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Relaxation of magnetized multi-ion plasmas in an internal conductor

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Abstract: The study explores the potential formation and characteristics of relaxed structures in multi-ion magnetized plasmas, comprising heavy ions, light ions, and inertia-less electrons. By employing vortex dynamic equations with current density, the system relaxes to triple Beltrami states. Solutions for the relaxed states are determined in two scenarios: a simple slab geometry and a slab geometry with an internal conductor. The influence of Beltrami parameters and density ratios of plasma components on equilibrium structure formation in both geometries is investigated. Additionally, we emphasize the equivalences between these geometries. This investigation holds significance for understanding relaxed structures in various astrophysical phenomena, including solar wind, Earth's ionosphere, near-Earth plasma sheet, upper ionosphere, and Saturn, as well as in laboratory plasmas with two positively charged ions of different masses. Furthermore, this research contributes to elucidating the underlying physics of relaxed structures, which are observed in celestial bodies like Jupiter's magnetosphere.

Refrences:

[1] S. M. Mahajan and M. Lingam, Phys. Plasmas **22**, 092123 (2015).

[2] Z. Yoshida and Y. Giga, Math. Z. **204**, 235 (1990).

[3] L. Woltjer, Proc. Natl. Acad. Sci. U. S. A. **44**, 489 (1958).

[4] J. B. Taylor, Phys. Rev. Lett. **33**, 1139 (1974).

[5] N. A. Salingaros, Appl. Phys. Lett. **56**, 617 (1990).

[6] L. C. Steinhauer and A. Ishida, Phys. Rev. Lett. **79**, 3423 (1997).

[7] L. C. Steinhauer and A. Ishida, Phys. Plasmas **5**, 2609 (1998).

[8] S. M. Mahajan and Z. Yoshida, Phys. Rev. Lett. **81**, 4863 (1998).

[9] Z. Yoshida and S. M. Mahajan, J. Math. Phys. **40**, 5080 (1999).

[10] Z. Yoshida and S. M. Mahajan, Phys. Rev. Lett. **88**, 095001 (2002).

[11] S. Ohsaki, N. L. Shatashvili, Z. Yoshida, and S. M. Mahajan, Astrophys. J. **559**, L61 (2001).

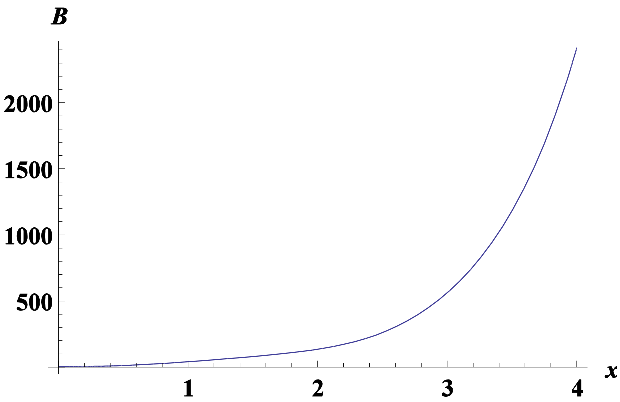
[12] S. Ohsaki, N. L. Shatashvili, Z. Yoshida, and S. M. Mahajan, Astrophys. J. **570**, 395 (2002).

[13] S. M. Gondal, M. Iqbal, S. Ullah, M. Asghar, and A. H. Khosa, J. Plasma Phys. **85**, 905850306 (2019).

[14] A. Janos, G. W. Hart, and M. Yamada, Phys. Rev. Lett. **55**, 2868 (1985).

[15] S. M. Mahajan and Z. Yoshida, Phys. Plasmas **7**, 635 (2000).

[16] Z. Yoshida, S. M. Mahajan, S. Ohsaki, M. Iqbal, and N. Shatashvili, Phys. Plasmas **8**, 2125 (2001).



Plot of the magnetic field ($\boldsymbol{B}$) for density ratio $n_{ih} = 0.322 n_e$ and $n_{il} = 0.677 n_e$ for simple slab geometry. The scale parameters are $\lambda_1 = 2.0363$, $\lambda_2 = 4.79852 + 1.444\, i$, and $\lambda_3 = 4.79852\text{-}1.444\, i$.