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I) **Stochastic transport equations and 2D Navier-Stokes equations with transport-type noise: introduction and preliminary rigorous results**

In this lecture we shall introduce the SPDEs that will constitute our main field of investigation, explain the role of Stratonovich operation and describe foundational results of well posedness.

II) **The limit to deterministic equations with enhanced dissipation**

In this lecture we shall take a special scaling limit of the noise and prove convergence to deterministic equations with enhanced dissipation. This fact provides a perspective on LES models and Boussinesq hypothesis on turbulent viscosity. We shall also illustrate how to accommodate models of Smagorinsky type in this framework.

III) **Application to enhanced aggregation by turbulence**

The rigorous theory of the previous lectures has also quantitative consequences of interest for certain applications. One of them is the role of turbulence in particle aggregation, like raindrop formation. We shall describe how to deduce formulae for the mean collision kernel as a function of the Stokes number and turbulent kinetic energy.

IV) **Results and perspectives in 3D**

The 3D theory is less mature but very interesting. In this case, random stretching plays a major role. We shall describe preliminary results in cases where such stretching is dropped or under control due to strong rotation. The results are of interest not only for the verification of Boussinesq hypothesis but also for regularization by noise in the direction of preventing blow-up.

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