



WPI HAROLD J GAY LECTURE SERIES



PDEs and Fractals • Geometry with its applications has been at the heart of the development of partial differential equations and boundary value problems since the very beginning. In physics, biology, economics, and other applied fields, a variety of new problems are now emerging that display unusual geometrical, analytical and scaling features, possibly of fractal type. The objective of these lectures is to acquire the view of outstanding mathematicians on the subject of differential equations and fractals, and their developments and applications, in a broad perspective encompassing both classical highlights and contemporary trends.

Giovanni Gallavotti

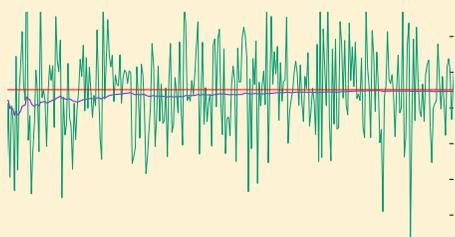
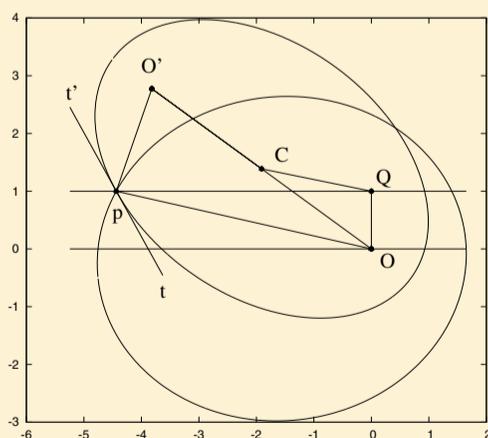
INFN and Professor Emeritus,
University of Rome La Sapienza, Italy

Entropy, Irreversibility and Probability in chaotic systems

Friday, April 12, 2019

4:00pm, Olin Hall 107

Irreversibility became central in thermodynamics with the problem of determining the maximum efficiency of a thermic machine and led to the II law of Thermodynamics which can be seen as the beginning of the theory of irreversibility dominated by the new physical quantity named Entropy. The immediately attempted interpretations of the II law as a consequence of the existence of atoms (still an hypothesis at the time) expose the apparently irreconcilable microscopic reversibility and macroscopic irreversibility: after Maxwell's derivation of the macroscopic dissipation equations from the molecular (reversible) motion and Boltzmann's H-theorem the basic ideas were slowly assimilated and accepted into a consistent thermodynamic theory of equilibrium states. • The closely related problem of a thermodynamic theory of stationary states out of equilibrium (like a steady flow of a fluid under constant forcing), in which dissipation plays a key role, did not go beyond the first order corrections to equilibrium thermodynamics, with the major development of Onsager's reciprocity of transport coefficients resting on microscopic reversibility. In the '60s chaotic notions (already known to play a key role in celestial mechanics since Poincaré) became essential and, therefore, objects of intense research, and in the '80s the simulations of microscopic evolutions gave new impulse to the theory and the problems of nonequilibrium thermodynamics and its statistical mechanics interpretation. • After a brief review of the early developments, the recent works on the irreversible chaotic evolutions will be described and, using as example the Navier-Stokes fluid equations, a close analogy between the statistical theory of equilibrium and a statistical theory of nonequilibrium will be discussed with particular attention to the mechanical interpretation of viscosity (or more generally friction) and its relation with chaotic evolutions.



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Refreshments available before the lecture • Participation of faculty and students is most welcome

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Poster Organization: Rhonda Podell