

Hints for auroral and magnetospheric polarized radio emission from the scallop-shell star 2MASS J05082729 – 2101444

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Scallop-shell stars are a recently-discovered class of young M dwarfs showing complex optical light curves, characterized by periodic dips and additional features stable over tens to hundreds of rotation cycles, whose origin is not understood. 2MASS J05082729–2101444 is a ~25 Myr-old scallop-shell star identified using TESS data, with photometric period of 6.73 h attributed to rotation. Among the ~50 recently confirmed scallop-shell stars, it is one of the few detected at radio frequencies between 1–8 GHz. We observed this rare system with the upgraded Giant Meterwave Radio Telescope at 570–725 MHz, covering 88% of the photometric period in each of the two observations scheduled almost a month apart in 2023. We have detected ~mJy emission from the target in both epochs, with significant circular polarization fraction $|V/I|$ ~20–50%. The 3.5-min phase-folded light curves reveal unique variability in circular polarization, showing an ~ hour-long helicity reversal in both epochs, similar in amplitude, length, and possibly phase. These results suggest two emission components: a persistent moderately polarized one and a highly polarized, short burst-like component, likely due to electron cyclotron maser (ECM), indicative of auroral emission and potentially responsible for the helicity reversal. I'll present these uGMRT observations and discuss the scenarios responsible for the observed behavior.

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