MHD simulations of oscillating cusp-filling tori around neutron stars

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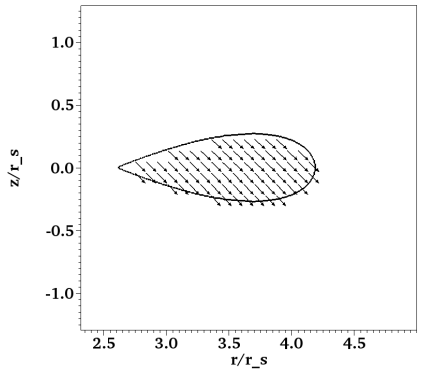

Figure 1: Initial configuration of the cusp-filling torus around non-rotating neutron star. Solid line represent the density contour in a meridional cross-section of the cusp-filling torus at $r_c = 3.47\ r_s$. The inner edge of the torus is terminated by a cusp at $2.62\ r_s$. Solid arrows represents the initial uniform sub-sonic diagonal velocity perturbation.

We performed axisymmetric, grid-based, ideal magnetohydrodynamic (MHD) simulations of oscillating cusp-filling tori orbiting a non-rotating neutron star [1]. A pseudo-Newtonian potential was used to construct the constant angular momentum tori in equilibrium. The inner edge of the torus is terminated by a "cusp" in the effective potential. The initial motion of the model tori were perturbed with uniform sub-sonic diagonal and vertical velocity fields. As the configuration evolved in time, we measured the mass accretion rate ($\dot{M}$) on the surface of neutron star and obtained the power spectrum of $\dot{M}$. The prominent mode of oscillation in the cusp torus is the radial epicyclic mode. From our analysis it follows that the mass accretion rate carries a modulation imprint of the oscillating torus [2]. Our results can be verified by the astronomy satellite ASTROSAT. It is equipped with the Large X-ray Proportional Counters which can investigate quasi-periodic oscillations in low mass X-ray binaries.

References

[1] V. Parthasarathy, W. Kluźniak, M.Čemeljić, Manuscript in preparation

[2] Abramowicz M. A., Horak J., Kluzniak W., 2007, Acta Astron., 57, 1

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