Different Class of the pulsars:
Neutron star zoo

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Neutron stars zoo

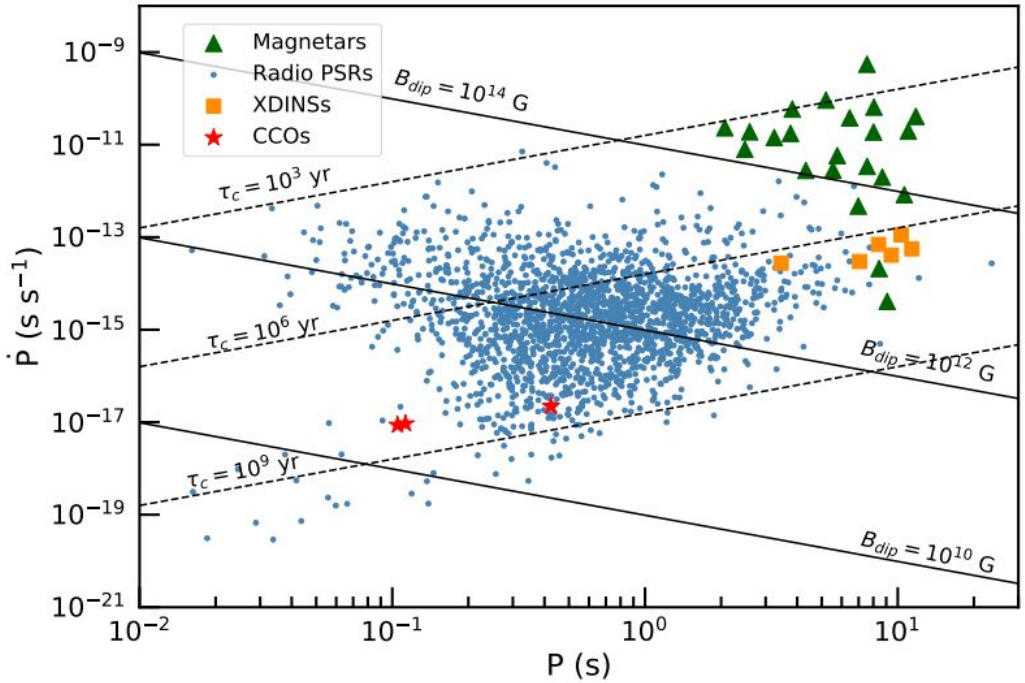

Figure 1. P–$\dot{P}$ diagram with the isolated neutron stars included in the ATNF pulsar catalogue v.1.65. Green triangles, blue dots, orange squares and red stars represent magnetars, rotation-powered pulsars, X-ray dim isolated neutron stars and central compact objects, respectively. Also plotted are lines of constant dipolar magnetic field (solid lines) and characteristic age (dashed lines) as derived from equations 1.1 and 1.3. Image credit: A. Borghese.

Borghese, A., 2020. Exploring the neutron star zoo: An observational review. *Proceedings of the International Astronomical Union*, *16*(S363), pp.51-60.

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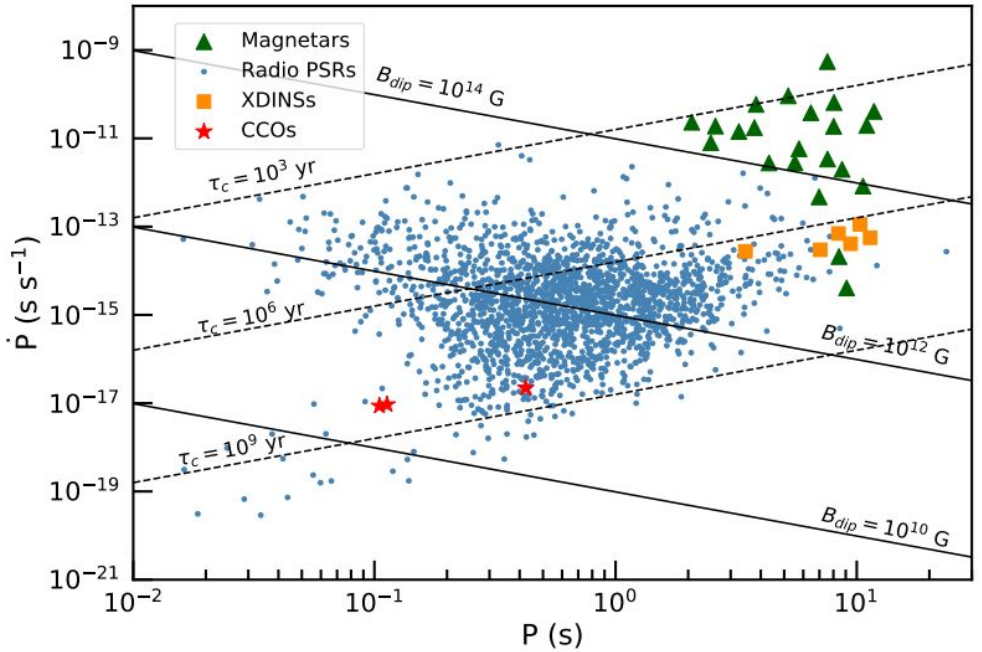
- **Rotation-powered pulsars (normal pulsars):**
  - P ~ 1 second
  - dP/dt ~ 10^{-15} ss^{-1}
  - B_{surf} ~ 10^{11} - 10^{13} Gauss
  - τ_c ~ 10^3 - 10^8 Year
  - Radiation:
    - Radio -band
    - X-Ray
    - Gamma ray



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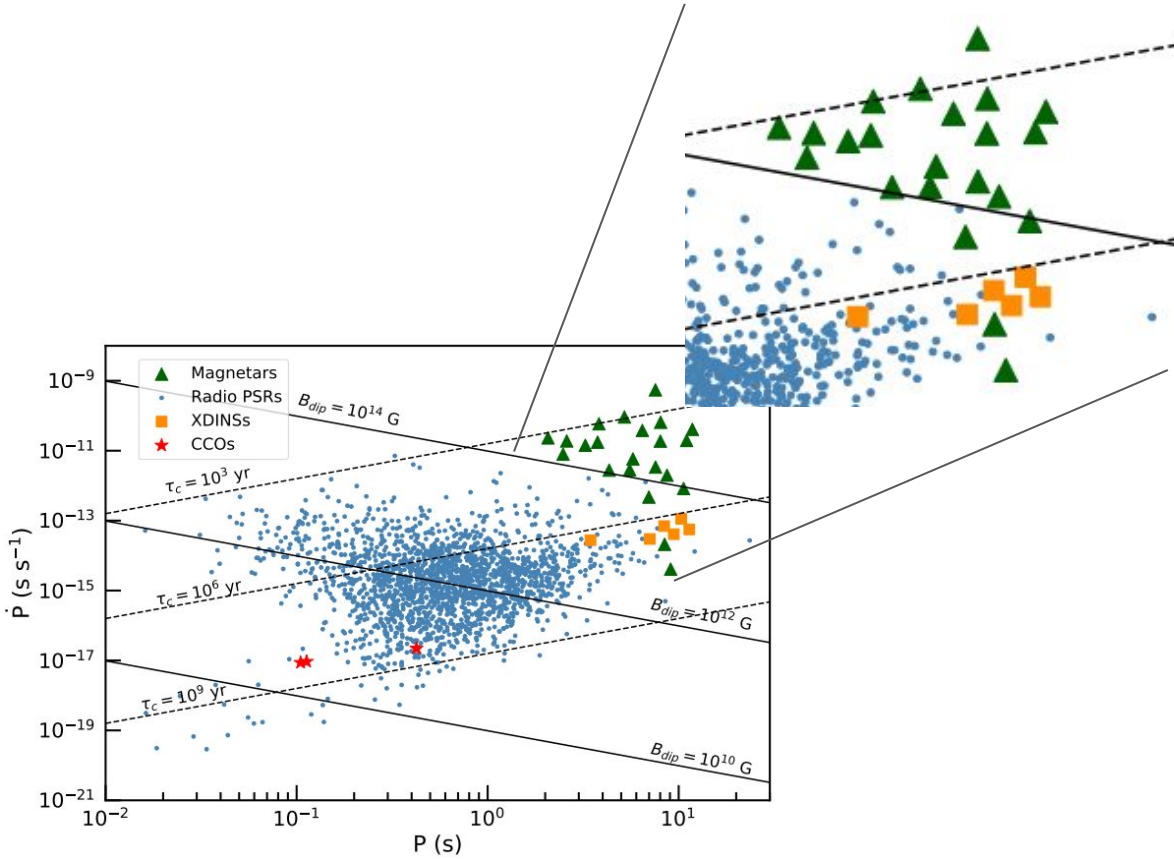
- **Magnetars:**
  - P ~ 1 -12 second
  - dP/dt ~ 10^{-11} ss^{-1}
  - B_{surf} ~ 10^{14} - 10^{15} Gauss
  - τ_c ~ 10^3 - 10^5 Year
  - Radiation:
    - X-Ray



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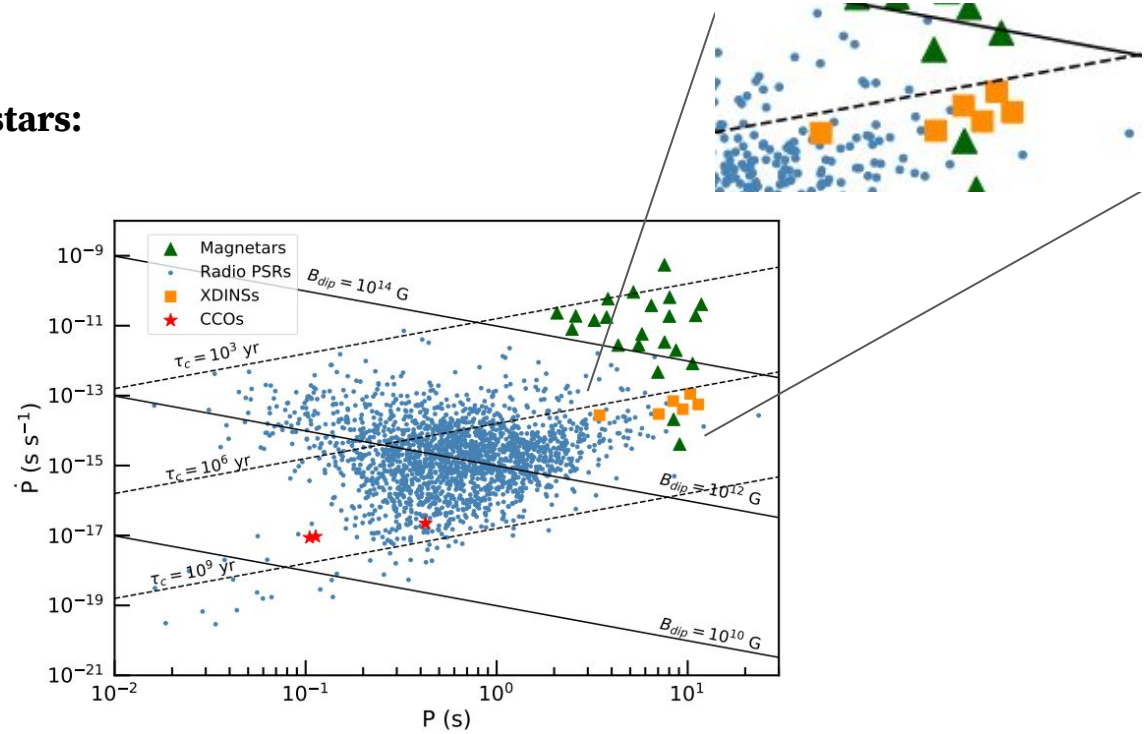
- **X-Ray dim isolated neutron stars:**
  - P ~ 3 -12 second
  - dP/dt ~ 10^{-14} - 10^{-13} ss^{-1}
  - B_{surf} ~ 1 - 4 × 10^{13} Gauss
  - τ_c ~ 1 - 4 × 10^6 Year
  - Radiation:
    - Radio-silent
    - X-Ray
    - Optical
    - UV



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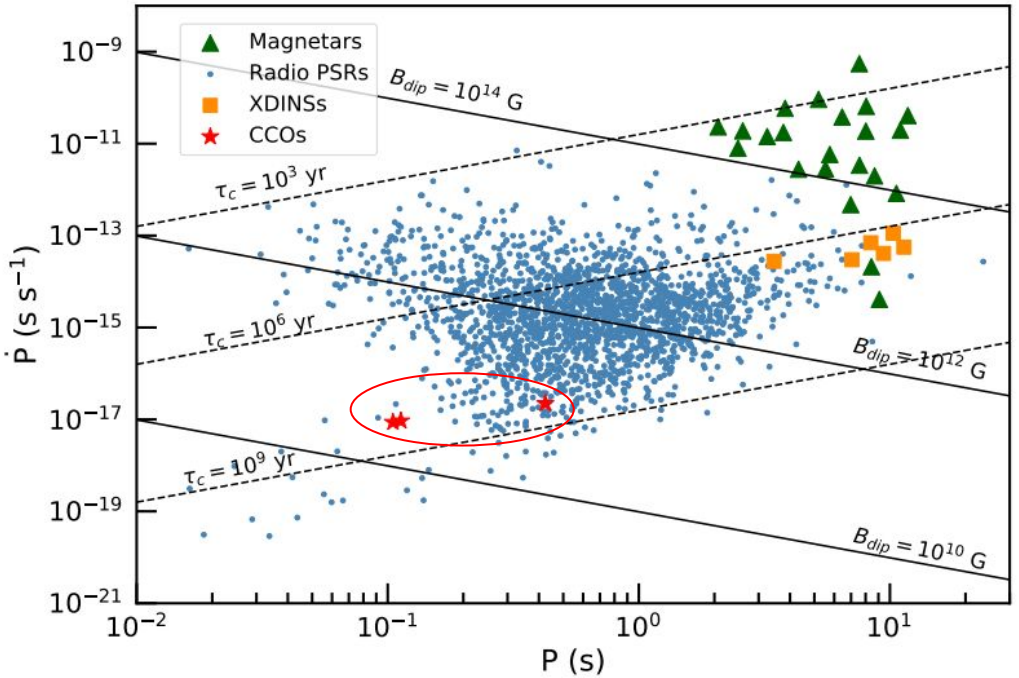
- **Central Compact Objects:**
  - P ~ 0.1 - 0.4 second
  - dP/dt ~ 10^{-18} - 10^{-17} ss^{-1}
  - B_{surf} ~ 10^{10} - 10^{11} Gauss
  - τ_c ~ 10^8 Year
  - Radiation:
    - X-Ray



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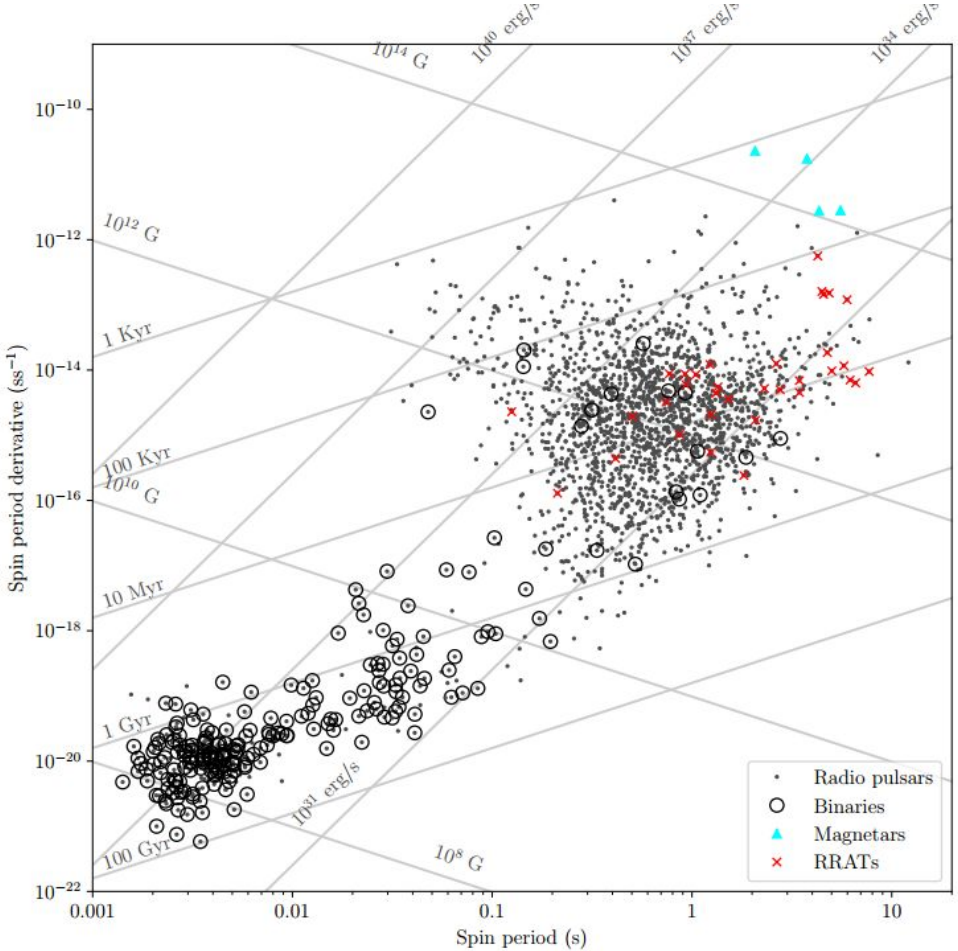
- **Millisecond Pulsars (most binary):**
  - P ~ 0.001 - 0.1 (s)
  - dP/dt ~ 10^{-22} - 10^{-15} (ss^{-1})
  - B_{surf} ~ 10^{7} - 10^{11} (G)
  - τ_c ~ 10^{9} (Year)
  - Radiation:
    - Radio band
    - X-Ray
    - gamma-Ray



Haniewicz, H., 2022. *Observations of radio pulsars and their physical implications* (Doctoral dissertation, University of East Anglia).

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- **Conclusion:**
  - With new observations, we see more new types of the pulsars that we can not very good classified them and a classification scheme could be worthwhile.
  - The ultimate picture in this regard can be existence of a H-R like diagram for the pulsars.

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Thanks for your attention