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Precision MSP Timing with MeerKAT

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MeerTime is a large survey project for pulsar timing using the MeerKAT telescope in South Africa, bringing together astronomers from 15 institutions on four continents. The design of the array, which consists of 64 14-metre dishes located in the South African Karoo desert, provides a sensitivity comparable to a 100-metre telescope with access to the entire sky south of $\delta \approx +40^\circ$ and high dish slew rates to maximise on-sky time. MeerTime science is divided into four themes: precision Millisecond Pulsar (MSP) timing, globular cluster pulsars, relativistic binary pulsars, and the non-recycled pulsar population. The MSP timing project utilises the sensitivity and versatility of MeerKAT to push the limits of pulsar timing precision and pave the way for MSP timing with the Square Kilometre Array. During the first two years of the MeerTime project, we conducted a census of 187 MSPs, with an emphasis on MSPs in the "deep south" ($\delta < -30^\circ$) which are largely inaccessible to northern observatories. Using those results, we identified ≈ 80 sources with the best timing precision for gravitational wave searches and designed projects to optimise our time allocation for the next three years. In addition, studies of interstellar scintillation in bright sources have been used to independently measure pulsar distances and velocities and binary parameters. Future timing projects include targeted campaigns to determine binary system masses, long-term timing to measure proper motions and parallaxes, and large-sample studies to refine our understanding of the MSP population and emission mechanisms. In this talk, I will provide an overview of the MSP timing project and observing strategies and discuss current and future work including wideband timing and single-pulse studies.