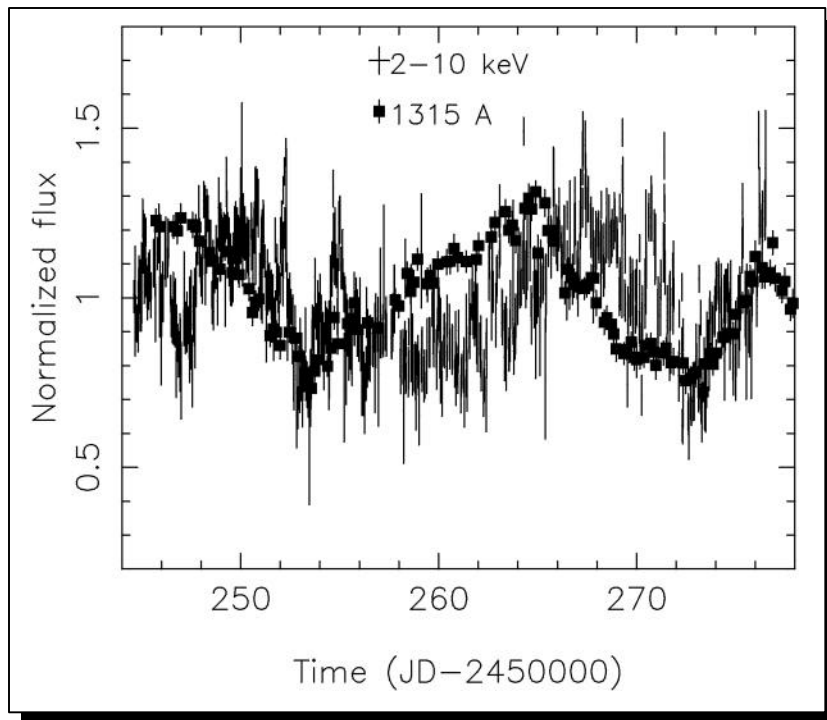




## New Constraints on the Continuum-Emission Mechanism of AGN: Intensive Monitoring of NGC 7469 in the X-ray and UV

RXTE flexible observing allows long term, nearly continuous, coordinated monitoring of AGN

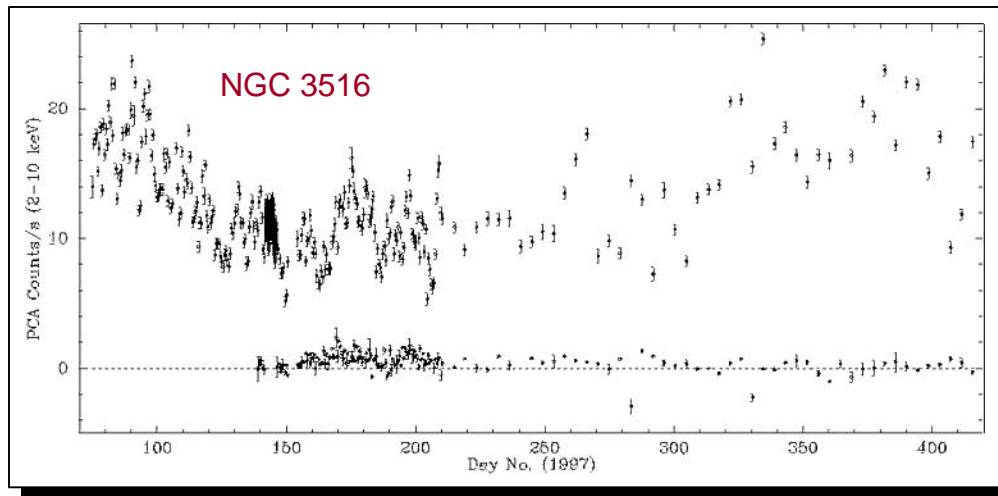


- X-ray and UV monitoring probes the formation mechanisms of the AGN continuum emission
- Seyfert 1 galaxy NGC 7469 observed nearly continuously for 30 days with RXTE and IUE (Nandra et al., 1998)
- X-rays show strong variability with an RMS amplitude of  $\sim 16\%$ . Peak to peak variations of a factor of 2.
- The X-rays vary more rapidly than the UV, with no strong correlation, rather, the X-ray peaks lag the UV peaks by about 4 days.
- Suggests UV/Optical is not simply thermally reprocessed X-rays, more complex models for continuum production required



## Characteristic Variability Timescales in AGN: Continued Monitoring of the Seyfert 1 Galaxy NGC 3516

X-ray variability can provide strong constraints on the physical conditions in the centers of AGN and may be the most direct way to probe the smallest accessible regions.



NGC 3516 shows dramatic variability on all timescales (Edelson & Nandra, 1998)

First AGN power density spectrum to span four decades in frequency (EXOSAT covered < two decades)

- PDS shows significant flattening as one goes from short to long timescales
- Turnover frequency indicates a characteristic variability timescale of  $\sim 1$  month
- Turnover cannot be due purely to light travel-time effects
- PDS similar to Galactic XRBs; suggests similar physical processes are operating

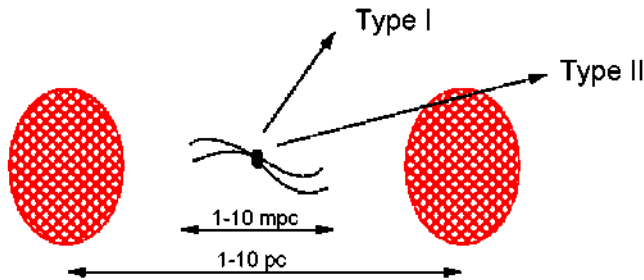
*Much of the interesting action in AGN is on the longest, not the shortest, accessible timescales!*



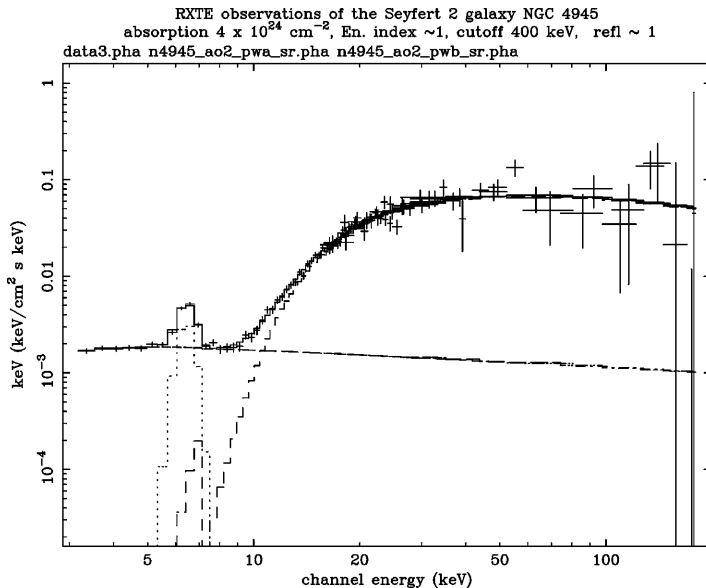
# Evidence for the Unified Model of Seyfert I and II Galaxies

## RXTE Spectroscopy of NGC 4945

Testing the Unified Scheme of Active Galaxies



- Unifying models suggest that system orientation with respect to the line of sight determines whether an AGN is seen as Seyfert 1 or 2.
- If true, the central source of a Seyfert 2 should look like a Seyfert 1, except for strong photoelectric absorption below 10 keV
- Combined PCA and HEXTE spectroscopy of NGC 4945 from 2 - 200 keV (Madejski et al. 1998)
  - Large column depth,  $N_H = 4 \times 10^{24} \text{ cm}^{-2}$
  - Underlying power law continuum
- Underlying continuum of NGC 4945 is very similar to that of the bright Seyfert 1 IC 4329a and other co-added Seyfert 1 spectra from GINGA.
- RXTE spectroscopy confirms the applicability of the Unified Schemes with respect to the X-ray properties of AGN.





# RXTE Spectroscopy of Seyfert 1 Galaxies: Reprocessing in an Accretion Disk?

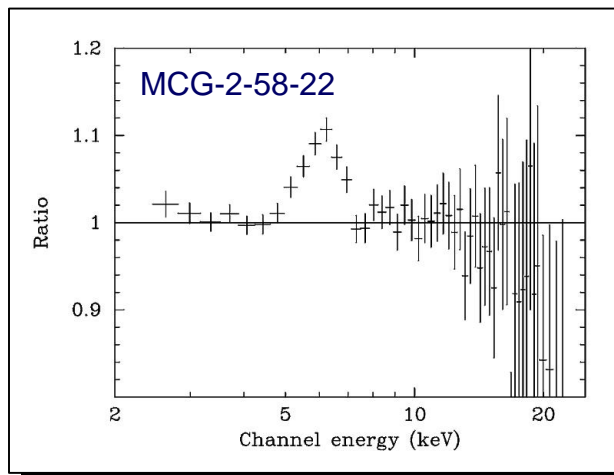
Features of Fe  $K\alpha$  fluorescence and Compton reflection tell us

- o Geometry and distribution of matter
- o Velocity structure
- o Density and ionization state

*ASCA indicates broadened Fe  $K\alpha$  lines from an accretion disk (Nandra et al., 1997)*

## RXTE results for Seyfert 1 Galaxies

- o Fe  $K\alpha$  emission and Compton reflection clearly detected in 7 of 8 Seyfert 1s.
- o Fe  $K\alpha$  line flux does not necessarily track the continuum variability.
- o Not all Seyfert 1s with strong Fe  $K\alpha$  emission show reflection. Why?



MCG-2-58-22 has a strong (EW  $\sim$  300 eV) and broad (FWHM  $\sim$  33,000 km/s) Fe  $K\alpha$  line yet shows no reflection from the disk

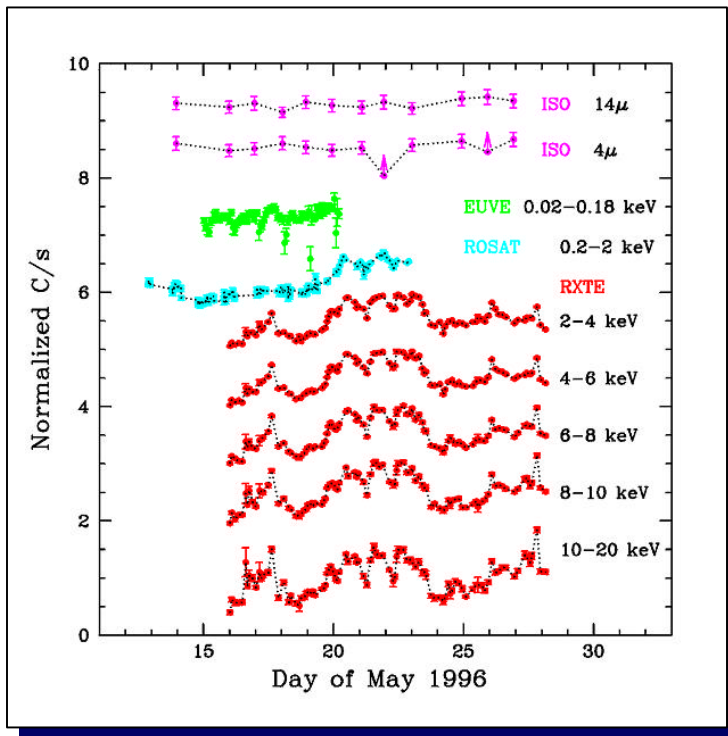
NGC 4051: Fe  $K\alpha$  line is approximately constant while continuum flux varies by a factor of  $\sim$  10. Implies a significant non-disk or outer-disk contribution to the line.

Ratio of PCA data to a power law model



# Multiwaveband Variability of Blazars: The Emission Process in PKS 2155-304

Multifrequency monitoring traces how variability patterns evolve and is necessary to uncover time lags, which are crucial diagnostics of the emission process and the physics and structure of the jet.



- Strong variability on short timescales
- X-ray synchrotron spectrum detected up to 100 keV
- Variability in different wavebands strongly correlated
- Energy dependence of PCA amplitude
- No time lags detected with limits down to a few hours
- But, flare in X-rays that is not present in EUVE or ROSAT

Correlated variability is consistent with synchrotron self-Compton emission from a homogeneous medium.



# Prospective Achievements of the Rossi X-Ray Timing Explorer

---

- Millisecond accretion-powered pulsars and kilohertz QPOs —
  - Advance understanding of nuclear burning in dense matter, the physics of the inner disk, the EOS of dense matter, and GR effects in the strong-field regime
  - Discover additional accretion-powered millisecond pulsars and observe further outbursts of the 2.5-msec accretion-powered pulsar
- Accreting black holes in the Galaxy —
  - Advance understanding of the role of the inner disk in jets formation and use X-ray spectra and QPOs to determine the mass and spin of black holes
  - Discover a bright BH X-ray nova and the first eclipsing BH system
- Supermassive black holes in AGN —
  - Resolve new questions about the role of Compton reflection, determine the characteristic variability time scales, and establish a unified model of AGN
  - Relate the rapid X-ray variability of AGN and X-ray binary systems
- Origin of gamma-ray bursts —
  - Determine X-ray afterglow variability and spectra from 1,000–10,000 seconds
- Long-term behavior of X-ray binary systems —
  - Advance understanding and test precessing-disk and disk-instability models