PHYSICAL MATHEMATICS SEMINAR

A general framework for modelling turbulent fluids

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ABSTRACT:

Despite significant advances over the past two centuries, a complete general mathematical framework for the turbulent motion of fluids has yet to be put forth, and remains the longest standing unsolved problem in classical physics. I will present such a framework, which is based on constructing the detailed equations of motion for a fluid's kinetic energy density from first principles. The approach departs from the usual Reynolds decomposition, and yields a set of closed and solvable equations. Within this prescription, the linear terms in the Navier-Stokes equations correspond to a symmetric matrix operator, and the nonlinear convective term enters as an anti-symmetric operator that provides coupling between eigenstates of the flow. In particular, I will present a derivation for the turbulent energy spectrum which includes the Kolmogorov energy cascade, elucidate the linear and nonlinear mechanisms for transitions to turbulence, and show a data collapse onto a single power law for a wide range of experimental measurements on the turbulent transition in pipe flow. Careful attention will be given to the physical picture and scaling, in addition to the rigorous mathematical program.

TUESDAY, SEPTEMBER 27, 2022
2:30 PM – 3:30 PM
Building 2, Room 449

http://math.mit.edu/seminars/pms/

ZOOM ***(and in person)***

https://mit.zoom.us/j/95597721876

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