Abstract:

Pulsars, periodic radio sources, emit radiation in characteristic pulses that vary in shape, frequency and intensity. The mechanism whereby such pulses are generated is still not well understood, but with greater resolving power, it might prove possible to probe the nature of the pulses in more detail and discover the intricacies of a magnetic field that produces such striking lighthouse emission. To achieve the requisite level of resolving power, this project aims to use Very Long Baseline Interferometry (VLBI) to resolve the image of the pulsar that has been scattered by interstellar medium. Such scattering provides an opportunity for interferometry with a baseline on the order of an astronomical unit, thus resolving the pulsar to nanoarcsecond precision. To this end, raw voltage observations were taken at 325MHz and 150MHz frequencies on bright calibrator sources and fainter millisecond pulsars at the Algonquin Radio Observatory (ARO), the Giant Metrewave Radio Telescope (GMRT) in India, the Low Frequency Array (LOFAR) in the Netherlands, and the Effelsberg 100-m Radio Telescope in Germany. In order to constructively add the signal from the different locations, it was necessary to write a routine to calculate the difference in the arrival time of the pulse between each of the VLBI sites and each of GMRT’s thirty antennas. Some additional code was written to identify dropped signals in the ARO and GMRT acquisition systems. Finally, detailed information was needed regarding the rapidly changing period of the millisecond pulsars so that the signal could be folded in time, increasing the signal to noise ratio. Having done this folding, we have successfully spotted both bright and millisecond pulsars at ARO and GMRT. At the moment, the project is still in the early stage of interpreting observations, confirming pulsar sightings at each individual telescope, and further observations will be taken later in the year in order to attempt the interstellar interferometry that is the primary aim.