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Monitoring the auroral pulses of the slowest-pulsing ultracool dwarf

Abstract

A small fraction of ultracool dwarf stars (UCDs) are known to produce non-thermal radio emission, including highly circularly polarised, periodic pulses. This level of activity at radio frequencies marks a breakdown of the conventional solar-like activity paradigm. Instead, this emission is likely driven by auroral current systems powered either between the interaction between the stellar magnetosphere and surrounding plasma, or the interaction of the magnetospheres of a star and a companion exoplanet.

Circularly polarised periodic pulses from the nearby M-dwarf SCR J1845-6357 have been detected in observations with the Australian Square Kilometre Array Pathfinder (ASKAP). The emission increases from a quiescent state of ~0.5 mJy to ~3 mJy at 943 MHz with ~90% circular polarisation. These pulses last approximately 2 hours with a 14.1 hour period, in agreement with the known rotation period of the star, suggesting that the emission originates from the star rather than an exoplanet interaction. However, this source does not fit the standard paradigm in that it is much older (>1.5 Gyr vs ~100 Myr) and rotates much slower (14.1h vs <5h) than the known population of radio-active UCDs and hence, presents a unique opportunity to study how magnetic breaking and rotation spindown occurs in late-stage stellar evolution.

The sensitivity of MeerKAT will allow us to obtain a higher resolution pulse dynamic spectrum than is possible with other radio facilities and in turn, better understand the properties of the emission and the mechanism by which it is produced.