The structure of AGNs from X-ray Absorption variability

Guido Risaliti (Arcetri & CfA)
Ubiquitous Variability of $N_H$ in Seyfert Galaxies

$N_H$ variable in 23/25 sources

Timescales from months to years

Clumpy absorber
Sub-parsec distance

Risaliti, Elvis & Nicastro 2002
Next step: Search for column density variations in hours -- days

**Two methods:**

1. Campaigns of snapshot observations within ~a few days

2. Analysis of HR light curves in long observations
Chandra campaign (6x15 ks) of NGC 1365

1) Repeated snapshot observations
2) Single long observations

Mrk 766

- F(2–10 keV)
- F(6–10 keV) (x5)
NGC 4388

$\Delta N_H \approx 2 \times 10^{23}$ cm$^{-2}$

$\Delta T \approx 15$ hours

NGC 4151

Puccetti et al. 2007)
General results:

Eclipses of the X-ray source are COMMON in nearby AGN

\[ \Delta N_H \sim 10^{23} - 10^{24} \text{ cm}^{-2} \]

V > 10³ km/s

D \sim 10^{13} \text{ cm}

n \sim 10^{10} - 10^{11} \text{ cm}^{-2}

X-ray absorber = BLR clouds
NGC 1365 in high state: Suzaku observation
Shape, size and dimensions of BLR clouds

\[ V_c > 2000 \text{ km/s} \]

\[ R_x \]

\[ R_{\text{head}} \]

\[ L_{\text{tail}} > 2 \times 10^{13} \text{ cm} \]

\[ \theta < 2.4^\circ \]
LIMITATIONS:

- Fluxes: $F(2-10)_{\text{INTR}} > 10^{-11} \text{ erg cm}^{-2} \text{ s}^{-1}$

- Time intervals ($T > 15$ ks)

- Non-homogeneous analysis

→ Analysis possible only for the most extreme cases in ~15 sources + ~20 type 1s
XMM, ~15 ks (NGC 1365)

WFXT, 5 ks

WFXT, 5 ks
1/10 flux
WFXT deep survey:

- Statistical analysis of HR variations for hundreds of sources → evaluation of the relevance of variable absorption in different classes of AGN

- Spectral analysis of $N_H$ variations (analogous to that performed on bright sources with XMM/Suzaku) for several tens – a few hundred sources → determination of average physical parameters (size, shape, density, distance) of BLR/X-ray obscuring clouds

- Time-resolved spectroscopy on time scales of a few 100 sec for very bright sources → complete characterization of the BLR/X-ray absorbing clouds