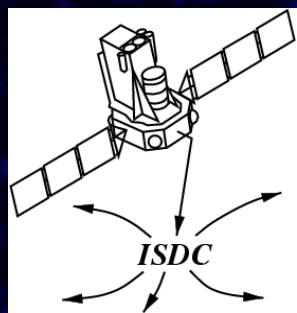
Hard X-rays...INTEGRAL... multiwavelength...variability... ...AGN...3C 273.

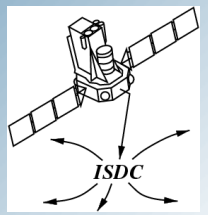
Simona Soldi

INTEGRAL Science Data Centre



SDAST meeting #37, Copenhagen, 13-14 March, 2007

High energy emission from AGN



Contents

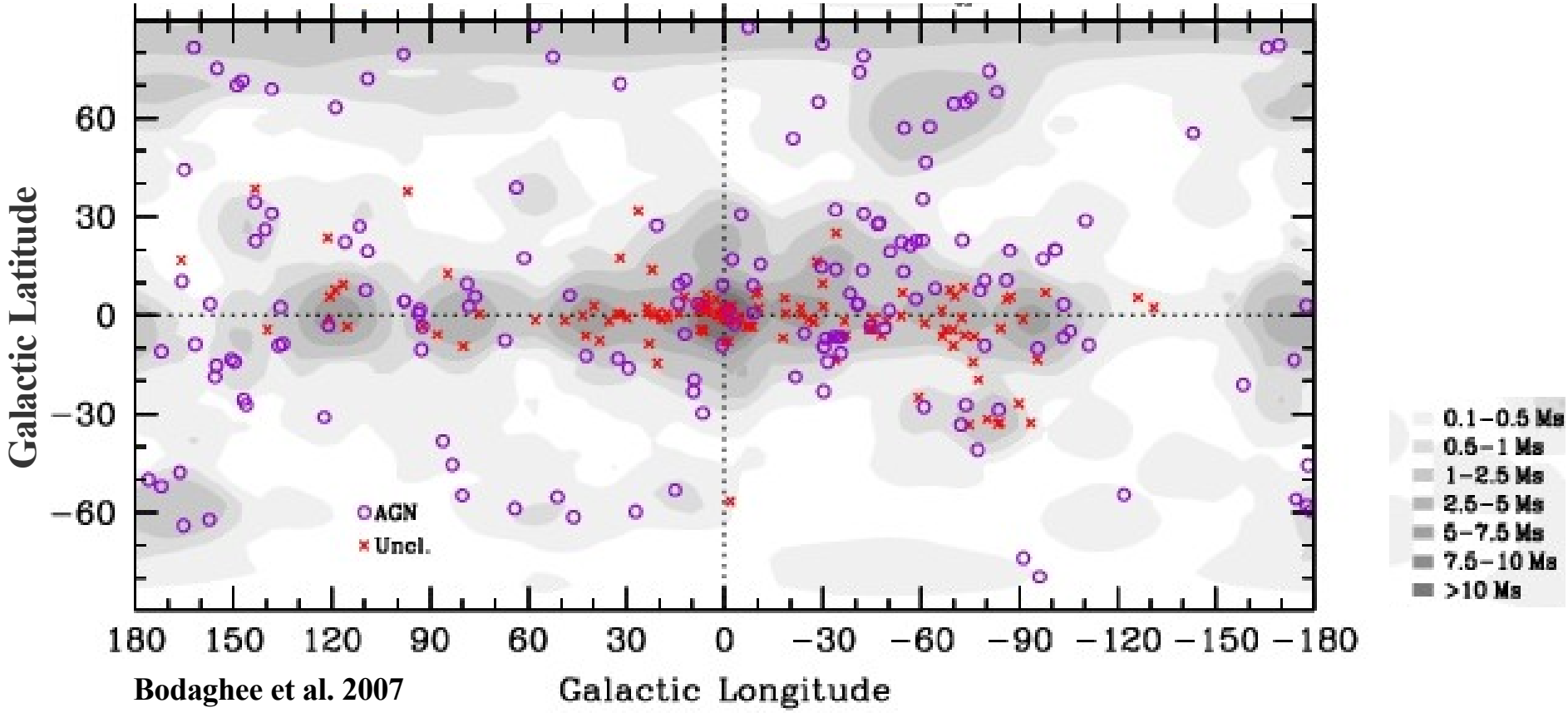
- Hard X-ray emission of AGN as seen by INTEGRAL
  - Signature of Comptonisation in Seyfert galaxies
    Studies of single objects
  - AGN contribution to the XRB at 20-40 keV
    Population studies

- Multiwalength study of 3C273 variability

INTEGRAL AGN

~160 AGN detected in 4 years of INTEGRAL observations

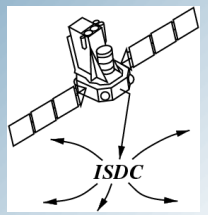
Beckmann et al. 2006, Bassani et al. 2006, Sazonov et al. 2007, Bird et al. 2007, Bodaghee et al. 2007



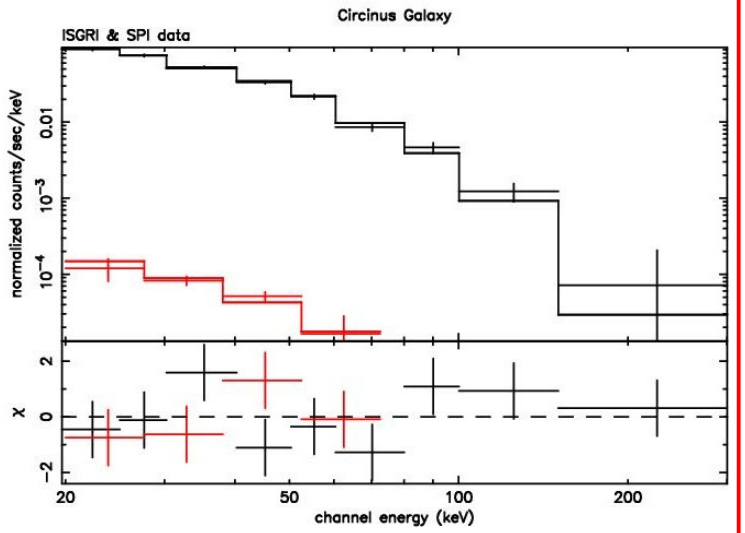
Bodaghee et al. 2007

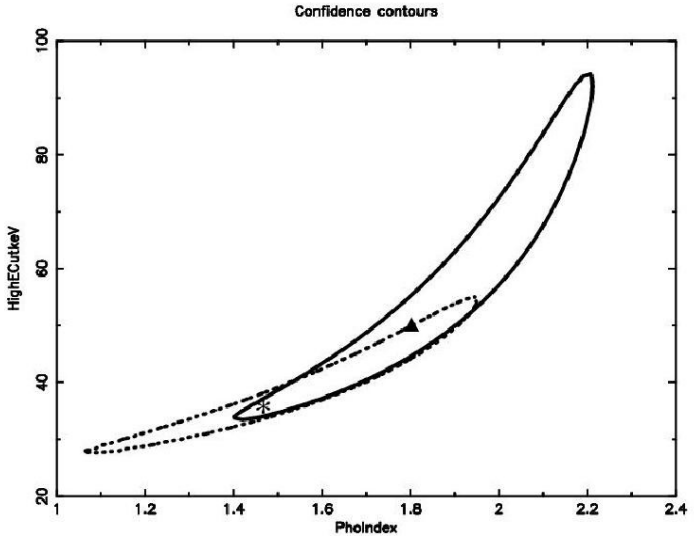
Bright AGN

Soldi, Beckmann, Bassani et al. 2005, A&A 444, 431
Beckmann, Shrader, Gehrels, Soldi et al. 2005, ApJ 634, 939



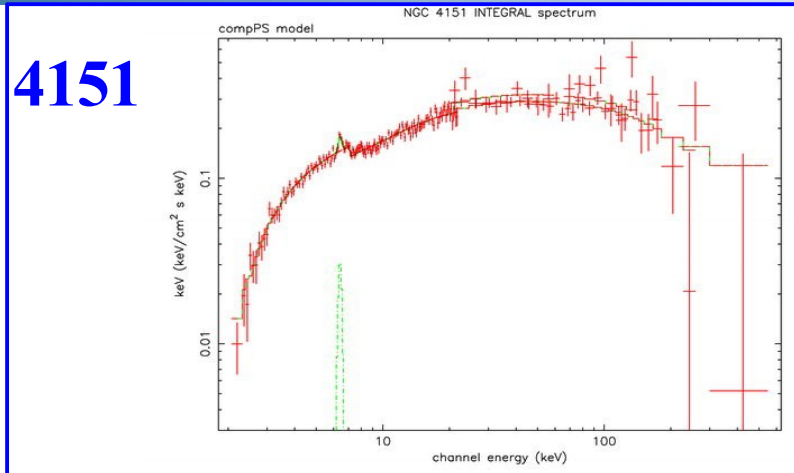
Hard X-ray emission of AGN as seen by INTEGRAL

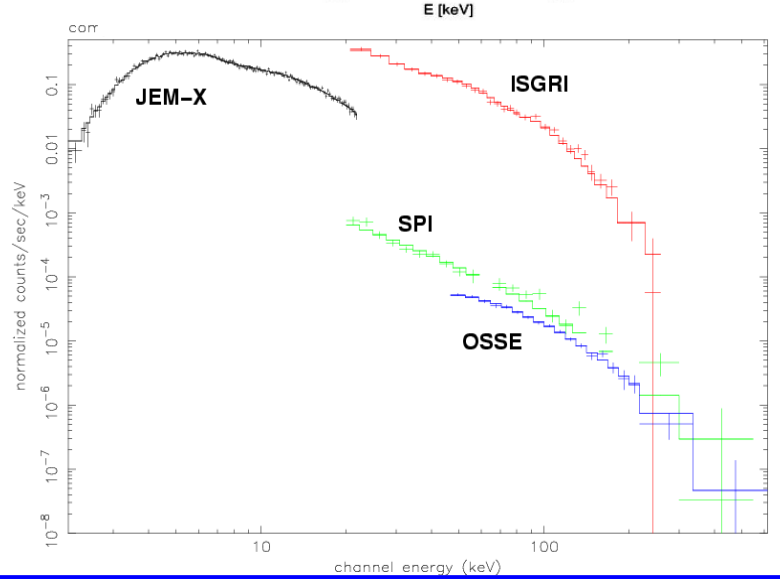




Circinus galaxy

NGC 4151





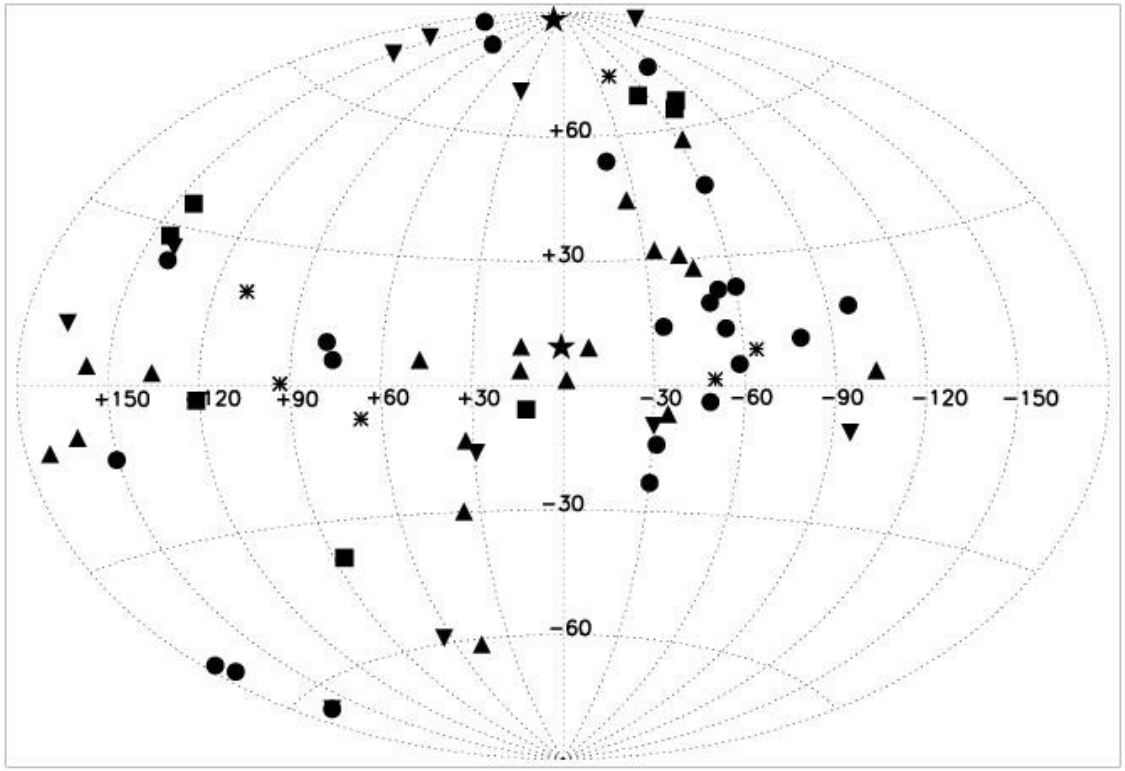
The first INTEGRAL AGN catalog

Beckmann, Gehrels, Shrader, Soldi 2006, ApJ 638, 642
Beckmann, Soldi, Gehrels, Shrader, Produit 2006, ApJ 652, 126

Data:

- 1.5 years of INTEGRAL public data
- ISGRI detections of AGN
- Extracted images and spectra with ISGRI, SPI and JEM-X

▲ Seyfert 1
▼ Seyfert 1.5
● Seyfert 2
■ Blazar
★ Galaxy Cluster
✻ Unidentified AGN

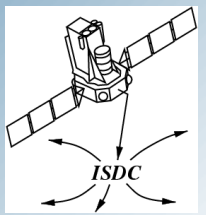


Objects:

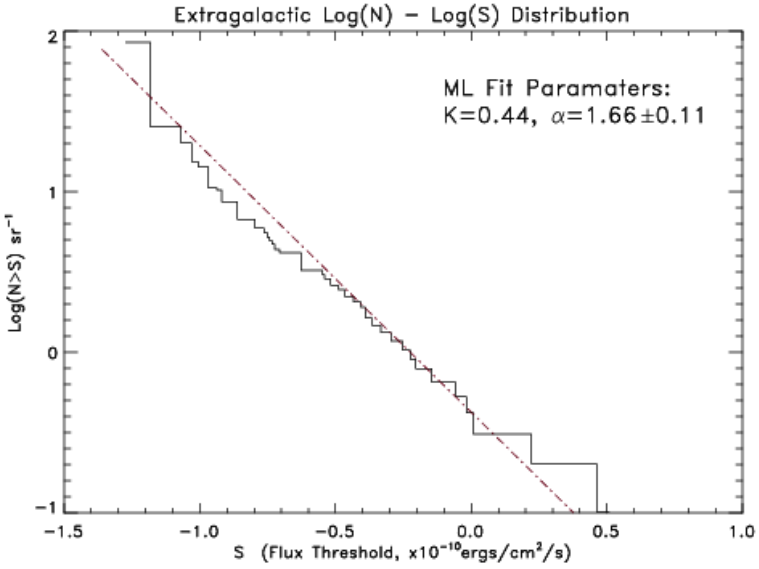
- 73 total objects
- 23 Sey1, 11 Sey1.5, 23 Sey2
- 8 Blazar/BL Lac
- 2 Clusters of galaxies
- 6 AGN of unknown type
- Low redshift: $z = 0.025$
- Bright objects: $L_X = 43.2$ erg/s

Log N - log S and LF

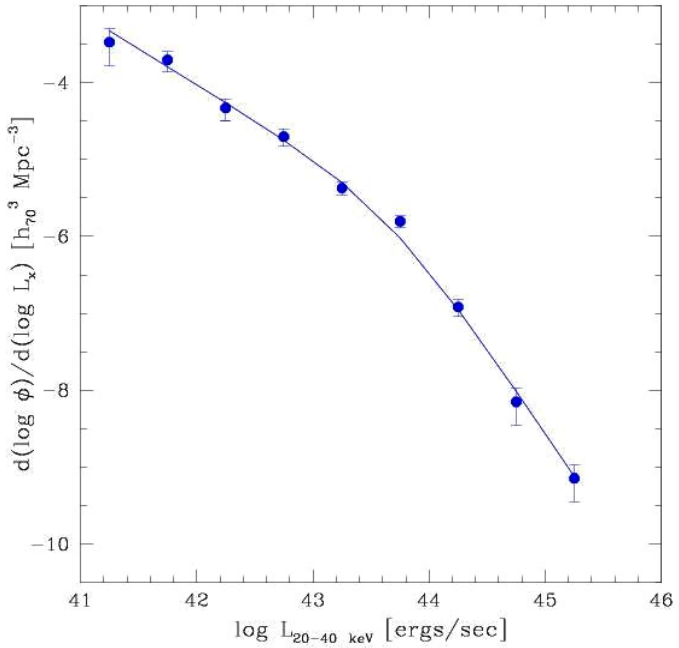
Beckmann, Soldi, Gehrels, Shrader, Produit 2006, ApJ 652, 126



Hard X-ray emission of AGN as seen by INTEGRAL



high flux limit of our sample

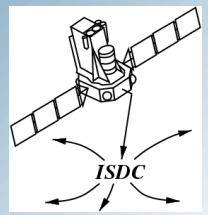


- Comparison with 3-20 and 2-10 keV (Sazonov & Revnivtsev 2004, Ueda et al. 2003, La Franca et al. 2005)
- ~60 % of the CXB explained
- Similar population as at lower energies

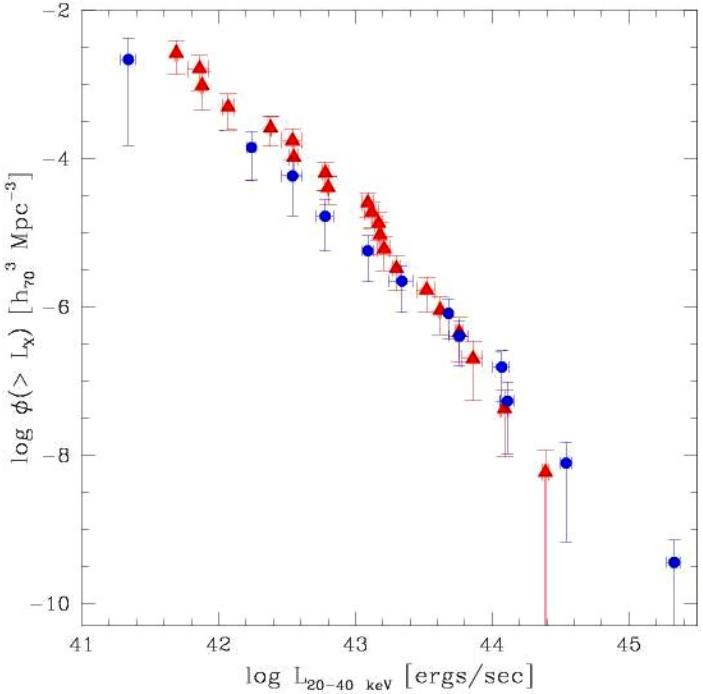
What sources are responsible for the bump at 30 keV in the cosmic X-ray background?

Absorbed sources

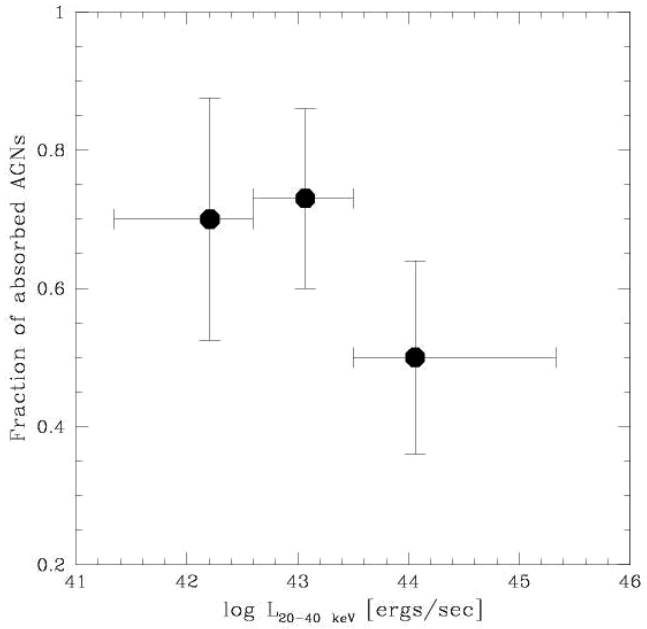
Beckmann, Soldi, Gehrels, Shrader, Produit 2006, ApJ 652, 126



- Absorbed =: $N_H > 10^{22}$ cm^{-2} or Seyfert 1-2 → absorbed/ unabsorbed = X=1.0-1.4
- X = 1.9 (Bassani et al. 2006), X = 1.7 (Sazonov et al. 2007)
- Swift/BAT High Latitude Survey, 15-200 keV, X = 1.5 - 2.2 (Markwardt et al. 2005)
- Only a few (4) Compton thick AGN



▲ Absorbed AGN
● Unabsorbed AGN



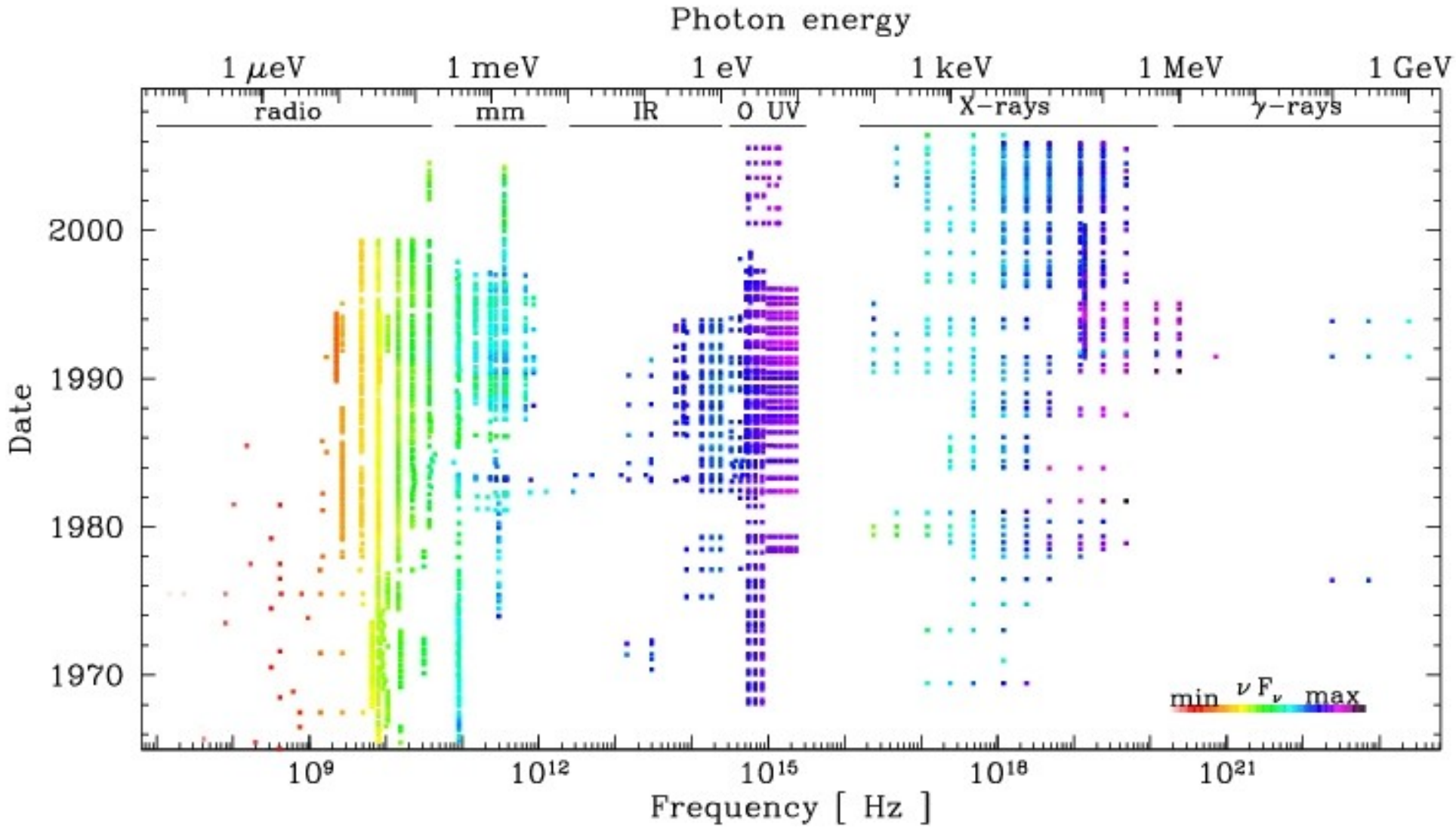
How to account for the cosmic hard X-ray background?

- XLF depending on luminosity?
- XLF depending on redshift?
- Contribution of normal galaxies?

INTEGRAL AGN

Multiwalength study of 3C 273

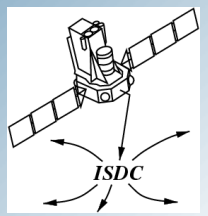
Soldi, Türler, Courvoisier, Paltani et al. in preparation

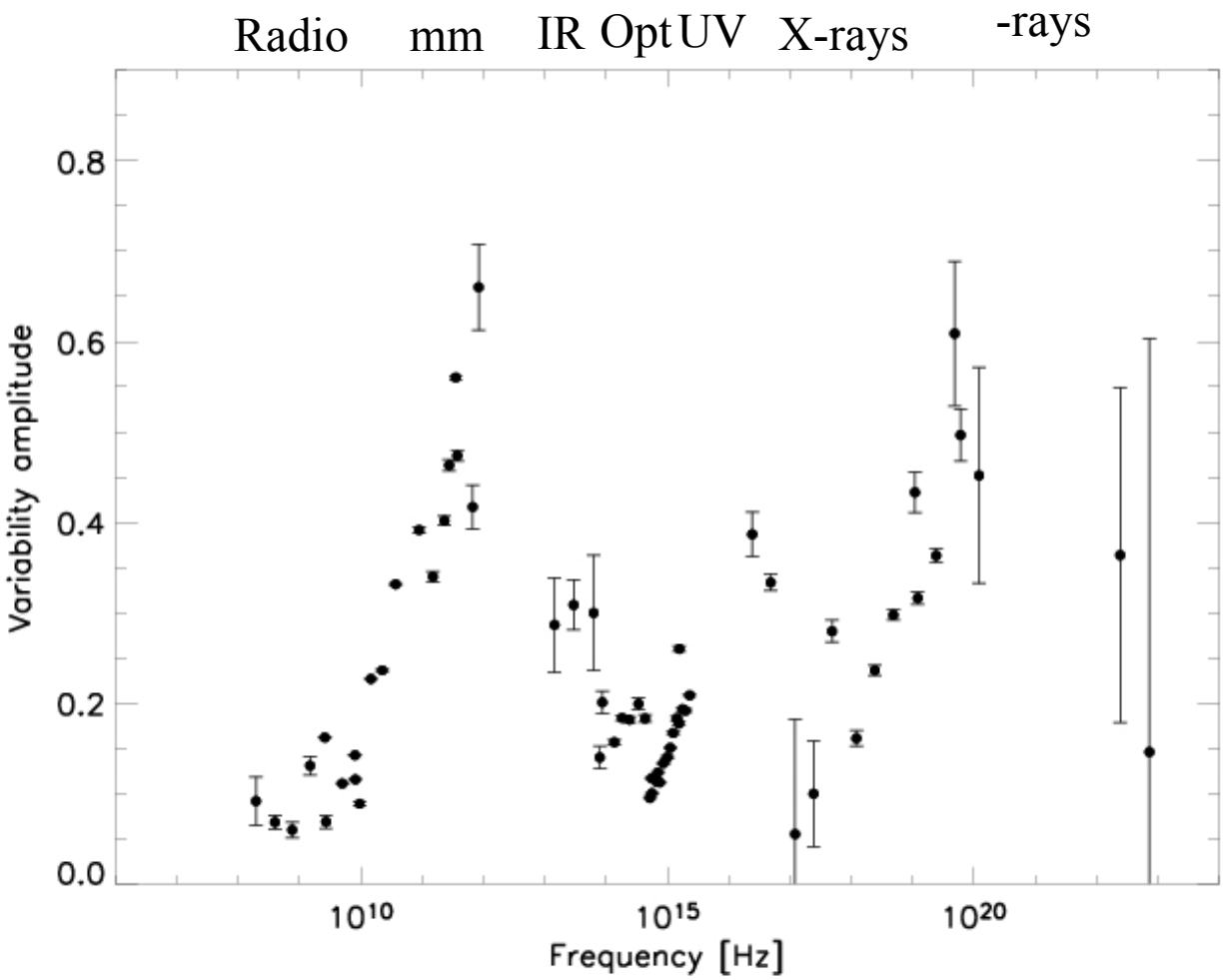


http://obswww.unige.ch/3c273/

Variability amplitude of 3C 273

Soldi, Türler, Courvoisier, Paltani et al. in preparation





$$F_{var} = \sqrt{\frac{var^2 - \langle\sigma^2\rangle}{\langle F\rangle^2}}$$

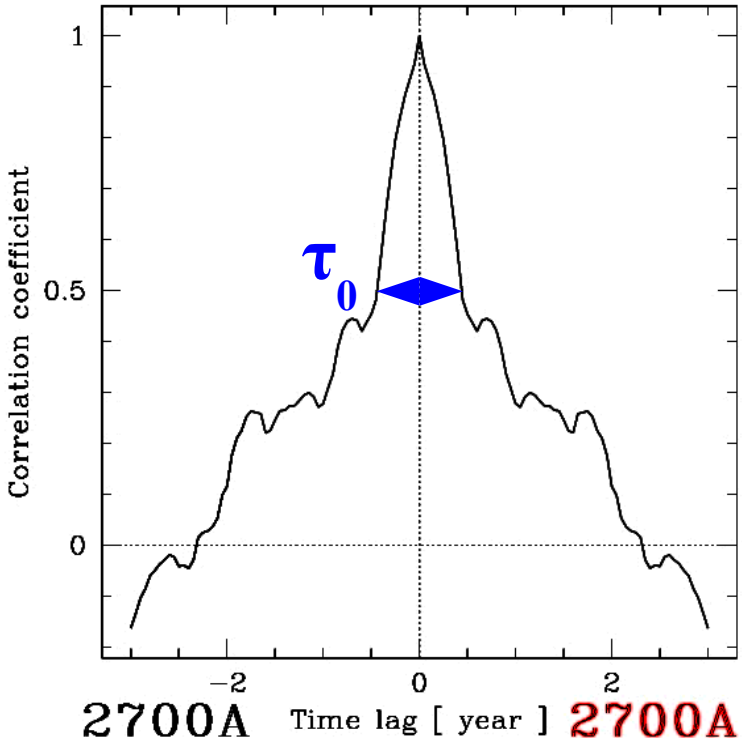
(Vaughan et al. 2003, MNRAS 345, 1271)

Characteristic time-scale of 3C 273

Soldi, Türler, Courvoisier, Paltani et al. in preparation

Auto-correlations

$$A(\tau) = \frac{\int_{-\infty}^{\infty}(F(t)-\langle F\rangle)(F(t+\tau)-\langle F\rangle)dt}{\int_{-\infty}^{\infty}(F(t)-\langle F\rangle)^2 dt}$$



Characteristic time-scale