

# Martin Lebrat

ETH Zürich

## Heat and spin transport through an atomic quantum point contact

**Abstract:** Quantum point contacts (QPC) refer to narrow constrictions connecting two large conducting regions, and are among the simplest mesoscopic devices whose transport properties are influenced by the quantum nature of matter. For example, the conductance of a QPC becomes quantized when its width is comparable to the de Broglie wavelength of the particles traversing it -- historically, electrons. The very same phenomenon can be observed with fermionic atoms, whose charge is neutral and whose effective spin can be encoded into different hyperfine states.

In this talk, we report on a few salient transport properties of lithium-6 atoms through a quantum point contact precisely defined by a set of optical potentials. The versatility of cold-atom techniques allows us to directly measure heat or spin currents, and to tune interatomic interactions. In a first experiment performed with a unitary Fermi gas close to the superfluid transition, we probe the thermoelectric effects induced by a temperature difference across the QPC. We show that the system evolves towards a non-equilibrium steady state, associated with a reduced heat diffusion and a strong violation of the Wiedemann-Franz law. In a second experiment performed with weakly interacting atoms, we locally lift the spin degeneracy of atoms inside the QPC using an optical tweezer tuned very close to atomic resonance. We observe quantized, spin-polarized transport that is robust to dissipation and sensitive to interaction effects on the scale of the Fermi length. These results open the way to the quantum simulation of efficient thermoelectric and spintronic devices with cold atoms.