中国科学院数学与系统科学研究院

偏微分方程及其应用中心

学术报告

报告题目： **On the Sobolev stability threshold for 3D Navier-Stokes equations with rotation near the Couette flow**

报 告 人： 许孝精教授，北京师范大学

时　　间： 2025.02.19(周三)，上午 10:30--11:30

地　　点： **思源楼 803**

摘　　要：

In this talk, we investigate the dynamic stability of periodic, plane Couette flow in the three-dimensional Navier-Stokes equations with rotation at high Reynolds number $\mathbf{Re}$. Our aim is to determine the stability threshold index on $\mathbf{Re}$: the maximum range of perturbations within which the solution remains stable. Initially, we examine the linear stability effects of a linearized perturbed system. Comparing our results with those obtained by Bedrossian, Germain, and Masmoudi [Ann. Math. 185(2): 541 – 608 (2017)], we observe that mixing effects (which correspond to enhanced dissipation and inviscid damping) arise from Couette flow while Coriolis force acts as a restoring force inducing a dispersion mechanism for inertial waves that cancels out lift-up effects occurred at zero frequency velocity. This dispersion mechanism exhibits favorable algebraic decay properties distinct from those observed in classical 3D Navier-Stokes equations. Consequently, we demonstrate that if initial data satisfies $\left\|u_{\mathrm{in}}\right\|_{H^{\sigma}}<\delta \mathbf{Re}^{-1}$ for any $\sigma>\frac{9}{2}$ and some $\delta=\delta(\sigma)>0$ depending only on σ, then the solution to the 3D Navier-Stokes equations with rotation is global in time without transitioning away from Couette flow. In this sense, Coriolis force contributes as a factor enhancing fluid stability by improving its threshold from $\frac{3}{2}$ to 1. This is a joint work with Wenting Huang and Ying Sun.