Novel transient radio sources in MWA surveys

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Description:
The Murchison Widefield Array (MWA) is a low frequency (80 — 300 MHz) radio telescope operating in Western Australia and the only SKA_Low precursor telescope. The MWA has collected more than 20PB of data spanning nearly a decade of operations. In an undergraduate project in 2020, using just 24h of data, we detected a new type of radio source, which we have localised to our own Milky Way, and repeats on the very unusual cadence of once every twenty minutes. The object may be an unusual type of neutron star, or possibly a highly magnetic white dwarf: either way, it was entirely unexpected, and shows the power of searching these archives.

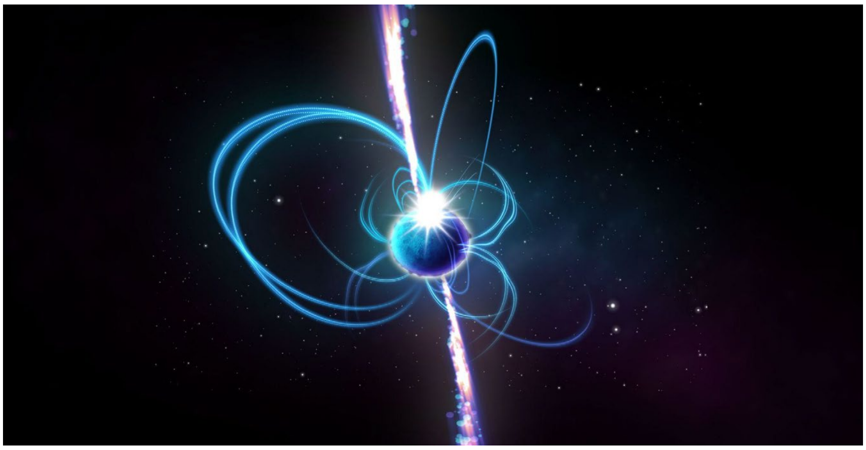
Now that we know such sources exist, it is imperative to find more of them in order to study their nature and their astrophysics. Fortunately, there are thousands of hours of data, representing large volumes of the Galaxy, which have not yet been searched, as well as new monitoring campaigns being conducted with the upgraded instrument. These data are expected to contain many more examples of this new type of source. The project uses existing pipelines to search MWA data for these transients, with a particular focus on data covering our own Galaxy, where we expect more periodic radio transients to reside.

We can then:

- Study the spatial distribution and duty cycles of the objects;
- Perform rapid follow-up in X-ray, optical, and with high-time resolution radio observations;
- Uncover their physical nature, and how they connect to other astrophysical phenomena such as Fast Radio Bursts.

If the new transients are staggeringly rare, and no new detections are made, there are other exciting science projects that would be well-supported by searching these data:

- X-ray binaries (XRBs) formed of a black hole and a donor star can produce bright radio outflows in the form of jets, which deposit a considerable amount of energy into the surrounding environment. We can use data from this project to explore the physics of these jets and how they interact with their environments, to understand more about these extreme objects
- Slow radio pulsars and magnetars that repeat on timescales of 1 — 10 seconds are very rare; the data in this project would find more, and measure the variations in the morphology, intensity, spectrum and polarisation of the pulse profiles at low frequencies, which explores the magnetic event that caused the outburst and how the magnetic fields subsequently evolved.



An artists’ impression of an ultra-long period magnetar, the type of extreme source that this project aims to detect.