RCNP, OSAKA UNIVERSITY
NUCLEAR PHYSICS
THEORY SEMINAR

Title: Quantum field theoretical approach to relativistic hydrodynamics

Speaker: Dr. Masaru Hongo (iTHEMS Program RIKEN)

Date and Time: Feb 27th (Wed.) in 2019
14:00-15:00,15:30-16:30

Place: Lecture room 1 on the 6th floor of RCNP main building

Abstract:

Hydrodynamics is a low-energy effective theory which describes a long-distance and long-time behavior of many-body systems. It is applicable not only to a non-relativistic weakly-interacting dilute gas but also a relativistic strongly-interacting dense liquid such as the quark-gluon plasma created in high-energy heavy-ion collision experiments. Although relativistic hydrodynamics itself is well-established formalism, its foundation from underlying microscopic theories (in particular, quantum field theories) remain s unclear. In this seminar, I will review recent developments for quantum field theoretical approaches to relativistic hydrodynamics. In the first part, we provide the field-theoretical derivation of the conventional (non-fluctuating) relativistic Navier-Stokes equation based on the recent development of non-equilibrium statistical mechanics [1]. We show that the procedure to derive hydrodynamic equations is similar to the so-called renormalized/optimized perturbation theory, and also give a path-integral formula for local thermal equilibrium which results in the emergence of thermally induced curved spacetime [2]. These results enables us to derive hydrodynamic equation based on quantum field theories. In the second part, we also introduce further developments related to fluctuating hydrodynamic: the Schwinger-Keldysh effective field theory for dissipative hydrodynamics [3], which is formulated in the similar manner with the chiral perturbation theory for low-energy QCD.

- References:
[1] T. Hayata, Y. Hidaka, M. Hongo, and T. Noumi, Phys. Rev. D 92, 065008 (2015).
[2] M. Hongo, Annals of Physics, 383, 1 (2017)
[3] M. Crossley, P. Glorioso, H. Liu, JHEP, 1709, 095, (2017)

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