Unveiling SGRs with *INTEGRAL*

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Isolated Neutron Stars – London – 24/04/06

INTEGRAL Results

Short Bursts

- SGR 1806-20
  - Spectral Evolution within the bursts (H-I Anticorrelation)
  - Log N – Log S (α=0.91±0.09)
  - Huge Ouburst on October 5 2004

Giant Flare of December 27th 2004

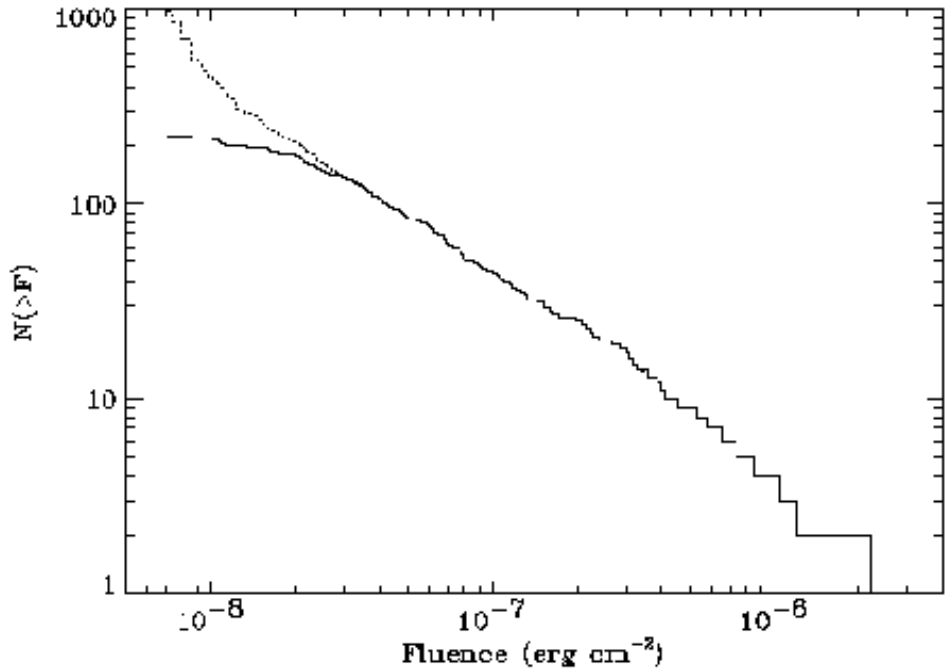
- High energy afterglow

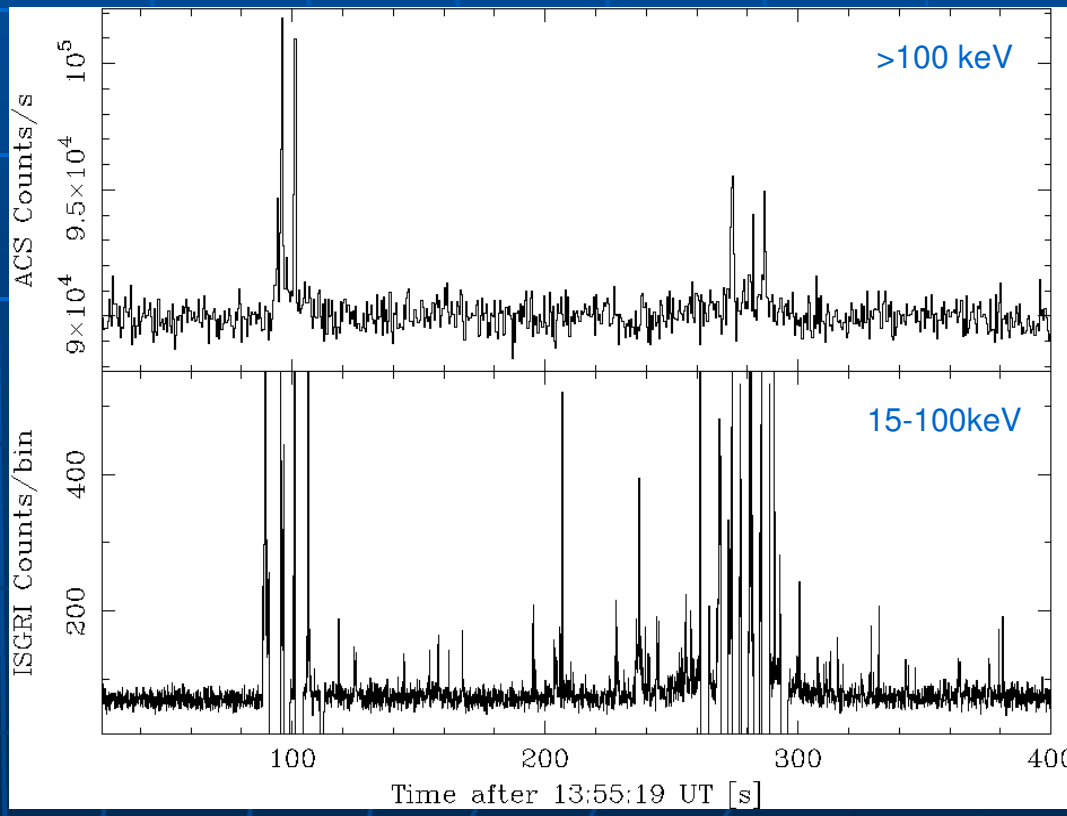
Persistent Emission

- SGR 1806-20
- SGR 1900+14
- AXPs - Comparison with SGRs

Bursts - SGR 1806-20

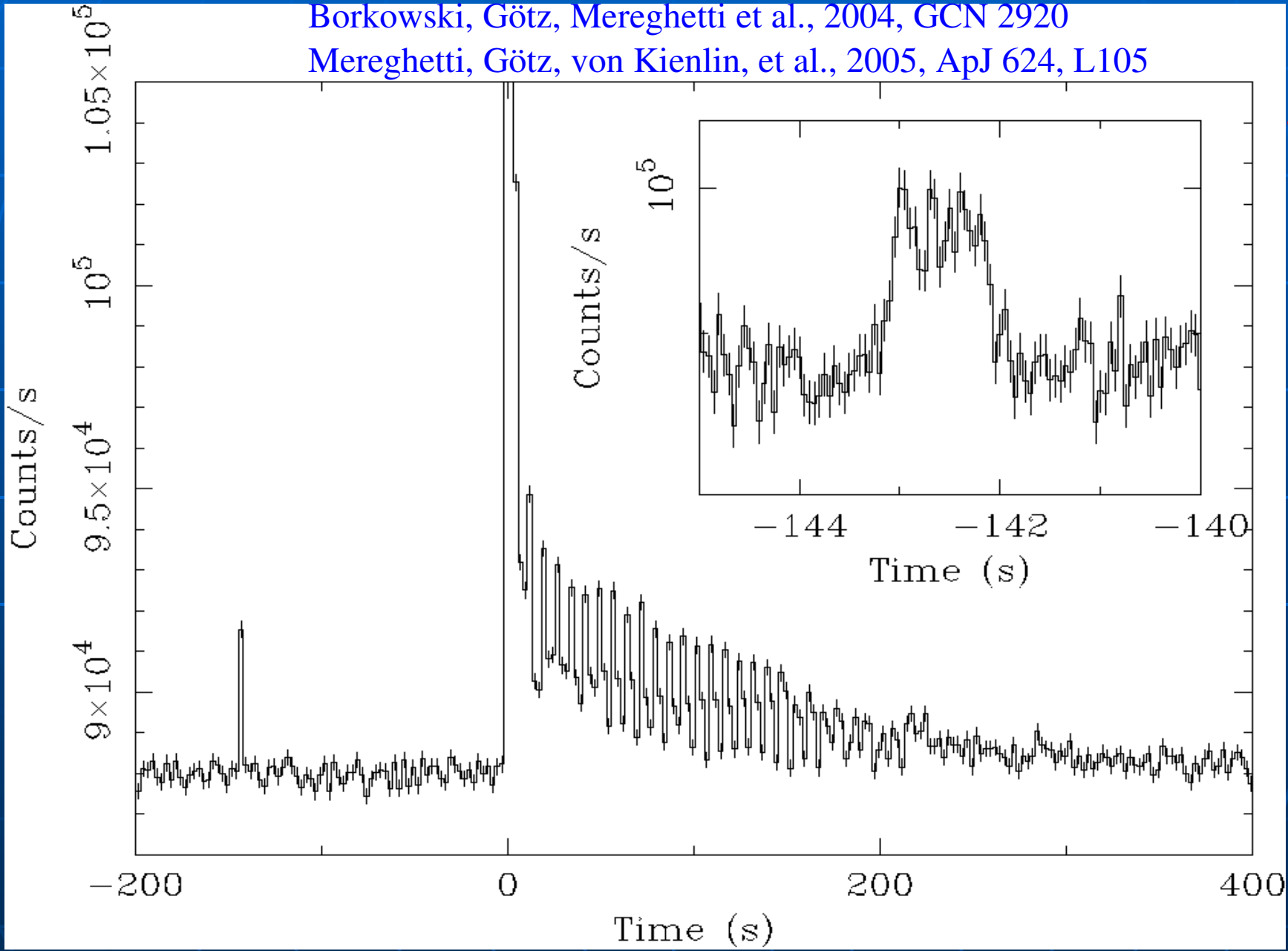
- SGR 1806-20 entered a new period of activity in July 2003
- More than 400 bursts have been detected by *INTERGAL* Burst Alert Sytem since then. Durations and energy spectra are typical.
- ~300 of them have been analyzed (including a huge outburst on October 5 2004). Thanks to the good sensitivity of IBIS/ISGRI they have been studied in detail. (Götz et al. 2004; Götz et al. 2006)





SGR 1806-20 - December 27 2004 Giant Flare

Borkowski, Götz, Mereghetti et al., 2004, GCN 2920
Mereghetti, Götz, von Kienlin, et al., 2005, ApJ 624, L105

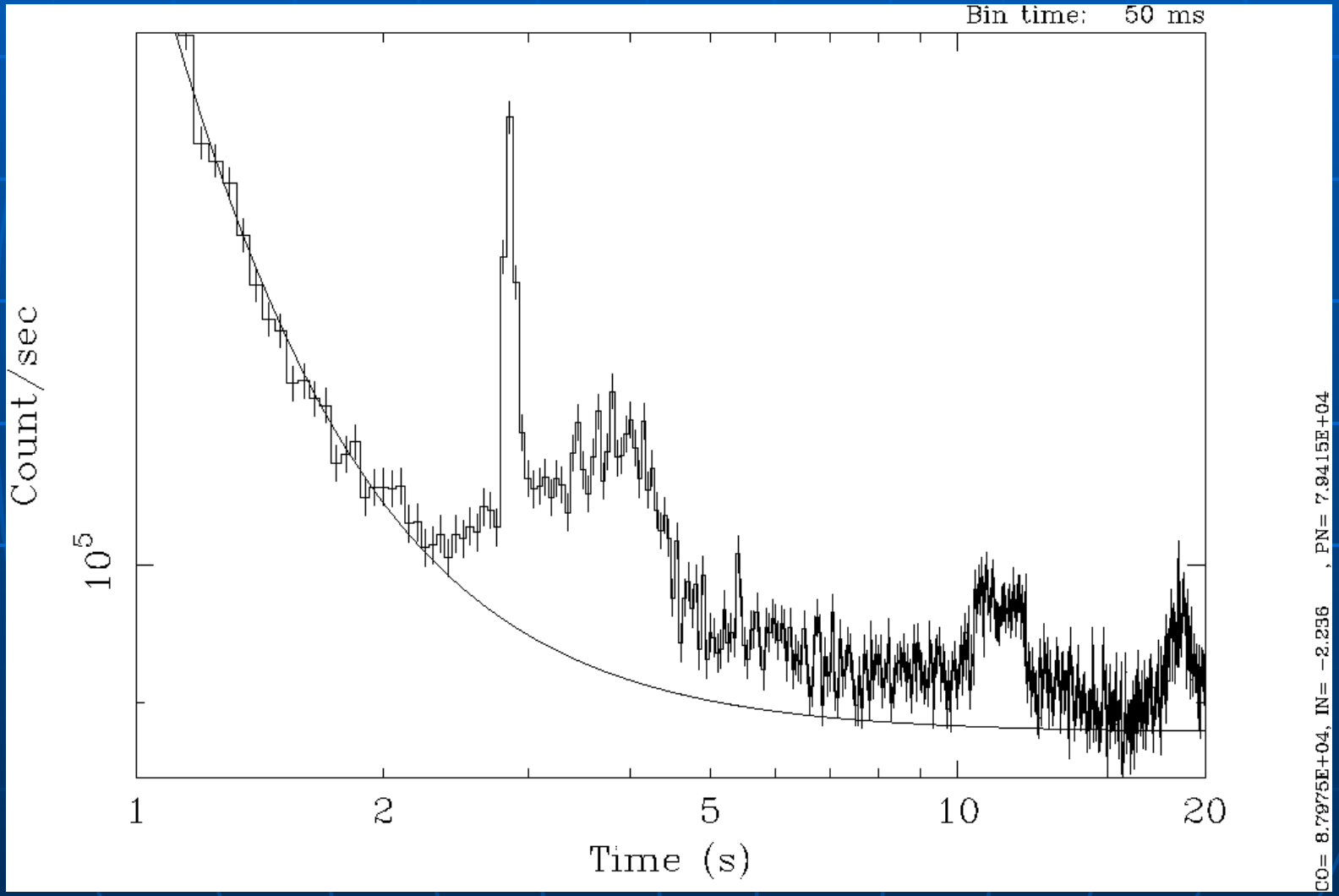


SPI-ACS Data
>100 keV

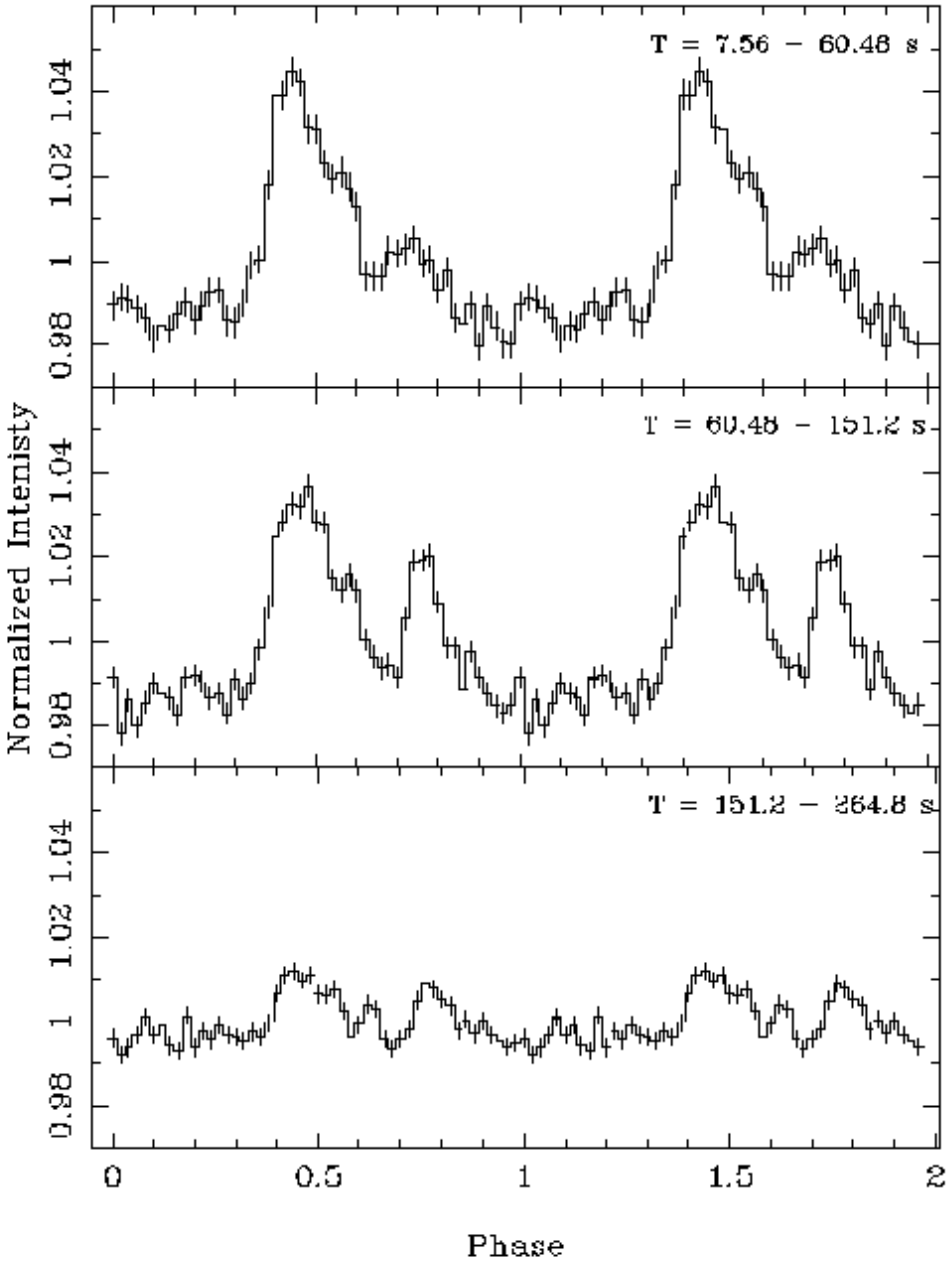
P=7.56s

~10^{46}_{d15} erg!

Moon Reflection

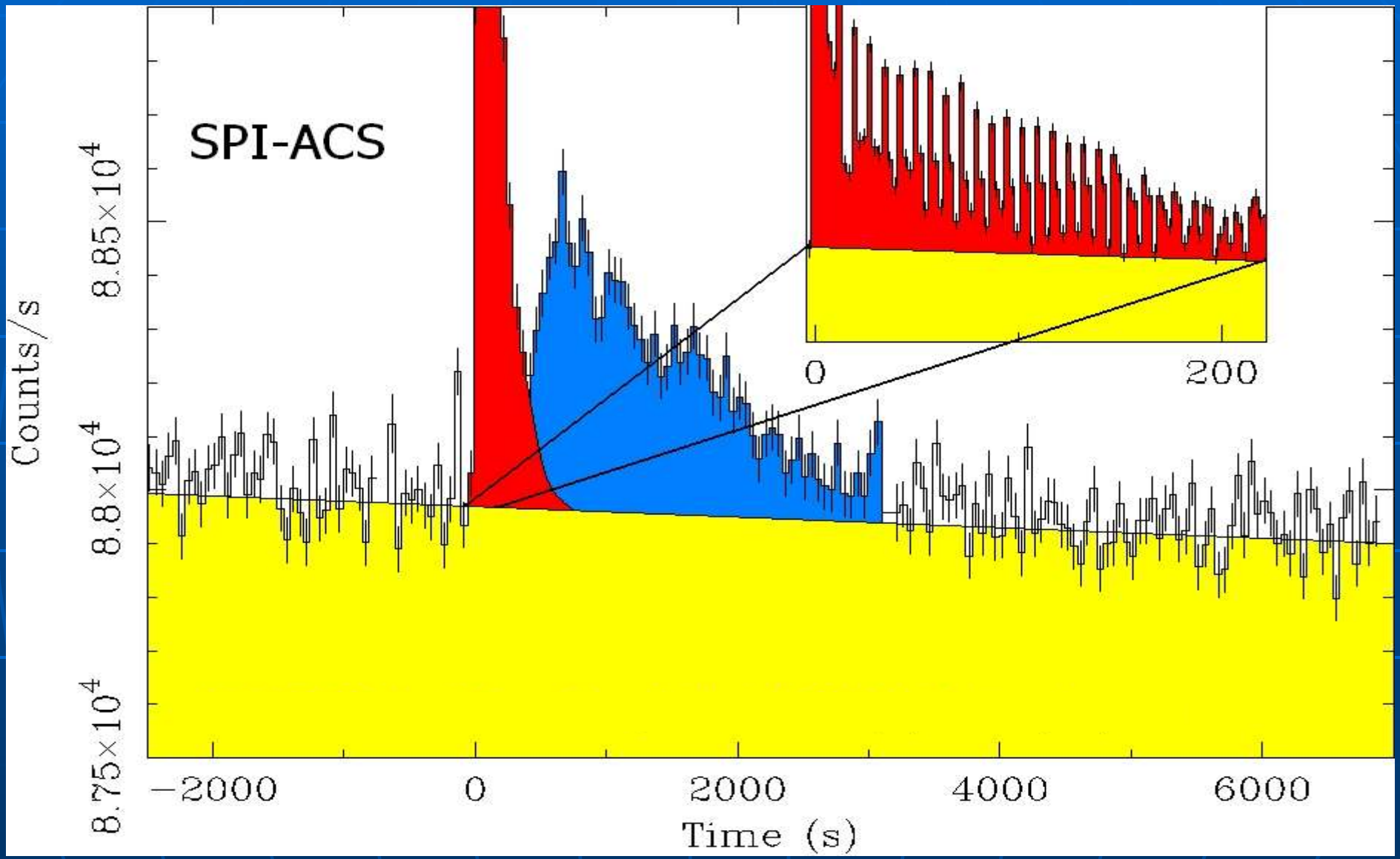


Pulse Profile Variations



E>100 keV

Possible detection of an early high-energy afterglow

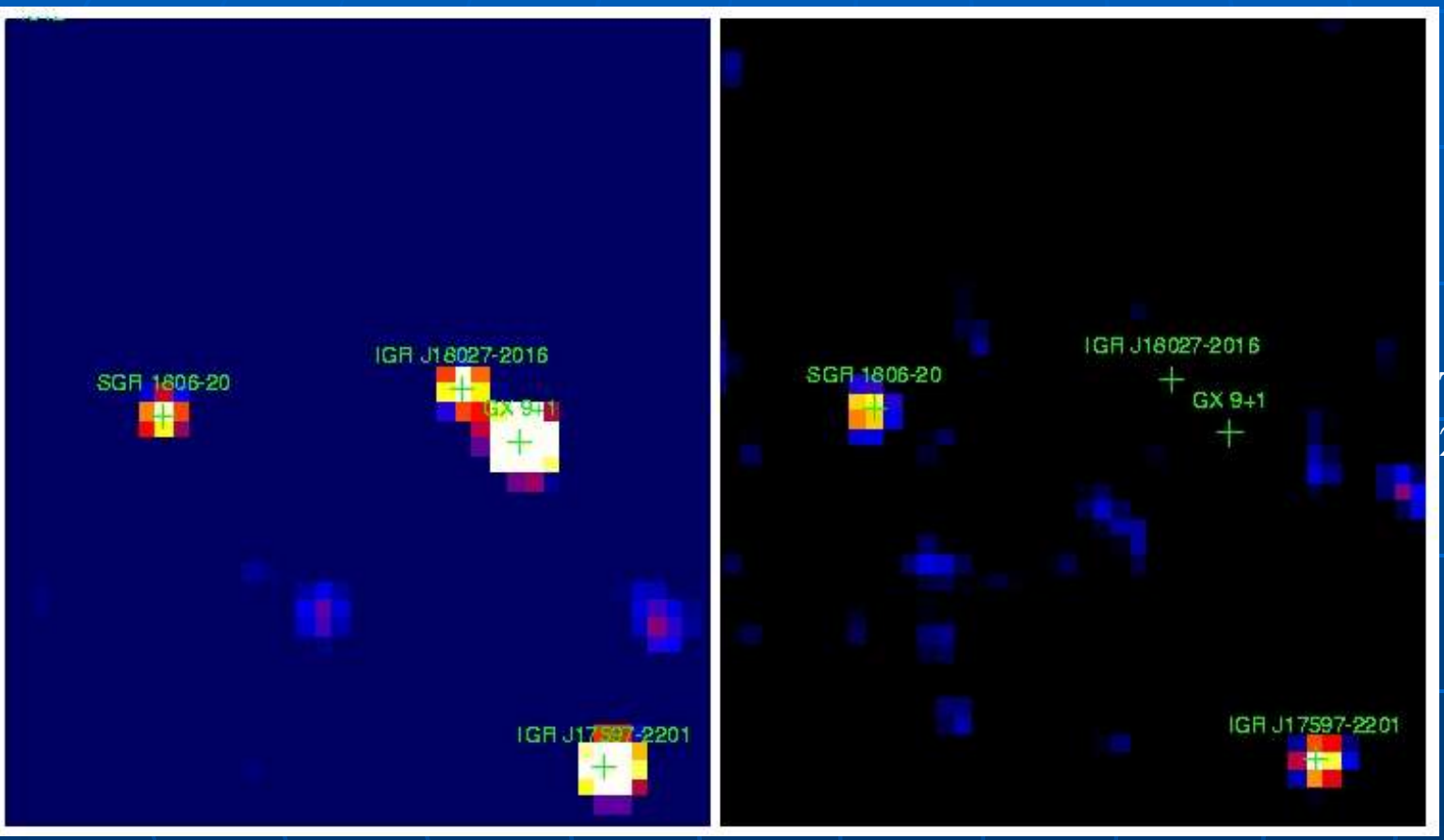


Bulk Lorentz factor ~ 15 $(E/5\times10^{43}\ \mathrm{erg})^{1/8}\ (n/0.1\ \mathrm{cm}^{-3})^{-1/8}(t_0/100\ \mathrm{s})^{-3/5}$

Compatible to what derived from the radio afterglow

Persistent Emission – 1806-20

Mereghetti, Götz, Mirabel & Hurley, A&A, 433, L9 2005



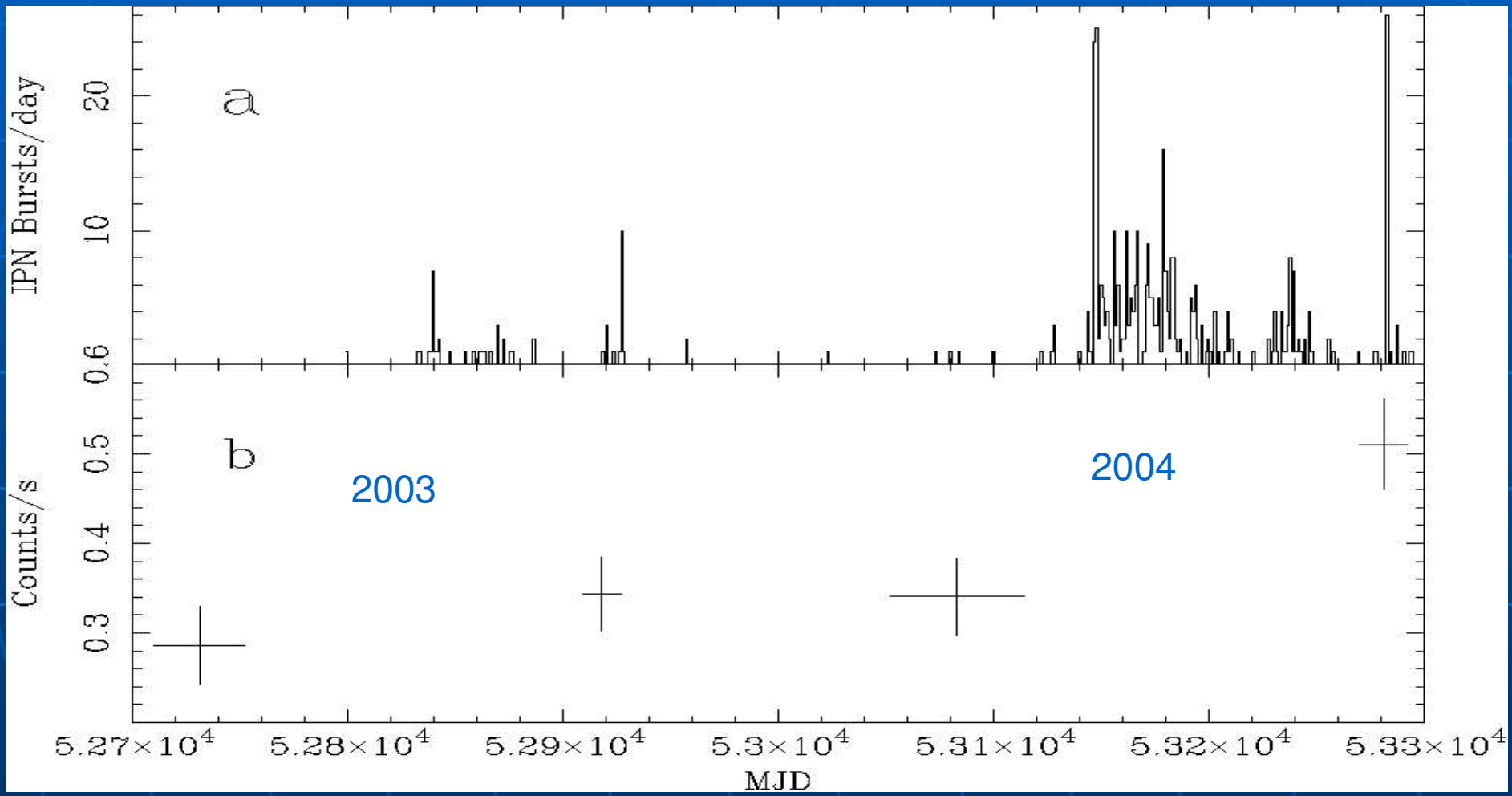
Total Exposure Time ~1 Msec
2003-2004 Data

IBIS/ISGRI 20-60 keV 60-100 keV

First detection of emission above 10 keV from an (moderately active) SGR counterpart

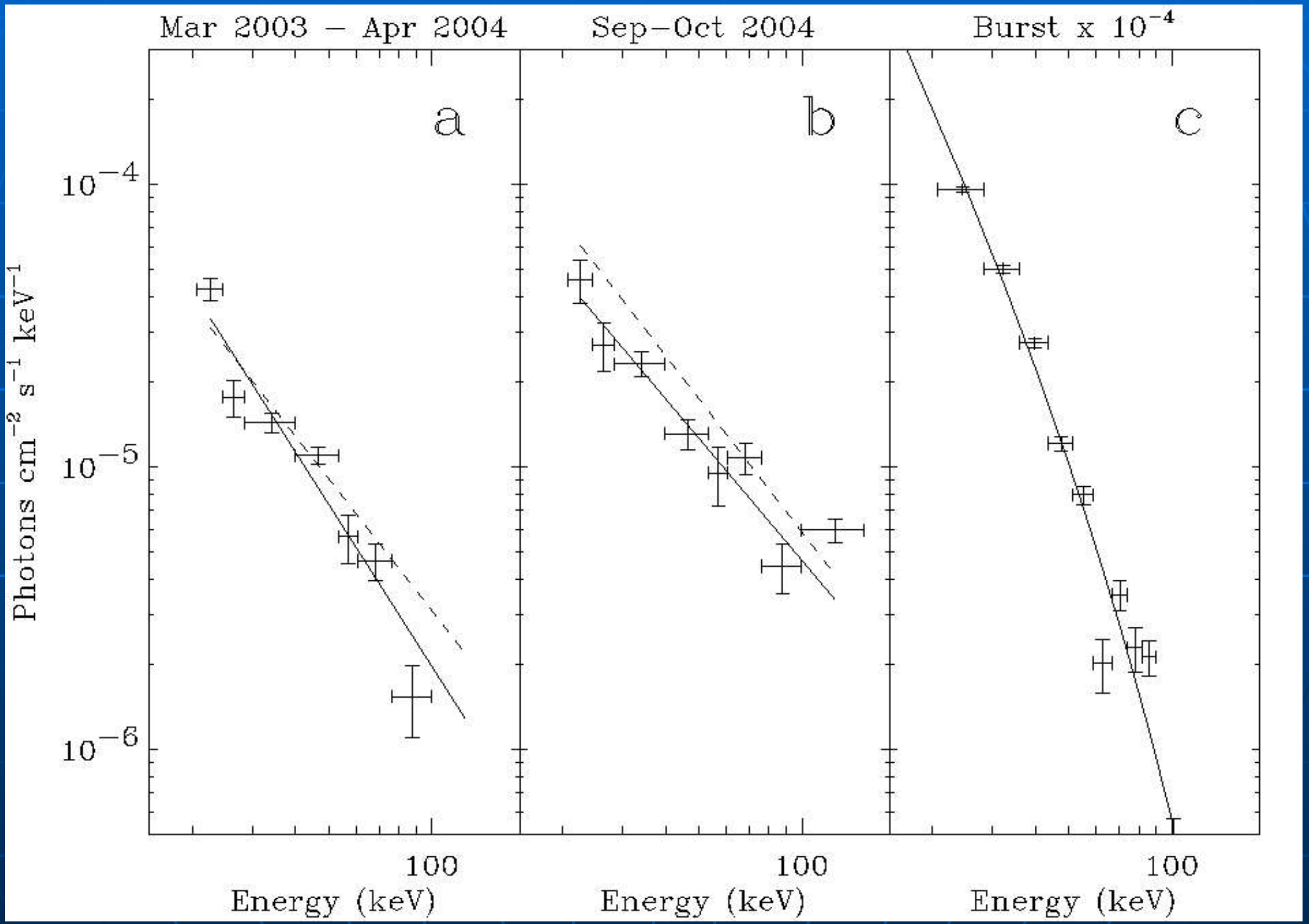
-> Non thermal processes in the Magnetosphere

Mosaicking contiguous observations: Time variability

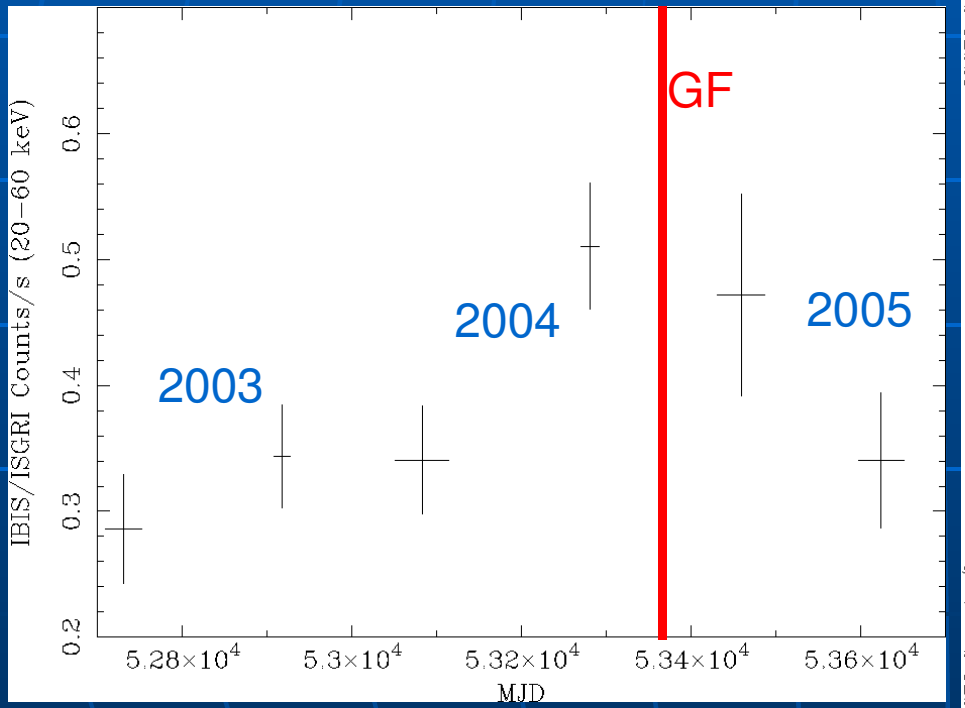


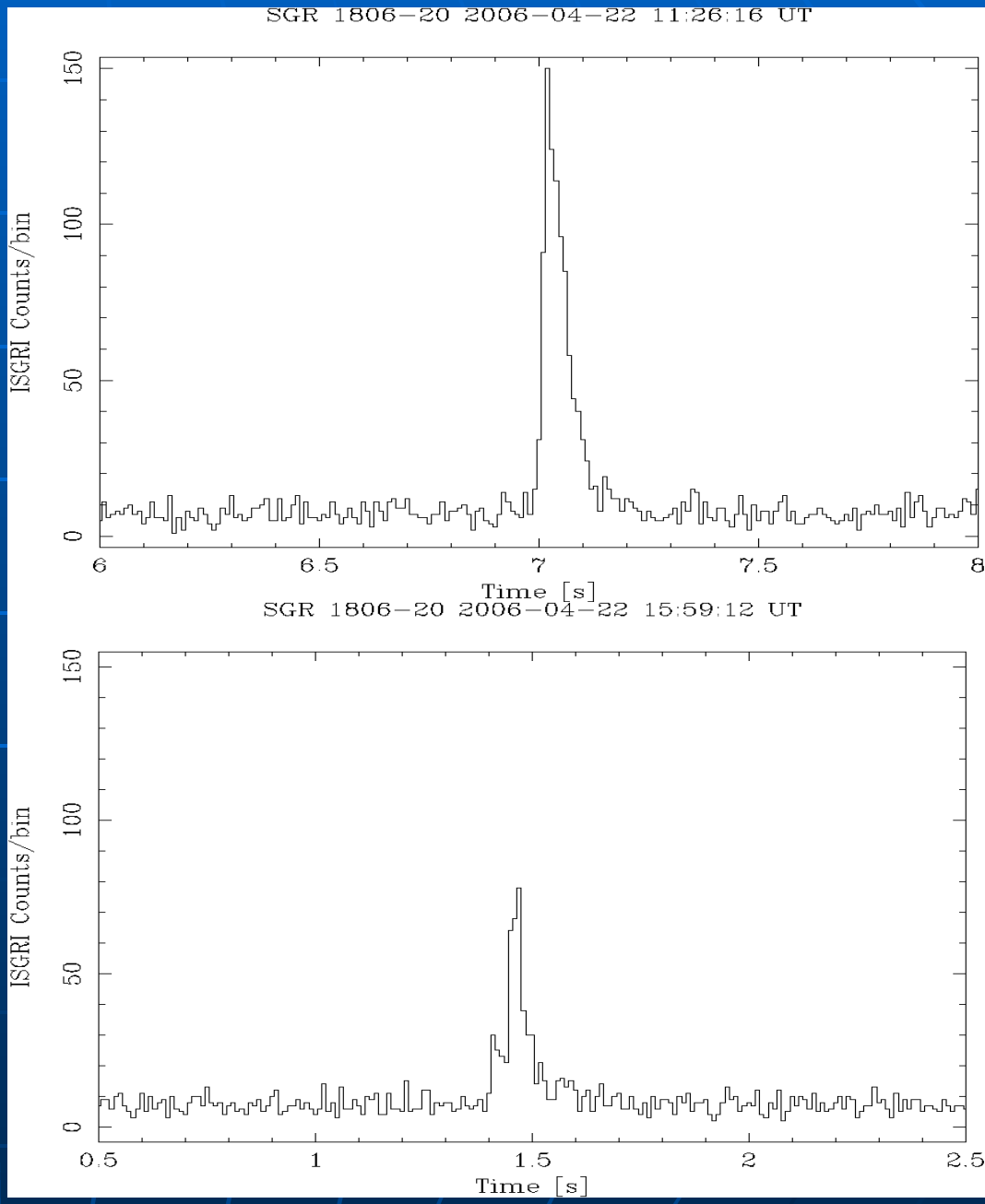
Larger degree of twist in the magnetosphere-> more bursts and harder spectra, as predicted by Thompson, Lyutikov and Kulkarni (2002)

Persistent Emission -1806-20: Spectra

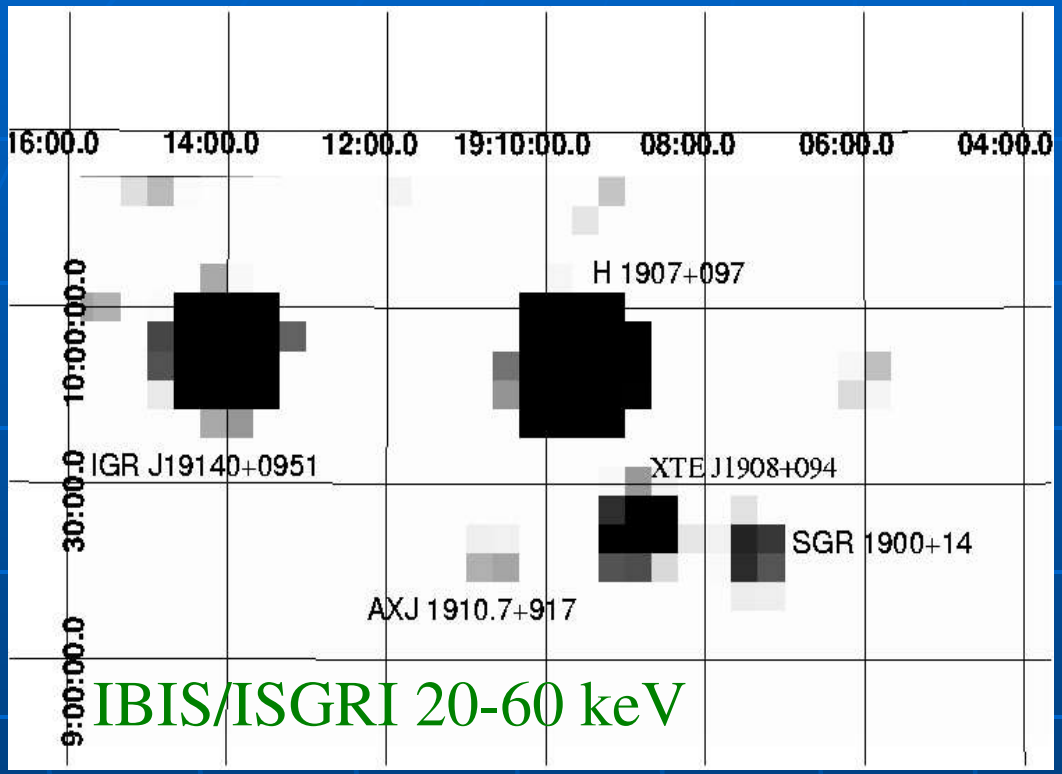


INTEGRAL 1806 Monitoring





Persitent emission - SGR 1900+14: an SGR in quiescence



Götz et al. 2006, A&A 449, L31

~~Last bursts from 1900 detected in November 2002~~

Reactivation on March 25th!

Very soft spectrum Γ ~3.1, faint flux ~ 10^{-12} erg cm^{-2} s^{-1}

Exposure time 2.5 Ms (2003-2004), indication of flux increase and hardnening

Persistent hard X-ray emission can be due to:

- Bremsstrahlung photons produced in a thin layer close to the neutron star (Thompson & Belobodorov 2005). Cutoff at ~100 keV.

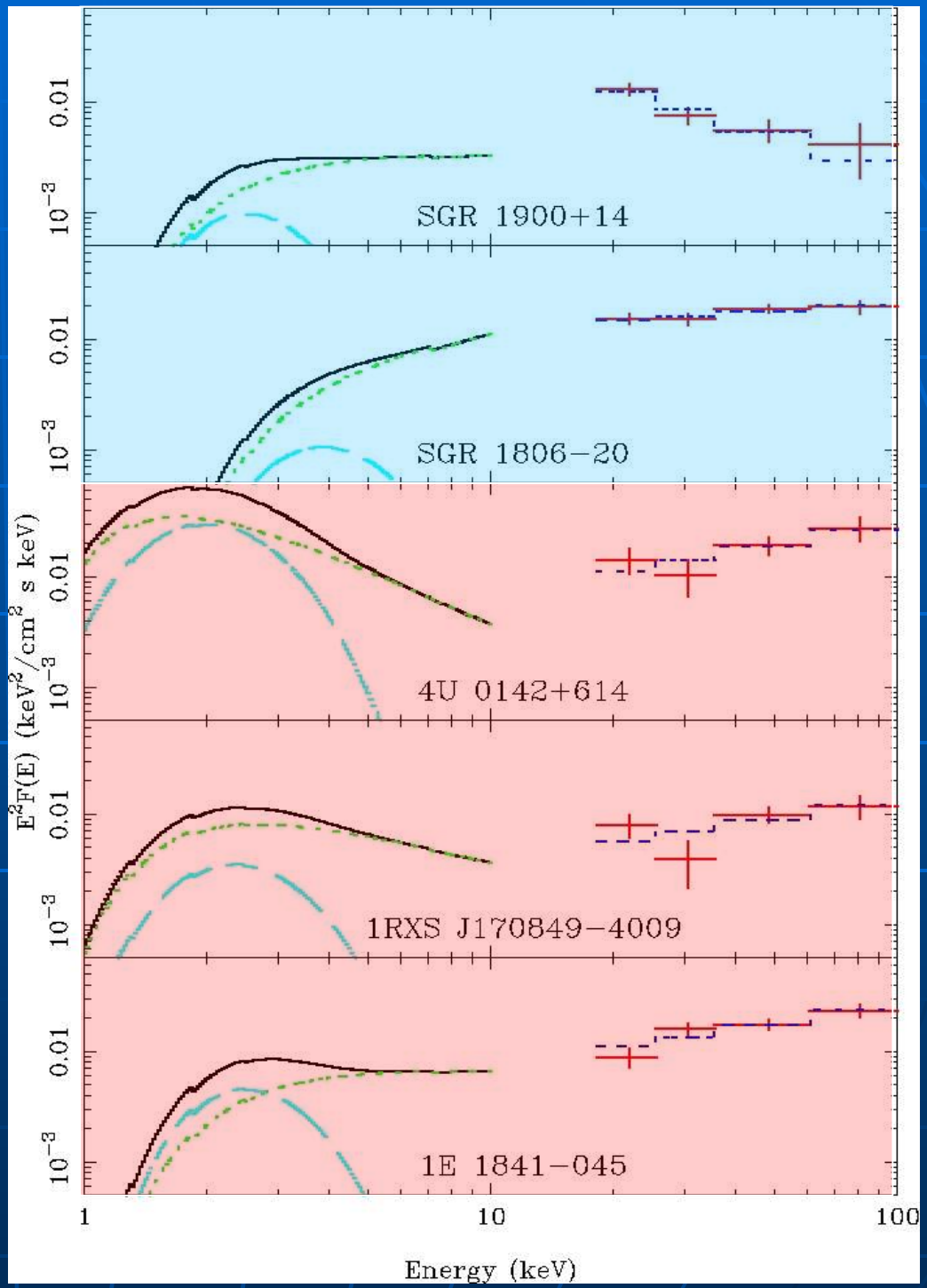
- at 100 km altitude in the magnetosphere through multiple resonant cyclotron scattering (Thompson et al. 2002). Cutoff at ~1 MeV

Homogeneous *INTEGRAL/IBIS* data analysis:

The difference *among* the SGR can be explained in terms of the different activity

(These) AXPs are not active from the bursting point of view and have very soft spectra below 10 keV

SGRs and AXPs behave differently at hard X-rays!



Summary

- SGR 1806-20 has been studied in detail:
  - bursts (spectral evolution and LogN-LogS),
  - persistent emission discovery
  - 27 December 2004 Giant Flare
    - Monitoring of the source activity
    - Search for pulsations
    - Cutoff?

- SGR 1900+14: discovery of the persistent hard X-ray emission
    - *INTEGRAL* AO4 monitoring proposal
    - Analysis of the 2005 *INTEGRAL* Data
    - Reactivation: XMM and *INTEGRAL* ToOs on April 1st

  (Analysis on going)

- AXPs: hardening of the tails with energy for 3 of them
    - Rest of the AXPs? Too soft or too faint?