SDSS J1201+30
a tidal disruption candidate

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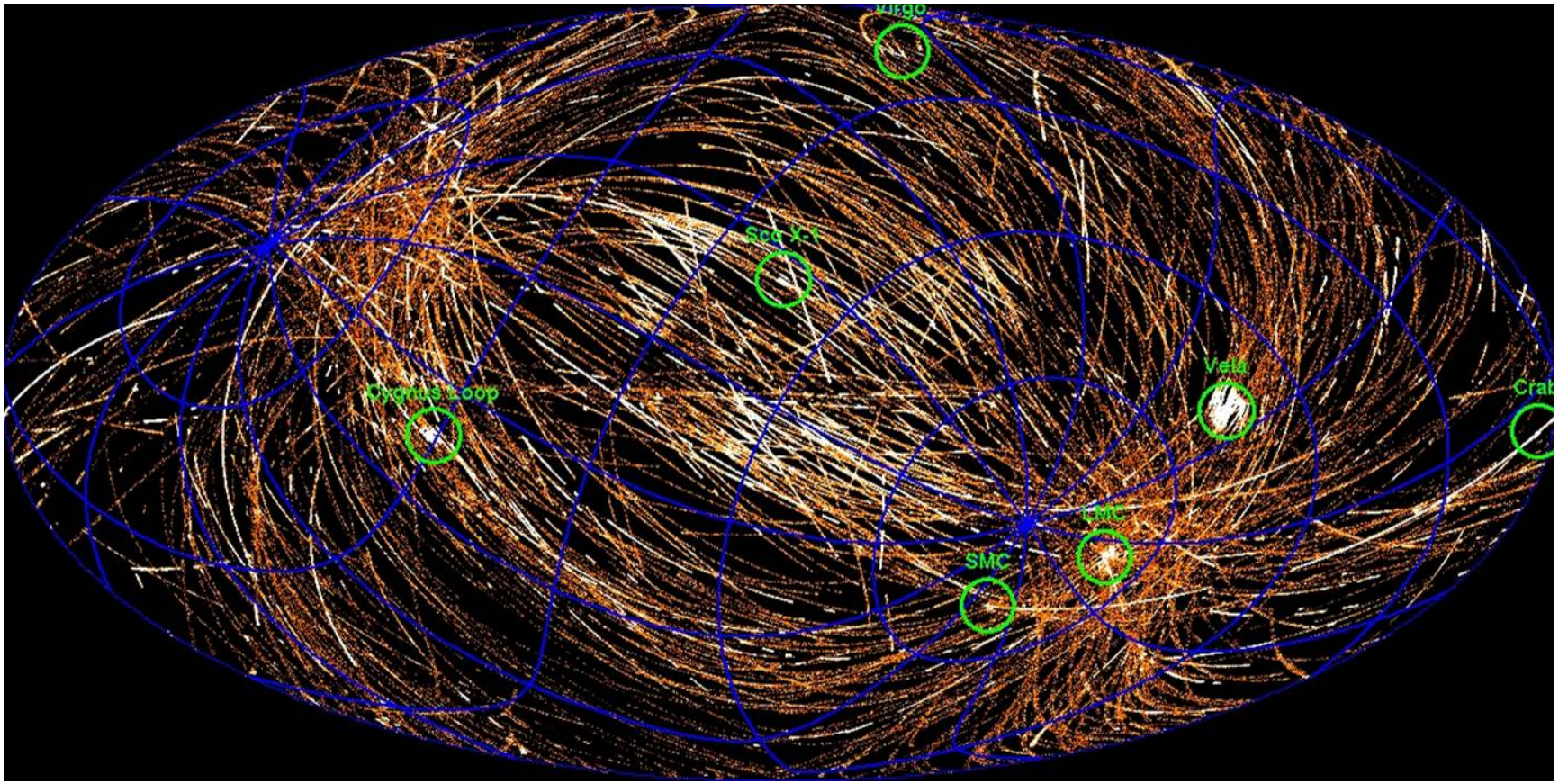
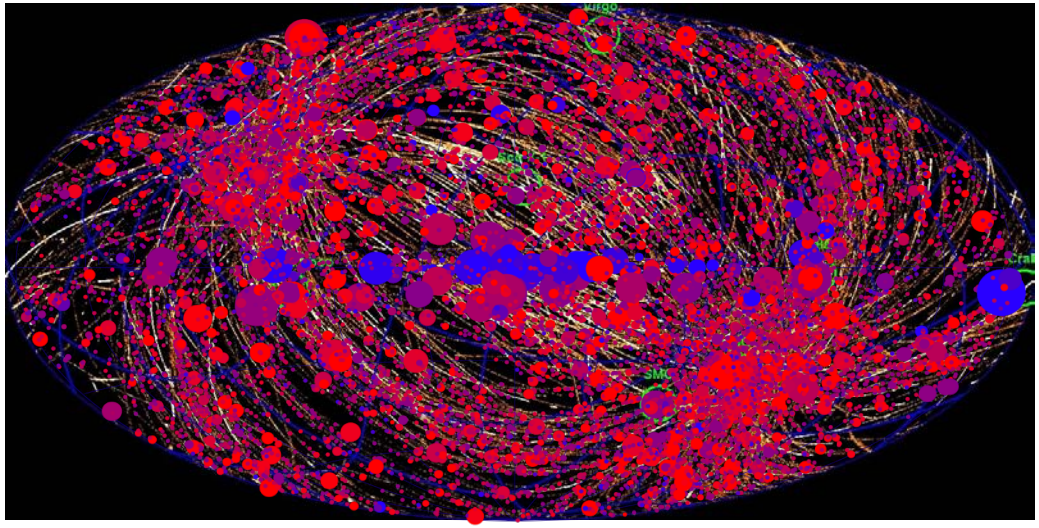
XMM-Newton slew survey



Searching for flares

XMM
Slew survey

1-11 seconds
exposure time



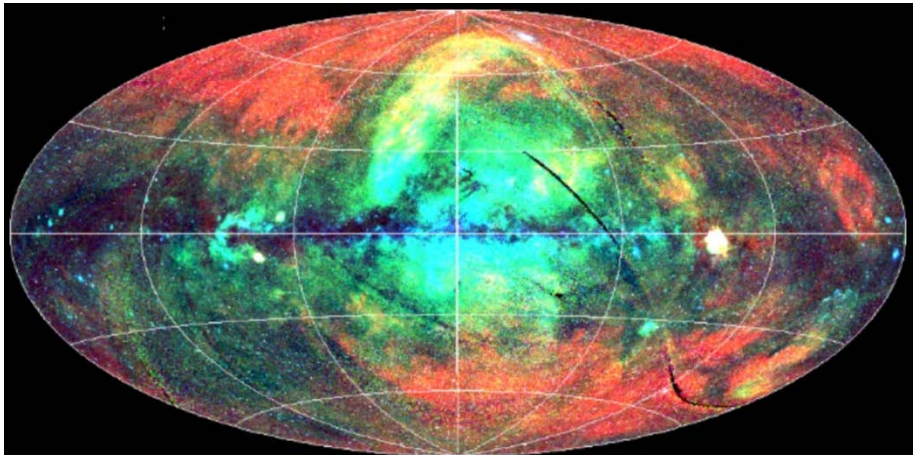
4000 deg^2 / year

Currently 55% of sky.

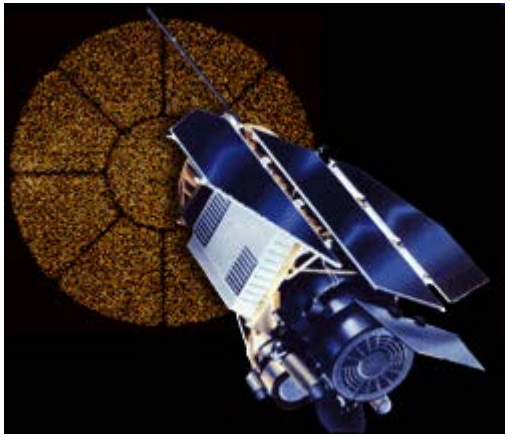
$F_{0.2\text{-}2}$>6x10^{-13} cgs

$F_{2\text{-}10}$>4x10^{-12} cgs

and compare with…..

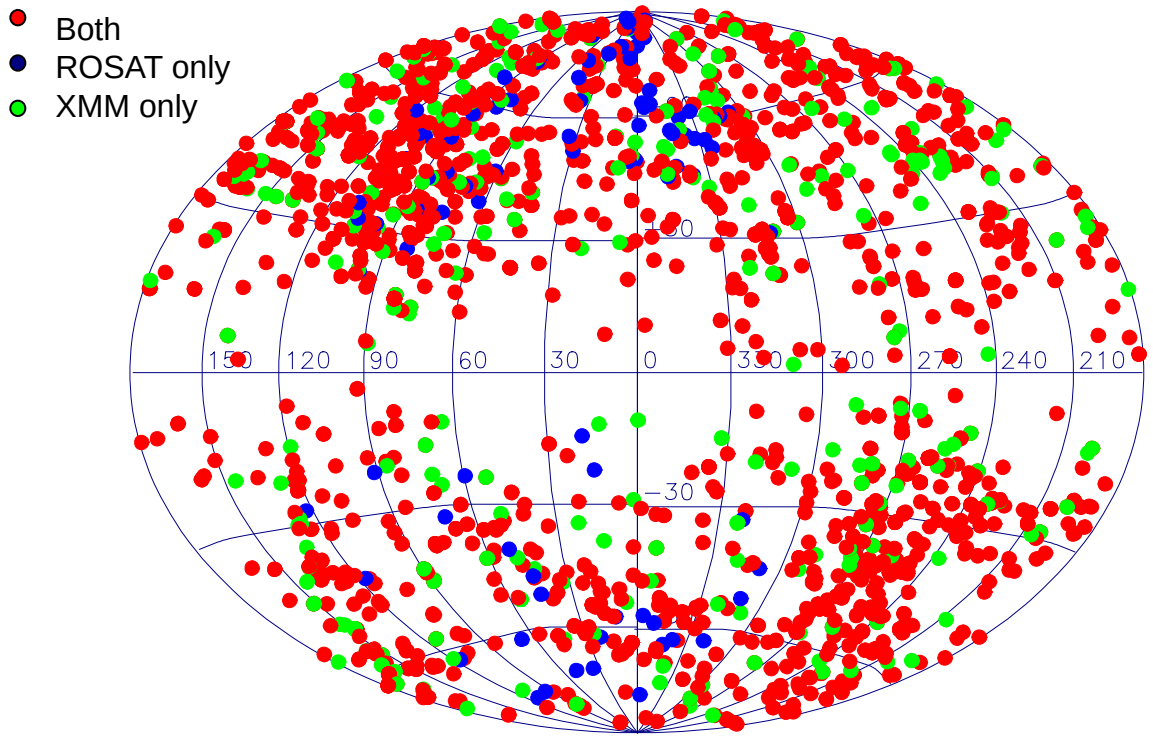


Full sky in 1990 / $F_{0.2\text{-}2}$>3x10^{-13} cgs



25% of sky from1990-1998

AGN combination

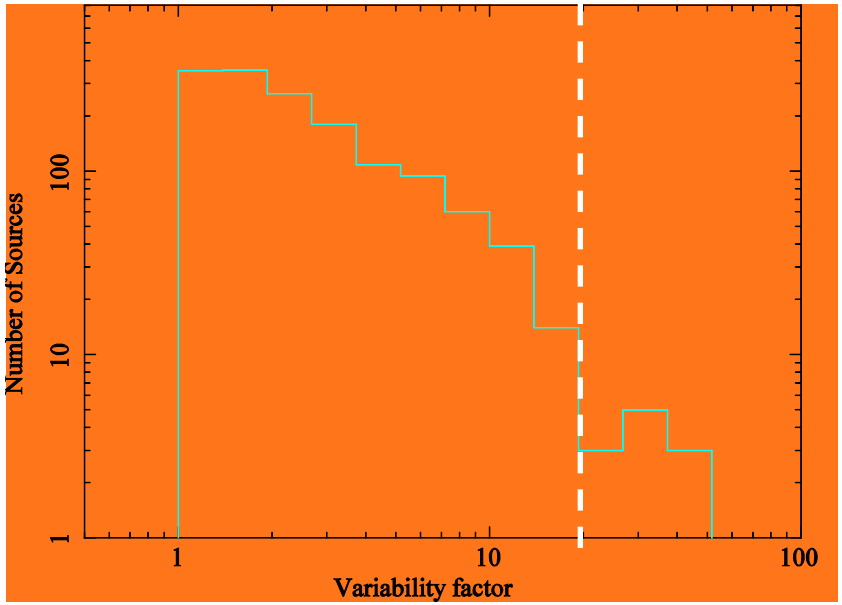


Overlap with 2000 galaxies with a detection in both instruments or detection in one and a useful upper limit in the other.

Compare flux over a baseline of 3 – 21 years (mostly 11-21 years)

Fast TD detection strategy

- Source search XMM slew data and compare with RASS within 10 days
- Look for extragalactic sources varying by >20x
- Is it a known AGN from catalogues, existing optical spectra ?
- If not then initiate monitoring with SWIFT
- Take optical spectrum
- Start triggered TOO program with XMM

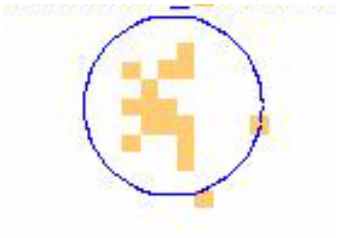


Most AGN consistent within factor 3

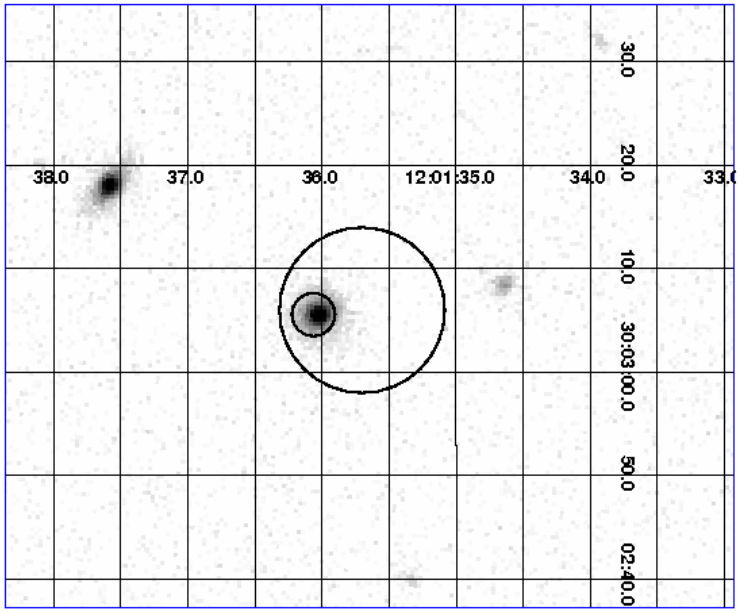
5% of AGN vary by >10 and
only 1% by factor >20

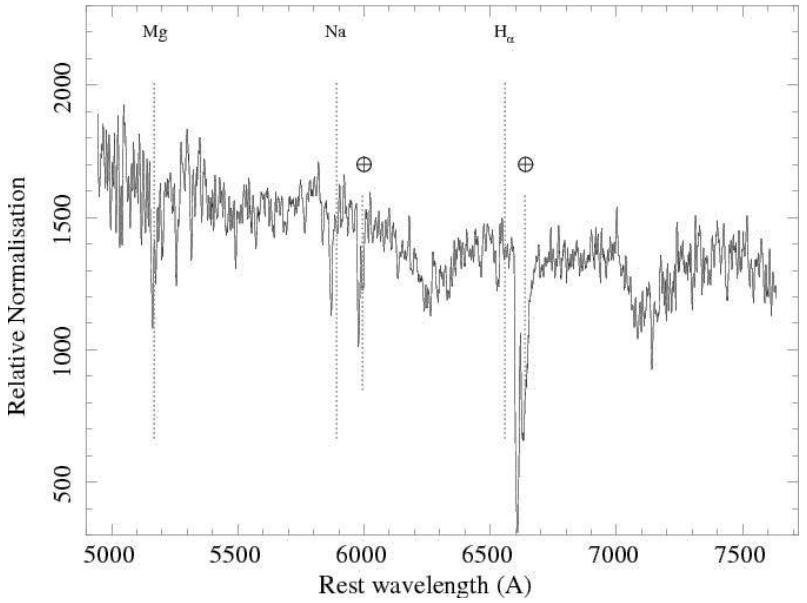
SDSS J120136+300305: discovered 10th June 2010

- Bright slew source in a SDSS galaxy (19 photons)
- 56x brighter than RASS upper limit.
- Soft X-ray spectrum
- $L_x = 3 \times 10^{44}$ ergs/s (z=0.146)
- Optical spectrum shows no emission lines ($L_{bol} < 3 \times 10^{41}$ ergs/s)



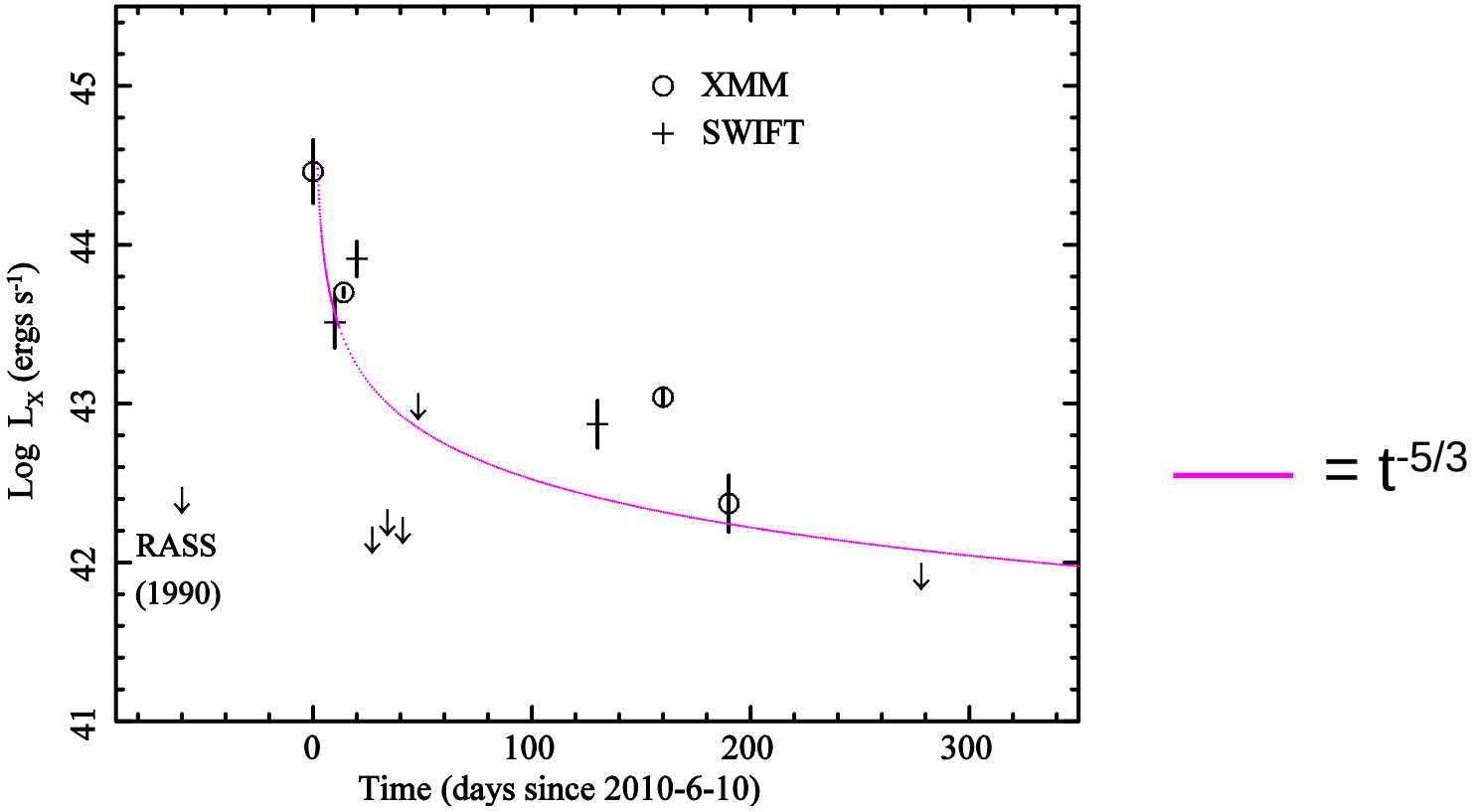
Slew – total band





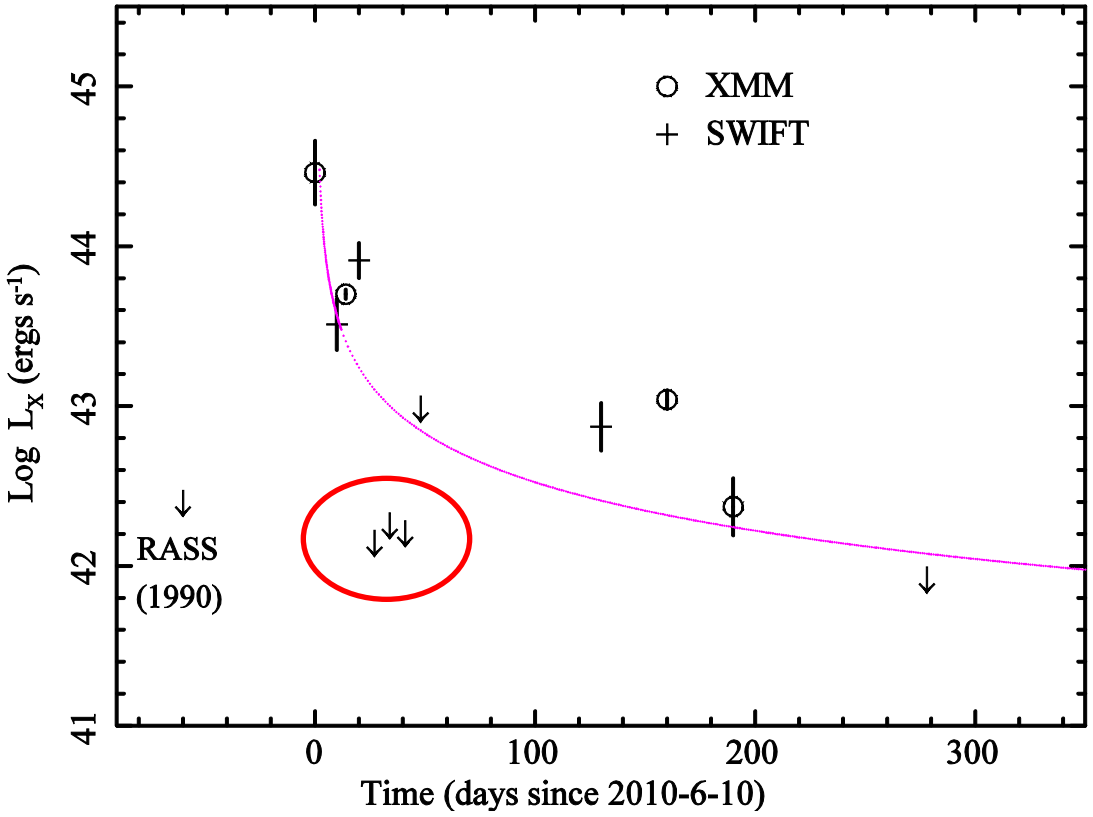
Calar-Alto – June 22

SDSS1201+30: light curve



Monitoring started 10 days after the XMM slew, every week by SWIFT and a long-look initially and then again after six months by XMM.

SDSS1201+30: light curve

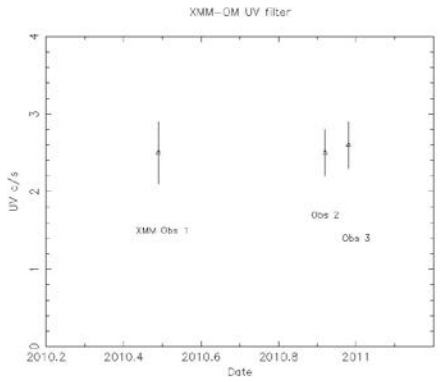


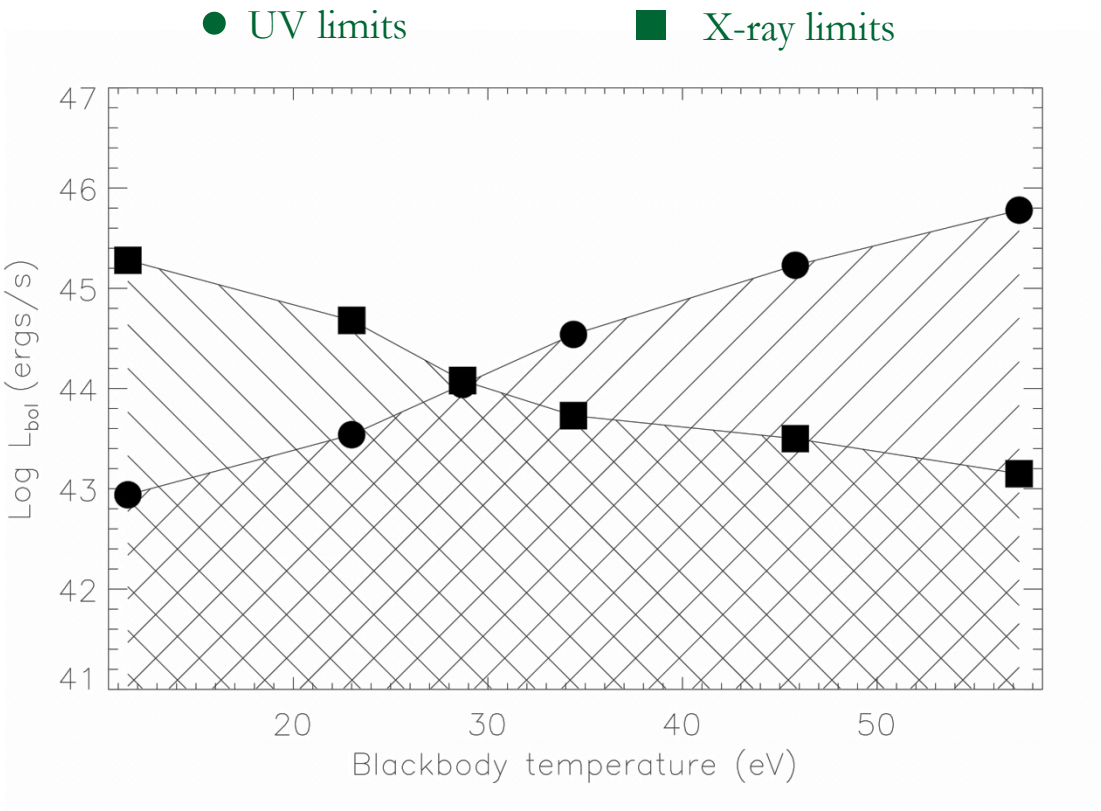
>50x drop in flux in 1 week

? Absorption
? Jet instabilities
? Clumpy accretion

Absorption in wind? : black-body emission

Strubbe & Quataert, 2009, 2011 :
Dense accretion, $L>L_{edd}$ -> outflows -> variable absorption.

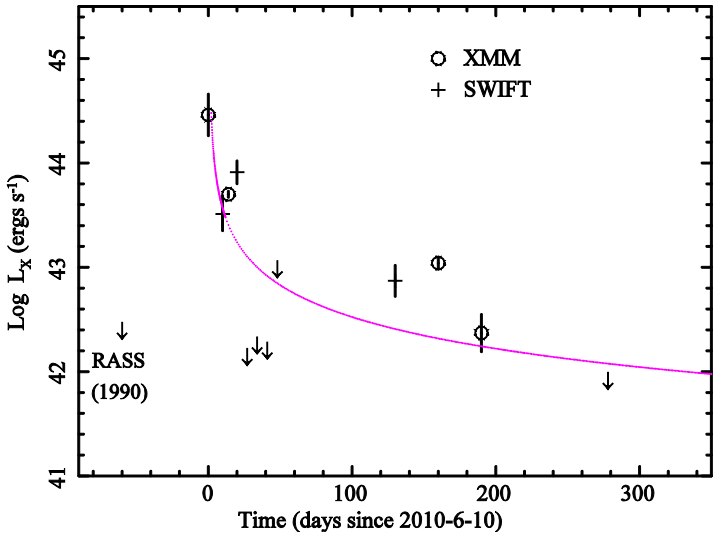




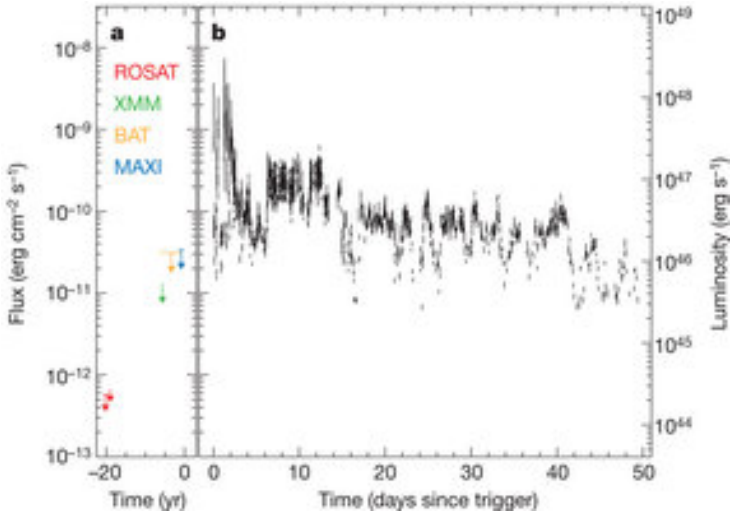
UV doesn't vary. Combined with broad X-ray spectrum can constrain any optically thick Black-body emission to $L<10^{44}$ ergs/s. Expanding shell should radiate at ~10^{45} ergs/s, hence unlikely that absorption is in an expelled wind.

Jet instabilities? : radio emission

1201+30



Swift 1644+57

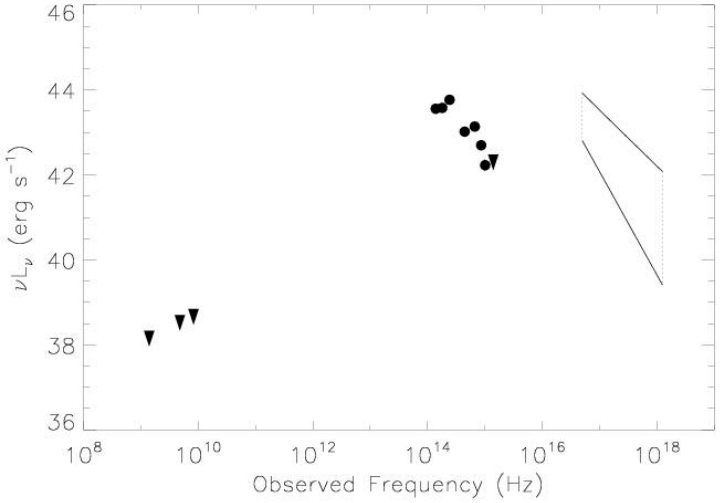


eVLA snapshot taken after 15 months

1.4 GHz < 201 uJy

4.8 GHz < 135 uJy

8.3 GHz < 108 uJy

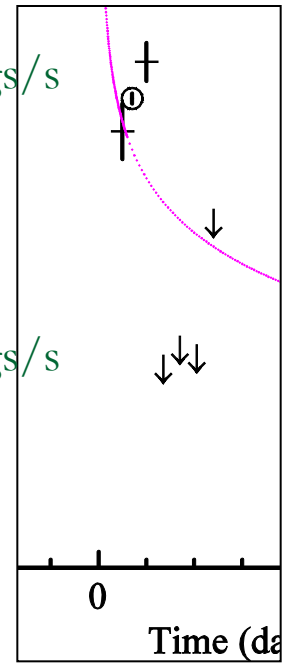


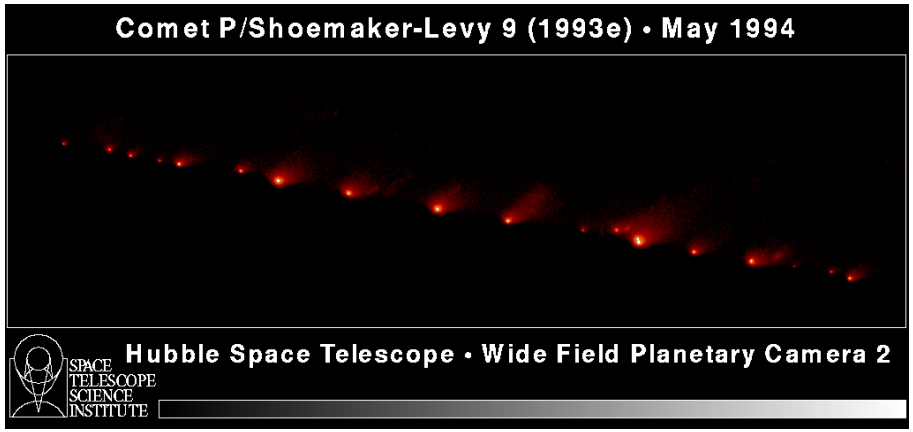
No radio – no jet – no after-glow

Clumpy Accretion ?

L_{bol} ~3×10^{44} ergs/s

L_{bol} <6×10^{42} ergs/s





Time to consume material from a debris disk, $T = 180\ M_7\ \dot{m}_{0.1}^{-2}\ r_{10}^{7/2}$ days

(Wang, Cheng & Li 2012; $r_{10} = 10 R_S$)

With L_{bol} ~3×10^{44} ergs/s …..

M_{BH}

M_{BH}<$2x10^7$ $m_\odot$ from L_K
(Marconi & Hunt 2003)

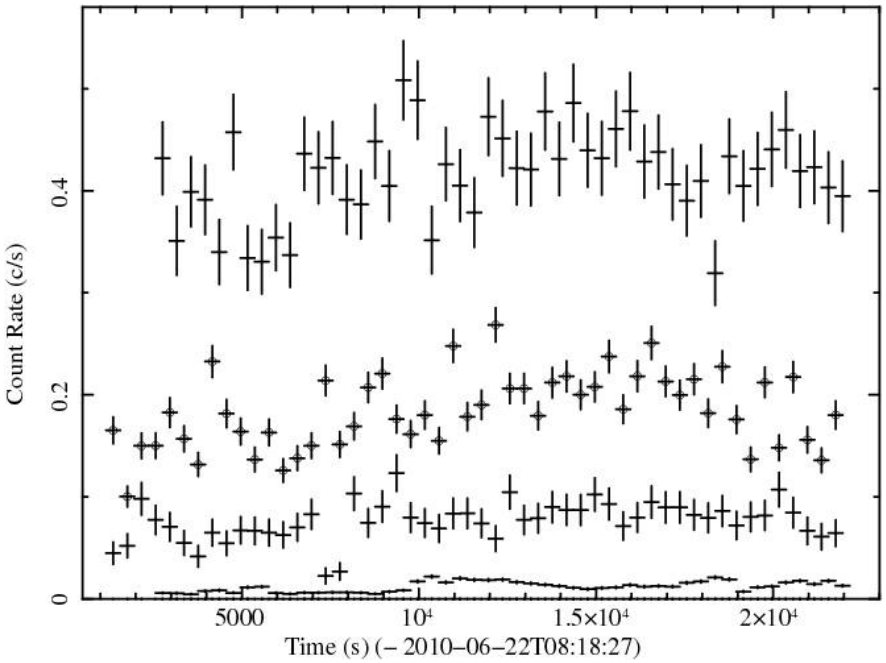
Galaxy morphology = circular

Lack of UV emission

Slow short-term variability (50% in 4ks)

All support a high(er) mass value

Say M_{BH}~10^7 $m_\odot$



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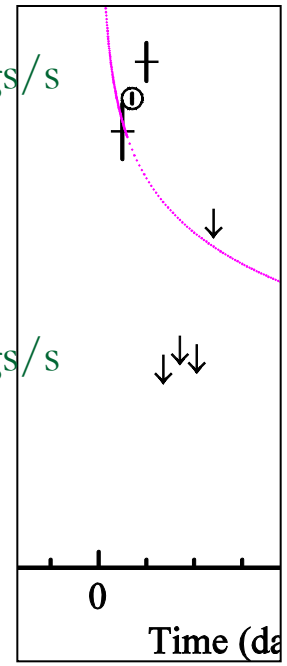

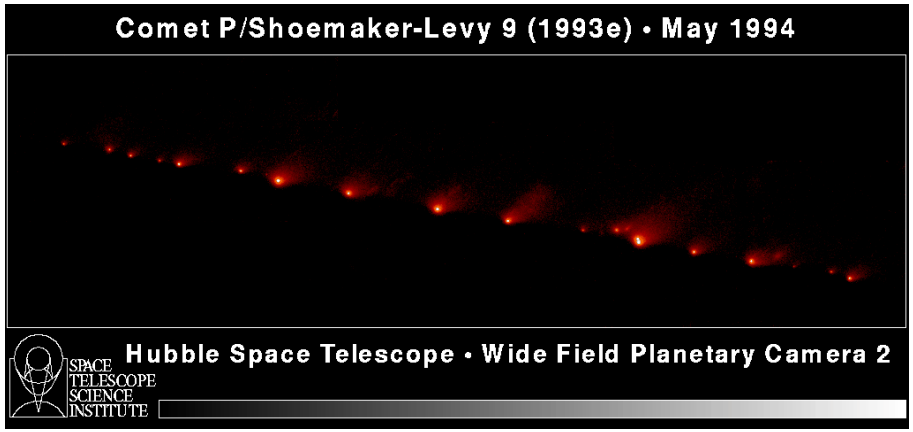

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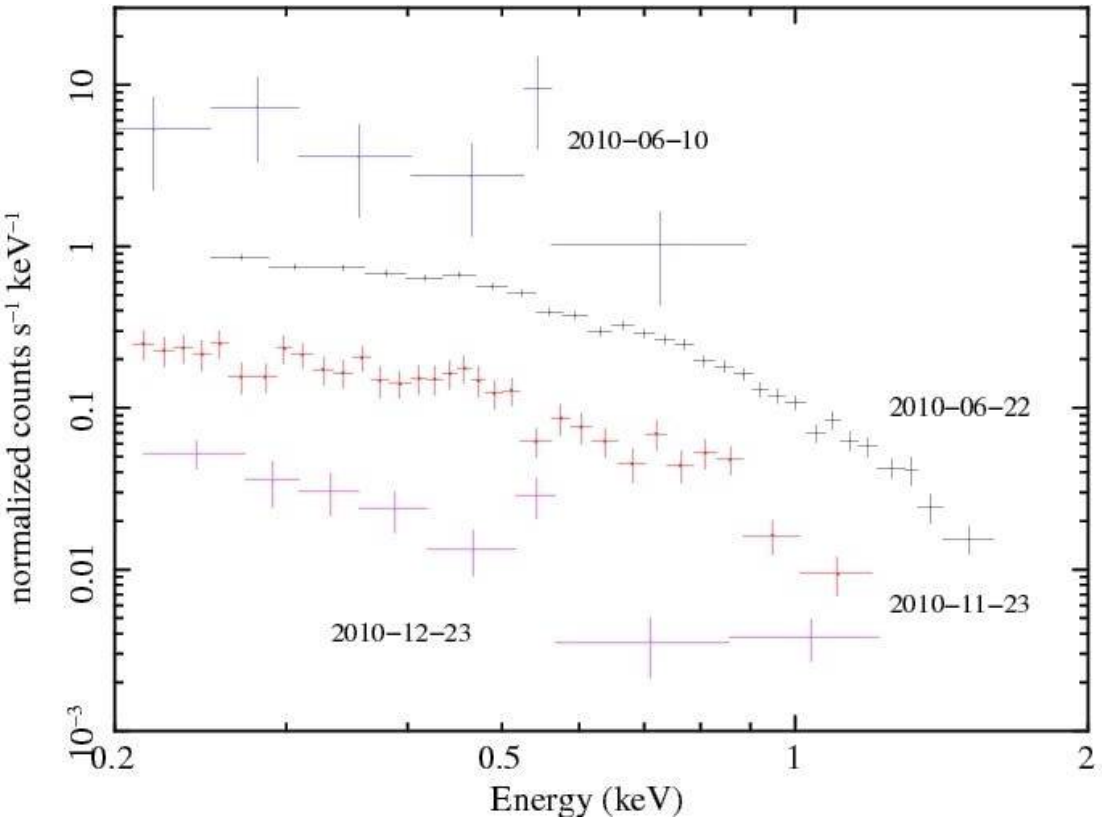
(Wang, Cheng & Li 2012; $r_{10}=10R_S$)

With L_{bol} ~$3x10^{44}$ ergs/s
if $M_{BH}=10^7$ - $\dot{m}=0.2$, and if $r=6R_S$ or if $M_{BH} = 5x10^6$

then T ~ 7 days

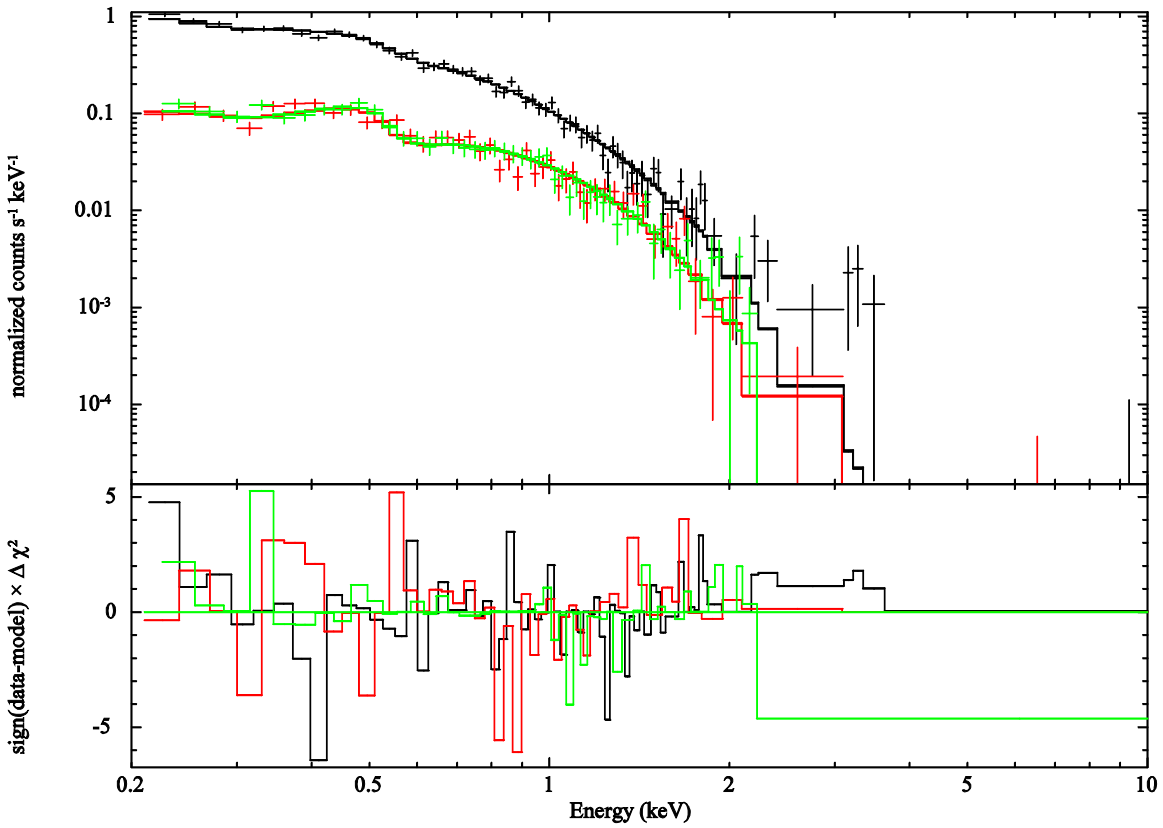
Possible in terms of material return ???

SDSS1201+30: Overall X-ray spectrum



Spectral shape remains broadly the same over the first 200 days

SDSS1201+30: XMM spectrum - t+12 days

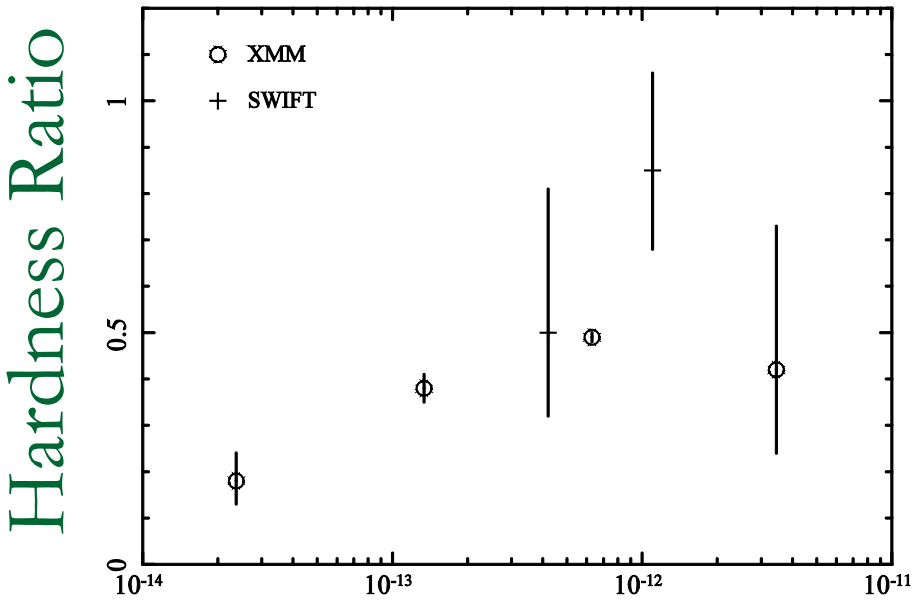


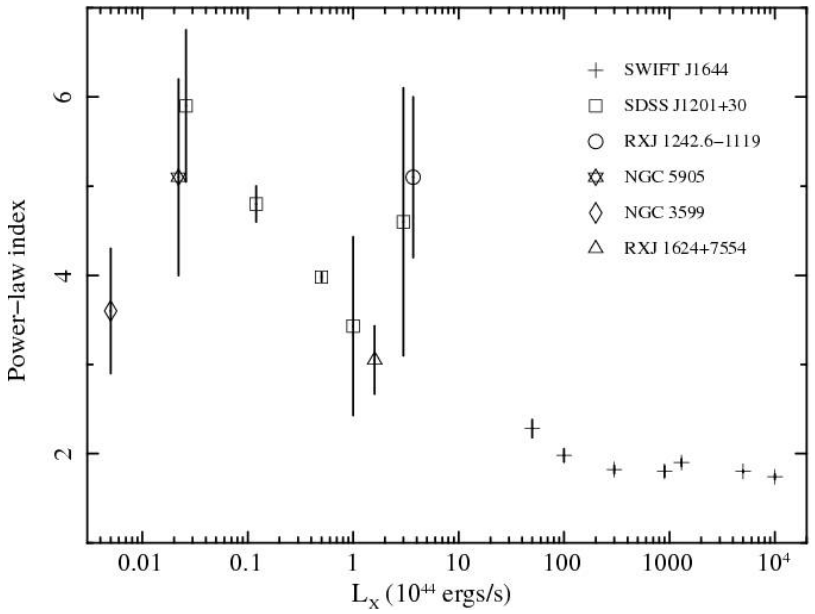
NOT optically thick multi-coloured black-body or comptonised black-body.

Soft- can fit with single Brem of 390 eV or bkn power-law

Partial thermalisation ?

SDSS1201+30: X-ray spectral evolution



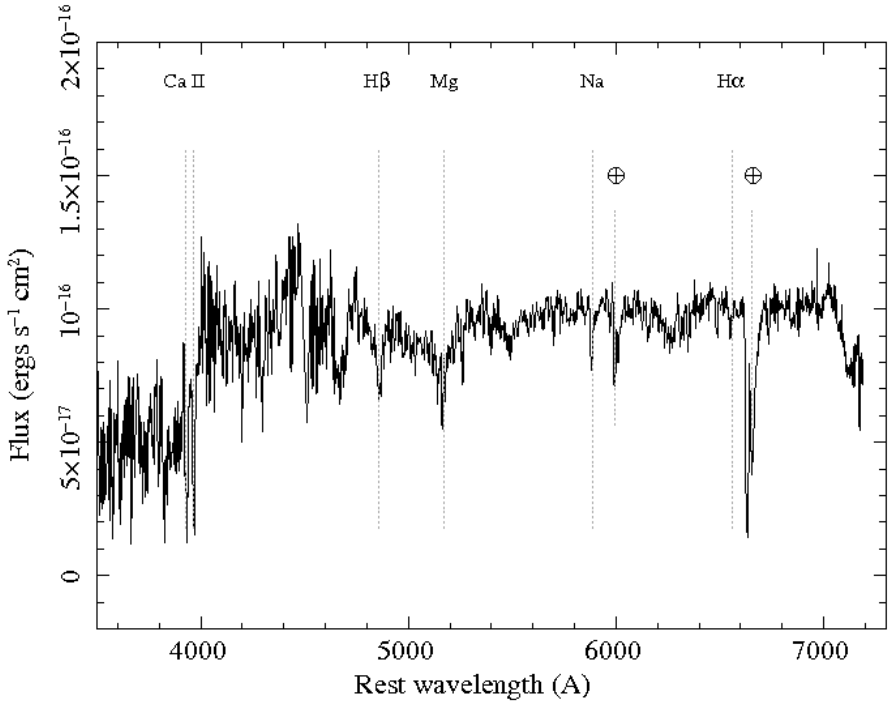


Softens with time / decreasing flux

Not expected for comptonisation from a forming accretion disk by high-energy electrons – will this come later ?

Spectral slopes for 1644+57, 1201+30 and other TDEs near peak emission

SDSS1201+30: Optical reverberation ?



Took second optical spectrum with WHT after 1 year
Still no induced lines – little CLR material ?

SDSS1201+30: Could it be an AGN ?

Theoretically, can AGN ?

1. increase their output by 3-4 orders of mag
2. exhibit a soft X-ray spectrum at peak
3. decrease their output rapidly for the first few months after peak and then more gently for the next few years

And if so what is the mechanism?

$$M_{BH} \sim 10^{7}\ m_{\odot}$$

$$m_{dot} \quad <10^{-4} \quad >10^{-1} \quad <10^{-3}$$

SDSS1201+30: Summary ?

- Why so variable?
- What is the spectral emission mechanism?
- When will it settle into an AGN-like accretion mode?