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Probing neutron star magnetic fields using X-ray polarimetry

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X-ray polarisation is set to open a new window into highly energetic astronomical sources like neutron stars and black holes. The upcoming launches of IXPE (a satellite-based soft X-ray polarimeter) in late 2021 and XL-Calibur (a balloon-borne hard X-ray polarimeter) in 2022 will soon provide sensitive X-ray polarisation measurements. These measurements can be used to study the strong magnetic field around neutron stars. The polarisation of X-ray photons emitted from a neutron star is strongly influenced by plasma and possible vacuum birefringence effects. Both anisotropies are induced as a result of the large magnetic-field strength and depend on the relative direction of the polarisation vector and the local magnetic field. Consequently, a measurement of X-ray polarisation will provide strong constraints on the magnetic-field configuration around the star. In addition, polarisation can also give the long sought-after experimental confirmation for the presence of vacuum birefringence. This phenomenon is a long-standing prediction of quantum electrodynamics and results from vacuum fluctuations in external magnetic fields. In this presentation, I will highlight how X-ray polarimetry can be used to study neutron-star magnetic fields using the unique capabilities of XL-Calibur, during its balloon flight from Esrange, Sweden, in summer 2022

Author: IYER, Nirmal Kumar (KTH)

Presenter: IYER, Nirmal Kumar (KTH)

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