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Exploring flares and their space weather effects in an active M-dwarf - AD Leo

Abstract

Low mass, M type stars are the most common stars in the Milkyway with high rates of occurrence of Earth-like planets around. These stars are known to be highly active, resulting in high flaring rates. Strong flares can drive energetic particles and outflows across inter-planetary space potentially disrupting the exoplanetary magnetic fields leading to the erosion of planetary atmospheres. Stellar activity originates at different layers of stellar atmosphere, and evolve in different physical pathways producing various multiwaveband (Xray - radio) observables as they propagate outwards accelerating particles and heating local plasma. Metrewave bursts are coherent emissions produced by flare-accelerated electrons at harmonics of local plasma frequencies as they traverse across coronal isodensity layers. Modelling their spectro-temporal evolution, combined with Xray to visible range spectroscopic observables will allow us to constrain the flare models and construct a detailed picture for each flare from their genesis to exo-space weather impacts. The primary objective of this work is to capture multiple wideband flaring events, model them robustly and classify them for the first time based on physical mechanism and space weather impact for a well-known flare star, AD Leo. MeerKAT observations in UHF band, proven to be sensitive to stellar bursts from low to mid corona, will be complemented by AstroSaT (Xray to optical) observations which are already approved. Given multiwaveband rate of ~ 0.25 - 0.8 per hour, we request 40 hours of on-source time for the project to sample ~ 10 - 24 flares to enable multi-event study and flare classification.