

## **Pattern formation, dynamical control and critical dynamics in ultracold atoms**

Prof. Dr. Ludwig Mathey

*Institut für Laserphysik, Universität Hamburg*

To illustrate the diversity of many-body dynamics I will present three recent studies on its implementation in cold-atom systems. Firstly, I will present our demonstration of pattern formation as a far-out-of-equilibrium phenomenon in condensates. The condensate is prepared in an optical lattice, which is then strongly tilted, triggering the emergence of a transient, ordered state. This transient state displays a stripe pattern that is not interpretable as an equilibrium density wave. Secondly, I will describe our proposal to detect and dynamically control the conductivity of a Josephson junction of coupled condensates. This proposal conceptualizes and condenses a key ingredient of our proposed mechanism of light-enhanced superconductivity in high- $T_c$  superconductors, to be implemented in cold atoms. Thirdly, I will discuss our recent demonstration of a dynamical Kosterlitz-Thouless transition in 2D Bose gases, and the understanding of this transition via a real-time renormalization approach.