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Gravitational instability of strongly coupled magnetized quantum plasma with radiation pressure

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The field of quantum plasmas is a subject of great interest in both the space and astrophysical plasmas and the quantum effects can be observed in the structure formation through gravitational collapsing process of astrophysical objects, such as white dwarfs, neutron stars, magnetostars and supernovas, where the density can reach several orders of magnitude that of ordinary solids [1]. This study examines the gravitational instability of infinitely conducting magnetized strongly coupled quantum plasma, under the influence of radiation pressure within the framework of a generalized hydrodynamic (GH) fluid model [2]. The general dispersion relation, valid for strongly and weakly coupled quantum plasma under kinetic and hydrodynamic limits respectively, is derived using normal mode analysis for perpendicular and parallel propagation. Jeans instability criteria are obtained for kinetic and hydrodynamic limits for both modes of wave propagation, and it is found that the critical Jeans wavenumbers in each case are modified due to the presence of viscoelastic compressional speed, radiation pressure, quantum effects and *Alfvên* wave velocity. It is also observed that the radiation pressure, quantum effects and viscoelastic parameters suppress the growth rate and thus have stabilizing effects on the initiation of gravitational collapse. The effects of various parameters on the growth rate of instability are calculated numerically and the outcomes are depicted graphically.

References

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