Topical issue on relativistic hydro- and thermodynamics

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The editors of *The European Physical Journal A — Hadrons and Nuclei* feel that the journal can further serve the community by organizing from time to time a bundled publication of articles related to a subfield in research that addresses a given problem utilizing inter-related, still-developing methods and being in the forefront of interest while wondering or puzzling about the “why’s and how’s”. In such topical article collections, which are not connected to any conference, all contributions match one of our journal’s regular article types: either a full-length *Regular Article* with novel results (or, in its shorter form, a *Letter*) or a *Review Article* by experts in a well-defined subfield.

In the present case, although the option of giving a review of already published results was explicitly offered, two-thirds of all submitting authors decided to report on their newest research and the submitted manuscripts were accordingly handled as research papers during the editorial decision-making process. Both the invited submissions as well as the articles submitted in response to our open call for papers have been peer-reviewed following the usual standards of the journal. Many of the submissions are thus presented in revised versions for better clarity and increased scientific value. We would like to thank the referees, whose efforts made all this possible.

The subfield addressed in the present topical article collection is *Relativistic Hydrodynamics and Thermodynamics*. Related methods and new ideas are presented as applied to high-energy hadron physics from pp to AA heavy-ion collisions at the hadron, quark-gluon or parton level. They aim to describe experimentally observed spectra of particles or a theory intended to describe strongly coupled plasmas in a dual framework, *i.e.*, with weak coupling and perturbative means. Relativistic hydrodynamics is a subfield involving not only a number of fundamental physics issues but also essential methodological problems. It cannot be meaningfully addressed without a deeper understanding of fundamental statistical physics objectives, such as trying to construct universal descriptions of finite size deviations from the classical infinite reservoir picture (as non-extensive thermodynamics seeks to do), or such as incorporating the description of power law tails of momentum and energy distributions into the very models which serve as a basis for the hydrodynamical description.

In the following we will present this article collection in more detail and shall introduce first the *Review* papers: a survey by Cleymans and Worku of relativistic thermodynamics and its relevance in describing transverse momentum spectra in high-energy experiments is followed by a review on the consequences of fluctuations in the theoretical description and experimental observation of high-energy collisions, not restricted to the Gaussian approximation (Wilk and Włodarczyk). A beautifully elegant mathematical way to relate kinetic theory and hydrodynamics with the help of renormalization group techniques is then described in detail by Tsumura and Kunihiro. Further reviews deal with more specific core problems of relativistic hydrodynamics: Shear viscosity is revisited by Song and jet-quenching by Betz, and are both among the most important and interesting applications of theoretical concepts in this research field. Lastly, the review by Mota, Kodama, Souza and Takahashi addresses fundamental methodological questions in hydrodynamic modeling, in particular the question of coarse graining.

The *Regular* research articles, which present a number of novel findings and approaches, are opened by a letter-style contribution on the prospect of dealing with multi-component systems in relativistic hydrodynamics (El, Bouras, Wesp, Xu and Greiner). This is followed by theoretical considerations of matching conditions (Osada), higher moments of fluctuation (Wang, Csernai *et al.*) and iterative fluid dynamics (Wunderlich and Kämpfer). Developments on the 14-moment derivation from kinetic theory (Denicol, Molnár, Niemi and Rischke) and tackling the problem of new particle production during or towards the end of the fluid evolution (Huovinen and Petersen) are then addressed, as is the non-extensive approach to kinetic theory and hydrodynamics (Biró and Molnár). Exact analytic solutions (Csanád, Nagy and Lökös) and a study of the heat conduction-related Kelvin-Helmholtz instability (Awasthi, Asthana and Agrawal) round out this topical collection.

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Guest Editors