On the Euler–Poisson equations

Lavi Karp
Department of Mathematics, ORT Braude College, P.O. Box 78, 2161002 Karmiel, Israel
email: karp@braude.ac.il

Abstract The Euler–Poisson equations

$$\begin{cases} \rho_t + \nabla \cdot (\rho u) = 0 \\ (\rho u)_t + \nabla \cdot (\rho u \otimes u) + \nabla P(\rho) = -\rho \nabla \Phi \\ \Delta \Phi = 4\pi\rho \end{cases}$$

is a hyperbolic–elliptic system that describes the dynamic behavior of many important physical flows, and in particular, the evolution of a star regarded as an ideal gas with self gravitation. It is known that this can be written a symmetric hyperbolic system and therefore has a well–posed initial problem provided that the density is bounded below by a positive constant. However, in astrophysical context the density is expected to have compact support, or tend to zero at spatial infinity. It turns out that the system becomes degenerated whenever the density approaches zero. The talk will discuss a certain method to overcome this difficulty and will present well-posdness for densities that decay to zero at infinity and have a finite mass.

This is a joint work with U. Brauer.