TRANSONIC SHOCK IN A NOZZLE

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(This is a joint work with Prof.Xin Zhouping)

In this talk, we are concerned with the problem on the existence, uniqueness and well-posedness of a solution with a transonic shock to the steady flow through a two-dimensional or three-dimensional nozzle with variable sections. Phenomena involving transonic flows and transonic flows with shocks are fundamental to the gas dynamics, and have been studied extensively in the literature. In particular, profound understanding has been achieved both physically and mathematically by Morawetz. Recently, some important wave patterns involving the transonic shock waves have also been treated for various models and geometries by S.Canic, Guiqiang Chen, Shuxing Chen, B.L.Keyfitz, E.H. Kim, Zheng Yuxi and so on.

In the book of Courant and Friedrichs, the following transonic phenomena in a nozzle is illustrated: Given the appropriately large receiver pressure p_r, if the upstream flow is still supersonic behind the throat of the nozzle, then at a certain place in the diverging part of the nozzle a shock front intervenes and the gas is compressed and slowed down to subsonic speed. The position and the strength of the shock front are automatically adjusted so that the end pressure at the exit becomes p_r. Motivated by the conjecture of Courant-Friedrichs, we will study the transonic shock problem under the conditions that the pressure at the exit is appropriately larger than that in the entry. We will show that the conjecture can not be true for the general given pressure at the exit, namely, the problem is ill-posed generally. But for a class of special pressures at the end, which are determined by the appropriate boundary conditions, we will prove that the transonic shock in a nozzle is stable.