Draft version February 12, 2020
Typeset using LaTeX default style in AASTeX61

ON THE STRUCTURE OF A QUASI-KEPLERIAN ACCRETION DISKS SURROUNDING MILLISECOND X-RAY PULSARS

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(Received; Revised; Accepted)

ABSTRACT

In this study, we investigated the time-independent dynamics (disc structure, forces and torques) of a quasi-Keplerian disc around a millisecond pulsar (MSP) with an internal dynamo. We considered the disc around a MSP to be divided into the inner, middle and outer regions. By assuming that the disc matter flows in a quasi-Keplerian motion, we derived analytical equations for a complete structure (temperature, pressure, surface density, optical depth and magnetic field) of a quasi-Keplerian thin accretion disc, and the pressure gradient force (PGF). In our model, the MSP-disc interaction results into magnetic and material torques, such that for a given dynamo (ϵ) and quasi-Keplerian (ξ) parameter, we obtained enhanced spin-up and spin-down torques for a chosen star spin period. Results obtained reveal that PGF results into episodic torque reversals that contribute to spinning-up or spinning-down of a neutron star, mainly from the inner region. The possibility of a quasi-Keplerian disc is seen and these results can explain the observed spin variations in MSPs like SAX J1808.4-3658 and XTE J1814-338.

Keywords: 97.80.Jp X-ray binaries, 97.60.Gb Pulsars, 97.10.Gz Accretion and accretion discs

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