Fluid & Bio Dynamics Seminar

MAX PLANCK INSTITUTE
FOR DYNAMICS AND
SELF-ORGANIZATION

Duality of Navier-Stokes to a one-dimensional system

Prof. Dr. Alexander Migdal

School of Mathematics
Institute for Advanced Study
Princeton, NJ, USA

The Navier–Stokes (NS) equations describe fluid dynamics through a high-dimensional, nonlinear partial differential equations (PDEs) system. Despite their fundamental importance, their behavior in turbulent regimes remains incompletely understood, and their global regularity is still an open problem. Here, we reformulate the NS equations as a nonlinear equation for the momentum loop $\boldsymbol{P}(\theta,t)$, effectively reducing the original three-dimensional PDE to a one-dimensional problem. A key result of this reformulation is the derivation of a *No Explosion Theorem*, establishing that finite-time singularities do not occur under stochastic initial conditions. We also present an explicit analytical solution - the Euler ensemble - which describes the universal asymptotic state of decaying turbulence and is supported by numerical simulations and experimental validation.

Monday, May 5th, 2025 at 14:15
MPI-DS, Prandtl lecture hall and
Zoom ID 691 0007 9220, Passcode 856480

Max Planck Institute for Dynamics and Self-Organization
Laboratory for Fluid Physics, Pattern Formation and Biocomplexity
Prof. Dr. Eberhard Bodenschatz, Dr. Taraprasad Bhowmick
Email: taraprasad.bhowmick@ds.mpg.de
Am Faßberg 17, 37077 Göttingen, Germany