

Studying the FRB-like giant pulses of the distant Crab ‘twin’, PSR B0540–69, and modelling its local magneto-environment

Abstract

Giant pulses from a young neutron star (NS), because of the pulse brightness and ultra-short durations, provide near-instantaneous sampling of the energetic pulsar's surrounding environment. A recent study of the extra-galactic young NS, PSR B0540-69, revealed it shares many of the curious emission characteristics increasingly attributed to Fast Radio Bursts (FRBs): it emits irregular giant pulses, some very narrow in their spectral extent and highly linearly polarized. These properties pose the question how similar are its surroundings to those of FRBs?

The environment of PSR B050-49 is its supernova remnant in the Large Magellanic Clouds. This dense and magnetised nebula will naturally lead to time variations in dispersion measures (DM) and rotation measures (RM), characteristics that are also seen in repeating FRBs. But, at a distance of 50 kpc, it takes MeerKAT to improve our understanding of PSR B050-49's intrinsic and environmental characteristics. It is so faint, that only since the advent of MeerKAT has its unique emission characteristics become known.

In this proposal, using 10 hrs of L-band PTUSE data, we will more than double the high resolution giant pulses from PSR B0540-69 recorded to date; allowing us to study the relationship between its narrowband and broadband emissions. Our proposed cadence will lead to measurements of changes in DM and particularly RM, only hinted at previously. By studying these changes jointly with the pulse scattering and profile polarisation characteristics, we will make the first map of the magnetised environment around PSR B0540-69, the only extra-galactic giant pulse-emitter currently known.