Comptonisation in TDE

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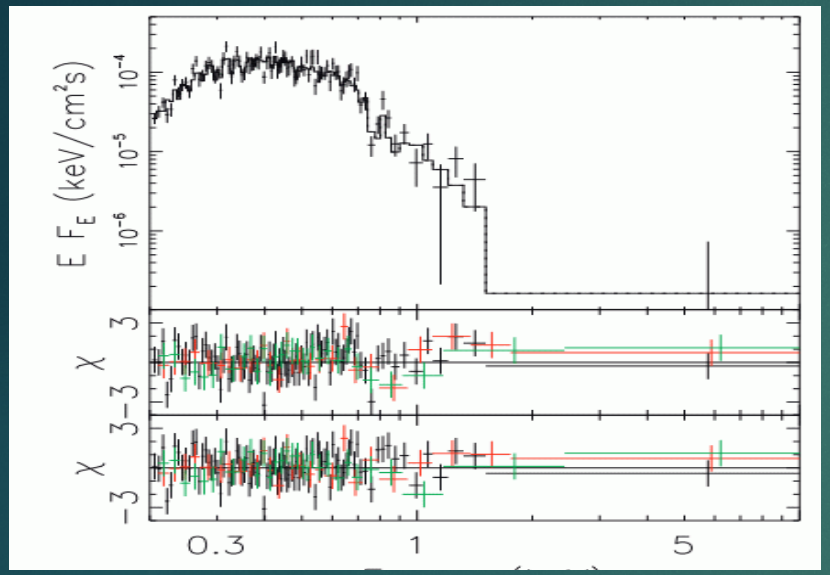
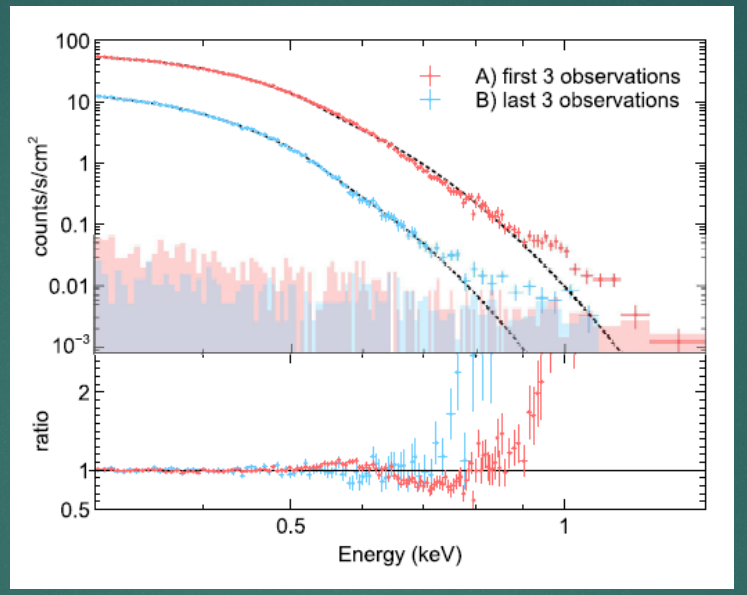
Early-phase X-ray spectra



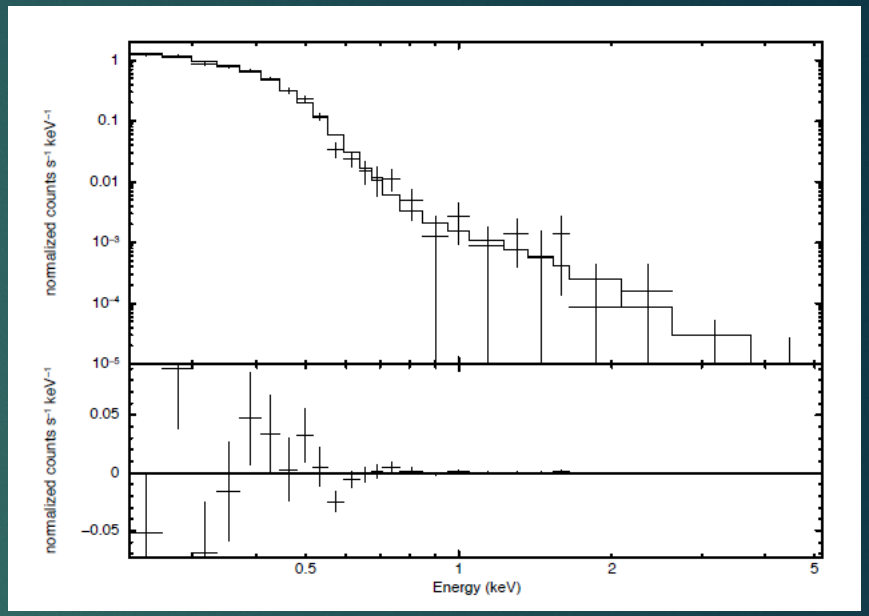
3XMM J 1521+07 - Lin et al. 2015

kT=99+/-3 eV



ASASSN-14li – Kara et al. 2018

kT=57+/-1 eV

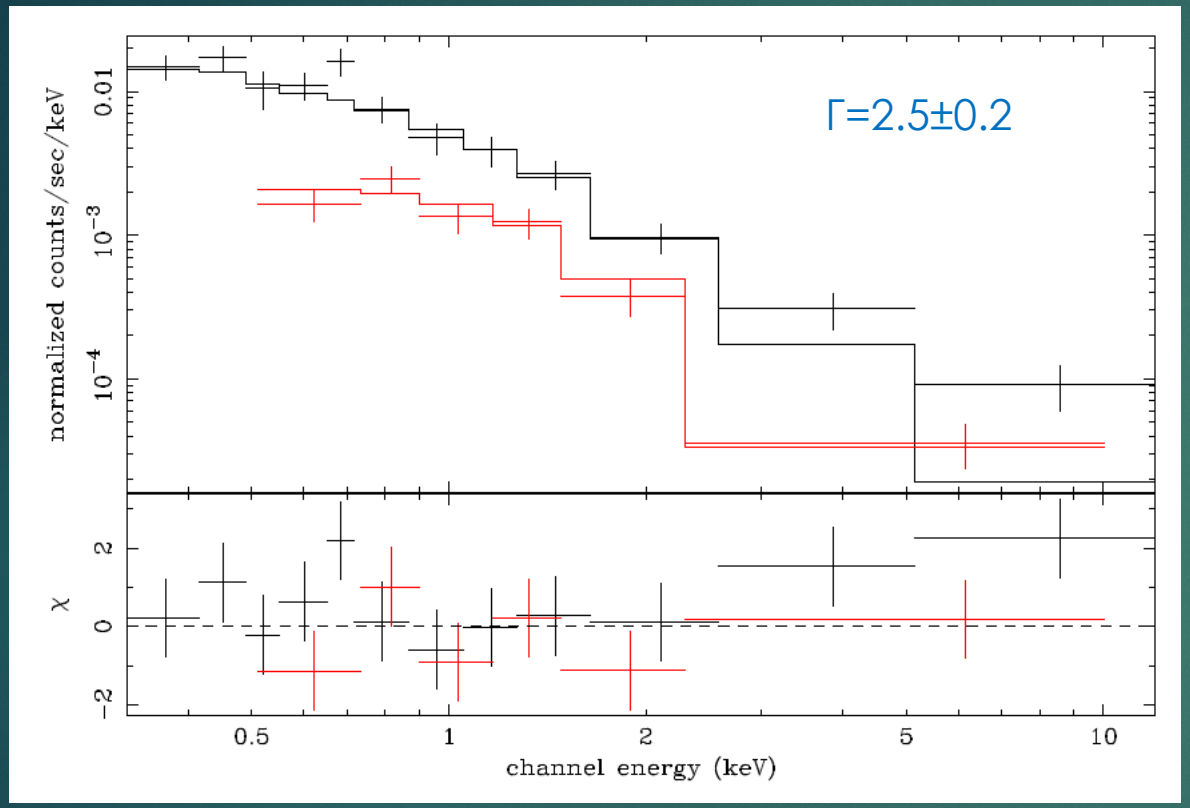


ASSASN-15oi – Gezari et al. 17

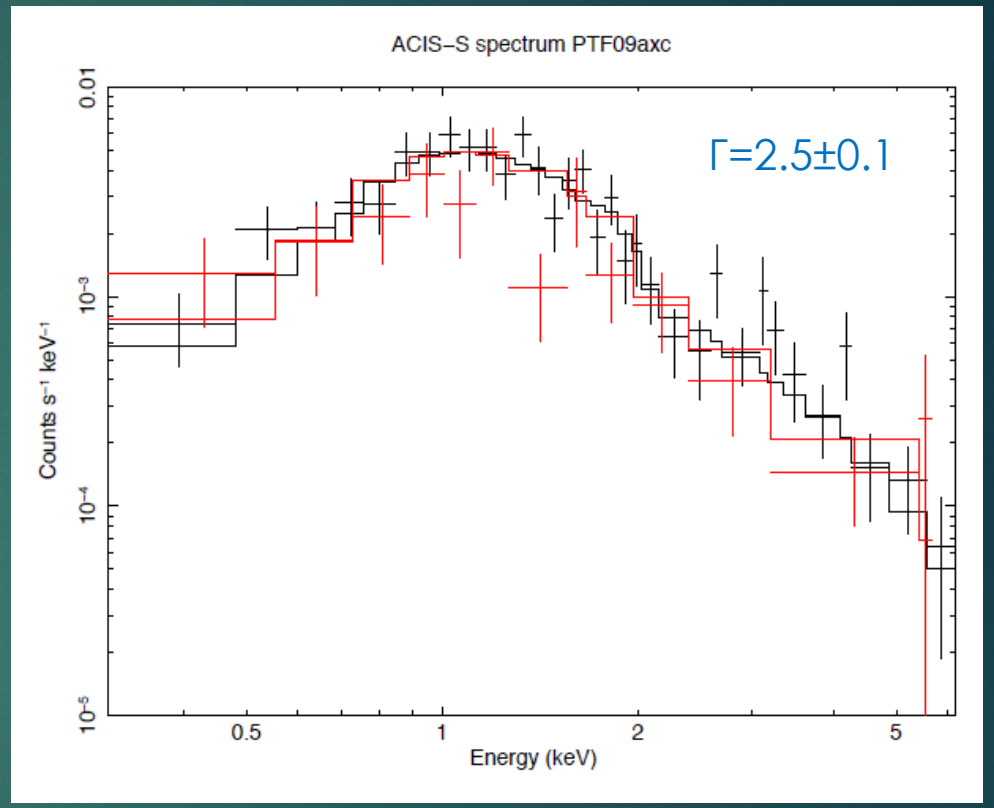
kT=42+/-1 eV

Initially TDE X-ray spectra tend to be dominated by thermal emission with **kT~40-100 eV**.

Late-phase X-ray spectra



RXJ~1242.6-1119 XMM-Newton spectrum taken 10 years after discovery – Komossa et al. 2004

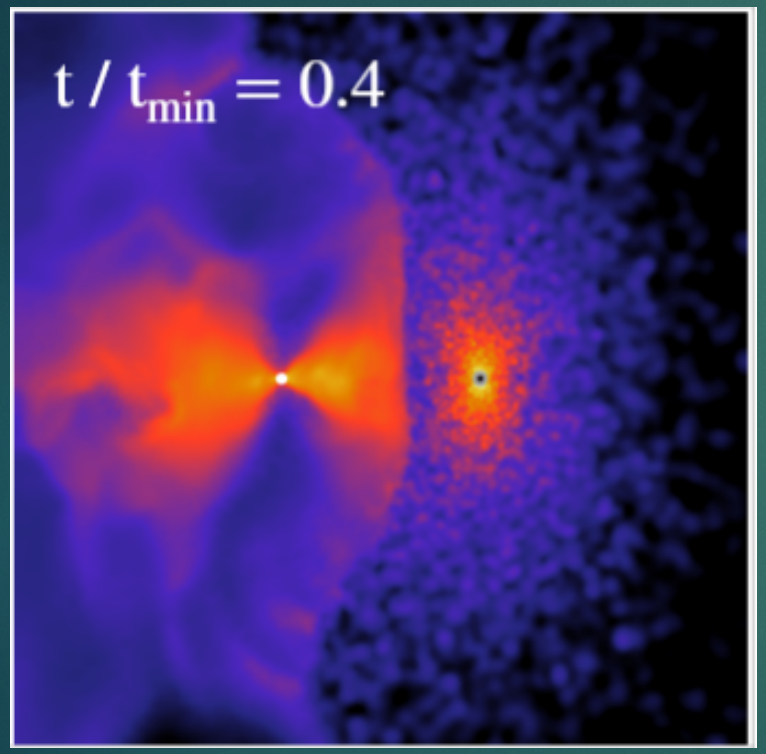


PTF09axc, Chandra spectrum, 8 years After discovery – Jonker et al. 2019

After a few years the spectrum is dominated by a steepish power-law component Γ~2.5-3.5

What causes the transition?

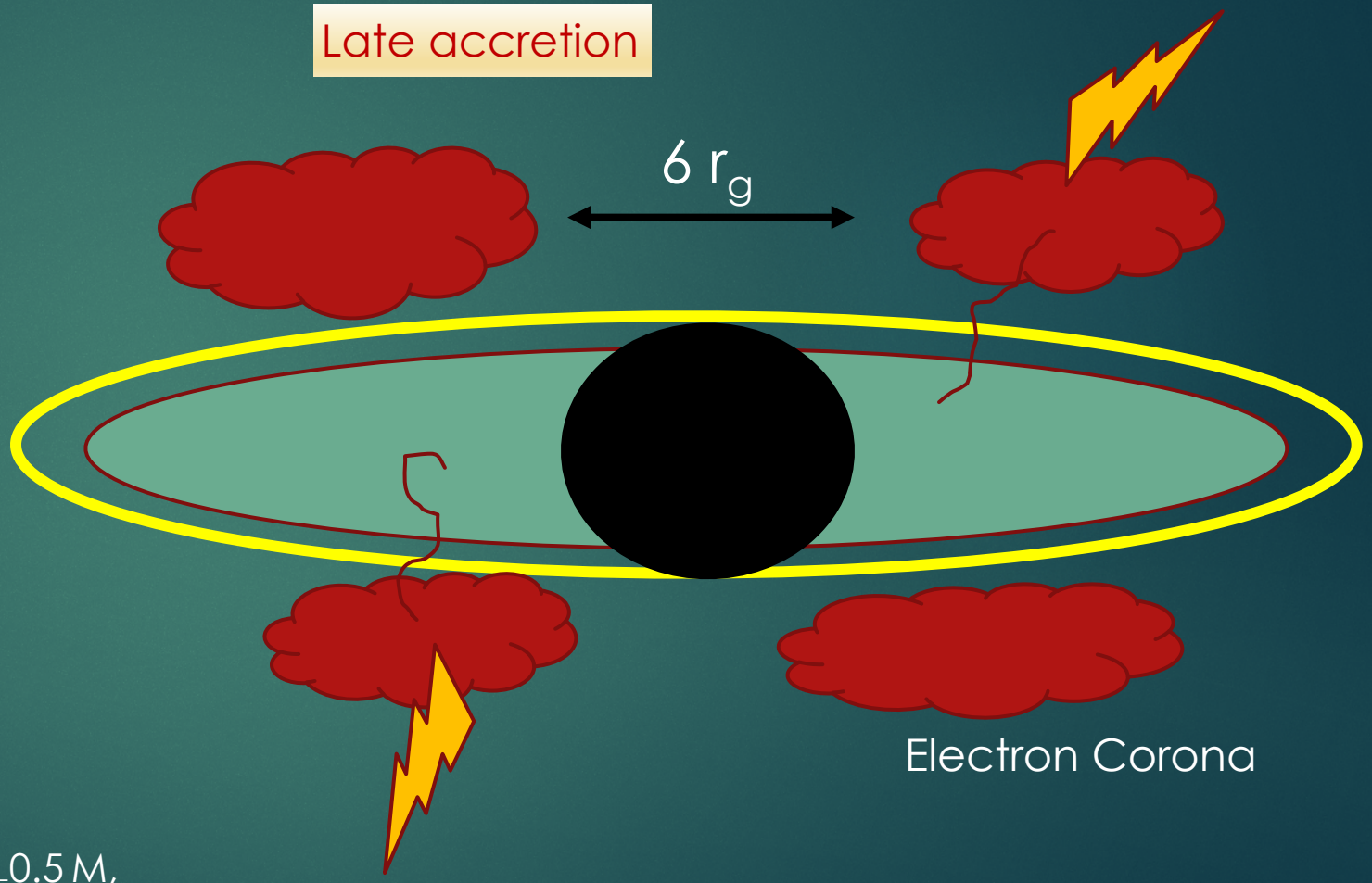
Early accretion



Bonnerot & Lu 2019

M_{BH}=2.5x10⁶, M_{*}=0.5 M,
16 days after
stream interaction

Late accretion



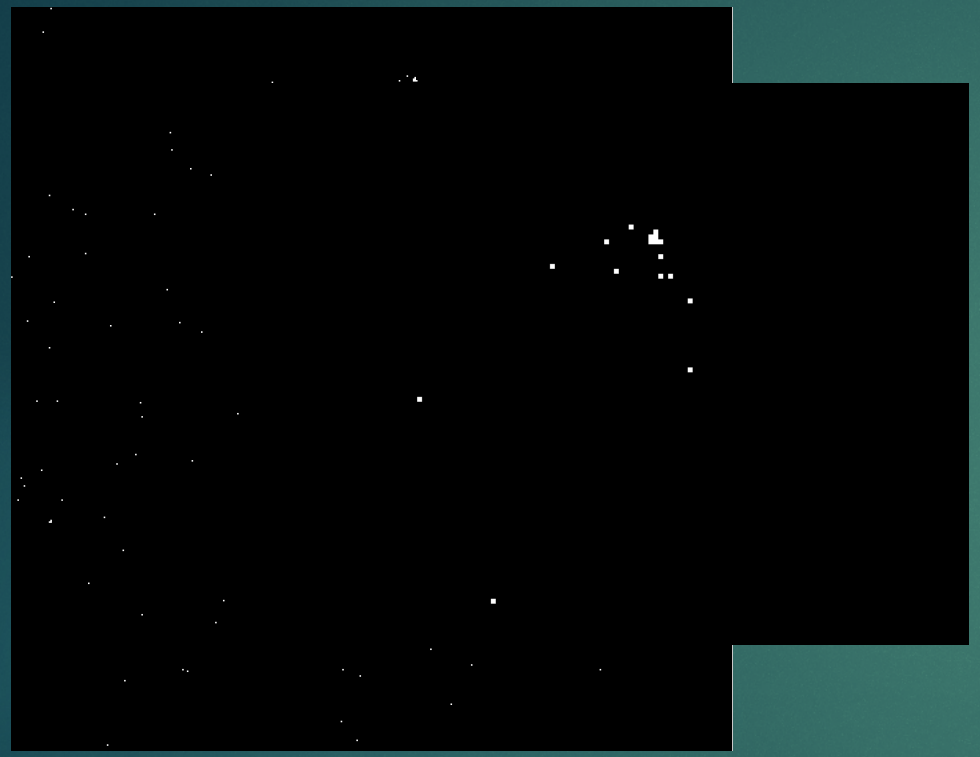
Cannizzo, Lee & Goodman 1990

How and when does transition occur ?

? Is Comptonising corona always there but becomes increasingly important as thermal diminishes ?

? If corona develop laters does it build up slowly or quickly ?

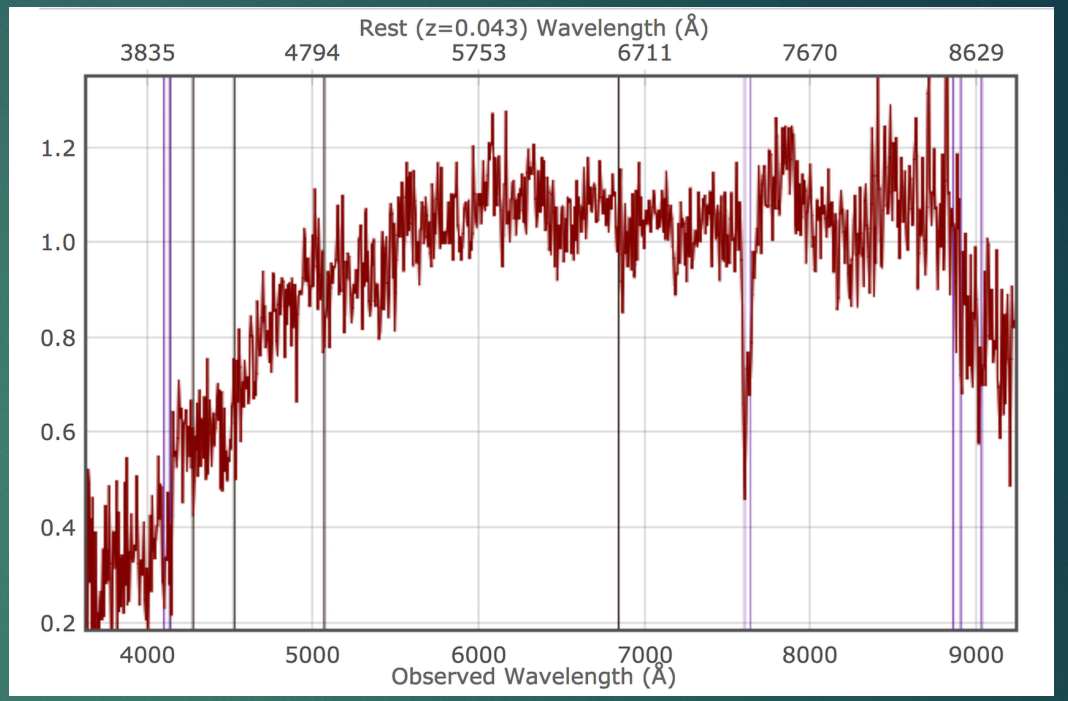
New source: XMMSL2 J1404-25



Discovery image – 15 Feb 2018

Atel #11394

3.4 s, 13 photons



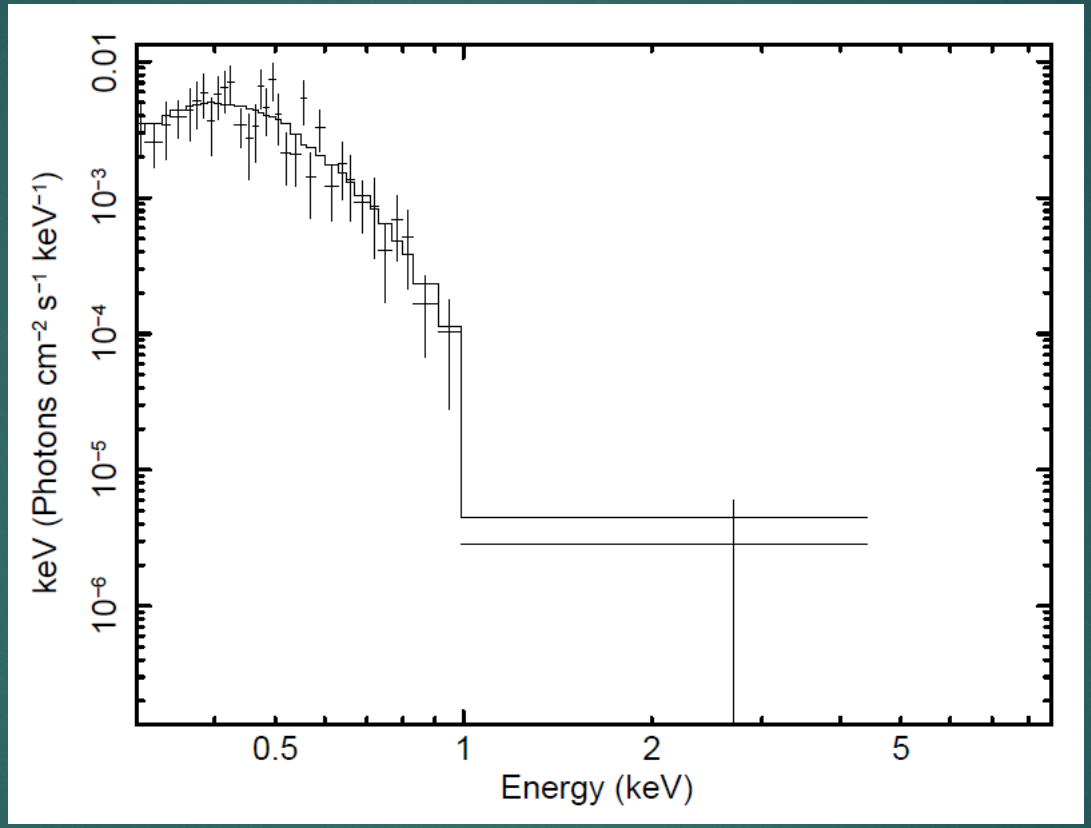
ePESSTO NTT, EFOSC2 spectrum (8 Mar 2018)
Atel #11395

2MASX 1404671-1511433

z=0.043

>20 brighter than ROSAT in 1990

New source: initial spectrum

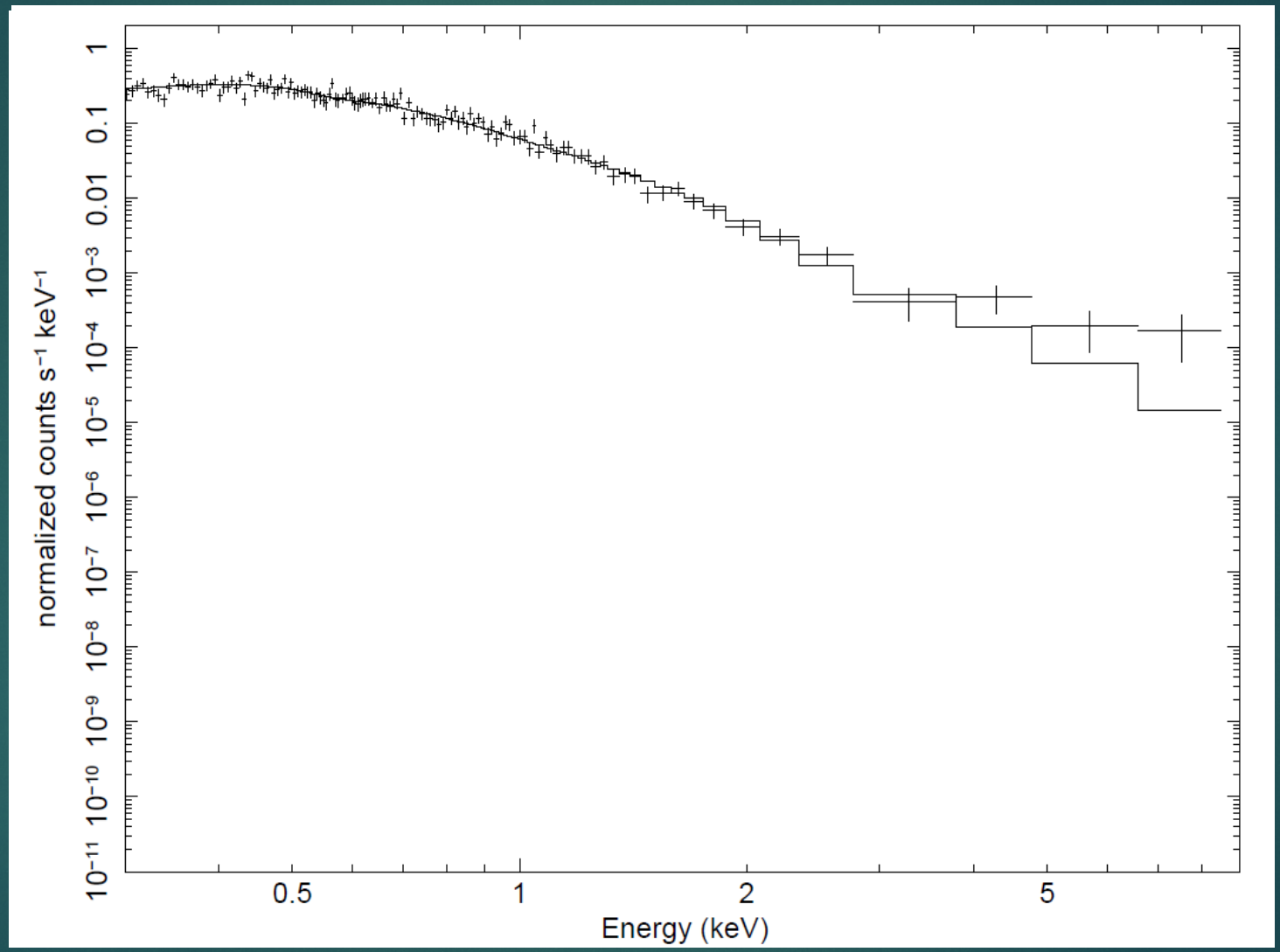


Black-body

kT=77+/-2 eV

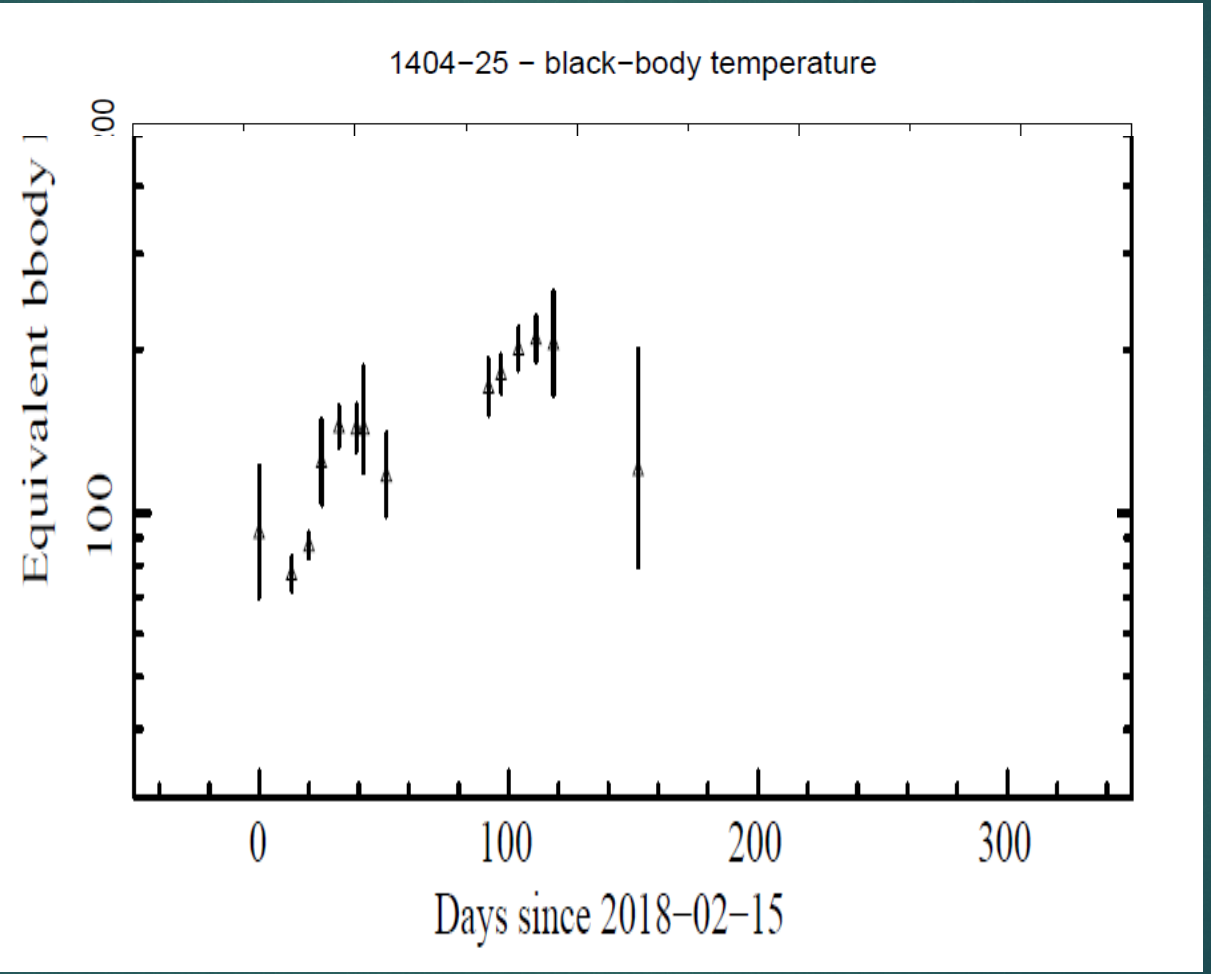
Swift-XRT, 28 Feb 2019

Changing spectrum



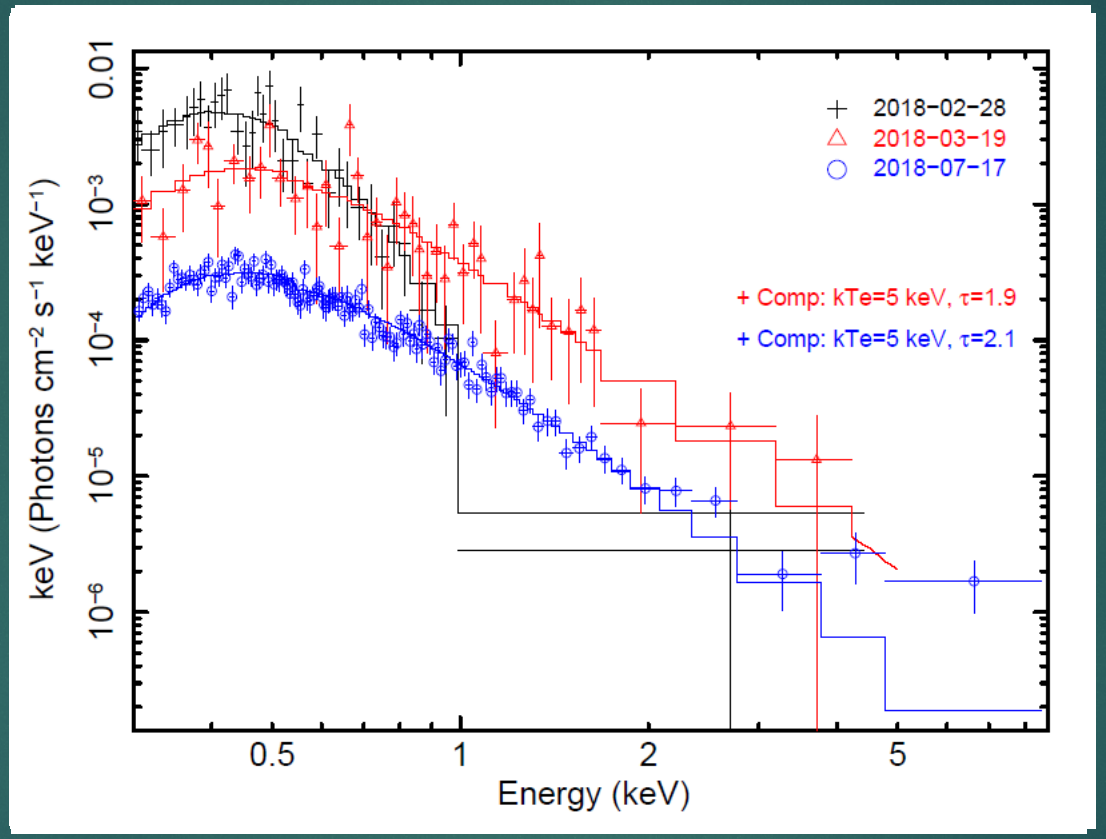
(fit with TBABS*COMPBB)

New source: hardness



Evolution of equiv temperature

New source: initial spectrum



Black-body

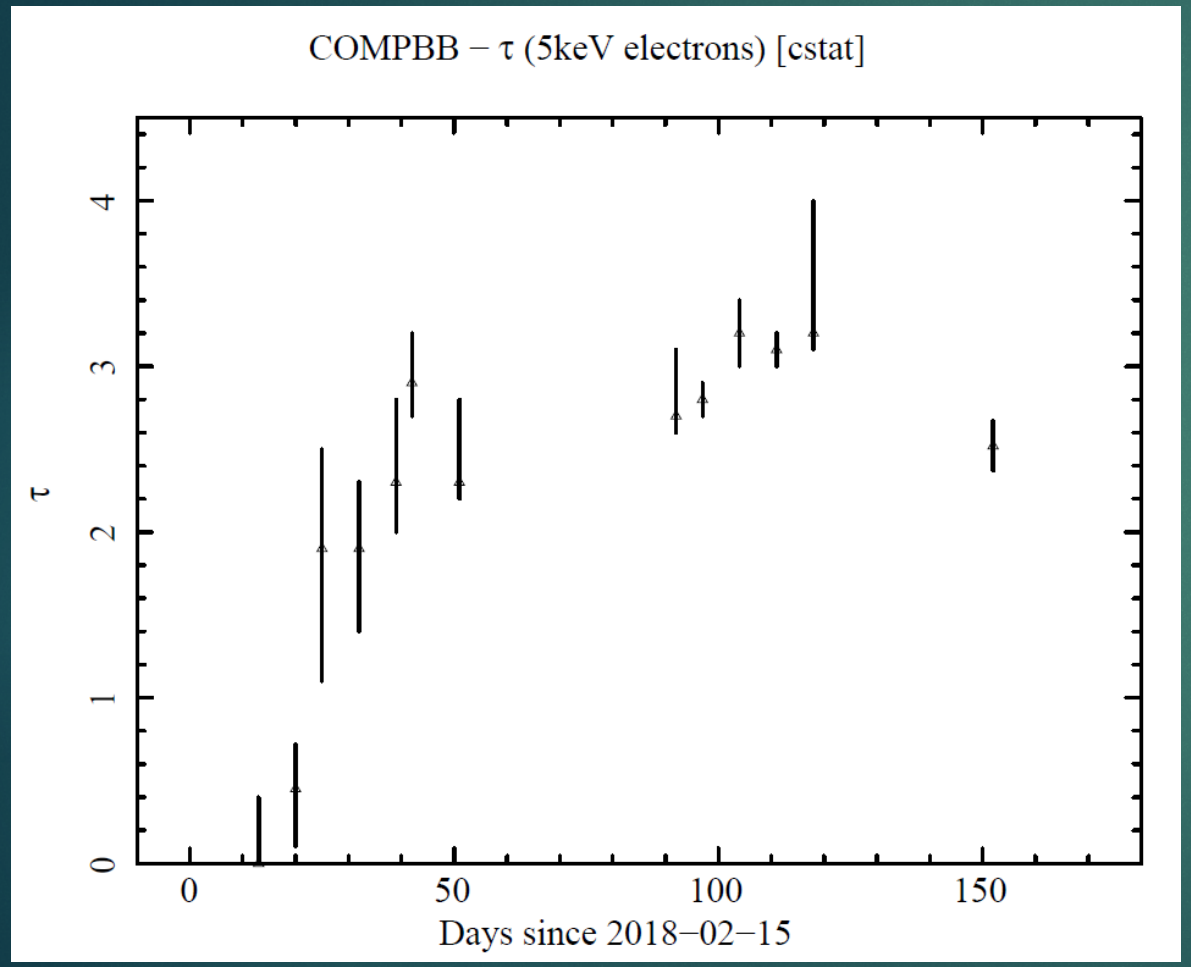
kT=77+/-2 eV

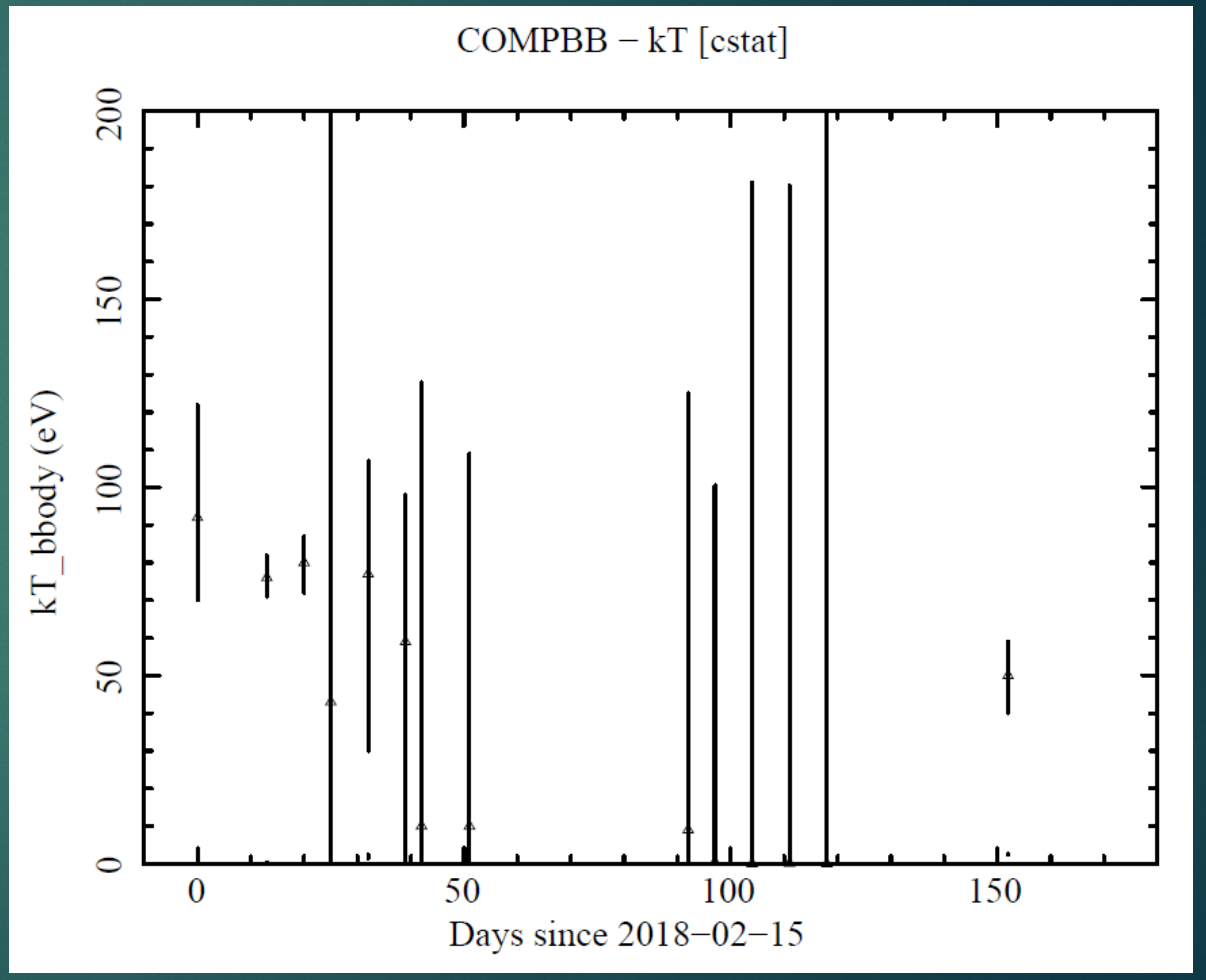
Comptonisation:

tau=1.9
kTe=5 keV

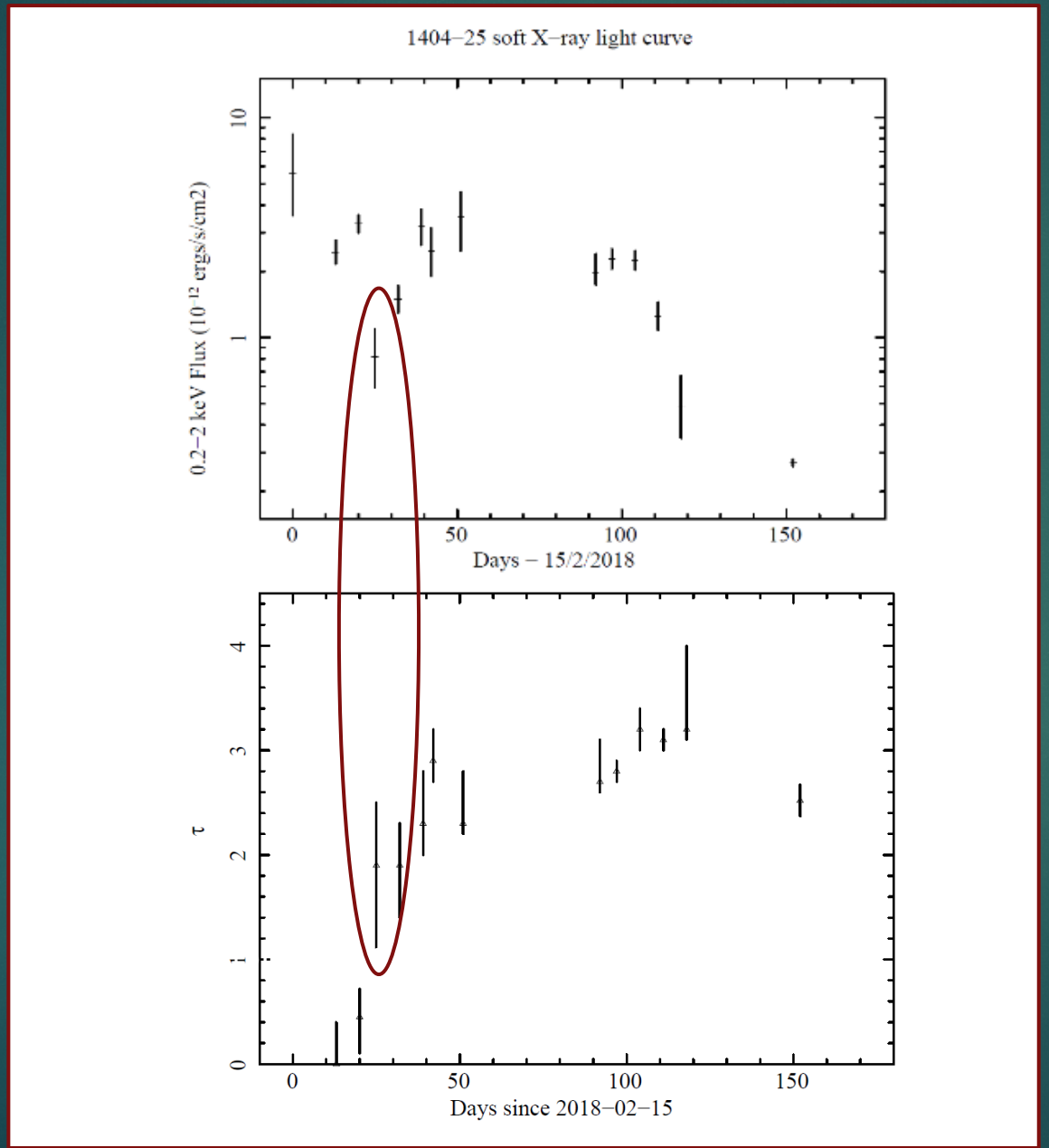
Developed within 7 days.

New source: Compton evolution





Sudden Spectral Change ?



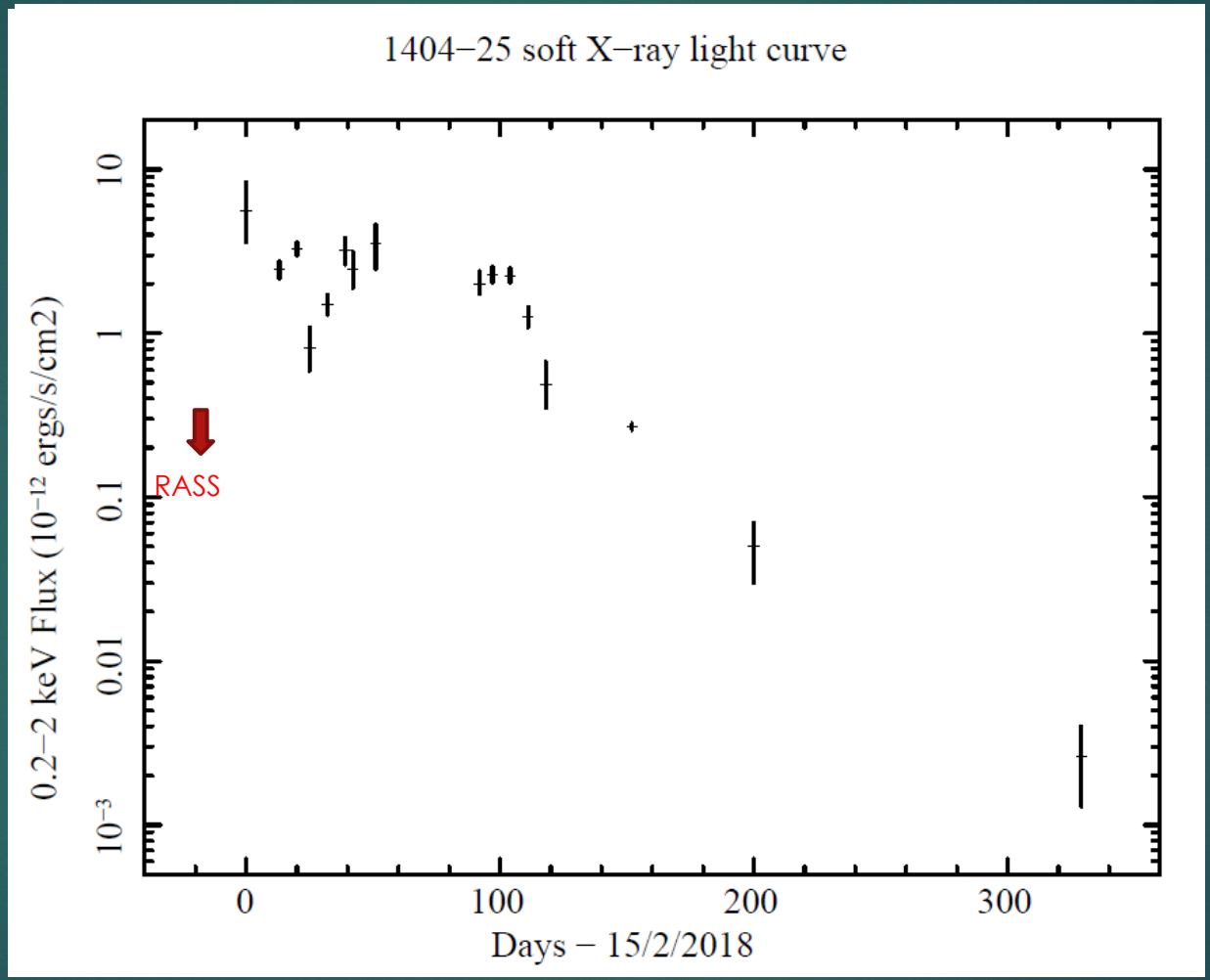
Electron optical depth

Sudden change between Swift obs 2 and 3 ?

Coincides with factor 4 Dip in flux ?

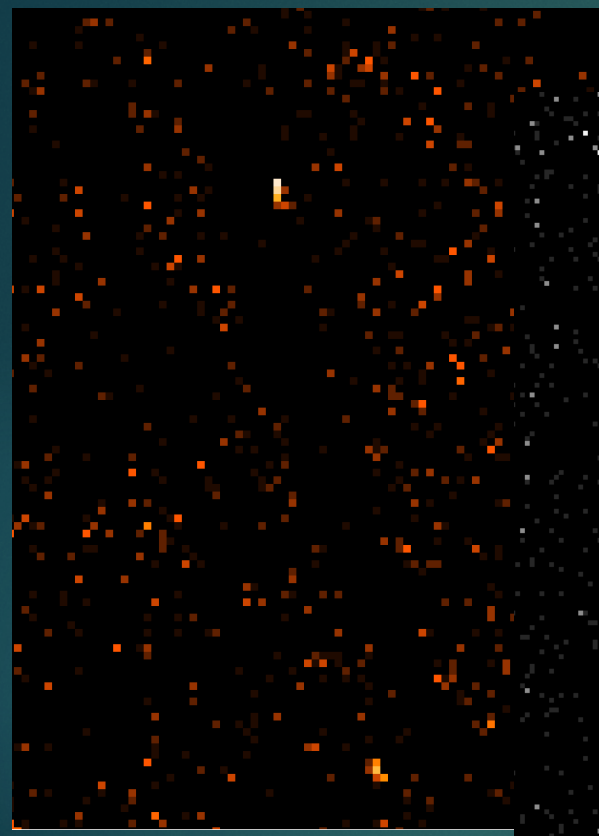
No obvious increase in Obscuration (NH)

New source: evolution of light curve

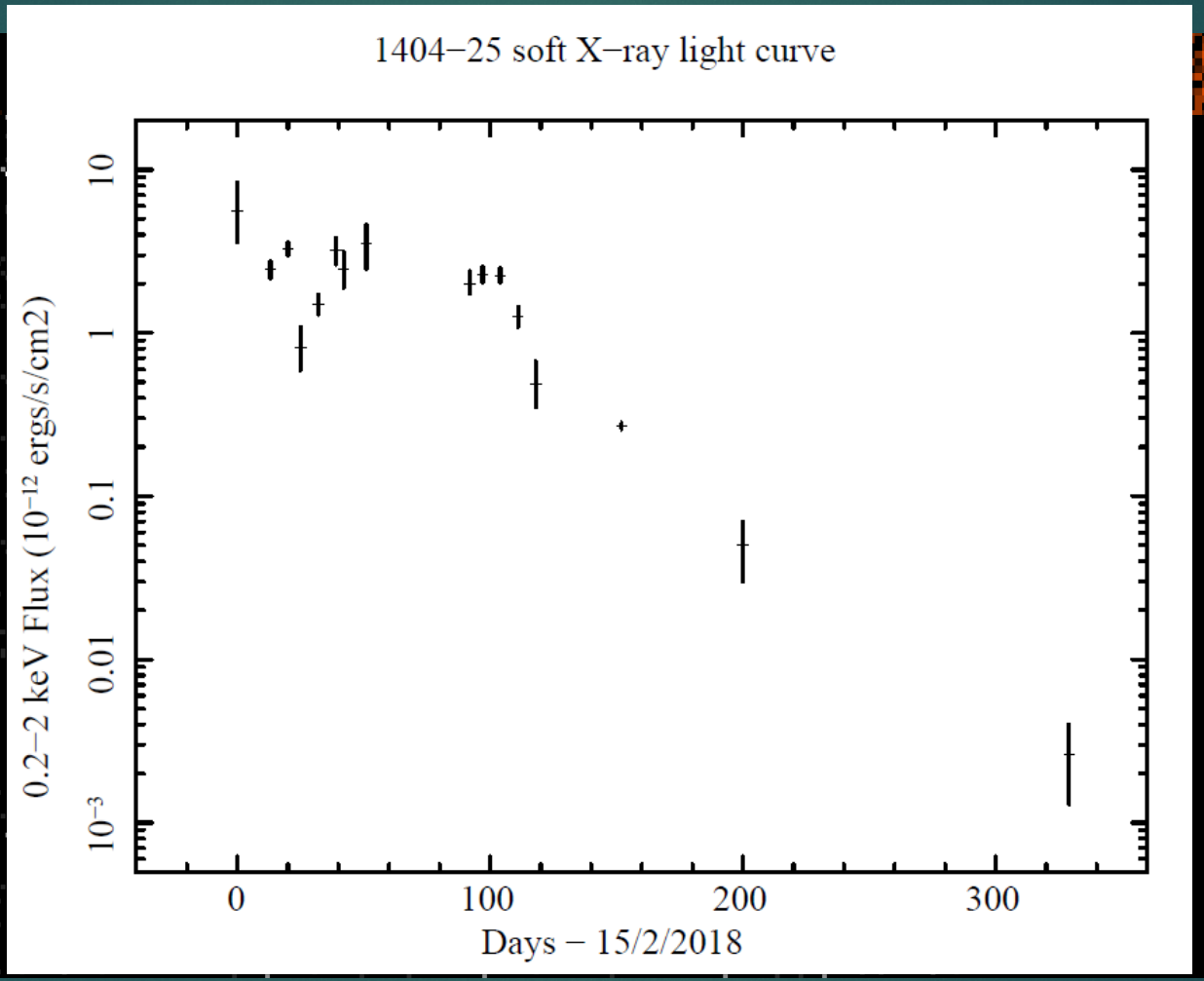


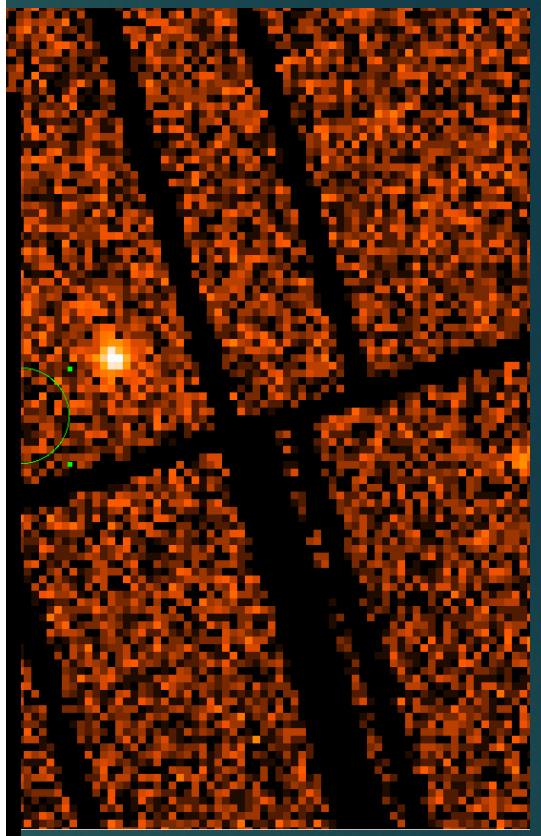
0.2-2 keV observed light curve

New source: 320d after discovery



EPIC-pn, 0.2-2 keV

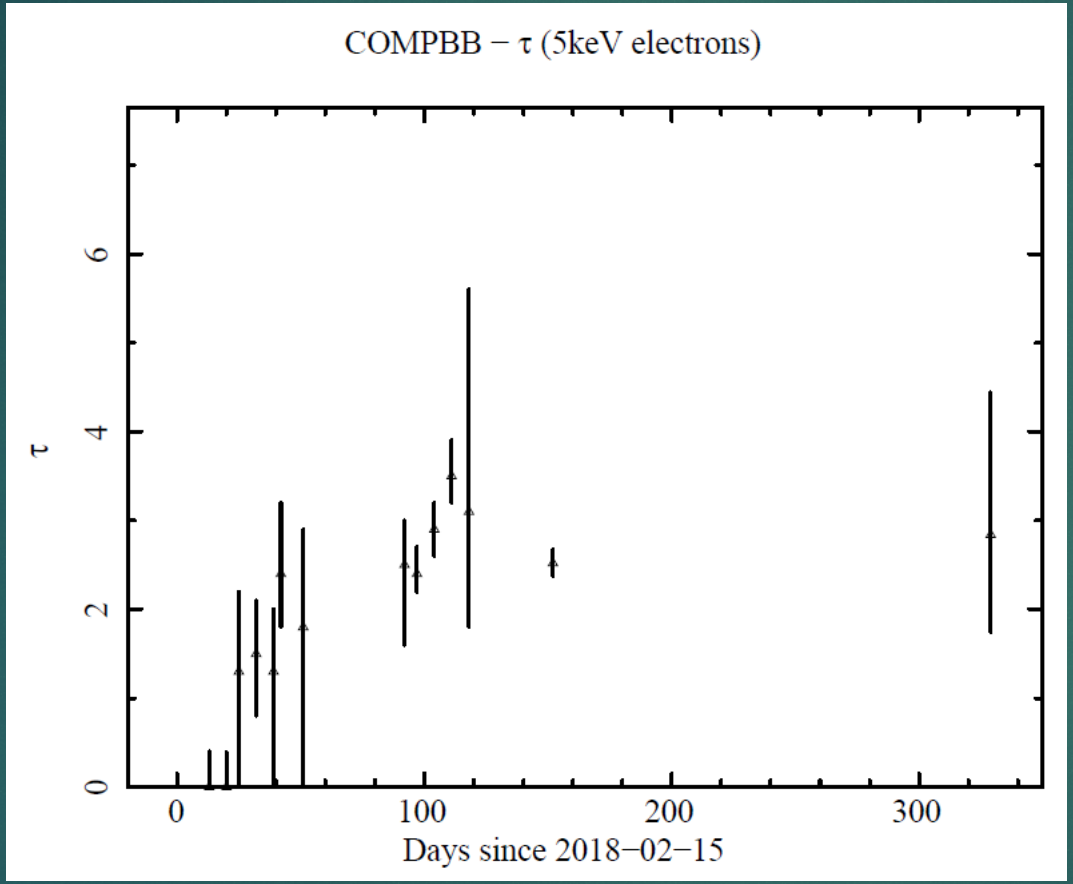




NuSTAR A, 3-100 keV

Shown to be intrinsic – thanks NuSTAR

Full evolution of electron optical depth



Build up to peak electron optical depth after 120d.

Maintained until day 320.

Black hole mass

$M_{BH}=2.5\pm2 \times 10^6$

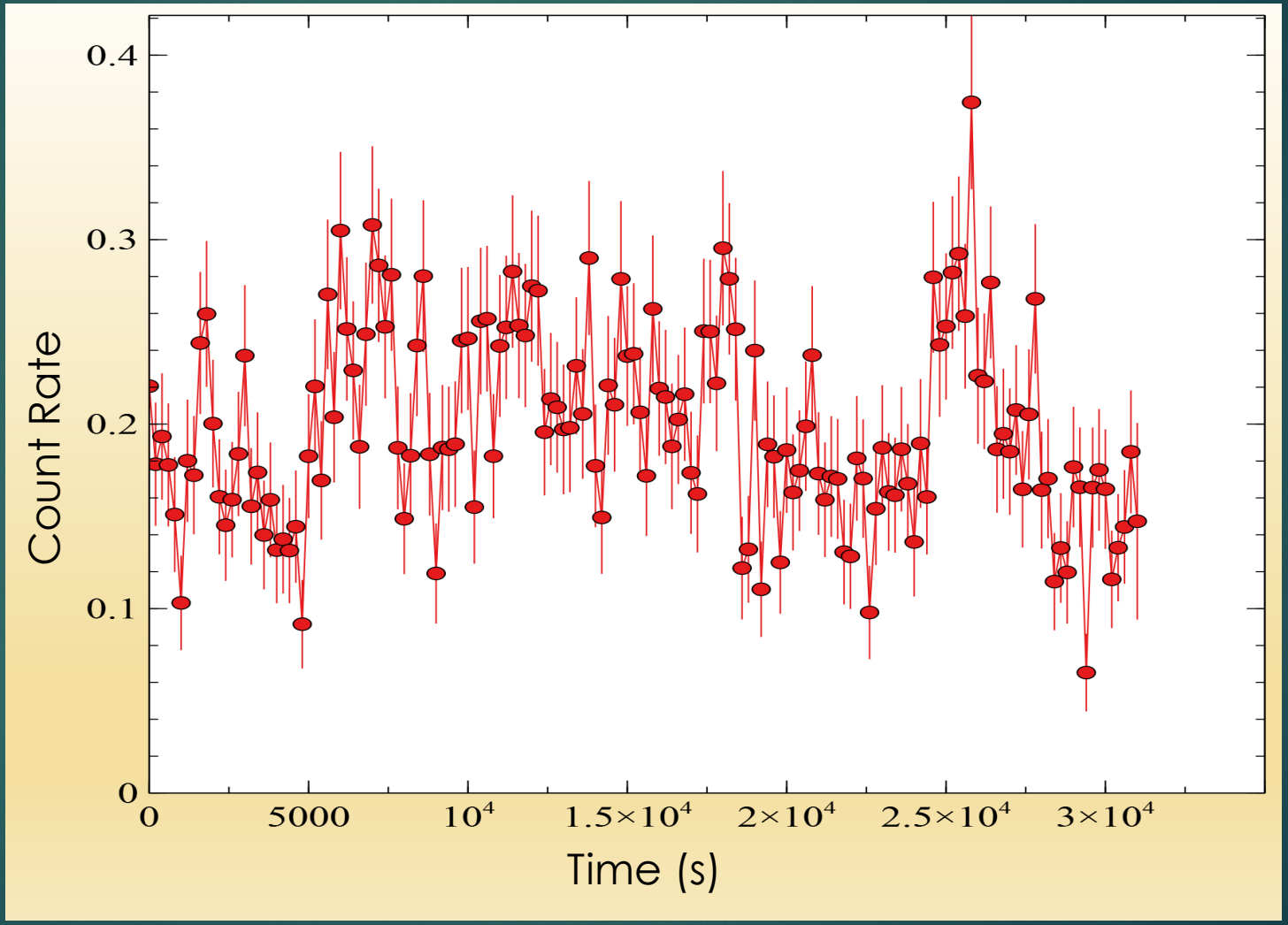
From variability
(Ponti et al. 2012)

$M_{BH}=4\pm2 \times 10^6$

From $L_X \sim 1 \times 10^{44}$ erg/s/ag

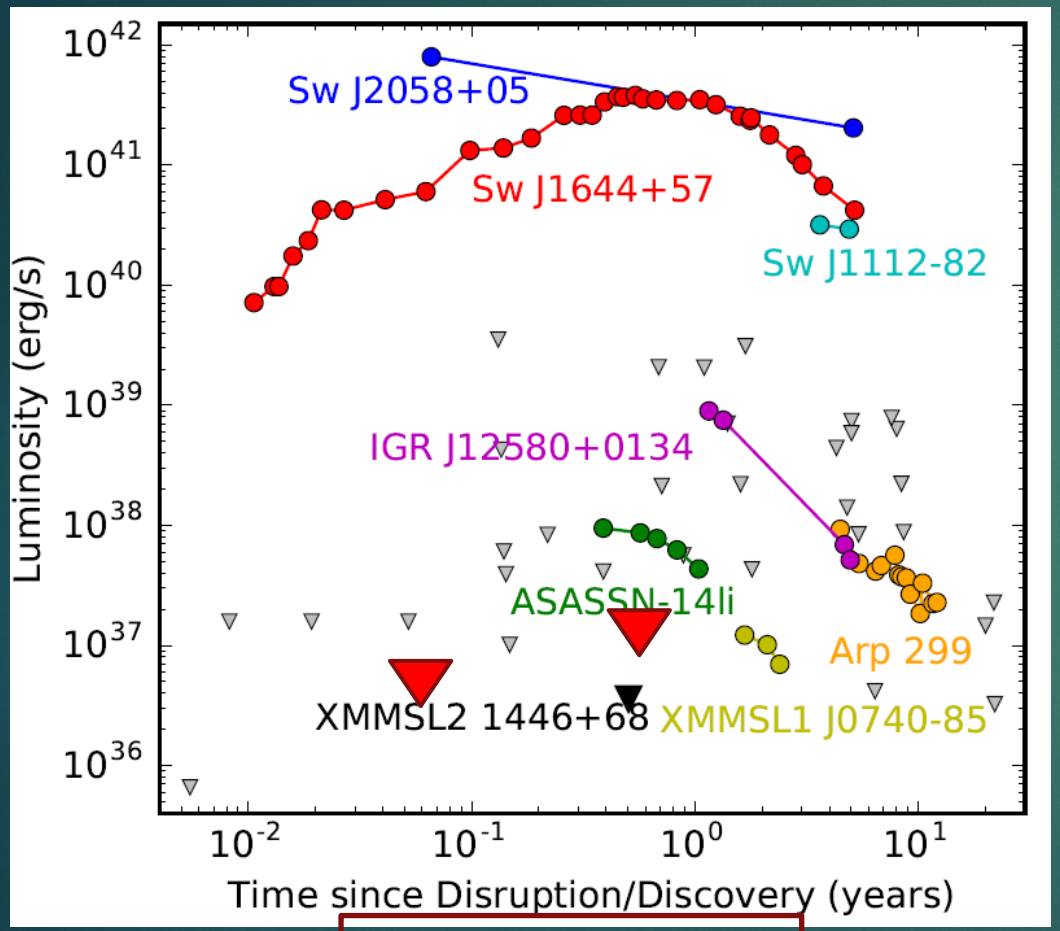
$L_X \sim 1 \times 10^{41}$ erg/s

$m_{edd} \sim 0.5 \rightarrow 5 \times 10^{-4}$

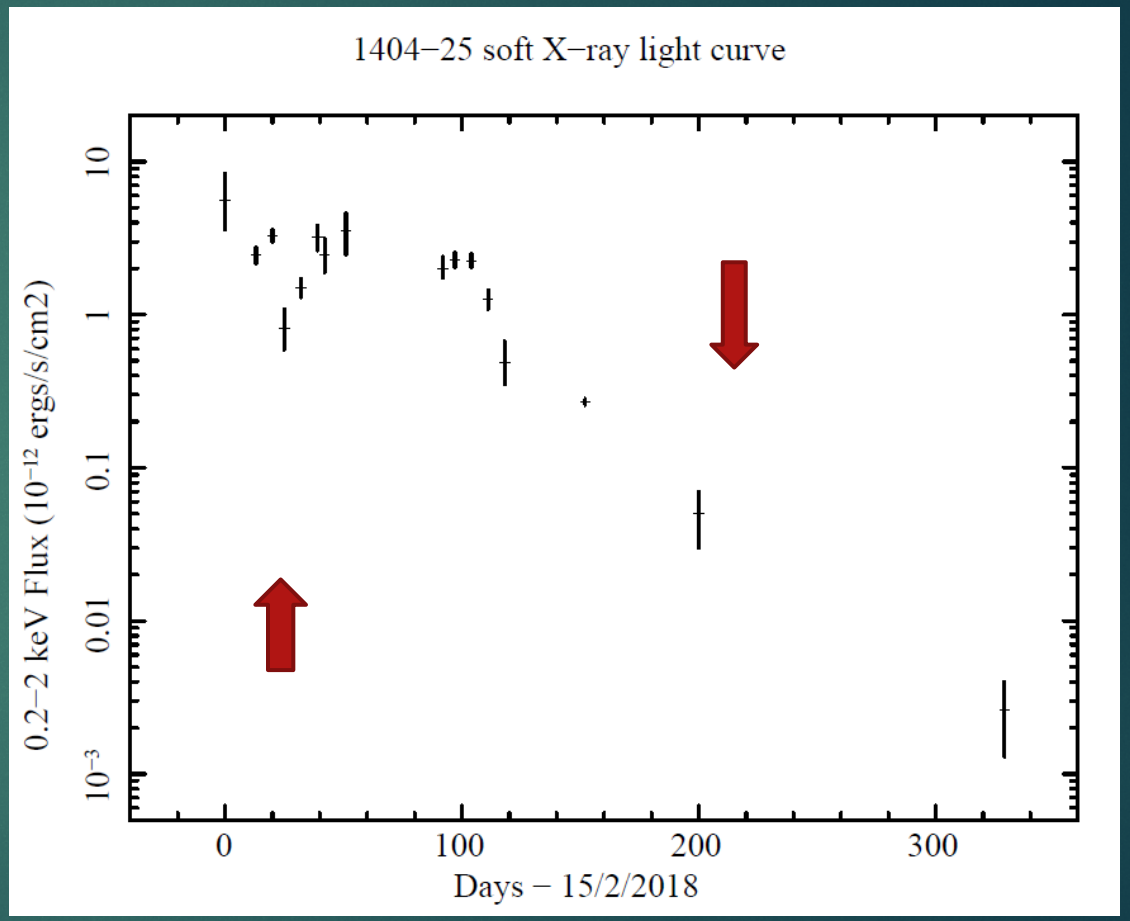


XMM-Newton, 0.2-2 keV – 17/7/2018

Radio (non) emission



L_{6GHz}<2x10^{37} ergs/s



F_{6GHz} < 11, 35 uJy (eVLA)

Sumary

- X-ray TDE discovered with rapidly evolving X-ray spectrum in M_{BH} ~$2x10^6$ M• galaxy
- Comptonisation region begins to forms within 7 days and is "complete" after ~120 days
- Luminosity decays by factor ~1000 in 320 days
- After 320 days event has reached the typical late-time luminosity (LX=$2x10^{41}$ ergs/s) and spectral shape (Γ~3).