

## **Exploring quantum matter using cavity quantum electrodynamics**

Prof. Dr. Jean-Philippe Brantut

*EPFL, Switzerland*

Cavity quantum electrodynamics (QED) is one of the most powerful frameworks to observe and leverage quantum phenomena. While it has been thoroughly studied for simple quantum systems such as two-level systems or harmonic oscillators, it has only recently become available for complex, correlated quantum many-body systems. In the last five years, we have developed systems combining cavity QED with Fermi gases. In this talk, I will describe several intriguing consequences of the interplay of strong atom-atom and strong light-matter coupling, such as the onset of coherent excitations mixing Fermion-pairs and photons, pair-polaritons or the coupling of density fluctuations with light. I will then present the use of the cavity to induce long-range interactions in a strongly-interacting Fermi gas, leading to density-wave order, a system of direct relevance to condensed matter physics. Last, I will outline the perspectives open by cavity QED for quantum simulation in general, and our approach to control the spatial structure of light-matter interactions.