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Global Solutions of the Compressible Euler-Poisson Equations with Large Initial Data of Spherical Symmetry

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We are concerned with a global existence theory for finite-energy solutions of the multidimensional Euler-Poisson equations for both compressible gaseous stars and plasmas with large initial data of spherical symmetry. One of the main challenges is the strengthening of waves as they move radially inward towards the origin, especially under the self-consistent gravitational field for gaseous stars. A fundamental unsolved problem is whether the density of the global solution forms concentration to become a delta measure at the origin. To solve this problem, we develop a new approach for the construction of approximate solutions as the solutions of an appropriately formulated free boundary problem for the compressible Navier-Stokes-Poisson equations with a carefully adapted class of degenerate density-dependent viscosity terms, so that a rigorous convergence proof of the approximate solutions to the corresponding global solution of the compressible Euler-Poisson equations with large initial data of spherical symmetry can be obtained. Even though the density may blow up near the origin at certain time, it is proved that no concentration (delta measure) is formed in the vanishing viscosity limit for the finite-energy solutions of the compressible Euler-Poisson equations for both gaseous stars and plasmas in the physical regimes under consideration.

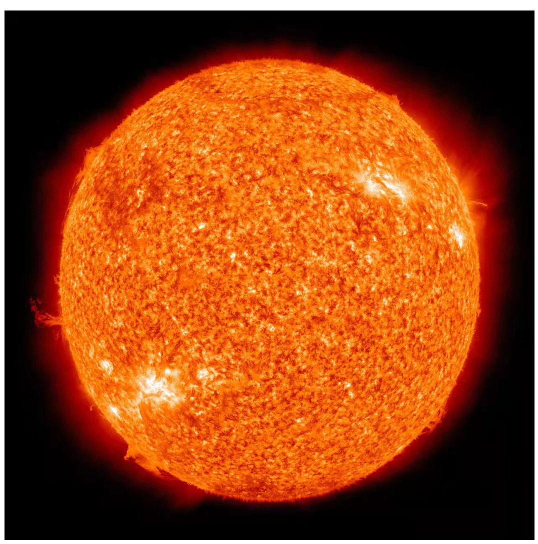

Figure 1: Gaseous Star.

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