AAPPS-DPP2024, Nov 3-8 2024, Grand Swiss-Bel Hotel, Malacca, Malaysia

Quadruple Beltrami states in Earth's dusty mesosphere

S. M. Gondal[1]

[1] Department of physics, University of Engineering and Technology, Lahore, Pakistan

e-mail (speaker): sabagondal@uet.edu.pk

Abstract: The research describes a model of dusty plasmas involving three fluids: electrons, ions, and negatively charged dust grains. This model exhibits strong coupling between the magnetic field and the fluid components of the plasma. By satisfying the Beltrami condition, the generalized vorticities and associated flows align parallel to each other. Steady-state solutions obtained through solving Ampère's law for the magnetic field reveal a quadruple Beltrami state, characterized by four scale parameters. Graphical representations in the x-y plane illustrate the dynamics of the magnetic field, with self-organized structures heavily influenced by scale parameters and the mass of negatively charged dust grains. Examination of equilibrium magnetic field structures in Earth's mesosphere indicates diamagnetic behavior, transitioning to a paramagnetic state with a slight decrease in dust grain mass. This insight can aid in understanding phenomena like noctilucent clouds and polar mesospheric summer echoes in Earth's mesosphere, with potential applications in environmental and defense science. Additionally, this research contributes to enhancing our understanding of Earth's environment for future studies.

Refrences:

[1] S. M. Gondal, Phys. Plasmas **27**, 113703 (2020).

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

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

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

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

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

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

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

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

[13] P. N. Guzdar, S. M. Mahajan, and Z. Yoshida, Phys. Plasmas **12**, 032502 (2005).

[14] C. Bhattacharjee and J. C. Feng, Phys. Plasmas **27**, 072901 (2020).

[15] R. Bhattacharyya, M. S. Janaki, and B. Dasgupta, Phys. Lett. A **315**, 120 (2003).

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