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### Nonlinear stability of expanding stars in the mass-critical Euler-Poisson system

The gravitational Euler-Poisson system is a fundamental astrophysics model of a Newtonian star. We first give a brief overview of the existing results on the free-boundary compressible Euler-Poisson system. We then study the question of nonlinear stability of homogeneous expanding star-solutions discovered by Goldreich and Weber in 1980's in the mass-critical gravitational Euler-Poisson system. We show that these solutions are nonlinearly stable with respect to small perturbations. We thus construct a new class of global-in-time solutions, which are not homogeneous and therefore not encompassed by the existing works.The problem is mass-critical with respect to an invariant rescaling and the nonlinear analysis is carried out in suitably chosen similarity coordinates. We present some interesting open questions at the end. This is a joint work with Juhi Jang.