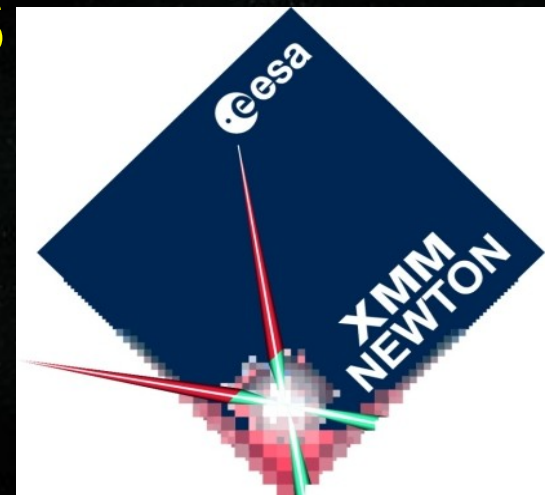


X-ray properties of the Fermi/LAT pulsars

Milano, 2012 October 1st



**Martino Marelli
De Luca, A. & Caraveo P. A.**

**Marelli, M. Et al. 2011, ApJ, 733, 82
Marelli M., 2012, arXiv 1205 1748
2nd Fermi pulsar catalog, in preparation**

The aim of this work

- γ -ray sources have big error boxes (arcmins) : arcsec position facilitate discovery of gamma pulsations or improve gamma timing solutions

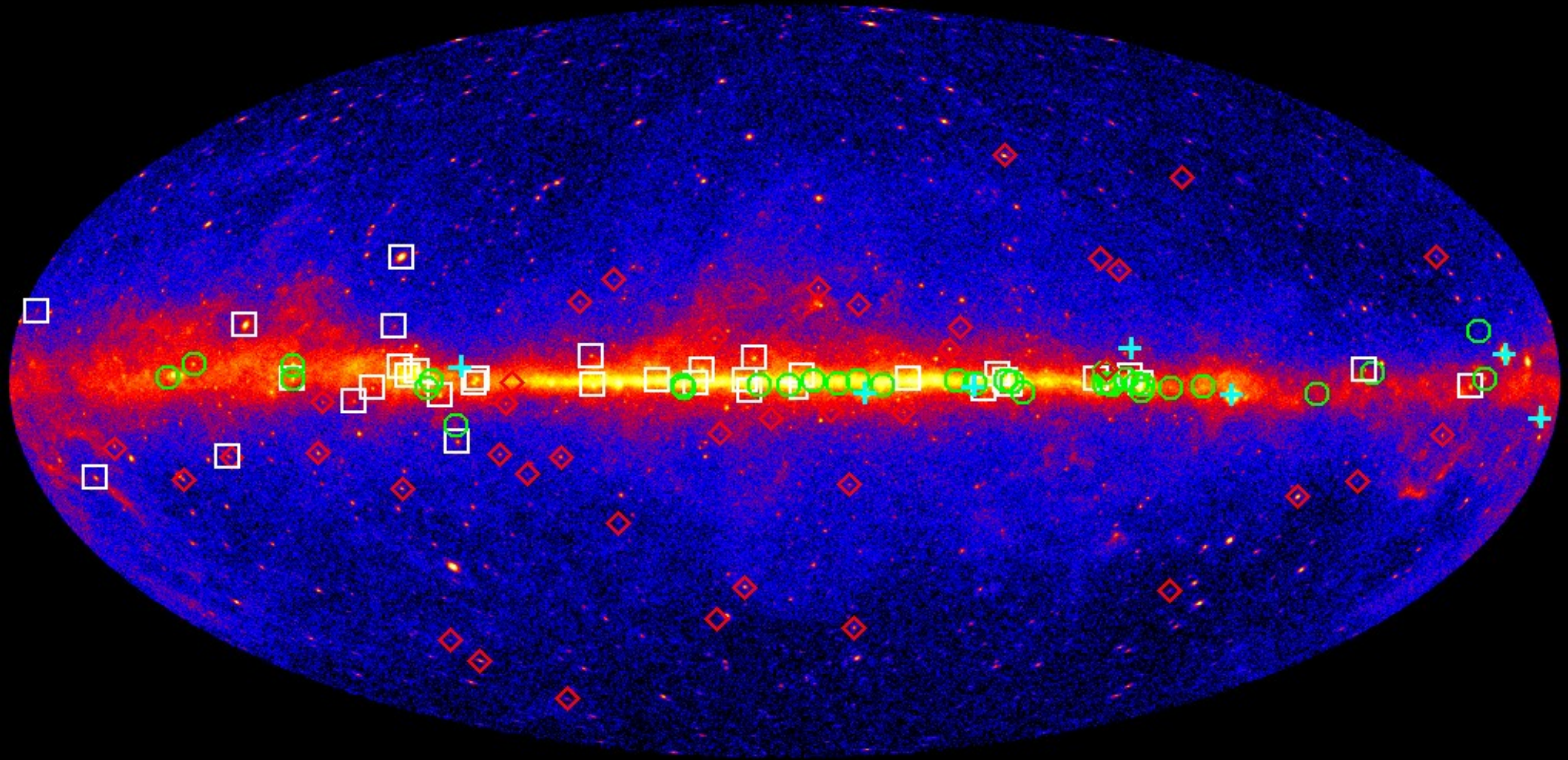
- Is there any correlation between the X-ray and gamma-ray spectra of NSs?

- Is there any difference in the spectra of the three families of pulsars detected by Fermi? If yes, what does it means?

y-rays:
117 pulsars fitted by (cutoff) powerlaws; search for nebular emission possible only for brightest ones

X-rays:
data from Swift, Chandra, XMM-Newton, Suzaku re-analyzed by using the same tools, models and PWN treatment

The dataset



43 young Radio-Loud 34 young Radio-Quiet **40 Milliseconds**



117 γ -ray PSRs

if: pow spectral shape,
pseudo-distance from γ :

- **Upper limit flux**

- **Position**

if: mean spectral shape
and nebula,
pseudo-distance from γ :

- **X-ray flux**

- **Position**

- **Spectral character.**

- **PWN spectrum**

- **thermal and non-thermal X-ray fluxes**

**51 without X-ray
counterpart (t.0)**

**11 with X-ray
detection (t.1)**

**55 characterized
in X-rays (t.2)**

28 radio-loud(65%)

21 radio-quiet(60%)

17 millisecond(40%)

- Only fully characterized pulsars have been used
- For pulsars with distance known, we plotted X-ray and γ -ray luminosities vs E_{rot} (see e.g. Possenti et al. 2002, Kargaltsev&Pavlov 2008)
- We also fitted γ -to-X-ray flux ratio vs E_{rot} , B and age : such value is distance-independent!!
- In preparation : analyses on thermal and nebular fluxes

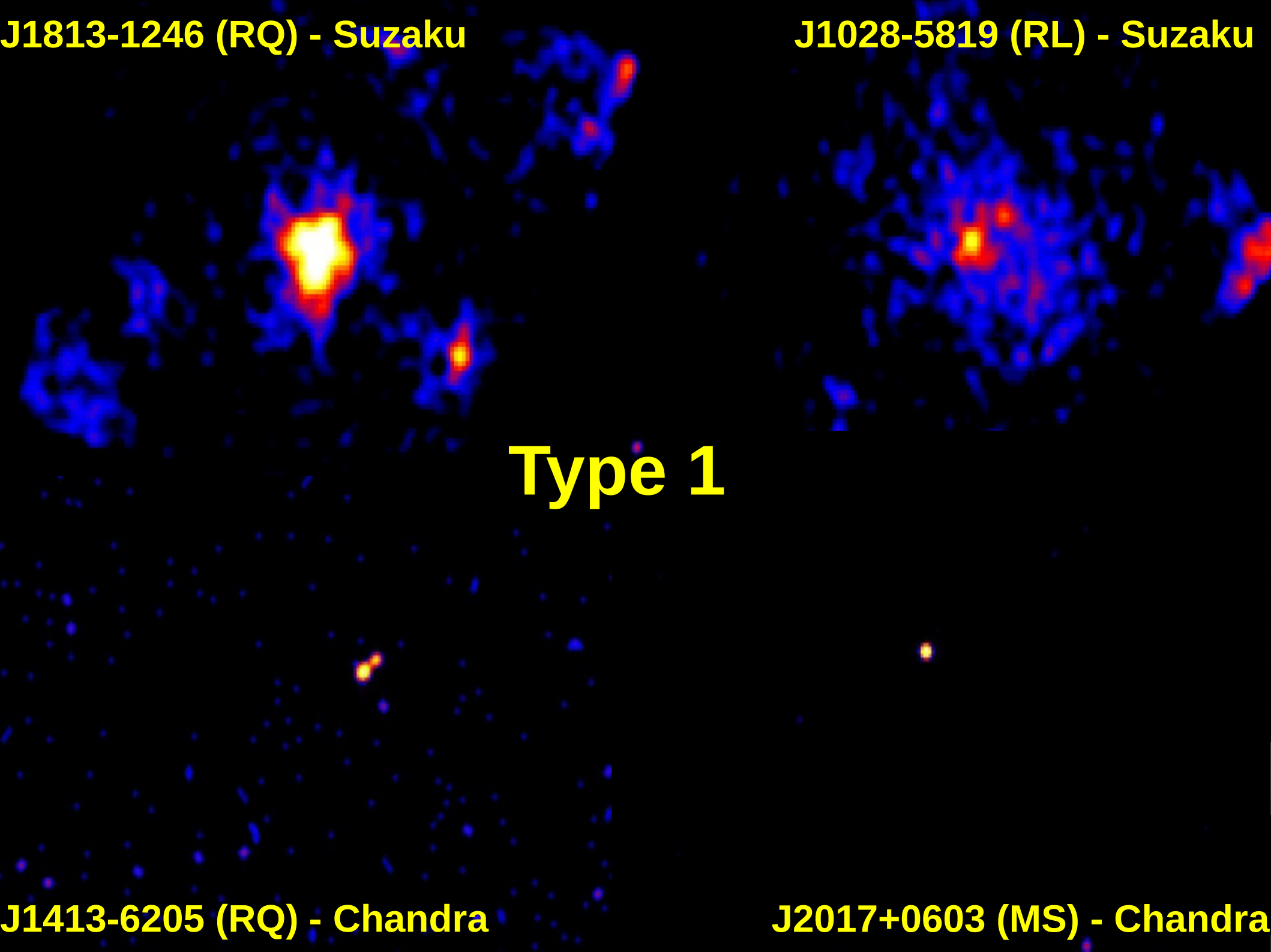
J1813-1246 (RQ) - Suzaku

J1028-5819 (RL) - Suzaku

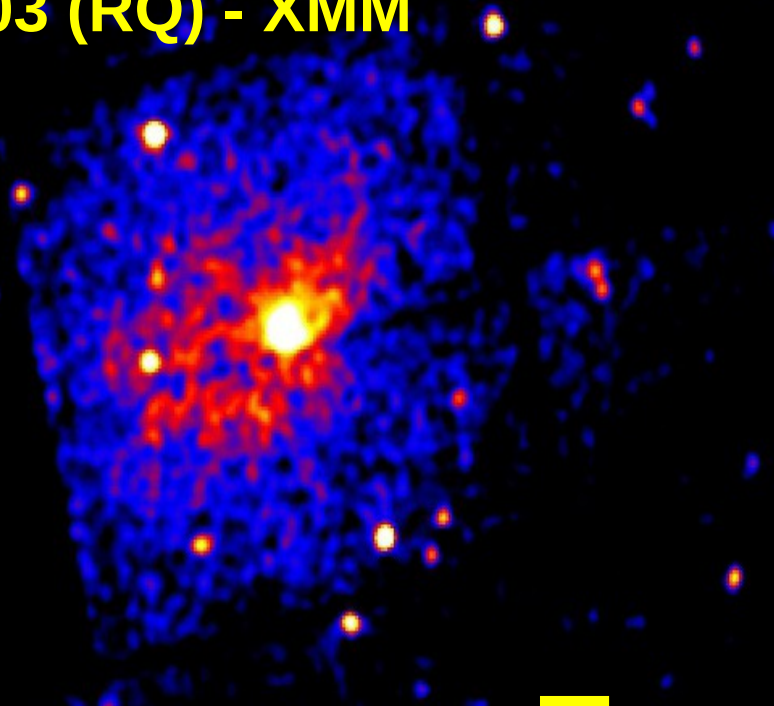
Type 1

J1413-6205 (RQ) - Chandra

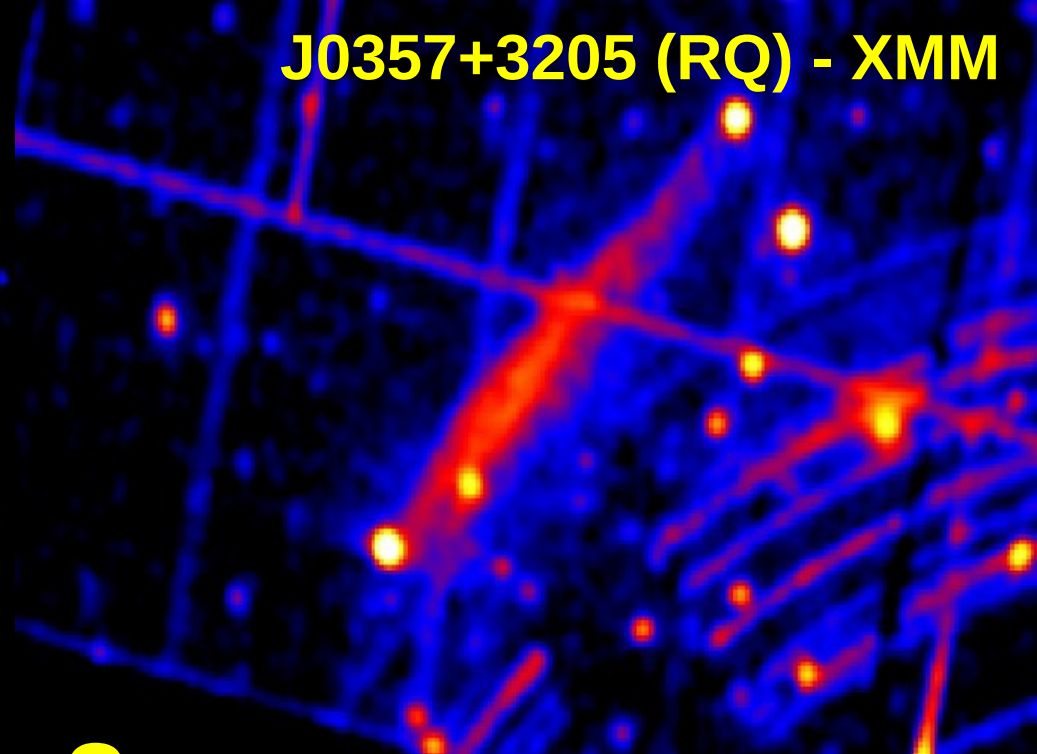
J2017+0603 (MS) - Chandra



J0007+7303 (RQ) - XMM

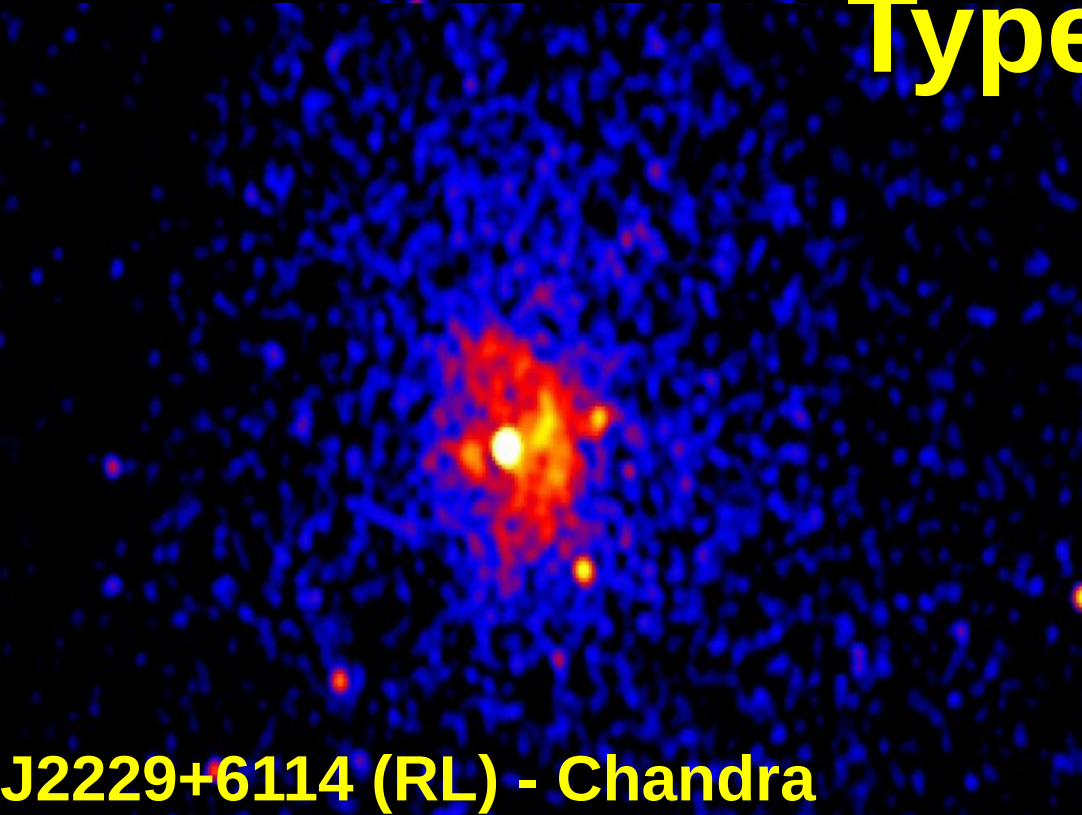


J0357+3205 (RQ) - XMM

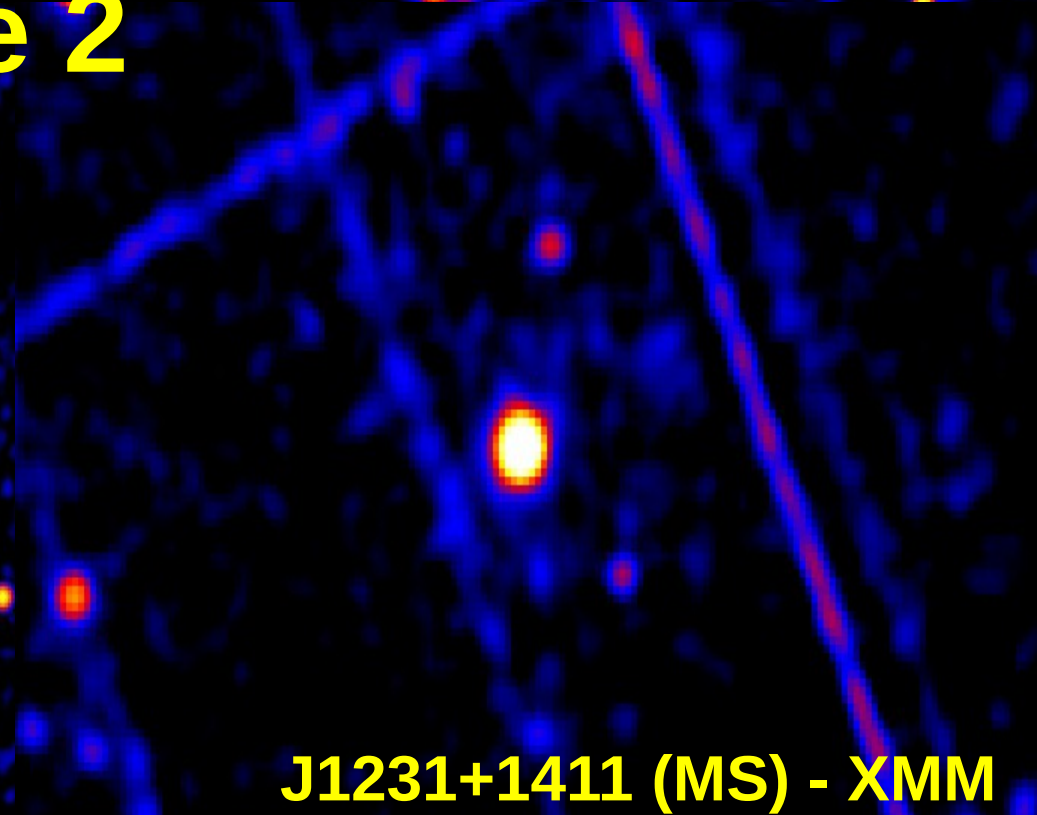


Type 2

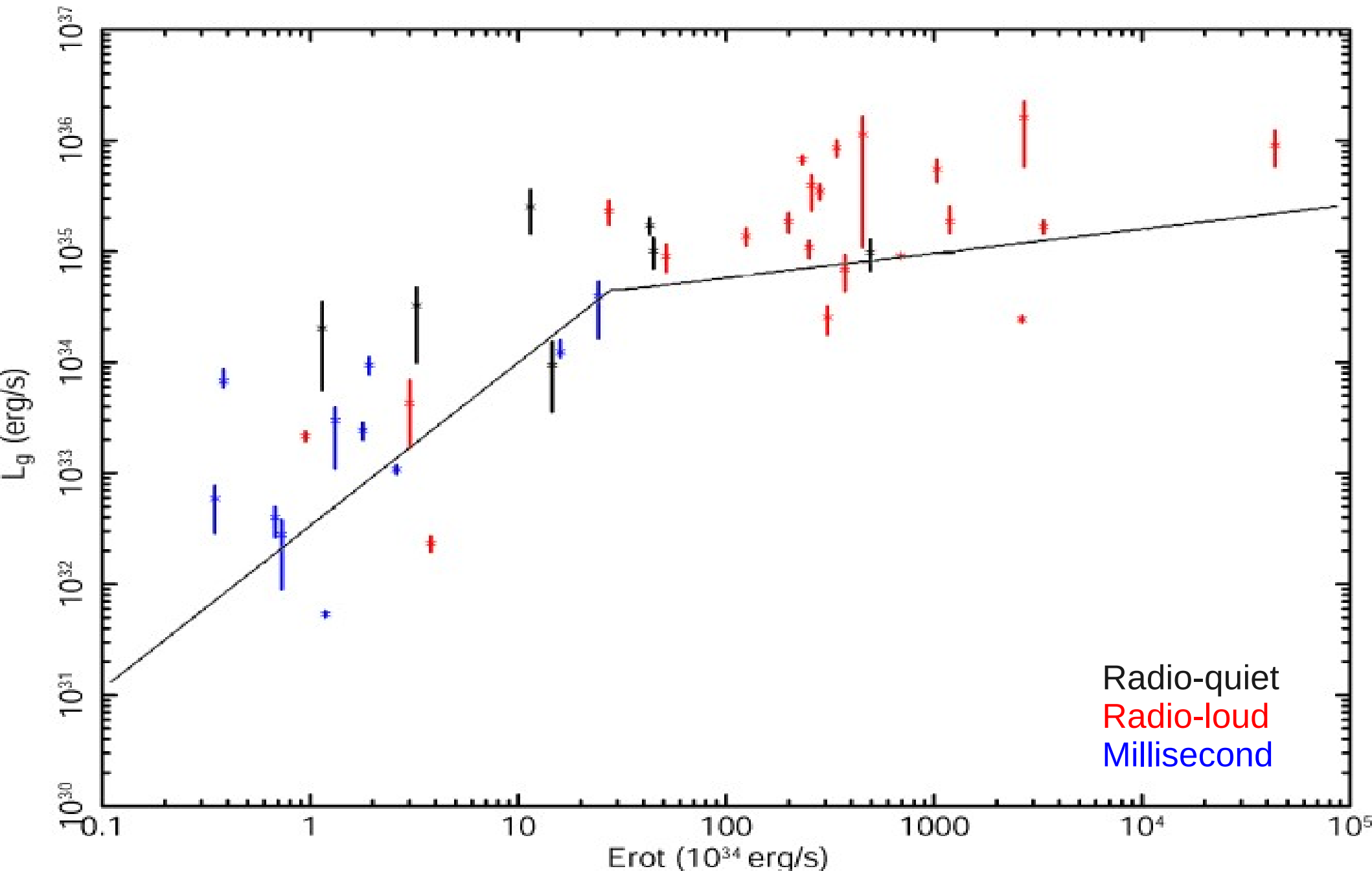
J2229+6114 (RL) - Chandra



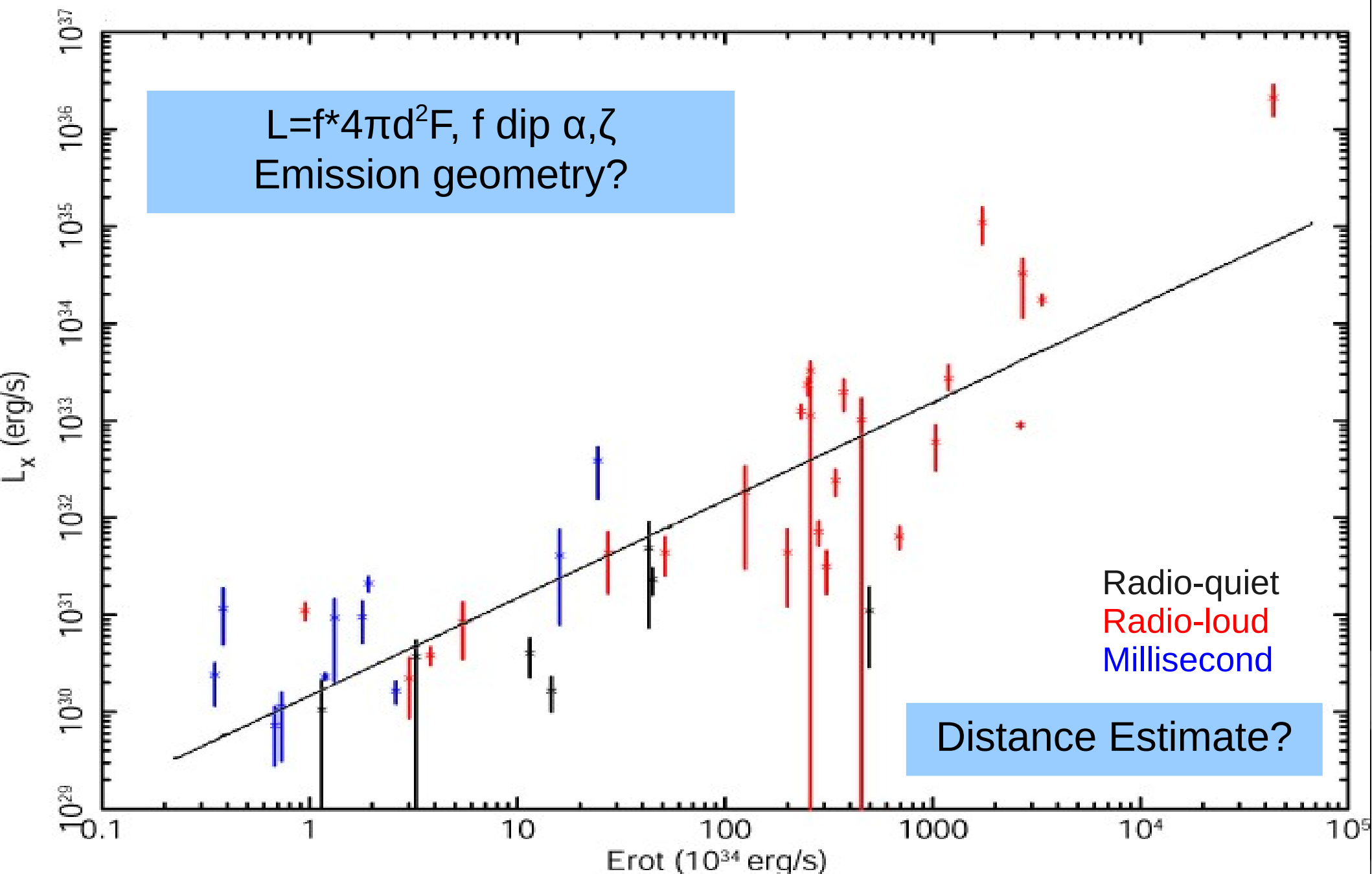
J1231+1411 (MS) - XMM



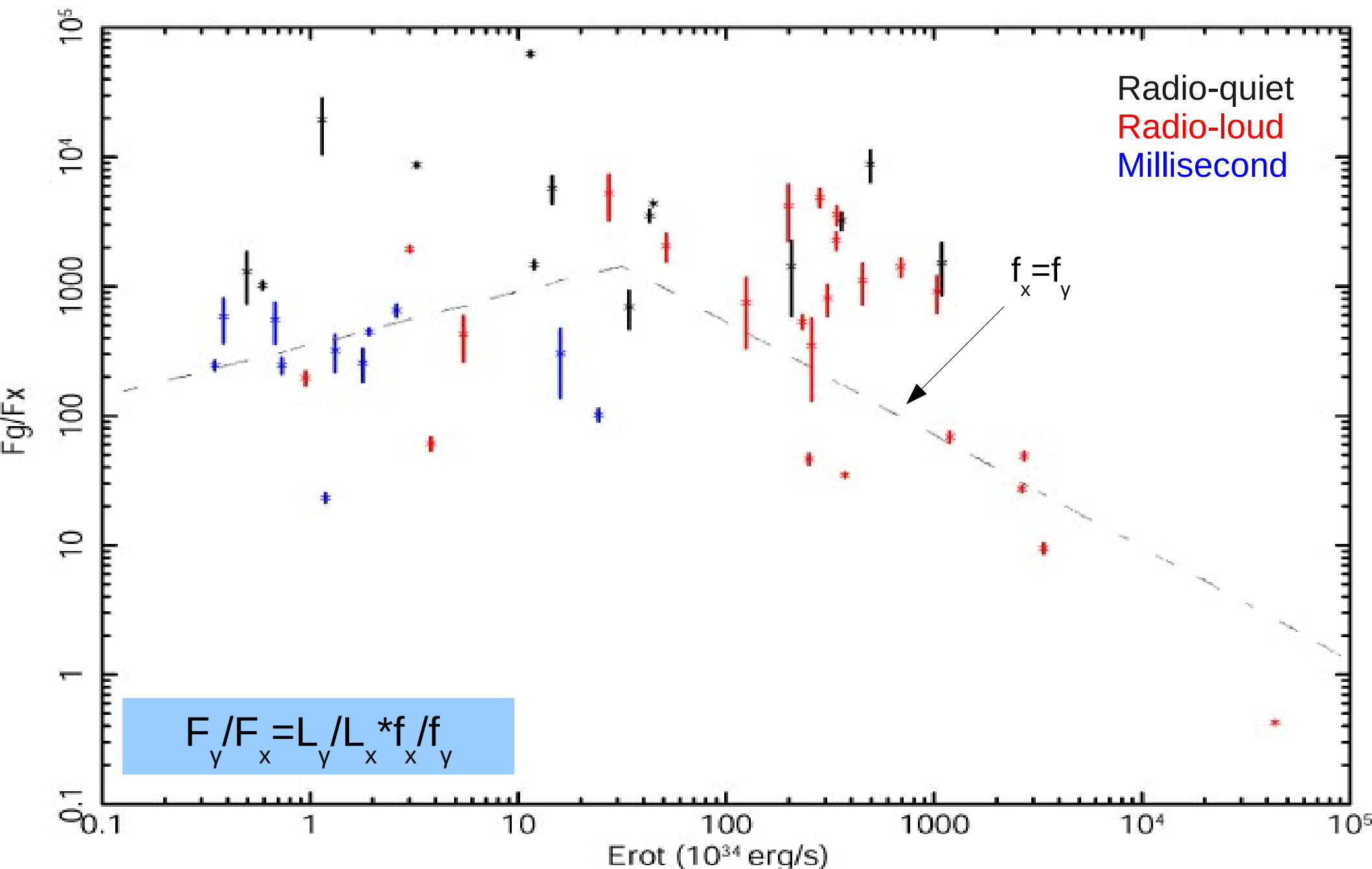
The γ -ray luminosity



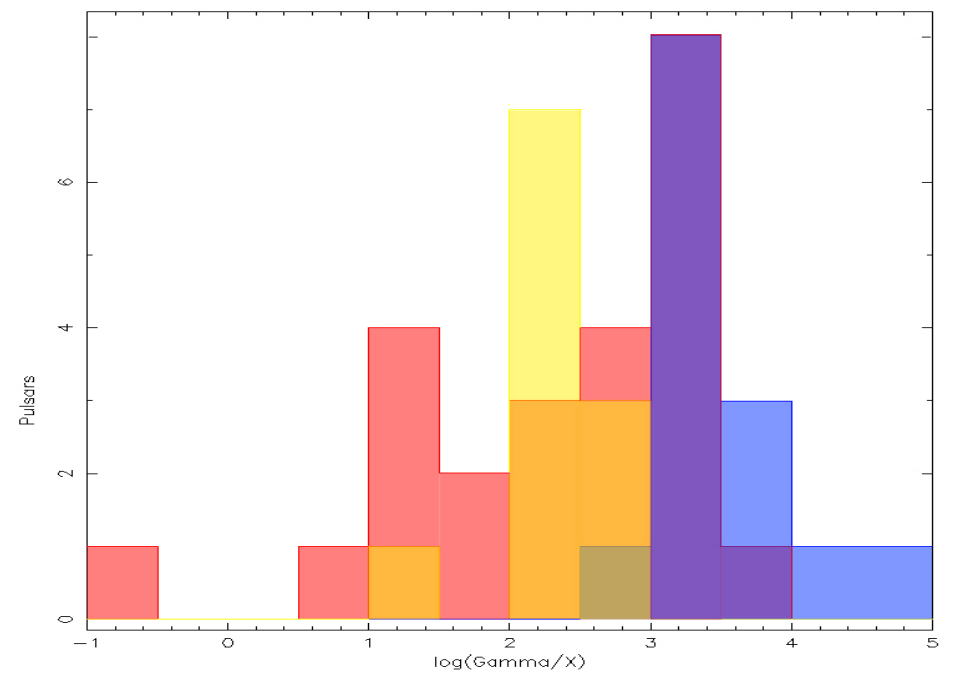
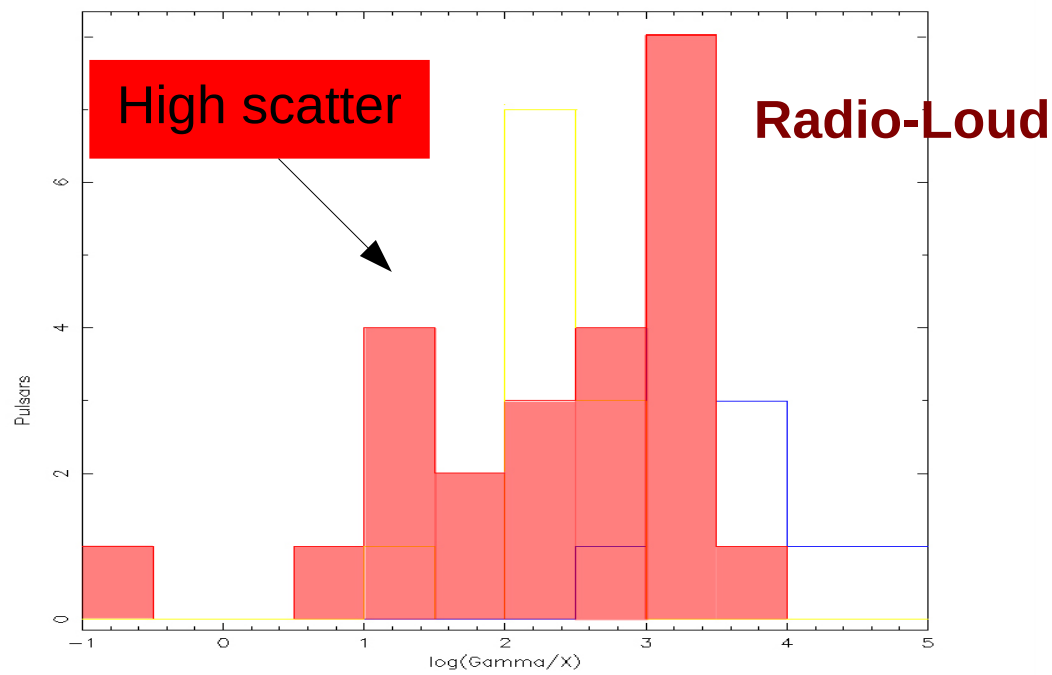
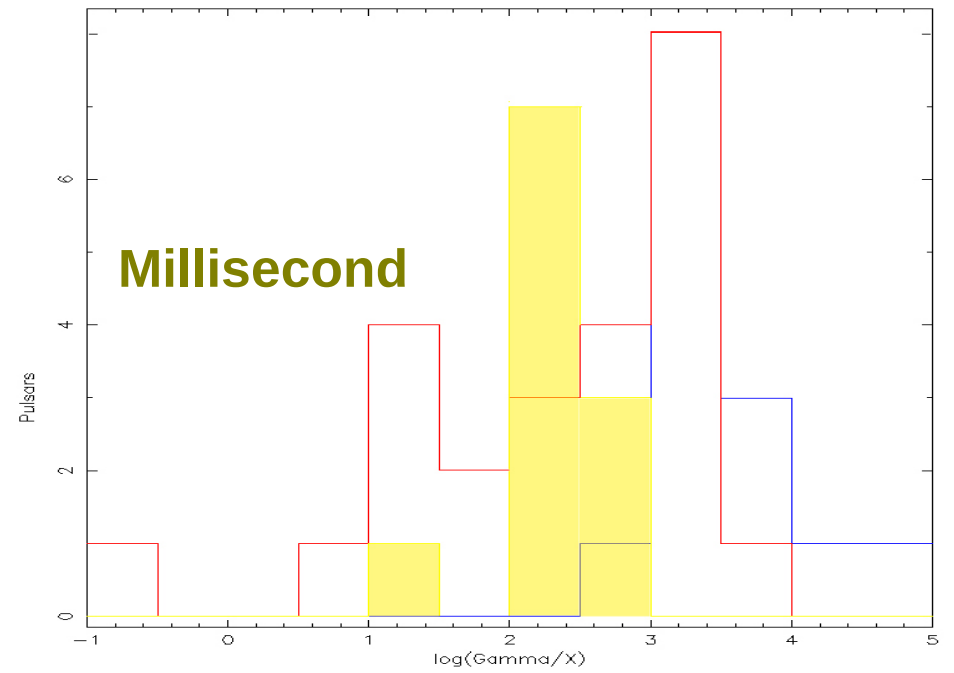
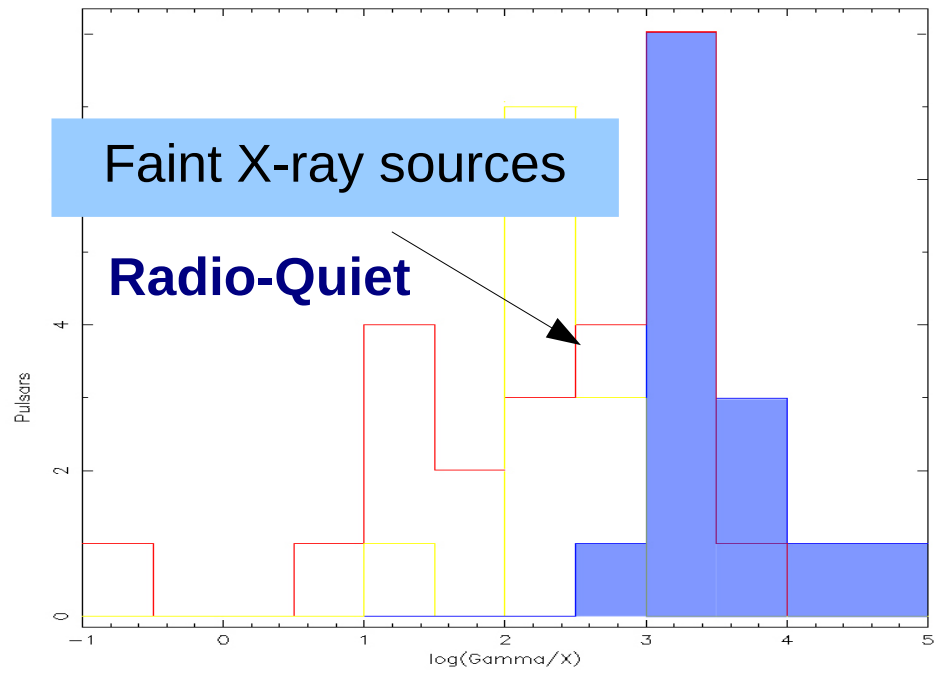
The X-ray luminosity



γ -to-X



γ -to-X



Conclusions:

- We made a catalog of the newly discovered X-ray pulsars (Becker et al. 2009)
- $L_x \sim E_{rot}$ BUT high scatter (distance or geometry?)
- $L_\gamma \sim E_{rot}$ with a lower scatter (distance or geometry?)
- RQ pulsars are underluminous in the X band: a geometry different than RL ones could explain such behaviour
- MS pulsars have a more uniform behaviour (geometry?) than RL ones
- the correlation between X and γ -ray emission is loose, if any

(Our work is just a starting point)