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Mechanical Faraday effect to inform on pulsar rotation direction[1]

RENAUD GUEROULT, Laplace-CNRS-INPT-UPS, Y. SHI, LLNL, J.-M. RAX, LOA-ENSTA-CNRS, N. J. FISCH, Princeton University — Pulsar polarimetry is widely used to infer interstellar magnetic fields. These magnetic field estimates typically rely on the assumption that the observed polarisation rotation stems entirely from Faraday rotation in the magneto-optic plasma found between the linearly polarized point source pulsar and our planet. Yet, the magnetosphere that surrounds pulsar can in principle also affect polarization. While the classical Faraday rotation in the pair plasma magnetosphere itself may be negligible, we show that a mechanical polarization rotation (or mechanical Faraday) effect should arise from the pulsar magnetosphere rapid rotation [1]. Importantly, while this mechanical effect can be mistaken for Faraday rotation in the interstellar medium (ISM) due to its identical wavelength-square signature at typical GHz observation frequency, it can in principle be disambiguated in the sub-GHz thanks to a different wavelength scaling near a cut-off frequency. Separating these two contributions through low-frequency pulsar polarisation observations could thus permit correcting for possible systematic errors in ISM magnetic field estimates. It also offers a conceptual means to determine the rotation direction of pulsars, which remains otherwise inaccessible. [1] Gueroult et al, arXiv 1903.01193

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