Formation of Local Fast Flows in the Self-Gravitating, Weakly Rotating Fluid By Reverse Dynamo Mechanism

Lasha Gudushauri[a], *Nana Shatashvili*[a, b]

e-mail: lasha.ghudushauri174@ens.tsu.edu.ge

[a] Department of Physics, Faculty of Exact and Natural Sciences, Javakhishvili Tbilisi State University, 1, Chavachavadze ave, Tbilisi 0179, Georgia

[b] Andronikashvili Institute of Physics, TSU, 6, Tamarashvili st. Tbilisi 0177, Georgia

We investigated the dynamics of a weakly rotating, self-gravitating neutral fluid applying the unified dynamo/reverse dynamo mechanism within the approximation of gravito-electromagnetism. We have shown that in such a system, where the ambient energy is mostly from the microscale „gravito-magnetic" field, the generation of local super-Alfvénic flow takes place. The explored phenomenon is a result of „gravito-magneto-fluid" coupling, which is analogous to the unified dynamo/reverse dynamo model resulting from magnetic-fluid coupling in a two-fluid plasma. For the real part of one of the roots of the derived dispersion relation, at large wave numbers, for Beltrami parameters (a) leading to the largely separated characteristic scales of the system a local macroscale super-Alfvénic flow generation is found when the initial ambient energy is mostly „gravito-magnetic". It is shown that both fields are generated simultaneously, and the greater the macroscale velocity/„gravito-magnetic" field is (generated locally), the greater will be the macroscale „gravito-magnetic"/velocity field (generated locally). The growth rate of the macroscale fields is defined by the Beltrami parameter (thus by the initial equilibrium state of the system) and the initial turbulent energy. It is remarkable that by decreasing the parameter χ, which characterizes the matter by the speed of sound, the „gravito-Alfvén-Mach" number of the locally generated macroscale flow decreases. The developed model for the possibility of the macroscale flow generation in a weakly rotating, self-gravitating fluid, is important for the investigation of further dynamics of various astrophysical objects where the self-gravity and the formation of fast outflows/jets are significant.

The work was partially supported by Shota Rustaveli National Science Foundation Project No.FR-22-8273.