

Title

Understanding the Origin of Interstellar Scintillation

Abstract

We propose a scintillation monitoring campaign with MeerKAT of 6 bright, southern pulsars, with the goals of mapping the distribution of scattering screens, with the goals of elucidating the origin of pulsar scintillation - from our local environment, the interstellar medium, and the pulsar's local environment - and using scintillation as a precision probe of pulsar emission and motion. Parabolic `scintillation arcs' are regularly seen in the 2D power spectra of scintillation, revealing thin scattering layers, and encoding the relative distance and velocity and distance of the pulsar, screen, and Earth. Annual variations of the arc curvatures will be used to uniquely determine the distance and geometry of these screens, to investigate the Local Bubble boundary, the supernova remnants of young pulsars, and other astrophysical associations. Models of scintillation have specific predictions for the evolution of image positions in frequency, and the role of magnetism is confining requisite plasma densities; these effects will be probed in our proposal. More ambitiously, we will attempt to perform `interstellar interferometry', probing pulsar emission on ~ 10 km scales. These effects are subtle, requiring very high instantaneous S/N, and wide bands, making MeerKAT the ideal telescope for these science goals.