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On the stability of swirling flows in a finite pipe SHIXIAO WANG, University of Auckland — We study the stability mechanism of the swirling flow in a finite pipe. We first revisited the Rayleigh's linear stability theory, and build up the nonlinear theory in the framework of Hamiltonian system. We then consider the Lamb-Oseen vortex in a finite pipe with fixed flowrate condition at the boundaries. By using recently developed perturbation method of the linear operators, we analyzed the global stability equation and found the disturbance flow fields. We then conducted a study of the kinetic energy transfer mechanism between the disturbance and the base flow by using the Reynolds-Orr equation. We found that the energy transfer takes place actively at the boundaries as well as inside the flow. This is contrast to the solid body rotation flow. We further investigated Lamb-Oseen vortex in a slightly divergent pipe and showed that the internal flow has a leading role in the energy transfer mechanism. This study clarifies the relation of the Rayleigh stability and the global stability found by Wang and Rusak, and provide a basic understanding of the stability mechanism of swirling flows in a finite pipe.

Shixiao Wang
University of Auckland

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