# CESQ Colloquium

## Tuesday May 12 @ 3 PM

### Seminar Room, Centre Européen de Sciences Quantiques, Campus de Cronenbourg


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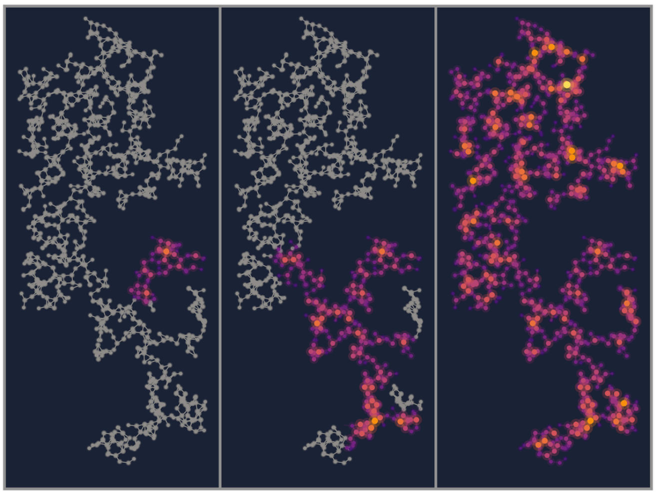
### RPTU Kaiserslautern


## *Classical and quantum contact processes using Rydberg facilitation*


Contact processes play an important role in classical non-equilibrium dynamics, describing the spreading of diseases, the dynamics of earthquakes and forest fires, and the distribution of information through the internet. One of their characteristic features is the competition between excitation spreading and dissipation, resulting in a non-equilibrium phase transition between an absorbing state and an active phase of permanent excitation spreading. Rydberg facilitation in a gas of laser-driven atoms is an ideal model system for studying such dynamics. I will show using large-scale numerical simulations and experimental results that the classical facilitation dynamics in a gas of atoms is very complex due to the effective network structure of ground-state atoms and the mo;on of the gas. This leads to different non-equilibrium universality classes and a phenomenon called self-organized criticality (SOC), where due to dissipation a many-body system drives itself to the critical point of the phase transition. I will then show that the quantum counterpart of a contact process, where the spreading occurs through coherent couplings, displays even richer dynamics and offers new means of control. E.g. a quantum contact process on a topologically non-trivial lattice can be confined to a protected subspace corresponding to either a single site or a fully excited lattice. Furthermore, excitation spreading can be controlled to occur in quantized steps and on demand when employing topological pumps.

Large-scale numerical simulations of contact processes are only possible in the classical regime. In order to take quantum effects in large spin systems into account, new approaches are needed. I will introduce a semiclassical phase-space method that allows to simulate systems of many spins including leading order quantum corrections.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