9th Asia-Pacific Conference on Plasma Physics, 21-26 Sep, 2025 at Fukuoka

KdV Modeling of Field-Aligned Potentials in Alfvenic Double Layers by using (r, q) distribution function

Saba Khalid[1]

[1]Government College University Lahore, Pakistan.

e-mail (speaker): Sabakhalid@gcu.edu.pk

Abstract: In this study, we have investigated the field-aligned potentials associated with Alfvenic double layers in multicomponent space plasmas, utilizing the Korteweg-de Vries (KdV) equation. By considering non-Maxwellian effective temperature scales [1], we explore how this temperature distributions influence the formation and behavior of double layers, which are critical for understanding plasma phenomena in space environments. The KdV equation, known for its ability to describe nonlinear wave propagation, is applied to model the dynamics of field-aligned potentials, providing insights into the role of ion and electron interactions in shaping plasma structures. The results highlight the importance of non-Maxwellian effects on the stability and characteristics of Alfvenic double layers, offering a deeper understanding of plasma processes in astrophysical and space science context. Double layer observations reported by FAST, THEMIS, Magnetospheric Multi-Scale (MMS), and other satellite missions have validated the existence of double layers with substantial parallel electric fields [2, 3, 4, 5]. These field aligned structures play an important role not only in the dynamics of near-Earth plasmas but also at the boundary of other planets [6, 7]. These findings prompted our investigation into double layers and the accompanying electric fields in low-β space plasmas.

References:

[1] S. Khalid, Navaira Izhar, M. N. S. Qureshi, Phys. Plasmas **32** 042302 (2025).

[2] R. Ergun, L. Andersson, D. Main, Y.-J. Su, C. Carlson, J. McFadden and F. Mozer, Physics of plasmas **9** (9), 3685-3694 (2002).

[3] Y. Vasko, R. Wang, F. S. Mozer, S. D. Bale and A. V. Artemyev, FrPhy **8**, 156 (2020).

[4] F. Mozer and C. Kletzing, Geophysical research letters **25** (10), 1629-1632 (1998).

[5] F. S. Mozer, C. W. Carlson, M. Hudson, R. Torbert, B Parady, J. Yatteau and M. C. Kelley, Physical Review Letters **38** (6), 292 (1977).

[6] D. Newman, M. Goldman, R. Ergun and A. Mangeney, Physical Review Letters **87** (25), 255001 (2001).

[7] S. D. Bale, D. Burgess, P. J. Kellogg, K. Goetz, R. L. Howard and S. J. Monson, Geophysical Research Letters **23** (1), 109-112 (1996).