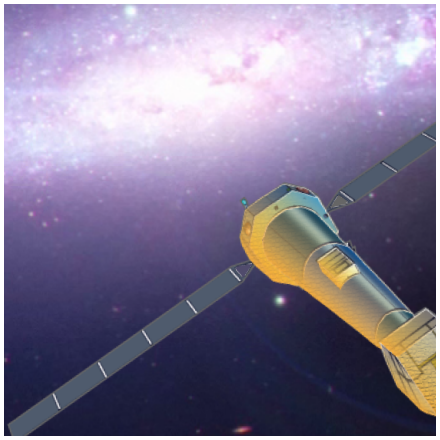
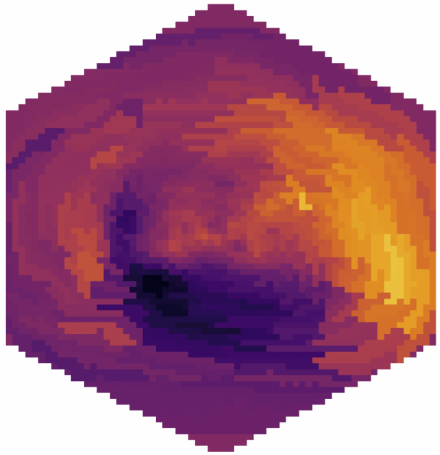
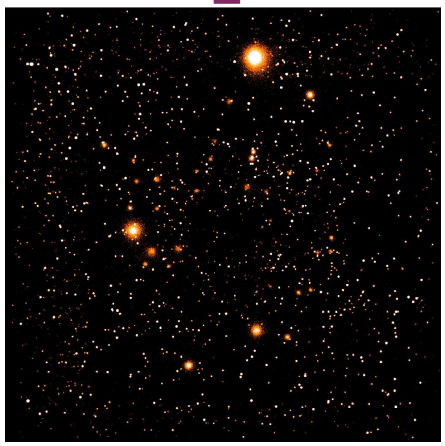
ATHENA

Understanding the build-up of SMBH and Galaxies







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(building on work by the Athena SWG2.2)

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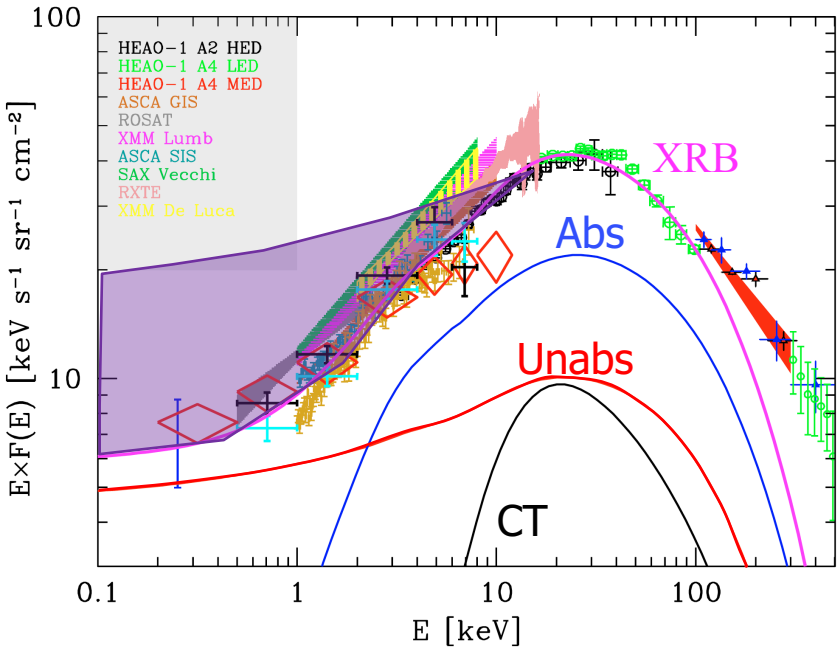
Outline

- Why care?
- SWG 2.2 (post-CORE)
  - Heavily obscured AGN
  - Ionised absorption in AGN
  - Ultra-Fast Outflows in AGN
  - Moderate velocity outflows in AGN
- Synergies/interactions between SWG (and the community)
- Summary

Why care?

Gilli+07



- Most energy emitted from accretion in the Universe is obscured
- Relationship between build-up of SMBH and growth of host galaxies:
  - through obscured phase z~1-4
- Unclear (but significant) contribution of Compton Thick (CT) objects
- One possible mechanism of direct influence of AGN on host galaxy: outflows (also radiation and jets, but another SWG)
  - Warm absorbers (WA)
  - Ultra-Fast Outflows (UFO)

SWG2.2: Understanding the Build-up of SMBH and Galaxies

- Athena: wonderful capabilities (even with 15 row 1.4m^2)
- At this stage: concentrating in (too?) simple requirements, uniform across topics
  - 10 objects/bin (~3σ detection)
  - 5σ detection of individual spectral features
  - …
- In SWG2.2: concentrating in z~1-4, L_X~L* and statistics of populations (other SWG for z< and z>)
  - Heavily obscured AGN: deep survey, WFI spcpy
  - Ionised absorption in AGN: wide survey, WFI spcpy
  - Ultra-Fast Outflows in AGN: wide survey, WFI spcpy (X-IFU spcpy)
  - Moderate velocity outflows in AGN: dedicated, X-IFU spcpy

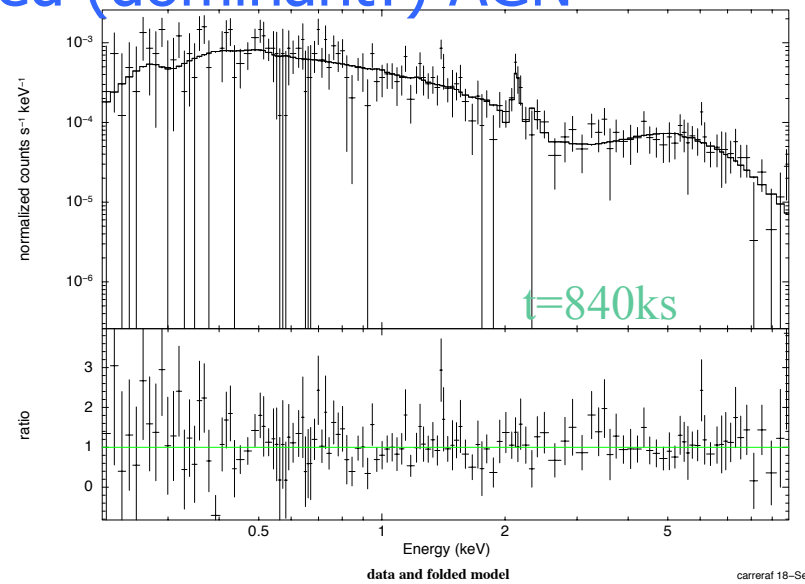
Methodology

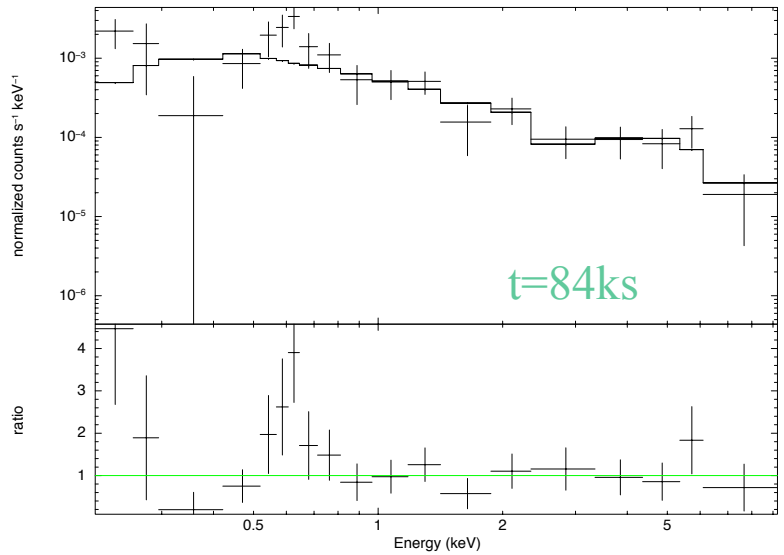
- Divide parameter space in bins (hyper-cubes):
  - z, L_X, N_H, ξ, $v_{turbulence}$…
- Explore different exposure times:
  - Survey geometry (post-CORE Tier 1: 14×840ks+106×84ks )
    - `SWG123-TN-0002_WFI_survey_postCORE_v1.0.pdf`
  - Dedicated
- Analysis of (many) spectroscopic simulations to quantify:
  - Exposure time needed to get a given quality in a given parameter bin
  - Area/Exposure time needed to get a given number of sources
  - (Impact of de-scoping options)
  - …

Heavily obscured (CT) AGN

$\log N_H = 24.5$
$L_X(2\text{-}10\text{keV}) = 5 \times 10^{44}$ cgs
$z = 2$

- Complete census of heavily obscured (dominant?) AGN
- Recovering within 30% L_X and N_H (CT: $\log(N_H/\text{cm}^{-2}) = 24.5, 25.5$) using only WFI spectrum and z
- Brightman&Nandra'11 torus
- Gilli+07 CXB model
- Including stray light
- Can do it for L* for z≤3
- Of course, in "real life" synergies with multi-λ data





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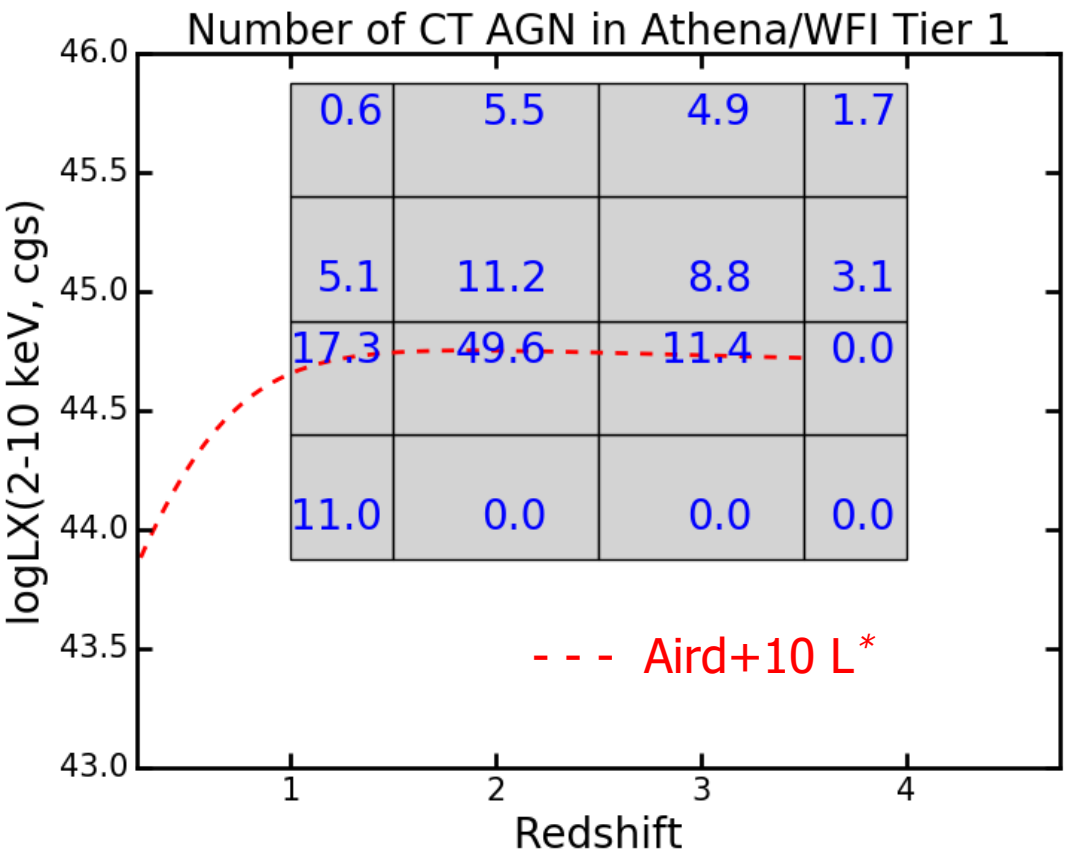
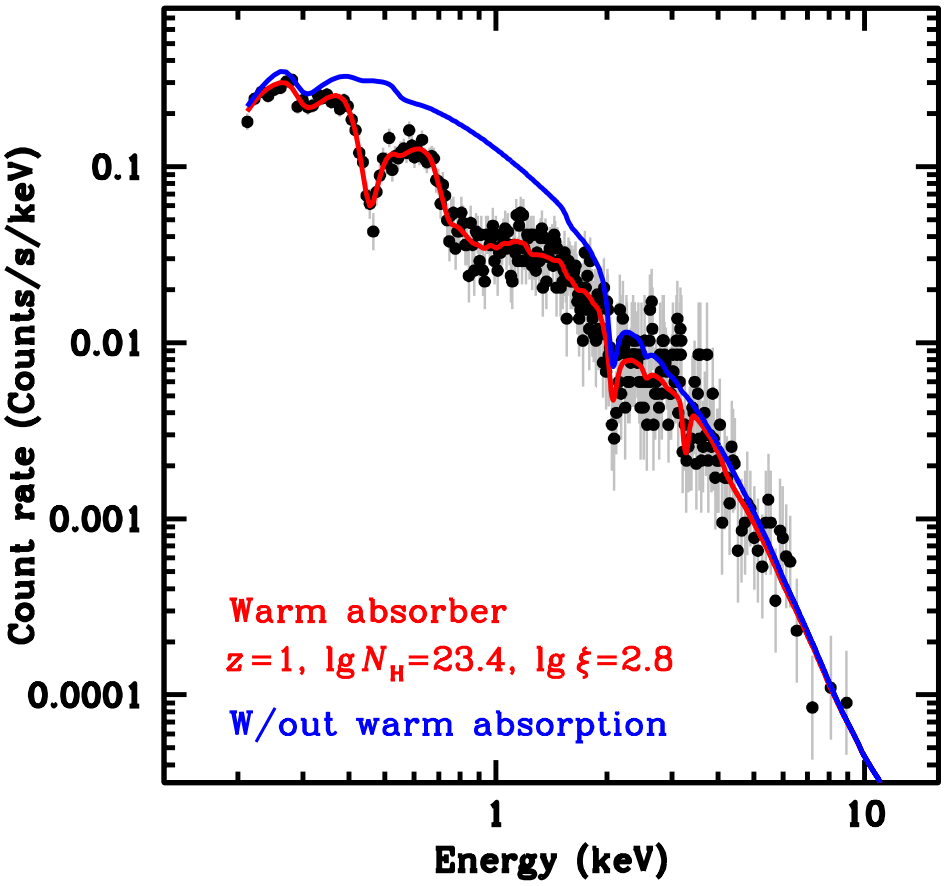


Ionised absorption in AGN

- Aims:
  - Determine incidence of WA in general population of AGN
  - Provide targets for detailed X-IFU studies
- Recovering within 50% logξ(2-4) and $N_{H,ion}$ ($\log(N_{H,ion}/cm^{-2})$=22-24) using only WFI spectrum
- Ueda+03 XLF, 40% WA (Blustin+05)
- Using wide (60ks) tier of survey
- Can do it for L* for z≤3



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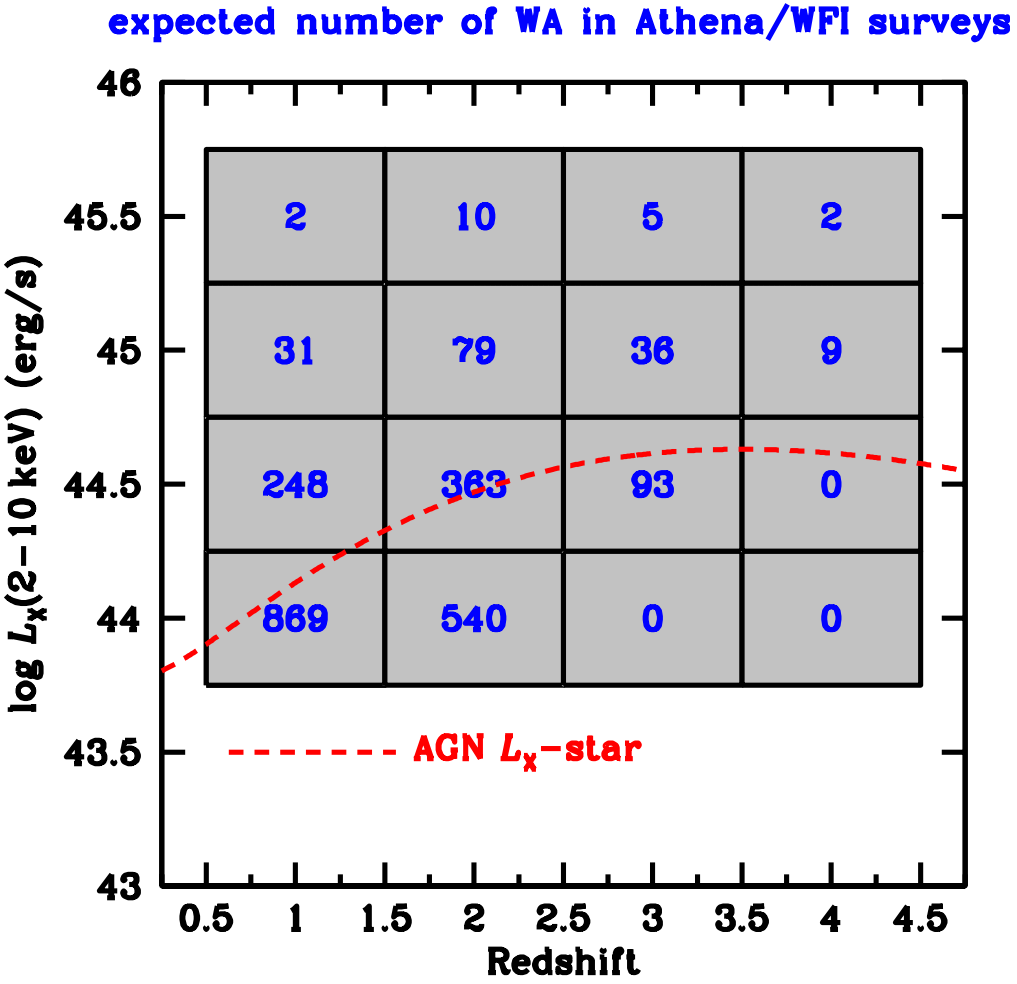

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Ultra-Fast Outflows in AGN

- Determine incidence, duty cycle and energetics of UFOs
- Detecting 6.7keV abs. feature at >5σ using only WFI spectrum
- $\log\xi=3.5$, $\log(N_{H,ion}/cm^{-2})=24$, $v_{turb}=3000$ km/s, $v_{out}=0.1c$ Lanzuisi+12
- Ueda+03 XLF, 30% UFO (Tombesi+10)
- Using wide (84ks) tier of survey: transient
- Can do it for $\log(L_X/erg/s)\geq44.5$ for $z\leq4$

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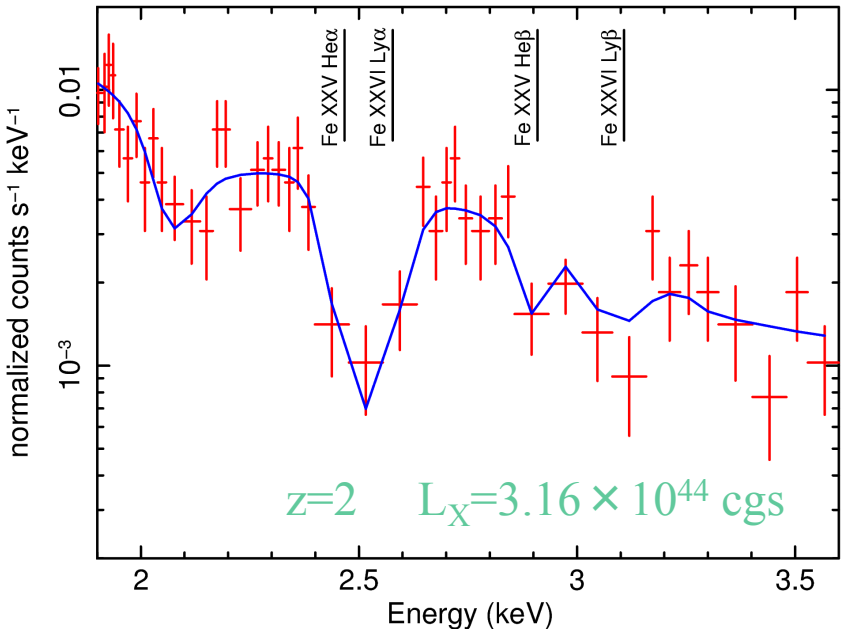

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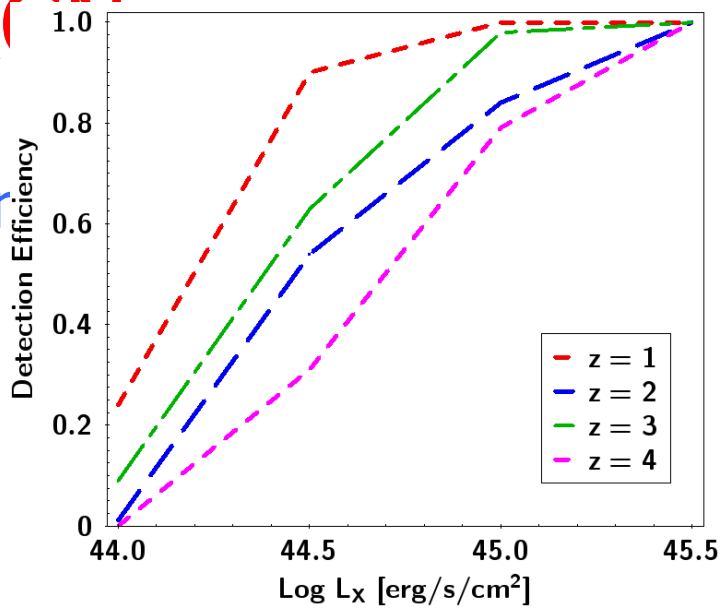
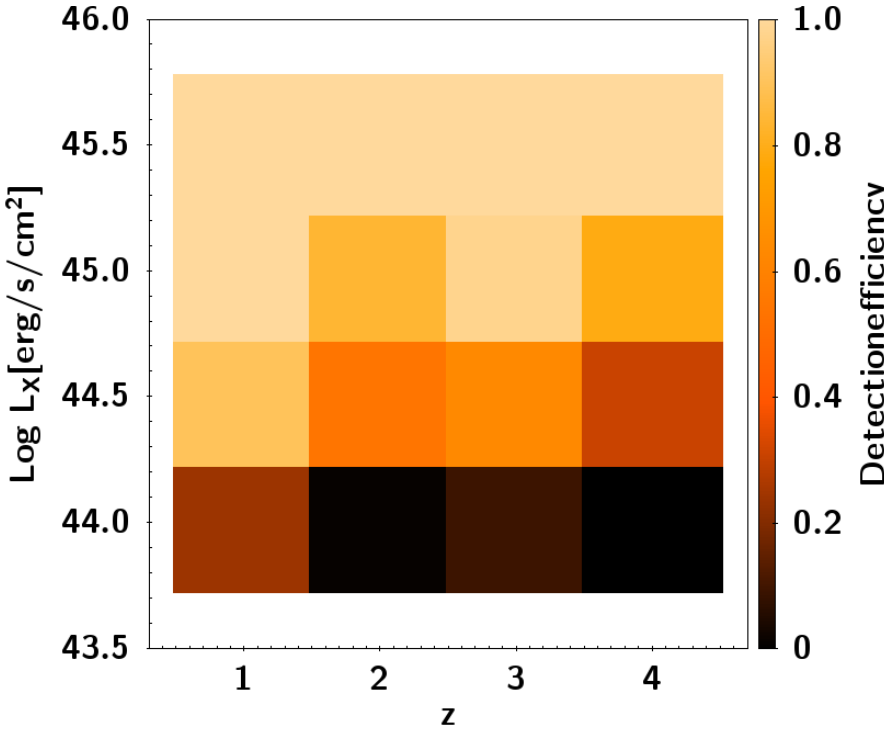
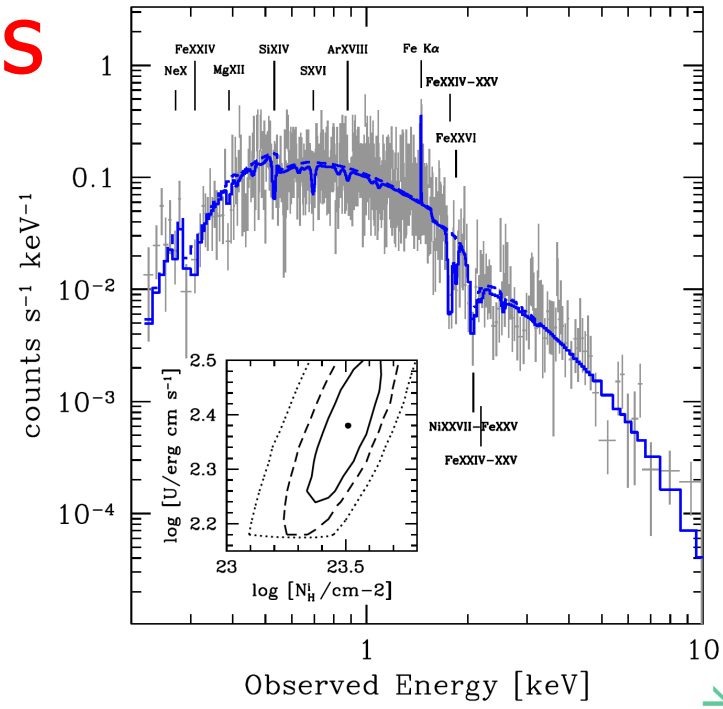


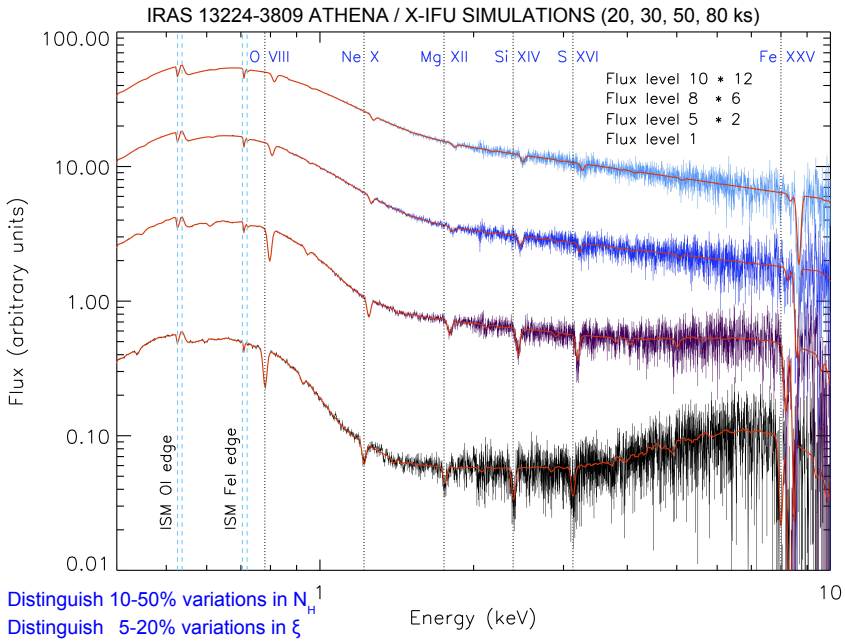


X-IFU observations of UFOs

- Martocchia+17: WISSH-like quasar z=3.4
  - X-IFU 15ks
  - UFO: log(U)=2.3, $\log(N_{H,ion}/cm^{-2})$ =23.4, v_{turb}=5000km/s, v_{out}=0.15c
- Ciro (yesterday's talk):
  - Based on model from Ciro+18
  - UFO varying with luminosity
- …

Martocchia+17, Brusa's talk





Courtesy C. Pinto, Pinto's talk

Synergies/interactions between SWG

- Related activities in other SWG: coordination?
  - SWG 2.1: Formation and growth of earliest SMBH: z>>
  - SWG 2.3: Feedback in local AGN and SF galaxies: z<<
  - SWG 3.5: Multi-wavelength synergy
  - SWG 1.3: AGN feedback in gal. clusters and groups: acc. modes
  - Instrument: MWG 5.2 (background), MWG 5.4 (end-to-end simulations), MWG 5.5 (Advanced analysis tools)
- Main open issue:
  - Good (and scientifically active) membership
  - Engaging them into SWG 2.2 activities

Summary

- Athena wonderful machine
- SWG2.2: Understanding the Build-up of SMBH and Galaxies
  - Relevant for assembly and evolution of galaxies
  - Concentrating in z~1-4 (3) and L_X~L*
  - Statistics of populations
  - Spectroscopic simulations and analysis
  - Requirements (simple)
- Different aspects:
  - Complete census of heavily obscured AGN: deep WFI survey
  - Determine incidence of warm absorbers in AGN: wide WFI survey
  - Determine incidence, duty cycle and energetics of UFOs: wide WFI survey (and dedicated X-IFU)
  - Measure mechanical energy of moderately ionised outflows: dedicated X-IFU
- Interactions with other SWG: z>, z<, multi-λ...
- Need to engage the community: concrete tasks and long-term