Uncovering Local Absorbed AGN with Swift and Suzaku

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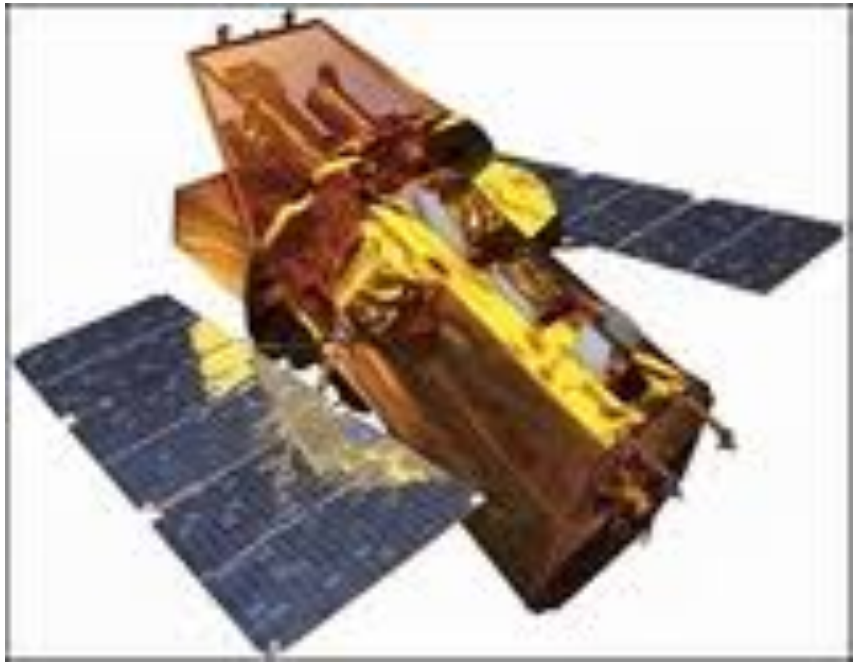
A new look at AGN

- What is the nature of black holes and how do they affect their host galaxies?
- Classical selection methods in the Optical/soft X-rays
  - contamination from star formation, heavily affected by dust and gas

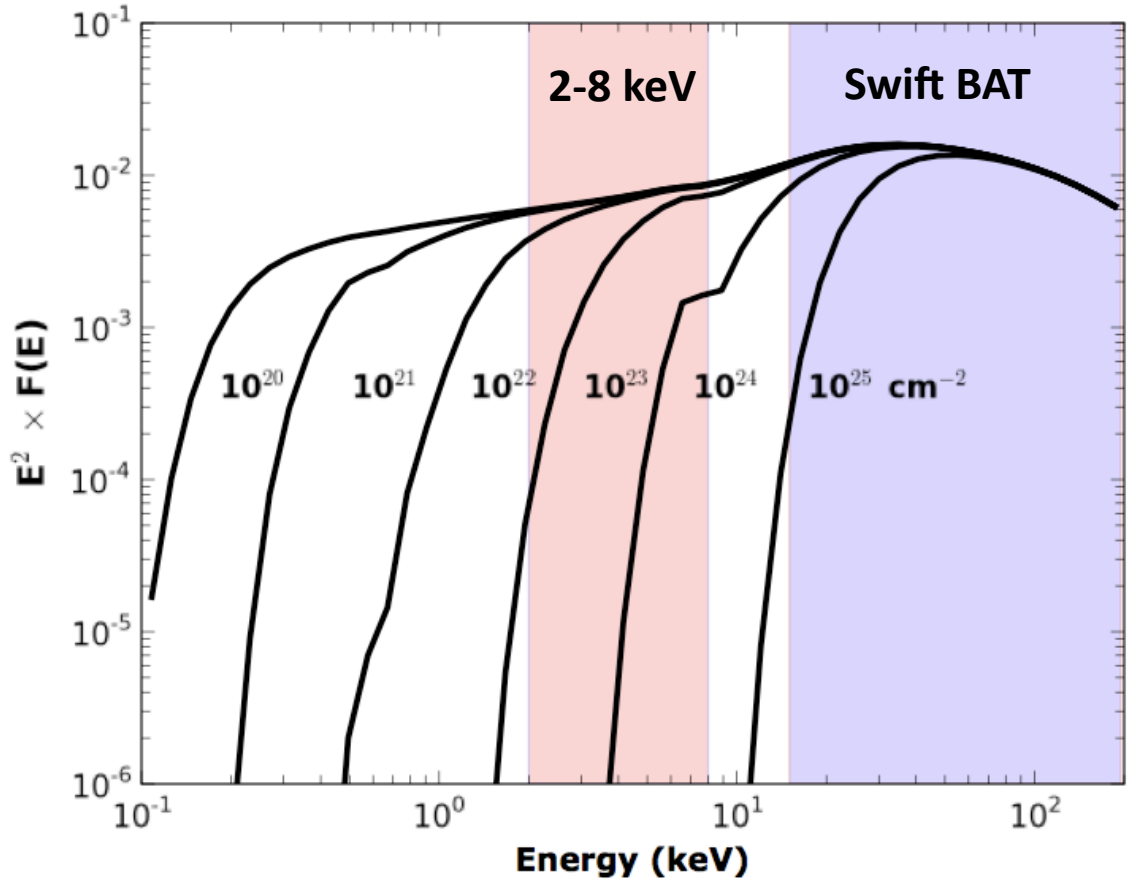
Swift Gamma-ray Burst Satellite



- A new survey of AGN
- Sensitive in the 14-195 keV band – Burst Alert Telescope (BAT)
- X-ray/optical/UV follow-ups with the XRT and UVOT
- See e.g., Tueller et al., 2008

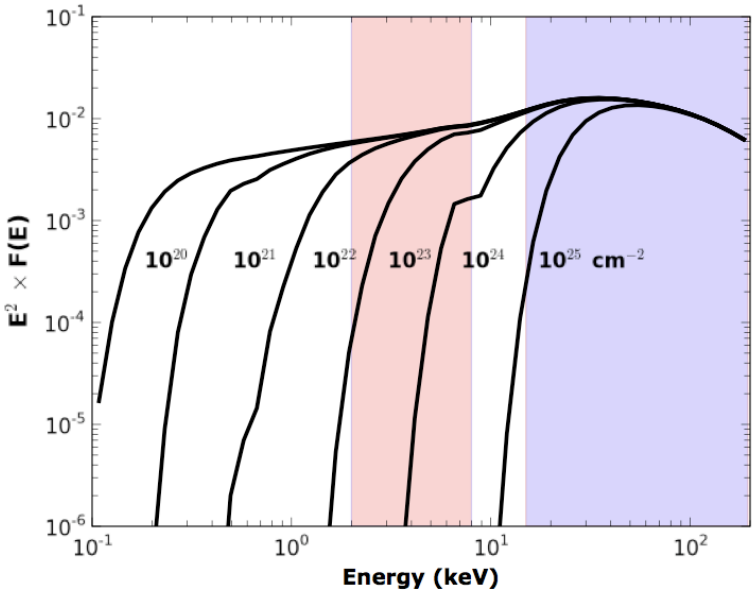
Very Hard X-ray Selection

Absorbed Power-law + Reflection X-ray Spectra

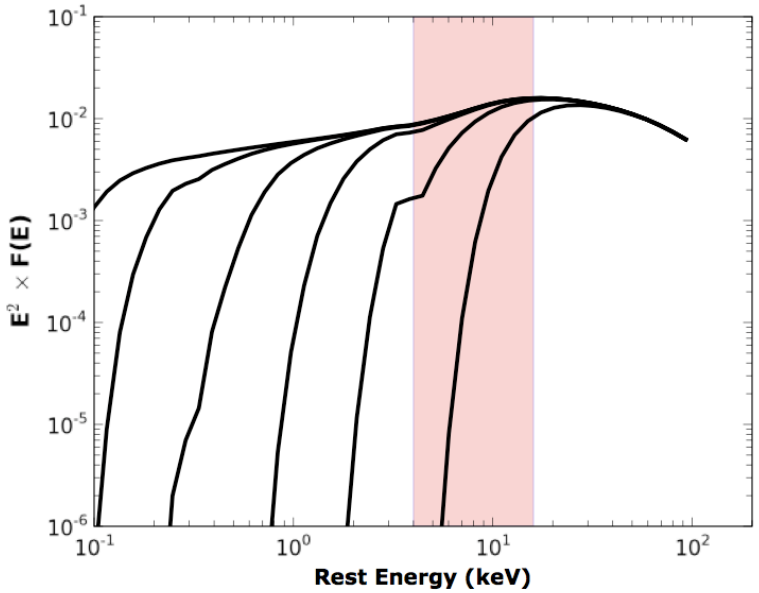


Finding Comparable AGN to the Higher-z Chandra Deep Field

Low Redshift AGN

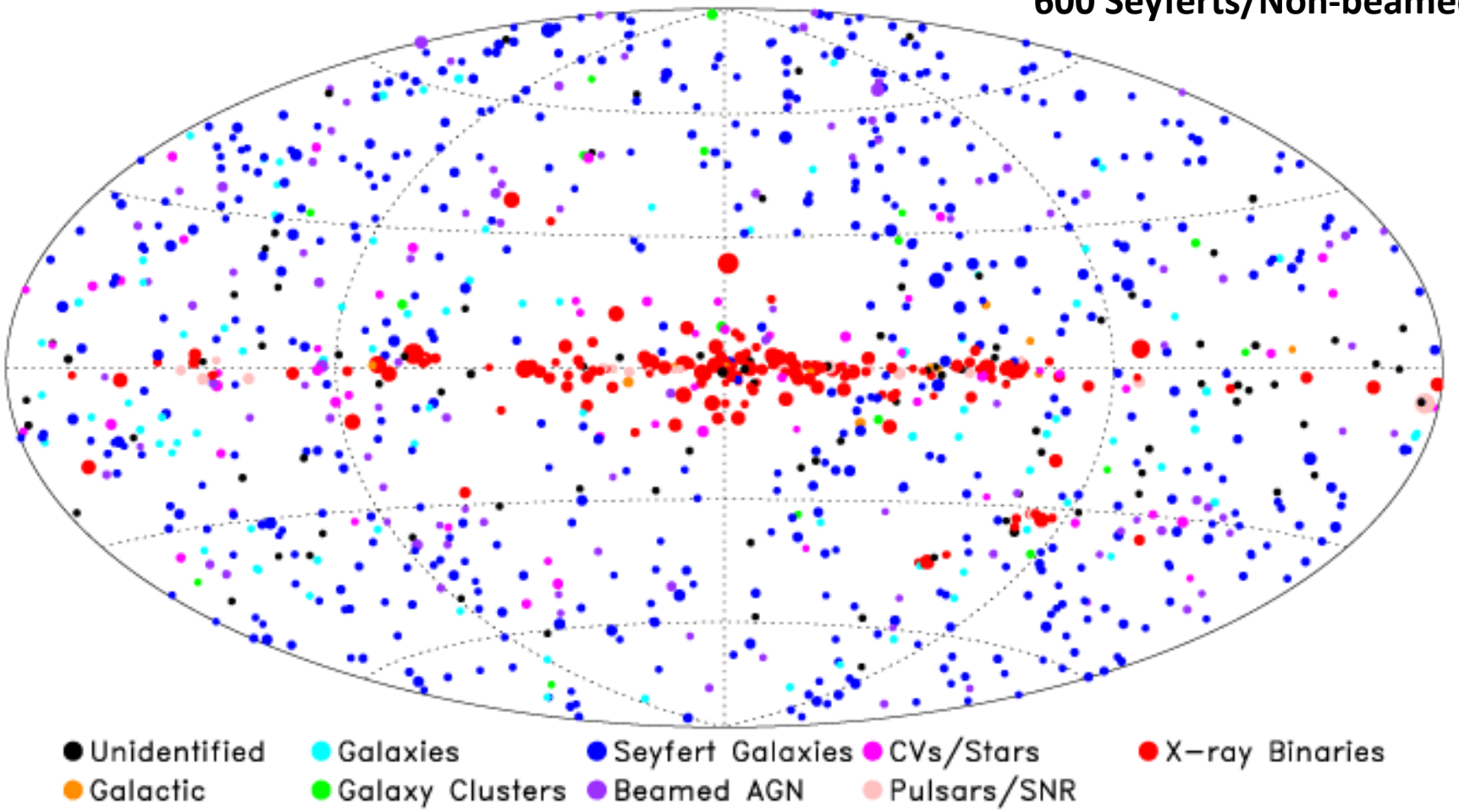


Higher Redshift z=1 AGN



All-Sky Survey

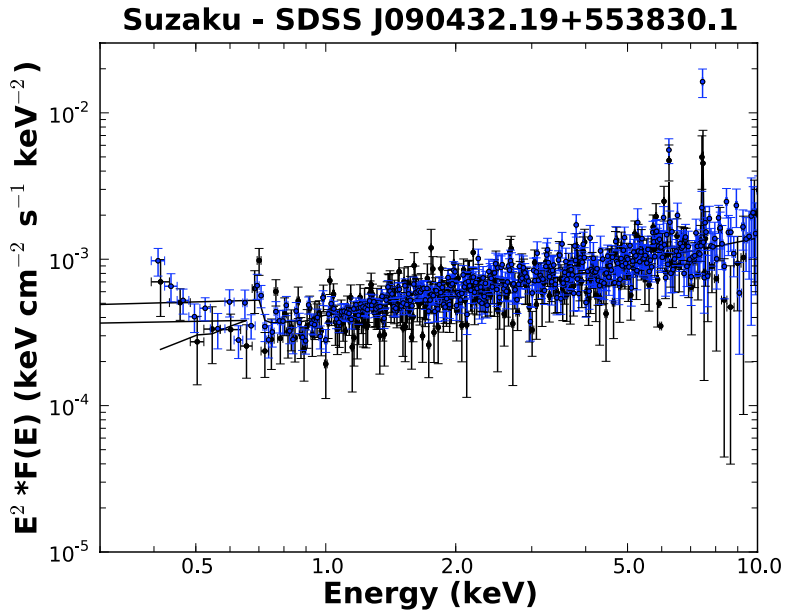
1000 AGN detected
~ 600 Seyferts/Non-beamed



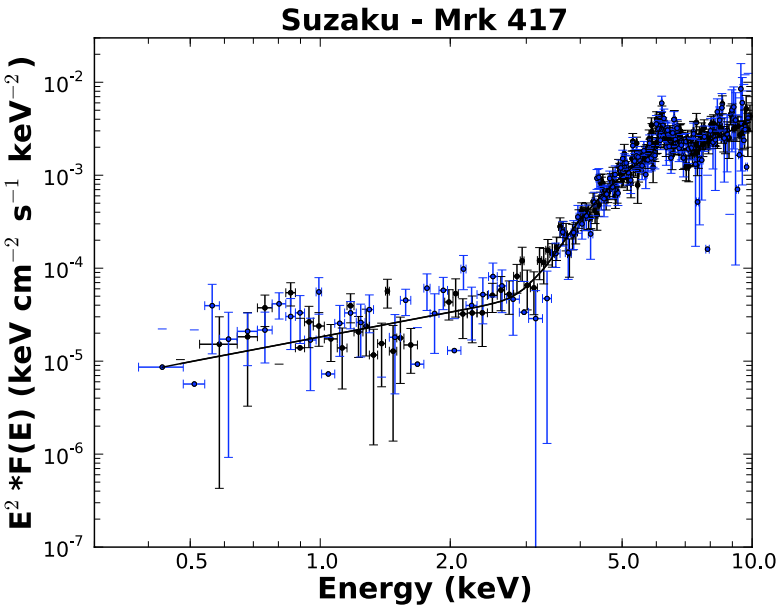
Baumgartner et al., submitted to ApJ

Detailed X-ray Spectral fitting

“Simple” power-law – 45%



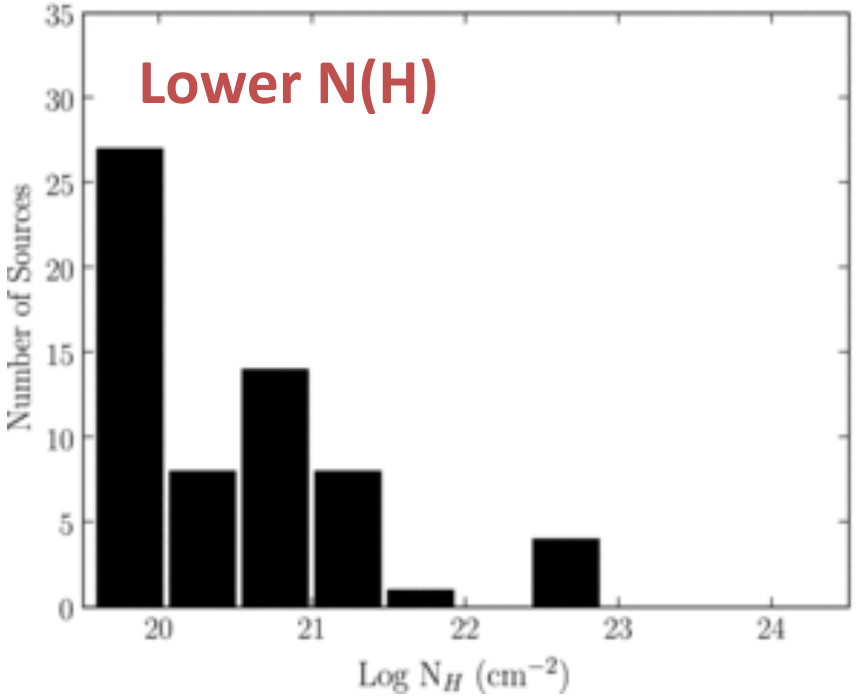
“Complex” sources – 55%



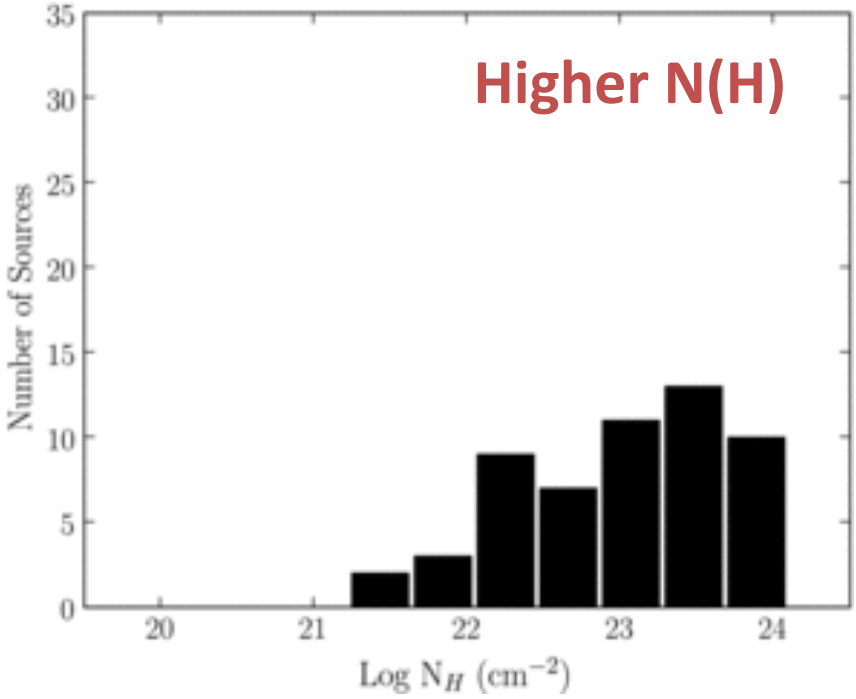
Winter et al. 2009a

Column density distribution

- Simple Model Spectra

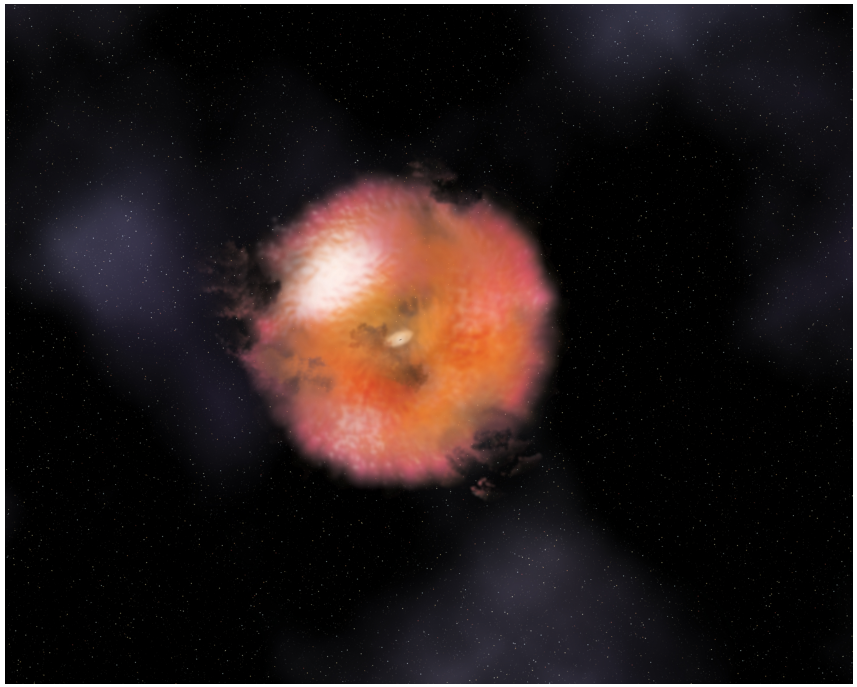


- Complex Model Spectra



Winter et al. 2009a

New Class of "Hidden" AGN

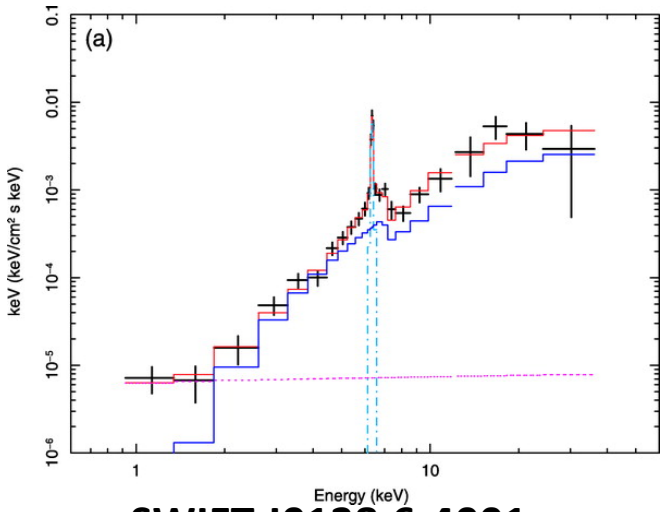


Credit: NASA and Aurore Simonnet, Sonoma State University.

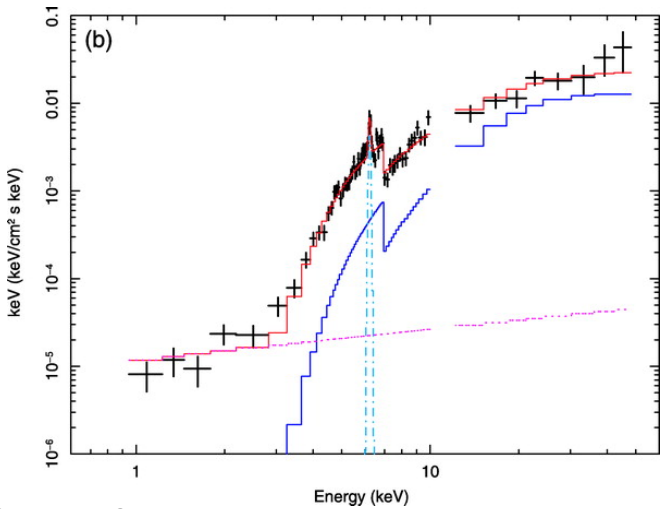
- High column density sources (log N(H) > 23)
- Identified with Suzaku follow-ups
- Significant portion of local AGN – 24%

Suzaku Spectroscopy reveals hidden/ buried AGN

SWIFT J0601.9-8636



SWIFT J0138.6-4001

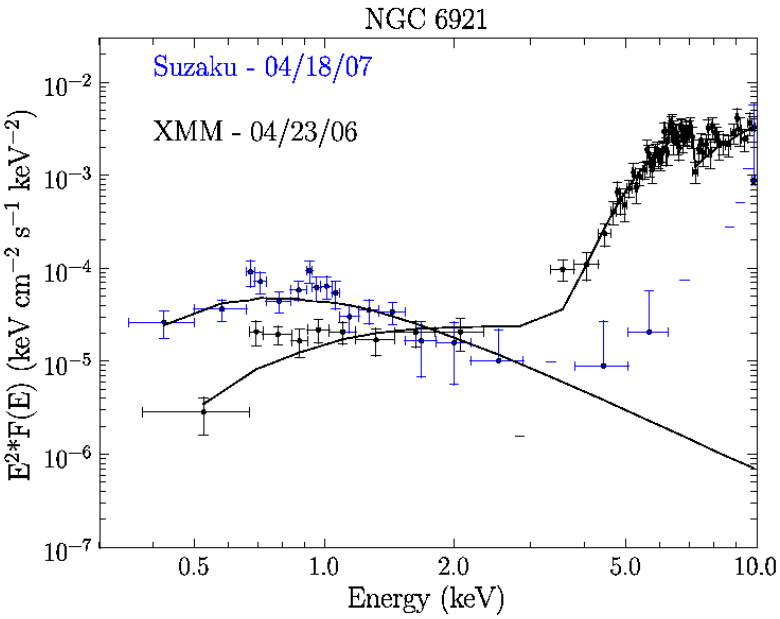


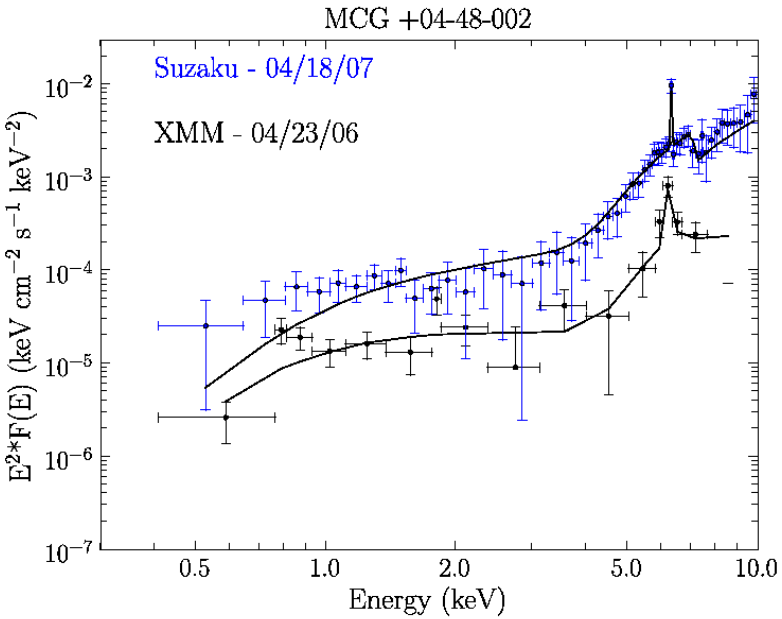
Ueda et al. 2007

- Small scattering fraction
- High log N(H) of 23.5 – 24
- ‘’Buried’’ in a geometrically thick torus
- Optical normal galaxy/ weak H-beta and [O III] emission

Suzaku Follow-ups: Could Hidden Sources be Compton Thick?

Difficult to determine based on XMM snap shot observations.



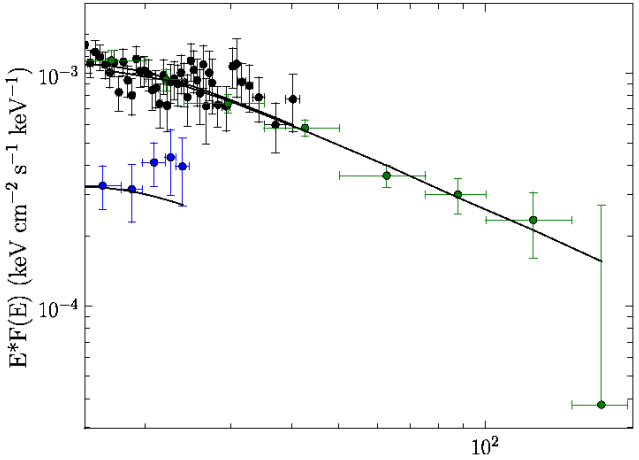


But, Suzaku follow-ups help reveal their X-ray properties.

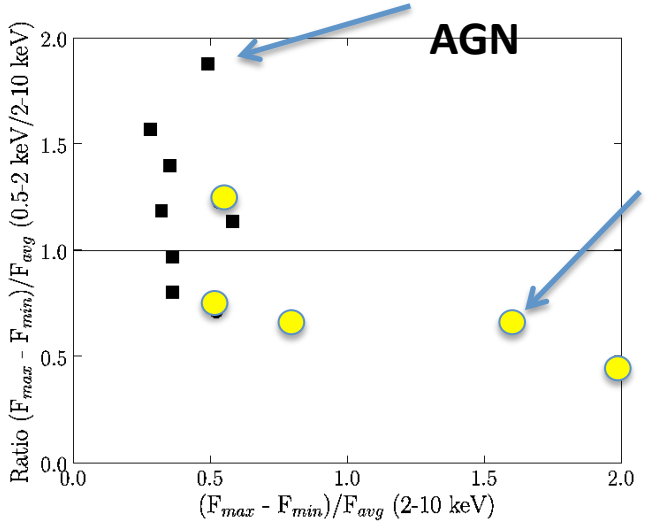
Winter et al. 2009b

Clues from Variability

NGC 1142: Suzaku PIN + BAT

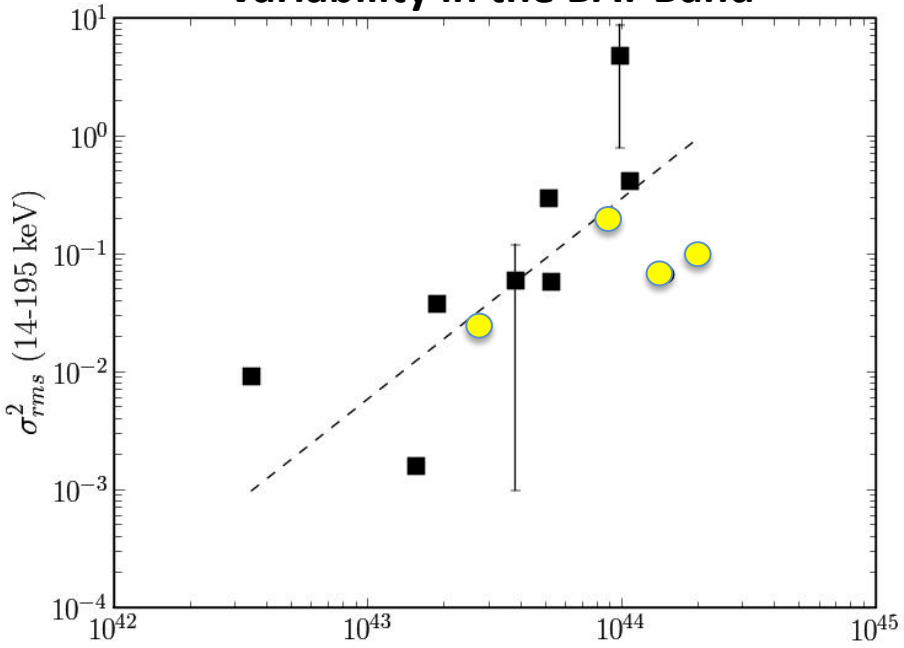


Unobscured AGN



Hidden AGN

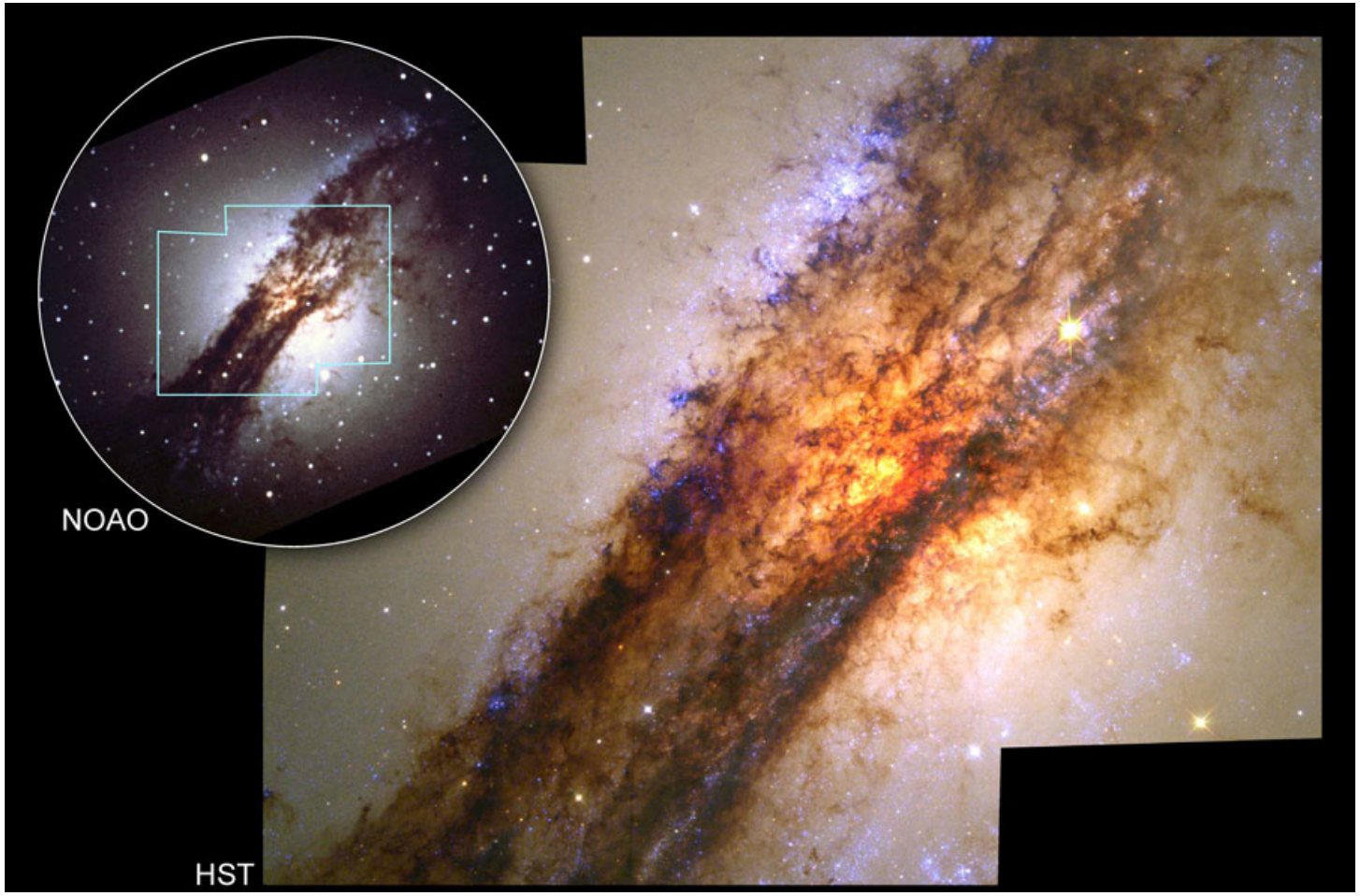
Variability in the BAT Band



Hidden AGN are:

- ✧**Variable in the PIN band**
- ✧**More variable than unobscured AGN in the 2-10 keV**
- ✧**As variable in the BAT band**

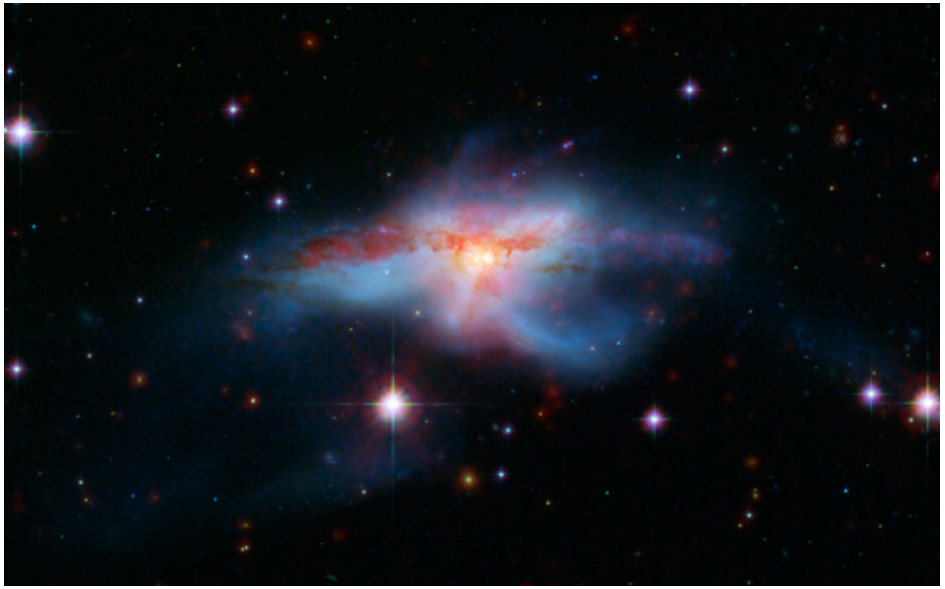
Compton-Thick AGN



Cen A: NASA APOD

What is Compton Thick?

NGC 1275: NASA APOD



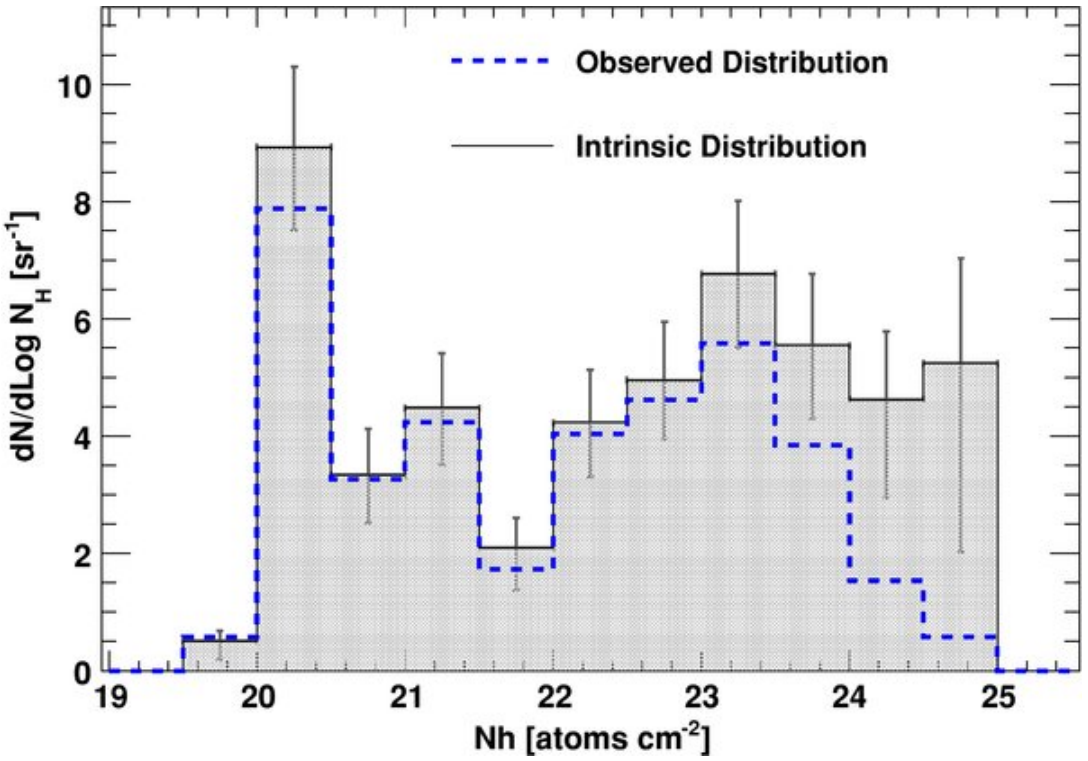
NGC 6240: Spitzer

✧ Potential Complex sources like: Cen A, NGC 1275, NGC 6240 (ULIRG)

✧ Flat Power-law Indices, strong Fe K EW, High Measured N(H)

How Many Compton Thick AGN?

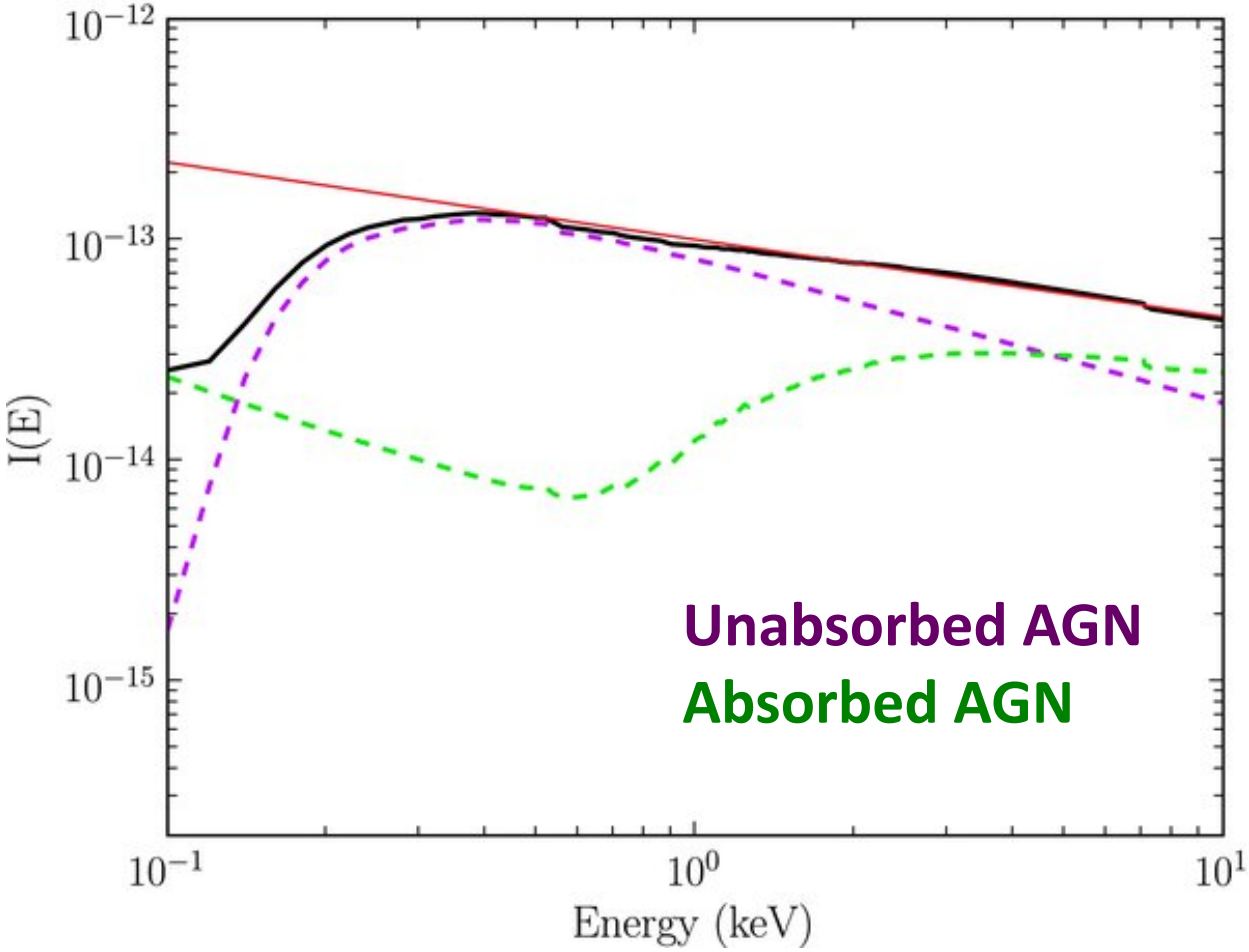
- Winter et al. 2009 – about 6 (or about 6% of local AGN in the 9-month sample)
- Burlon et al. 2010 – 4.6 (+2.1, -1.5)%
- But, correcting for X-ray absorption at hard energies they estimate 20 (+9, -6)%



Burlon et al., 2010

We replicate the CXB …

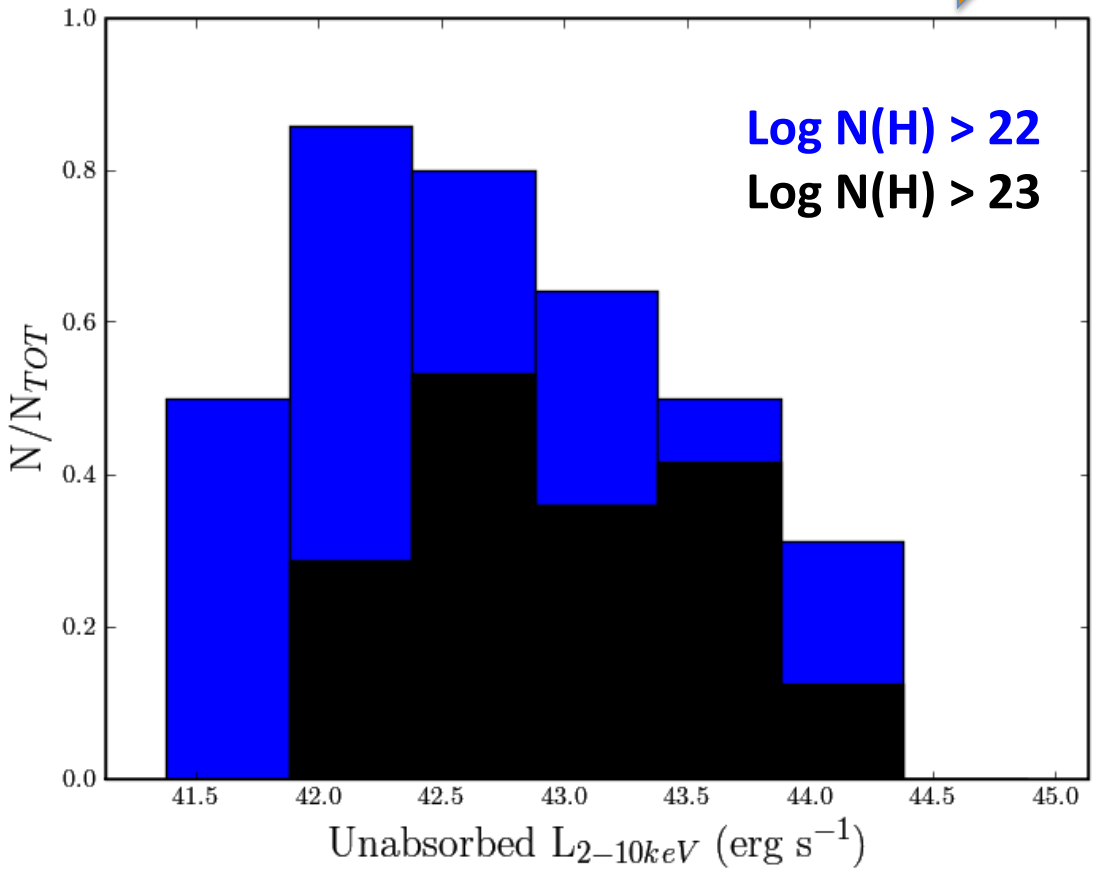
Marshall et al. 1980; Measure Γ = 1.4 for E<15 keV



Winter et al., 2009a

Luminosity-Obscuration Link

Increasing Luminosity

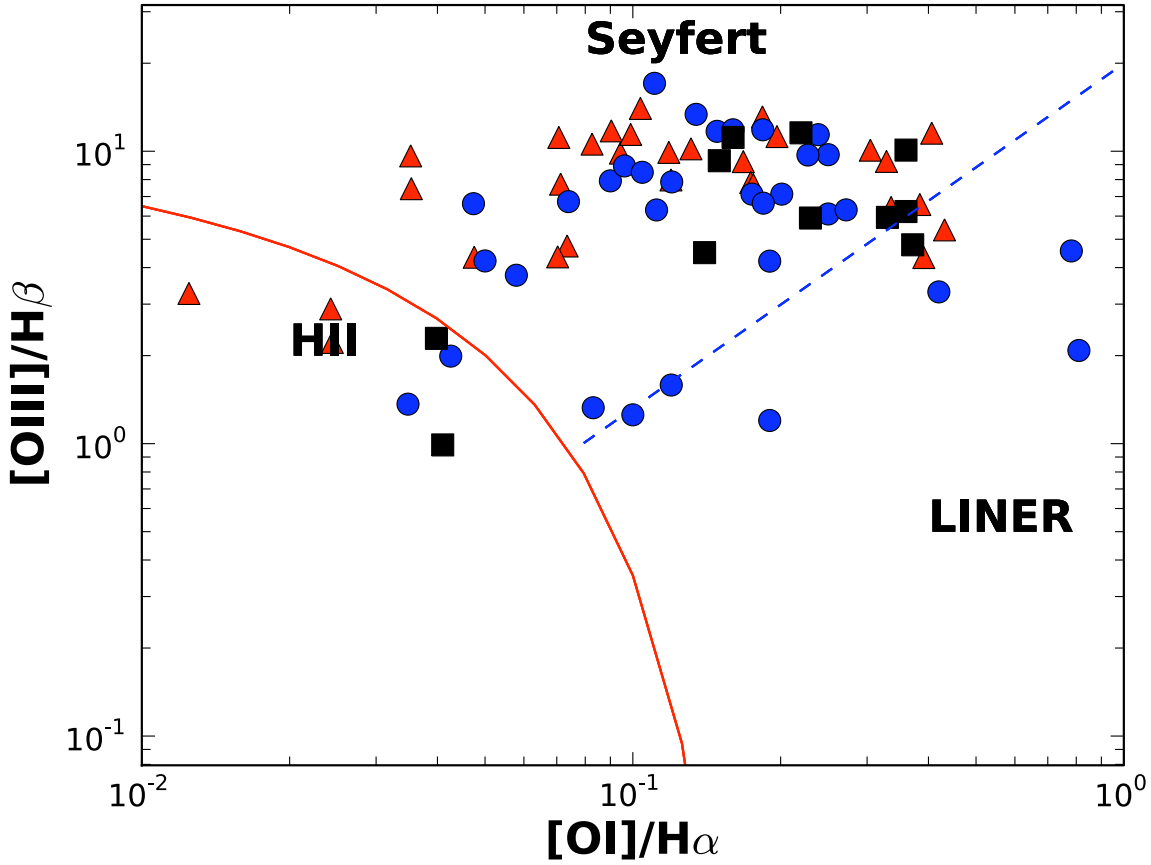


Fraction of Absorbed Sources per Luminosity bin

Binned Absorption Corrected Luminosity **Winter et al., 2009a**

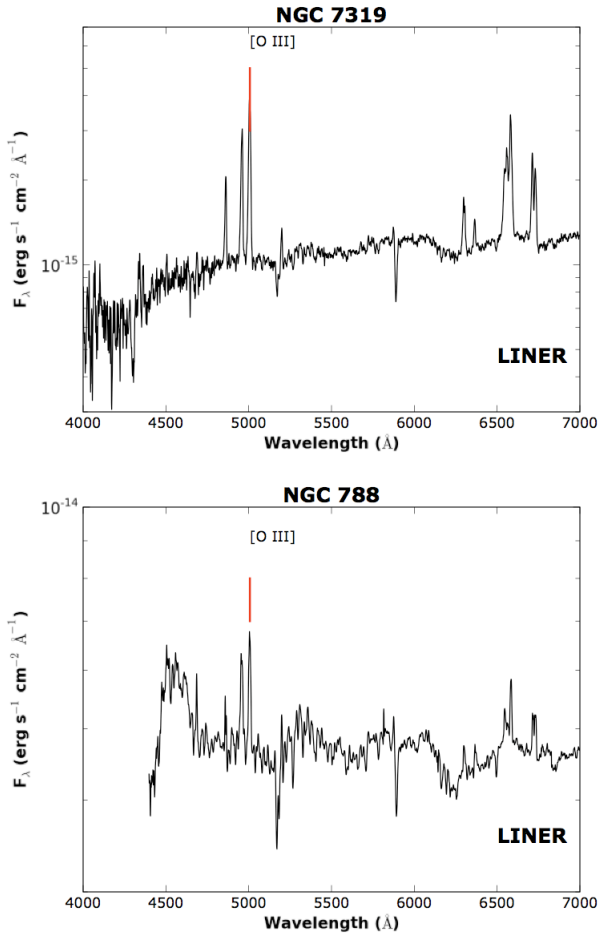
Clues from the Optical

Emission Line Ratio Diagnostics



Winter et al. 2010

Low Luminosity Sources



Winter et al. 2010

- Optical Absorbed/ Unabsorbed Seyferts have same Luminosity Distribution
- Composites/H II galaxies/LINERs are the least luminous
- Many of these are hidden AGN

Summary

- Swift is finding a large number of new absorbed AGN.
- Suzaku follow-ups reveal a significant population (24%) of hidden AGN with few Compton thick.
- Absorbed sources are less luminous.
- The optical spectroscopy reveals LINERs/H II/ composites.
- Next: we have 100s of more sources detected with Swift that are waiting to be followed up