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Constraining the multipolar magnetic field of millisecond pulsar PSR J0030+0451 via X-ray light curve fitting

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The Neutron star Interior Composition Explorer (NICER) was installed aboard the International Space Station (ISS) in 2017 with the major aim of gaining a better understanding of the extreme nature and composition of neutron stars (NSs). With its exceptional sensitivity, it hopes to constrain the equation of state for these compact objects to high precision. Modelling thermal X-ray light curves (LCs) of pulsars can also provide us with insights into the magnetic field structure of an NS which further helps us in understanding the morphology of the surface hot spots.

Recent studies suggest strong evidence for a multipolar magnetic field for the millisecond pulsar PSR J0030+0451 using NICER data, while also constraining the parameter space for the magnetic field configuration. We are refining the dipole plus quadrupole model of Kalapotharakos et al. (2021)[1], by including a more general magnetic field configuration, going up to an l=3 component of the multipolar field, and using Markov chain Monte Carlo (MCMC) methods to fit the NICER X-ray light curves.

Exploring the general magnetic multipolar parameter space using MCMC would help us constrain the field structure, and eventually the stellar mass and radius more robustly. In this talk, the newly implemented multipolar field configuration will be highlighted, and some preliminary results of exploring the parameter space using MCMC for the vacuum case will be shown.

[1] https://ui.adsabs.harvard.edu/abs/2021ApJ...907...63K/abstract

Apply to be considered for a student ; award (Yes / No)?

No

Level for award;(Hons, MSc, PhD, N/A)?

N/A

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