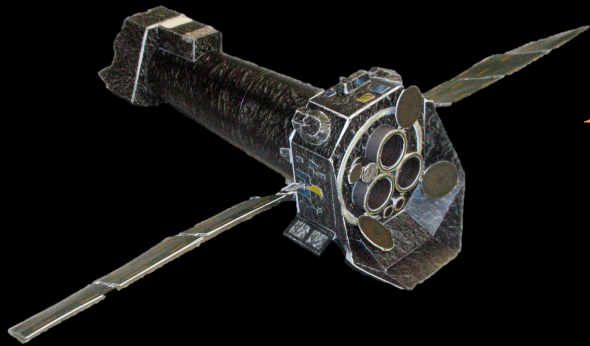




<b>Publication Year</b>	2016
<b>Acceptance in OA</b>	2020-04-29T15:23:56Z
<b>Title</b>	AGN Diagnostic Plot In The WISE And 3XMM Era: The Role Of Variability
<b>Authors</b>	Zaino, Alessandra, SEVERGNINI, Paola, Vignali, C., DELLA CECA, Roberto, Ballo, L.
<b>Publisher's version (DOI)</b>	10.5281/zenodo.163800
<b>Handle</b>	<a href="http://hdl.handle.net/20.500.12386/24337">http://hdl.handle.net/20.500.12386/24337</a>

# *AGN diagnostic plot in the WISE and 3XMM era: the role of variability*



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(University of Bologna)*

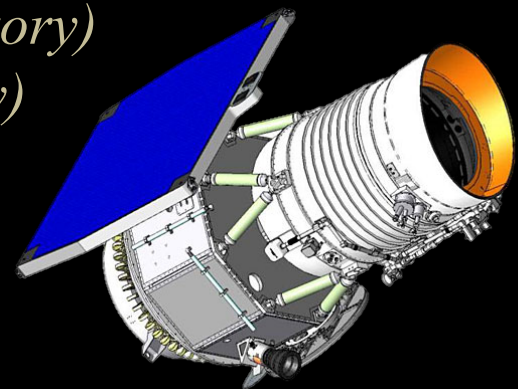
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*C. Vignali (Dept. of Physics and Astronomy, University of Bologna)*

*R. Della Ceca (INAF – Brera Observatory)*

*L. Ballo (INAF – Brera Observatory)*

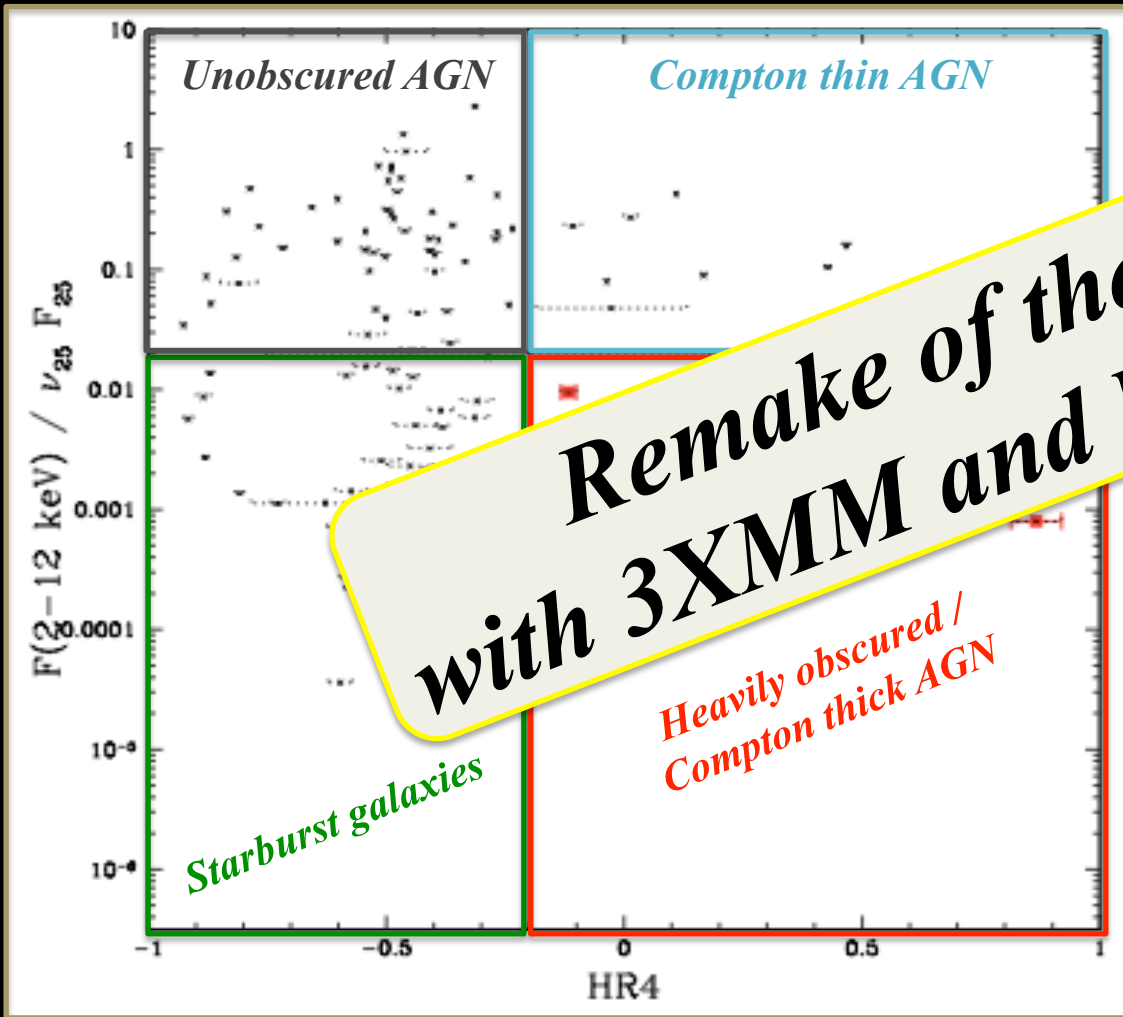


# *Outline*

- ❑ *2XMM-IRAS vs 3XMM-WISE diagnostic plot*
- ❑ *Catching the origin of variability*
- ❑ *Some examples of variable sources*
- ❑ *Conclusions and future perspectives*

# Diagnostic plot for AGN classification

✧ Severgnini et al. (2012)



Remake of the plot  
with 3XMM and WISE data

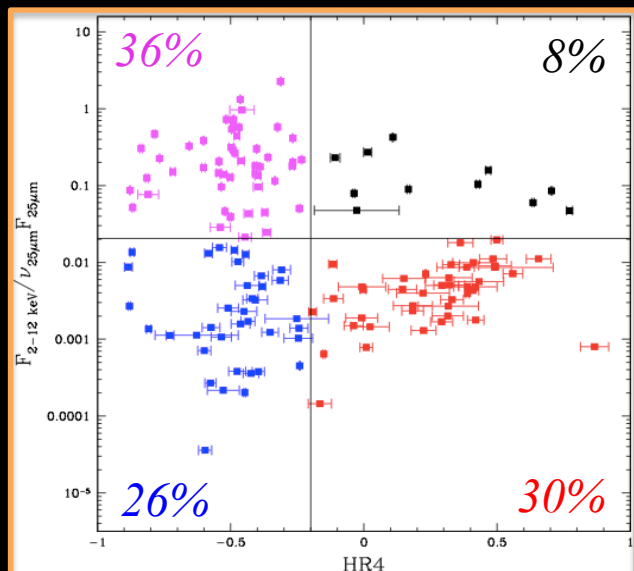
Heavily obscured /  
Compton thick AGN

145 sources  
 $F_X(4.5-12 \text{ keV}) > 10^{-13} \text{ erg cm}^{-2} \text{ s}^{-1}$   
 $0.14 \text{ Jy} < F_{25\mu\text{m}} < 544 \text{ Jy}$

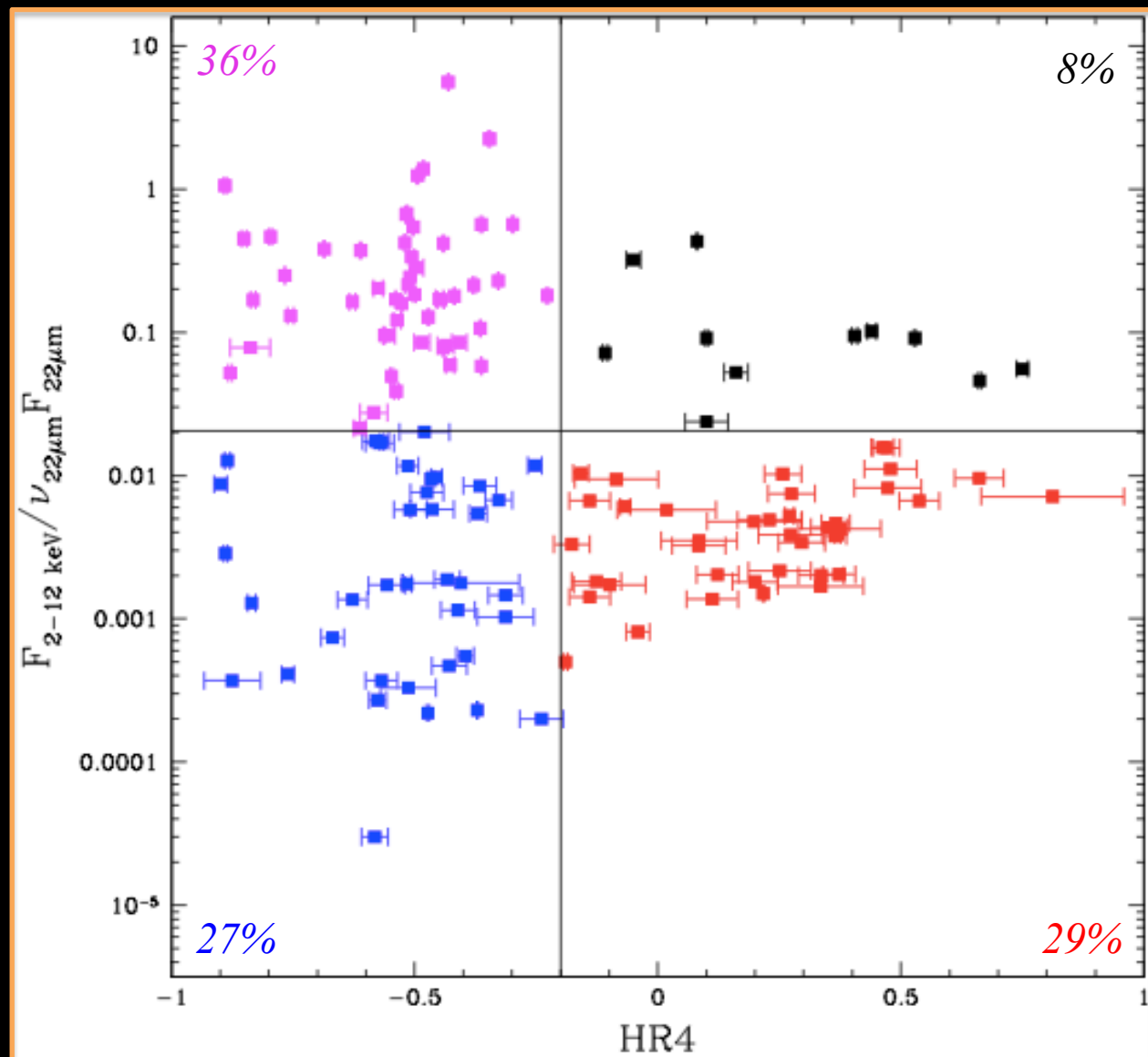
$$HR4 = \frac{cts(4.5-12 \text{ keV}) - cts(2-4.5 \text{ keV})}{cts(4.5-12 \text{ keV}) + cts(2-4.5 \text{ keV})}$$

# 2XMM-IRAS vs 3XMM-WISE plot

## 2XMM-IRAS



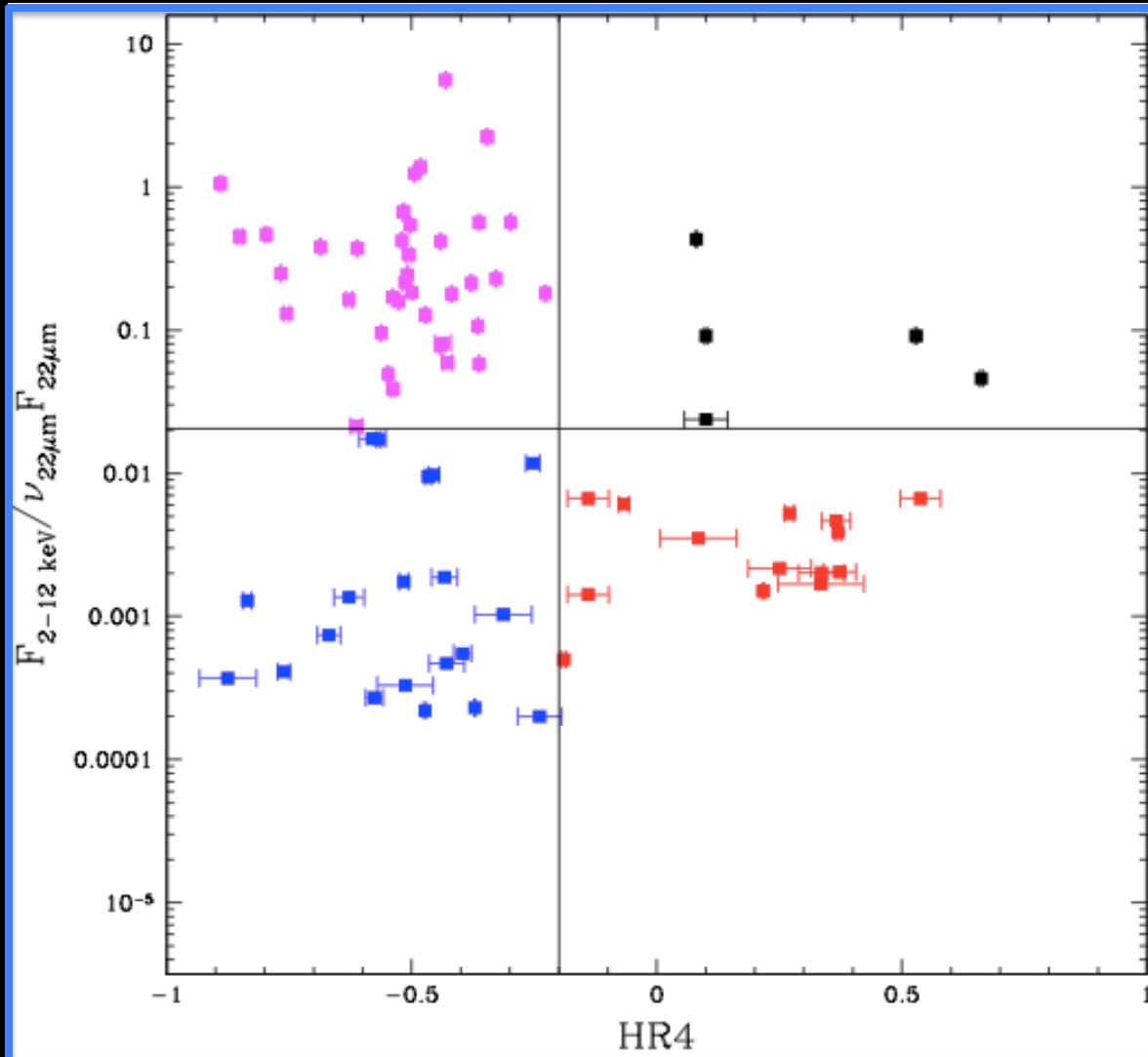
## 3XMM-WISE



- *Stability of the diagnostic plot*
- *Only <5% of the sources change its location within the plot*

# *Does variability play a role?*

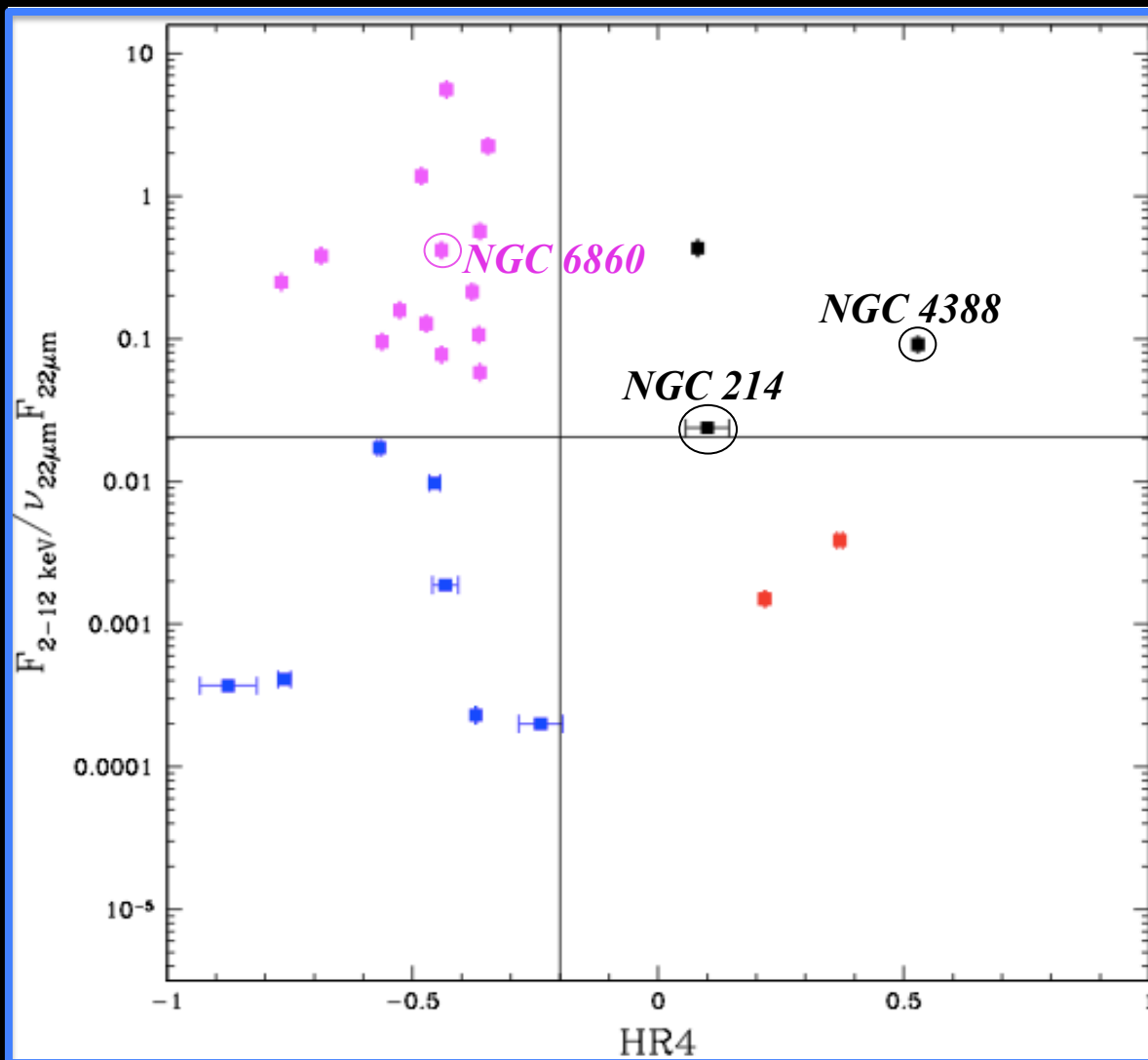
*Sources with multiple detections in the 3XMM catalogue*



*~55% of the sources*

# *Does variability play a role?*

*Sources with multiple detections in the 3XMM catalogue*



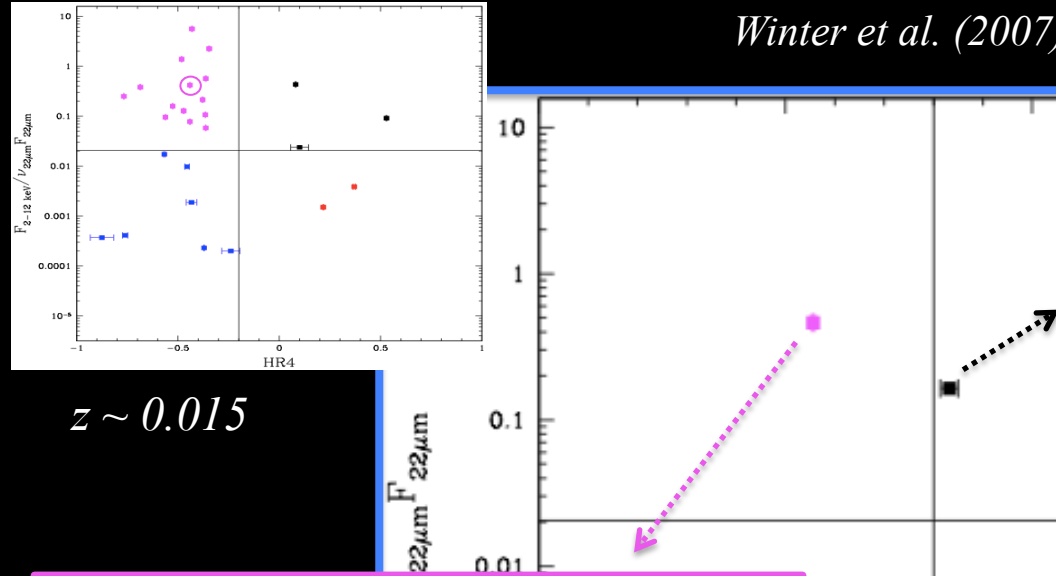
*check for  
variability*

$\Delta F_X > 2$   
and/or  
 $\Delta \text{HR4} > 2$

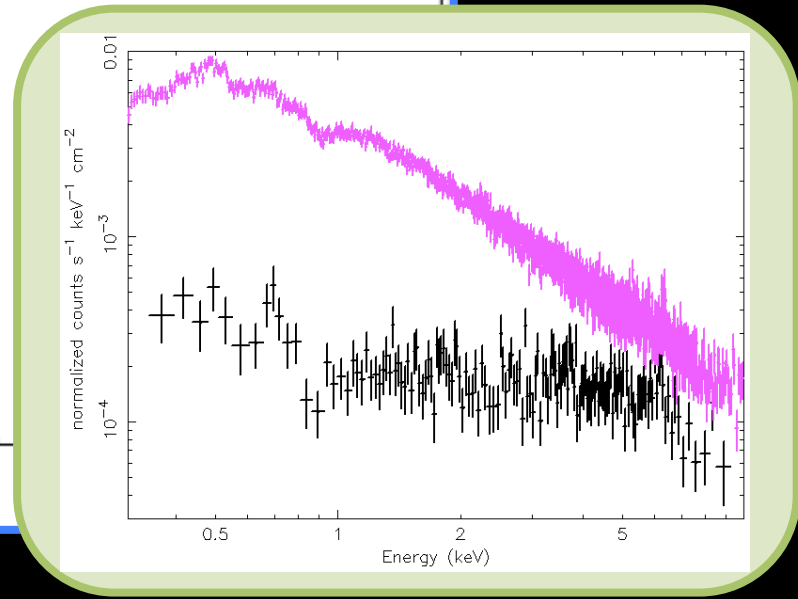
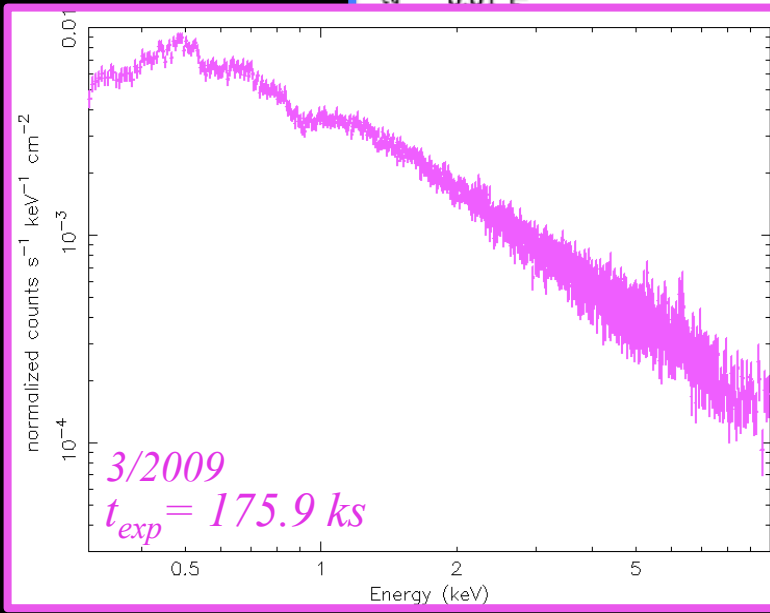
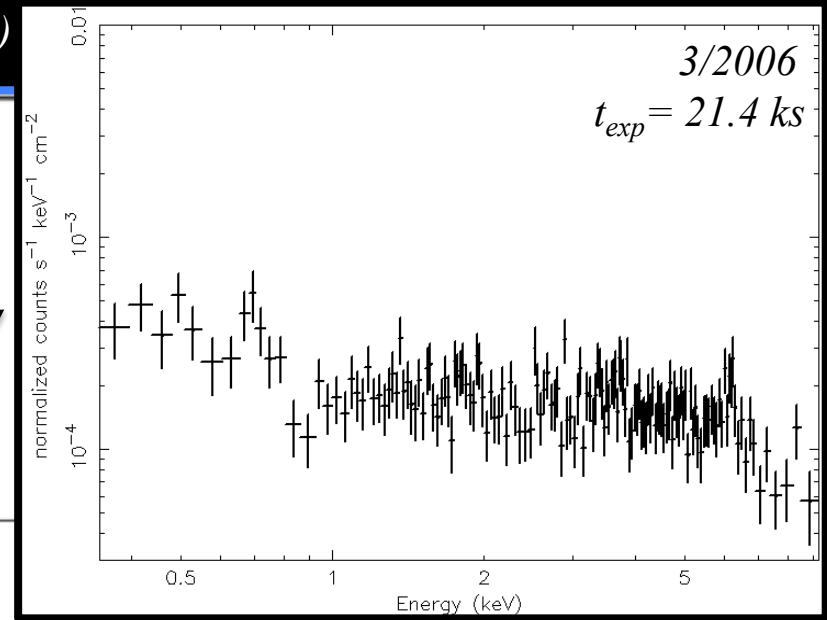
*~33% of the sources  
with multiple detections*

# Some examples of variable sources - NGC 6860

Winter et al. (2007)



$z \sim 0.015$

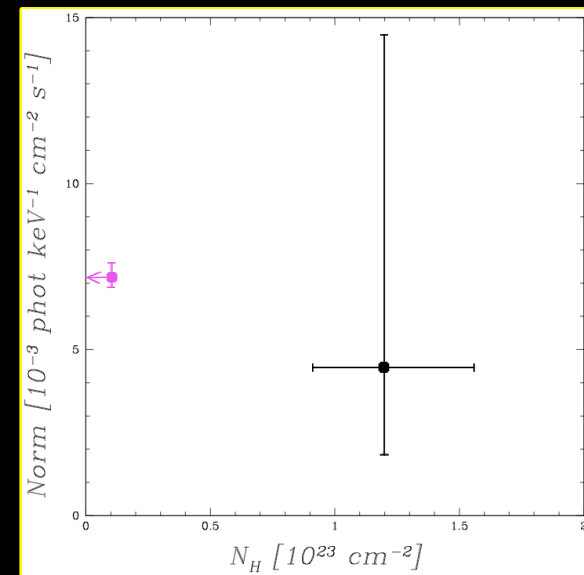
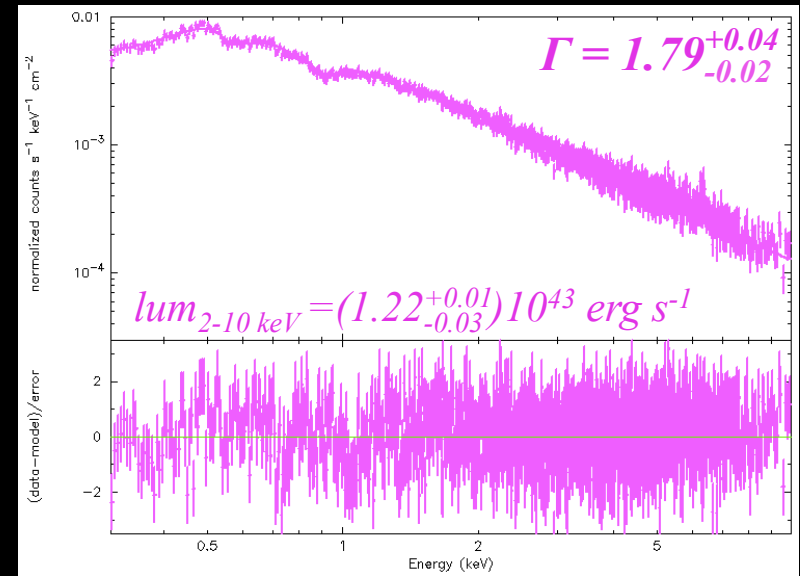
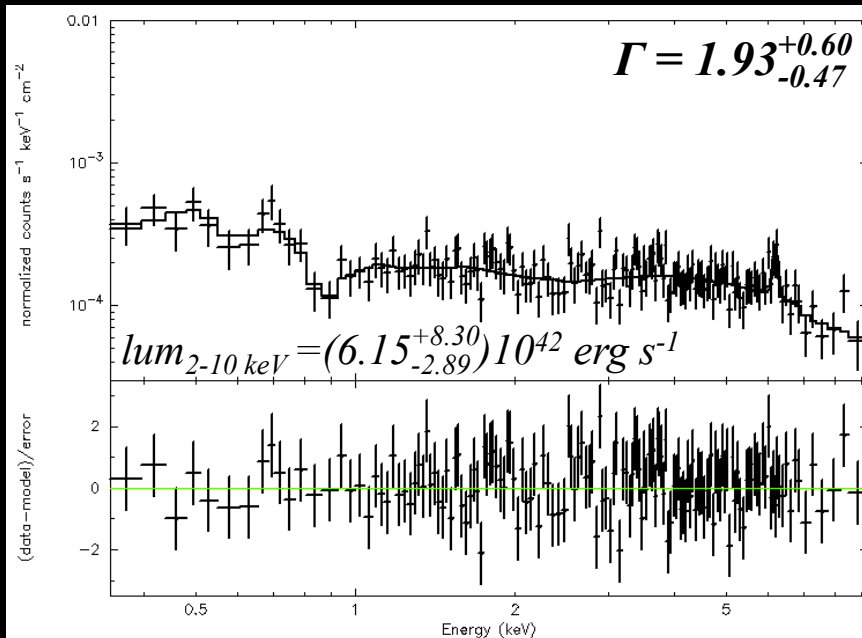


Winter et al. (2010)

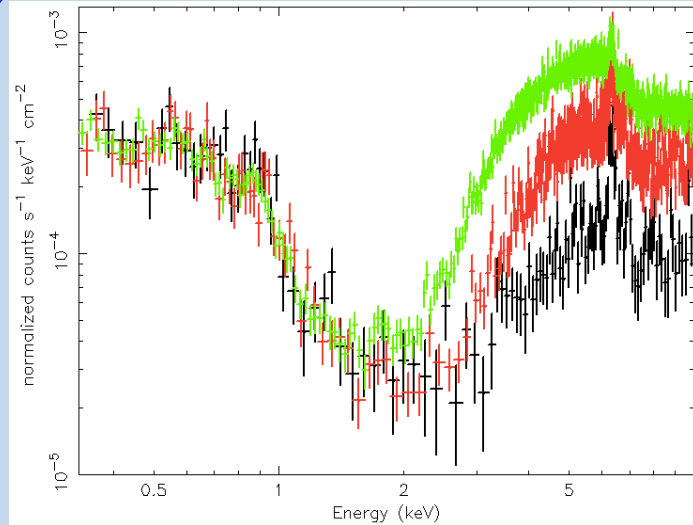
# Some examples of variable sources - NGC 6860

- *absorbed powerlaw*
- *ionized absorber*
- *reflection component*
- *FeI  $k_\alpha$  line*

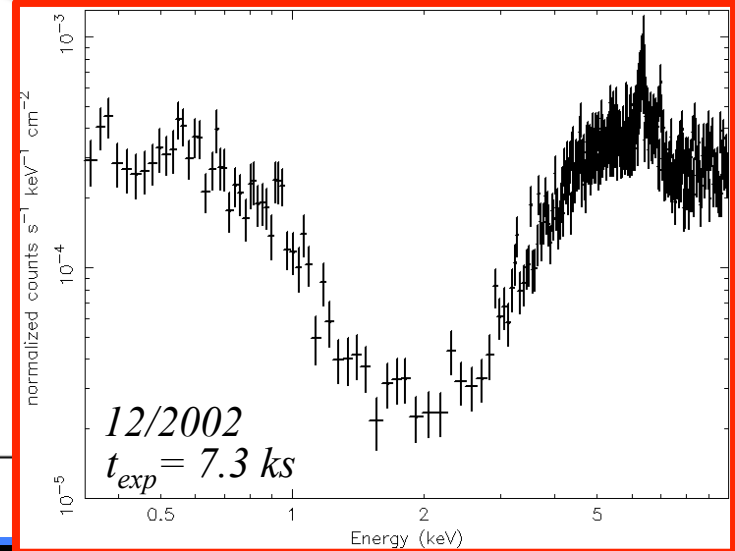
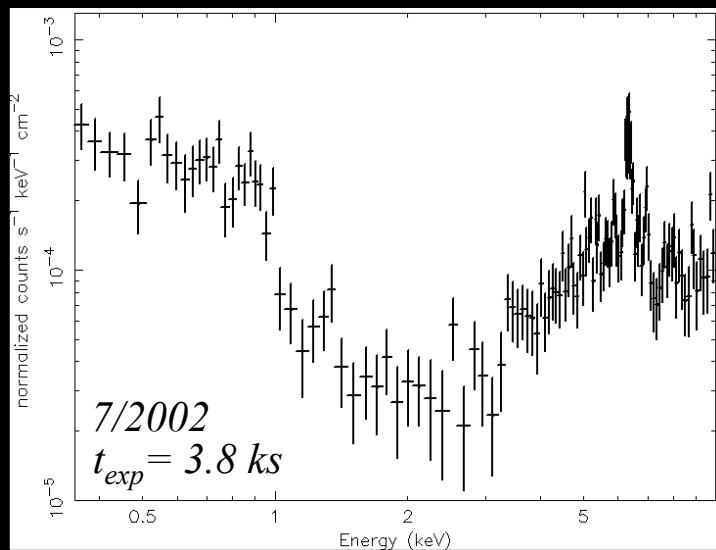
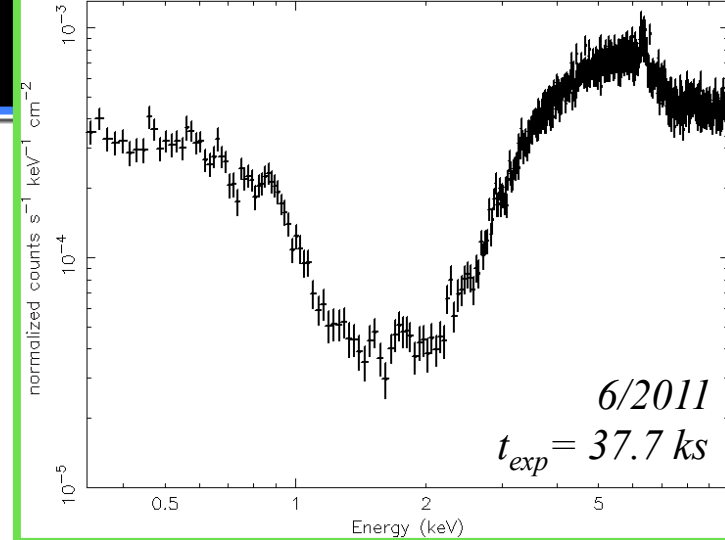
$z \sim 0.015$



# Some examples of variable sources - NGC 4388



$z \sim 0.008$

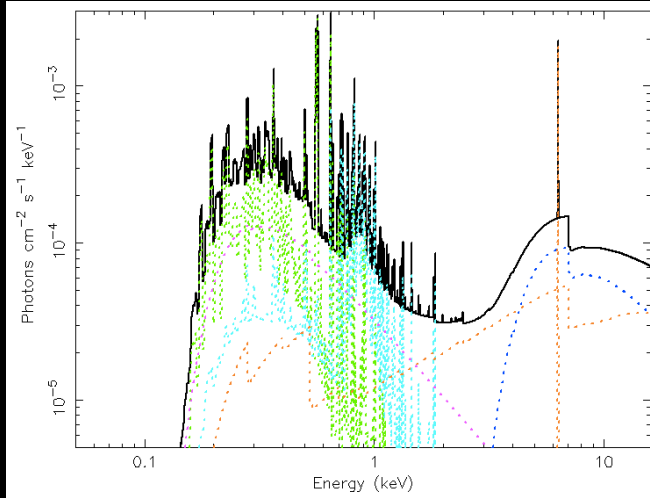


Beckmann et al. (2004)

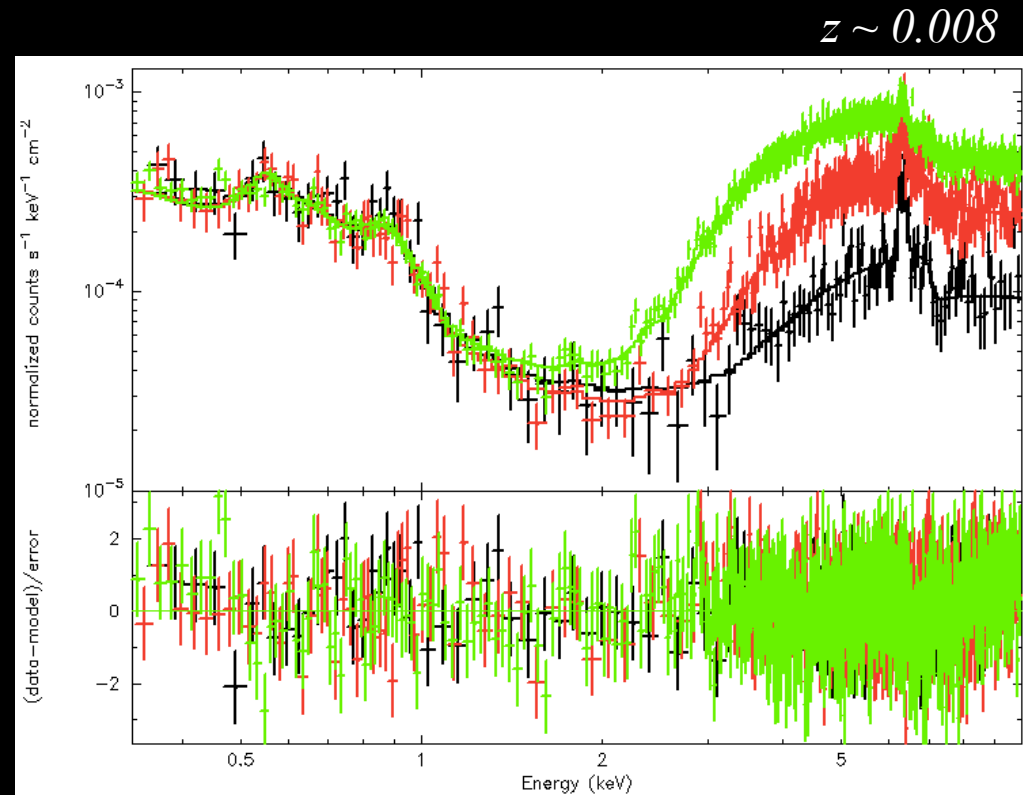
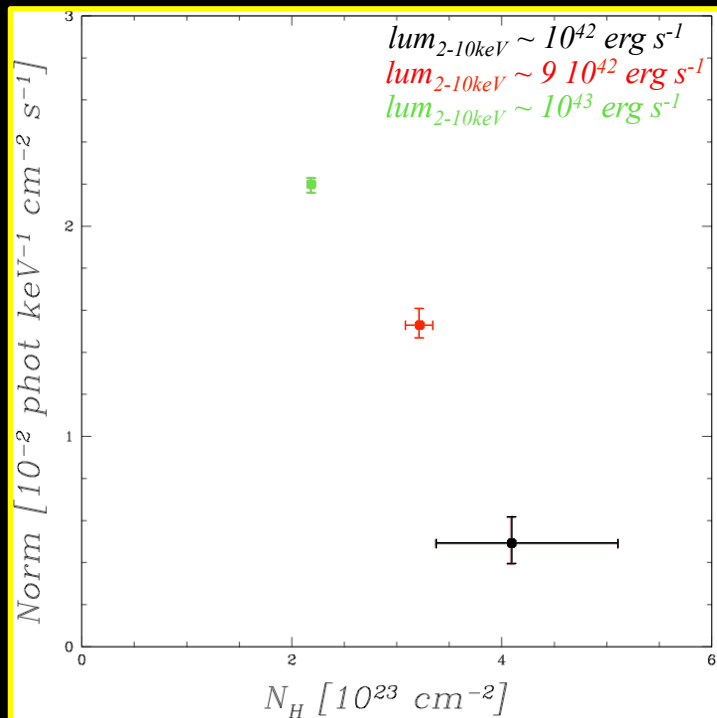
Active Galactic Nuclei 12 – Naples, 26-29 September 2016

Beckmann et al. (2004)

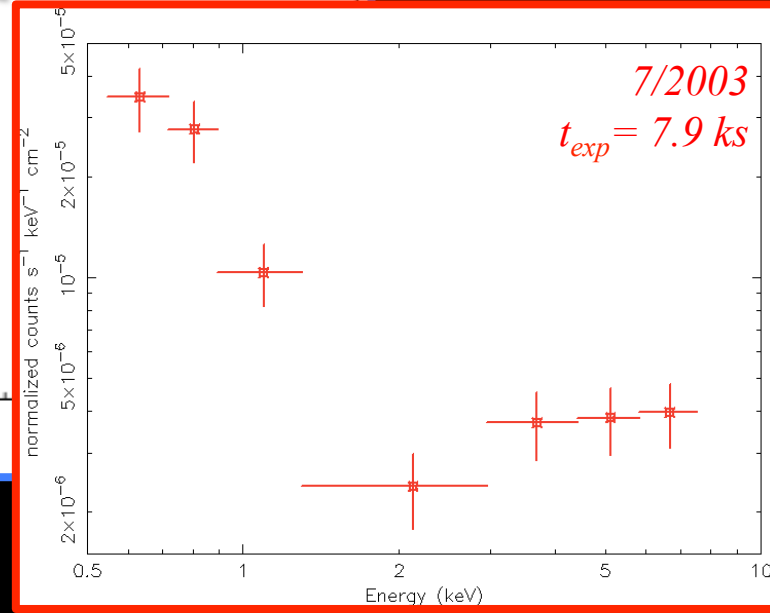
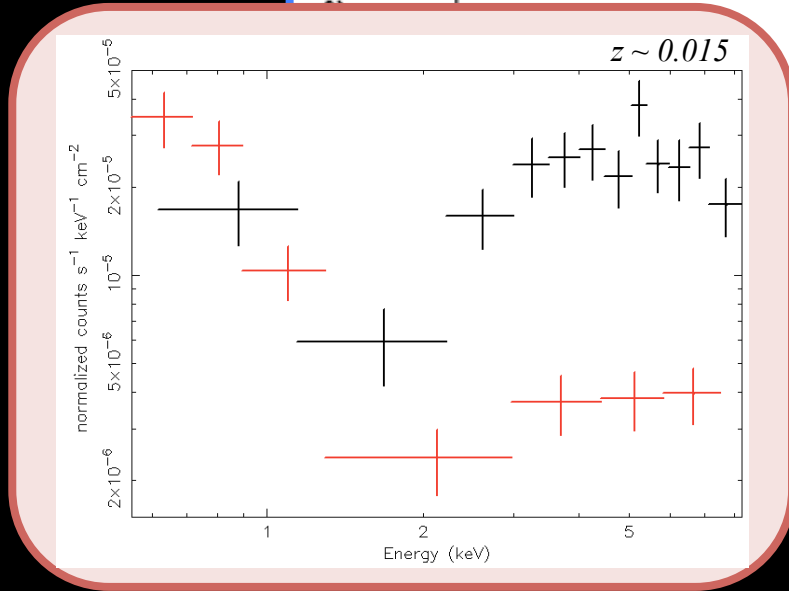
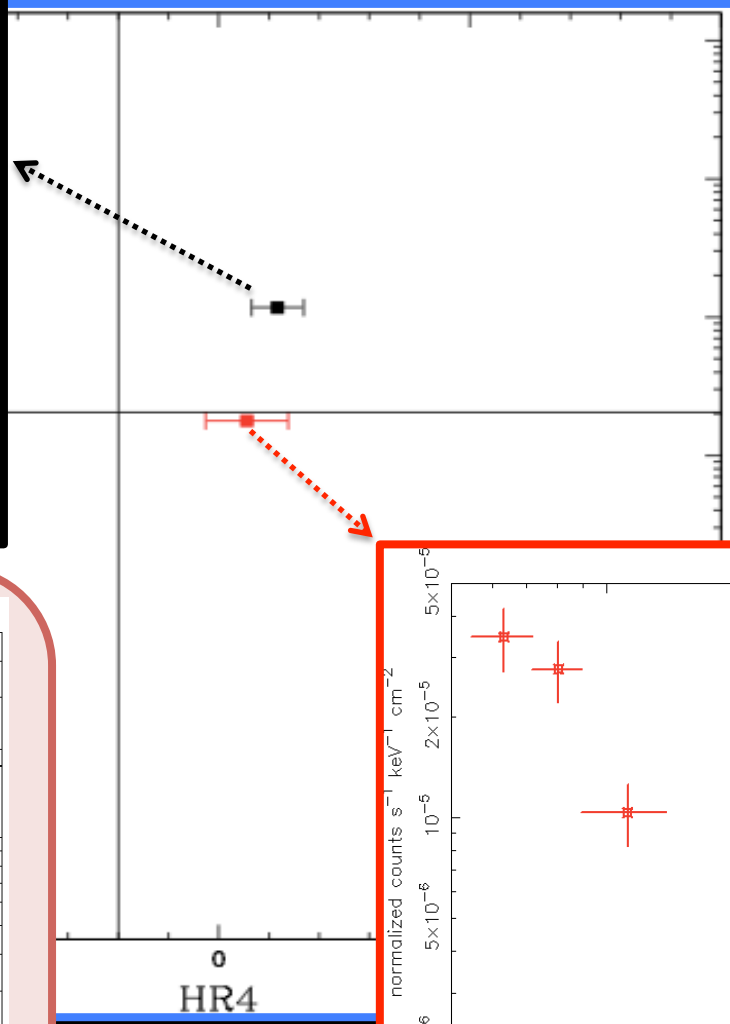
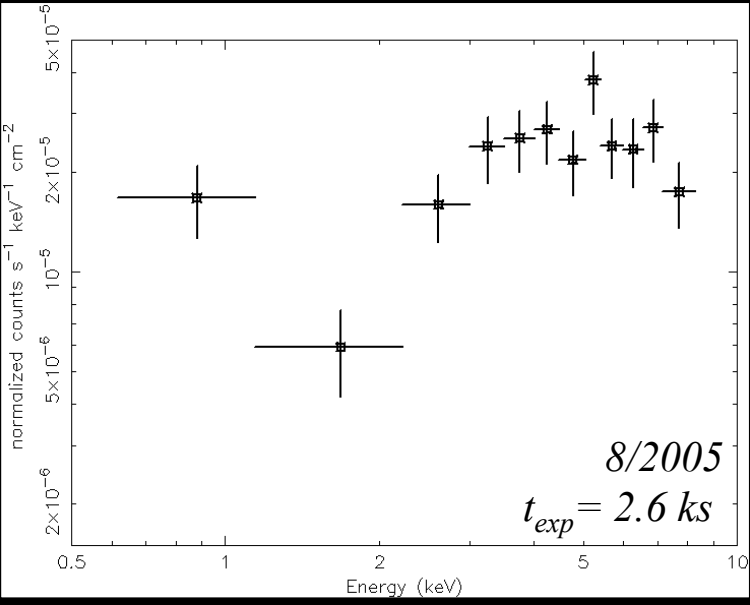
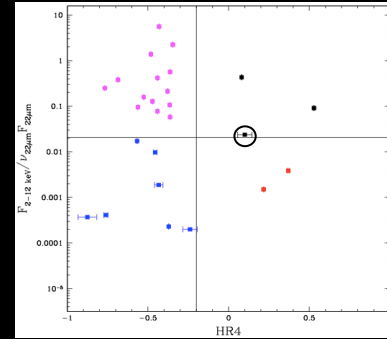
# Some examples of variable sources - NGC 4388



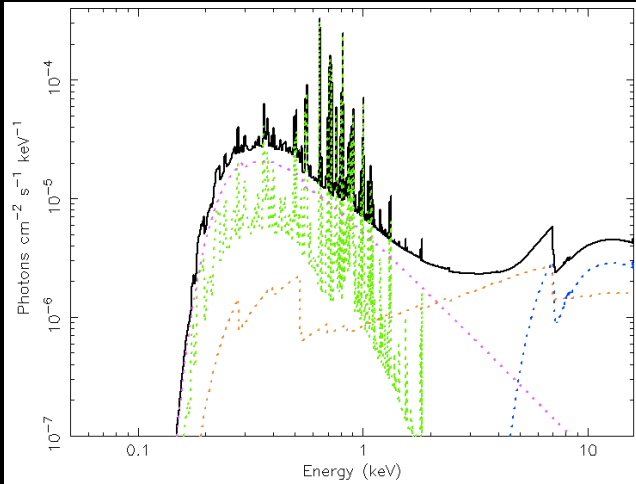
- thermal components:  $kT_1 = (0.19 \pm 0.01) \text{ keV}$   
 $kT_2 = (0.67^{+0.04}_{-0.03}) \text{ keV}$
- scattering < 1%
- absorbed powerlaw:  $\Gamma = 1.7$  (fixed)
- reflection component + FeI  $k_\alpha$  line



# Some examples of variable sources - NGC 214



# Some examples of variable sources - NGC 214



- *thermal component:  $kT = 0.35^{+0.29}_{-0.10}$  keV*
- *scattering < 1%*
- *absorbed powerlaw:  $\Gamma = 1.9$  (fixed)*
- *reflection component*

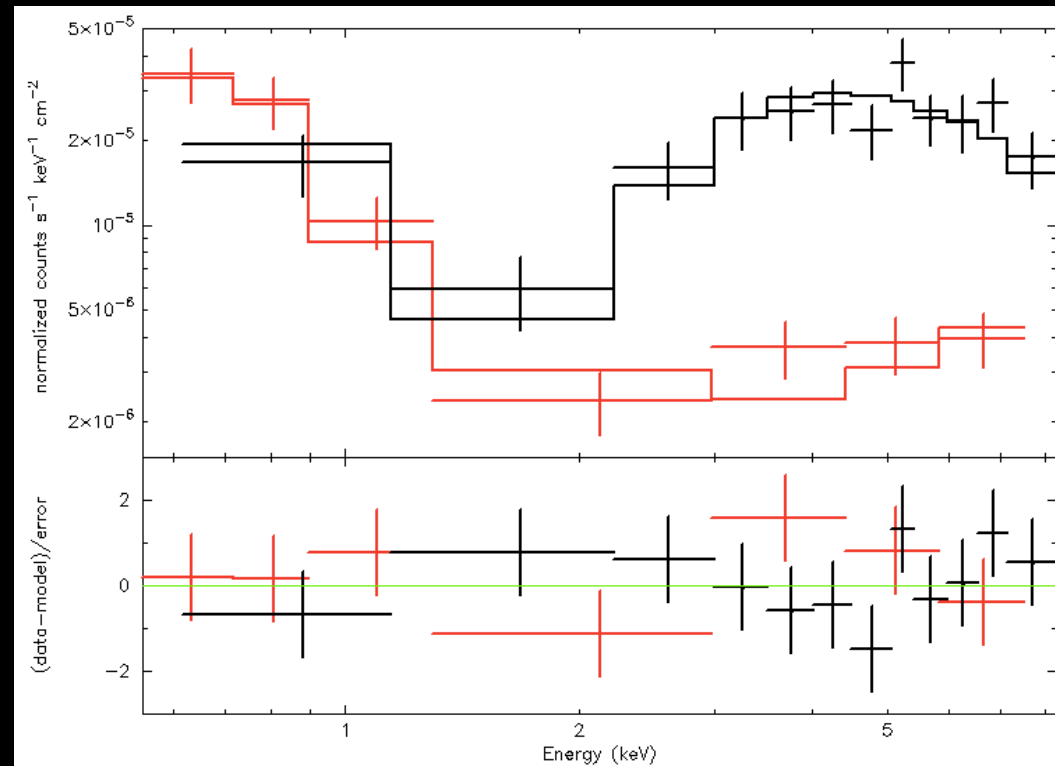
$$N_H = (1.19^{+0.43}_{-0.29}) 10^{23} \text{ cm}^{-2}$$

$$N_H = (1.23^{+0.97}_{-0.32}) 10^{24} \text{ cm}^{-2}$$

$$lum_{2-10\text{keV}} \sim 10^{42} \text{ erg s}^{-1}$$

$$lum_{2-10\text{keV}} \sim 10^{42} \text{ erg s}^{-1}$$

$z \sim 0.015$



# *Conclusions and future perspectives*

## **Summary:**

- *Revisiting mid-IR/X-ray selection of local AGN sources with the latest 3XMM and WISE data*
- *Investigation of the role of variability within the AGN selection and classification through a diagnostic plot*

## **Conclusions:**

- *Plot stability*
- *Diagnostic plot as hint of the origin of source variability*
- *Overall, plot in agreement with spectral analysis*

## **Future perspectives:**

- *Carry out variable sources spectral analysis*
- *XMM/NuSTAR proposal to investigate the origin of variability*
- *Investigation of starbursts variability*



Thank you!

*Napoli, 26-29 September 2016*

**Active Galactic Nuclei 12**  
*a Multi-Messenger perspective*

