Catastrophic Formation of Macro-Scale Velocity and Magnetic Fields in Multi-Component Degenerate Relativistic Gas of Astrophysical Objects

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Through the equilibrium analysis of astrophysical binary systems consisting of degenerate electron-ion gas with small fraction of the relativistic hot electron-ion gas we explored the creation of new macro-scales due to the different nature relativism in the characteristic parameters opening the new pathways for energy transformation [1]. We considered the case of both mobile and immobile ions in complex relativistic three-fluid system with 2-temperature electrons. We've shown the possibility of the catastrophic formation of the large-scale velocity/magnetic fields when there is a transformation of one type energy to another [2] in such a composite relativistic gas; the causes of the energy transformations depend not only on the initial helicities and energy of the equilibrium system but also on the temperature and density of the constituent species, on the hot fraction parameters. We have found that the fate of the system – the final equilibrium state of the system reached via relaxation – is defined by the very initial state of this system. The characteristic Beltrami parameters of the system are defined by the compound system helicities that can change in a dynamic situation. Consequently, it is possible that at some stage of the system evolution these parameters are brought to the favorable range for the strong flow/magnetic field formation. We found that the formation of the large-scale fast degenerate electron flows is possible for rather wide range of characteristic parameters of the system. The condition for the catastrophe is found analytically for extreme case of compound system. These results are very important for the study of stellar evolution and collapse problems.

References

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