London, 2006 April 24

Long term spectral variability in the Soft Gamma-ray Repeater SGR 1900+14

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BeppoSAX and *XMM-Newton* observations of SGR 1900+14

- 7(+2 very short) ***BeppoSAX*** observations from 1997 May 12 to 2002 April 27
- 1 ***XMM-Newton*** observations on 2005 September 20-22 (+1 on 2006 April 1, but data not yet available)

Burst activity of SGR 1900+14

Giant Flare

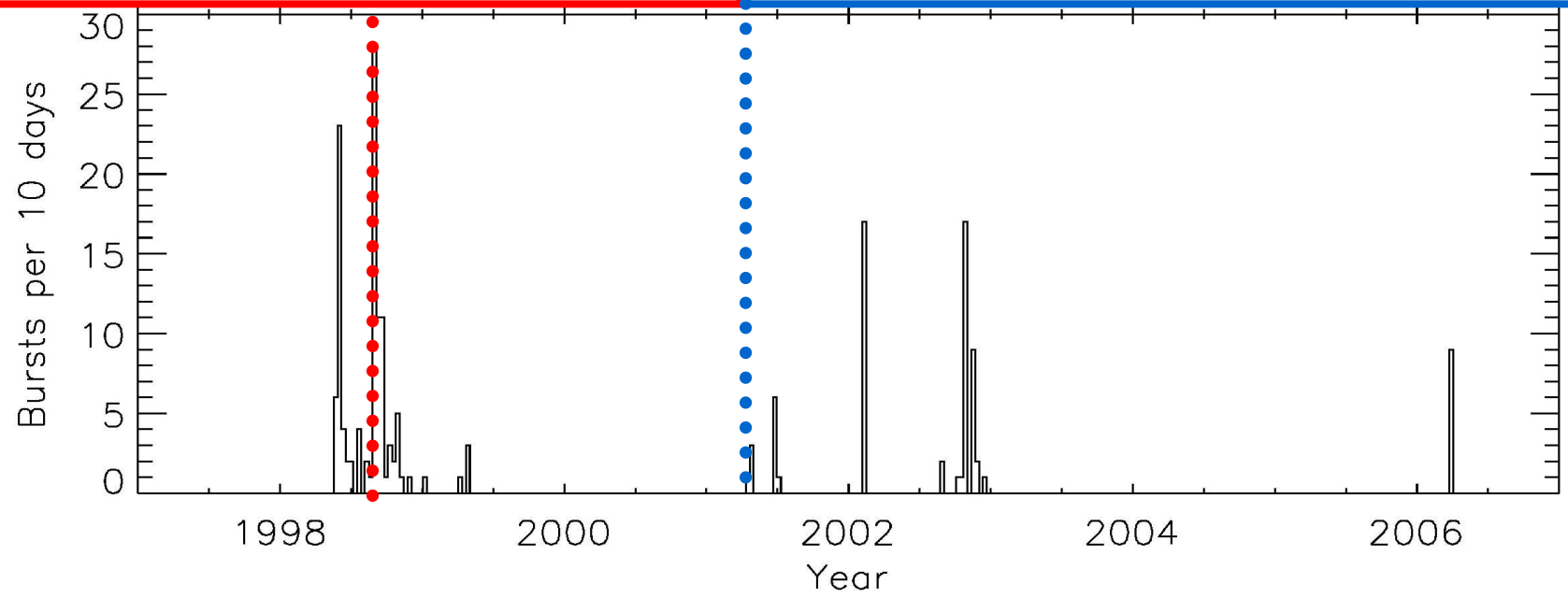
1998 AUG 27

Fluence~7E-3 erg/cm²

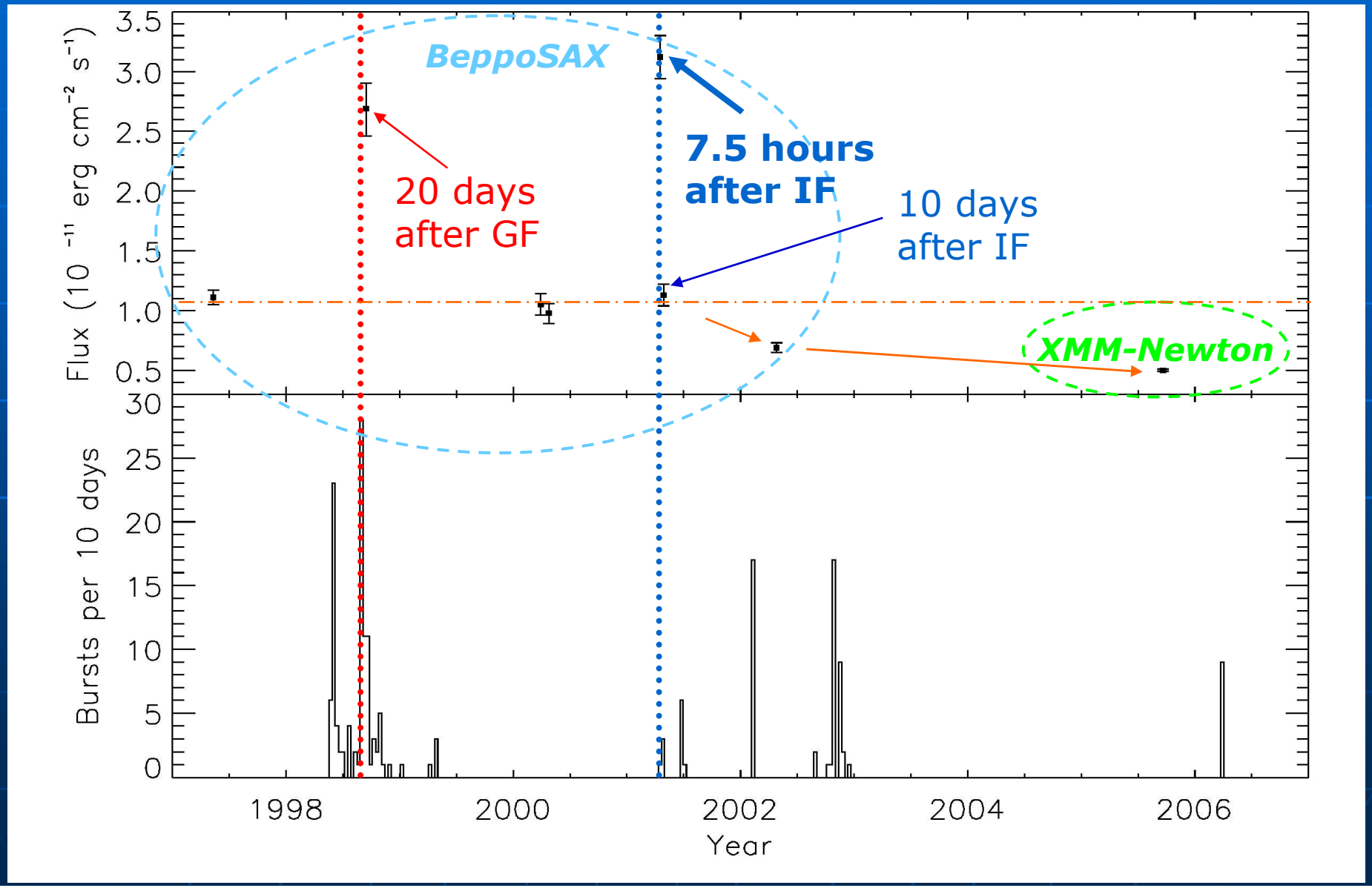
Intermediate Flare

2001 APR 18

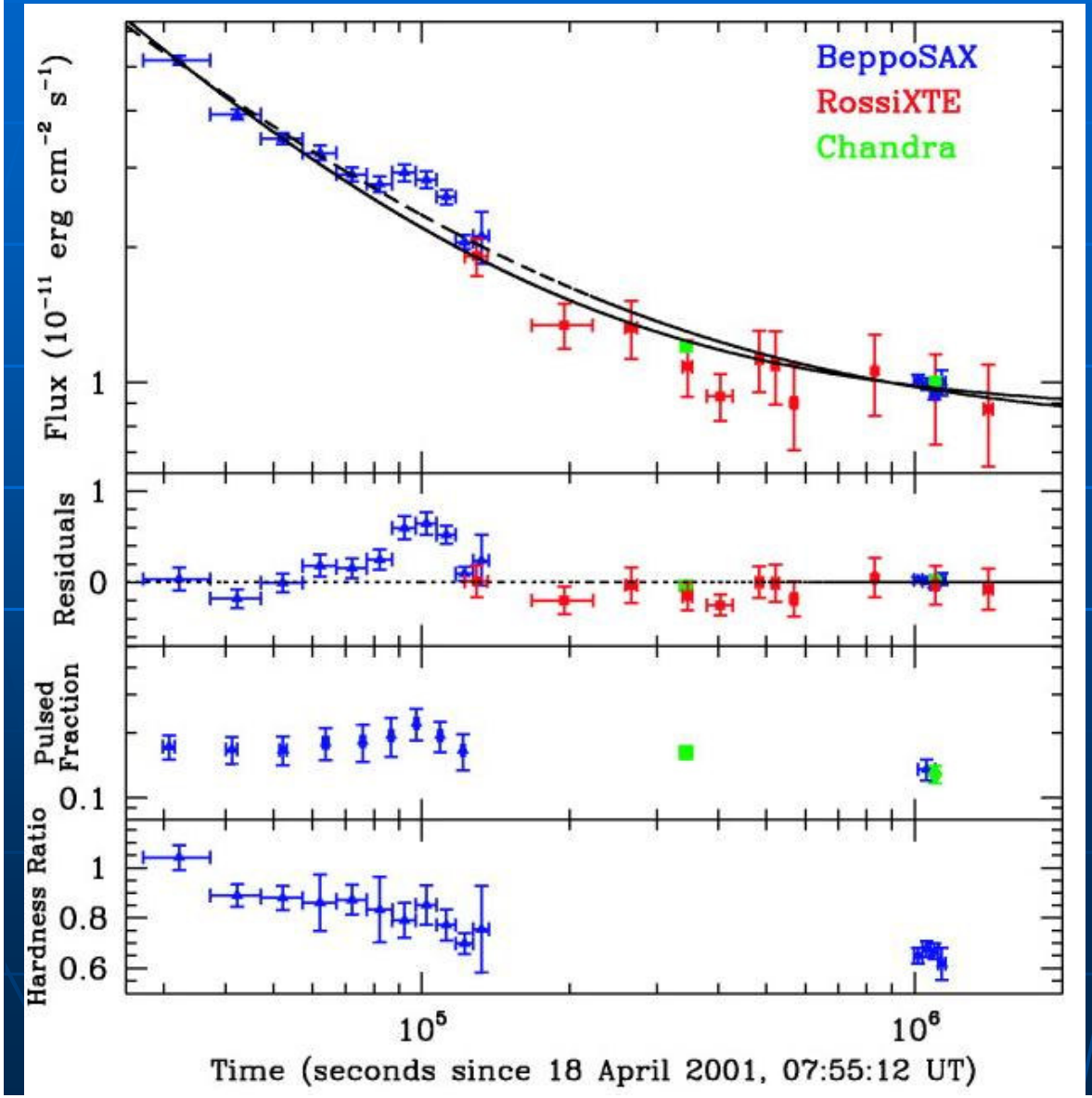
Fluence~3E-4 erg/cm²



Flux evolution



Afterglow (2001 April 18)



Feroci et al. (2003)

Afterglow decay:

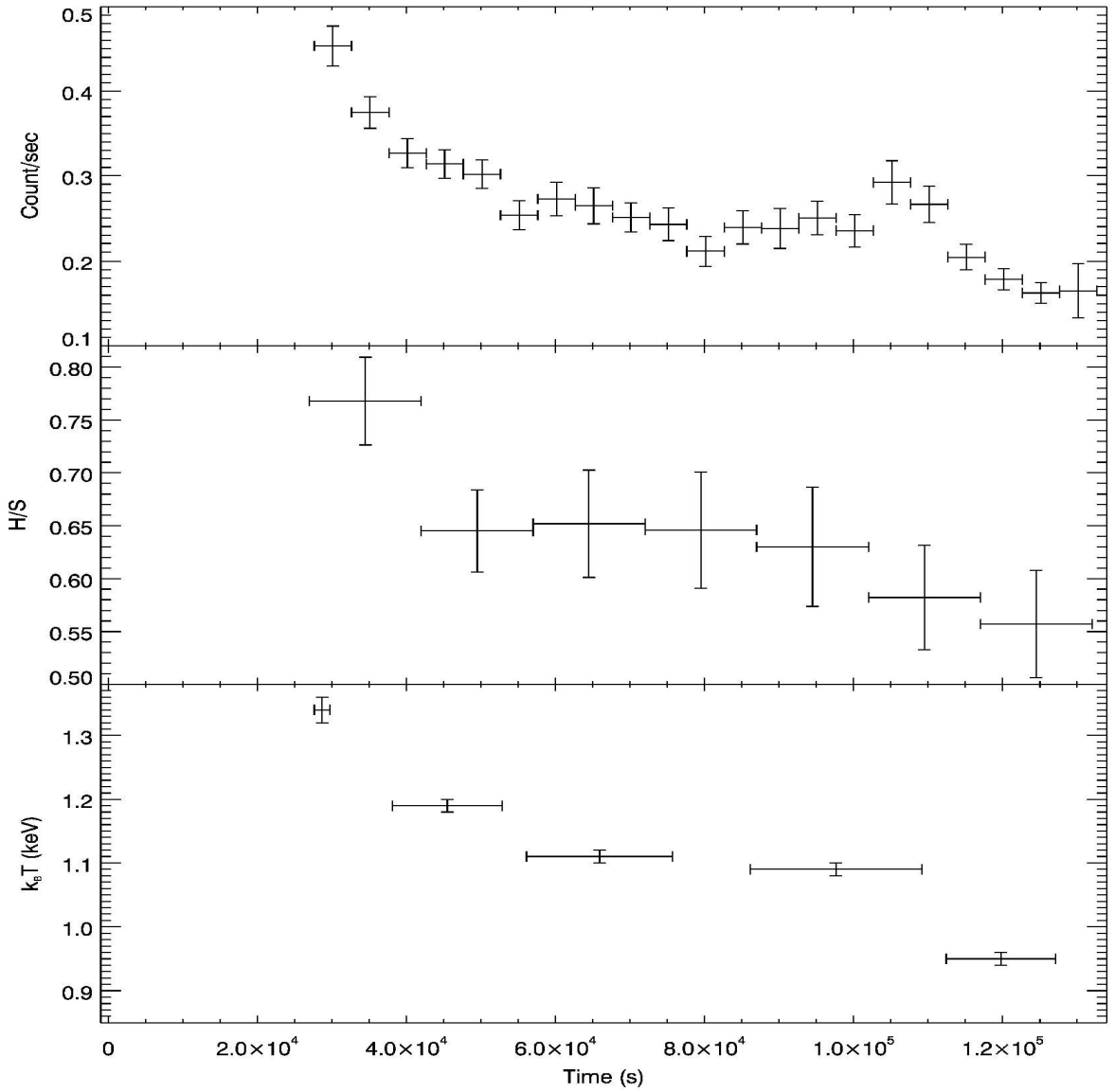
$\Delta F \sim t^{-1}$

(+bump at $t \sim 10^5$ s)

Depends on subtraction of persistent emission level

Hardness ratio:
softening

Afterglow (2001 April 18)



Time resolved spectra:

Equivalent fit with two models:

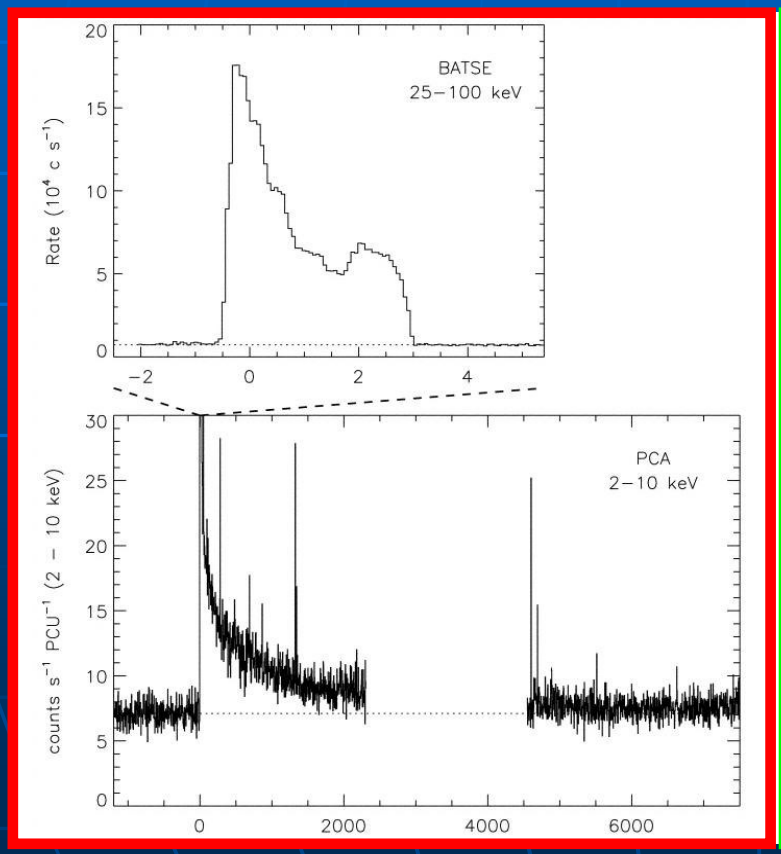
- PL+BB with variable k_BT (1.3-0.7 keV, R_{BB}=1.9 km)

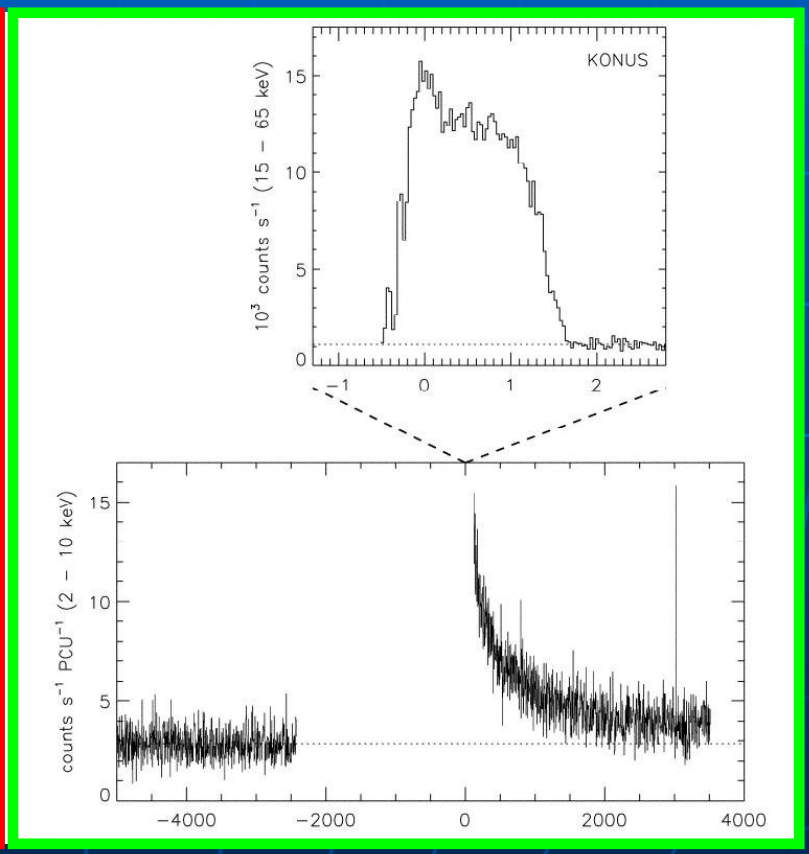
OR

- (PL+BB) *fixed* at quiescent values + **additional BB** with variable k_BT (1.35-0.95 keV , R_{BB}=1.6 km)

Afterglow (2001 April 18)

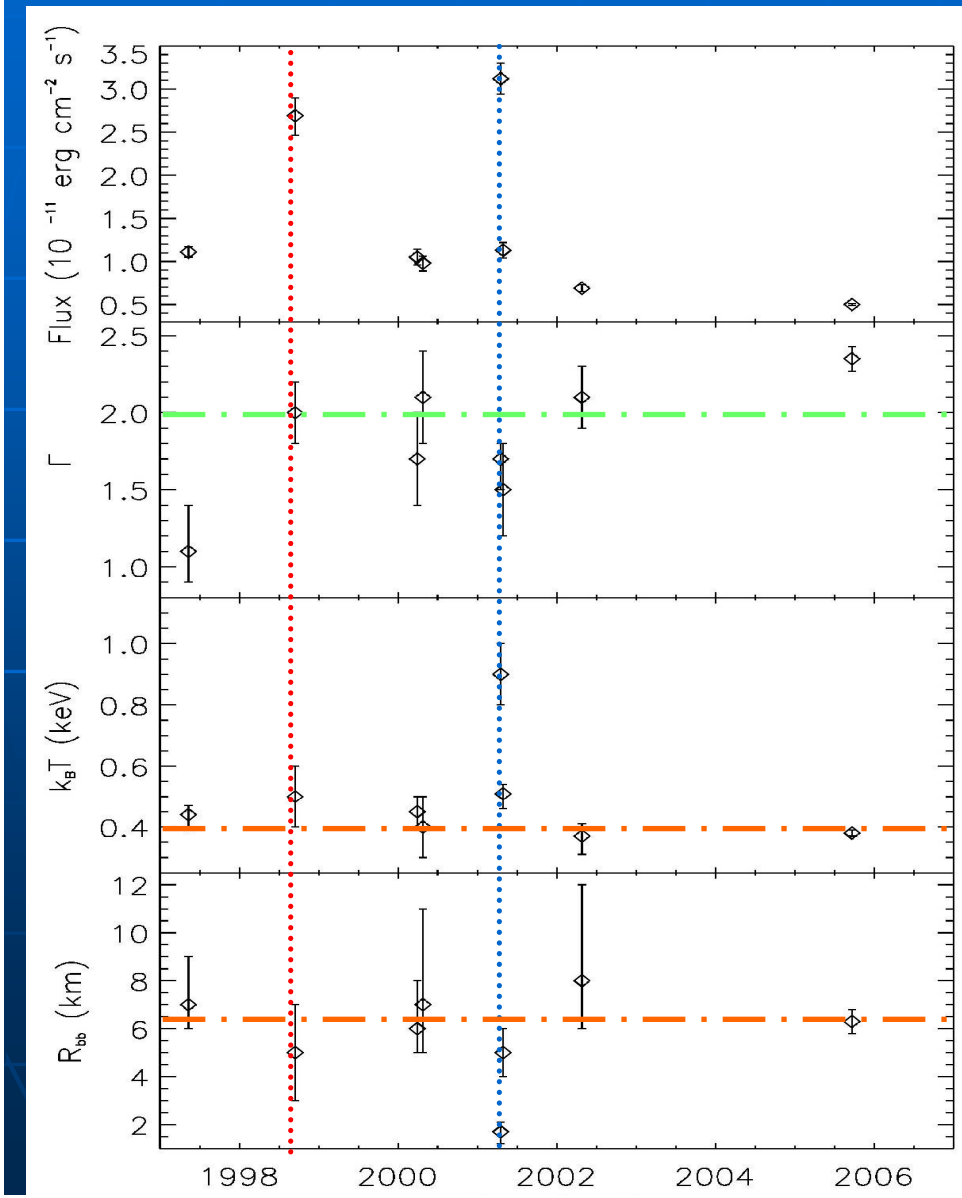
Cooling blackbody, similar to *(shorter)* afterglows observed with *RossiXTE* after *(weaker)* Intermediate Flares of **1998 AUG 29** *(Ibrahim et al. 2001*, having also a PL component) and **2001 APR 28** *(Lenters et al. 2003)*





Hot spot on magnetar surface produced by burst?

Spectral variability



MODEL: ph.abs + PL + BB

N_H=2.55x10^{22} cm^{-2} *(fixed)*
BB is required only in 4/7 obs.

The only observation **before the Giant Flare** has a **harder** spectrum (Γ~1.1)

The *XMM-Newton* spectrum is slightly softer (Γ~2.35) than the *BeppoSAX* post-flare ones

All observations far from strong flares have **consistent blackbody parameters**:

k_BT~0.4 keV,

R_{BB}~6.5 km (for d=15 kpc)

Pulse profiles and pulsed fraction

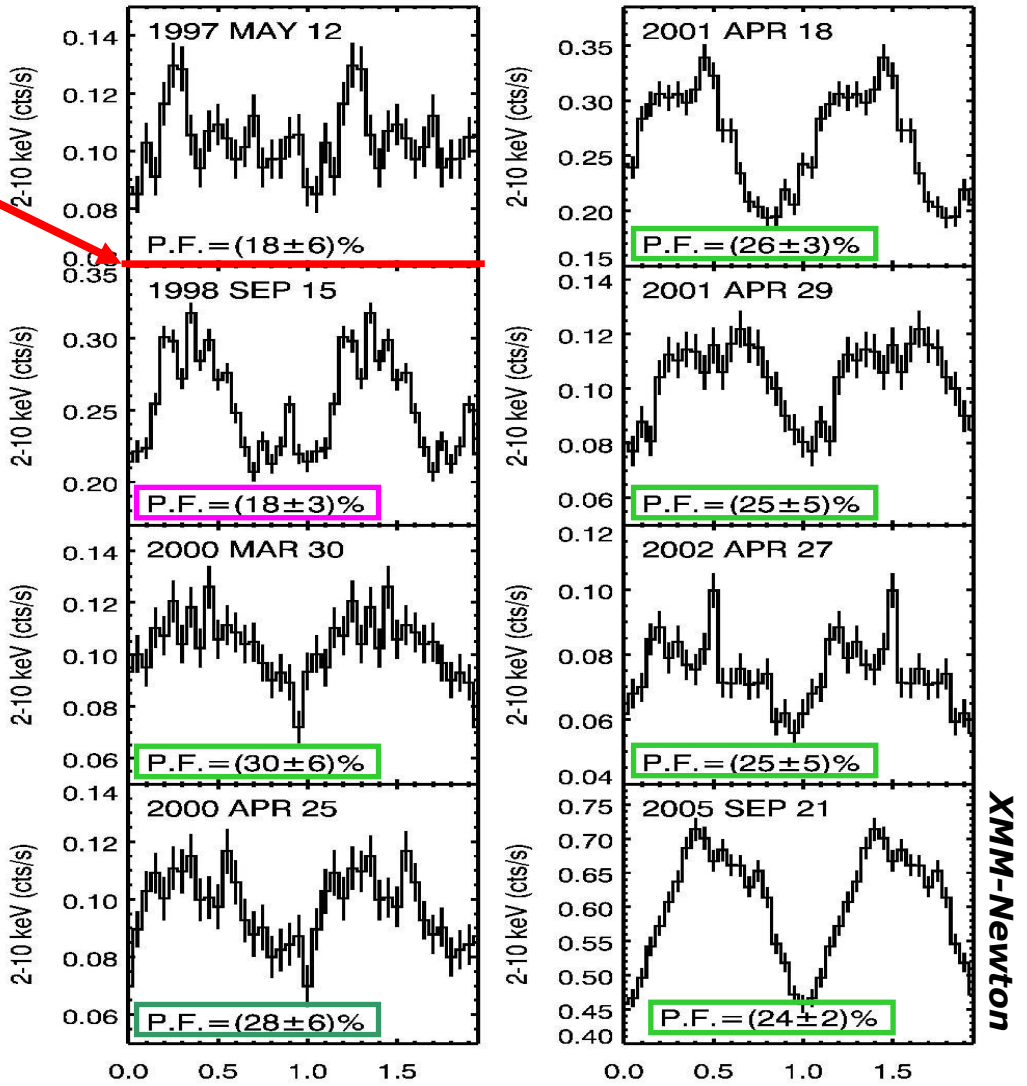
Giant Flare

Change in pulse shape
⇒ global reconfiguration of magnetosphere

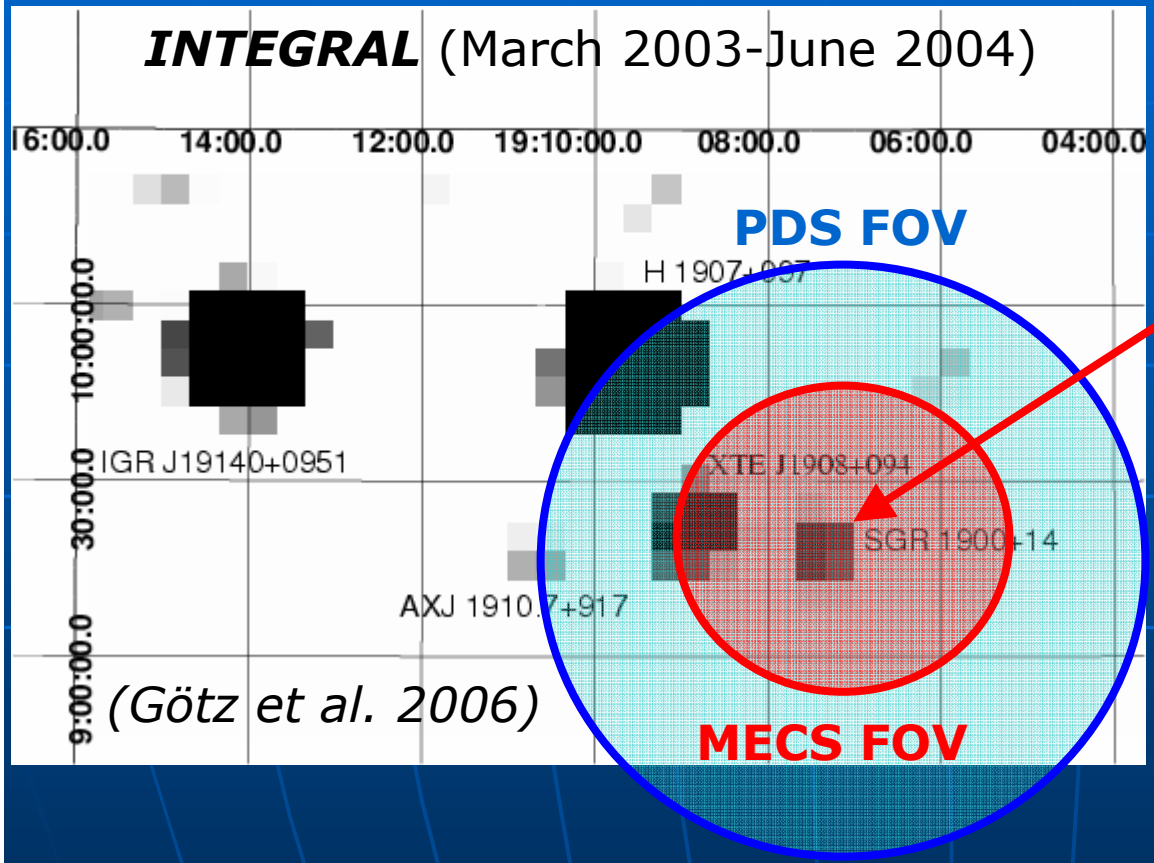
After the Giant Flare:

Constant P.F., but smaller
20 days after the flare.
Also SGR 1806-20 has stable P.F., but decreased after the Giant Flare *(Rea et al. 2005, Tiengo et al. 2005)*

⇒ Larger emitting (or reprocessing) region
or
additional non-pulsating component (with similar spectrum)



Hard X-ray emission



Discovery of hard X-ray persistent emission from SGR 1900+14 with *INTEGRAL*
(Götz et al. 2006):

$F_{20\text{-}100}=(1.5\pm0.3)\times10^{-11}$ erg cm^{-2} s^{-1}

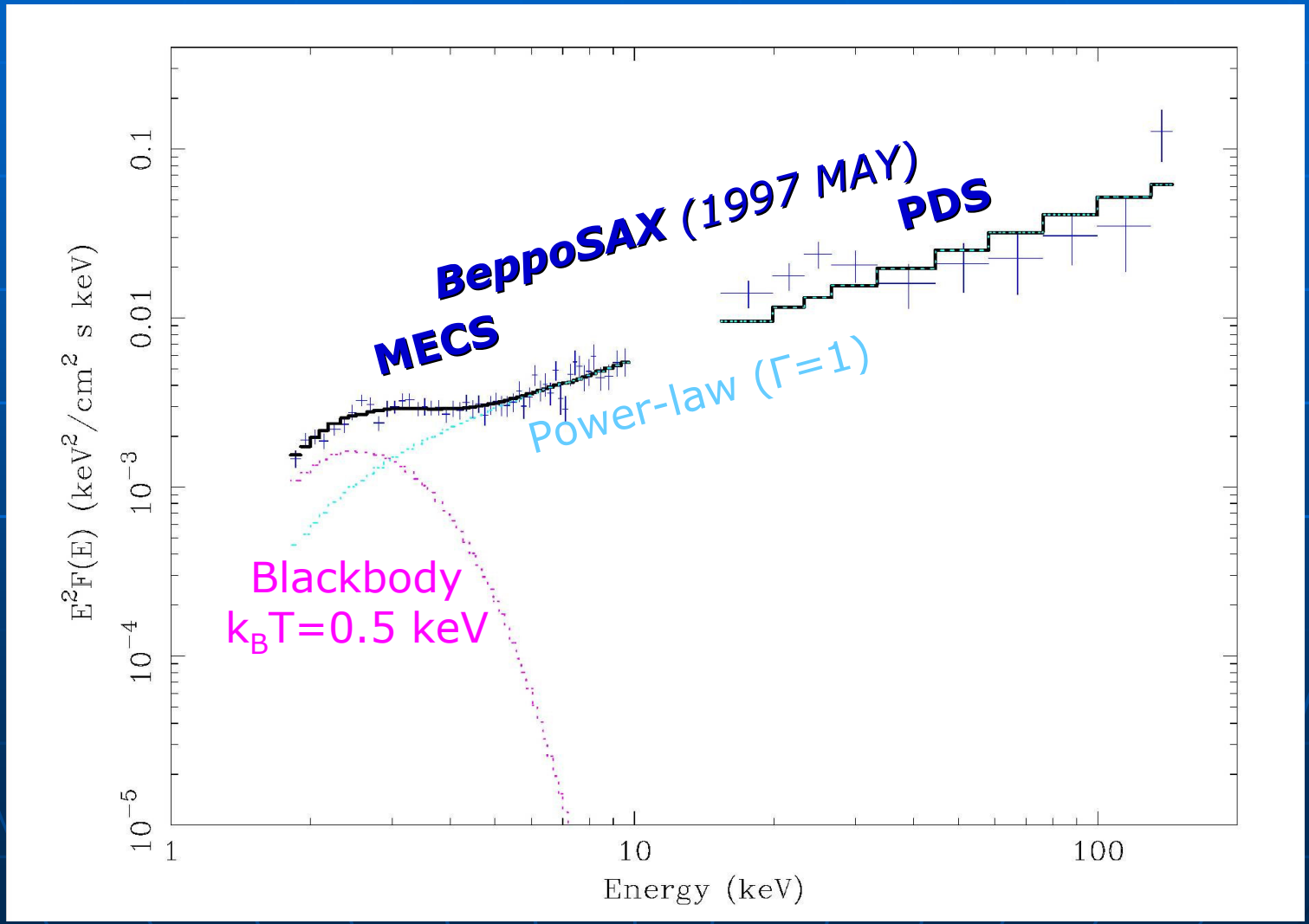
$\Gamma=3.1\pm0.5$

Transient sources in *BeppoSAX* PDS field of view:

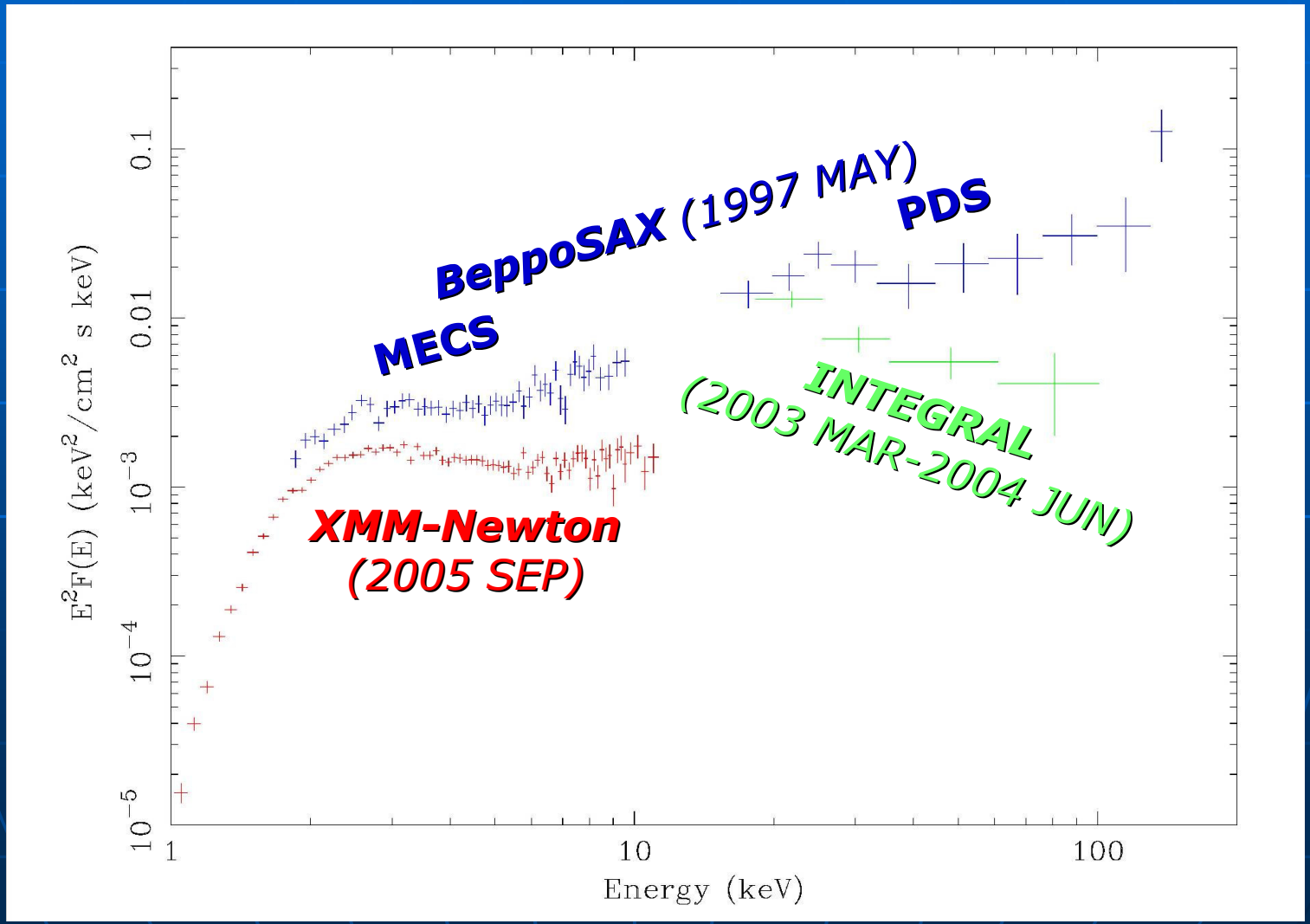
- *H 1907+097:* X-ray pulsar, P=440 s
- *XTE J1906+09:* X-ray pulsar, P=89 s
- *XTE J1908+094:* BHC, in MECS FOV

All OFF only in first *BeppoSAX* observation (pre-Flare)

Hard X-ray emission

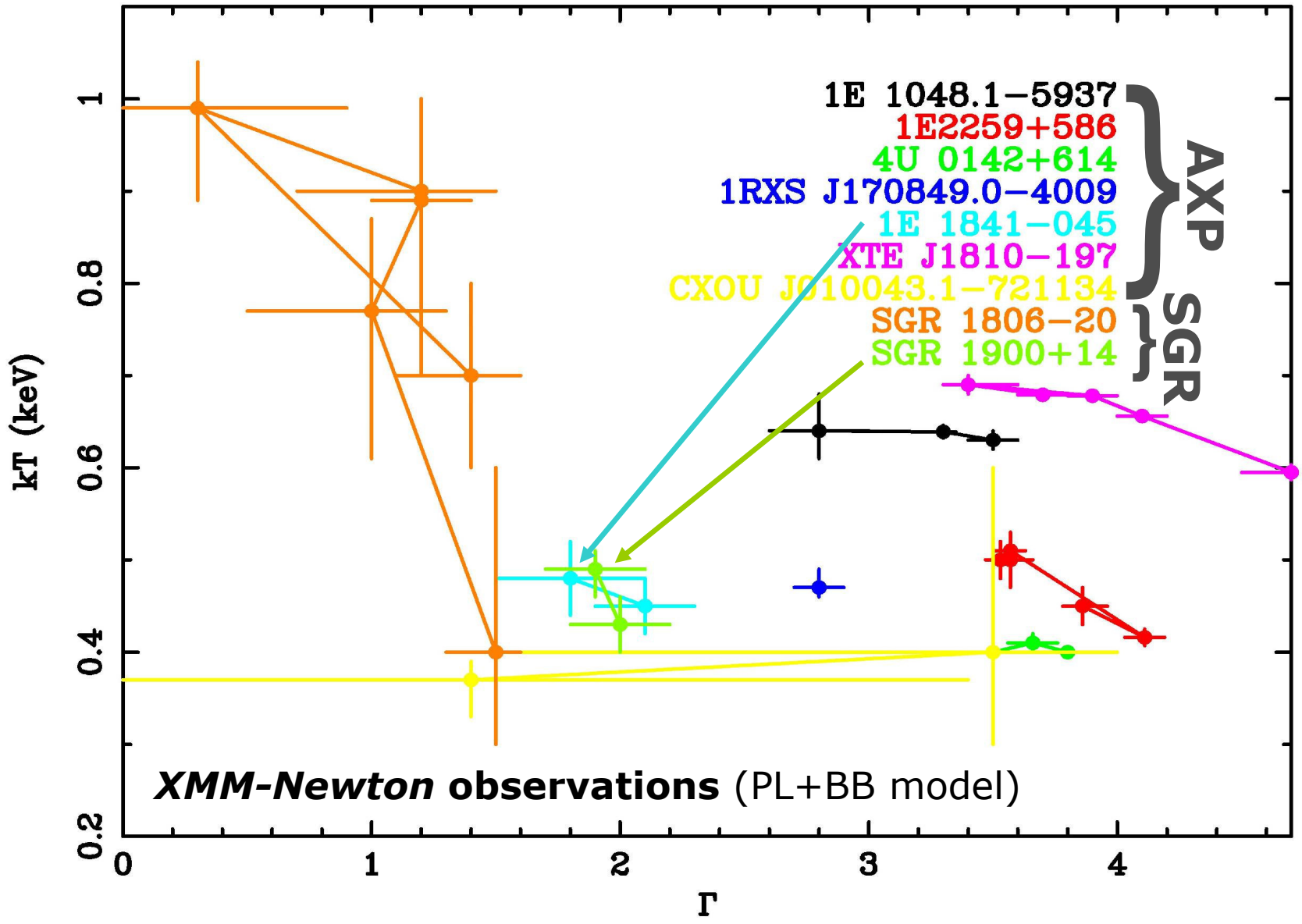


Hard X-ray emission



Conclusions

- Fading in 2002 and 2005: flux increase after reactivation?
- Same blackbody component in all quiescent observations
- Cooling blackbody after I.F. of 2001 April 18: crustal heating?
- Harder spectrum before G.F. (as in SGR 1806-20), also in hard X-rays
- Spectrum harder than most AXPs, but very similar to AXP 1E 1841-045


1E 1048.1−5937
1E2259+586
4U 0142+614
1RXS J170849.0−4009
1E 1841−045
XTE J1810−197
CXOU J010043.1−721134
SGR 1806−20
SGR 1900+14
AXP
SGR
kT (keV)
Γ
0.2
0.4
0.6
0.8
1
0
1
2
3
4
XMM-Newton observations (PL+BB model)