Large-scale velocity and magnetic field generation/acceleration in stellar atmospheres

Ketevan Kotorashvili [a] , *Nino Revazashvili* [a] , *Nana L. Shatashvili* [a, b]

e-mail: keti.kotorashvili2014@ens.tsu.edu.ge

nino.revazashvili2014@ens.tsu.ge

[a] Department of Physics, Faculty of Exact and Natural Sciences, Ivane Javakhishvili Tbilisi State University (TSU), 3 Chavchavadze Avenue, Tbilisi 0179, Georgia

[b] TSU Andronikashvili Institute of Physics, Tbilisi 0177, Georgia

We investigated the generation/acceleration of large-scale magnetic field and flow in two-fluid plasmas of stellar atmospheres ((i) with degenerate electrions and non-degenerate ions; (ii) a degenerate e-p plasma) by reverse dynamo mechanism [1]. For this purpose, we derived relevant dynamical equations (charge conservation, mass conservation, momentum conservation and equations of motion). For the background equilibrium we have applied the two-fluid Beltrami-Bernoulli states. (i) Electron gas is degenerate while ions are non-degenerate for the problem of White Dwarfs' (WD) atmosphere [2], taking into account classical (Newtonian) gravity for nonrelatvistic flows (justified by observations). Since Bernoulli and Beltrami conditions for classical and compact objects differ due to the modifies the effective mass (high density/degeneracy dependent) for the electron fluid, we consider the density inhomogeneity in the study. (ii) In dense degenerate pair-ion charged fluids two distinct routes lead to the creation of multi scale equilibrium structures, often met in astrophysical conditions [3]. The separation of scales leads to formation of smaller-scale structures and creation of new channels for energy transformations. For these problems we derived a closed set of equations for reverse dynamo mechanism; the degeneracy effects are taken into account in the Bernoulli condition. Based on this models we studied generation/amplification of magnetic field and flow in compact objects' outer layer/ atmospheres like WDs and Pulsars. We examined a possible role of degeneracy in magneto-fluid coupling effects in two fluid stellar-atmospheres for the problem of macroscopic fields' evolution.

The work was partially supported by Shota Rustaveli National Science Foundation Project N FR17_391;
The work of K.K. and N.R. was partially supported by TSU "Targeted scientific research program"grant "Large-scale velocity and magnetic field generation/acceleration in stellar atmospheres", 2018.

References

[1] S.M. Mahajan, N.L. Shatashvili, S.V.Mikeladze, K.I.Sigua. ***Astrophys. J.*** **634**, 419-425 (2005)

[2] V. I. Berezhiani, N. L. Shatashvili, and S. M. Mahajan, ***Phys. Plasmas*** **22(2),** 022902 (2015).

[3] N.L. Shatashvili, S.M. Mahajan, V.I. Berezhiani. . ***Astrophys Space Sci*** **361:70** (2016)