

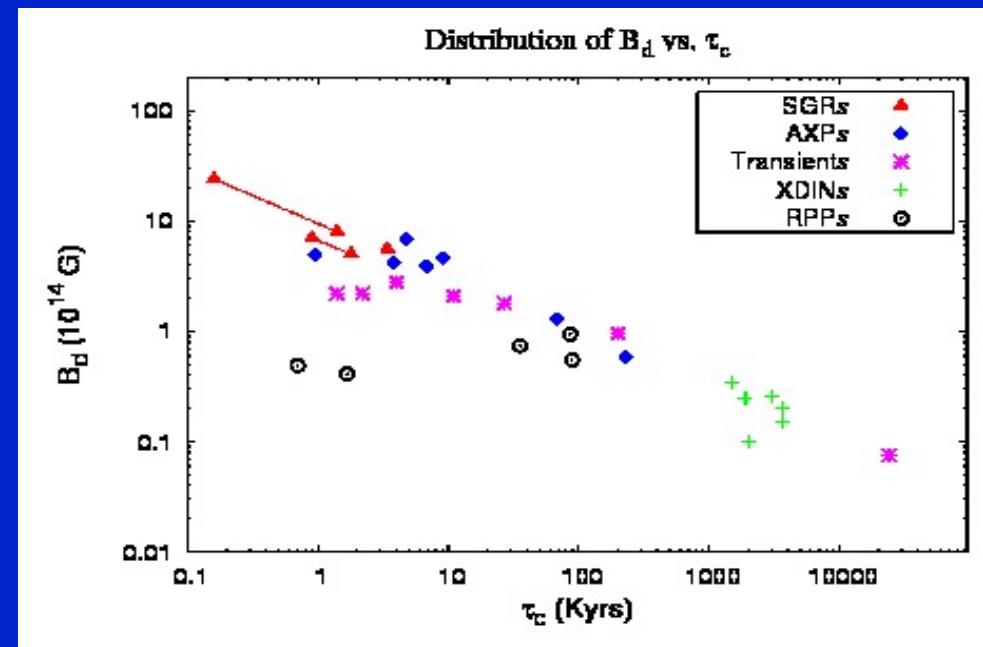
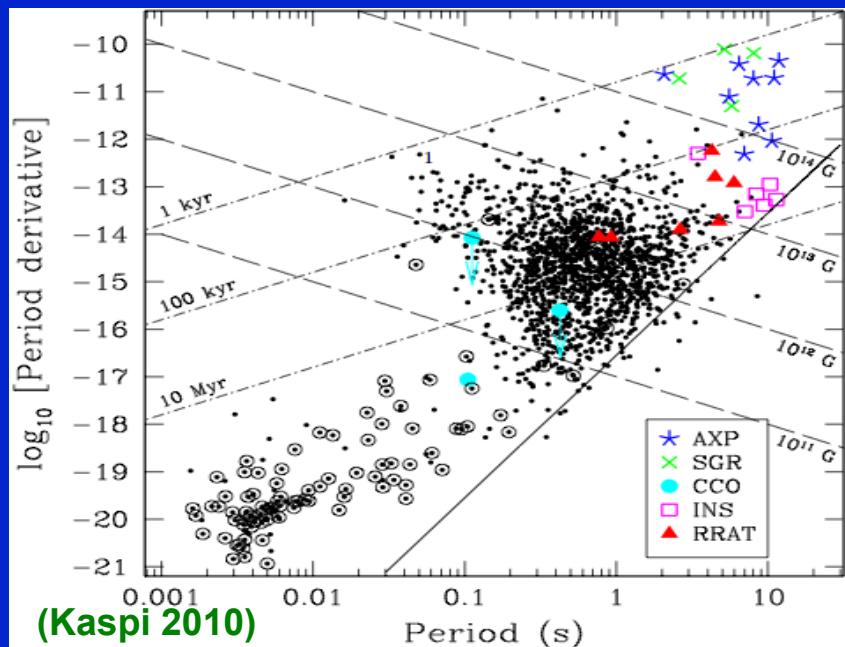
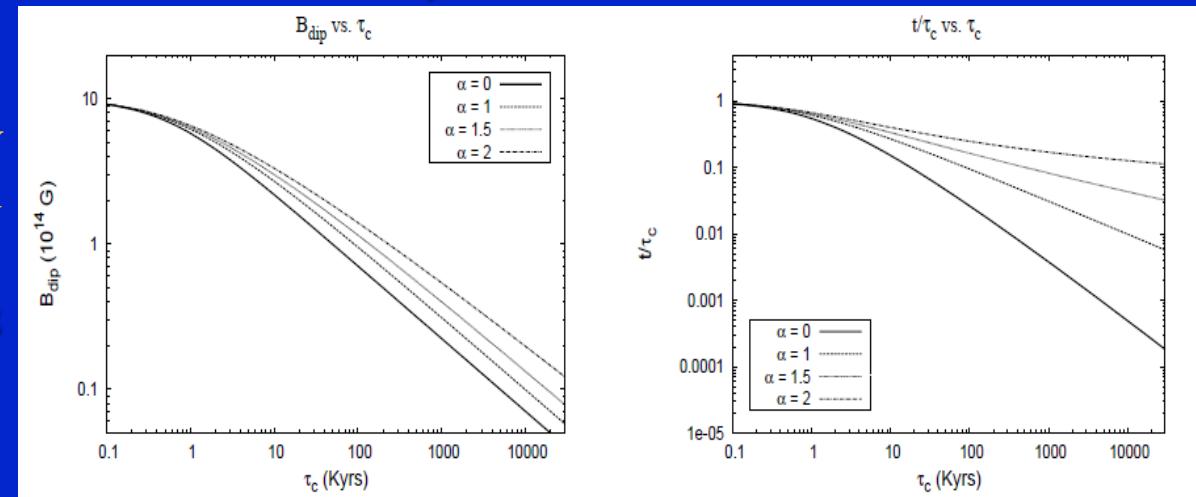
Magnetar Evolution & B-field Decay

(Dall'Osso, JG & Piran 2012, MNRAS, 422, 2878)

a phenomenological study
of magnetar B-field decay

$$\dot{B}_d = -B_d/\tau_d \propto B_d^{1+\alpha}$$

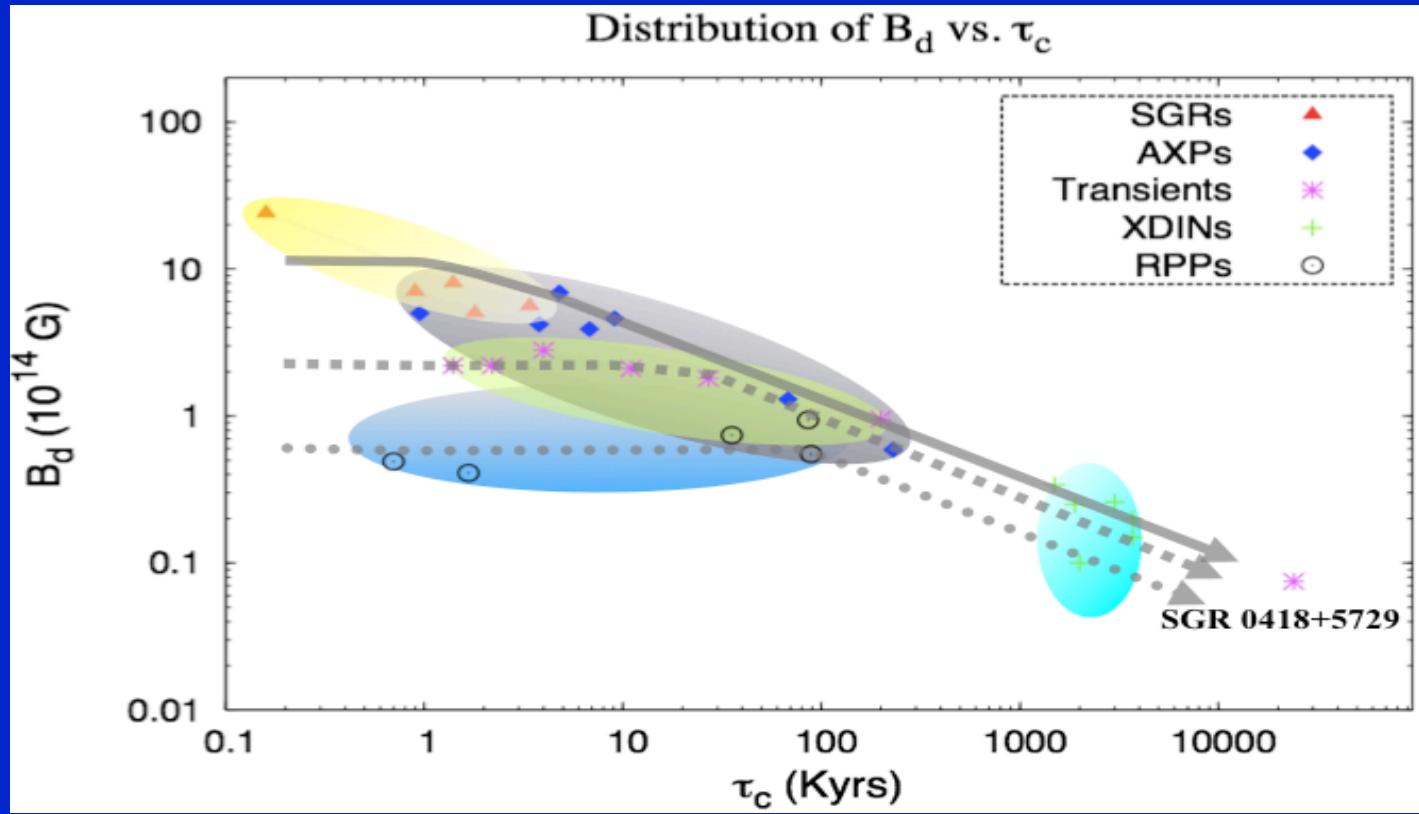
$$\tau_d \propto B^{-\alpha} \text{ with } \alpha < 2$$



Spindown age: $\tau_c = -\Omega/2\dot{\Omega} = P/2\dot{P}$

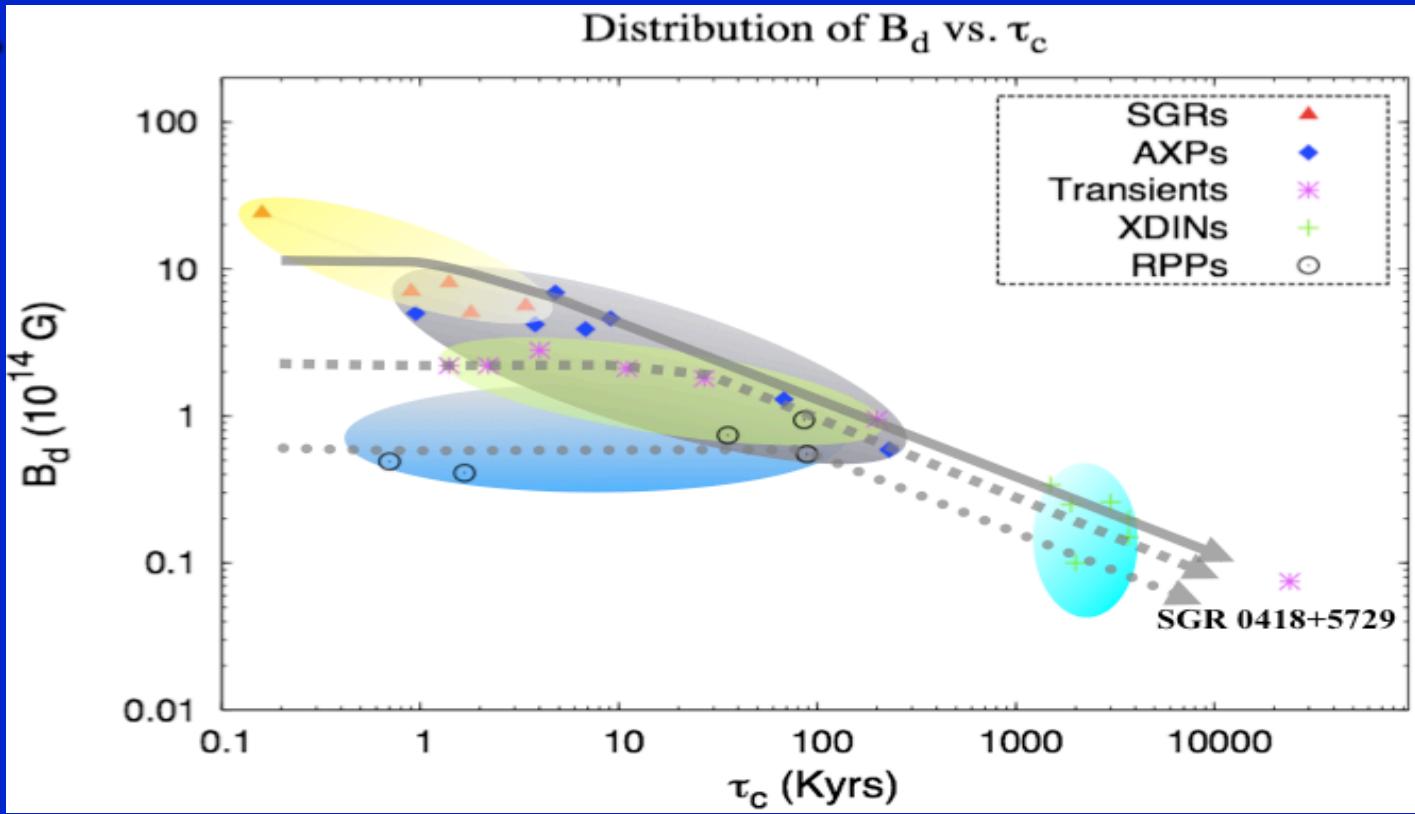
$B_d = 3.2 \times 10^{19} (P[\text{s}] \dot{P})^{1/2} \text{ G} \propto \tau_c^{-1/2}$

Possible evolution:



1. SGR/AXP branch (Kouveliotou et al. 1998): SGR → AXP → XDIN?
 $B_{d,i} \sim 10^{15}$ G, $B_{int,i} \gtrsim 10^{16}$ G; early $L_X \sim 10^{35}$ erg/s $\ll L_{B,int}$ (v -limited)
2. Transient branch: Transient SGR/AXP → ???
 $B_{d,i} \sim 2 \times 10^{14}$ G, $L_{X,quiescent} \ll L_{B,dip}$ → $B_{int,i} \sim ?$, $L_{X,outburst} \sim L_{X,SGR/AXP}$
 →? ordered $B_{int,i} \gtrsim 10^{16}$ G suppresses quiescent heat conduction to surface
 ◆ $B_{int,SGR/AXP} \rightarrow \alpha\text{-}\Omega$ dynamo, $B_{int,transient} \rightarrow ???$ (remnant field?)
3. High-B RPP → XDIN?

Sources of interest:



SGR J0418+5729: $B_{d,i} \sim (3-5) \times 10^{14}$ G, while currently $t_{age} \sim 1-2$ Myr,
 $B_d \sim (4-7) \times 10^{12}$ G, $B_{int} \sim (1-2) \times 10^{14}$ G (for $B_{int,i} \gtrsim 10^{16}$ G) &
 $L_{B,int} \sim L_X \sim (4-10) \times 10^{30}$ erg/s **Later obs.:** $B_d = 6 \times 10^{12}$ G (Rea+ 13')

XDINs: $t_{age} \sim 0.1-0.6$ Myr, $B_{d,i} \sim (0.3-20) \times 10^{14}$ G, L_X likely remnant heat ($L_{B,int}$ might contribute a little); no evidence for $B_{int} \rightarrow ?$ related to other high-B NSs without bursting activity (RPP, CCO?)