# Kolloquium

**Thema:** Quantum optics and information science in multi-dimensional photonics networks  

**Datum:** 14.10.19  

**Uhrzeit:** 16:15  

**Ort:** H6  

**Vortragender:** Prof. Dr. Christine Silberhorn  

Integrated Quantum Optics, Department Physics, Paderborn University  

Classical optical networks have been widely used to explore a broad range of transfer phenomena based on coherent interference of waves, which relate to different disciplines in physics, information science, and even biological systems. At the quantum level, the quantized nature of light, this means the existence of photons and entangled states, gives rise to genuine quantum effects that can appear completely counter-intuitive. Yet, to date, quantum network experiments typically still remain rather limited in terms of the number of photons, reconfigurability and, maybe most importantly, network size and dimensionality. Photonic quantum systems, which comprise multiple optical modes as well as highly non-classical and sophisticated quantum states of light, have been investigated intensively in various theoretical proposals over the last decades. However, their implementation requires advanced setups of high complexity, which poses a considerable challenge on the experimental side. The successful realization of controlled quantum network structures is key for many applications in quantum optics and quantum information science. Here we present three different approaches to overcome current limitations for the experimental implementation of multi-dimensional quantum networks: non-linear integrated quantum optics, pulsed temporal modes and time-multiplexing. We present their applications in the framework of today’s quantum technologies.

**Inhalt:**

**Ansprechpartner:** J. Schnack
Kolloquium Mathematische Physik

**Thema:** Relativistic hydrodynamics, heavy-ion collisions, dynamical black holes and resurgent series

**Datum:** 18.10.19

**Uhrzeit:** 16:15

**Ort:** V3-201

**Vortragender:** Michal P. Heller

Max-Planck-Institute for Gravitational Physics, Potsdam

The past 12 years has constituted the golden age for theoretical studies of relativistic hydrodynamics. The experimental motivation for these developments came from ultra-relativistic heavy-ion collision at RHIC and LHC accelerators in which the paradigm of strongly-interacting medium modelled hydrodynamically became the working horse for explaining the data. These experimental and phenomenological developments have come hand-in-hand with theoretical progress in understanding relativistic hydrodynamics as an effective description embedded in quantum field theory. In my colloquium I will review the line of thought based on AdS/CFT (holography), an approach to study strongly-coupled quantum field theories using gravitational techniques, focusing on understanding the limits of applicability of relativistic hydrodynamics in far-from-equilibrium quantum field theory. A beautiful spin-off of this analysis is understanding hydrodynamic gradient expansion as a part of a trans-series, which encodes, through resurgence, information about genuinely non-equilibrium excitations of a collective state of matter. Based on a series of works reviewed in arXiv:1610.02023 and arXiv:1707.02282, as well as some later / ongoing work.

**Ansprechpartner:** S. Schlichting

Seminar Hochenergiephysik

**Thema:** Does the chiral magnetic effect change the dynamic universality class in QCD?

**Datum:** 08.10.19
Beam-Energy-Scan Program has two important goals: one is the search for the anomaly-induced transport phenomena called the chiral magnetic effect (CME) and the other is the search for the QCD critical point between the hadron and quark-gluon plasma phases. Since dynamic critical phenomena generally depend on low-energy gapless modes, it is a priori nontrivial whether the collective gapless mode called the chiral magnetic wave stemming from the CME affects the dynamic universality class in QCD. To address this question, we study the dynamic critical phenomena near the second-order chiral phase transition in massless two-flavor QCD under an external magnetic field. By applying the dynamic renormalization-group analysis to the Langevin-type low-energy effective theory near the phase-transition temperature, we find that the inclusion of the CME qualitatively changes the dynamic universality class from model E to model A within the conventional classification by Hohenberg and Halperin.
Seminar Mathematische Physik

**Thema:** Critical behaviour and characteristic polynomials of non-Hermitian random matrices

**Datum:** 23.05.19

**Uhrzeit:** 16:15

**Ort:** D5-153

**Vortragender:** Nicholas Simm

University of Sussex

I will discuss some recent developments regarding the normal matrix model. In particular my interest will be in certain critical models where the limiting support of the eigenvalues can radically change its topology by slightly adjusting an external parameter. I will discuss how aspects of the model can be explicitly mapped to the study of expectations of characteristic polynomials of non-Hermitian random matrices (e.g. Ginibre or truncated unitary). Many of these averages are related to Painlevé transcendents, and by exploiting this, a precise and non-trivial asymptotic expansion of partition functions can be calculated in the critical models. This is joint work with Alfredo Deaño (University of Kent).

Ansprechpartner: Gernot Akemann

Seminar AG Zufallsmatrizen

**Thema:** Spectral radius of random matrices with independent entries

**Datum:** 23.10.19

**Uhrzeit:** 16:15

**Ort:** V3-201
Inhalt: We consider random $n \times n$ matrices $X$ with independent and centered entries and a general variance profile. We show that the spectral radius of $X$ converges with very high probability to the square root of the spectral radius of the variance matrix of $X$ when $n$ tends to infinity. We also establish the optimal rate of convergence, that is a new result even for general i.i.d. matrices beyond the explicitly solvable Gaussian cases. The main ingredient is the proof of the local inhomogeneous circular law [arXiv:1612.07776] at the spectral edge. This is joint work with László Erdős and Torben Krüger.

Ansprechpartner: Gernot Akemann