On the global solutions of physical vacuum boundary problem of compressible Euler equations with damping

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Abstract

Physical vacuum (also called physical vacuum singularity) that the sound speed is only $C^{1/2}$-Hölder but not Lipschitzian continuous across the vacuum boundary appears in several important situations such as gaseous stars, compressible flows with damping and shallow waters. This low regularity of the sound speed near vacuum boundaries creates big obstacles in the analysis of the evolution of vacuum boundaries of compressible fluids due to the high degeneracy of compressible Euler equations near vacuum states so that the standard symmetrization method developed by Friedrichs, Lax and Kato does not apply. In this talk, I will present the global-in-time regularity theory for the physical vacuum free boundary problems of compressible Euler equations with damping. The key idea is on higher order regularity estimates both near vacuum boundaries and uniform in time by constructing higher order weighted functionals resolving the physical singularity near vacuum boundaries. The nonlinear asymptotic stability of the celebrated Barenblatt self-similar solution for compressible Euler equations with damping will be emphasized. The results presented are based on a joint work with Huihui Zeng.