Investigating an extreme transient AGN from the XMM-Newton slew survey

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XMM-Newton slew survey



Has covered 65% of sky in the 0.2-2, 2-12 and 0.2-12 keV bands as of Jan 2013



Compare with ROSAT, sky-survey and pointed obs.

XMM – ROSAT extragalactic variability



Small number of very high variability galaxies – factors 50-300



ROSAT sky surveys



RASS

Covered 92% of sky from 1990-1991 from 0.2-2.4 keV ROSAT pointed observations

Covered 25% of sky from 1991-1998 from 0.2-2.4 keV



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ROSAT high variability galaxies – Tidal Disruptions (TD)



ROSAT high variability galaxies - AGN



ROSAT also discovered a small number of high-var AGN.



XMM Slew – Tidal Disruption Candidates



SDSS J1201+30





SDSS J1323+43









XMM Slew – High variability AGN (Candidates)



011100130 2014

n-lay

-

Year

XMM Slew – High variability AGN properties

Typical slew variable AGN properties





Soft spectrum model - M_BH=10^5 - few x 10^6

Tidal disruption



Disk emission (in X-rays if M_{BH}<few x10⁶) Soft excess component Usually no power-law

Flaring AGN – M_{BH} < few x10⁶



Disk emission Soft excess component Low-level power-law

External additional material

Internal additional material

Can distinguish between the two scenarios from the luminosity history, e.g. from the strength of narrow lines in the optical spectrum; from the level of the bottom of the light curve and perhaps from the length of the rise time



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2MASX 0619-65 : something different ?



2MASX 06192755-6553079



2MASX 0619-65 : something different ?





2MASX 0619-65 : something different ?



XMM pointed obs t0+34 days



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2MASX 0619-65 : correlated UV variability



Usually UV is invariate in the slew TD and AGN light curves, while the X-rays fall by a factor 10-100.

Here U drops by 1.6 mags



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2MASX 0619-65 : an AGN-like X-ray spectrum



85% of $F_{0.2-2 \text{ keV}}$ provided by plaw 15% by soft excess

3% of $F_{2-10 \text{ keV}}$ provided by reflection

Comparison of XMM pointed Obs. taken 34 and 159 days after discovery.

Doesn't look like there is any intrinsic absorption



2MASX 0619-65 : an AGN-like X-ray spectrum

normalized counts s-1 keV-1

normalized counts s-1 keV-1

0.1

0.01

10-3

9.0

20

0.1

0.5



Hardness Ratio v Flux

No spectral relationship with flux. Variability mainly driven by the Power-law normalisation. Comparison of XMM pointed Obs. taken 34 and 159 days after discovery.

Energy (keV)

Doesn't look like absorption

T0+34 days

T0+159 days



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2MASX 0619-65 : a SY I-like optical spectrum



Broad Balmer lines, FWHM~5000 km/s

 $L_{[OIII]} = 1 \times 10^{40} \text{ ergs/s}$ $L_{H\beta}, \text{narrow} = 4 \times 10^{39} \text{ ergs/s}$

 L_{bol} , optical = 7x10⁴¹ to 1x10⁴³

Lamastra (2009), Stern & Laor (2012), Netzer (2009)

AAT/AAOmega 2dF – t0+24 days AAT/AAOmega 2dF – t0+325 days



2MASX 0619-65 : peak Luminosity and SED

10-10 $L_{2-10,peak} = 3x10^{43} \text{ ergs/s}$ 10-11 10-12 The SED looks like that of an 10-13 LLAGN, not obviously a cm⁻² strong blue bump or X-ray 10-14 ergs s⁻¹ thermal component. Use a 0-15 **Bolometric correction of** 10-16 $k_{x} = 10$ 10-17 $L_{bol,X} = 3x10^{44} \text{ ergs/s}$ °° - 1 - 1 - 1 0 - 6 10-5 10-4 10⁻³ 10 0.01 0.1 100 1000 104 Energy (eV) 2MASX 0619-65 SED L_{bol} , optical = 7x10⁴¹ - 10⁴³ $M_{BH} \sim 6 \times 10^7$ from the broad lines, **Increase in bolometric luminosity** K-Lum and X=ray variability of 30-400



So what is it?

Tidal disruption ?

• Unusual X-ray spectrum

AGN?

 Would imply an increase in accretion rate >30 in <20 years.



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A TDE with similar properties ?

Swift J1644+57 1049 10-8 1048 Flux (erg cm⁻² s⁻¹) 10-9 er Luminosity 1047 10-10 1046 10-11 5 10 15 20 25 Time (days since trigger)

Bloom+ 11, Burrows+ 11, Zauderer+ 11, Levan+ 11, Barres de Almeida & De Angelis 11, Krolik+Piran 11, Cannizzo+ 11, Miller & Gueltekin 11, Metzger+ 11 etc.

Not the same thing !



Burrows+ 2011

Relatively hard spectrum, Γ ~2 in X-rays with strong variable Radio emission (Zauderer+ 2011) believed to be dominated by a Jet.

2MASX 0619-65 not detected in Radio -F_5.5GHZ < 110 uJy

A different TDE with similar properties

NGC 4845



Nikolajok & Walter 2013

Factor 500 X-ray flux decline In 1.5 years



Γ=2.2, soft emission removed by intrinsic NH=7E22 column



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An AGN with similar properties

NGC 2617



Shappee et al. 2014

L OIII / L bol = 300



Factor 20 increase from ROSAT, XMM



Factor 10 variability over a few days UV follows the X-rays

> NGC 2617 is an AGN which has changed its accretion properties Within the last few years.

X-ray spectrum has underlying gamma~2 $M_{BH} \sim 4 \times 10^{7}$

Conclusions

- Most high-variability, extragalactic sources detected by XMM v ROSAT comparisons are soft.
- One source, 2MASX 0619-65, dominated by power-law.
- Not clear yet if due to a TD, AGN variability or hybrid

