Scientific Area	Quantum sensing
Topic title	Quantum calorimetry and sensing in the levitated regime
Main host institution	University of Strasbourg http://www.unistra.fr
Supervisor/institution	GENET Cyriaque, CNRS research director CESQ-ISIS – Light-Matter Interactions in Complex Systems laboratory https://nano.isis.unistra.fr/limacs/
Co-Supervisor/institution	Anja Metelmann / Karlsruhe Institute of Technology: https://www.ksop.kit.edu/principal_investigators_professors_6499.php
Mentor[1]/institution	TBC
Secondment institution	TBC

Topic description

Quantum calorimetry and sensing in the levitated regime

The proposed project employs an optomechanical platform of levitated nanoparticles of a special kind: molecular crystal lanthanide complexes (based on Yb^{3+}, e.g.). Up-conversion processes can be induced on such systems (local expertise in Strasbourg) acting as true nano-cryostats. We propose to combine the cooling of the internal degrees of freedom via up-fluorescence with the cooling of the center of mass motion of the nanocrystals (levitation regime). We will thus prepare levitated nano-cryostats on which internal and external energy levels can be coupled to each other, with new opportunities for low-temperature, high-resolution nanocrystals spectroscopy. In addition, this cryogenic cooling will yield long spin coherence times that will be interesting to exploit in the context of quantum sensing (magnetometry, e.g.) and weak force measurements (such as quantum vacuum fluctuations Casimir forces).

Recommended applicant's profile

The applicant must hold a Master degree in Physics with a solid background in classical and quantum optics, statistical physics, quantum fluctuations, quantum measurement theory. A strong aptitude for experimental physics is also demanded. The applicant should also be open-minded towards inter-disciplinarity and should enjoy team working. She/he will fully participate to the research life of the laboratory. An interest in teaching and mentoring younger lab internship students will be more than welcome.

[1] Mentor: The primary role of the mentors will be to identify and facilitate specific training objectives, advise on any problems faced by the DC, including career matters with an external perspective and provide mediation in the case of disputes.

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