Berlin Mathematics Research Center
MATH+

Berlin Mathematical School
BMS

MATH+ Friday Colloquium

Friday 26 June 2020 at 14:15

Welcome and organizational information 14:00

Online-Lecture

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Mathematics of Turbulent Flows: A Million-Dollar Problem!

Turbulence is a classical physical phenomenon that has been a great challenge to mathematicians, physicists, engineers and computational scientists. At the end of the last century, chaos theory was developed to explore similar phenomena that occur in a wide range of applied sciences, but the eyes have always been on the big ball – turbulence. Controlling and identifying the onset of turbulence can have a great economic and industrial impact ranging from reducing the drag on cars and airplanes to better design of fuel engines and predictions of weather and climate.

It is widely accepted by the scientific community that turbulent flows are governed by the Navier–Stokes equations for large Reynolds numbers – when the nonlinear advective effects dominate the linear viscous effects of internal friction. As such, the Navier–Stokes equations form the main building block in any fluid model, in particular in global climate models. Whether the solutions to the three-dimensional Navier–Stokes equations remain smooth, indefinitely in time, is one of the most challenging problems in mathematics. Indeed, it is one of the seven Millennium Problems for which the Clay Institute has offered million-dollar prizes.

Reliable computer simulations of turbulent flows are out of reach even for the most powerful supercomputers. This talk will describe, using layman's language, the main challenges that different scientific communities are facing while attempting to attack this problem, emphasizing the mathematical view of turbulence.

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