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Detection of Magnetospheric Interaction in Magnetic Hot Binary

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Although > 6% of isolated massive stars are magnetic, a magnetic field is rarely observed (<1.5%) in the case of close hot binaries. Among them, ϵ Lupi A is the only close hot binary where both the components are magnetic. The stars have anti-aligned dipoles pointing to interacting magnetic fields, and orbit close enough that their magnetospheres are predicted to overlap, leading to speculation that ϵ Lupi may exhibit magnetospheric interactions. Although several studies are going on to understand the nature of radio emission from single massive magnetic stars, only a few observations have been performed to study the stars in binary. In this work, we shall report the discovery of radio emission from ϵ Lupi observed with the upgraded Giant Metrewave Radio Telescope (uGMRT) and the MeerKAT radio telescope. The light curve shows a variable nature with the presence of strong, sharp, linearly polarized pulses near the periastron. This behavior makes ϵ Lupi the first-ever main-sequence binary to show direct evidence of magnetospheric interaction. We also witness some out-of-periastron spikes in the light curve that we try to explain by considering different phenomena: electron cyclotron maser emission, multi-polar interaction, or magnetic reconnection due to the relative motion of the magnetospheres of the components. We also observe a possible periodic variability of timescale much smaller than the orbital period in the light curve that might indicate the yet-unknown rotational period of one or both contributing stars. This complex system serves as a test-bed for different exotic physical processes that may arise in other magnetically interacting systems like star-star, planet-star, and moon-planet. We anticipate our work to be a starting point for a more detailed variability study.

Author: Mr BISWAS, Ayan (National Centre for Radio Astrophysics)

Co-authors: DAS, Barnali (University of Delaware); Mrs CHANDRA, Poonam (National Radio Astronomy Observatory); WADE, Gregg (Royal Military College of Canada); Mr MATTHEW E., Shultz (University of Delaware); CAVALLARO, Francesco (Istituto Nazionale di Astrofisica (INAF))

Presenter: Mr BISWAS, Ayan (National Centre for Radio Astrophysics)

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