NGC 5548
The Lean Years

Rob Detmers (SRON)
J. Kaastra (SRON)
E. Costantini (SRON / UU)
F. Verbunt (UU)
AGN X-ray Spectroscopy

- Accretion & Outflows.
- Connection absorber & other components.
- Velocity broadening of emission lines --> location gas.
- Ionisation of warm absorber --> physical state gas.

Chandra X-ray Grating Workshop Cambridge July 11 Rob Detmers
NGC 5548

- Very bright AGN, well studied X-ray + UV, low Galactic absorption.
- Earlier work (Kaastra et al. ‘02) --> multiple components.
- New Observation taken in april ’05 with LETGS.
- How do components respond to change in flux?
The year 2005

- Source very low state for long time (SWIFT & Optical) --> flux 5 times lower than 2002.

- Expect recombination in absorber + drop in line flux.
The year 2005

- **Spline continuum**: no a priori assumptions about continuum.
- **Slab absorber** (adjustable ionic column densities: for each ion all lines are fitted).
- **Emission lines**.
continuum (2-10 keV)

O VII\textsubscript{f}

**Flux**

- **LETGS**
- **HETGS**
- **XMM**
Location warm absorber

- $n \propto t_{\text{rec}}^{-1} : t_{\text{rec}} < 3 \text{ years}$ implies $n > 1.9 \times 10^8 \text{ m}^{-3}$.

- $\log \xi = 1.65 , L = 1 \times 10^{37} \text{ W (in 2002)}$.

- $\xi = L / (n \times r^2) : r < 35 \text{ pc}$.
Location O VIIIf emission gas

- Line response to change in flux within 3 years →
  $r < 1 \text{ pc.}$

- FWHM of line $< 310 \text{ km/s} →$
  $r < 6 \text{ pc}$ (Kaastra et al. ‘02).
The Iron Line

- Iron Fe Kα line at 6.4 keV → detected due to low continuum.

- FWHM = 7300±2600 km/s suggests location close to central source: r < 0.03 pc.
FeKα continuum (2-10 keV)

Flux [10⁻¹⁴ W/m²/s]

Year

2000 2001 2002 2003 2004 2005

LETGS HETGS XMM
Conclusions

- Gas in warm absorber reacts to lower flux by recombining --> $r < 35 \text{ pc.}$
- Gas emitting O VIIIf reacts to lower flux --> $< 1 \text{ pc.}$
- Surprise: Gas emitting Fe-K does not change.
Observations Used

- 1999 Chandra LETGS (Kaastra et al. ‘02).
- 2000 Chandra HETGS (Yaqoob et al. ‘01).
- 2001 XMM EPIC (Pounds et al. ‘03).
- 2001 XMM RGS (Steenbrugge et al. ‘03).
- 2002 Chandra LETGS/HETGS (Steenbrugge et al. ‘05).
- 2005 Chandra LETGS this research (Detmers et al. in prep).