Scattering study of Pulsars below 100 MHz

Karishma Bansal[1], Greg Taylor[1], and Kevin Stovall[2]

[1] Physics and Astronomy, University of New Mexico, Albuquerque NM
[2] National Radio Astronomy Observaory, Socorro, NM

The interstellar medium (ISM) consists of an ionized plasma which affects radiation as it traverses the medium. Observable ISM affects are dispersion, scattering, angular broadening, and interstellar scintillation. Pulsars are compact and emit short pulses which make them good candidates to study and understand all these effects. Furthermore, all of these effects are stronger at lower frequencies, though in a few cases the pulsar profiles also grow asymmetrically broader at lower frequencies which can complicate the analysis.

Different ISM models predict different frequency dependencies for the scattering time-scale τ_{sc}. For an isotropic homogeneous turbulent medium, the scaling relation is $\tau_{sc} \propto \nu^{-4}\ DM^2$, while for a Kolmogrov distribution of irregularaties, the expected relation is $\tau_{sc} \propto \nu^{-4.4}\ DM^{2.2}$. From previous observations, the exponent value alpha has been found to be < 4 for several high DM pulsars. This is believed to be due to anisotropic scattering mechanism. The effect of this anisotropy can be seen in the power spectra of the dynamic spectra as scintillation arcs. However, identifying such features has been difficult at low frequencies.

We present a study of scattering and scintillation for a sample of pulsars observed at low frequencies ($10 - 88$ MHz), using the first station of the Long Wavelength Array (LWA1). We examine the scaling relations for scattering and show examples of scintillation. The results yield insights into the small scale structure in the interstellar medium.