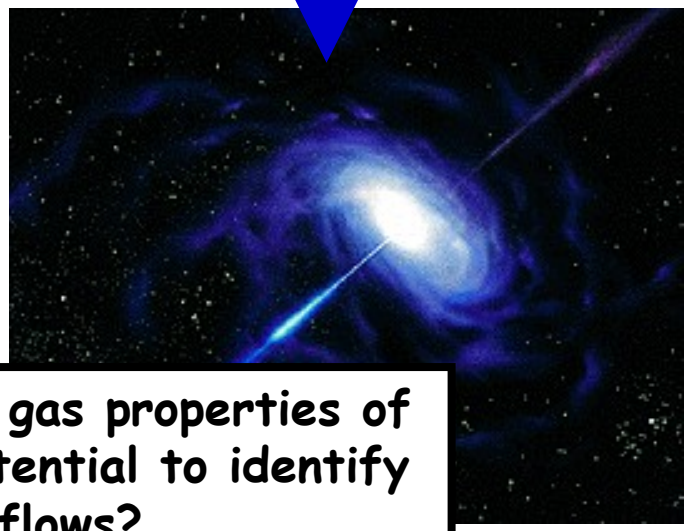
What can IXO/XEUS do for them?

Ultra-deep XEUS exposure of z=2.4 obscured AGN

Composite 12Ms Chandra spectra

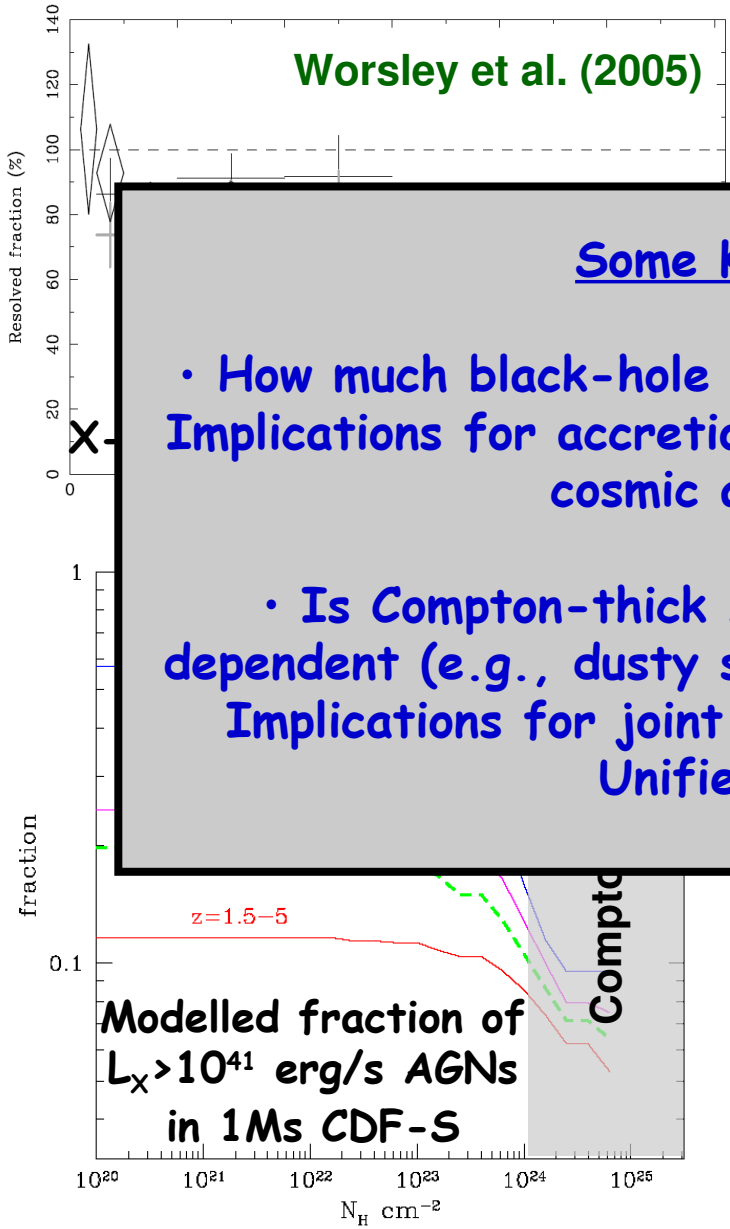


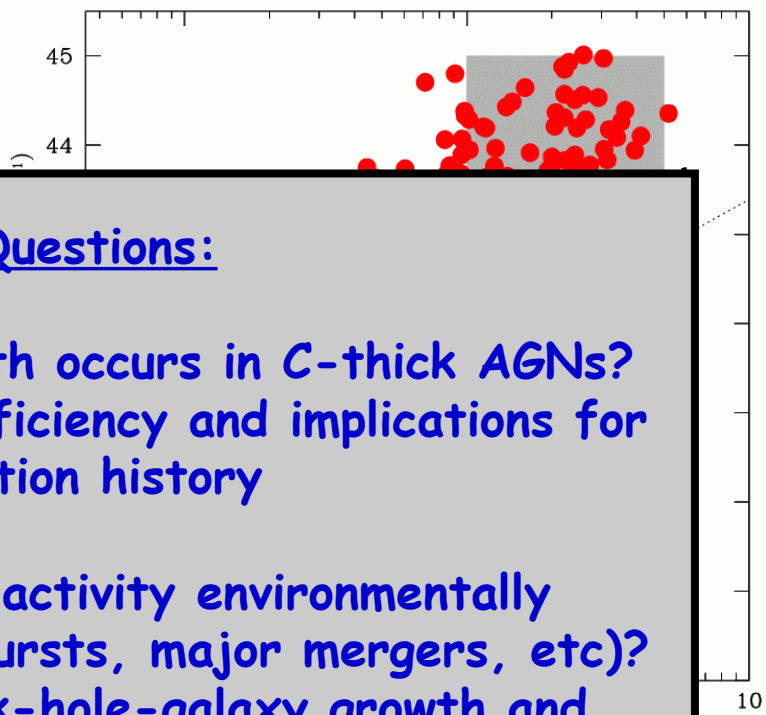




Includes outflowing emission-line gas properties of NGC1068 (Ogle et al. 2003): potential to identify accretion-related outflows?

But many AGNs are undetected in deepest exposures





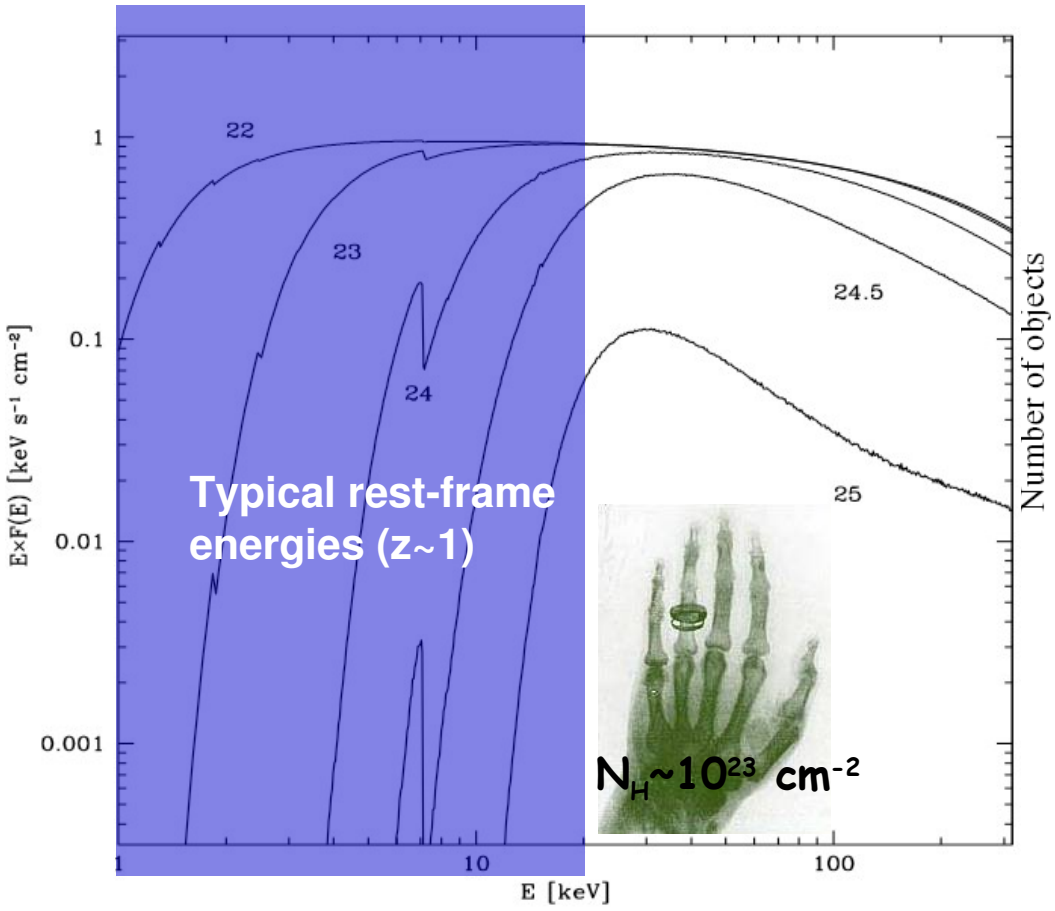
Some Key Questions:

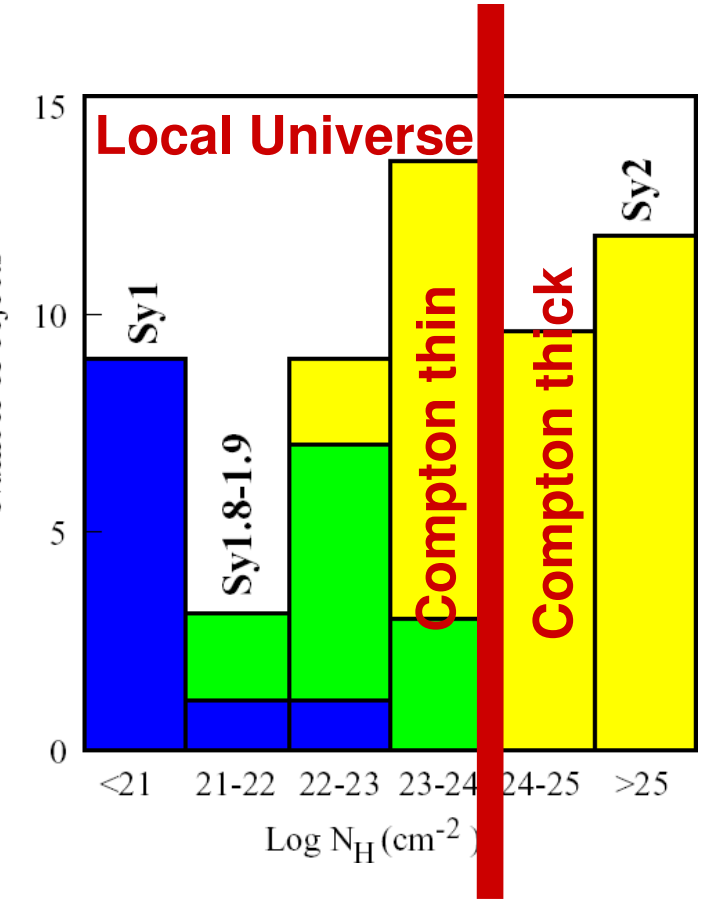
- How much black-hole growth occurs in C-thick AGNs? Implications for accretion efficiency and implications for cosmic accretion history

- Is Compton-thick AGN activity environmentally dependent (e.g., dusty starbursts, major mergers, etc)? Implications for joint black-hole-galaxy growth and Unified AGN models

Many of these objects could be luminous Compton-thick AGNs

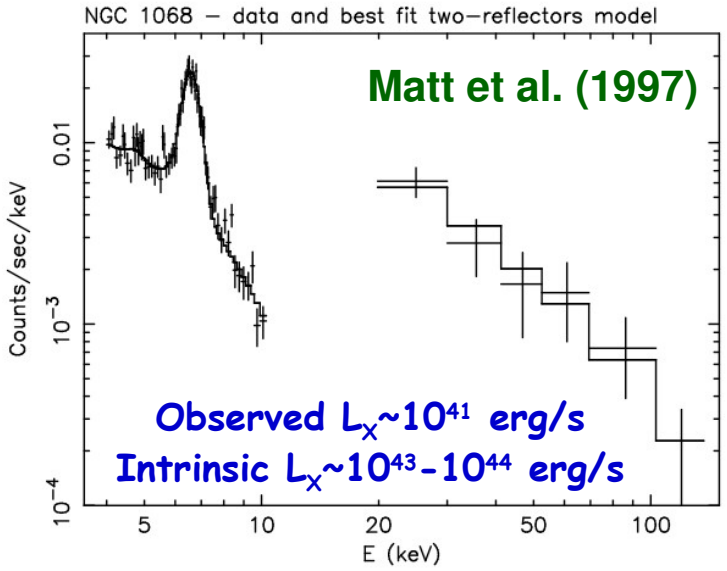
Difficulty in Identifying C-thick AGNs

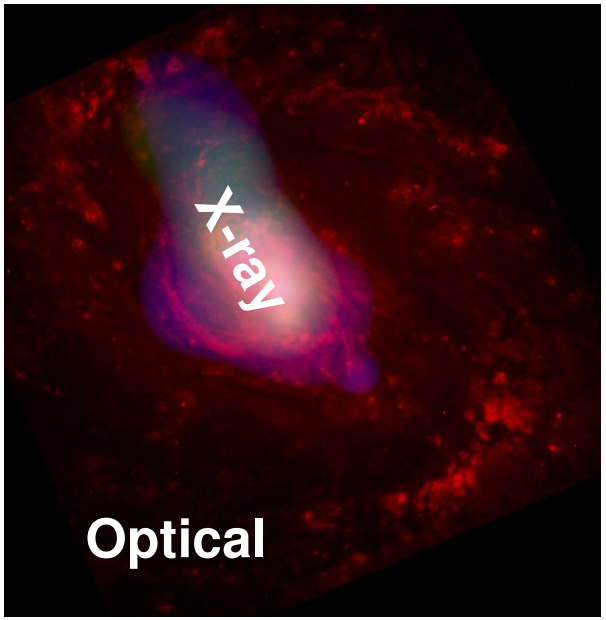




C-thick AGNs comprise ~50% of local AGN population BUT only ~50 have been robustly ID'd to date (~10^{-9th} of total population)!

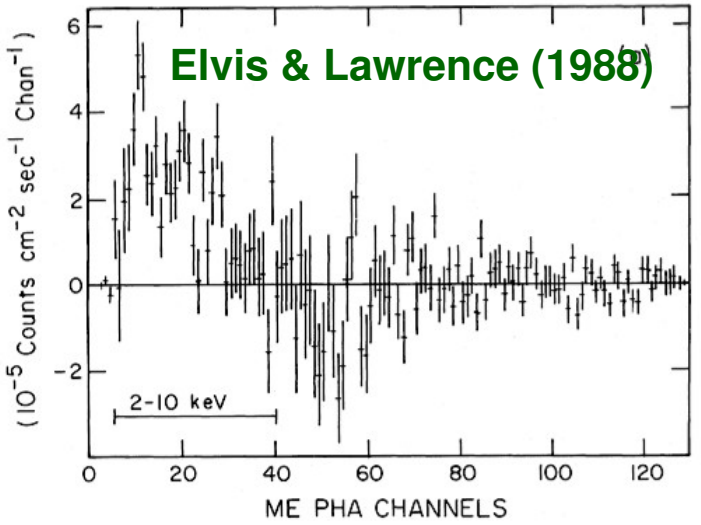
NGC1068: A Nearby Example

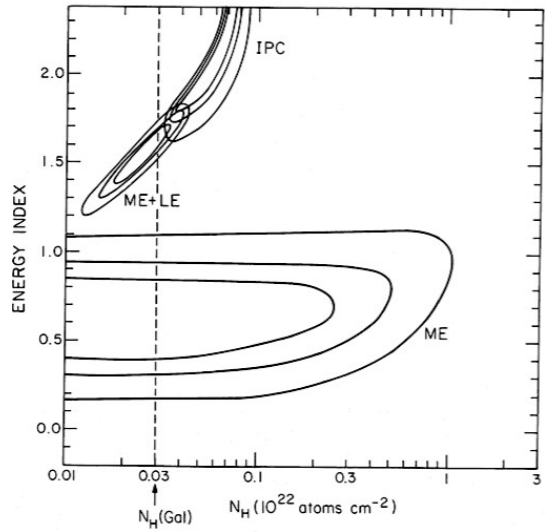




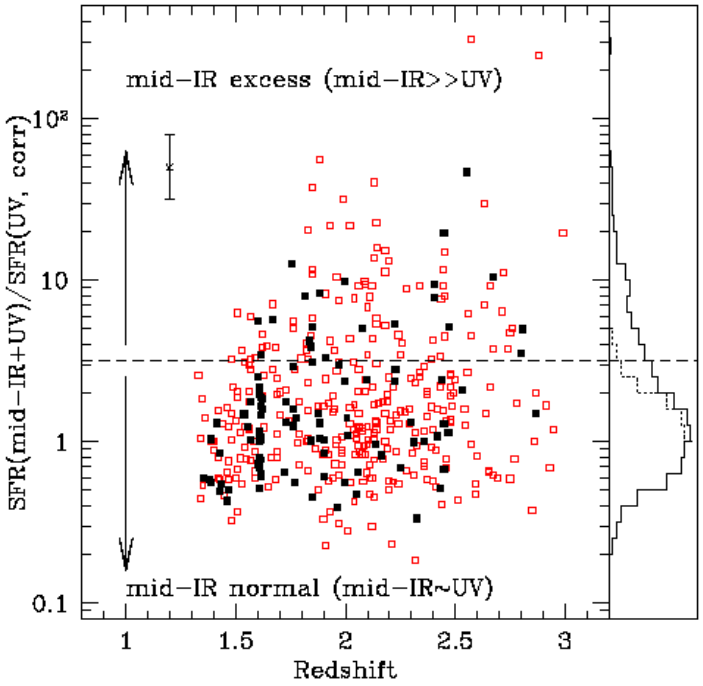
Good quality X-ray data

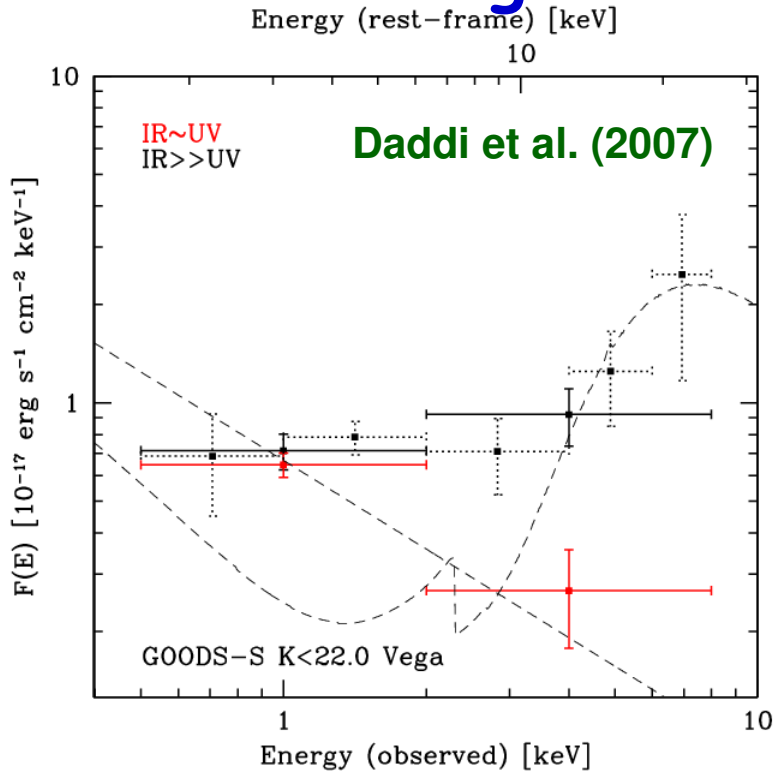
Poorer quality X-ray data



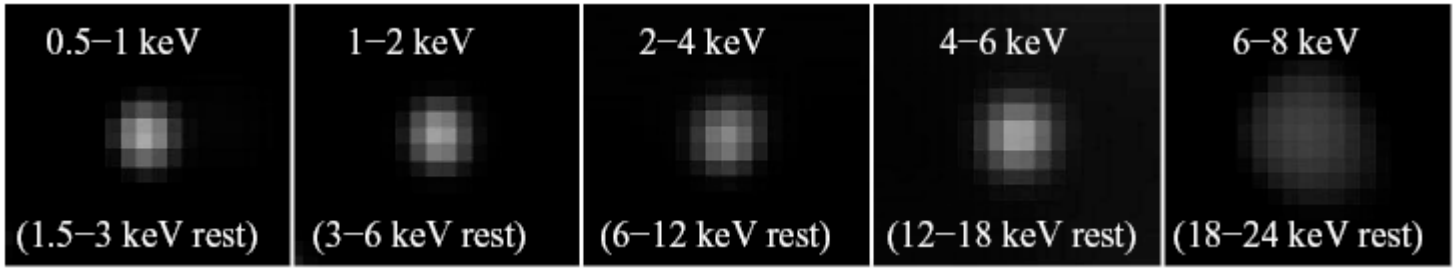


X-ray undetected IR AGNs in z~2 galaxies





Stacked X-ray data of mid-IR galaxies in narrow bands

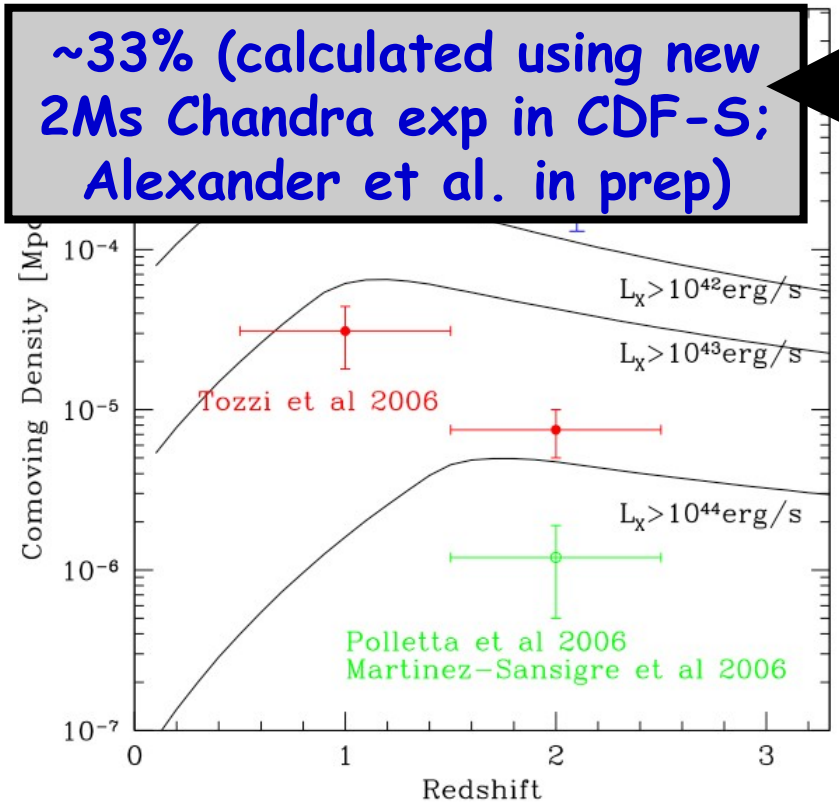


Very hard signal => significant fraction of obscured AGNs
(see also Fiore et al. 2008 amongst others)

Implying a large X-ray undetected (potentially Compton-thick) AGN population at z~2

Daddi et al. (2007)

~33% (calculated using new 2Ms Chandra exp in CDF-S; Alexander et al. in prep)

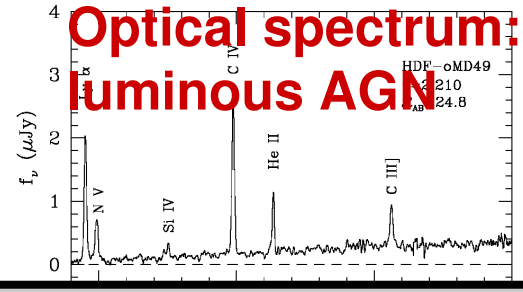


Caveats:

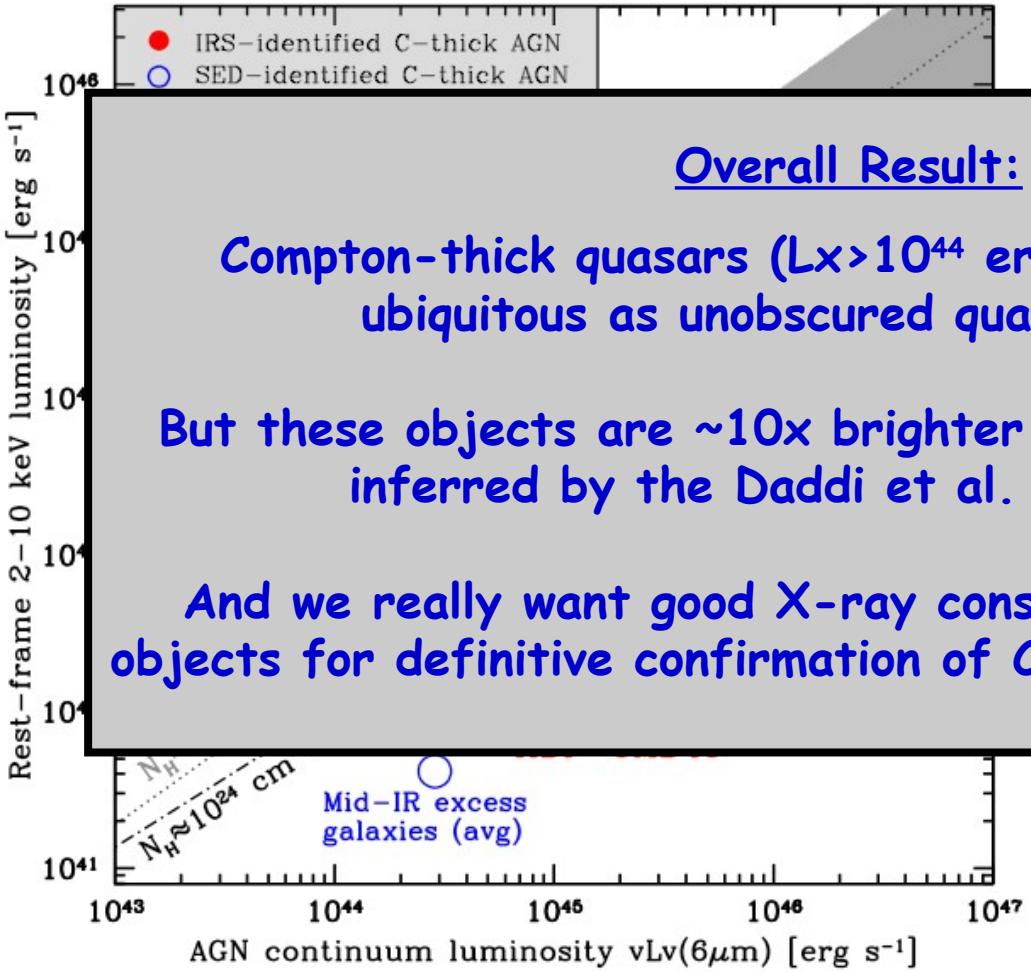
- X-ray stacking provides an average signal: what fraction of objects contribute significantly to the hard X-ray signal?
- AGN IR luminosity: uncertainty in decomposing the AGN from the SF component
- Absorption measure: difficulty in measuring a column density from poor S/N data… there are also significant complexities in C-thick AGN spectra

Solution: obtain independent indicators of intrinsic AGN luminosity and space density for individual z~2 objects

More Reliable Method of z~2 C-thick AGN Identification



Optical spectrum: luminous AGN

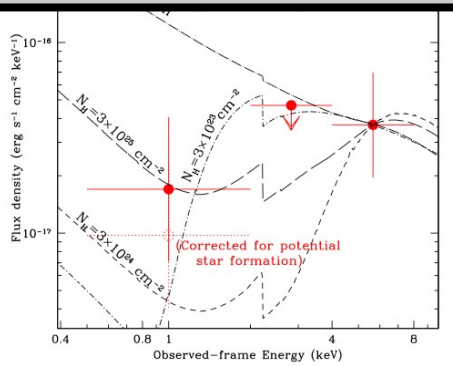


Overall Result:

Compton-thick quasars ($L_X > 10^{44}$ erg/s) are at least as ubiquitous as unobscured quasars at z~2…

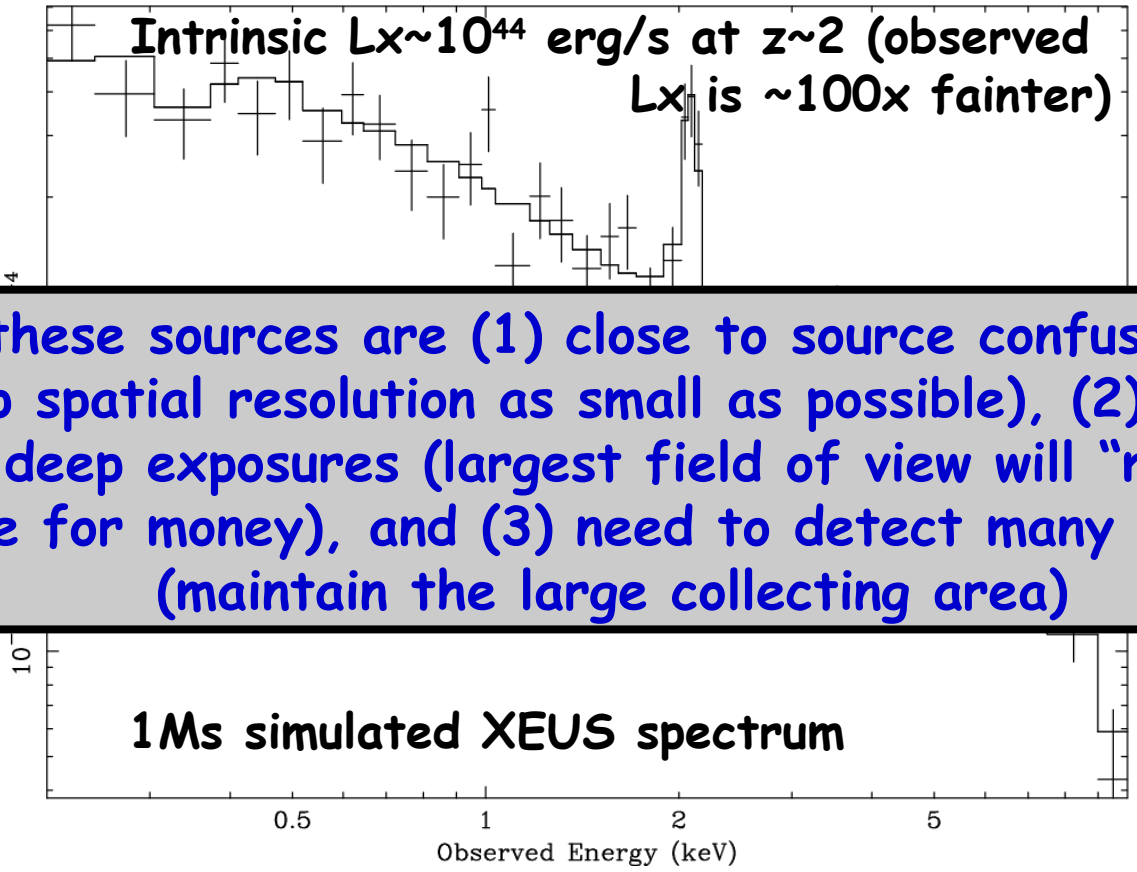
But these objects are ~10x brighter than than the objects inferred by the Daddi et al. (2007) study…

And we really want good X-ray constraints of all of these objects for definitive confirmation of Compton-thick absorption



8 X-ray counts: cannot tell if C-thick on basis of X-ray alone - need other data

Could IXO/XEUS identify a typical object?



But these sources are (1) close to source confusion limit (keep spatial resolution as small as possible), (2) require ultra-deep exposures (largest field of view will "maximise" value for money), and (3) need to detect many photons (maintain the large collecting area)

Yes, an X-ray faint Compton-thick X-ray undetected AGN in the 2Ms CDF-N can be identified in a 1Ms XEUS exposure… the Fe K-alpha emission line is clearly detected and could yield an estimate of the intrinsic AGN luminosity (e.g., following Iwasawa et al. 2005)

- 1Ms XEUS exposure could provide direct evidence for accretion-related outflows in distant obscured AGNs

- 1Ms XEUS exposure should be sufficient to reliably identify and quantify the X-ray properties of even moderate-luminosity (Lx~10^{43}-10^{44} erg/s) Compton-thick AGNs at z~2

- The current specifications promise to extend the detailed "ceusus" of AGN activity even below the source-detection limit of the deepest X-ray surveys and explore their role in galaxy formation

- However, spatial resolution needs to be as small as possible to minimise source-confusion issues… the largest possible field of view will also provide greatest "value for money" in the deepest exposures