

Casi scientifici con astronomia X nel periodo 2020-2035 : Hard X-ray

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Goals for Hard X-ray (> 10 keV)

- ◆ Locate massive black holes \rightarrow X-ray Background
- ◆ Study the population of Compact objects in our Galaxy
- ◆ Explosion dynamics and Nucleosynthesis in SN
- ◆ Understanding relativist jets in Blazars
- ◆ Galactic Center
- ◆ AGN and X-ray Binaries hard X-ray spectra
- ◆ ...

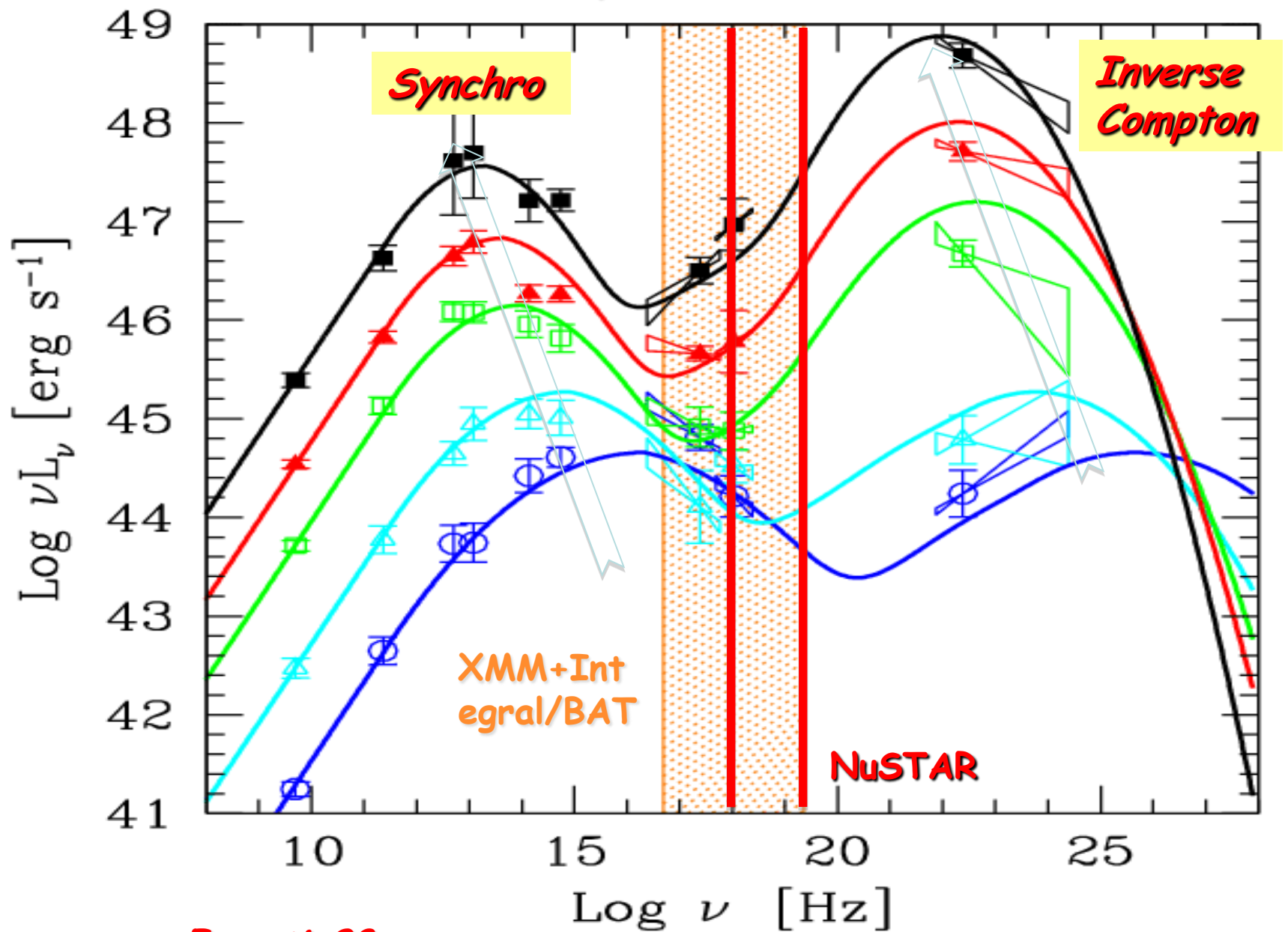
Hard X-ray in 2012-2020

- June 2012 - 2015(?) NuSTAR
- ≥ 2014 – 2020 (?) & ASTRO-H
- >2013 ASTROSAT – ART-XC

Spectral and Imaging capabilities > 8 -10 keV (Giorgio talk)

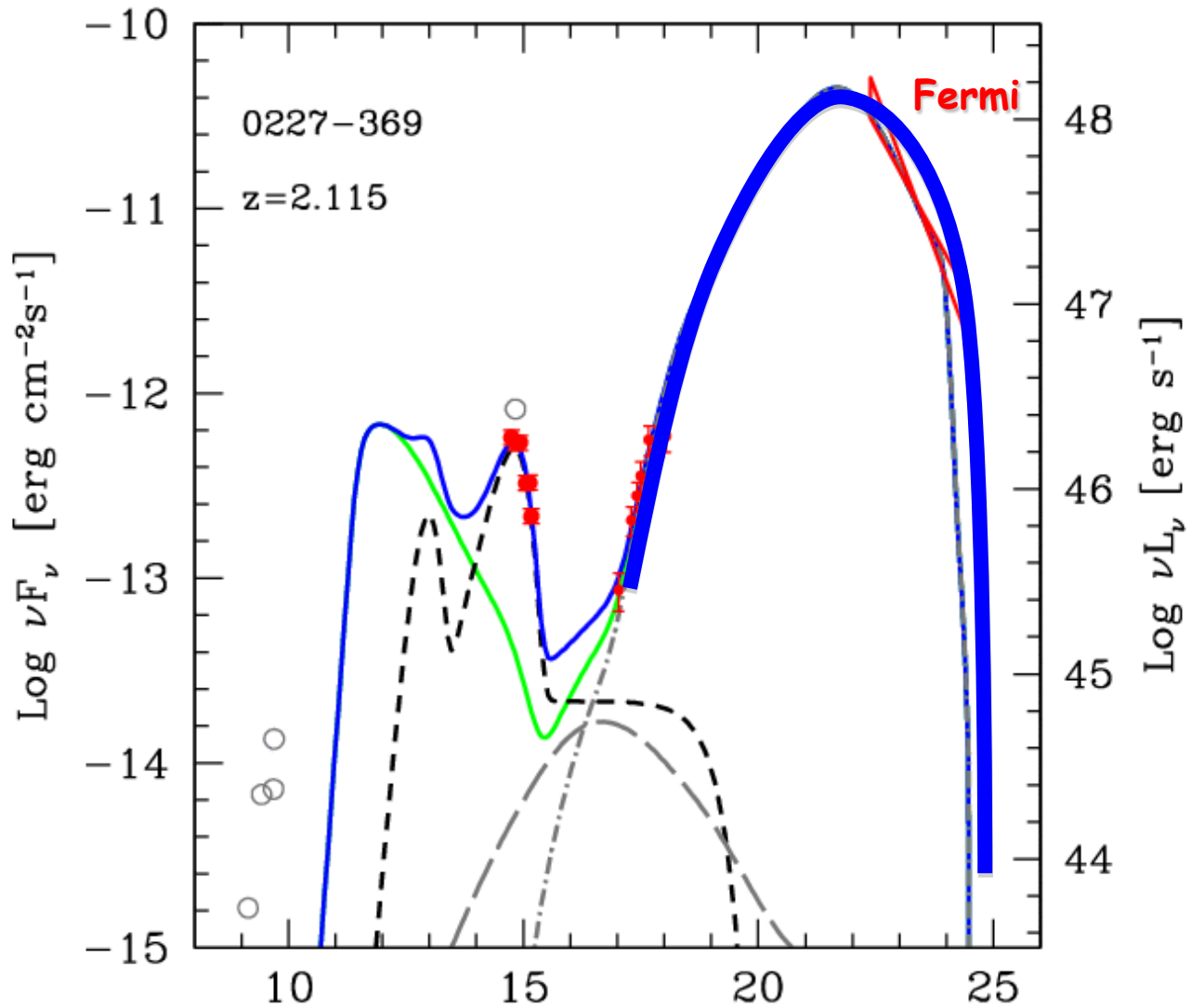
A few examples: BLAZARS, Obscured AGN, SN

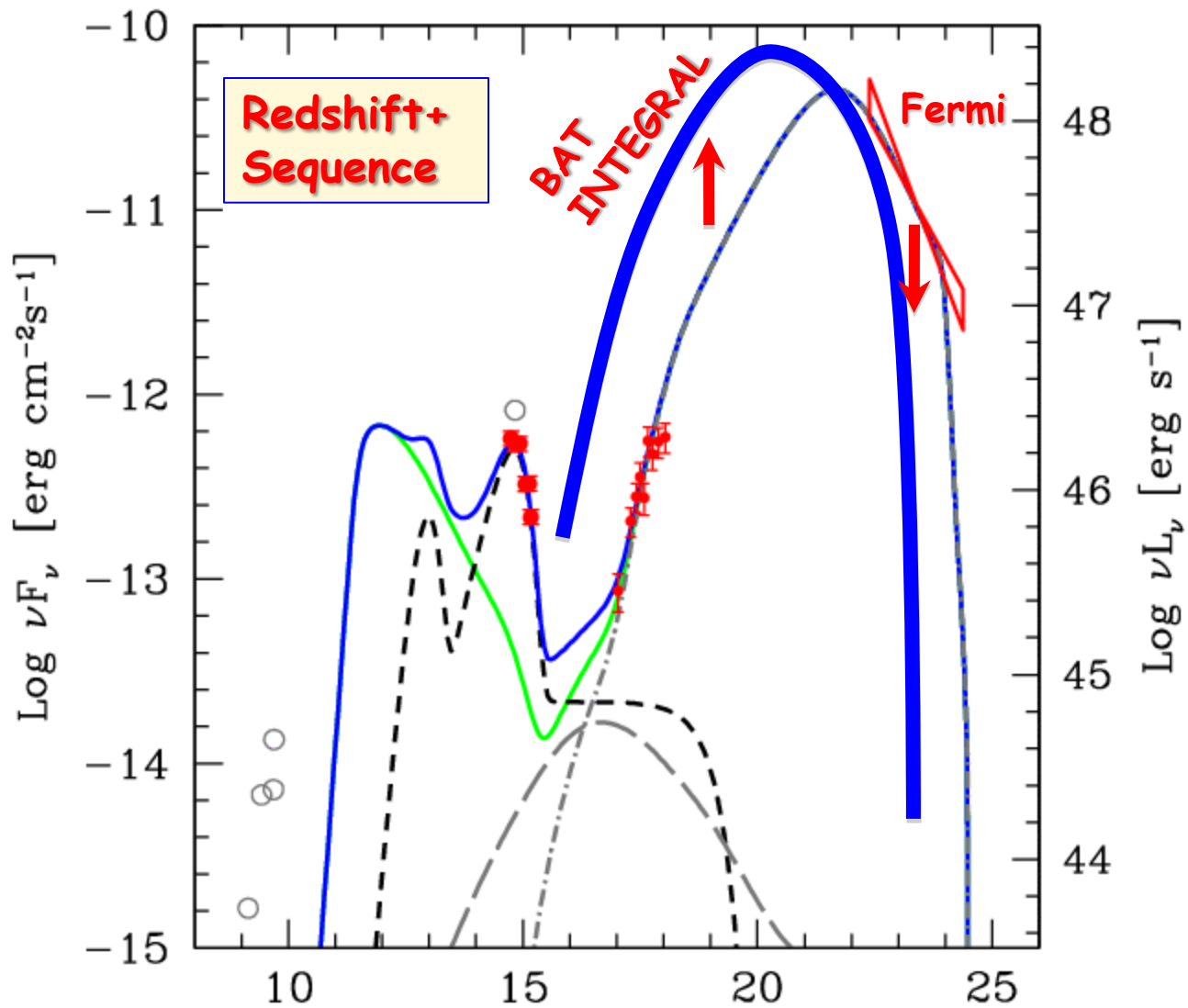
The "blazar sequence"

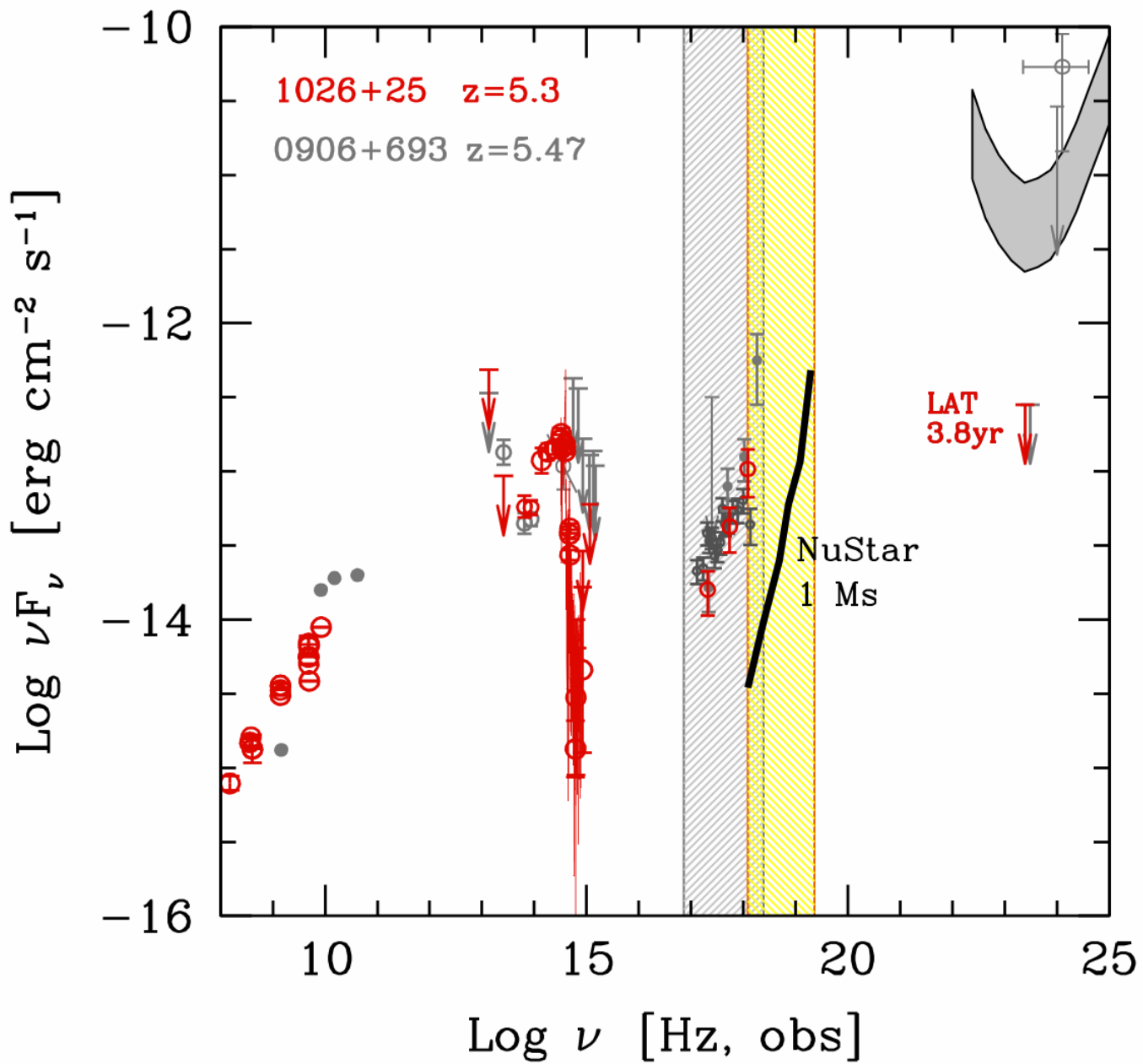


Fossati+98

The most luminous blazars: BAT and INTEGRAL blazars: z up to ~4

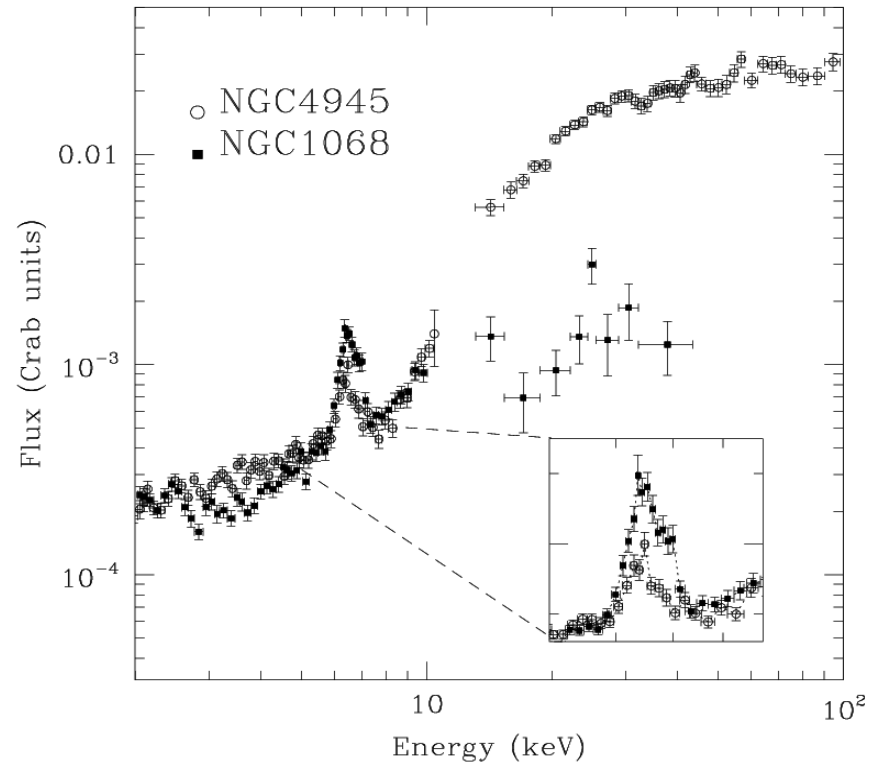
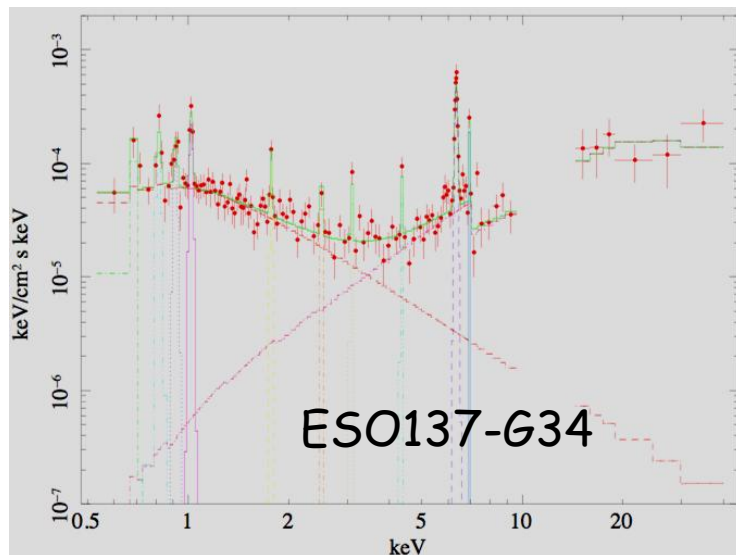
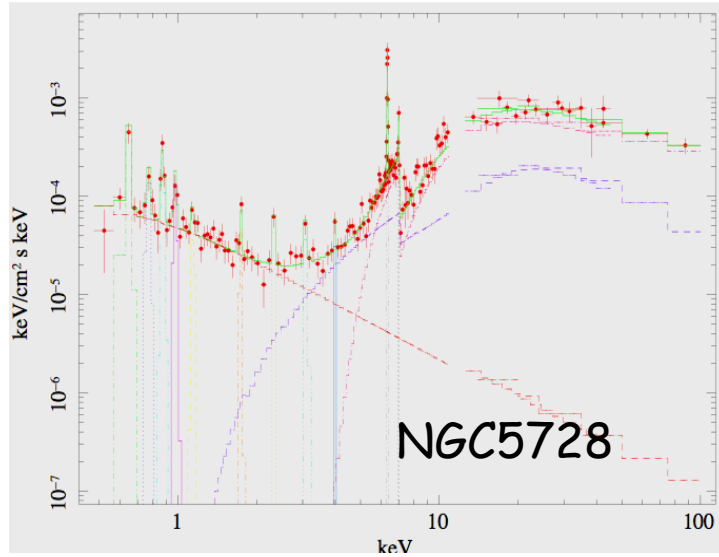






Sbarrato+ 2012

Obscured AGN & Reflection



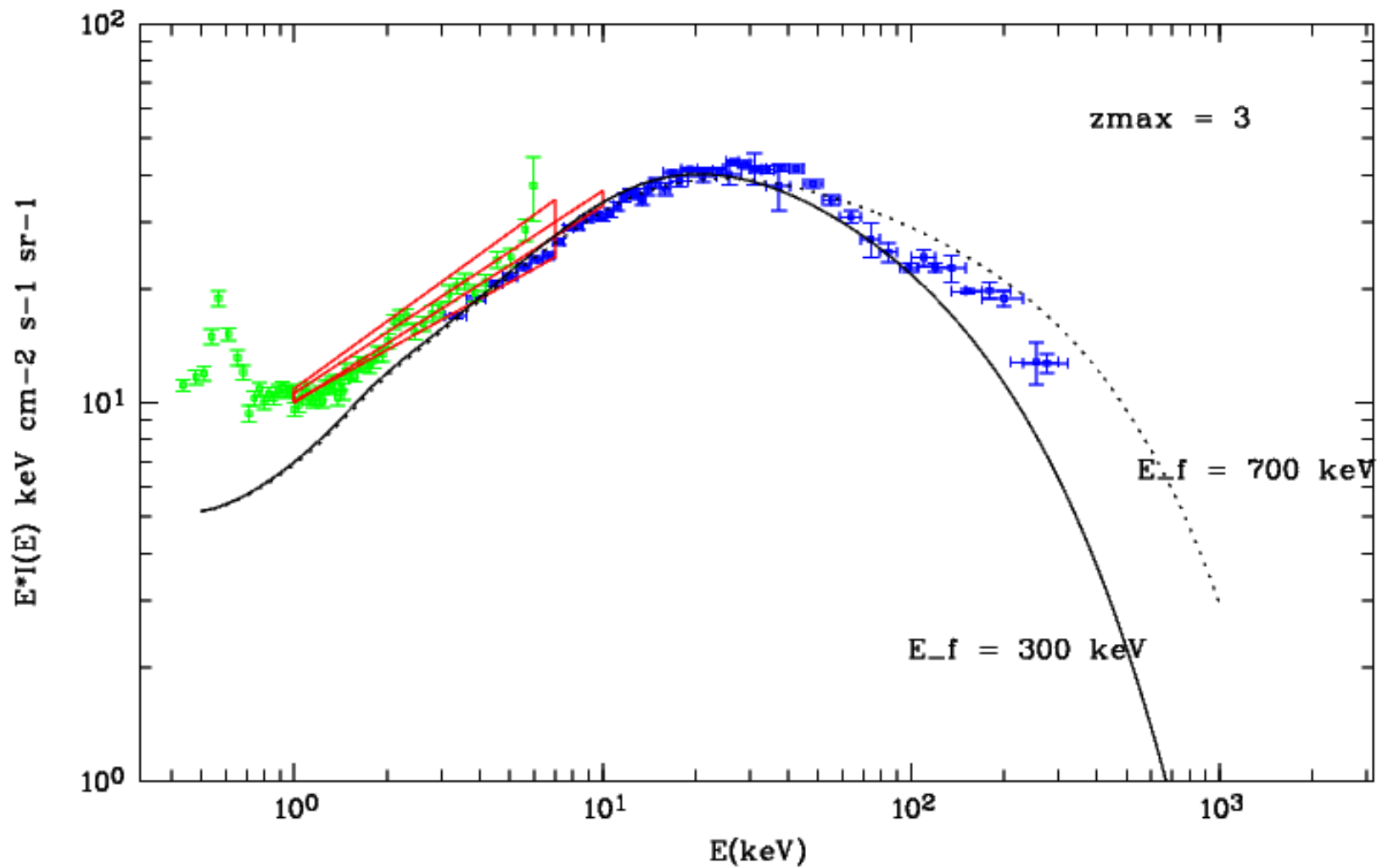
NuSTAR already exceptional results
For bright sources, deeper exposures will
push the limiting flux to a few 10^{-13} and the
Redshifts to $z \sim 1$ for unobscured AGN

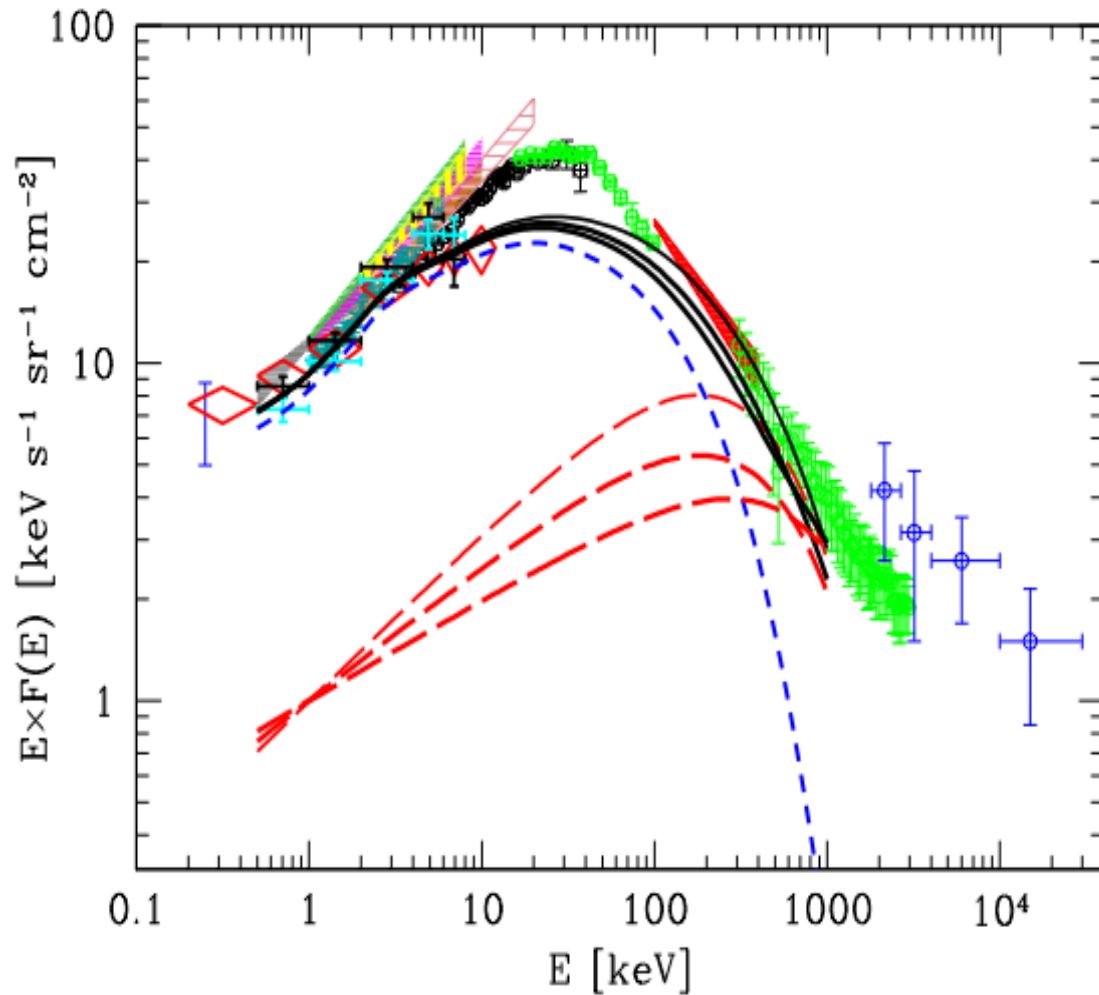
What would be the priority beyond 2020?

SPECTROSCOPY – IMAGING

Hard X-ray spectra of extragalactic and Galactic sources will be obtained and many scientific issues investigated down to relatively faint fluxes (NuSTAR spectra, Brighter limit for ASTRO-H, LOFT) and relatively high redshifts (0.5 for normal AGN, 3-5 for ultra luminous QSO and Blazars)

Spectroscopy > 50-100 keV



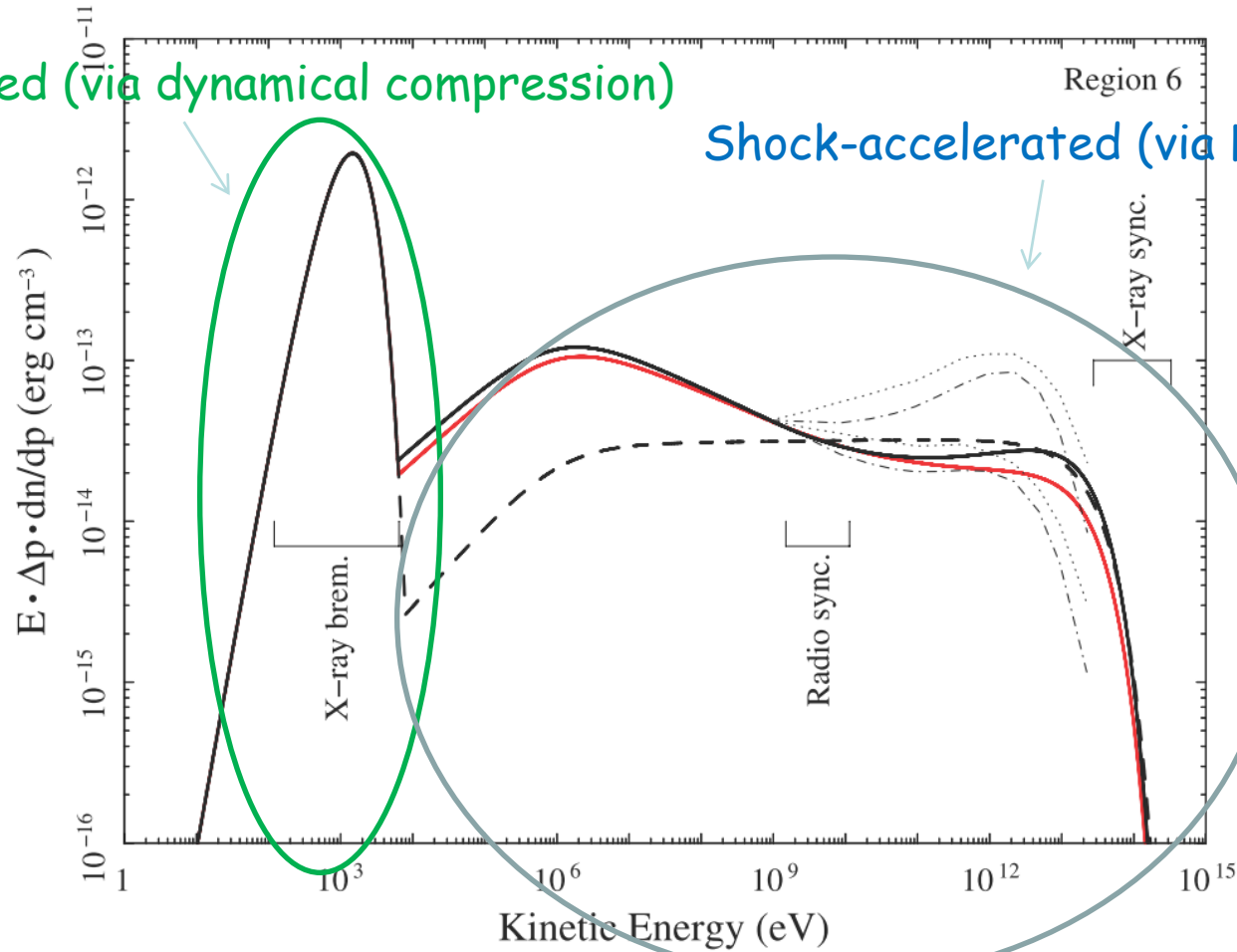


- Radio loud AGN / Blazars contribute some 10% to the soft XRB (Giommi et al 2005; Ajello)
- A break or cut-off must be present around 1 MeV otherwise the soft-gamma-ray background would be exceeded

Distribution of electrons in a supernova remnant

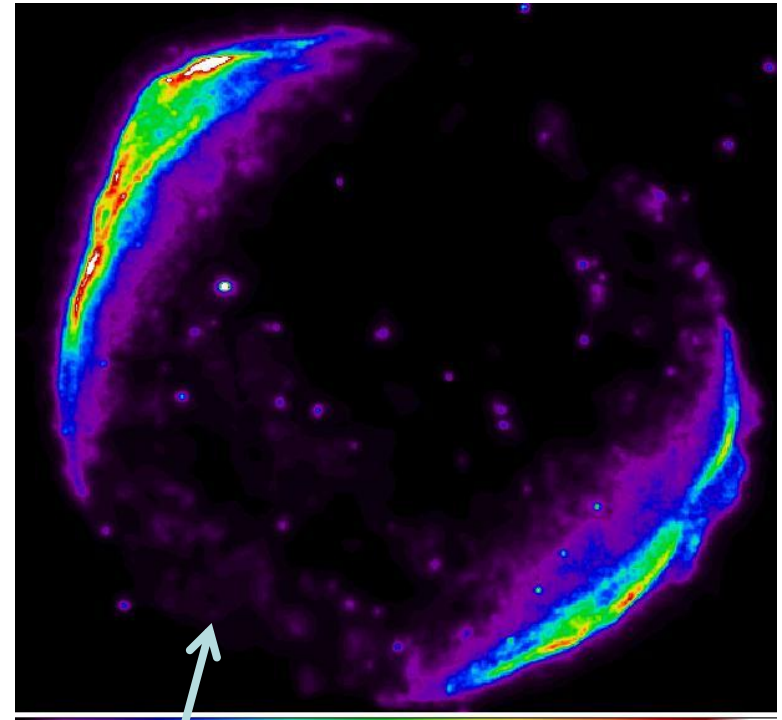
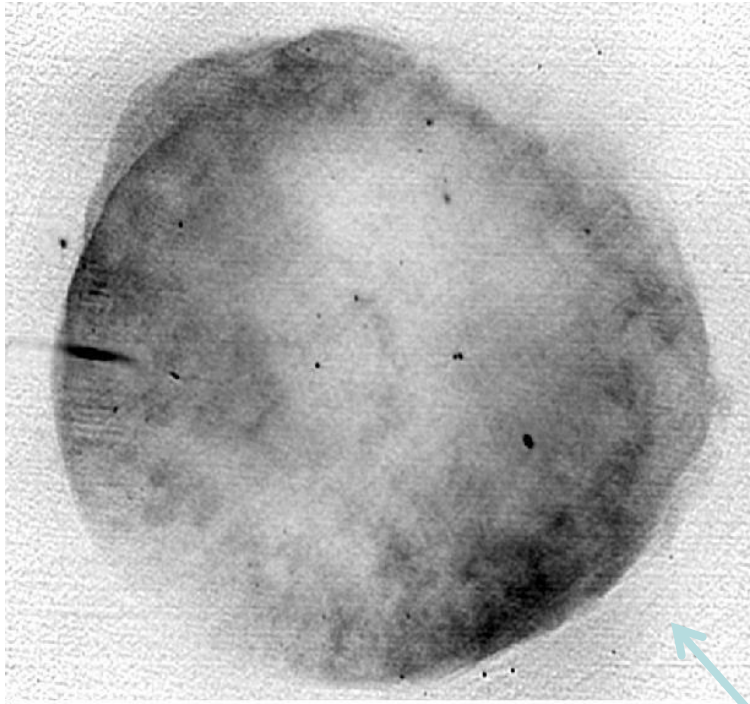
Shock-heated (via dynamical compression)

Shock-accelerated (via Fermi mechanism)



Allen et al. 2008

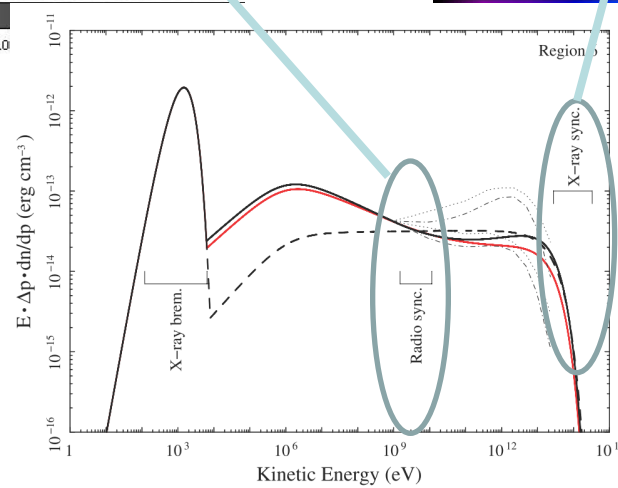
SN1006: the archetype of CR accelerating shell



VLA+single disk 1.5 GHz

XMM EPIC 2-4.5 keV

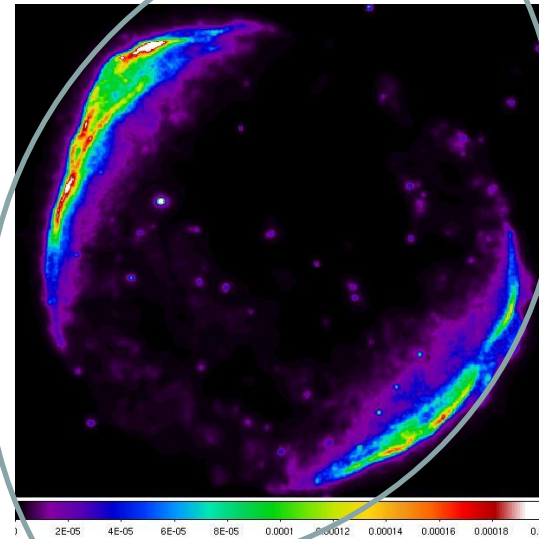
Miceli et al. 2009



- Radio and soft X-ray observations of non-thermal supernova remnants have shown **different local conditions** down to the smallest explored scale (of the order of arcsec)
- Hard X-rays ($E=10-100$ keV) can be of **limited help** for now
- Spectral resolution is ok, **we desperately need improvements on spatial resolution** (which also means background....)

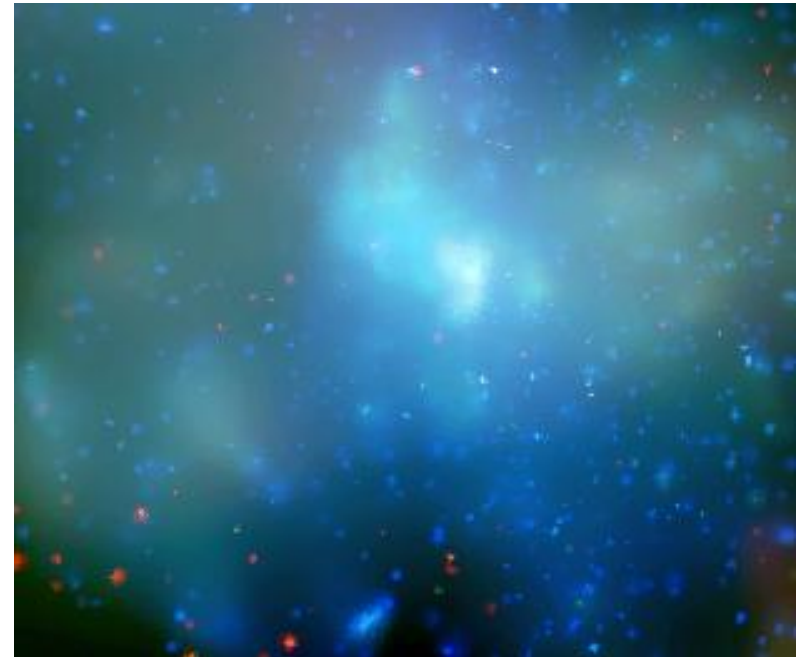
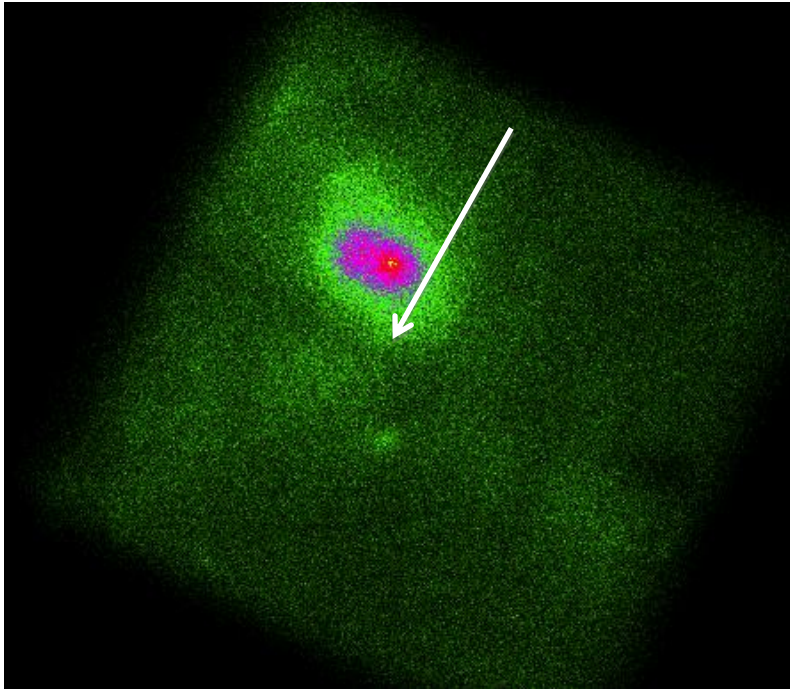
SN1006

- Allen+01
- fit to a broken power-law model
- The entire SNR is in the FoV of PCA at both NE and SW positions



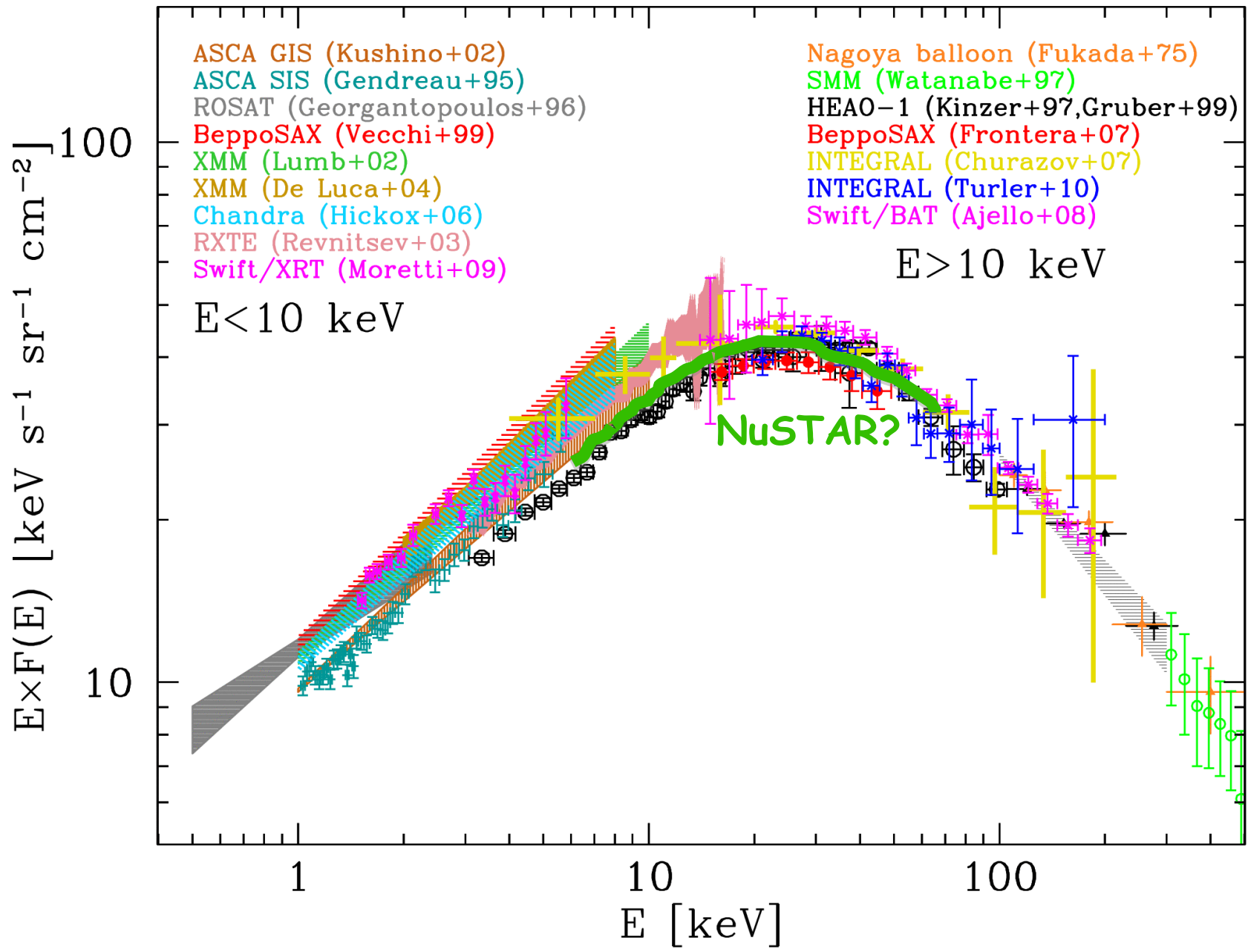
Sgr A*

Sgr A

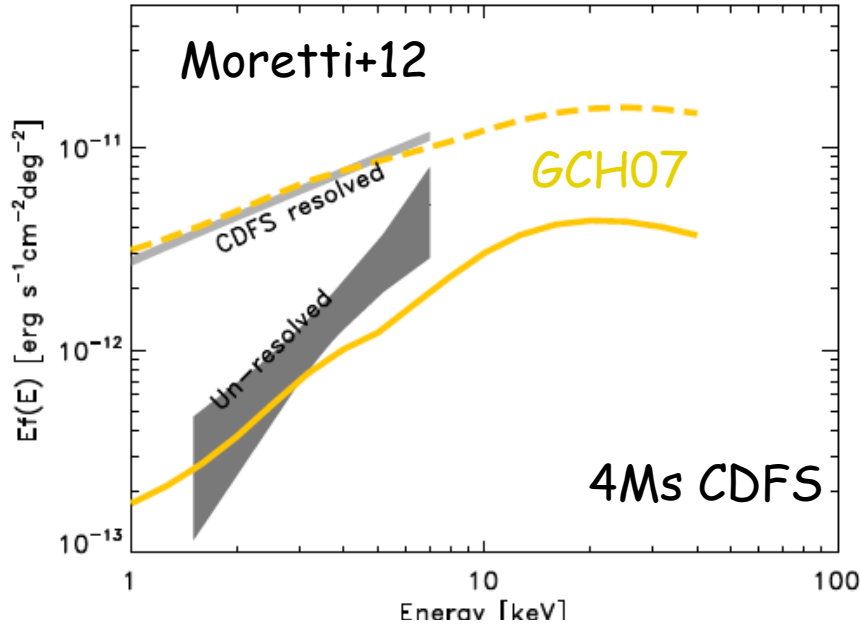


Joint campaign with Chandra and Keck – first night – lots of action!

The cosmic X-ray background spectrum

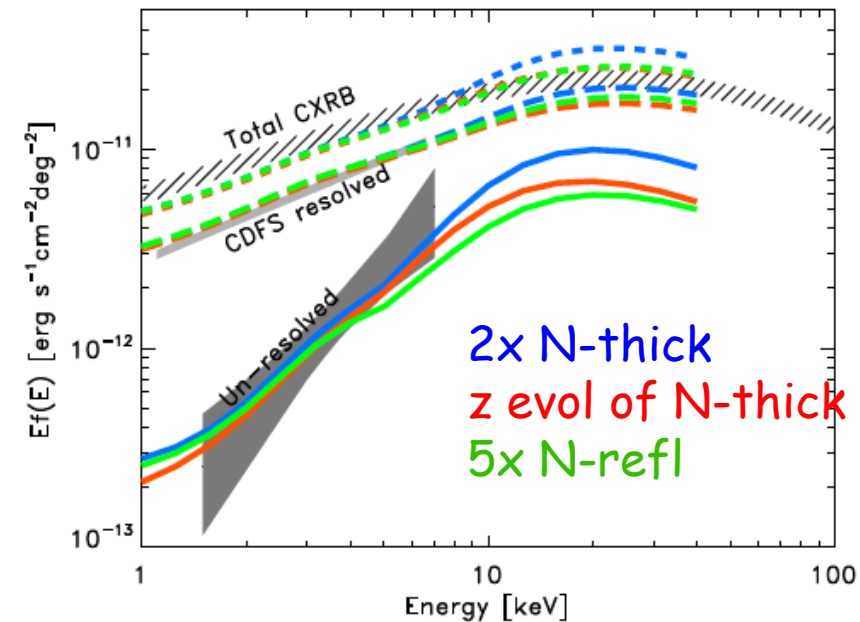


$E < 10$ keV: is the XRB now resolved?

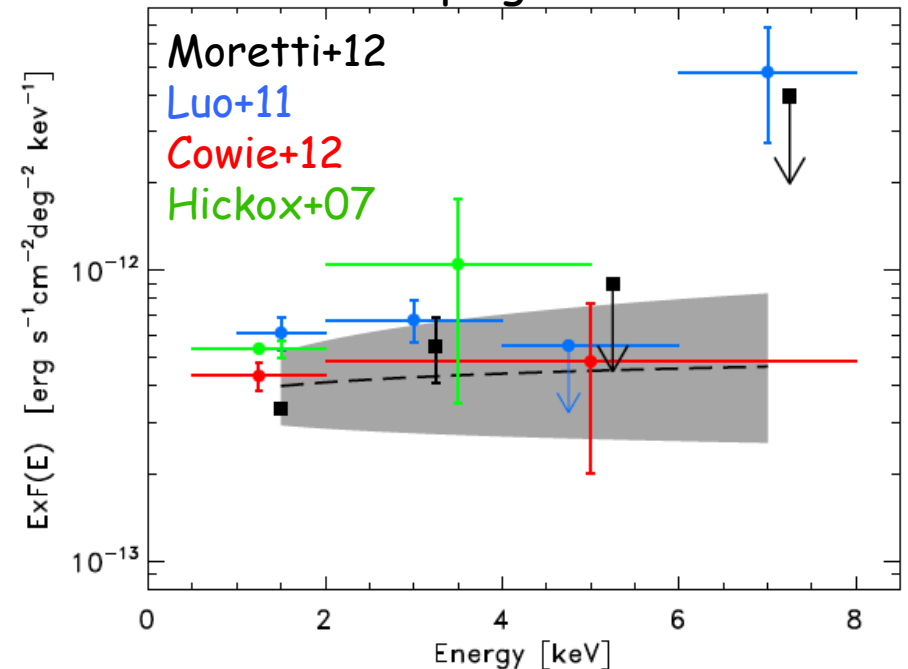


Probably not yet..

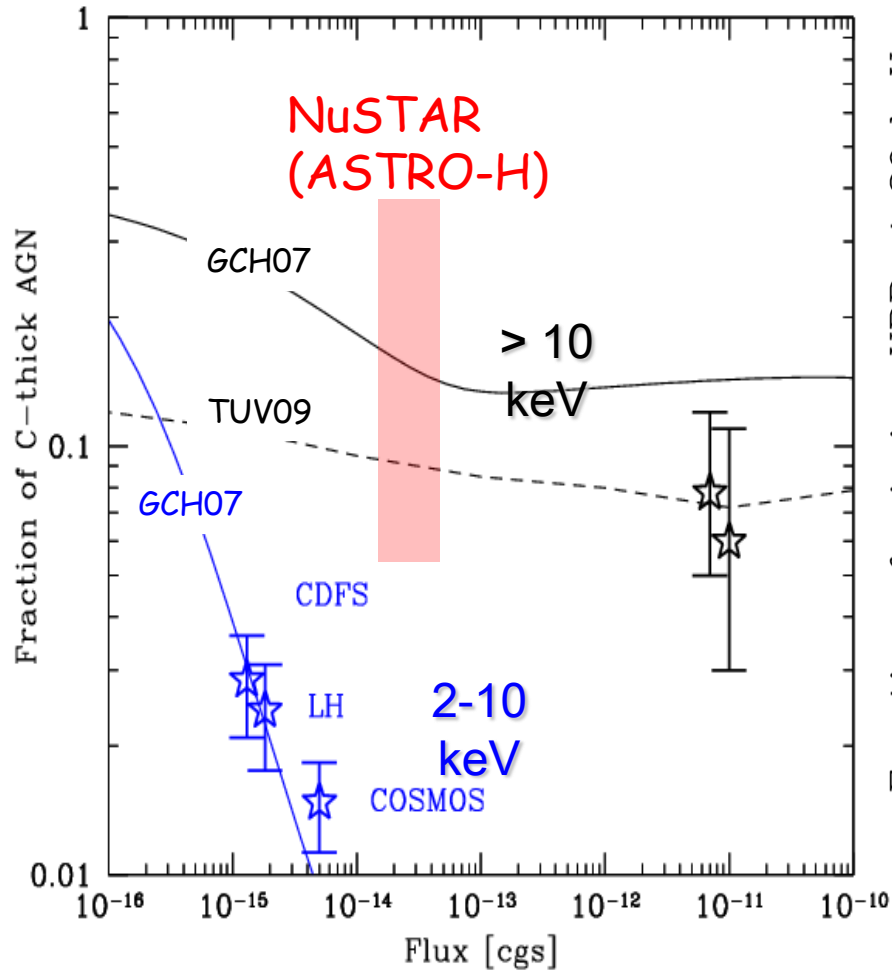
- 1) what is the absolute level of the XRB?
- 2) stacking contradictory (Luo/Xue vs Moretti)



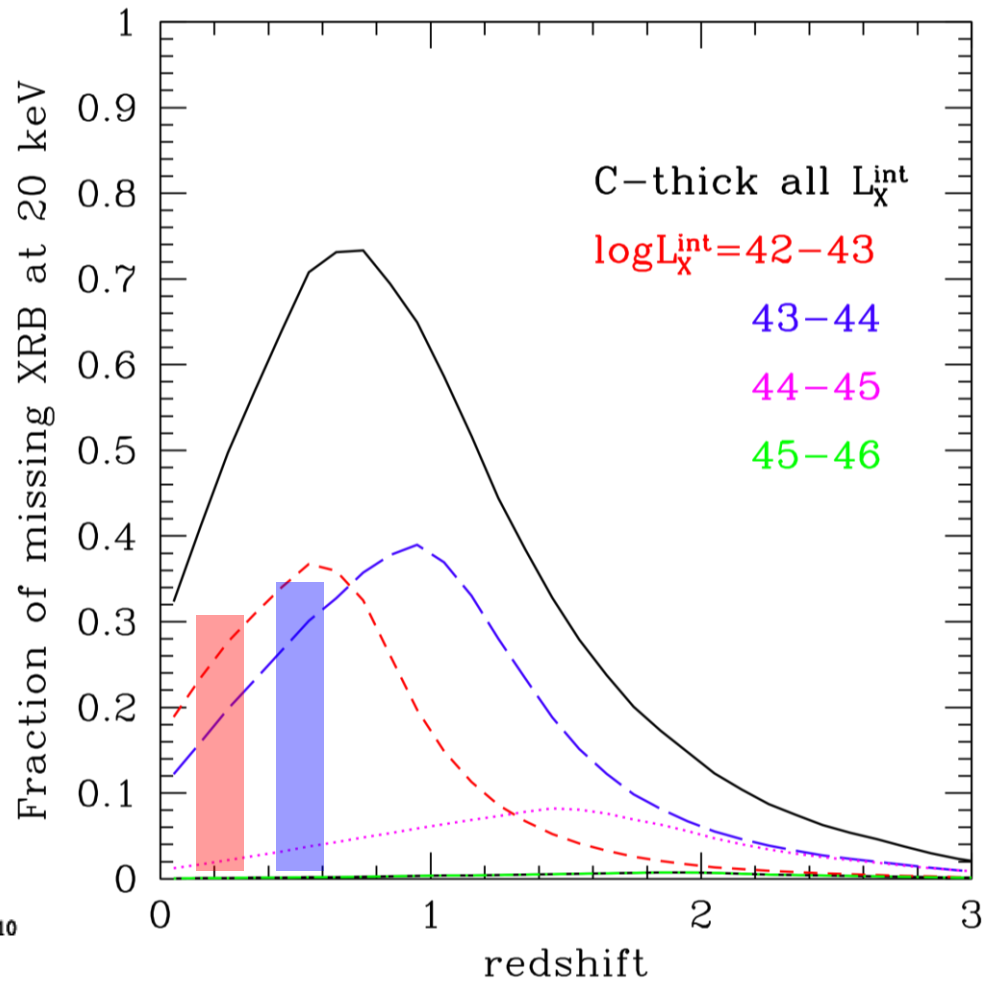
stack of opt galaxies in GOODS



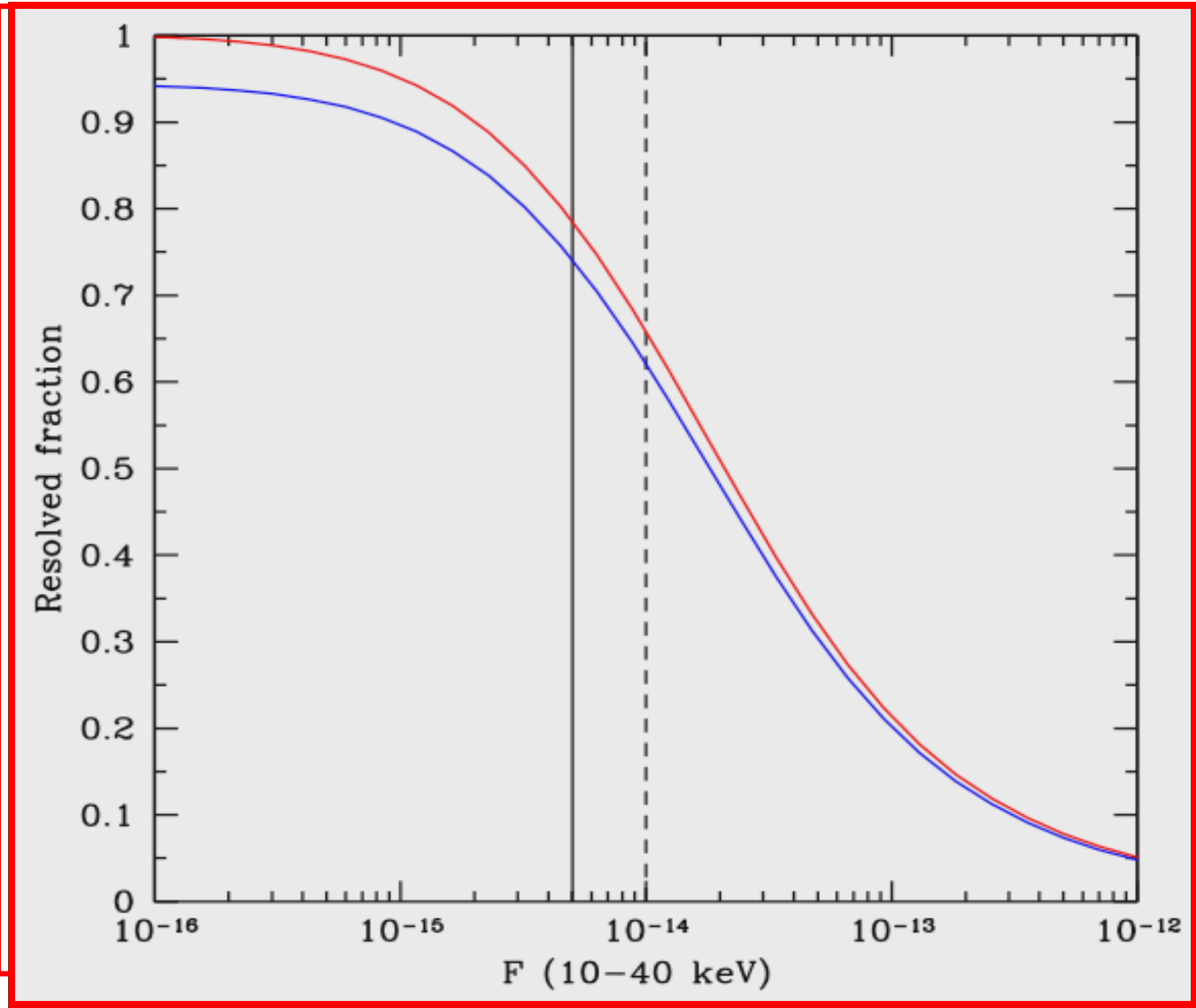
The fraction of C-thick AGN



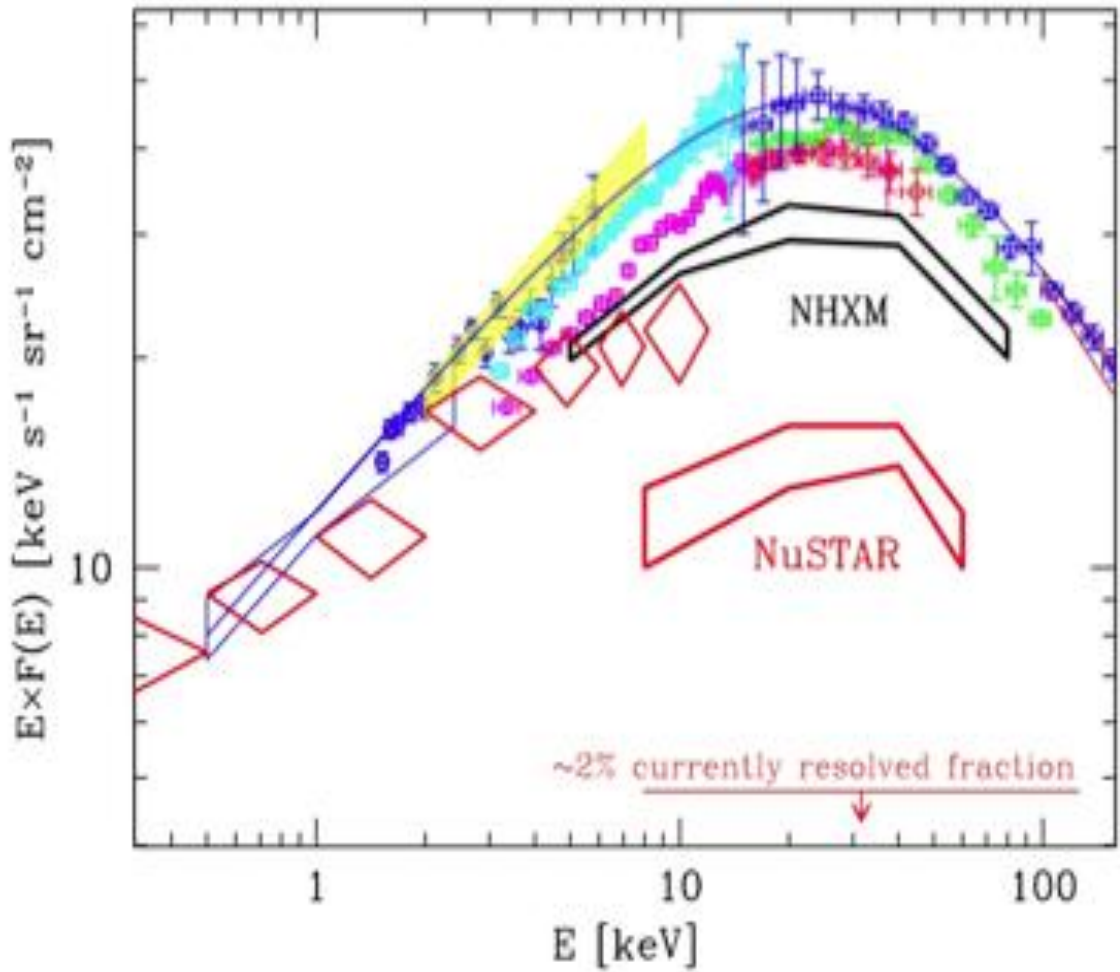
Credit: R. Gilli



NuStar limited to moderate z



Resolving (> 80%) the XRB



NuSTAR \rightarrow 30%

Astro-H $=<$ 10%

Summary

- Spatial Resolution \rightarrow 5 arcsec (?)
- Spectral capabilities $>$ 50 keV

