Physical Mathematics Seminar

Spots Stripes and Turbulence:
Pattern-Formation in Shear Flows

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ABSTRACT:

Locally perturbing a parallel shear flow induces a spatially localized patch of turbulence that slowly invades the surrounding laminar flow. Though spatio-temporal patterns such as these 'turbulent spots' play a crucial role in transitional flows, the mechanism which gives rise to the observed localized structures is not well understood. I will present the first evidence that a well-developed theory of a localized pattern in simpler PDE models carries over to Navier-Stokes flow and allows to capture the observed patterns. Specifically, I will demonstrate the existence of a new class of exact equilibrium and traveling wave solutions to the full Navier-Stokes equations. Those solutions share the topology of periodic solutions previously shown to play key roles in the transition to turbulence and turbulent dynamics itself but are localized in space. Solutions of different size are organized in a snakes-and-ladders structure strikingly similar to that observed in simpler pattern-forming PDE systems. These localized solutions are a step towards extending the emerging dynamical systems view of transitional turbulence to spatially extended flows and uncovering the mechanisms underlying spatio-temporal turbulent patterns.

TUESDAY, FEBRUARY 22, 2011
2:30 PM
Building 2, Room 105

Refreshments at 3:30 PM in Building 2, Room 290

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