Title: Turbulence.

Time lenght: 30h CM

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Objectives: the aim of the course is to provide a general presentation of turbulence theory from the point of view of statistical physics and notably in the framework of nonlinear physics.
In the first part, some examples will make clear the variety of phenomena which can be considered turbulent. The relation to dynamical systems and statistical mechanics concepts will be emphasised. The few exact results will be derived. The phenomenology will be presented in terms of scaling. In particular, the multifractal description of turbulence will be discussed.
In the second part of the course, some specific subjects of current research will dealt with, like wave turbulence, convection, magnetohydrodynamics and Lagrangian approach among others.
Basic notion of Fluid Mechanics and probability theory are required.

Contents:

- Introduction and examples
- Conserved quantities and symmetries
- Turbulence, dynamical systems and chaos
- Cascades and phenomenology of hydrodynamic turbulence
- Kolmogorov 1941 theory
- Vorticity dynamics and 2D turbulence
- Turbulence and statistical mechanics
- Intermittency and multifractal analysis
- Analysis of specific themes: Waves, Rotation, Lagrangian turbulence, MHD… (a choice will be made each year)

Bibliography:
Frisch, Turbulence, Cambridge
Landau & Lifschitz, Fluid Mechanics, Pergamon
Bohr, Jensen, Paladin, Vulpiani, Dynamical Systems Approach to Turbulence, Cambridge