



Monitoring Variable X-ray Sources in Nearby Galaxies

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Radio

Infrared

Visible

Ultra-violet

X-ray

Radio

Infrared

Visible

Ultra-violet

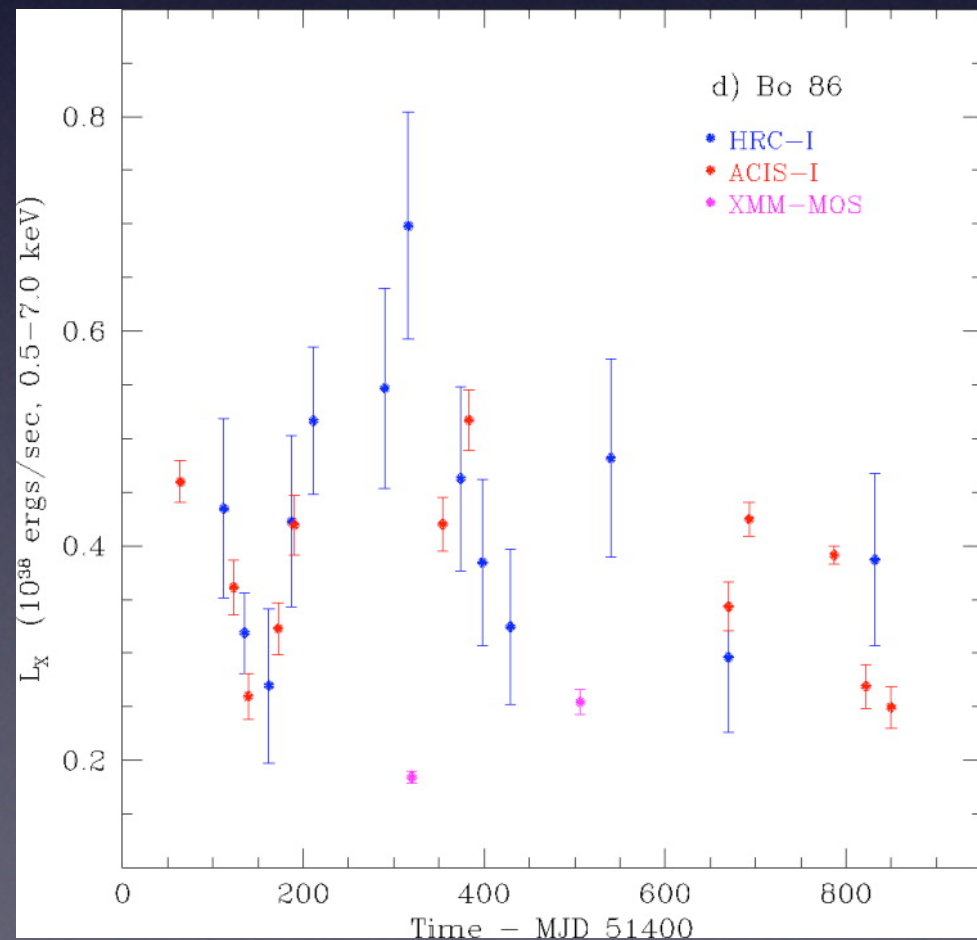
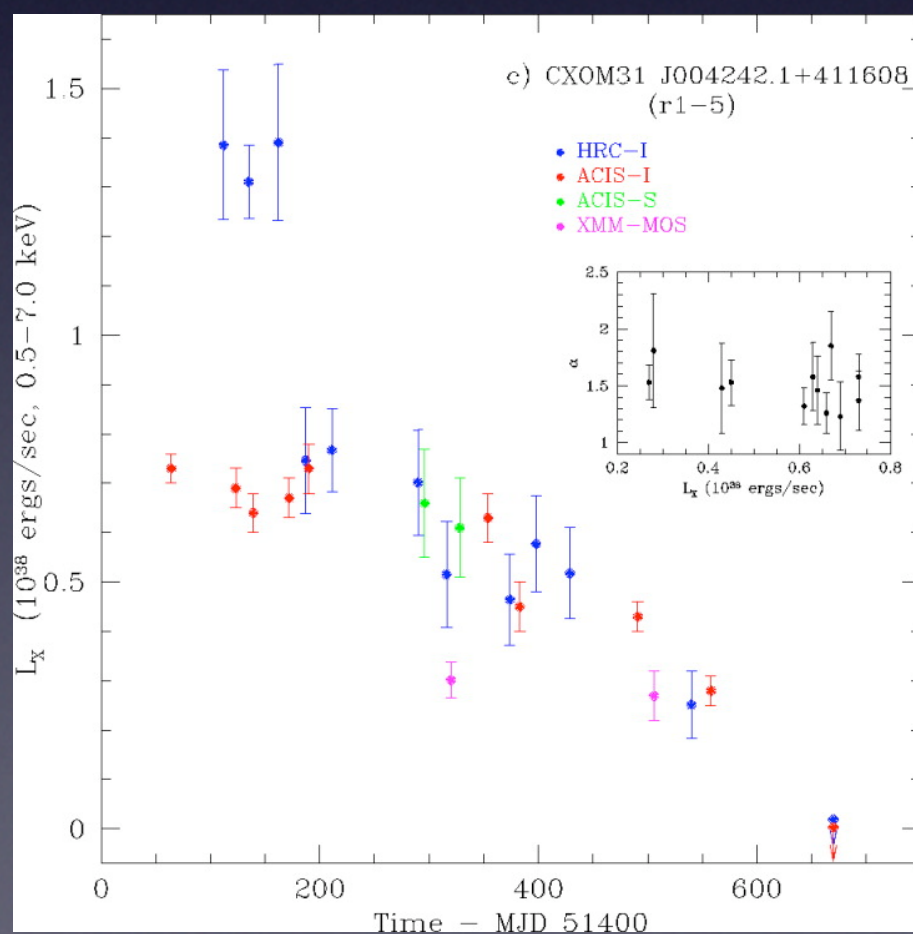
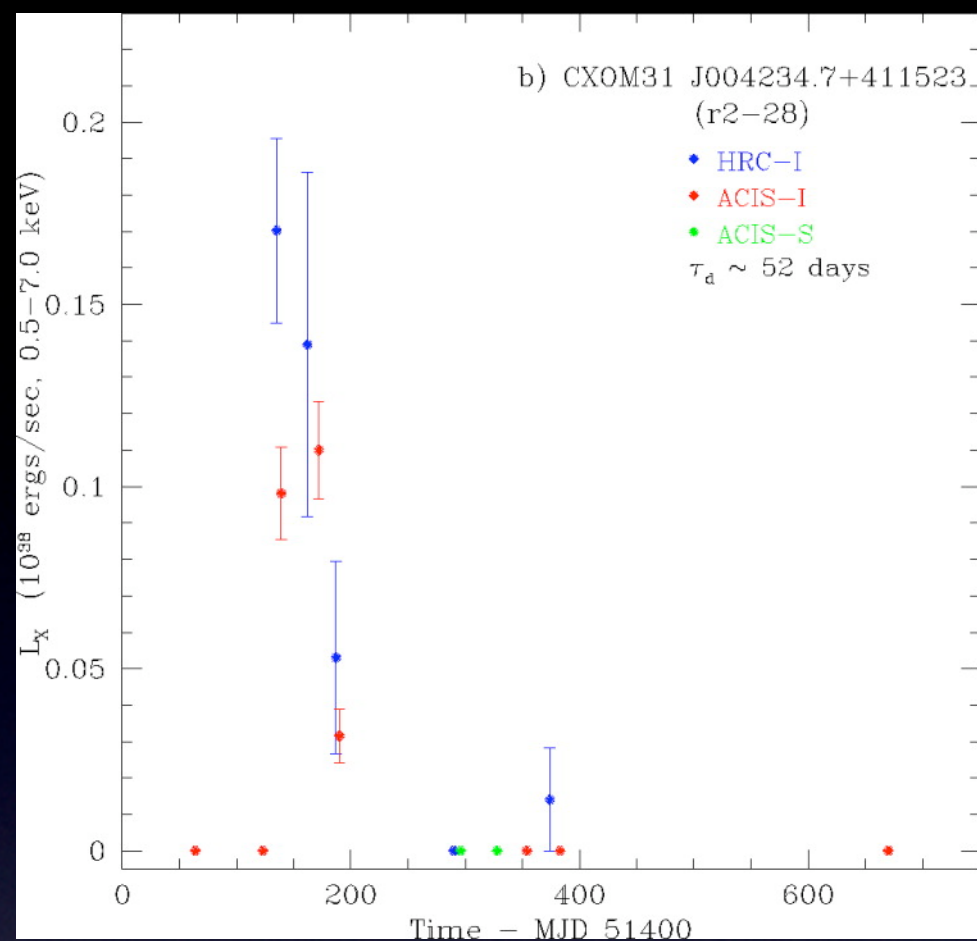
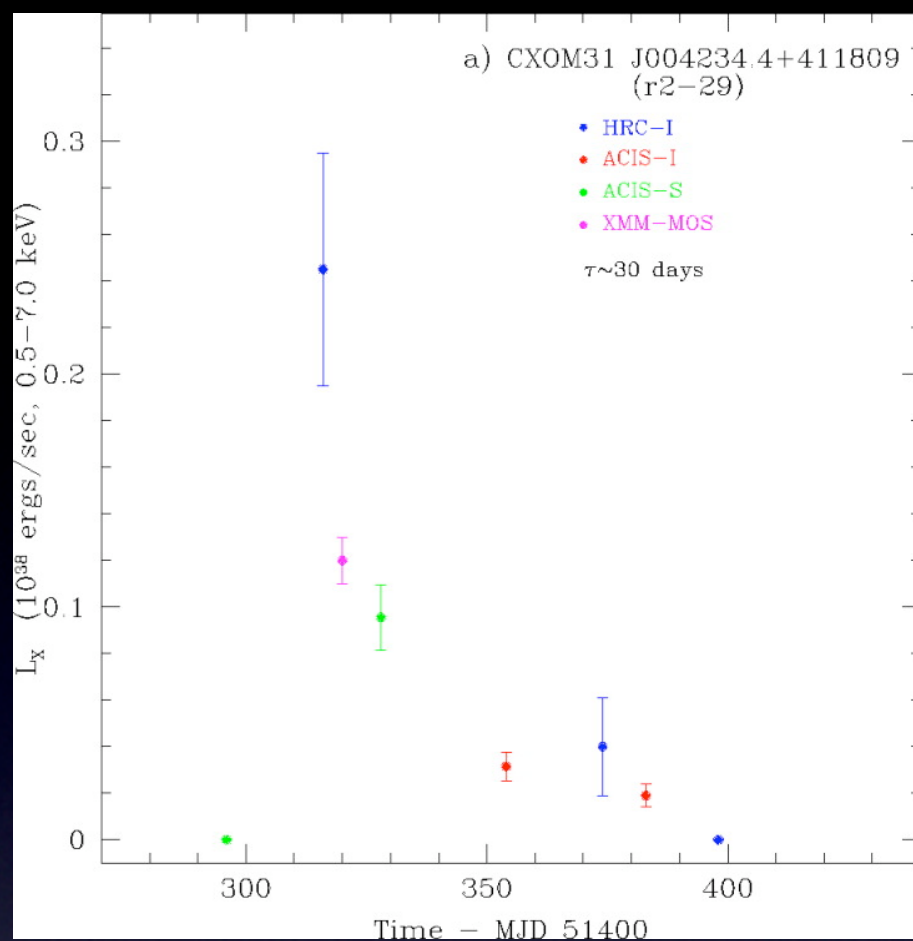
X-ray

M31 in the Pre-Chandra Era

- First X-ray detection: 0.5-5 keV with a rocket-borne proportional counter in 1973 (Bowyer+ 1974).
- Uhuru (Forman+ 1978)
- Einstein (van Speybroeck+ 1979)
- Ariel 5 (McHardy+ 1981)
- Ginga (Makishima+ 1989)
- ROSAT (Primini+ 1993; Supper+ 1997,2001)
- EXOSAT (Garcia+ 1997)
- BeppoSAX (Trinchueri+ 1999)
- ASCA (Takahashi+ 2001)
- RXTE (XTE All-Sky Slew Survey Catalog)

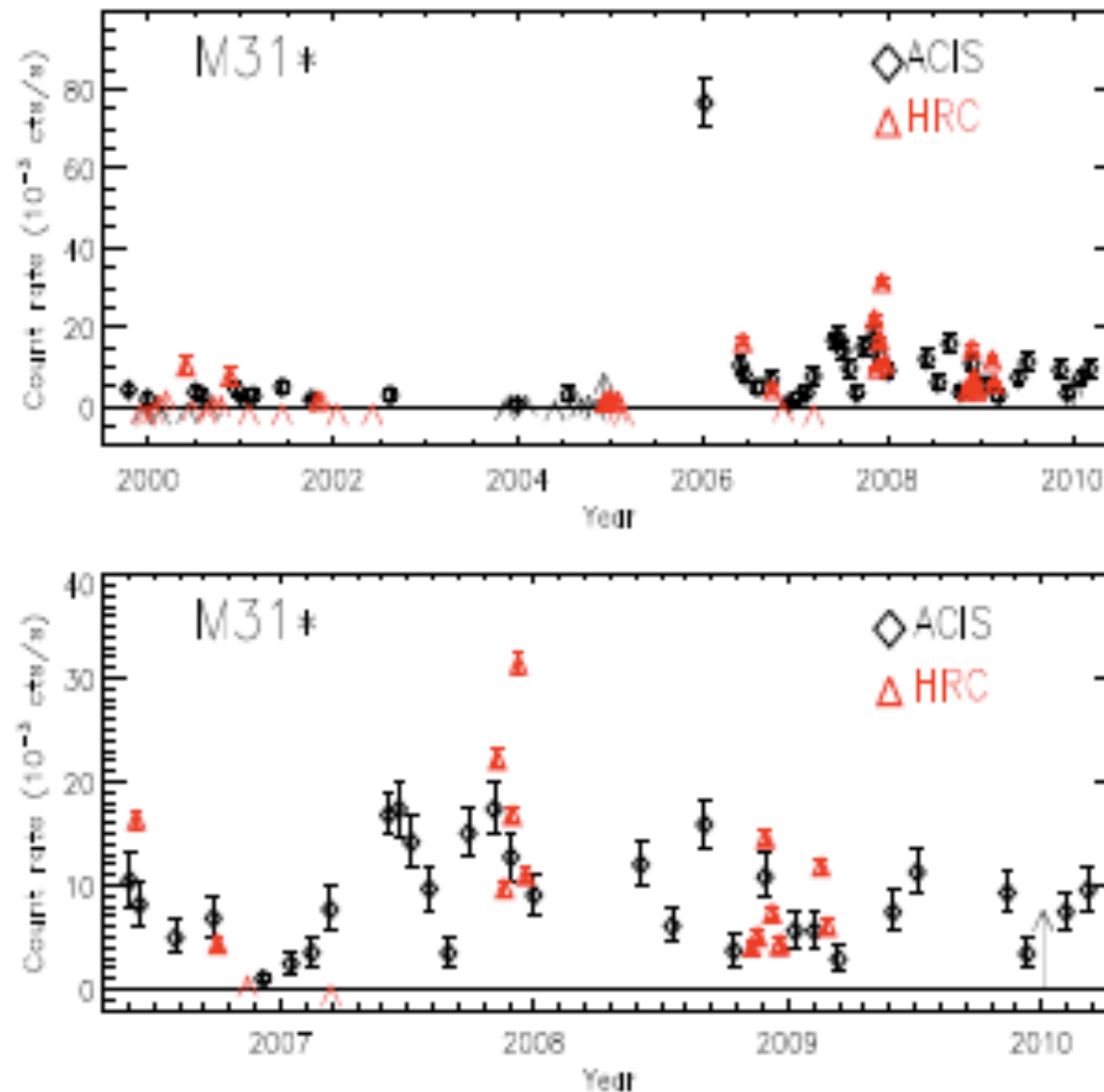
M31 in the Chandra Era

- 63 ACIS-I observations (305 ks)
 - 4 ACIS-S observations (55 ks)
 - 42 HRC-I observations (630 ks)
 - Total: 990 ks (M31 core only)
-
- XMM-Newton (670 ks), Suzaku (100 ks), Swift (150 ks), Fermi, ~~Integral (400 ks)~~, MAXI?



Kong+ 2002
Williams+ 2006

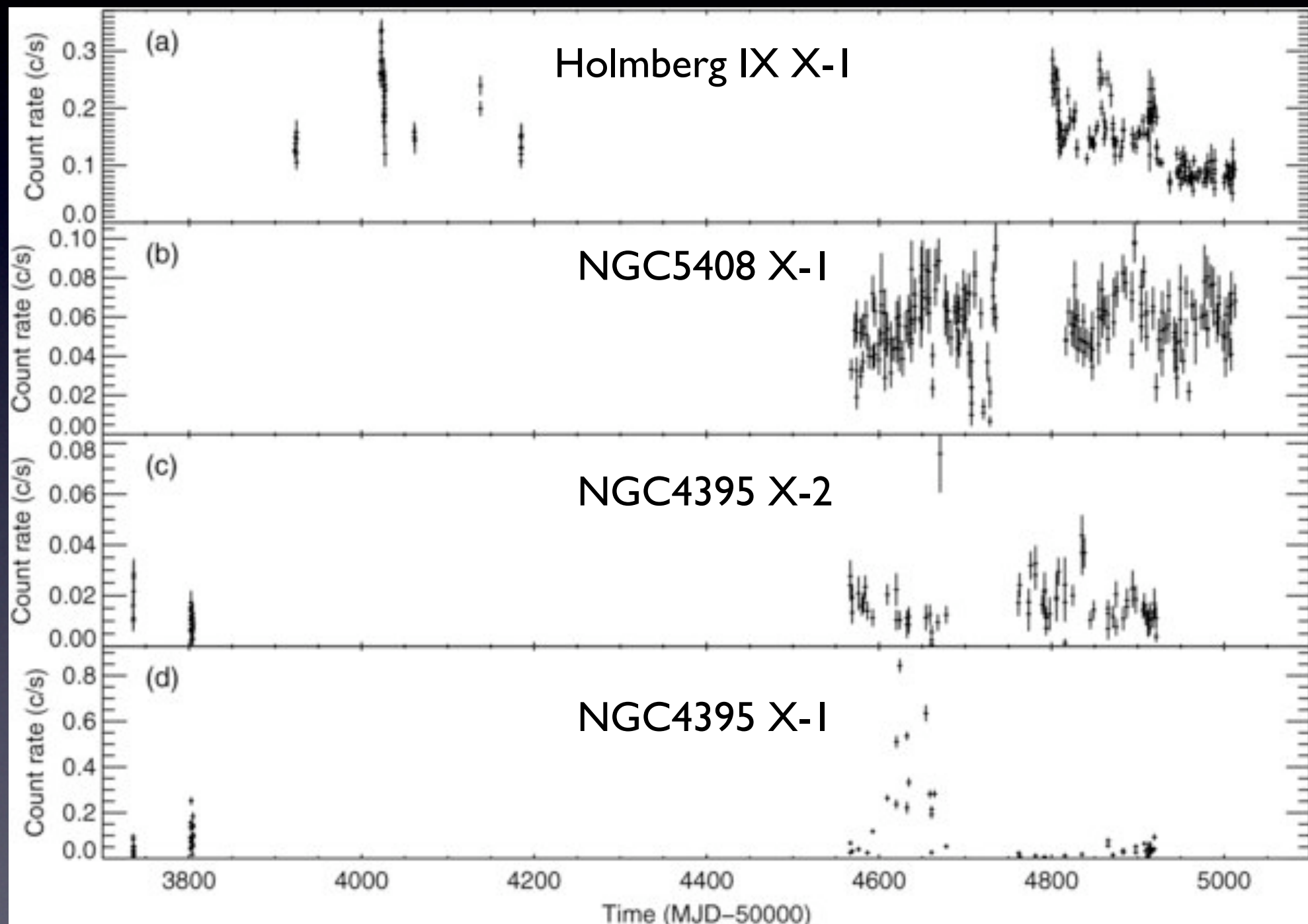
The supermassive blackhole of M31



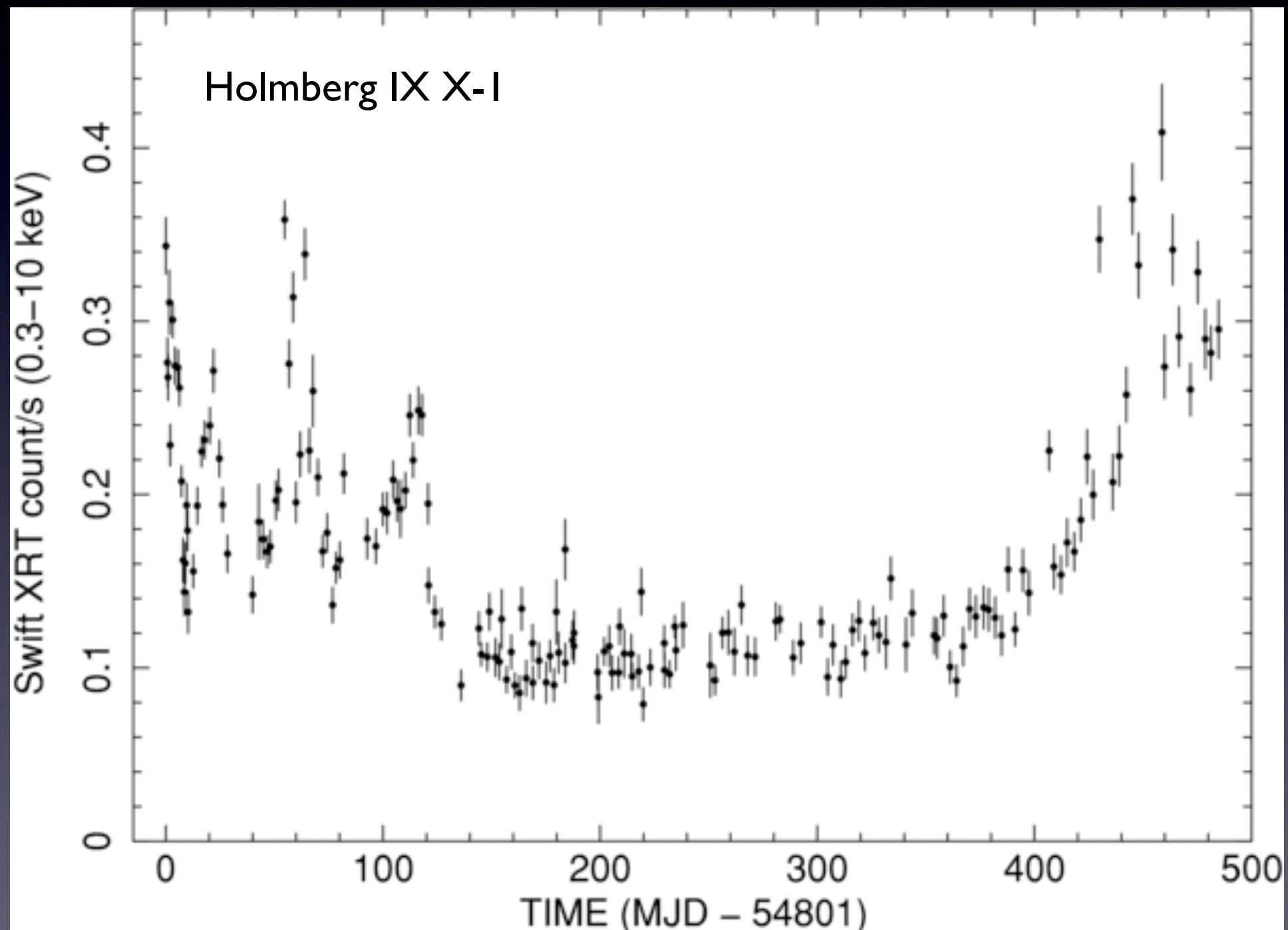
Swift Monitoring Observations of Ultraluminous X-ray Sources (ULXs)

- $L_x > 10^{40} \text{ erg s}^{-1}$
- Intermediate-mass black holes ($M > 100$ solar) or stellar-mass black holes?
- Before a dynamical mass measurement, X-ray observations are the only promising way to reveal their nature (e.g., Farrell+ 2009).
- Although Chandra and XMM have observed a few ULXs regularly, only Swift “monitors” nearby galaxies in a frequent basis.

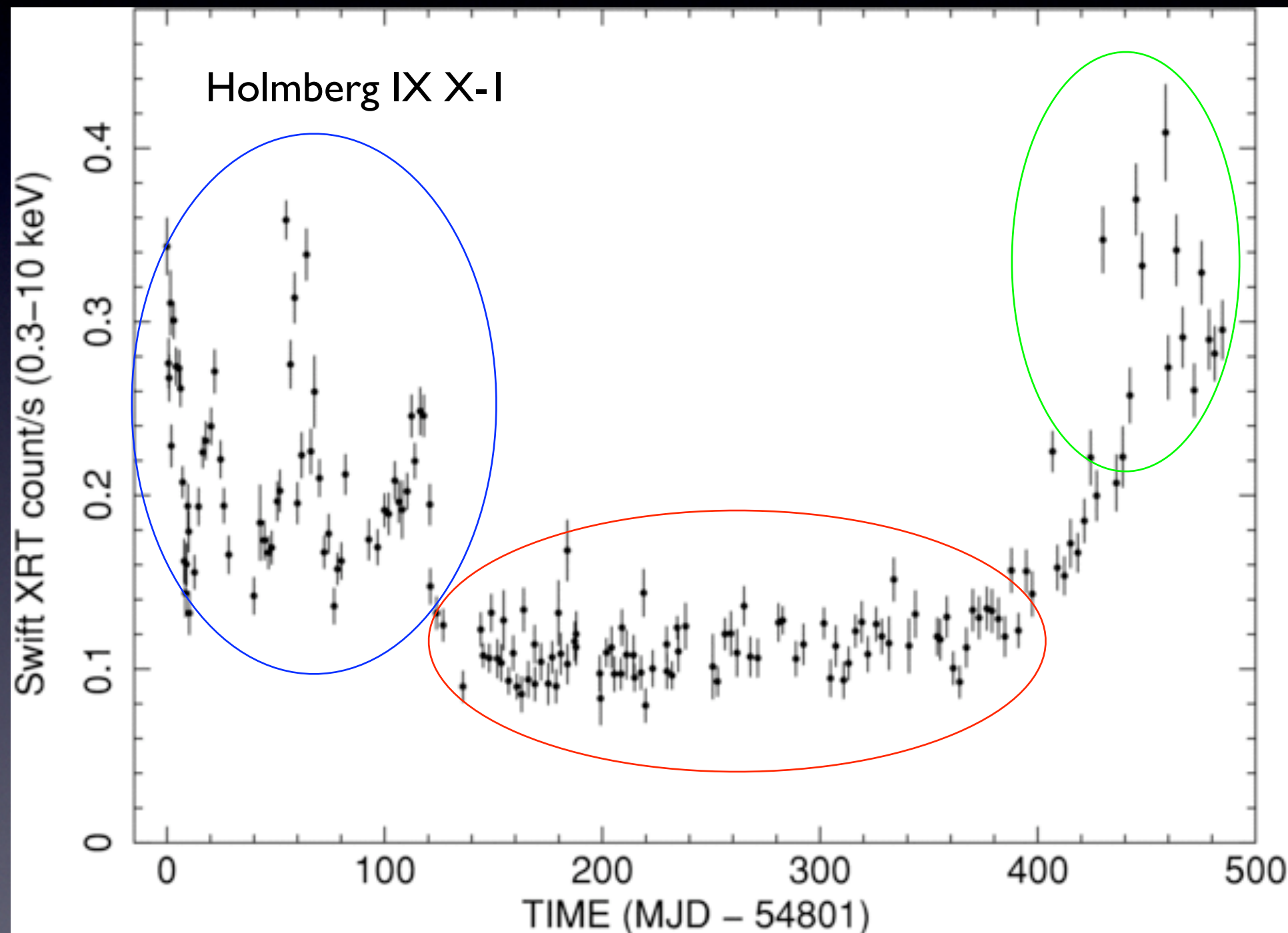
Swift Monitoring Observations of Ultraluminous X-ray Sources (ULXs)



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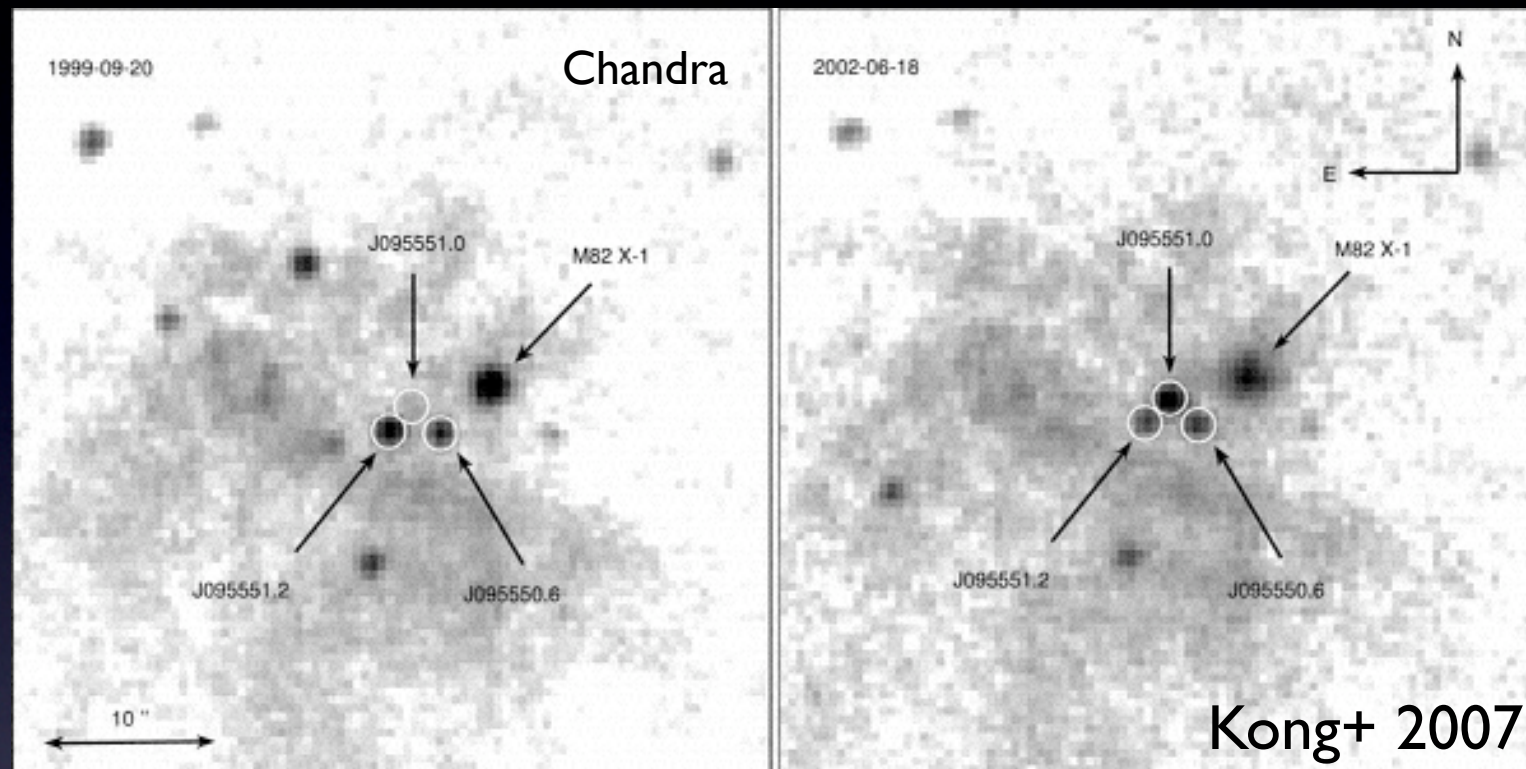


Swift Monitoring Observations of Ultraluminous X-ray Sources (ULXs)

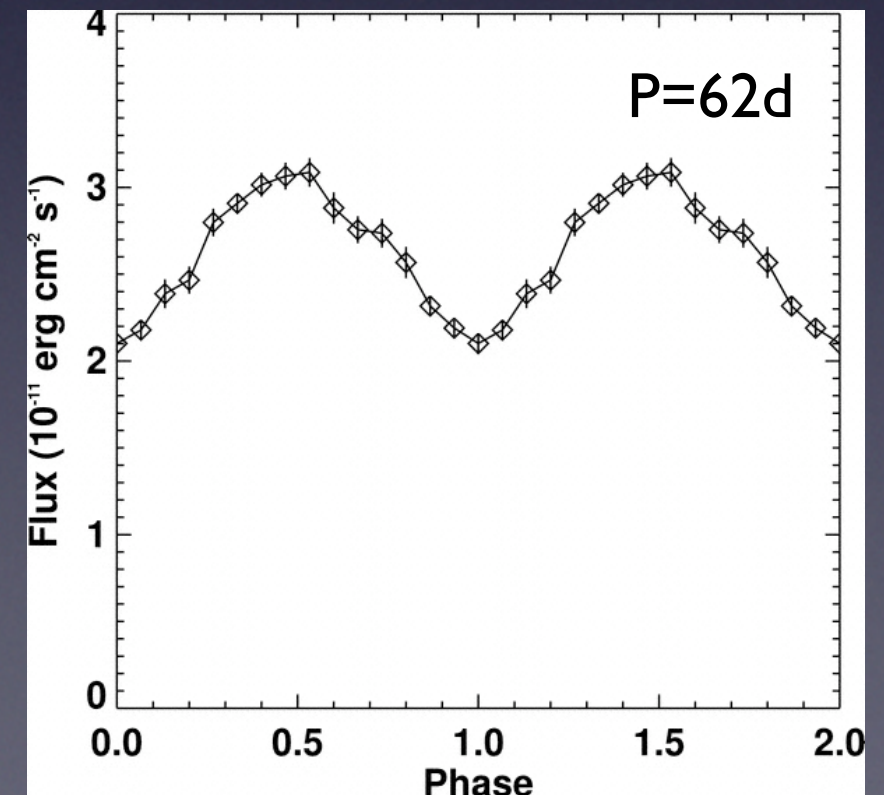
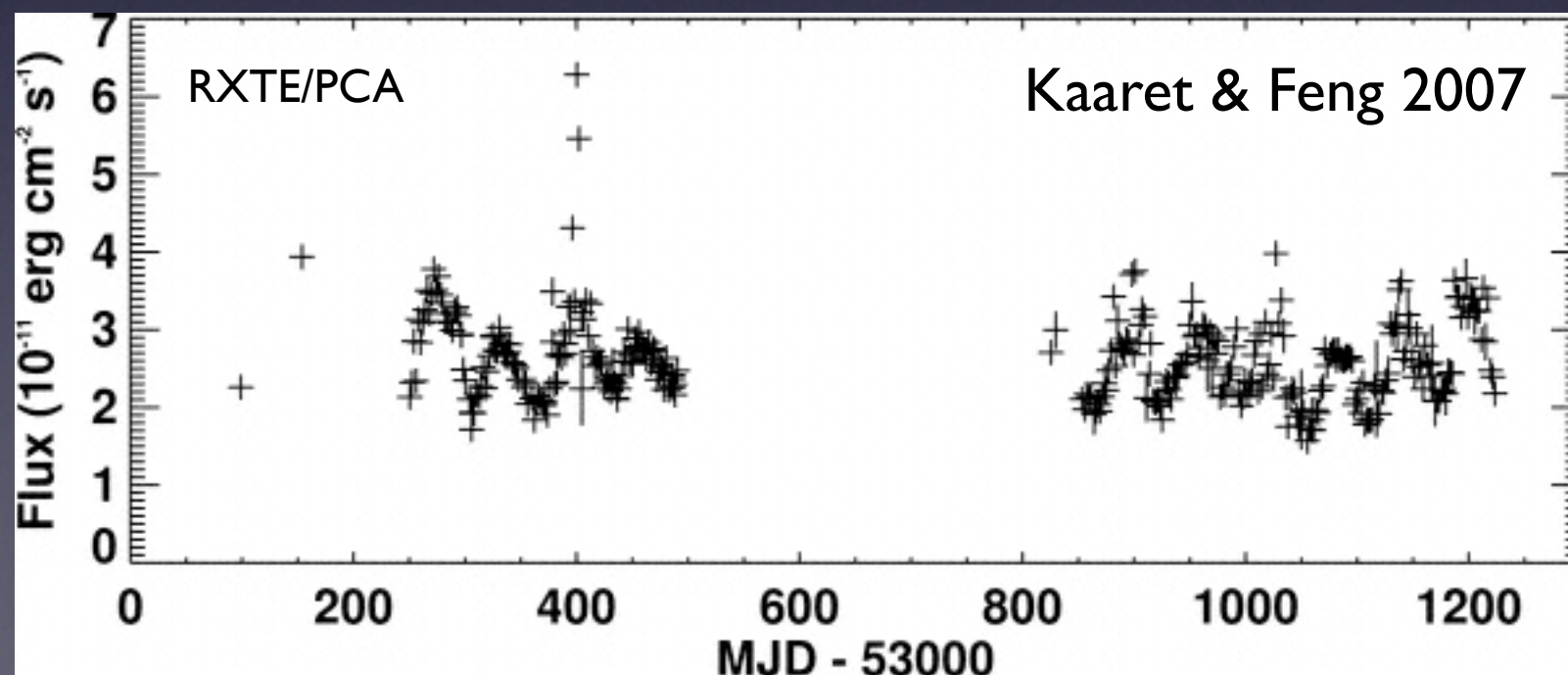


- Substantial variability is seen
- Subtle spectral variation is evident (see also poster P-12)

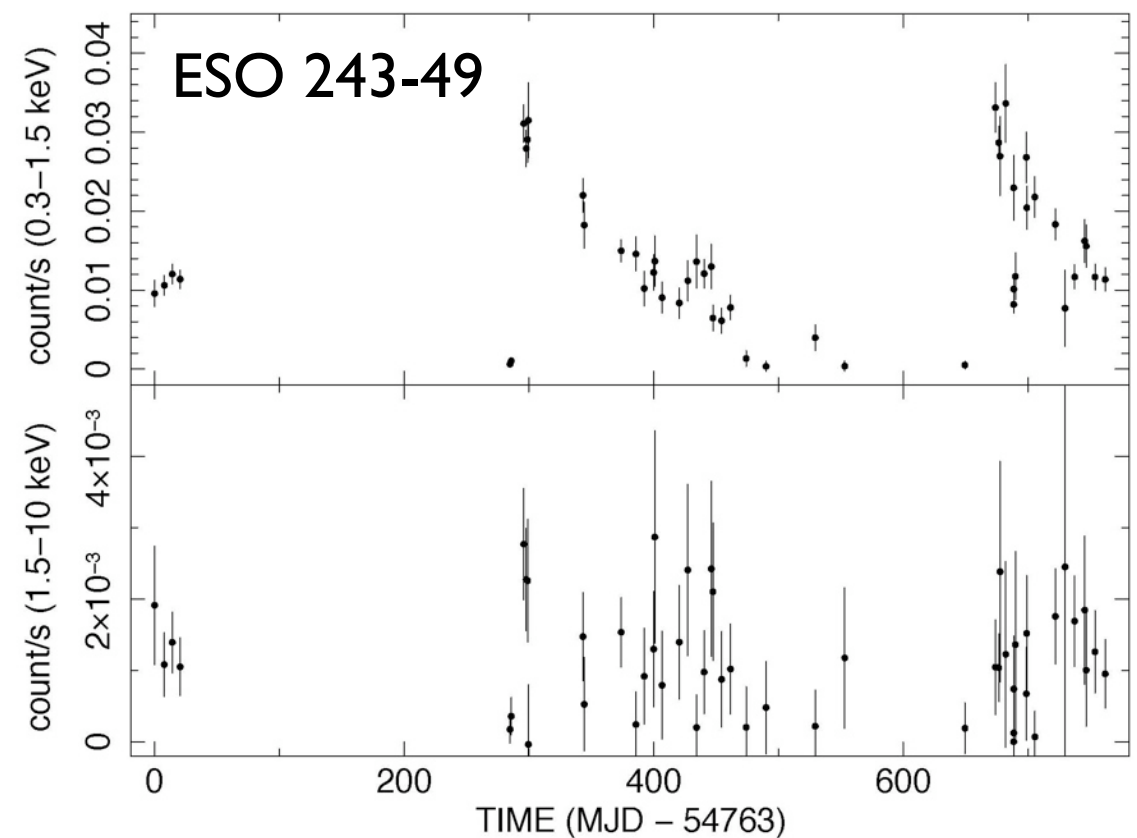
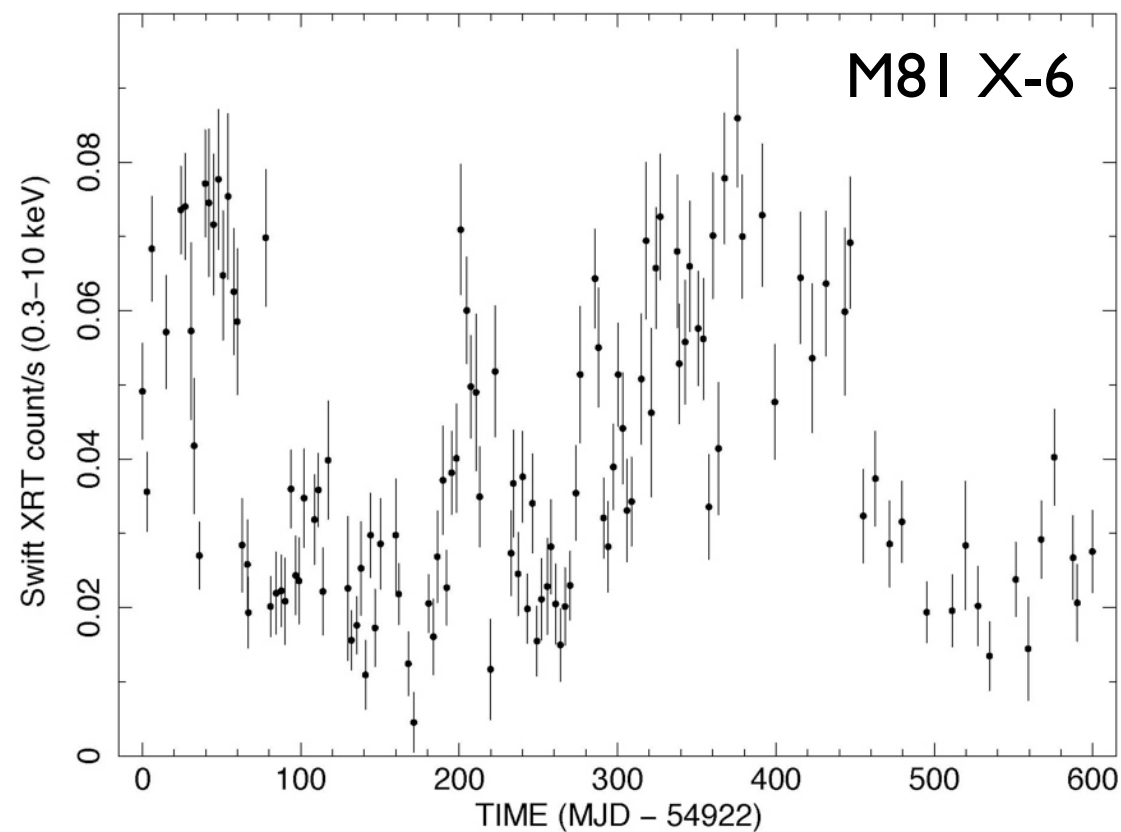
Monitoring Observations of Ultraluminous X-ray Sources (ULXs)



- M82 X-1
- $L_x \sim 10^{41} \text{ erg s}^{-1}$
- A 62-day periodicity found with RXTE indicates that it may be the orbital period



Swift Monitoring Observations of Ultraluminous X-ray Sources (ULXs)

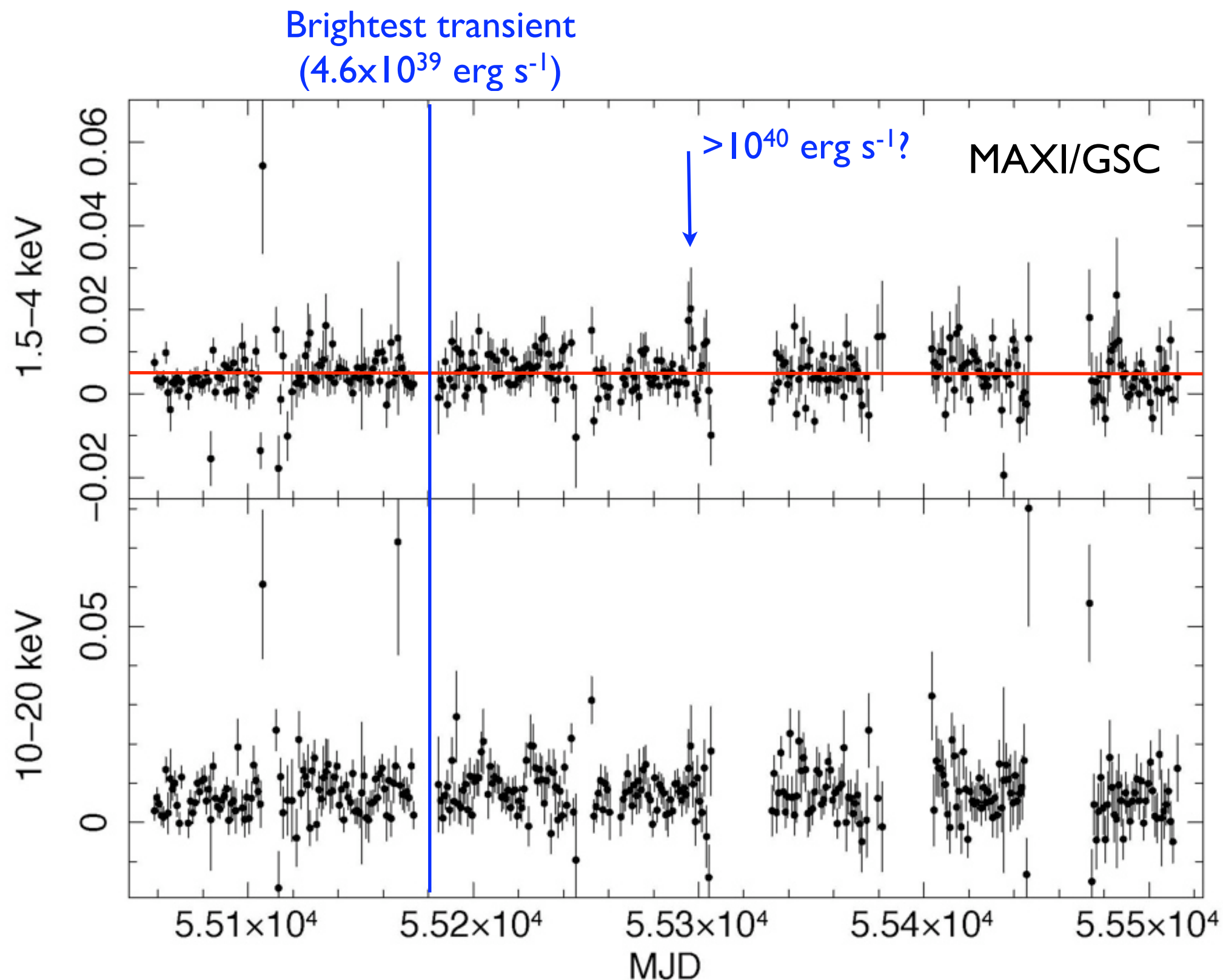


ESO 243-49: $L_x > 10^{42} \text{ erg s}^{-1}$
>500 solar-mass BH

Ultraluminous Transients in M31 with MAXI?

- Average M31 2-20 keV flux: ~ 2 mCrab (5×10^{39} erg s $^{-1}$)
- MAXI should detect M31 with 1-week data
- The brightest X-ray transient in M31: 4.6×10^{39} erg s $^{-1}$ (ATel 2356)

Ultraluminous Transients in M31 with MAXI?



M31 in the Chandra Era:

A High Definition Movie of a Nearby Galaxy

