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Using low frequency scatter broadening measurements for precision estimates of DM and its implications on GW detection using PTAs

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Pulsars are rotating neutron stars emitting a beam of radio light from their magnetic axis. As the pulsar signal passes through the interstellar medium (ISM), it gets smeared due to the variation of the group velocity of the radiation with wavelength caused by the electrons in the line of sight. This smearing can be due to dispersion by the integrated column density of electrons or multipath propagation due to inhomogeneities in the electron distribution across the line of sight. The dynamic nature of the ISM makes both these effects vary with observation epochs. This variation can mimic a slowly varying noise in ToA covariant with GW signature of an isotropic stochastic gravitational wave background (SGWB). We present a new method to estimate the DM accurately in presence of scatter broadening in the pulse profile by compensating for variable scatter broadening, estimated using 300-500 MHz wide-band upgraded Giant Metrewave Radio Telescope (uGMRT) measurements. We evaluate this method in comparison with traditional DM estimation methods, ignoring such effects, using simulated data. We also present results from this method using Indian Pulsar Timing Array (InPTA) data set on PSR J1643-1224 and discuss implications of our results.

Primary authors: SINGHA, Jaikhomba (Indian Institute of Technology Roorkee); INPTA, on behalf of the Indian Pulsar Timing Array Collaboration

Presenter: SINGHA, Jaikhomba (Indian Institute of Technology Roorkee)

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