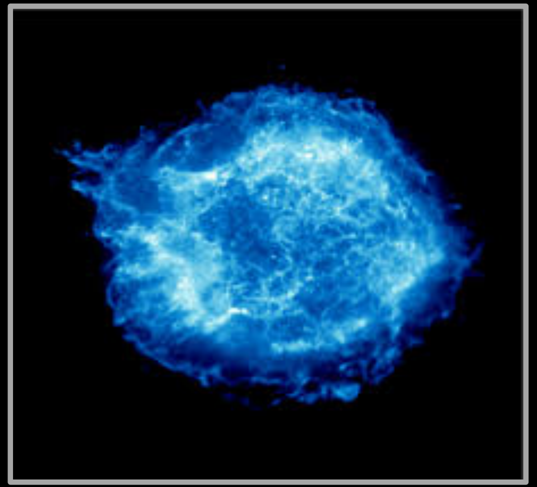
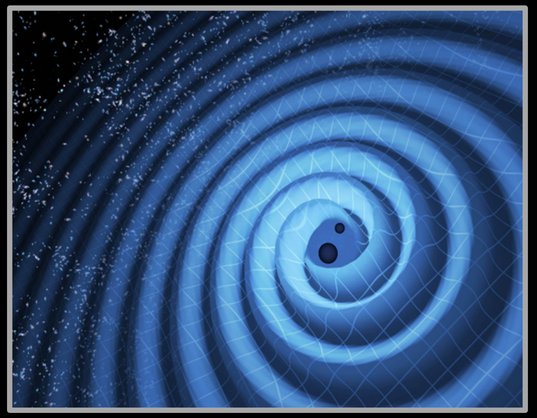
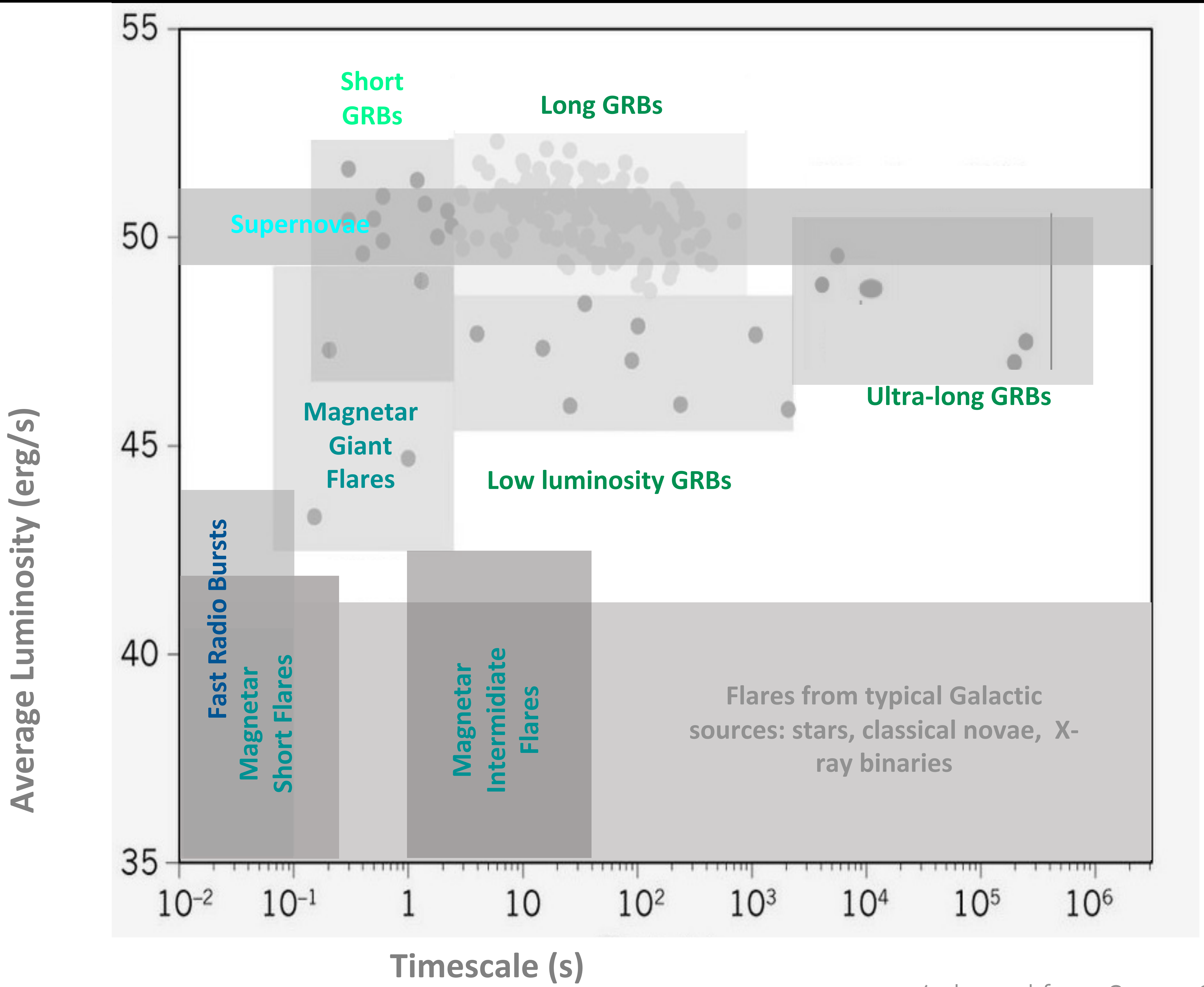
THE UNIVERSE MOST ENERGETIC TRANSIENTS

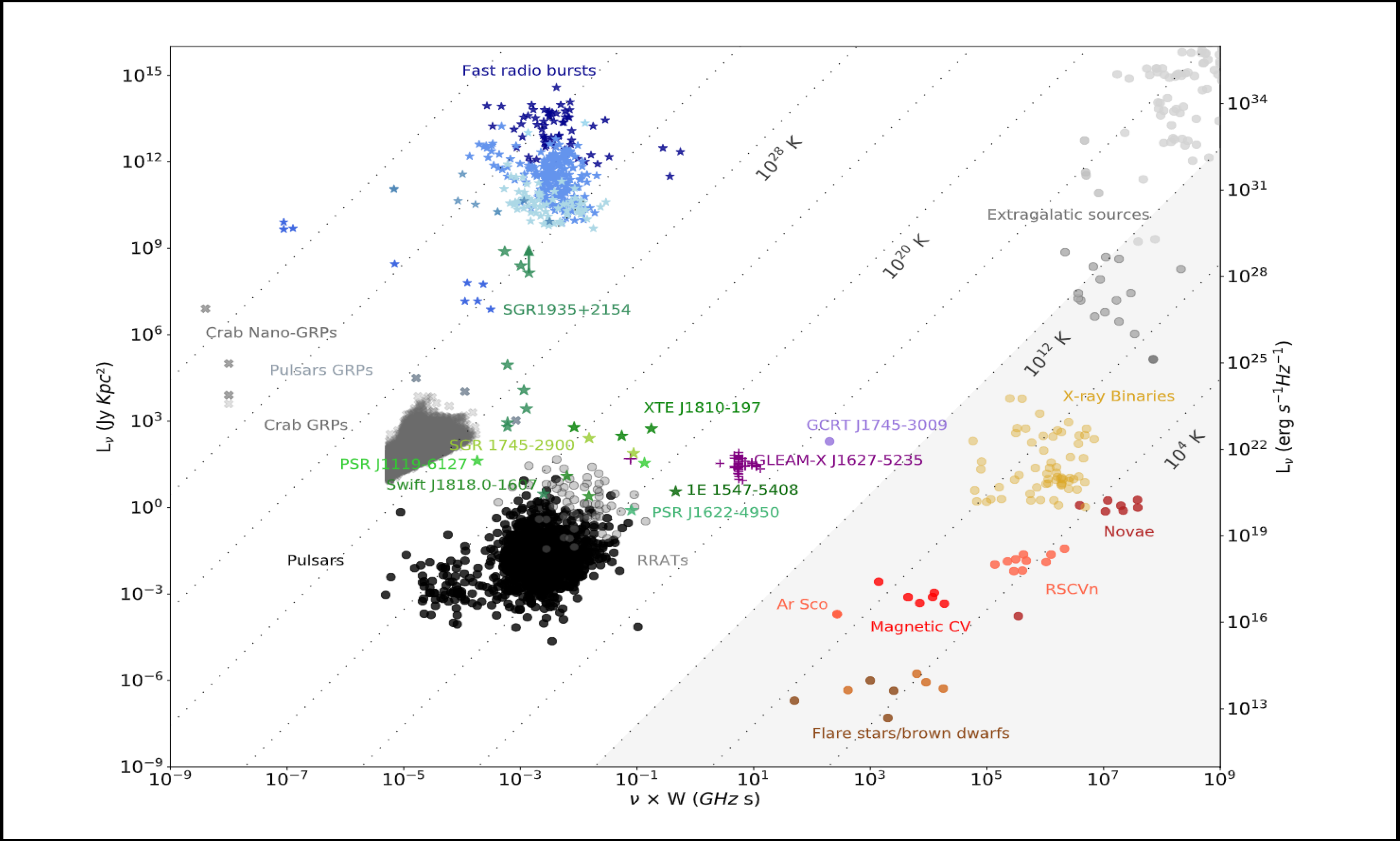






(adapted from Smartt 2015)

THE RADIO TRANSIENT SKY: FAST RADIO BURSTS AND MAGNETARS



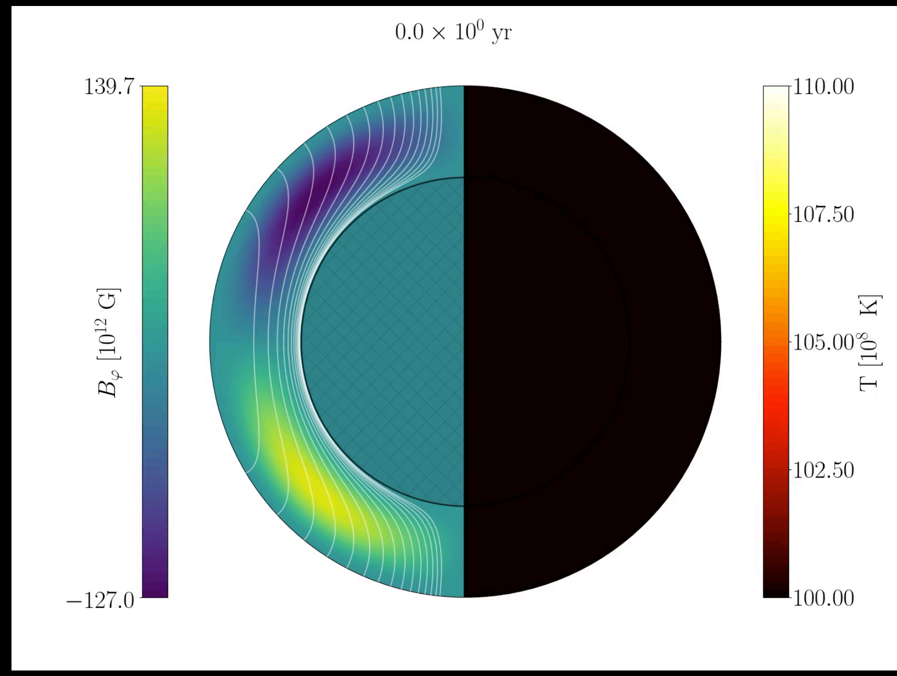
There is probably a large range of radio peak luminosities, and geometrical configurations, from radio pulsars to magnetars until Fast Radio Bursts.

See Possenti's talk!

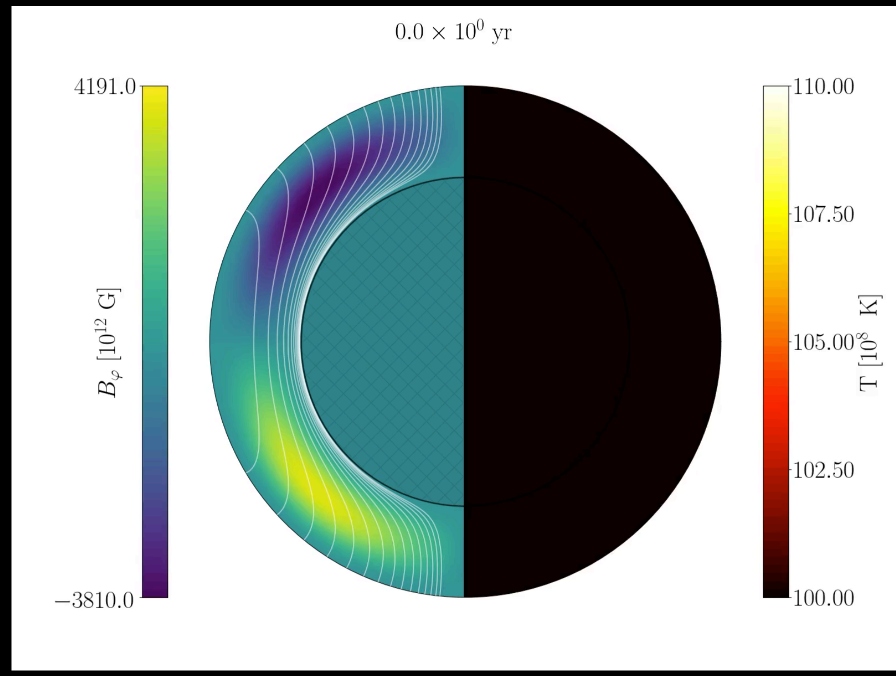
(Cordes et al. 2004, Pietka et al. 2015, Hurley-Walker et al. 2022, Rea et al. 2022, ApJ submitted)

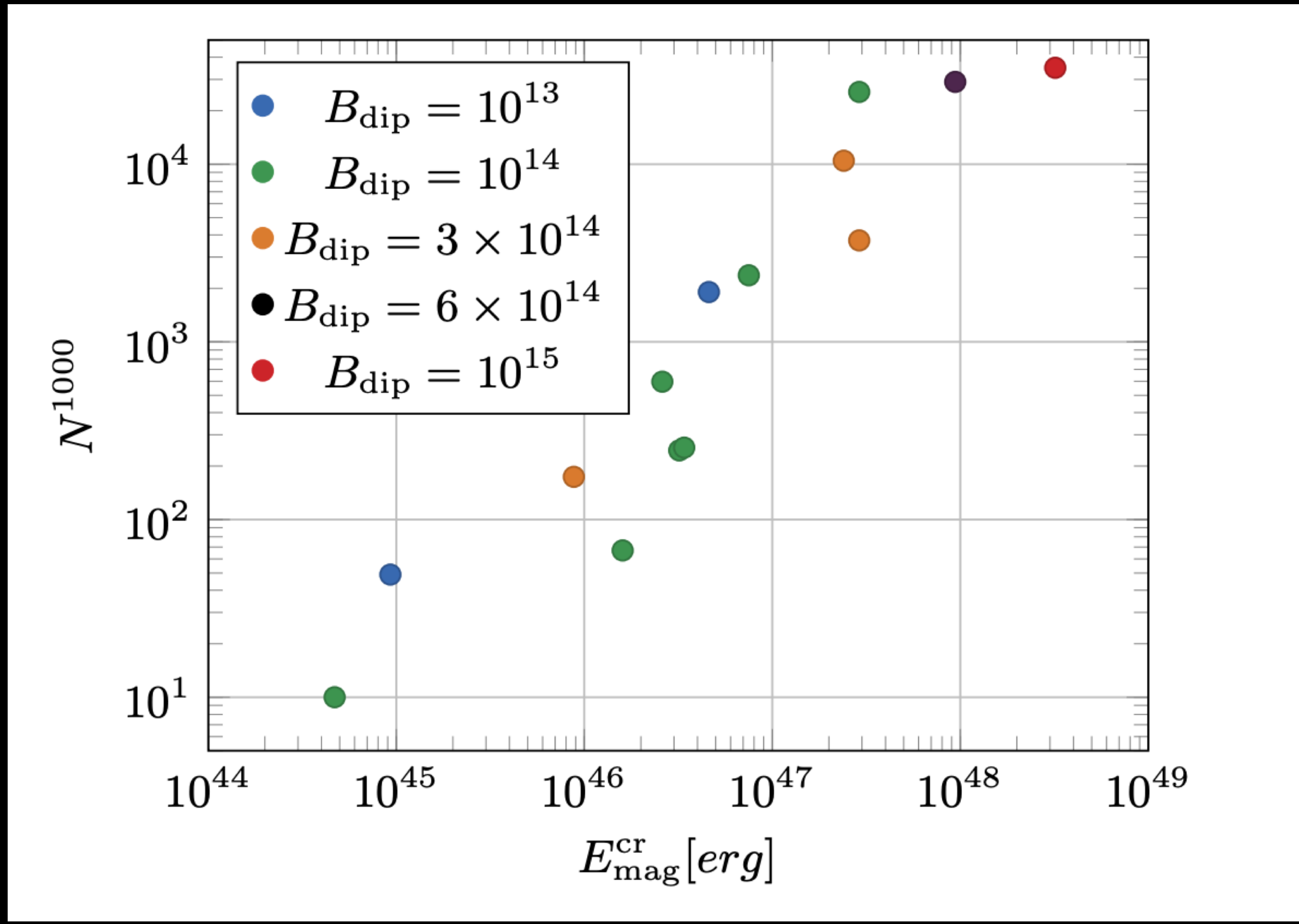
FAST RADIO BURSTS AND CRUSTAL FAILURES RATE IN YOUNG MAGNETARS

CrDipL
E_{dip} ~10^{13}G
$E_{cr,\,mag}$ ~10^{44}erg
No events in 1kyr

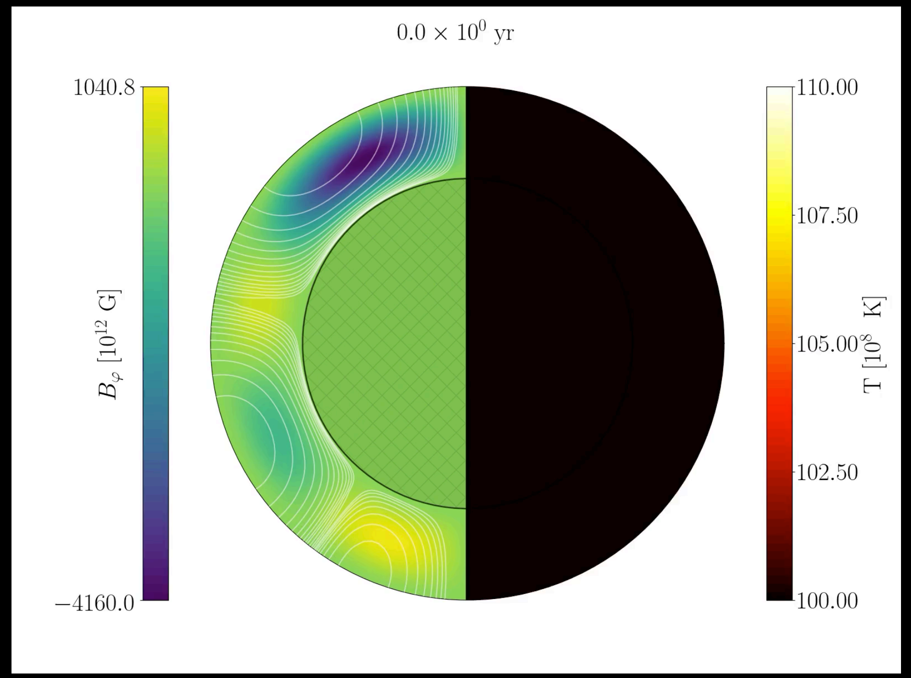


CrDipH
E_{dip} ~3x10^{14}G
$E_{cr,\,mag}$ ~3x10^{47}erg
First event in 0.4yr

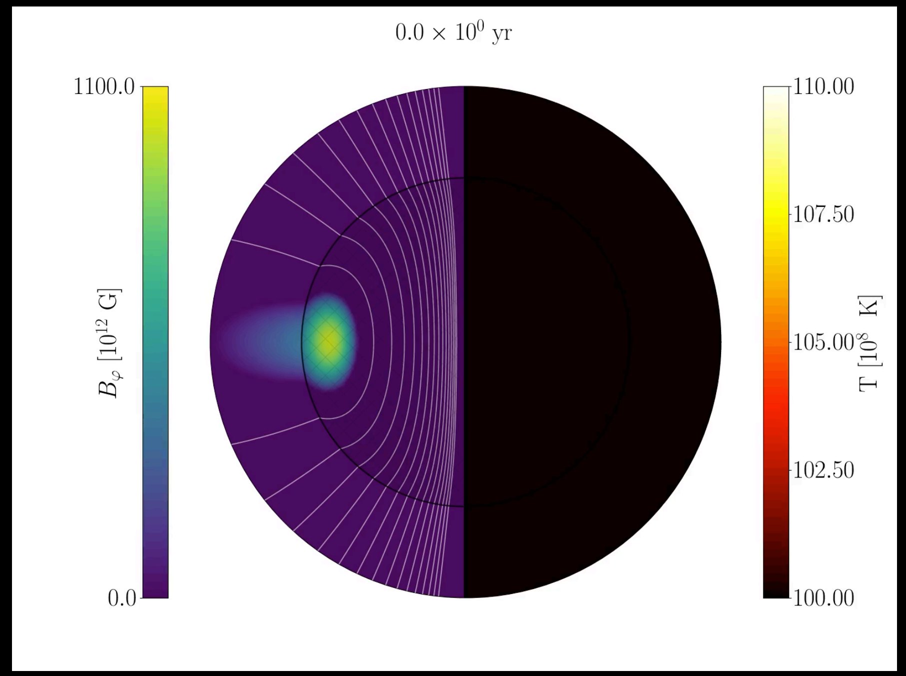




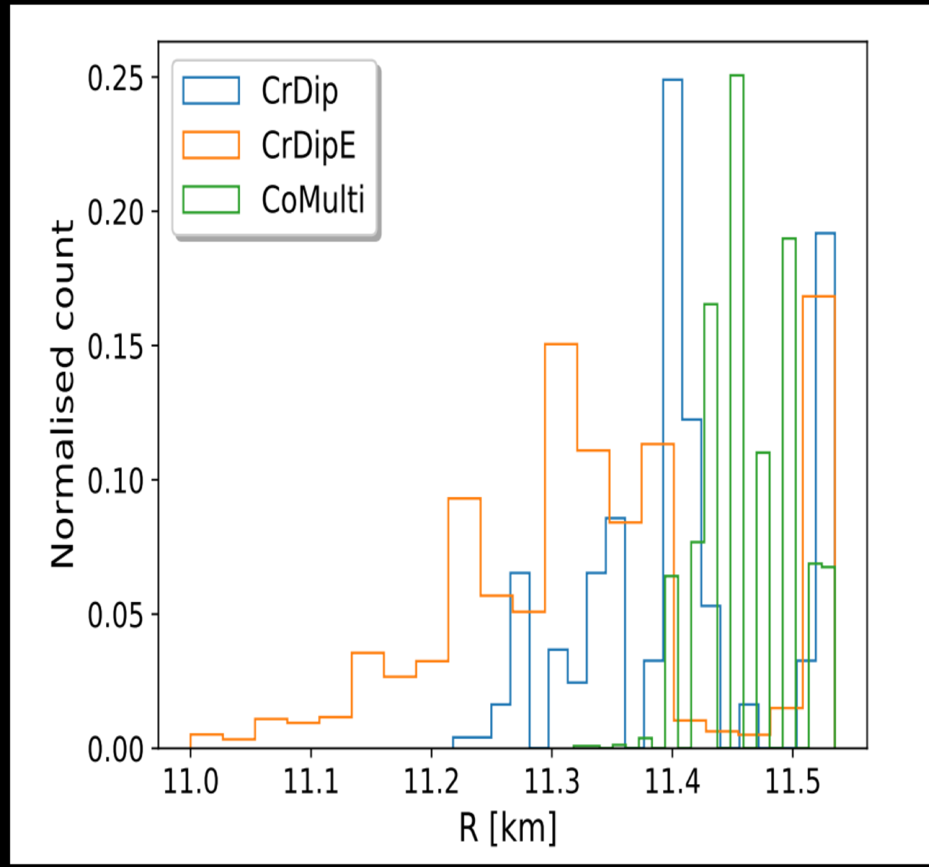
CrMultiT
E_{dip} ~10^{13}G
$E_{cr,\,mag}$ ~10^{46}erg
First event in 0.7yr



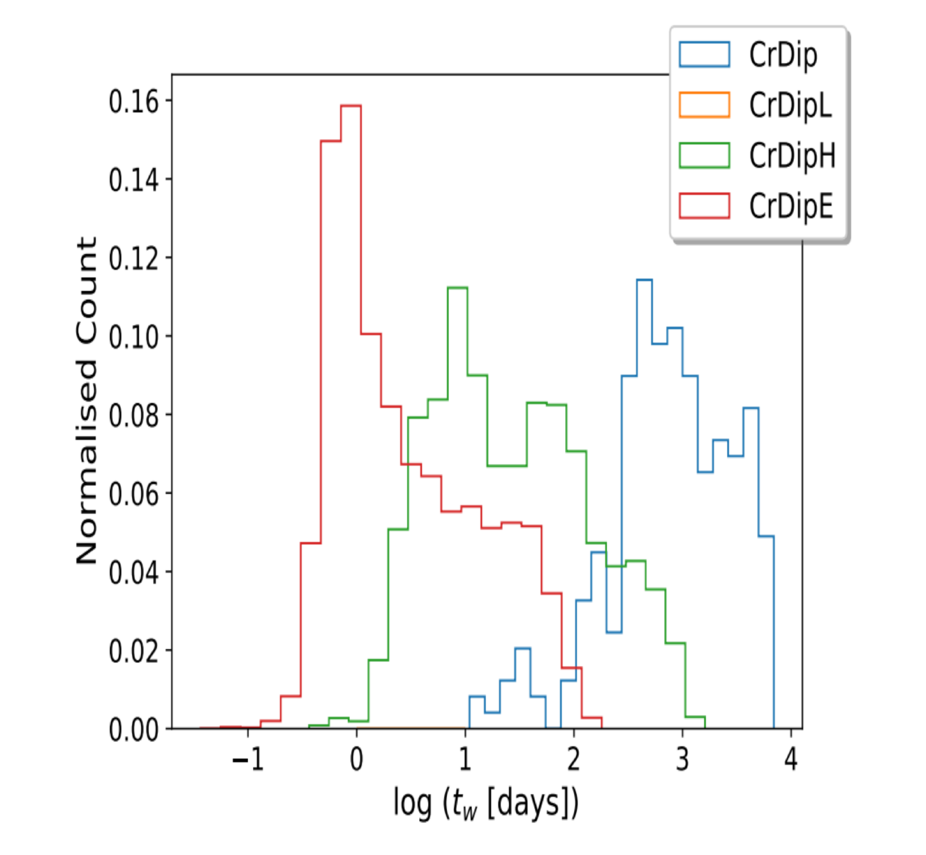
CoDipL
E_{dip} ~10^{14}G
$E_{cr,\,mag}$ ~5x10^{44}erg
First event in 13yr



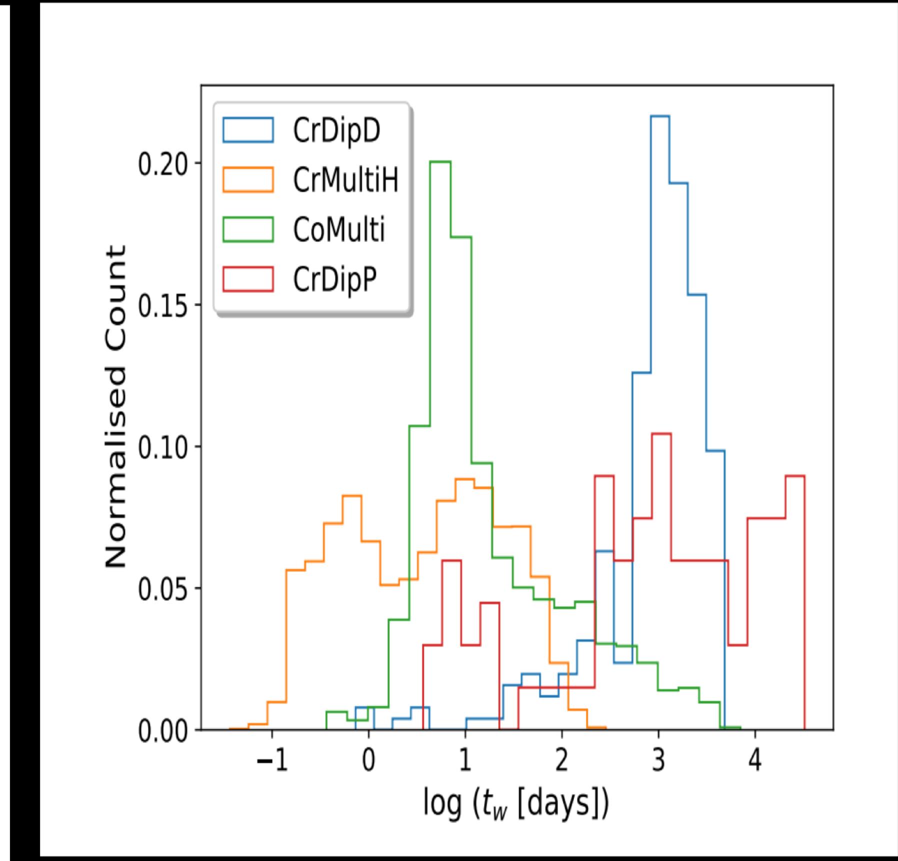
The crustal magnetic energy is the driving parameter to estimate the failure rate, and the B-configuration affects the waiting time.



Crustal failure location



Waiting times (Dipolar)

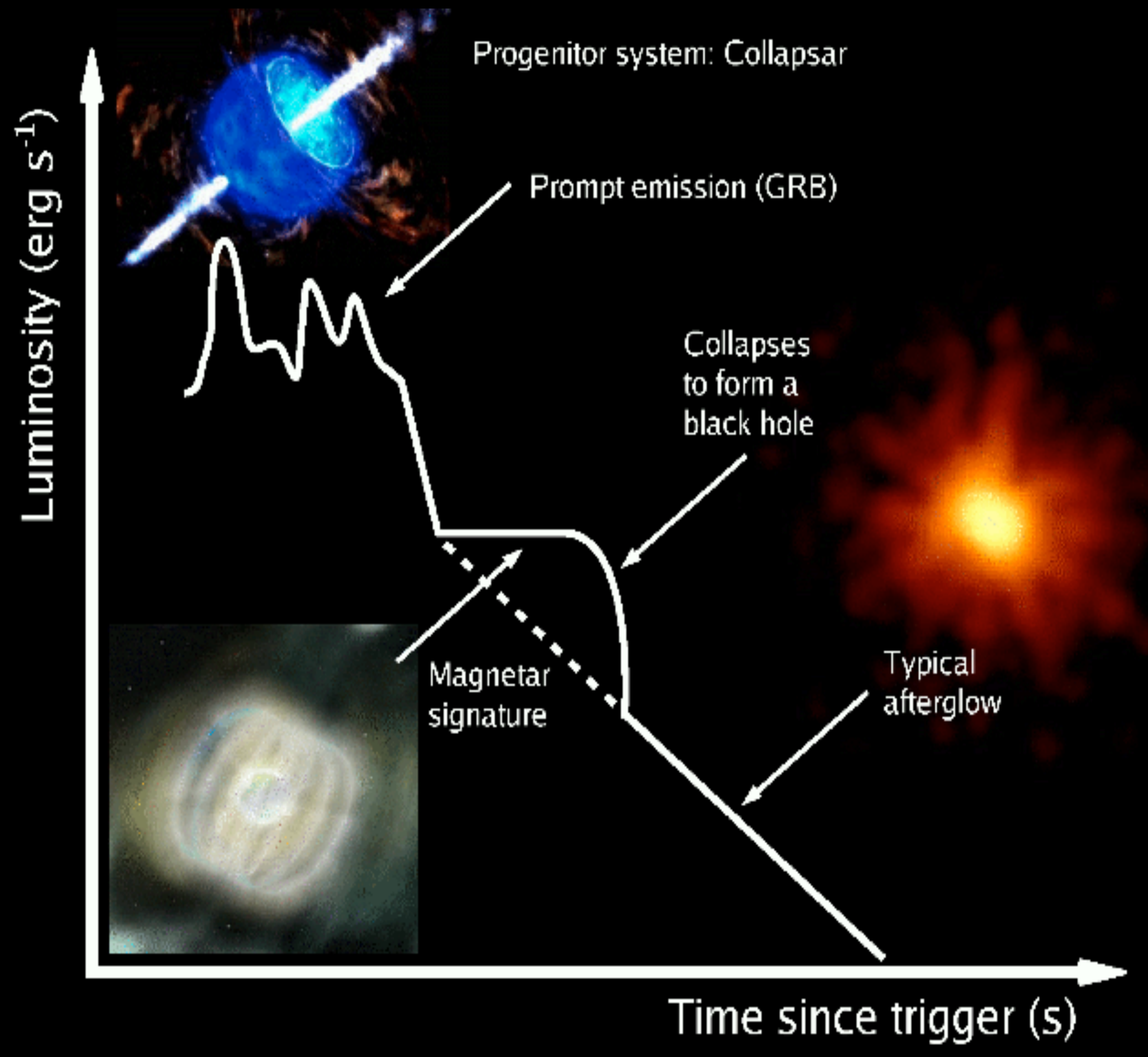


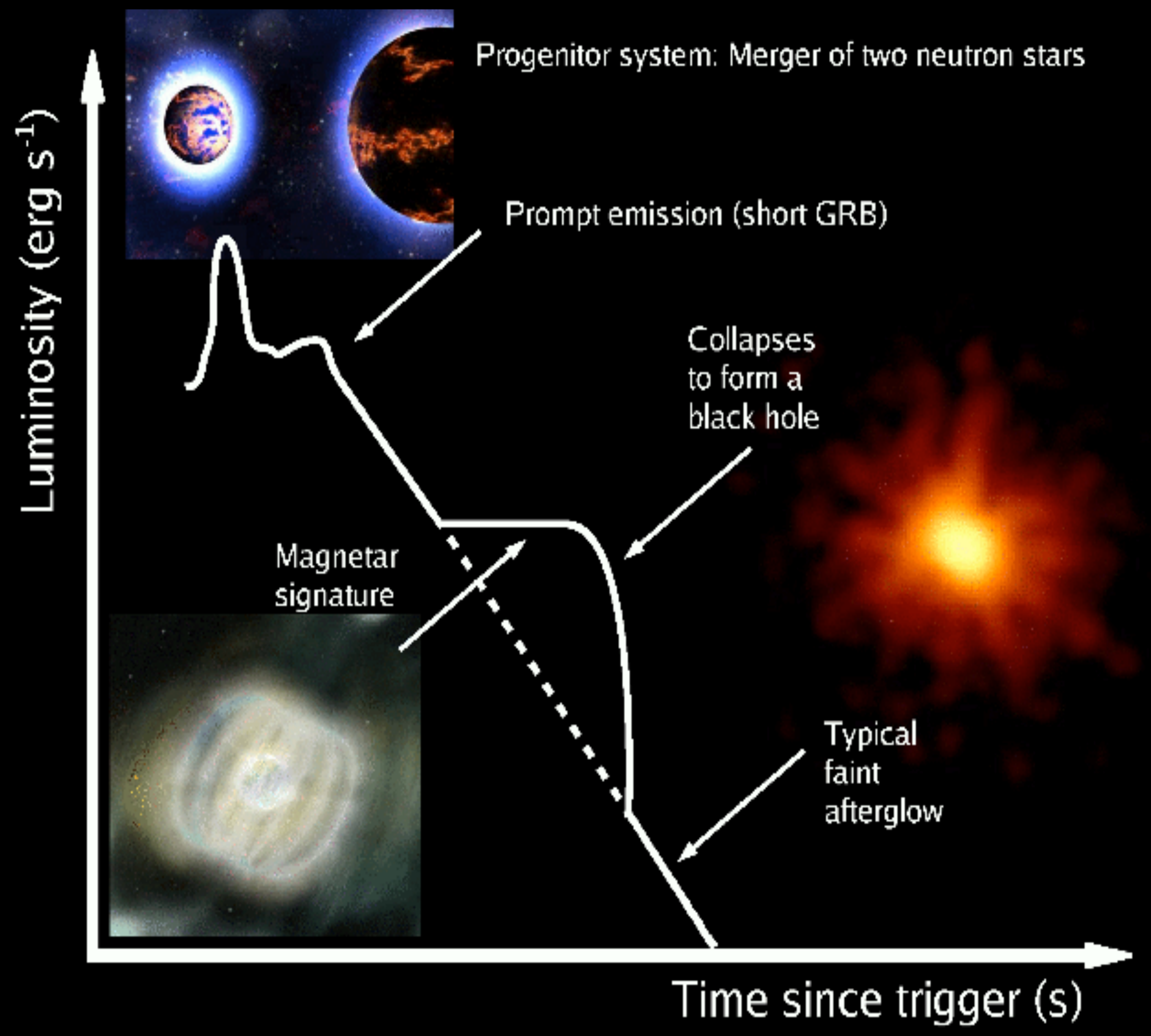
Waiting times (Other)

(Dehman, Vigano, Rea, Pons, Perna & Garcia-Garcia 2020, ApJ Letters)

THE HIGH-ENERGY TRANSIENT SKY: GAMMA-RAY BURSTS AND MAGNETARS

Collapsar model for Long-GRBs



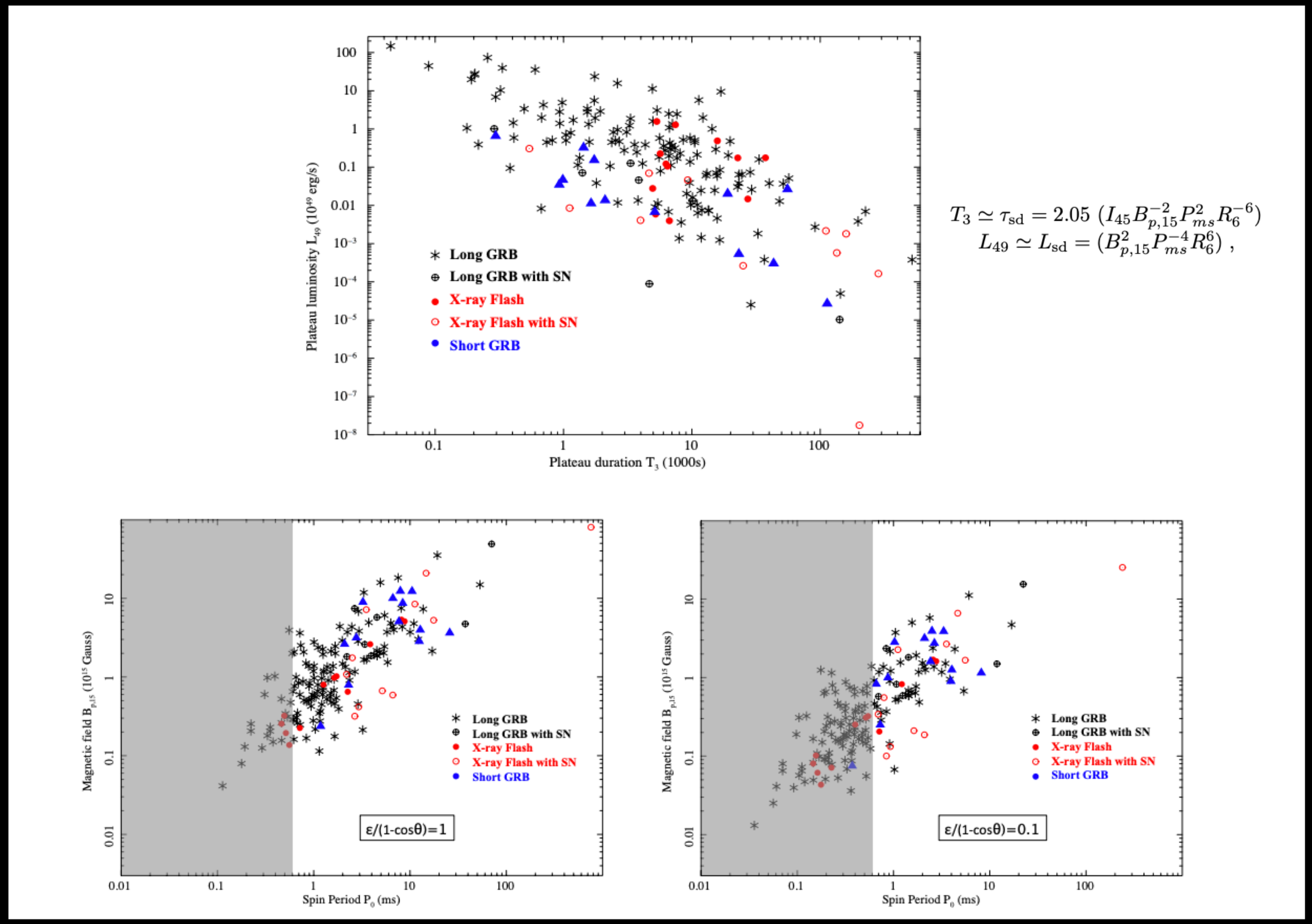


Binary mergers for Short-GRBs

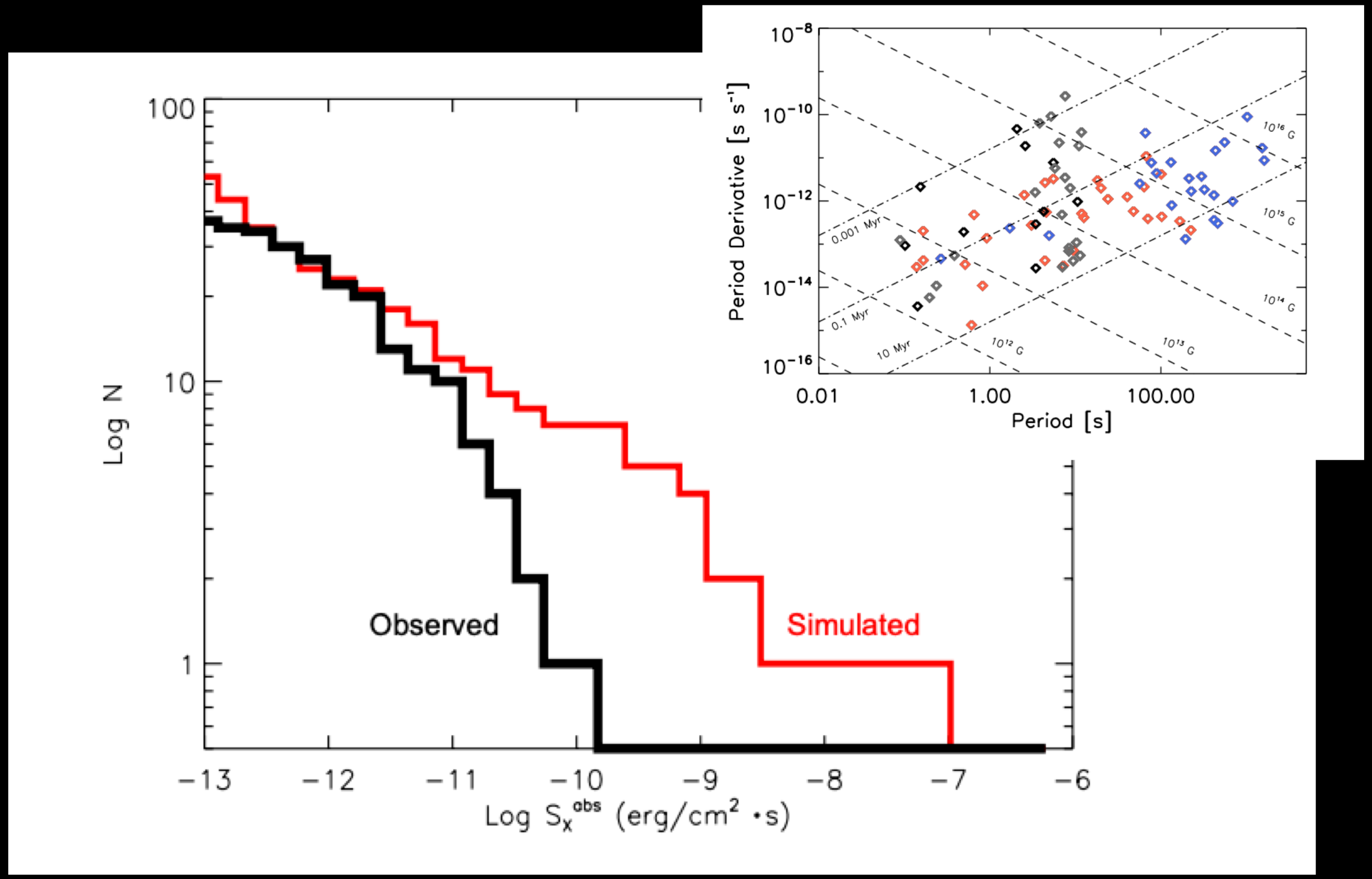
Some GRBs may be powered by a millisecond highly magnetized pulsar.

(Usov 1992; Zhang & Meszaros 2002; Dai et al. 200; Metzger 2009, 2011; Rowlinson et al. 2012, 2014)

SOME RESULTS ON MAGNETARS VERSUS GRBS



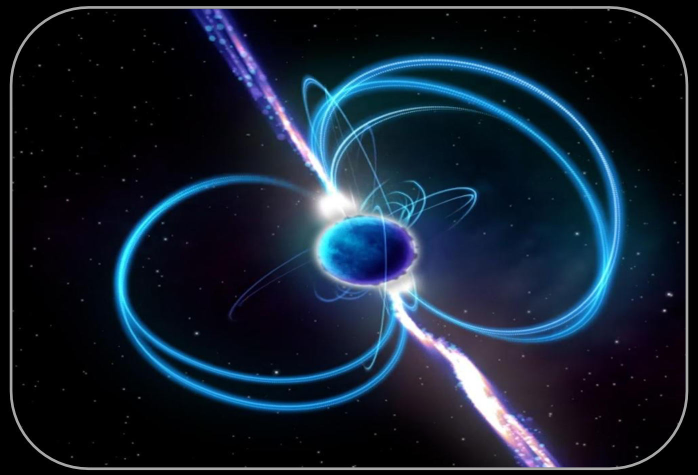
Pulsar Population Synthesis



- Simulating 100 magnetar-GRBs with B0 distributed as derived from Swift GRB plateaus in the past 1 Myr in the Milky Way, we would expect to have now ~25 "observable" magnetars. Numbers ok!
- However, the expected X-ray luminosities and spin period distribution of these GRB-magnetars cannot be reconciled with what observed in our magnetars. Properties are NOT ok!

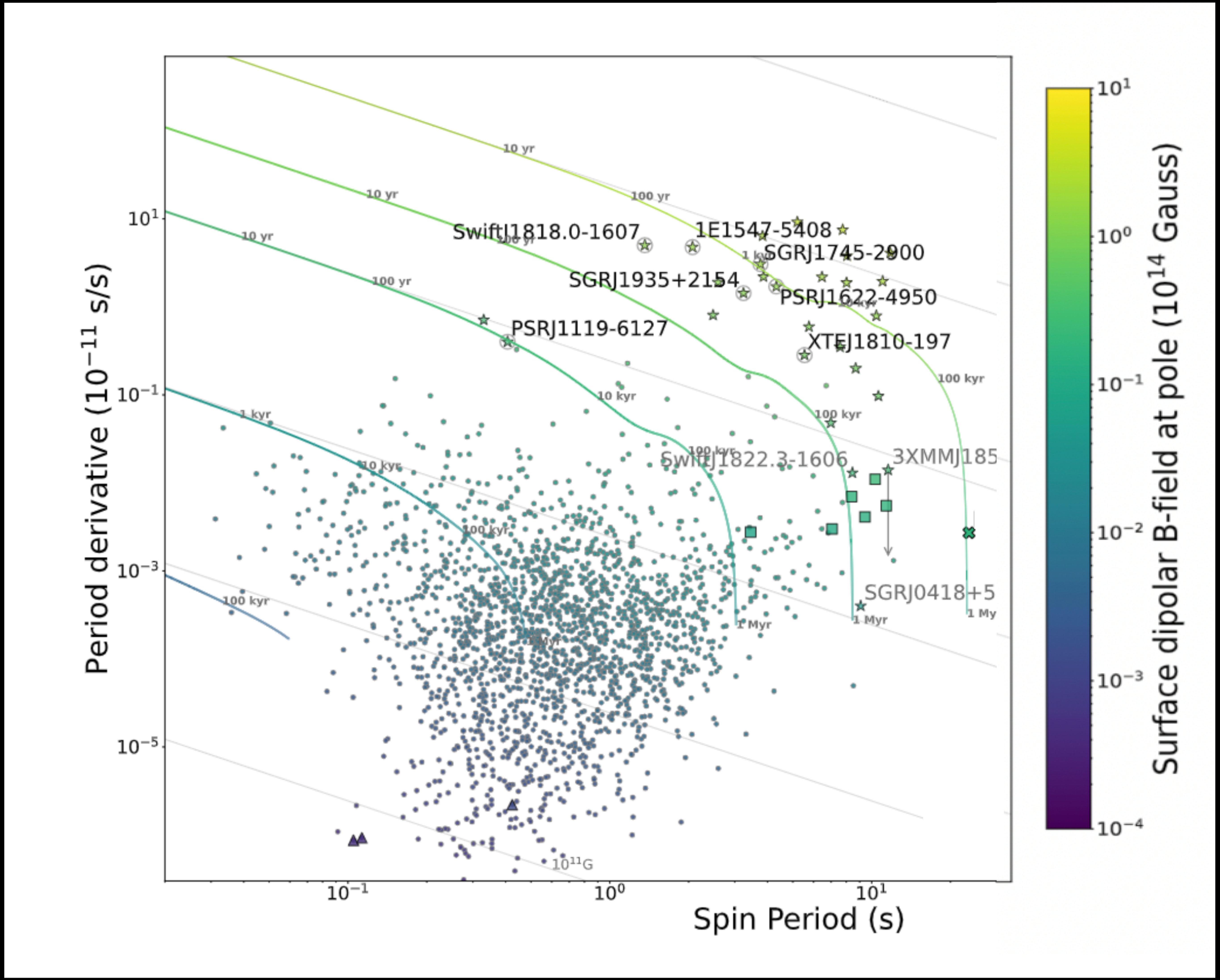
Our Galactic magnetars cannot have GRB progenitors

(Rea, Gullon, Pons et al. 2015, ApJ Letters)



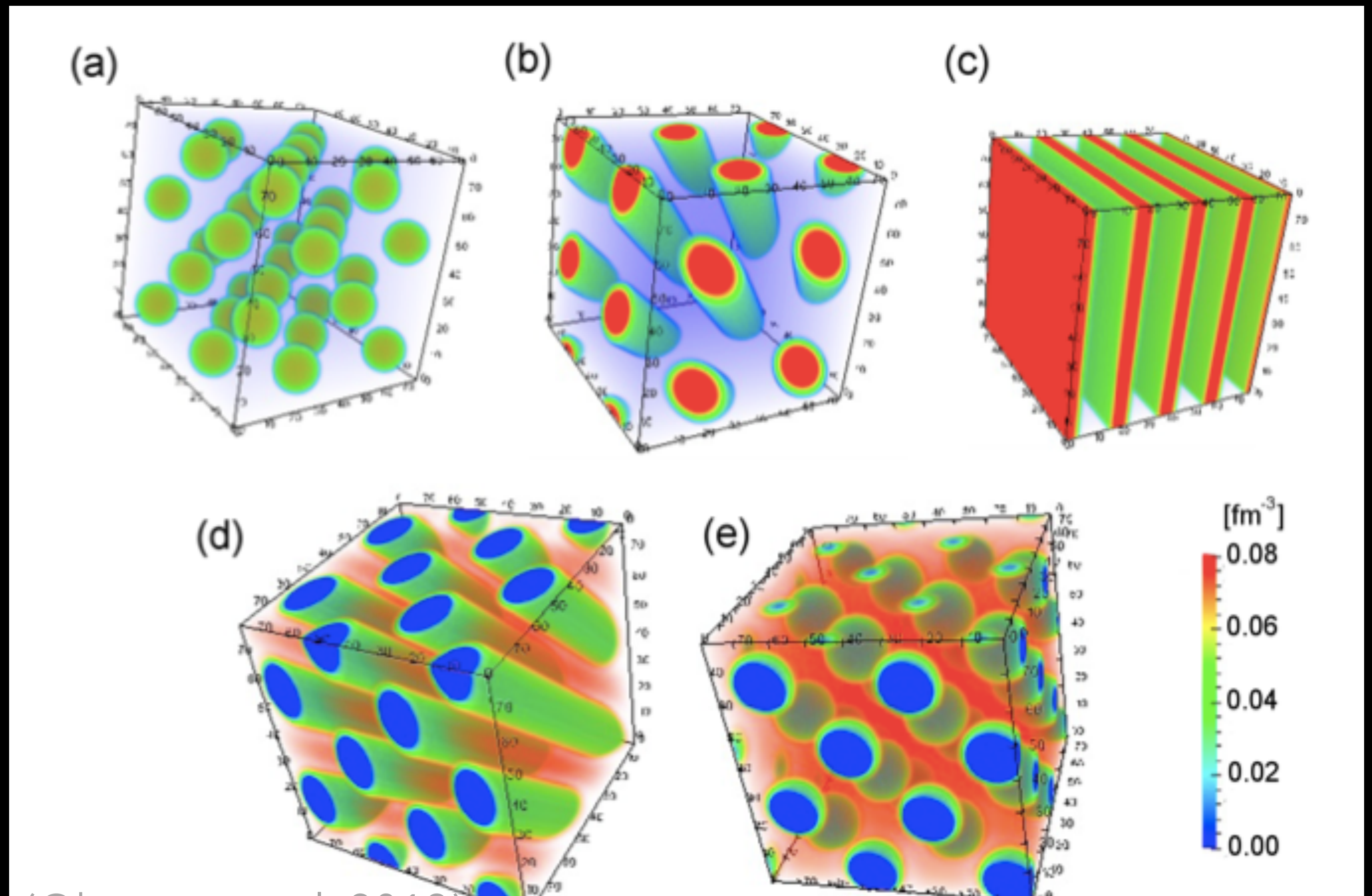
Newly discovered long periodic radio transients are challenging our understanding of pulsars.

THE SPIN PERIOD DISTRIBUTION OF ISOLATED PULSARS



(Pons, Vigano' & Rea 2013 *Nature Physics* 9, 431; Rea 2015, Physics Today)

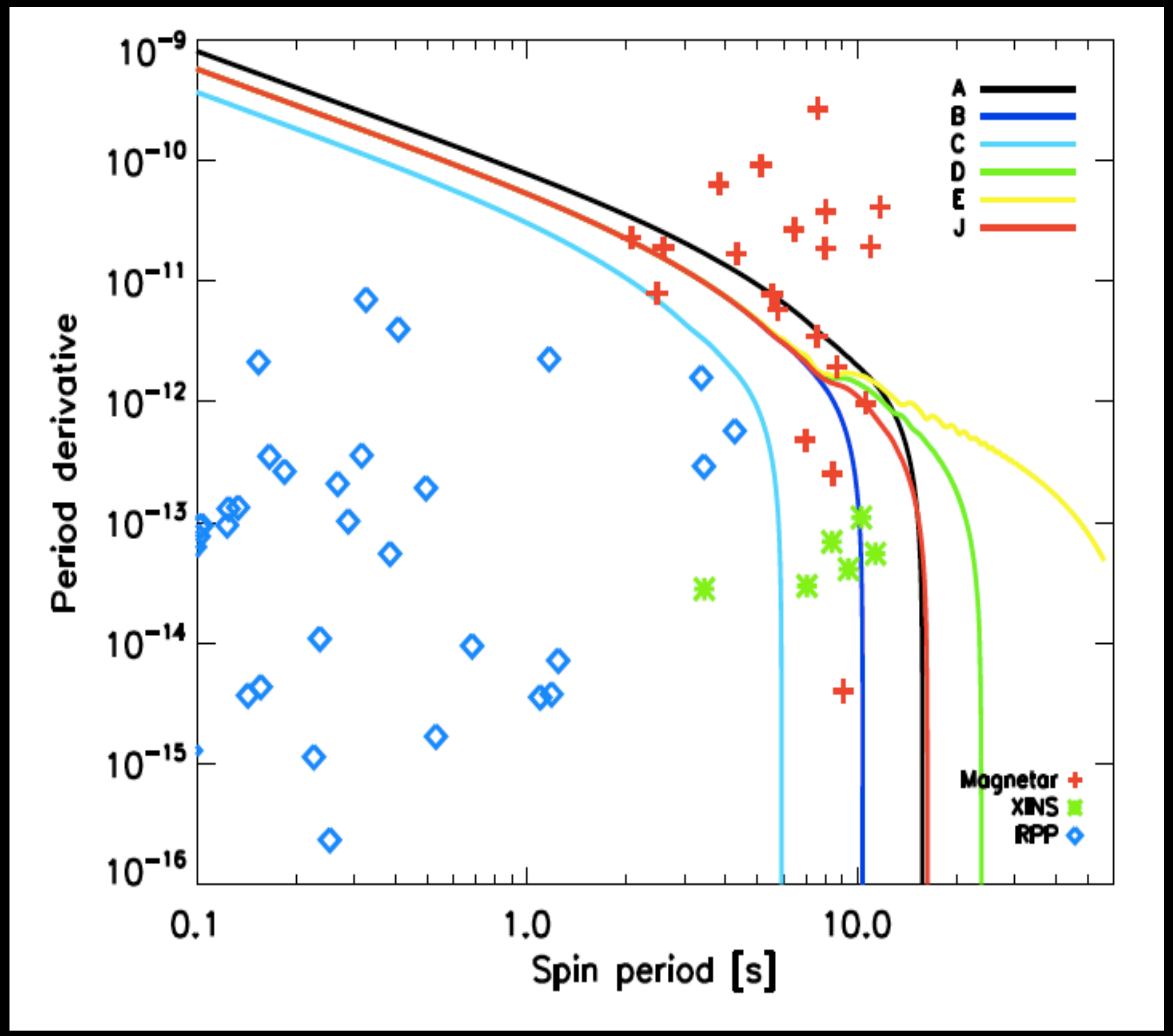
DENSE MATTER PASTA PHASE DRIVING SPIN DISTRIBUTION



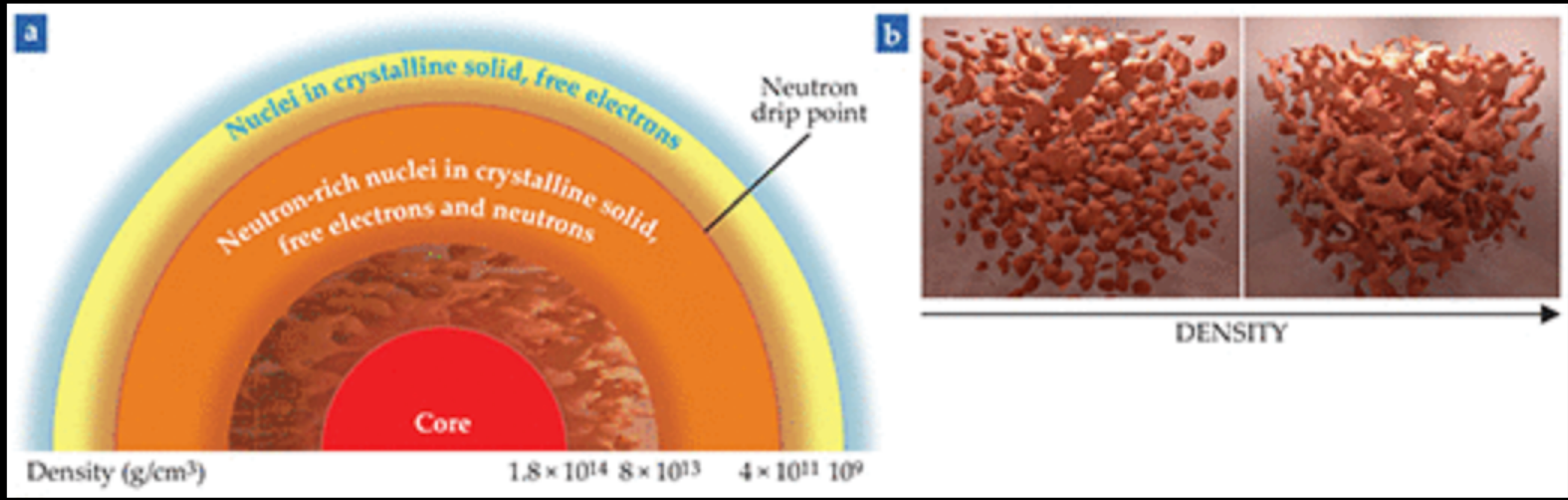
(Okamoto et al. 2013)

Magnetar spin limit as the first observational evidence of the existence of the Nuclear Pasta phase of matter.

At densities > 10^{13} gr cm^{-3} nuclei are favoured in pasta shapes (rods, slabs, bubbles).

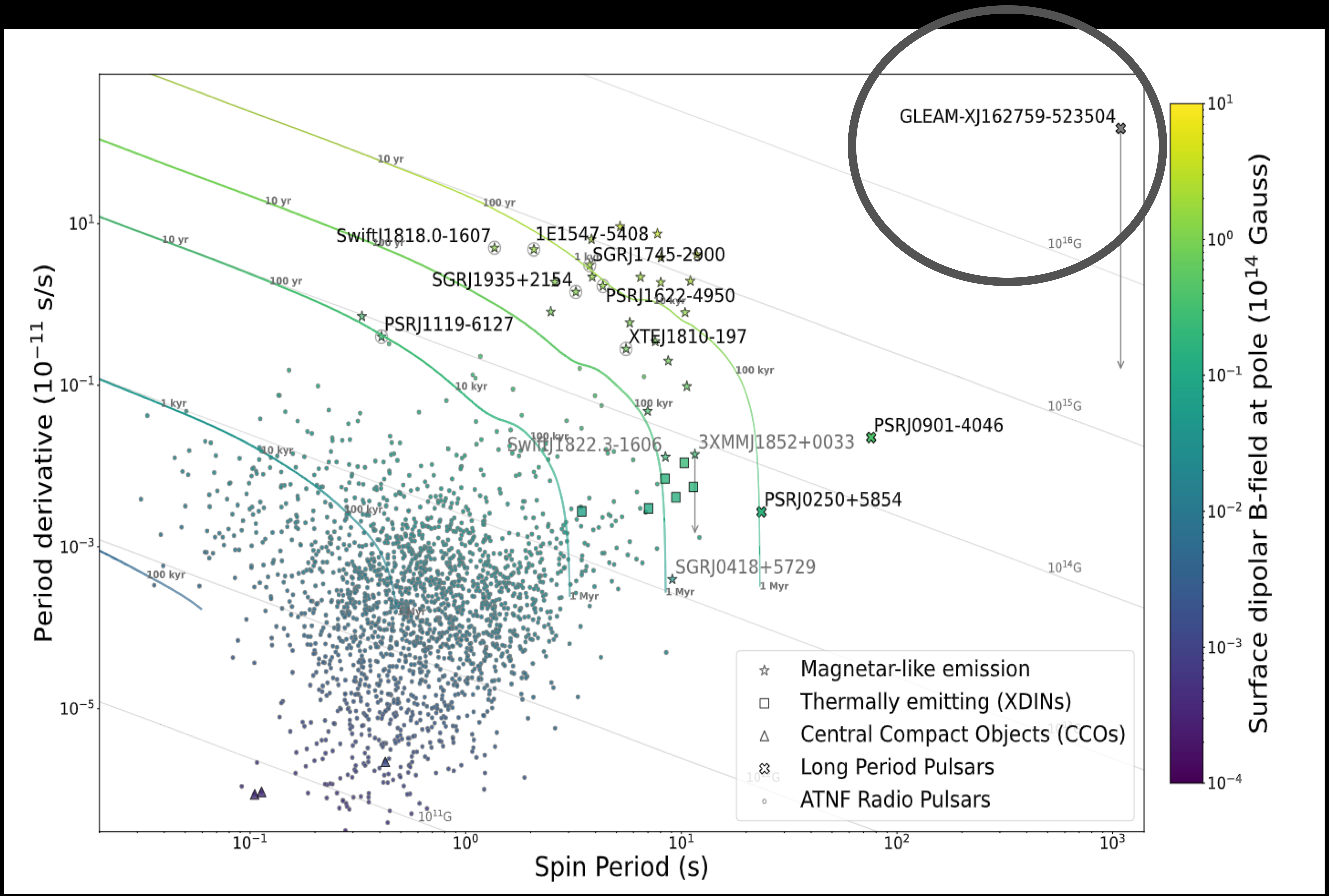


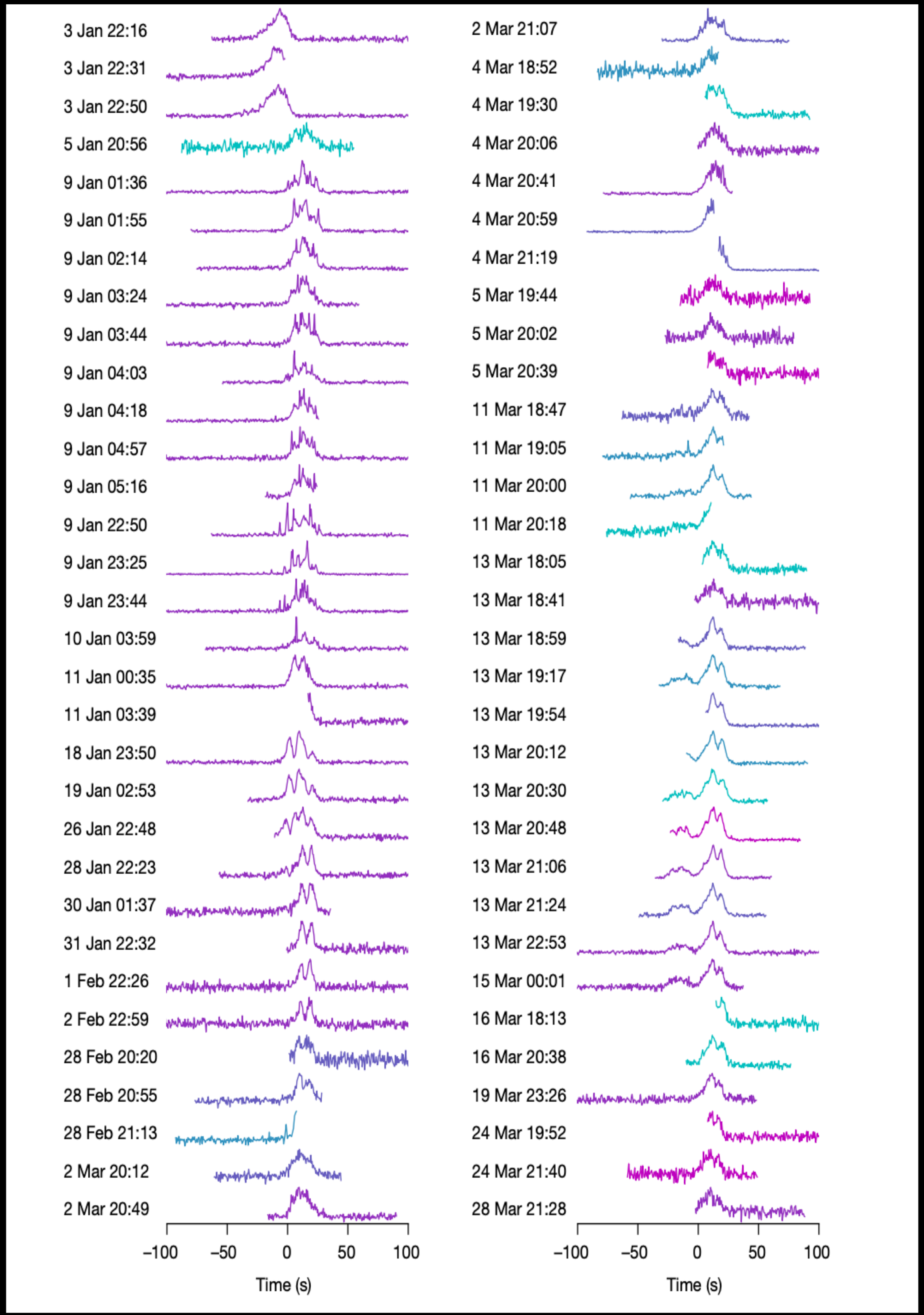
Model	$M[M_\odot]$	I_{45}	ΔR_{crust} [km]	ΔR_{pasta} [km]	Q_{max}
A	1.10	0.962	0.94	0.14	100
B	1.40	1.327	0.70	0.10	100
C	1.76	1.755	0.43	0.07	100
D	1.40	1.327	0.70	0.10	10
E	1.40	1.327	0.70	0.10	0.1
J	1.40	1.327	0.70	0.0	23



(Pons, Vigano' & Rea 2013 *Nature Physics* 9, 431; Rea 2015, Physics Today)

LONG PERIOD PULSARS





(Hurley-Walker et al. 2022, *Nature*; Caleb et al. 2022, *Nature*)