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Constraining the non-thermal emission site and geometry of AR Sco via optical po- larimetry

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Marsh et al. detected radio and optical pulsations from the binary system AR Scorpii (AR Sco). This system, with an orbital period of 3.55 h, is composed of a cool, low-mass star and a white dwarf (WD) with a spin period of 1.95 min. Takata et al. also detected X-ray pulsations from this source. These observations indicate no presence of an accretion disk or column. Buckley et al. found that optical pulsations from the white dwarf are strongly linearly polarised (up to 40%). The multitude of observations on the source has led to a plethora of models to explain these observations especially the pulsed non-thermal emission. These models fall into two groups proposing two different emission locales. The first suggests that the particles are accelerated and radiate at the interacting magnetic fields of the binary members, where shock could form. The majority of these models invoke magnetic reconnection, using precession of the WD to explain the optical and X-ray variations. The second group proposes that the particles radiate and cool inside the WD magnetosphere close to its magnetic poles. One prevalent idea is that particles are injected from the companion and encounter a magnetic mirror close to the WD. We previously fitted a standard pulsar rotating vector model to the polarisation emission angle data allowing us to constrain the magnetic field geometry in the emission region to a dipole-like field structure. Additionally, we determined that synchrotron radiation dominates as long as the pitch angles of the particles can be maintained. We then applied our model to orbitally phase-resolved polarisation position angle data and obtained a variation in magnetic inclination and observer angles over the orbital period. In this talk, we scrutinise the various models in light of our own findings as well as current observations. Finally, we make some speculations to explain the time evolution of the geometric parameters that we obtain.

Abstract field

Author: DU PLESSIS, Louis (Centre for Space Physics, North-West University)

Co-authors: HARDING, Alice (Los Alamos National Laboratory); VENTER, Christo (North-West University Potchefstroom Campus); WADIASINGH, Zorawar (NASA GSFC)

Presenter: DU PLESSIS, Louis (Centre for Space Physics, North-West University)

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