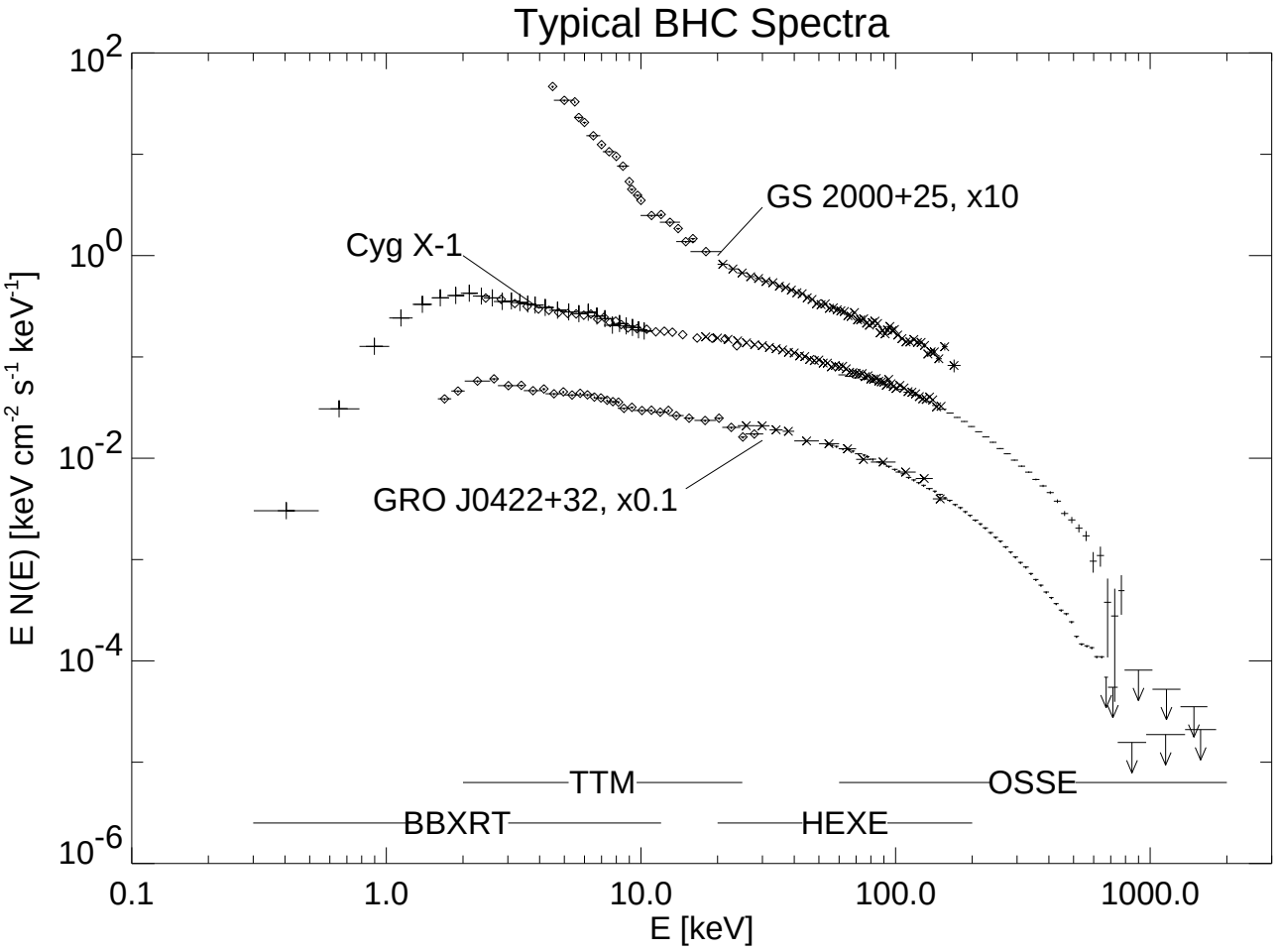
Application of Comptonization

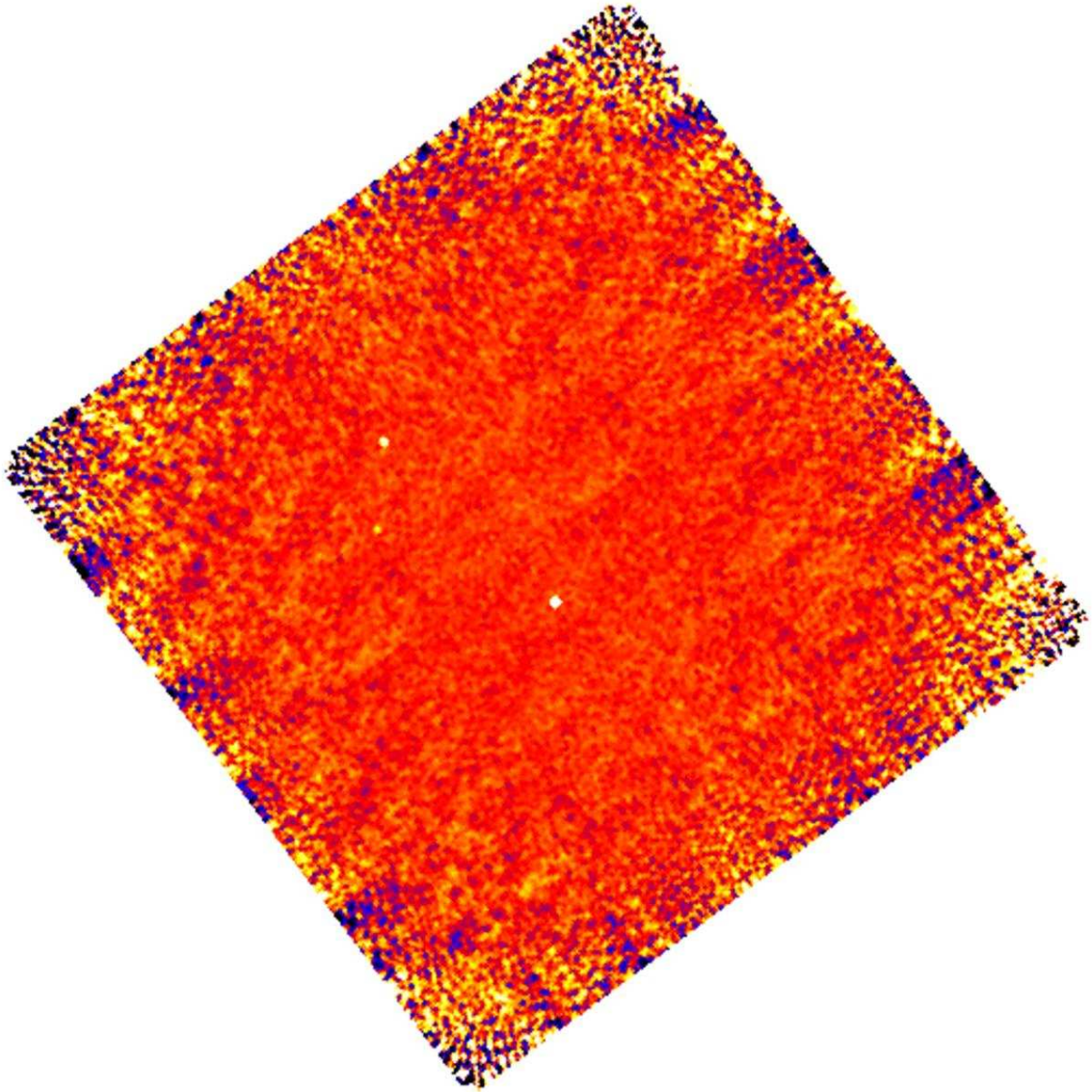
Galactic Black Holes



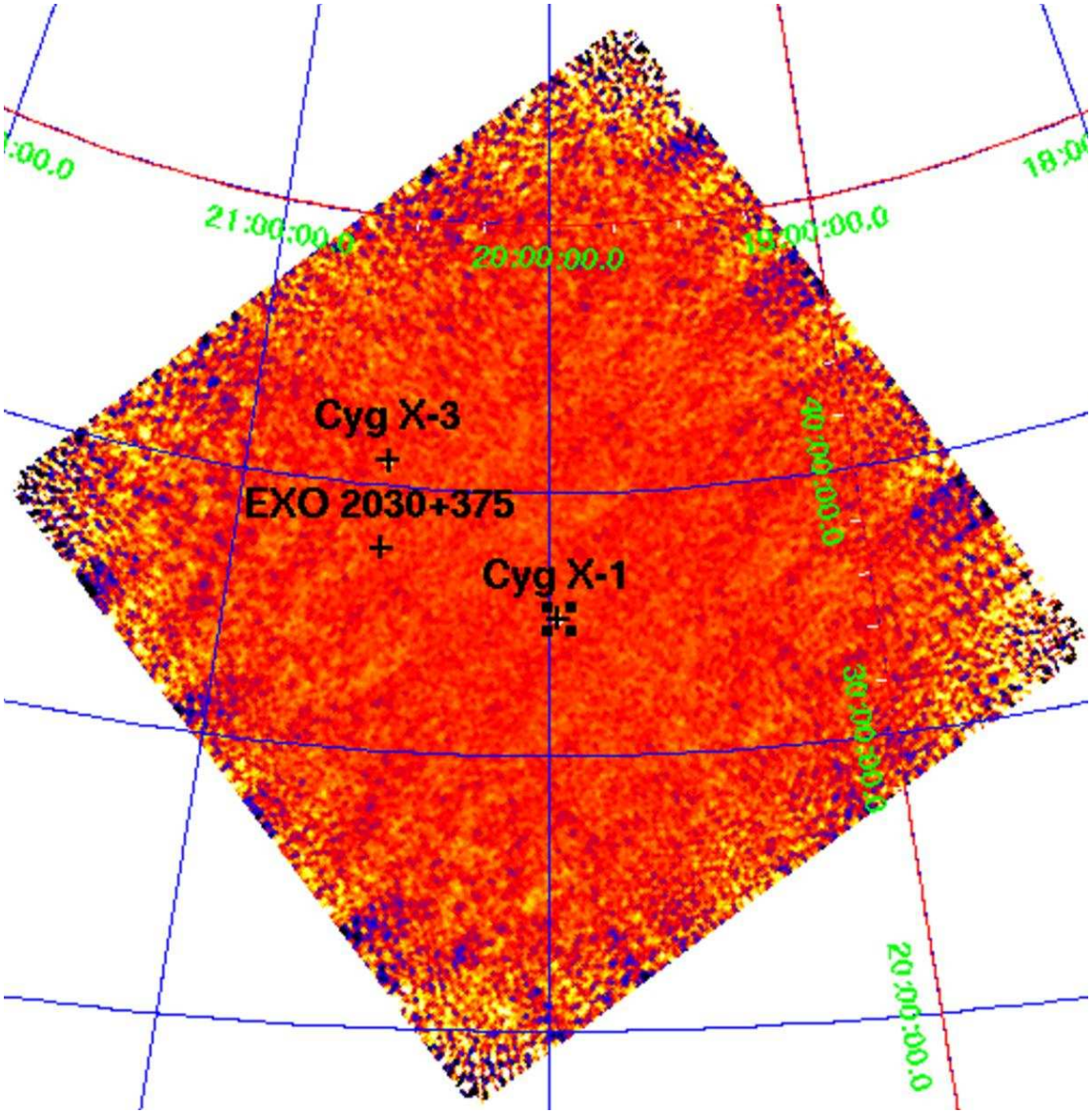
(Cyg X-1: Wilms et al., 1996, ; GRO J0422+32, GS2000+25: Sunyaev et al., 1993, Kroeger [priv. comm.])

X-ray spectra of galactic black hole candidates can be well explained by thermal Comptonization in a plasma with $kT \sim 150\,\mathrm{keV}$ and with $y \sim 1$.

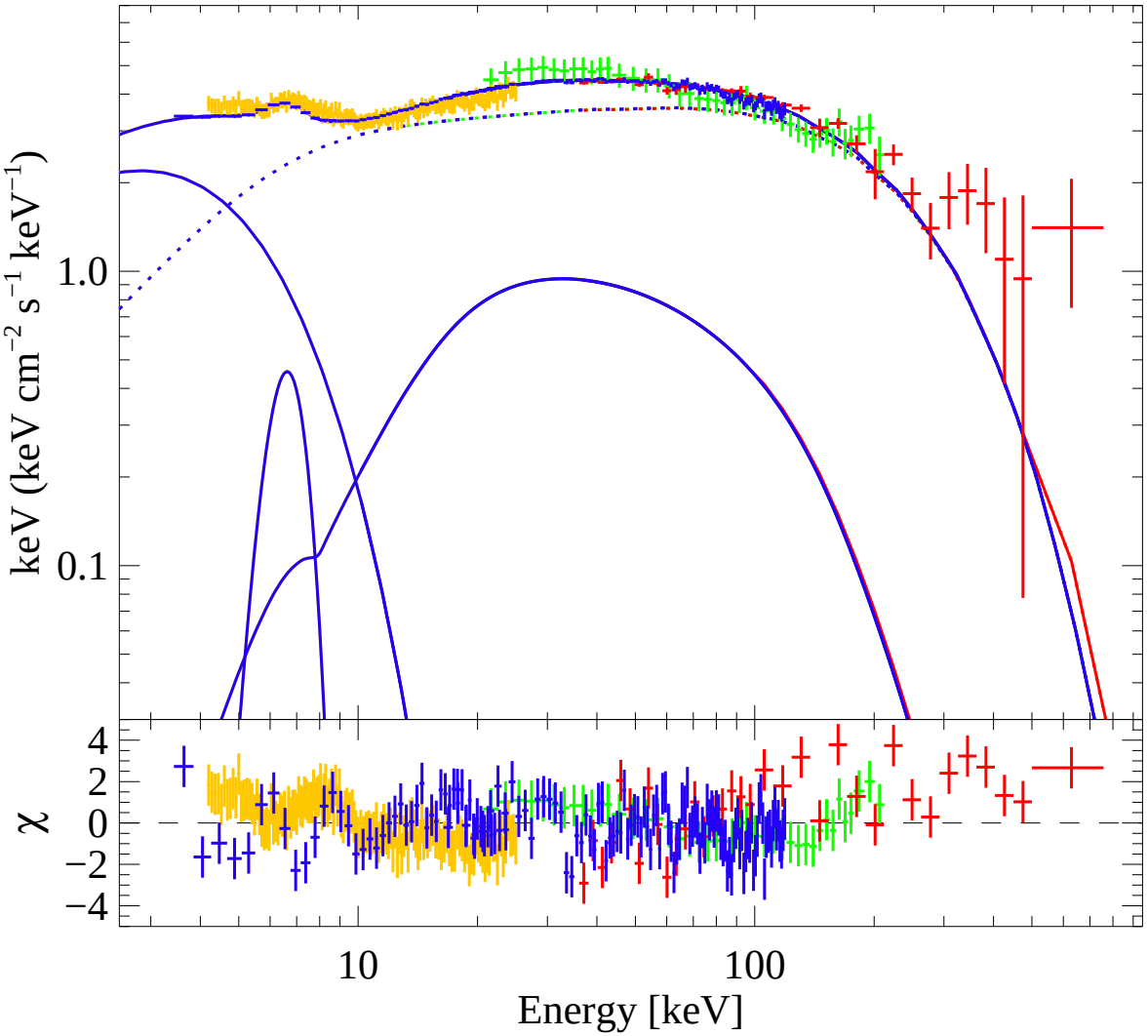
INTEGRAL/RXTE, I



INTEGRAL/RXTE, II



INTEGRAL/RXTE, III



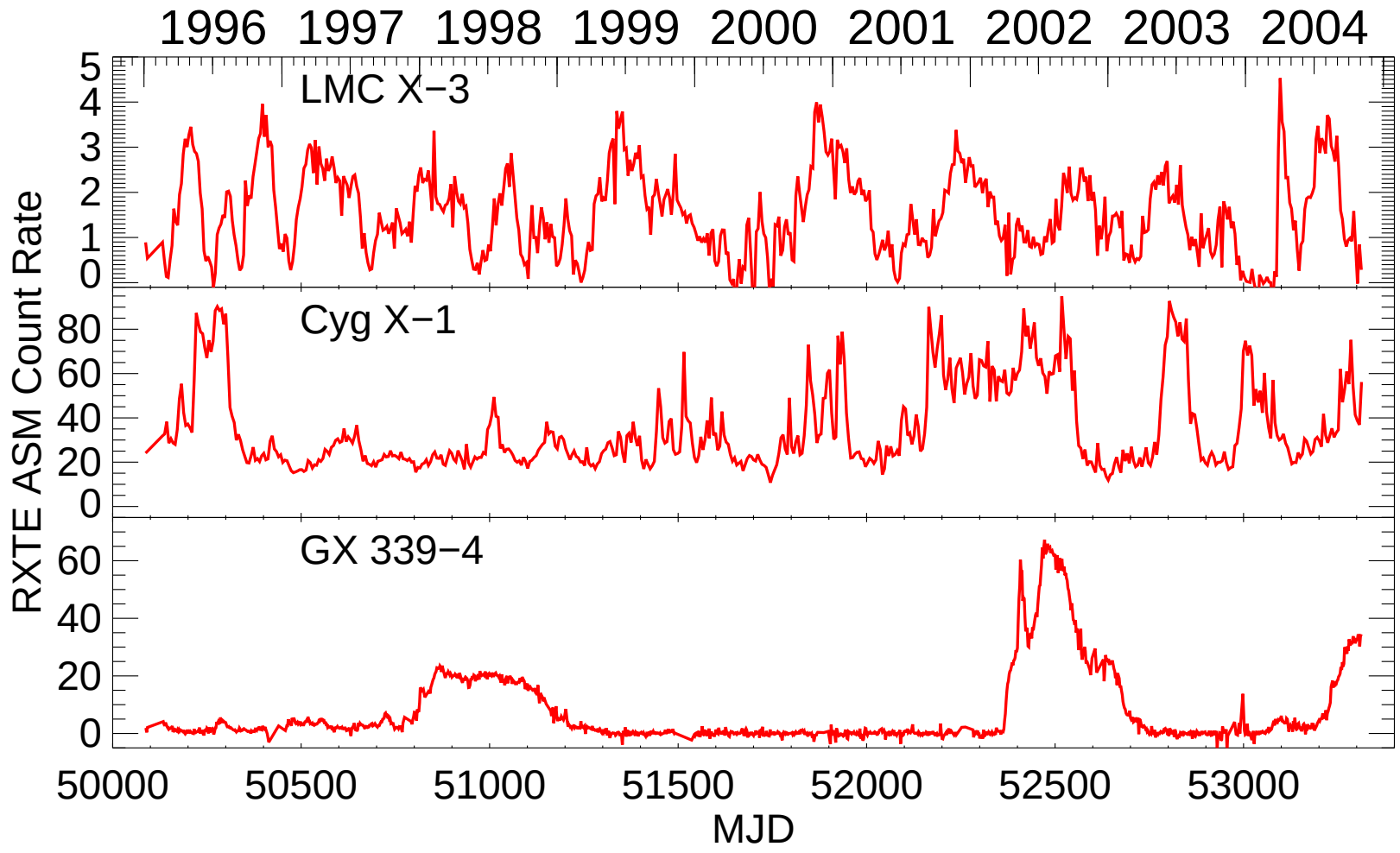
Fritz, et al., 2005, in prep.

Fit of a `Comptonization` model to *RXTE*/*INTEGRAL* data from the galactic black hole Cygnus X-1

$kT_{\mathrm{soft}} = 1.21\,\mathrm{keV}$,
$\tau_{\mathrm{e}} = 1.09$,
$kT_{\mathrm{e}} \sim 100\,\mathrm{keV}$

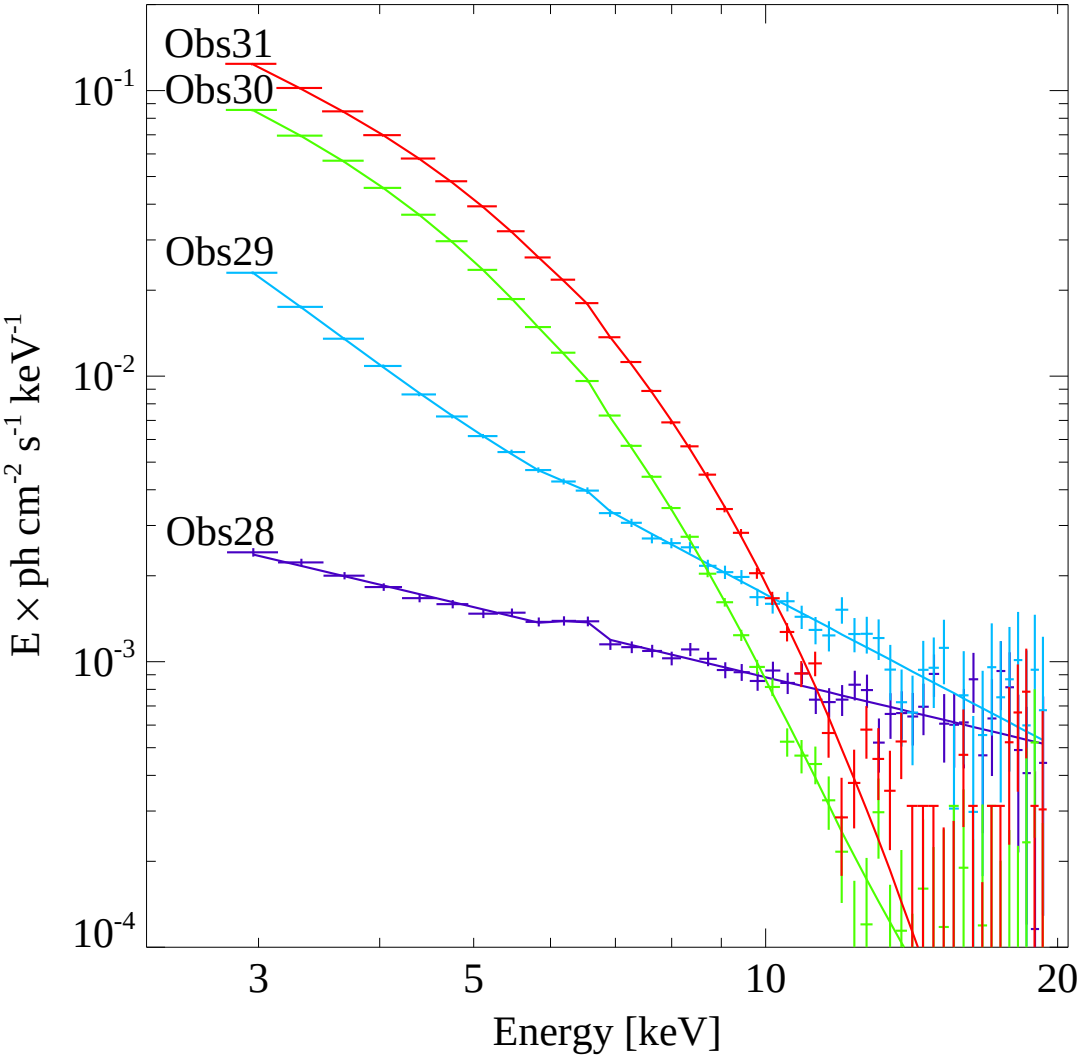
Note presence of a Compton reflection hump (evidence of close vicinity of hot electrons and only mildly ionised material)

INTEGRAL/RXTE, IV



Black Holes: Variability on all time scales

Spectral States, I

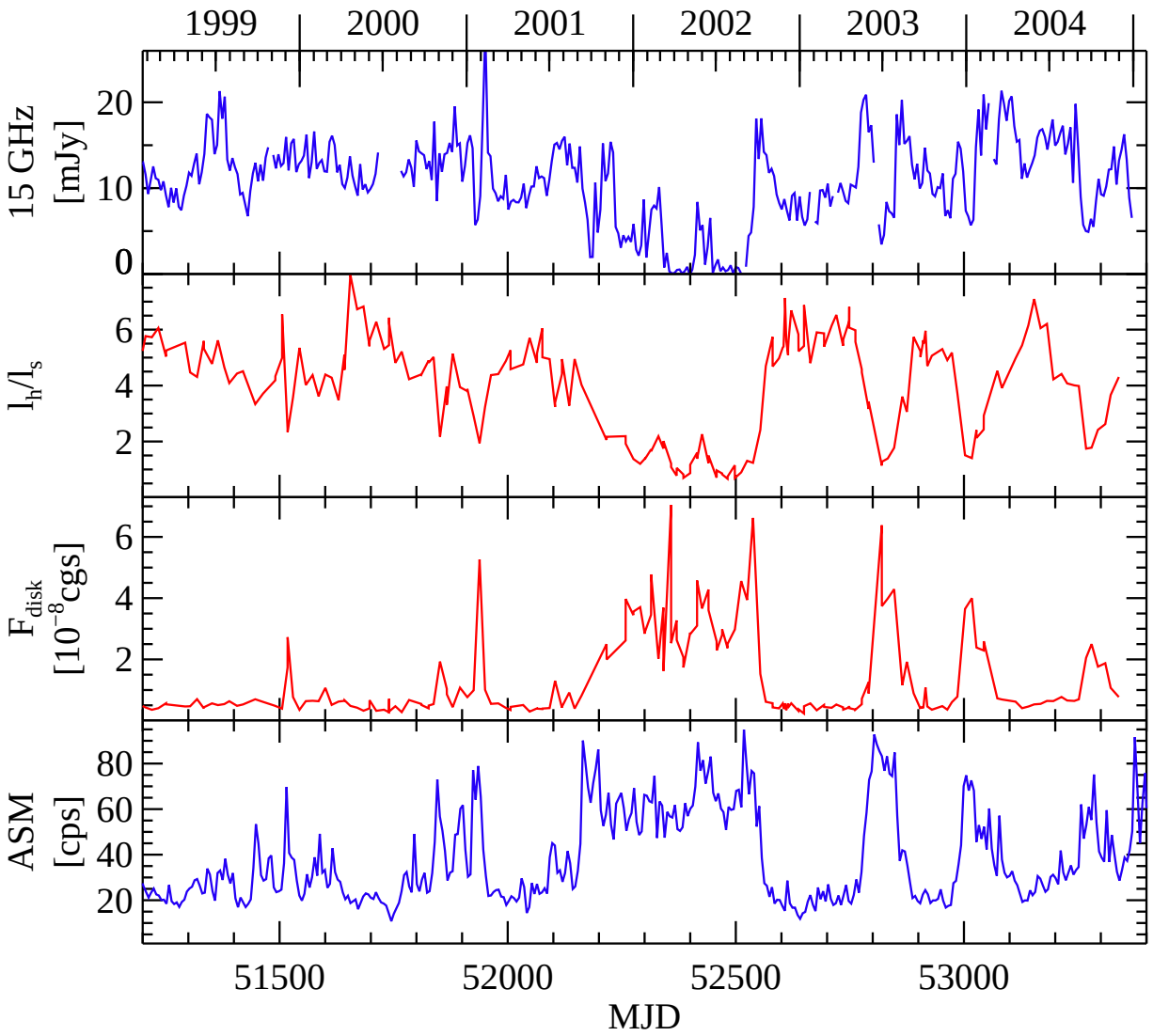


LMC X-3, Wilms et al. (2001)

X-ray States:

- $L_X \gtrsim 0.05\, L_{Edd}$:
  soft state/high state:
  - thermally dominated
  - low variability (few percent rms)
- $L_X \lesssim 0.05\, L_{Edd}$:
  hard state/low state:
  - power law spectrum,
  - high variability (few 10 percent rms)

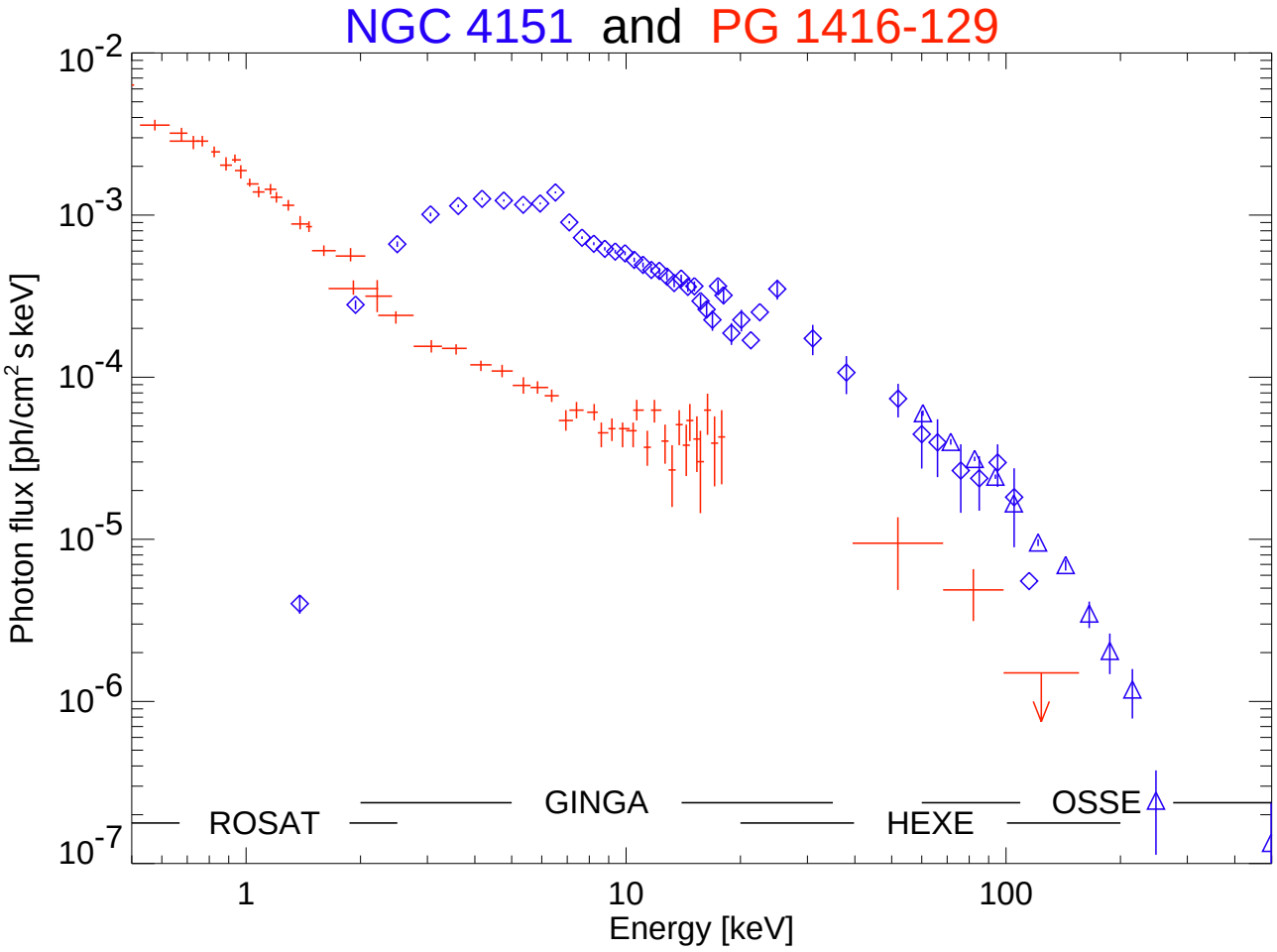
Spectral States, II



Cyg X-1 (Wilms et al., 2005, A&A, in press)

New satellites allow detailed study of evolution of Comptonizing plasma over timescales of years.

AGN



(PG 1416−129: de Kool et al., 1994, Williams et al., 1992, Staubert & Maisack, 1996; NGC 4151: Maisack 1991, 1993)

Note: NGC 4151 not corrected for interstellar absorption.

Spectral shape of AGN very similar to galactic Black Holes $\Longrightarrow$ Same physical mechanism (=Comptonization) responsible!