A possible Coronal Mass Ejection signal in a repeating Fast Radio Bursts

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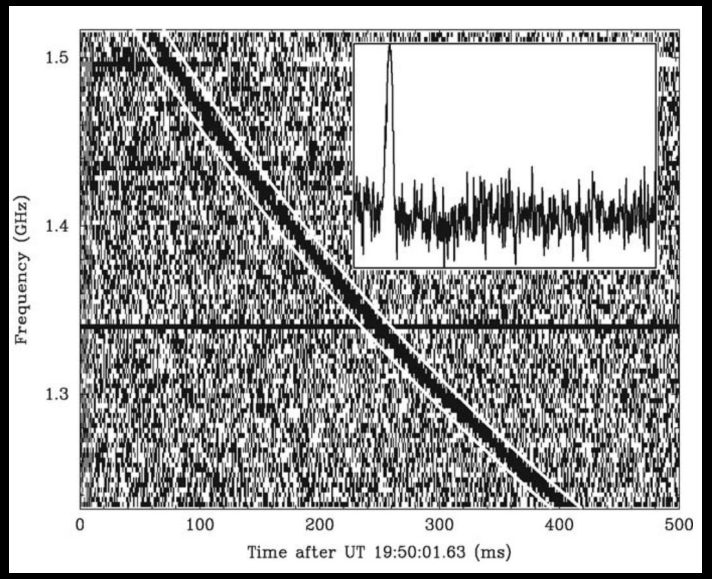
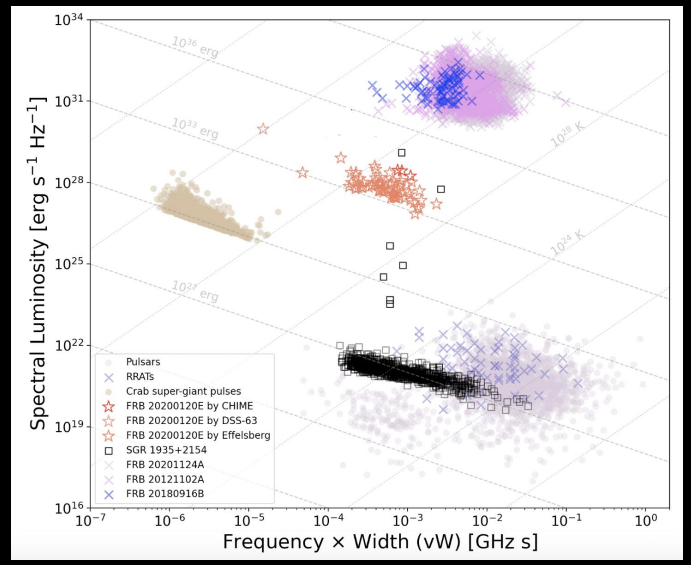
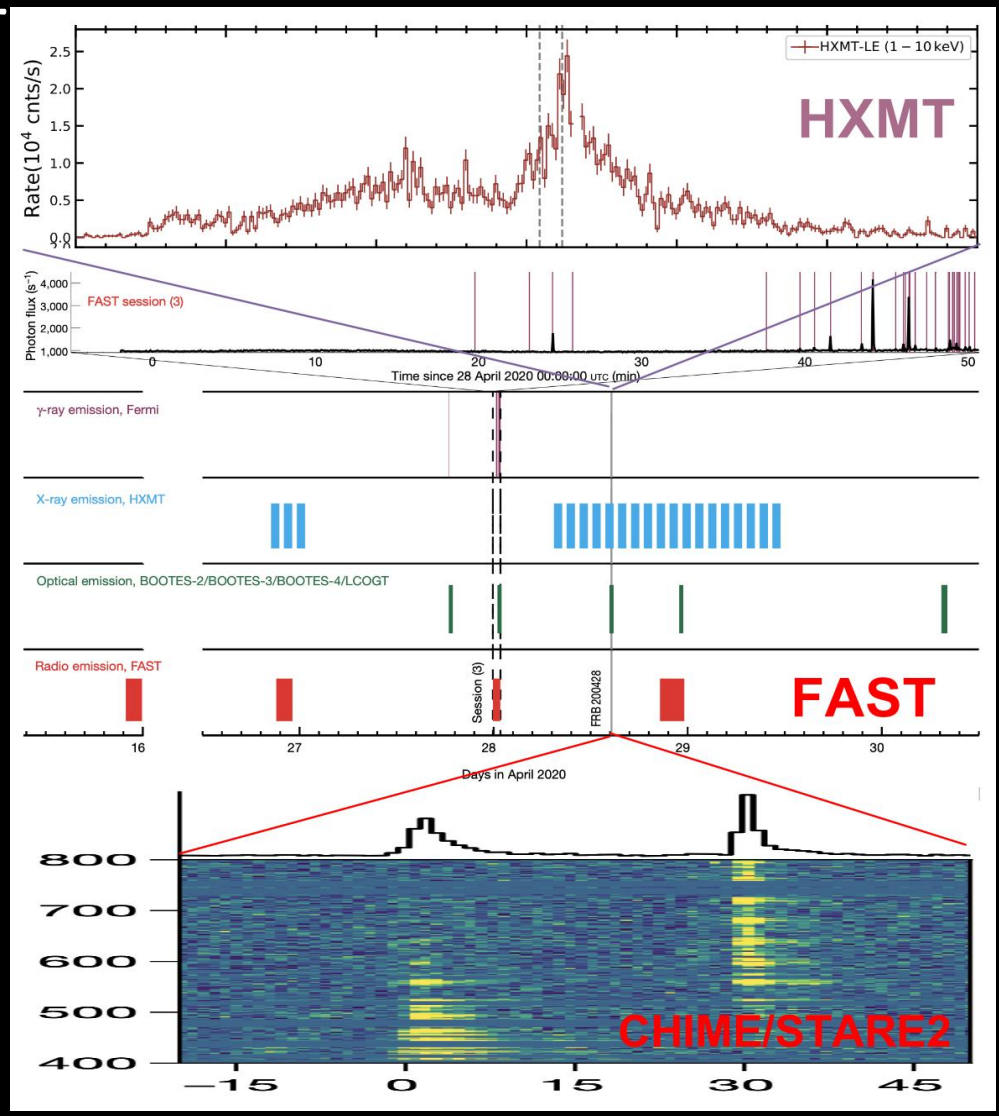
Fast Radio Bursts (FRBs)

- FRB: ms bright radio pulse + cosmo -> brightness T -> coherent emission, unknown origin
- Discovered by Lorimer et al. 2007
- some repeat, a few have (quasi-)periods
- FRB 20200428 & MW magnetar SGR 1935+2154: magnetar could produce (low-L) FRB





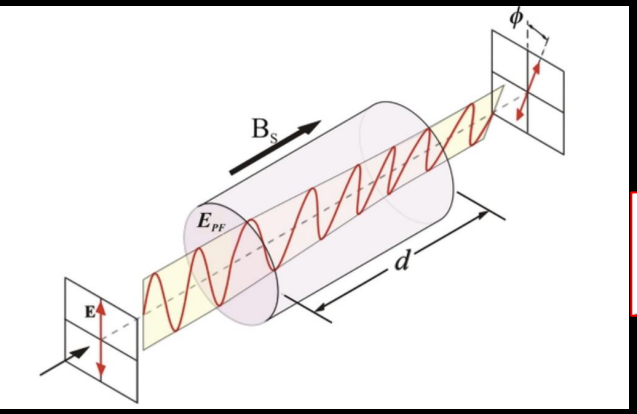


Lorimer et al. 2007, Science Bochenek et al. Nature, CHIME et al. Nature, Lin et al. 2020, Nature

circumburst magneto-environment

- polarization and rotation measure

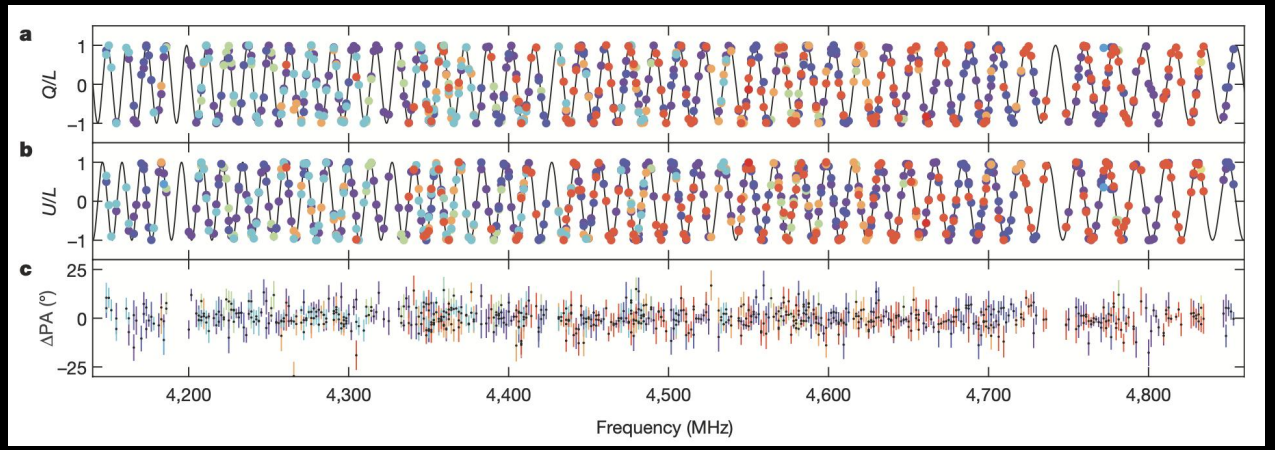
  in general, galaxy ~ 10 rad m^{-2}, star forming region ~100 rad m^{-2}

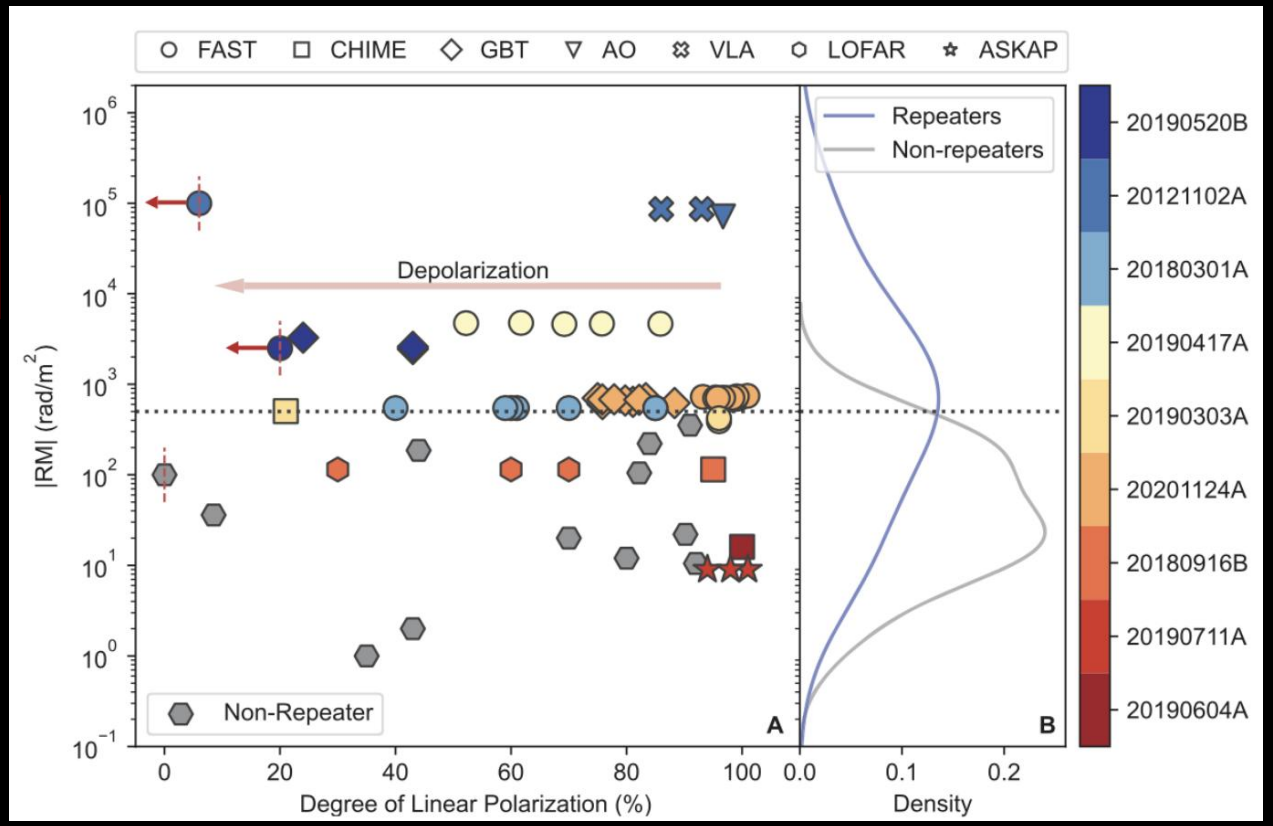


$$\mathrm{PA}(\lambda) = \mathrm{RM}\lambda^2 + \mathrm{PA}_\infty$$

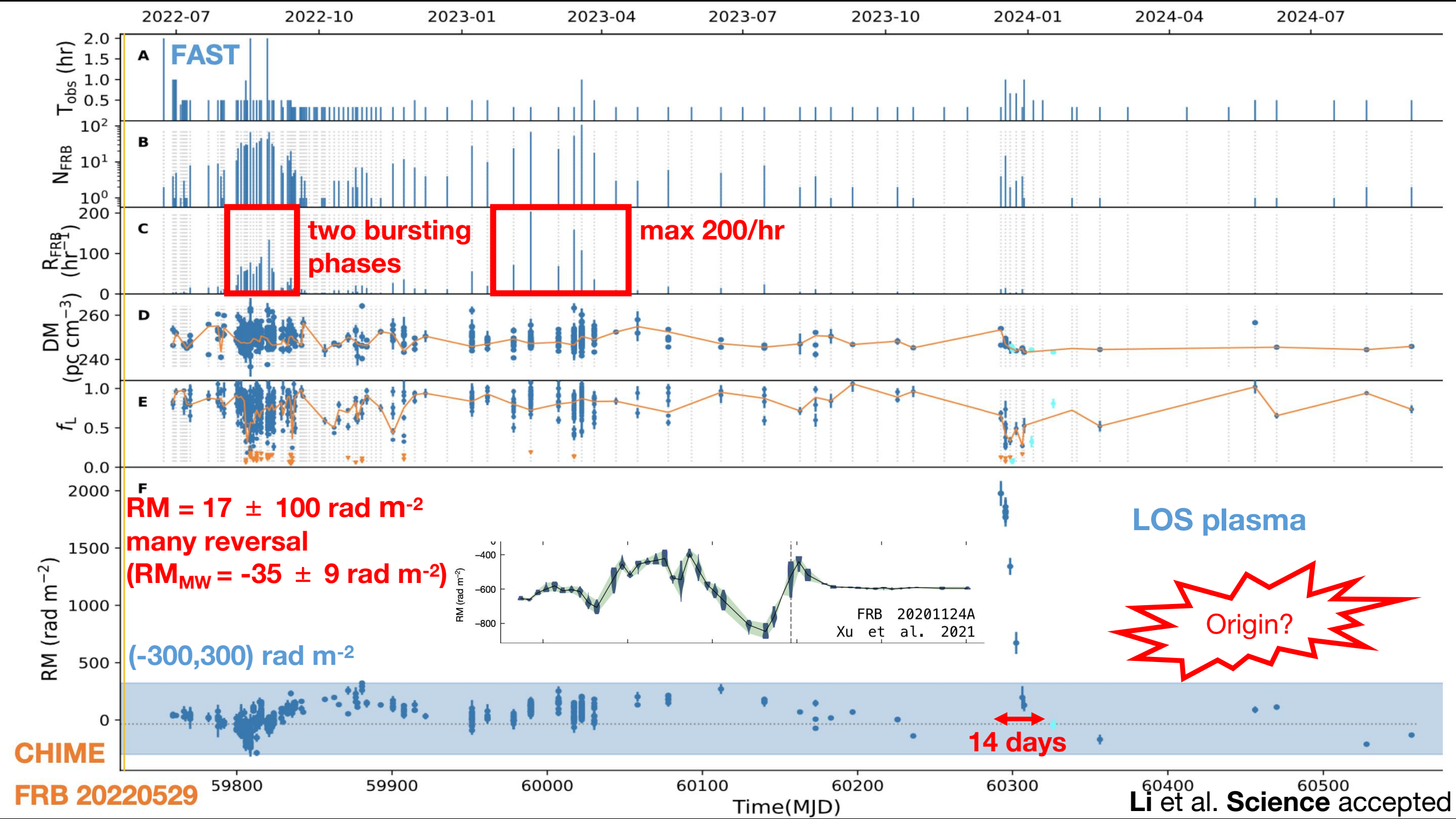
$$\mathrm{RM} = 0.81 \int_d^0 B_{\parallel}(l) n_e(l) \mathrm{d}l$$

magnetic field electron density





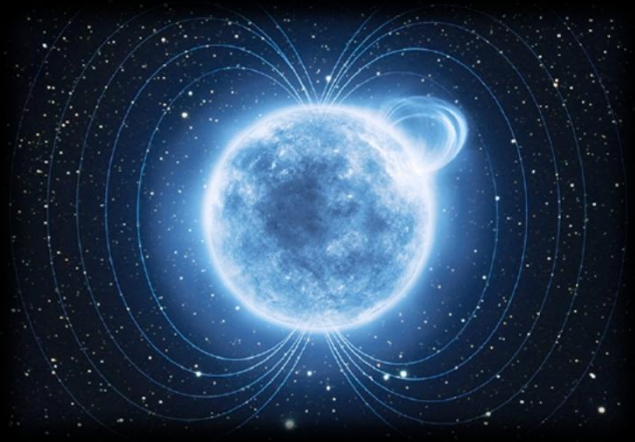
Michilli et al. 2018, Feng et al. 2022 Science

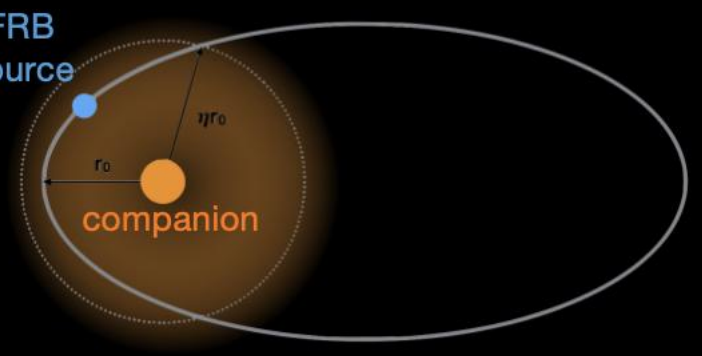


Li et al. **Science** accepted

circumburst magneto-environment

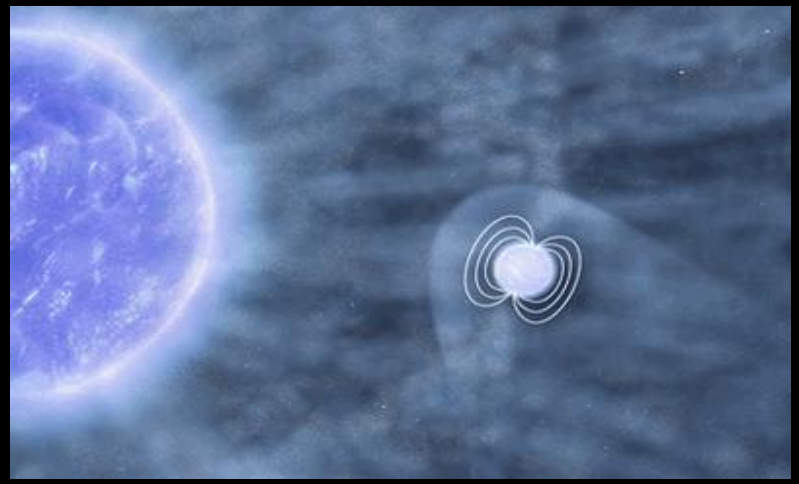
Magnetar flare/Pulsar wind
Negligible (electron-positron pair)
power law





Companion wind in Binary system
orbital configuration -> periodic RM evolution

Supernova Remnant (SNR)
Long-term monotonic (|RM| decreases)

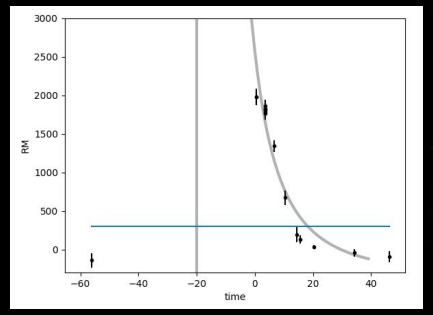


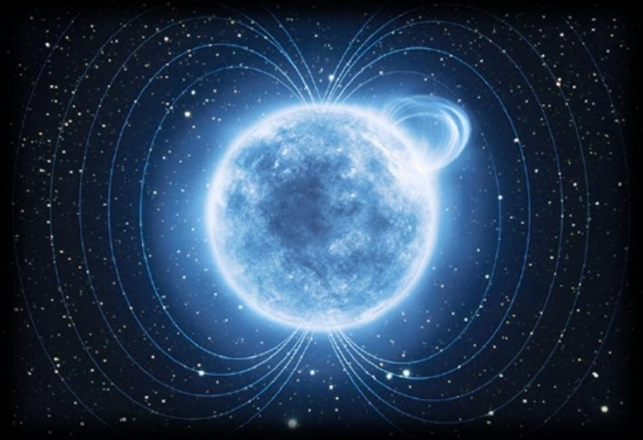
Companion CME in Binary system
random

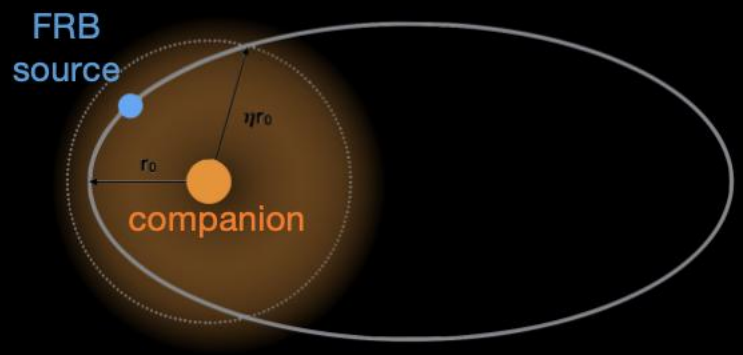
Yang et al. 2023

Possible explanations

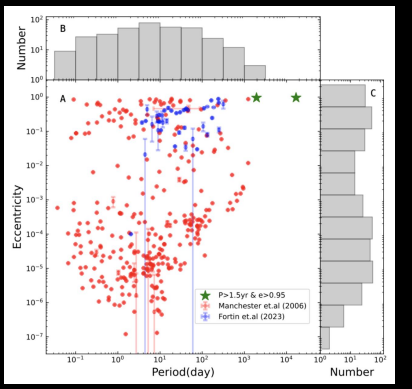
magnetar flare
pulsar wind



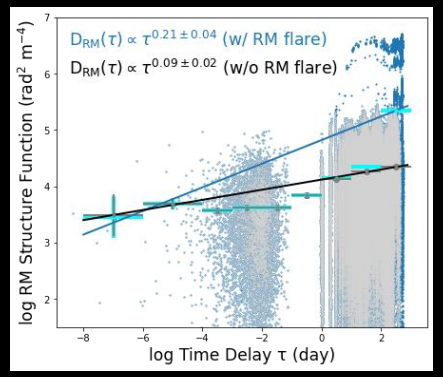


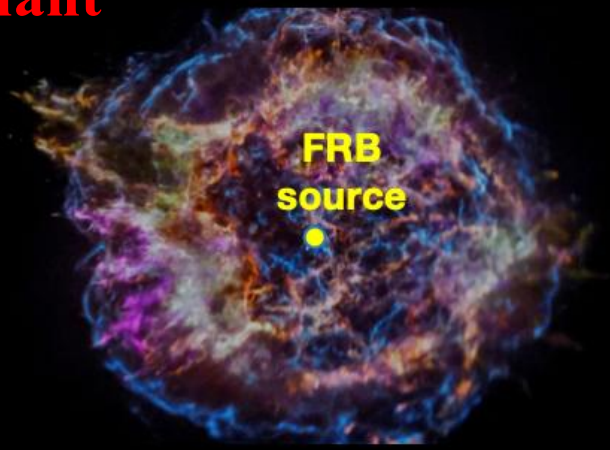


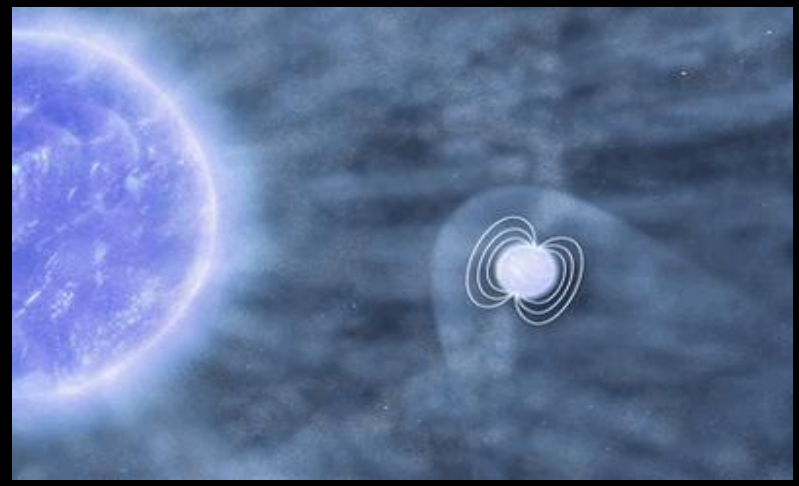
binary
configurations
e>0.95



supernova remnant
turbulence







stellar CME in binary systems

1) M ~ 10^{17} g, B_0 ~ 10^4 G, magnetized M dwarf.
2)M ~ 10^{21} g, B_0 ~ 1 G a binary system

Li et al. **Science** accepted, Arxiv: 2503.04727

Conclusions

- A dramatic increase and prompt recovery of magneto-environment (RM flare) of a rFRB was observed for the First time
  - hard to be explaned by magnetar flare, pulsar wind nebula, supernova remnents
  - maybe from orbit configuration of a binary, but extreme, and have a very strong preduction: periodic RM flare
  - easily explained by CME of the companion star

Thank you!

Strongly supports Binary model !

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