

A large radio telescope dish is silhouetted against a sunset sky. The dish is a complex lattice structure, and its feed horn is visible at the top. The sky is a mix of orange, pink, and purple, with some clouds. The telescope is mounted on a base, and another smaller dish is visible in the lower right.

FRB Lessons (not) learned

Ue-Li Pen, CITA

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Overview

- ▶ learned: scattering in host (not IGM/CGM), polarization, repetition
- ▶ unknown: object type, cosmological role
- ▶ controversial statistics: host DM, Log N/Log S: Euclidean? Frequency dependence? latitude dependence? Scattering? Repetition rate?
- ▶ Lensing!
- ▶ depolarization?

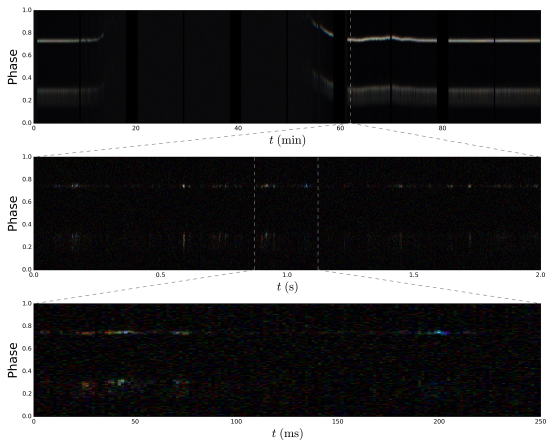
Plasma Lensing

- ▶ observed in pulsars due to companion wind (e.g. PSR B1957+20)
- ▶ systematic downward drift (seen in FRB121102) possibly due to screen reflection asymmetry

movie

credit: NASA's Goddard Space Flight Center/Cruz deWilde

Lensing



(Main et al 2017 in prep)

Lensing



Questions resolved

- ▶ scattering not intervening galaxy or IGM: FRB110523 (Masui et al 2015)
- ▶ some FRBs repeat
- ▶ VLBI holds key

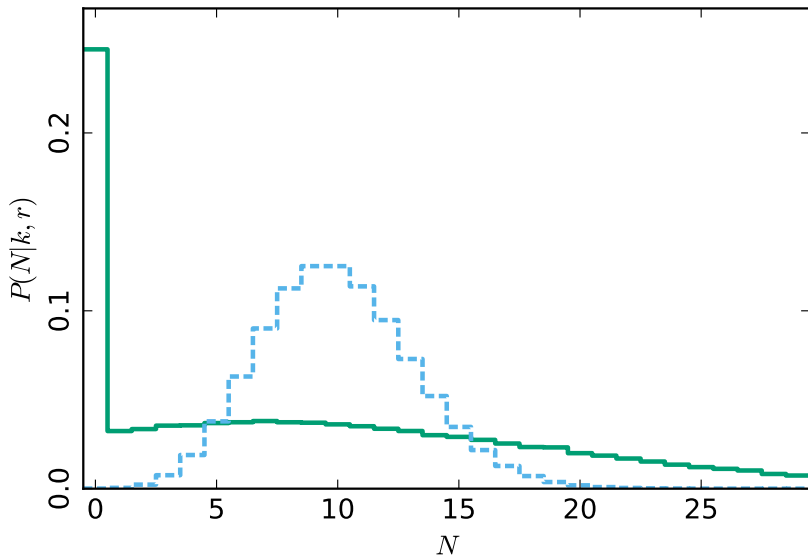
Questions confused

- ▶ Euclidean/spatial distribution?
- ▶ caveat: Bayesian arguments, look elsewhere effect, etc.
- ▶ repetition statistics?
- ▶ error underestimates?

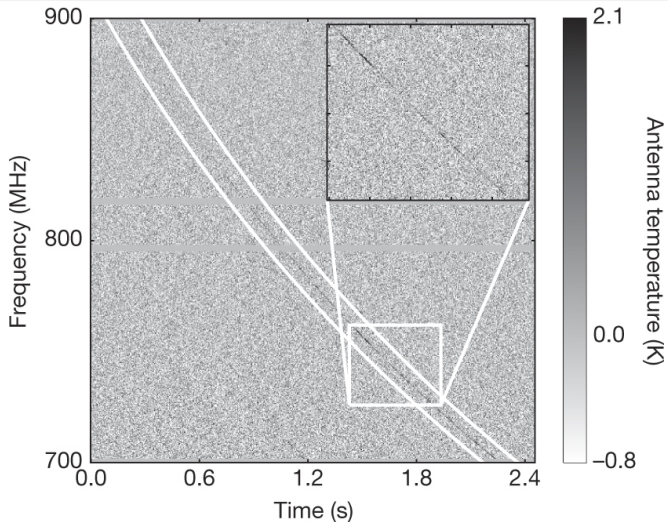
Repetition

- ▶ Opperman et al arXiv:1705.04881
- ▶ Weibull: single parameter clustered generalization of Poisson statistics.
- ▶ statistics of independent intervals.
- ▶ $\xi \propto t^{-0.66}$ is 10^{12} times more likely than Poisson
- ▶ repeat rate 5.5/day, non-poisson suggests rate is consistent with ALL FRB non-repetition for same rate!

non-Poisson

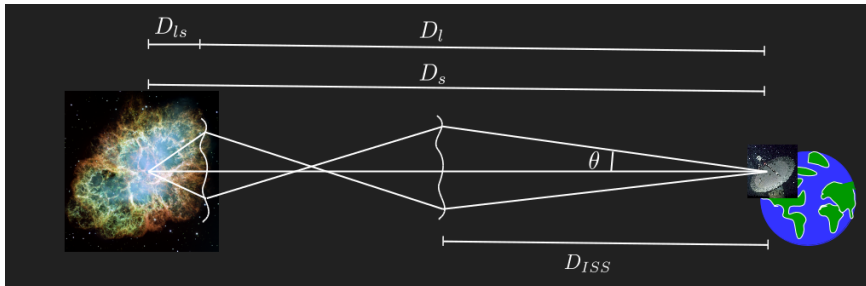


FRB110523



Masui et al 2015

Scattering



credit: R. Main)

Two screen physics

- ▶ FRB110523:
 - ▶ long $\sim 1\text{ms}$: local to host
 - ▶ short $\sim 1\mu\text{s}$: galactic (off plane)
- ▶ FRB121102:
 - ▶ short $\sim 10\text{ns}$: local to host
 - ▶ long $\sim 20\mu\text{s}$: galactic (in plane)

Depolarization

- ▶ of all known radio magnetars, 1 in 4(?) has $|RM| > 60,000$
- ▶ depolarized below 3GHz due to multipath propagation (near source)
- ▶ if seen from outside galaxy, probably still high RM and depolarization, but little scattering.
- ▶ store baseband data!

Conclusion

- ▶ FRB121102: binary plasma lensing? up to 100x observed for PSRB1957+20
- ▶ ISM structure: mapping cosmic plasma and magnetic fields
- ▶ potentially already constrains Lorenz boosted models for FRB121102
- ▶ galactic centre magnetar (and maybe crab) important example for understanding FRBs
- ▶ propagation may affect (de-) polarization, high RM possible, save baseband data!
- ▶ caveats: always beware of statistics!
- ▶ future possibilities: CGM, IGM, localization, $DM(z)$ cosmology?