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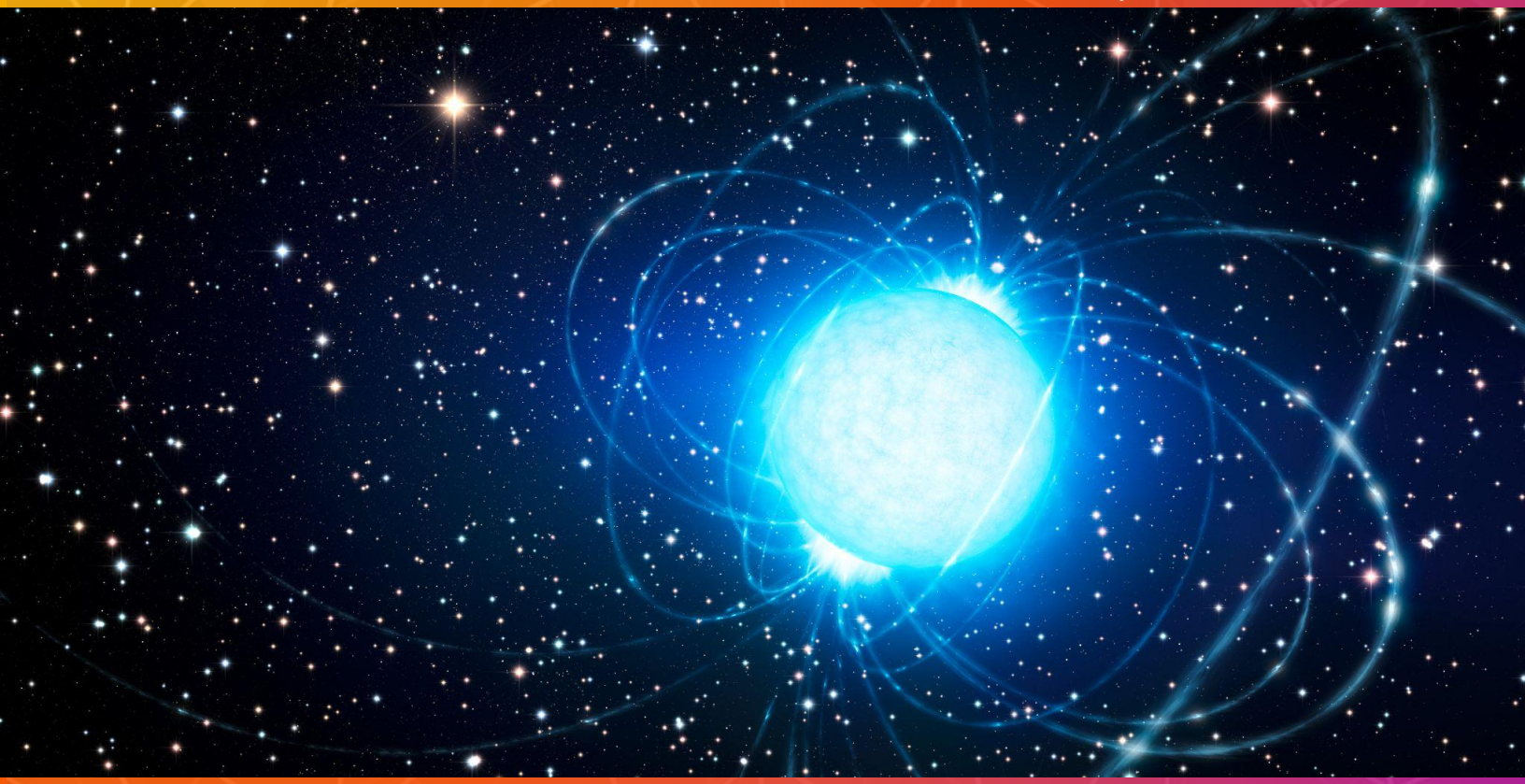

# An ultra-long period magnetar with periodic radio emission

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Most known neutron stars have been detected via periodic radio or X-ray signals correlated with their rotational period, which are generated either by a conversion of a fraction of their spin-down dipole radiation (pulsars) or twisting and/or reorganisation of their intense magnetic fields (magnetars). The known population typically rotates with periods of milliseconds to tens of seconds, but it is postulated that there exists an older, much more slowly-rotating neutron star population, which are thought to no longer generate emission. These “ultra-long period” (ULP) magnetars are candidate progenitors for Fast Radio Bursts, which themselves are now being localised to positions incompatible with young magnetars (e.g. globular clusters). ULP magnetars would explain many of the emission characteristics of FRBs, such as the quasi-periodic windows of emission, but were thought to be impossible to observe directly.

We have made the first direct detection of a ULP magnetar, using a low-frequency radio sky survey performed by the Murchison Widefield Array. Its emission is highly polarised and periodic on a timescale of ~20 minutes. Its dynamic spectrum shows high-fluence narrow-timescale “spikes” which are unresolved by our data, with fluence on par with FRBs generated by the Galactic centre magnetar. I will highlight the object’s main observational features, including its window of appearance, dispersion measure, polarisation attributes, and changes in its pulse profile over time. Along with X-ray and optical observations, these features have allowed us to constrain its physical attributes such as location in the Galaxy, radio luminosity, and likely magnetic field strength. I will conclude with a population estimate and thoughts on how we might best detect further examples, and follow them up to determine if they generate FRBs.

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