Mechanisms for Multi-Scale Structures in Dense Degenerate Astrophysical Plasmas

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Two distinct routes lead to the creation of multi—scale equilibrium structures in dense degenerate plasmas, often met in astrophysical conditions. By analyzing an e-p-i plasma consisting of degenerate electrons and positrons with a small contamination of mobile classical ions, we show the creation of a new macro scale L_{macro} (controlled by ion concentration). The temperature and degeneracy enhancement effective inertia of bulk e-p components also makes the effective skin depths larger (much larger) than the standard skin depth. The emergence of these intermediate and macro scales lends immense richness to the process of structure formation, and vastly increases the channels for energy transformations. The possible role played by this mechanism in explaining the existence of large-scale structures in astrophysical objects with degenerate plasmas, is examined. The results found in present study indicate that when the star contracts, for example, its outer layers keep the multi-structure character although density in the structures, as shown in [1], becomes defined by lighter components degeneracy pressure.

References

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