Abstract

We have developed a formalism to predict the fast radio burst (FRB) detection rates for any radio telescopes with given parameters. This also allows us to estimate the fluence, pulse width and redshift distribution of the FRBs predicted to be detected at the given radio telescope. This analysis requires us to make several assumptions regarding the FRB population and also regarding the pulse broadening due to scattering during propagation in the intervening inter-galactic medium (IGM). The FRB occurrence rate is normalised to the FRB detection rate at the Parkes radio telescope. We find that for a range of FRB parameter values and a range of possible scattering scenarios, the redshift distribution predicted by our formalism matches that observed at the Parkes radio telescope.

We have applied our formalism to predict the FRB detection rates for two Indian radio telescopes namely the upcoming Ooty Wide Field Array (OWFA) and the upgraded Giant Metrewave Radio Telescope (uGMRT). Considering OWFA, which will operate at a nominal frequency of $325\mathrm{MHz}$, we predict that this is expected to detect ~ 100 FRBs per day. For the uGMRT, we have considered FRB detection in four different frequency bands. We find that we have the best prospects of FRB detection in Band 3 $(250 - 500\,\mathrm{MHz})$ where uGMRT is expected to detect ~ 50 FRBs per day. Comparing FRB detection at OWFA and uGMRT, we find that OWFA can detect a large number of FRBs with poor localization on the sky whereas uGMRT can detect a smaller number of FRBs with better sky localization.

The radio telescopes Parkes, ASKAP, CHIME and UTMOST, all of which which function at different frequencies, have detected several FRBs each. We have used the observed dispersion measure and fluence of the non-repeating FRBs detected at these four telescopes to constrain the FRB population. Here we have parameterized the FRB population using the frreuency spectral index α, the mean energy $\overline{E}$ and the exponent γ of the FRB energy distribution. In the first analysis, we have used the two dimensional Kolmogorov-Smirnov test to find the allowed region of $(\alpha, \overline{E})$ space which is simultaneously consistent with the FRBs detected at all the four telescopes mentioned above. We find that in all cases the parameter range $\alpha > 4$ and $\overline{E} > 60 \times 10^{33}$ J is ruled out with 95% confidence. In a subsequent analysis, considering the FRBs detected at all the four telescopes, we have used the maximum likelihood method to estimate the e value of the parameters α, $\overline{E}$ and γ. We also present confidence intervals for these parameters.

Keywords: fast radio burst, transients, cosmology-observations, radio telescopes, scattering.

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