

Ultra-cold atoms in sub-wavelength potentials.

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In this talk I will present a new ongoing project that aims at manipulating ultra cold atoms in nano-structured periodic optical potentials. Cold atoms in optical lattices have proven to be excellent candidates to simulate both the Bose and Fermi Hubbard models and brought to the forefront the topics of quantum simulators [1] that are now extensively studied. The ability to simulate with cold atoms the electronic conduction of graphene [2] or the properties of two dimensional electron gas is an exciting perspective. In this context, we are developing a new, original and challenging hybrid quantum system made of cold fermionic atoms and surface plasmons that will allow to manipulate ultra-cold atoms in sub-wavelength lattice potentials [3]. In this presentation, I will emphasize on the novelty and perspectives of our work.

[1] I. Bloch, J. Dalibard and S. Nascimbène. *Nat. Phys.* **8**, 267 (2012).

[2] T. Uehlinger. *et al.*, *Phys. Rev. Lett.* **111**, 185307 (2013).

[3] M. Gullans *et al.*, *Phys. Rev. Lett.* **109**, 235309 (2012).