Colloquium

MAX PLANCK INSTITUTE
FOR DYNAMICS AND
SELF-ORGANIZATION

Ultimate turbulence

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We reconcile the various experimental observations for very large Rayleigh number Rayleigh-Bénard (RB) turbulence, where different effective scaling exponents γ in the relation $Nu \sim Ra^{\gamma}$ between the Nusselt number Nu and the Rayleigh number Ra have been observed. Here the analogy between RB flow and parallel flow along a flat plate is illuminating. In turbulent RB convection, the core part of the flow ("bulk") is always turbulent, while the kinetic boundary layers (BLs) can vary from scaling-wise laminar Prandtl-Blasius type boundary layer ("classical regime", $\gamma<1/3$) to fully turbulent Prandtl-von Karman type boundary layer, leading to an enhanced heat transport ("ultimate regime", $\gamma>1/3$). The nature of the transition may be of subcritical nature and be in analogy to the transition in parallel shear flow along a flat plate, which undergoes a transition between laminar and turbulent boundary layers that have different dependences of the skin friction coefficient on the Reynolds number. There is a similar analogy between RB flow and pipe and channel flows and Taylor-Couette flow.

Wednesday, November 1st, 2023 at 2:15 pm

MPI-DS Seminar room 0.77&0.79 and
Zoom Meeting ID: 959 2774 3389
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