ICTS Seminar

Title : Fluids: Entropy, Eightfold way and Schwinger-Keldysh Effective theory

Speaker : Loganayagam R, Institute for Advanced Study, USA

Date : Friday, February 20, 2015

Time : 2:00 p.m.

Venue : ICTS Seminar Room, IISc Campus, Bangalore

Abstract : Hydrodynamics is the low-energy effective field theory of any interacting quantum theory, capturing the long-wavelength fluctuations of an equilibrium Gibbs density matrix. Conventionally, one views the effective dynamics in terms of the conserved currents, which should be expressed via the constitutive relations in terms of the fluid velocity and the intensive parameters such as the temperature, chemical potential, etc.. However, not all constitutive relations are acceptable; one has to ensure that the second law of thermodynamics is satisfied on all physical configurations.

In this talk, I will begin by describing the structure this second law constraint imposes at any order in the gradient expansion. The key new ingredient here is the notion of adiabaticity, which allows us to take hydrodynamics off-shell. Adiabatic fluids are such that off-shell dynamics of the fluid compensates for entropy production. The space of adiabatic transport is quite rich, and admits a decomposition into seven distinct classes. Together with the dissipative class this establishes the eightfold way of hydrodynamic transport.

Next, I will describe the construction of an effective field theory which naturally incorporates this adiabaticity structure. I will argue for a new symmetry principle, an Abelian gauge invariance that guarantees adiabaticity in hydrodynamics and relate it to the microscopic description in terms of Schwinger-Keldysh path integral. I will end with speculations on how these structures might show up in dual gravity.