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Motion of a Self-Gravitating Incompressible Fluid with Free Boundary.

In this talk, we consider the motion of the free boundary of an incompressible fluid body subject to its self-gravitational force. This can be described by a free boundary problem of the Euler-Poisson system. This situation differs from the water wave case in that the constant gravity in water waves is replaced by the nonlinear self-gravity. I shall present some recent results, in particular we give a lower bound on the lifespan of smooth solutions. We show that the Taylor sign condition always holds; we prove that for smooth data of size ϵ, a unique solution exists and remains smooth for time greater than or equal to $O(1/\epsilon^2)$. This is achieved by constructing an appropriate quantity and a coordinate change, so that the new quantity in the new coordinate system satisfies an equation without quadratic nonlinearity. This is joint work with Shuang Miao, Sohrab Shahshahani and Sijue Wu.