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Nanoscale scanning probe magnetometer with a single NV center

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Abstract

The ability to map magnetic field distributions with high sensitivity and nanoscale resolution is of crucial importance for fundamental studies ranging from material science to biology, as well as for the development of new applications in spintronics and quantum technology. In that context, an ideal scanning probe magnetometer should provide quantitative magnetic field mapping at the nanoscale under ambient conditions. In addition, the magnetic sensor should not introduce a significant magnetic perturbation of the probed sample.

In this talk I will present the main results we obtained developing a magnetic sensing device based on optically detected electron spin resonance (ESR) of a single nitrogen-vacancy (NV) defect in a small nanodiamond. I will show that this magnetometer provides an unprecedented combination of spatial resolution and magnetic sensitivity under ambient conditions. The principle of the measurement is similar to the one used in optical magnetometers based on the precession of spin-polarized atomic gases. The applied magnetic field is evaluated by measuring the Zeeman shifts of the NV defect spin sublevels. The spatial resolution of such magnetometer is fundamentally limited by the size of the NV center's electron spin wave function (< 1 nm).

The speaker

Piernicola Spinicelli graduated at the University of Florence. He became PhD at the *Université Paris Diderot* and *Laboratoire Kastler Brossel (LKB)* in Paris with a thesis on the control of quantum properties of colloidal quantum dots. He started a postdoctoral fellowship at the *Ecole Normale Supérieure* in Cachan following several projects focused on the use of NV-centers for quantum information and magnetometry. He is actually postdoctoral fellow at the *Ecole Supérieure de Physique et Chimie Industrielle (ESPCI)* in Paris, working on nanoplasmonics with quantum dots.