Symposium Strong-Interaction Matter under Extreme Conditions (SYEC)

jointly organized by
the Hadronic and Nuclear Physics Division (HK) and
the Gravitation and Relativity Division (GR)

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Among the fundamental forces of Nature it is the strong interaction that predominates the properties of matter at temperatures as extreme as they have prevailed during the first microseconds after the Big Bang. In astrophysics, the greatest extremes of temperature and density occur during neutron-star mergers. And in the laboratory, extremes of temperature and density can be generated and studied in heavy-ion collisions.

This symposium covers topics ranging from the underlying theory of strong-interaction matter, Quantum Chromodynamics, as studied with large-scale simulations, to the exploration of its properties with heavy-ion collision experiments in the laboratory, and from astrophysical observations in the Universe.

Overview of Invited Talks and Sessions

(Lecture hall HBR 14: HS 1)

Invited Talks

SYEC 1.1	Wed	9:00– 9:45	HBR 14: HS 1	**Strong-interaction Matter under Extreme Conditions: a Review** — •Guy D. Moore
SYEC 1.2	Wed	9:45–10:30	HBR 14: HS 1	**Theory of Strong-Interaction Matter** — •Gergely Endrodi
SYEC 2.1	Wed	11:00–11:45	HBR 14: HS 1	**Unravelling the phase structure of strong-interaction matter with high-energy heavy-ion experiments** — •Tetyana Galatyuk
SYEC 2.2	Wed	11:45–12:30	HBR 14: HS 1	**Neutron star mergers in numerical relativity** — •Masaru Shibata

Sessions

SYEC 1.1–1.2	Wed	9:00–10:30	HBR 14: HS 1	**Strong-Interaction Matter under Extreme Conditions I**
SYEC 2.1–2.2	Wed	11:00–12:30	HBR 14: HS 1	**Strong-Interaction Matter under Extreme Conditions II**

SYEC 1: Strong-Interaction Matter under Extreme Conditions I

Time: Wednesday 9:00–10:30 Location: HBR 14: HS 1

Invited Talk SYEC 1.1 Wed 9:00 HBR 14: HS 1
Strong-interaction Matter under Extreme Conditions: a Review — •Guy D. Moore — Institut für Kernphysik, TU Darmstadt, Darmstadt, Germany

I will give a brief review of the thermodynamics and dynamics of strongly interacting (QCD) matter at the extremes of temperature and density which can be achieved in relativistic heavy ion collisions and which occurred in the very early Universe and occur today in the most compact astrophysical bodies. I will discuss the phase diagram, what theoretical tools can be brought to bear on it, what regions are accessible experimentally, and what we do and don't know. I will also describe attempts to predict the nonequilibrium behavior of strong-interaction matter as observed in heavy ion collisions.

Invited Talk SYEC 1.2 Wed 9:45 HBR 14: HS 1
Theory of Strong-Interaction Matter — •Gergely Endrodi — Bielefeld University, Bielefeld, Germany

In this talk I will review the current status of selected topics at the forefront of lattice field theory research on QCD under extreme conditions. In particular, I will concentrate on observables relevant for the equilibrium description of strongly interacting matter, including the equation of state, the phase diagram, as well as anomalous transport phenomena. The extreme conditions to be discussed encompass high temperatures, nonzero quark densities as well as background electromagnetic fields. These act as relevant control parameters for several physical systems ranging from dense neutron stars through the early Universe to off-central heavy-ion collisions.

SYEC 2: Strong-Interaction Matter under Extreme Conditions II

Time: Wednesday 11:00–12:30 Location: HBR 14: HS 1

Invited Talk SYEC 2.1 Wed 11:00 HBR 14: HS 1
Unravelling the phase structure of strong-interaction matter with high-energy heavy-ion experiments — •Tetyana Galatyuk — Technische Universität Darmstadt — GSI, Darmstadt

Large efforts worldwide are being devoted to the study of nuclear matter far from its ground state. The goal of this endeavour is to understand the microscopic properties and the phase structure of strong-interaction matter, which is governed by the laws of Quantum Chromo Dynamics (QCD), by creating extreme states of matter in the laboratory. The measurement of a comprehensive set of diagnostic probes offers the possibility to find signatures of new phases of QCD matter, and to discover the conjectured first order deconfinement and chiral phase transition, and the critical endpoint. In this talk I will discuss relevant observables to study criticality, emissivity, vorticity and the equation-of-state of strong-interaction matter.

Invited Talk SYEC 2.2 Wed 11:45 HBR 14: HS 1
Neutron star mergers in numerical relativity — •Masaru Shibata — Am Mühlenberg 1, Potsdam-Golm 14476

Neutron star mergers are not only the sources of gravitational waves but also the engines of high-energy astrophysical phenomena such as gamma-ray bursts and kilonovae. They are also the promising sources for synthesizing heavy elements through the rapid neutron capture process. To theoretically investigate these aspects of the neutron star mergers, we have to perform a numerical simulation in which relevant physics – general relativity, magnetohydrodynamics, neutrino transport, equation of state for high density matter – are taken into account. In this talk, I will report our latest effort for such a simulation paying particular attention to the kilonovae and nucleosynthesis.