Contribution ID: **824** Type: **Invited Speaker / Conférencier invité**

Nanophotonic Optomechanics in Diamond

Thursday 18 June 2015 09:45 (30 minutes)

Single crystal diamond is a desirable material for use in nanophotonics and optomechanics thanks to its well known excellent optical and mechanical properties. However, one can argue that diamond's most compelling characteristic its ability to host color center defects, such as the nitrogen vacancy, whose spin can be used to store and manipulate quantum information. These "artificial atoms" can be controlled optically, as well as mechanically through local stress fields.

We have developed single crystal diamond optomechanical devices which allow optical coupling to ultrahigh quality factor (720 000) mechanical resonances with a sensitivity approaching the standard quantum limit. Using this optomechanical interface, we have excited nanomechanical self-oscillations, and have demonstrated optical cooling to sub-Kelvin temperatures. Our presentation will review this work, and discuss efforts to couple optomechanical excitations to single spin in diamond.

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Session Classification: R1-1 Optomechanics – minisymposium I (DCMMP-DAMOPC) / Optomécanique – minisymposium I (DPMCM-DPAMPC)

Track Classification: Condensed Matter and Materials Physics / Physique de la matière condensée et matériaux (DCMMP-DPMCM)