Fluid & Bio Dynamics Seminar

MAX PLANCK INSTITUTE
FOR DYNAMICS AND
SELF-ORGANIZATION

Experimental investigations in high Reynolds number turbulent pipe flow

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Over the past quarter-century, research in wall-bounded turbulence has made tremendous progress, driven by experiments and numerical simulations at higher Reynolds numbers. However, this progress has deepened our understanding of wall-bounded turbulence, but at the same time, it has also raised many new questions. As John Kim noted in his review on pipe and channel flow: "Almost everything we thought we knew about wall-bounded turbulent flows, including the scaling laws that appear in textbooks, has been the subject of further scrutiny" (Kim, 2012, J. of Turbulence). One of the reasons for this uncertainty is undoubtedly the reliability of the data. Beyond achieving high Reynolds numbers, obtaining datasets are as close as possible to the true values remains a critical challenge today. To address this, we developed the experimental facility for high Reynolds number turbulent pipe flow, known as the High Reynolds Number Actual Flow Facility (Hi-Reff) over the past decade. This facility is uniquely designed for highly accurate flow rate measurements. Using this facility, we have conducted a series of experiment—including measurements of the friction factor, mean velocity, turbulence intensity profiles for all three velocity components, turbulent kinetic energy, and spectrum distributions—at Reynolds number up to Re=20000, with meticulous attention to accuracy.

In the seminar, I will present these results and compare them with previous research. While some findings in the present study align with the existing, others do not, and these comparisons alone will not fully resolve the questions posed by Kim. However, we believe that pursuing more reliable data through this process is a crucial step toward a solution. Based on our reliable experimental results, I will propose new scaling law for the universal mean velocity profile and self-similarity for the turbulence statistics.

Monday, May 26th, 2025 at 14:15
MPI-DS, Prandtl lecture hall and
Zoom ID 691 0007 9220, Passcode 856480

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