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Young Supernova Remnant Neutron Stars and FRBs

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1 Extended Abstract

Fast radio bursts (FRBs) are bright, millisecond-duration radio transients, of which there seem to be thousands per sky per day. Until recently, it was unclear if they were cosmological, Galactic, or even atmospheric. In Connor et al. (2016), we suggested FRBs originate from young pulsars in still-compact extragalactic supernova remnants (SNRs). This model suggests that lots of the phenomenology seen in FRBs can be explained locally. Dispersion and Faraday rotation could come from the dense, magnetized plasma in the surrounding material, as well as scattering The sub-milliarcsecond localization of the repeating FRB 121102 has shown a radio counterpart that is consistent with the supernova remnant hypothesis (Tendulkar et al. 2017). However in this case, the redshift of the host galaxy is $\sim$0.2, establishing that FRBs are at cosmological distances and that a considerable fraction of their extragalactic DM comes from the intergalactic medium. In my talk I will discuss the status of the young SNR pulsar model. I will discuss some outstanding mysteries, including the low rotation measures of linearly polarised sources other than FRB 110523, and the non-power-law spectral behaviour seen in the repeating burst.

If all or most of the DM of FRBs came from their local environment, then they would be occupy a small enough volume of the Universe that non-Euclidean effects would be negligible. However, the redshift of the 121102 host galaxy shows that the brightness distribution of FRBs should deviate from the standard flat-space prediction, where logN–logS=3/2. One typically expects the brightness distribution to flatten in the cosmological case, meaning there is a relative excess of very-bright events. To test this hypothesis, we built an incoherent beamformer on the Pathfinder to the Canadian Hydrogen Intensity Mapping Experiment (CHIME) to which we attached a transient search. Its enormous field of view but thermal insensitivity meant we were able to probe the ultra-intense tail of the FRB distribution. Having seen nothing, we constrain the allowed number of such events, as well as the brightness distribution power-law index.

References

[1] L. D. Connor, "Non-cosmological FRBs from young supernova remnant pulsars" *MNRAS*, **11**, 4, January 2016, pp. 459

[2] S. P. Tendulkar, "The Host Galaxy and Redshift of the Repeating Fast Radio Burst FRB 121102" *ApJ* **12**, 1, January 2017, pp. 834