



Contribution ID: 109

Type: **Orale**

## Observation of ultrastrong spin-motion coupling in nanofiber-based optical traps.

Friday, 12 July 2019 09:00 (15 minutes)

Optical nanofibers have proven as versatile light-matter interfaces. Atoms can be trapped close to the nanofiber surface using the evanescent part of light fields propagating in the fiber [Fig.(a)]. Due to the wavelength-scale confinement, these light fields can show strong polarization gradients. Atoms then experience strong gradients of the vector ac Stark shift, which act as a spatially varying fictitious magnetic field [Fig.(b)]. The fictitious field gradients result in a coupling between the atoms' motion and spin, which is formally equivalent to the atom-photon coupling encountered in cavity QED [1].

We take advantage of this spin-motion coupling to manipulate cold cesium atoms in a nanofiber-based optical trap. First, we harness the spin-motion coupling to perform degenerate Raman Cooling [2]. The final temperature of the atoms can be inferred from a fluorescence spectroscopy measurement, and indicates cooling close to motional ground state. The detuning of the spin-motion coupling mechanism can be set by changing an offset magnetic field. When recording spectra across the spin-motion resonance [Fig.(c)], avoided crossings are clearly apparent. A fit on experimental data yields coupling strengths which are a significant fraction of the mode (trap) frequency, which sets our system clearly in the ultra-strong coupling regime [3].

Indico rendering error

Could not include image: Problem downloading image (<https://bit.ly/2TUqGqX>)

[1] Schneeweiss et al., PRA 98, 021801(R)

[2] Meng et al., PRX 8, 031054

[3] Dureau et al., PRL 121, 253603

### Choix de session parallèle

6.3 Nanofibre optique: une nouvelle plateforme pour l'optique et l'information quantique

**Primary authors:** DAREAU, Alexandre (Laboratoire Charles Fabry, Institut d'Optique Graduate School, CNRS, Université Paris-Saclay, 91127 Palaiseau cedex, France); MENG, Yijian (Vienna Center for Quantum Science and Technology, TU Wien - Atominstitut, Stadionallee 2, 1020 Vienna, Austria); SCHNEEWEISS, Philipp (Vienna Center for Quantum Science and Technology, TU Wien - Atominstitut, Stadionallee 2, 1020 Vienna, Austria); RAUSCHENBEUTEL, Arno (Department of Physics, Humboldt-Universität zu Berlin, 10099 Berlin, Germany)

**Presenter:** DAREAU, Alexandre (Laboratoire Charles Fabry, Institut d'Optique Graduate School, CNRS, Université Paris-Saclay, 91127 Palaiseau cedex, France)

**Session Classification:** Séance Parallèle