Finite Dimensional Long-term Dynamics of Dissipative Evolution Equations and Their Reduction Methods

Edriss S. Titi
University of California, Irvine, USA
Weizmann Institute of Science, Israel

In this talk I will survey the mathematical theory of the long-term dynamics of nonlinear dissipative evolution equations. Such equations include, but are not limited to, the Navier-Stokes equations, Kuramoto-Sivashinsky equation, complex Ginzburg-Landau equation, reaction-difussion systems, and certain turbulence models (Smogarinsky model, the shell model, Navier-Stokes-alpha model, Clark model, Leray-alpha etc...). In particular, I will be discussing the theory of global attractors for these systems and estimating their finite dimensional fractal and Hausdorff dimensions. Furthermore, I will discuss the concepts of determining modes, nodes and other finite degrees of freedom. In addition, I will survey the theory of Inertial Manifolds, Approximate Inertial Manifolds, nonlinear Galerkin methods, Proper Orthogonal Decomposition (Karhunen Leove) and the Post-processing Galerkin method. I will also present some computational evidence supporting this theoretical study.