Institute Lecture

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Chaos and Determinisms: a two way road between Newton's laws and thermodynamics

@ 4.00 pm | Thursday, February 27, 2020

Venue: L 16 (LHC)

About the Talk

Determinism and chaos are two seemingly conflicting paradigms, which govern the laws of Nature. In physics, determinism is encoded in microscopic equations of motion predicting dynamics of particles at any moment from their initial conditions. At the same time laws of thermodynamics are based on probabilistic statistical ensembles. In the last century it was gradually realized that the two paradigms are not in conflict with each other. It is chaos, defined through extreme sensitivity of trajectories to perturbations, which leads to loss of determinism.

However, precise relation between chaos and ergodicity is still lacking. Recently it was Realized that quantum mechanics provides us with an elegant solution of this problem. Namely, it was found that stationary states of generic quantum systems are effectively described by random matrices leading to the powerful eigenstate thermalization hypothesis explaining thermalization. Interestingly the road between chaos and determinism is both ways. Chaos and following statistical mechanics is ultimately responsible for emergence of everyday forces like pressure and even inertia, which enter the deterministic equations of motion for macroscopic objects.

About the Speaker

Professor Anatoli Polkovnikov did his Ph. D in Yale University under Prof. Subir Sachdev. Following a post-doctoral fellowship with Profs. Mikhail Lukin and David Nelson at Harvard University, he joined Department of Physics, Boston University, where he is currently a professor. In recent years, Prof. Polkovnikov has made pioneering contributions to understanding various properties of interacting many-particle systems, especially when driven away from equilibrium. His research interest particularly focusses on representation of quantum dynamics through classical trajectories, understanding non-equilibrium thermodynamics from microscopics, universal aspects of dissipation for nearly adiabatic evolution, dynamics near phase transitions. His research also bridges a connection with experiments in cold atom systems. He has authored numerous highly cited papers and review articles and is recipient of many prestigious awards including Simons Fellowship in Theoretical Physics.

All are invited to attend

Dean of Research and Development