

Exploring the Dynamic Radio Sky of Low-Mass Stars

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Radio variability provides a powerful probe of magnetospheric processes across the stellar mass range, from magnetic massive stars to active low-mass stars. In low-mass systems, radio emission traces magnetic activity and coherent emission processes, while offering a potential avenue for investigating star–planet interaction (SPI). We present recent results from a multi-epoch radio study of low-mass stars, with particular emphasis on the nearby M3.5 dwarf CW UMa. Multi-epoch observations with ASKAP and the upgraded Giant Metrewave Radio Telescope (uGMRT) reveal persistent but strongly variable radio emission from sub-GHz to GHz frequencies, with variability on timescales ranging from minutes to days and stochastic, flare-like events. The emission is strongly circularly polarized, with a lower limit to the brightness temperature of $T_B > 10^{11}$ K, providing strong evidence for a coherent emission mechanism. Combining radio observations with TESS photometry and Zeeman–Doppler imaging, we investigate the connection between radio variability, stellar rotation, and large-scale magnetic-field topology. The highly ordered magnetic configuration of CW UMa, together with its pronounced short- and long-timescale variability, provides a detailed view of coherent radio emission from an active low-mass stellar magnetosphere. We place CW UMa in the broader context of radio variability in magnetically active stars, including magnetic massive stars and other active M-dwarf systems. Despite their different stellar parameters and magnetospheric scales, both populations can produce strongly variable and polarized non-thermal radio emission, while low-mass stars additionally provide a promising environment for exploring possible SPI signatures. These observations highlight nearby low-mass stars as an important population within the dynamic Galactic radio sky and demonstrate the importance of multi-epoch radio monitoring for characterizing variable and coherent stellar radio emission in current and future wide-field surveys.