The Hong Kong Mathematical Society
香港數學學會

2016 The Hong Kong Mathematical Society Plenary Lecture

On the Physical Vacuum of Compressible Fluids

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Abstract

Physical vacuum (also called physical vacuum singularity) that the sound speed is only $C^{1/2}$-Holder 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 and Navier-Stokes type equations near vacuum states so that the standard symmetrisation method developed by Friedrichs, Lax and Kato does not apply. In this lecture, I will first survey the progress in the local-in-time wellposedness theory, and then present the global-in-time regularity theory for the physical vacuum free boundary problems of compressible Euler equations with damping and Navier-Stokes-Possion equations of viscous gaseous stars. 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 with damping and the Lane-Emden solution for viscous gaseous stars will be emphasized. The results presented here include those joint with Zhouping Xin and Huihui Zeng.

Date: 21st May, 2016 Saturday
Time: 2:00 p.m. – 2:50 p.m.
Venue: P4, Chong Yuet Ming Physics Building, HKU

This event is co-organized with the Department of Mathematics, The University of Hong Kong

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