Scientific report on the workshop "Relativistic Hydrodynamics: theory and modern applications"
MITP Mainz, October 10-14 2016

The workshop gathered about 30 theoretical physicists from different communities with a common interest in relativistic hydrodynamics, both as a theoretical topic and for its applications to relativistic heavy-ion collisions and astrophysics. It was the main goal of the workshop to get together experts with a different background to discuss about recent advances in the field, share knowledge, and find new directions of common interest. The participants contributed very actively to the workshop, enjoyed the discussions, and all were very happy to have taken part in it. We believe that the workshop has been overall very successful.

A series of talks was devoted to new theoretical developments related to the derivation of hydrodynamics as an effective theory for the long-wavelength, low-frequency dynamics of a given system. These addressed formal classification of hydrodynamical theories (Rangamani), model-independent derivation of magneto-hydrodynamics with polarization (Kovtun), as well as derivation of hydrodynamics from kinetic theory (Denicol, Jaiswal, Noronha), from a path-integral formulation (Hongo, Pinzani), and from a variational principle (Floerchinger). Aspects of hydrodynamics as an asymptotic series and its convergence were presented by Heller. Holographical theories and their hydrodynamical limit were discussed by Starinets. The choice of frame and its impact on the definition of temperature were topic of a talk by Becattini. The thermodynamic coefficients needed to describe relativistically rotating fluids were presented by Grossi. How to implement hydrodynamic noise in the hydrodynamic equations was demonstrated by Kapusta.

Hydrodynamics in systems with large anisotropies, so-called anisotropic hydrodynamics, is nowadays a hot candidate for describing the early-time dynamics of heavy-ion collisions. Theoretical aspects of deriving anisotropic hydrodynamics were presented by Florkowski, Rischke, Ryblewski, Strickland, and Tinti.

Widespread interest has been generated in the heavy-ion community by the observation that the anomalies of Quantum Chromodynamics, the fundamental theory of strongly interacting matter, can give rise to interesting collective effects (the chiral magnetic effect, chiral magnetic waves, etc.). The theory of so-called anomalous hydrodynamics and possible observable consequences in heavy-ion collisions were addressed by Hirono, Kharzeev, Mace, and Wang.

The most recent developments in applying hydrodynamics to the description of the collective dynamics of matter created in heavy-ion collisions were presented in talks by Heinz, Csernai, Niemi, and Schenke. Romatschke presented a critical appraisal of the conclusion that the system created in the relativistic nuclear collisions is a fluid, based on the success of hydrodynamics.

There was a very appreciated session about the application of relativistic hydrodynamics in astrophysics, with talks by Del Zanna and Rezzolla. An interesting new venue, adapting magneto-hydrodynamics as applied in astrophysical scenarios to heavy-ion collisions, was shown in the talk by Inghirami.

Finally, we would like to thank the MITP staff for the outstanding work which contributed decisively to the success of the workshop,

The organizing committee

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