

## CONDENSED MATTER THEORY SEMINAR

Subject: **Full Counting Statistics of Electron Tunneling in Coulomb-Blockade Devices: Generalized Factorial Cumulants**

Speaker: **Prof. Dr. Jürgen König (Fakultät, Universität Duisburg-Essen and CENIDE)**

Date & time: **Friday, January 24<sup>th</sup>, 2020 at 3:15 p.m.**

Venue: **Seminar room 1.114**

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Tunneling of electrons into or out of Coulomb-blockade devices such as semiconductor quantum dots or metallic single-electron boxes is a stochastic process that gives rise to both thermal and shot noise. Recent progress in nanotechnology has made it possible to monitor the tunneling in and tunneling out events individually. This allows one to study the full counting statistics (FCS) of electron tunneling both in equilibrium and nonequilibrium and as a function of time. In this talk, we will show how the FCS can be used to acquire information about the system that is inaccessible from measuring the average transferred charge only. In particular, we will demonstrate how so-called generalized factorial cumulants indicate the presence of interaction [1]. In the limit of short measuring intervals, the factorial cumulants directly reveal correlated tunneling events of two electrons in Andreev-reflection processes [2]. They, furthermore, are suitable tools to detect violation of detailed balance in a stochastic system [3]. We also introduce the concept of inverse counting statistics [4] which seeks at identifying a stochastic system from a few measured factorial cumulants only. We show how coherent spin precession in a quantum-dot spin valve [5] or an attractive electron-electron interaction in a quantum dot [6] can be identified in the FCS. Finally, we present results of a recent experiment in which the analysis with the help of factorial cumulants gave access to the nonequilibrium dynamics of spin relaxation even in an equilibrium transport measurement.

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[2] P. Stegmann and J. König, Short-Time Counting Statistics of Charge Transfer in Coulomb-Blockade Systems, *Phys. Rev. B* 94, 125433 (2016).

[3] P. Stegmann and J. König, Violation of detailed balance for charge-transfer statistics in Coulomb-blockade systems, *Phys. Stat. Sol. B* 254, 1600507 (2017).

[4] P. Stegmann and J. König, Inverse Counting Statistics Based on Generalized Factorial Cumulants, *New J. Phys.* 19, 023018 (2017).

[5] P. Stegmann, J. König, and S. Weiss, Coherent dynamics in stochastic systems revealed by full counting statistics, *Phys. Rev. B* 98, 035409 (2018).

[6] E. Kleinherbers, P. Stegmann, and J. König, Revealing attractive electron-electron interaction in a quantum dot by full counting statistics, *New J. Phys.* 20, 073023 (2018).

[7] A. Kurzmann, P. Stegmann, J. Kerski, R. Schott, A. Ludwig, A.D. Wieck, J. König, A. Lorke, and M. Geller, Optical Detection of Single-Electron Tunneling into a Semiconductor Quantum Dot, *Phys. Rev. Lett.* 122, 247403 (2019).