COLLOQUE DE PHYSIQUE

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«Nanoscale quantum sensing with single spins in diamond»

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Quantum two-level systems offer attractive opportunities for sensing and imaging – especially at the nanoscale. In the almost twenty years since its inception, this idea [1] has advanced from proof of concept [2] to a mature quantum technology [3], with broad field of applications in physics, materials engineering, life-sciences, and beyond.

In this talk, I will present the founding principles and key engineering challenges in the field [3] and highlight particularly rewarding applications of single quantum sensors. A special focus will lie on new insights, these sensors bring to mesoscopic condensed-matter physics. Specifically, I will discuss the use of single-spin quantum sensors to study antiferromagnets [4] and atomically thin “van der Waals” magnets [5,6]– two classes of magnetically ordered systems which combine fundamental and practical interests, and which so far were notoriously hard to address due to their weak magnetisation and nanoscale spin-textures.

I will conclude with an outlook on future developments of quantum sensors, including integrated, portable devices, and quantum sensors operating under extreme conditions, such as high magnetic fields, or millikelvin temperatures, where new exciting applications wait to be explored.

[1] B. Chernobrod and G. Berman, J. of Applied Physics 97, 014903
[2] G. Balasubmaranian et al., Nature 455, 644
[3] P. Appel et al., Rev. Sci. Instr. 87, 063703; N. Hedrich et al. Phys. Rev. App., 14, 064007; www.qnami.ch
[4] N. Hedrich et al., Nature Physics 17, 574
[5] M. Gibertini et al., Nature Nanotechnology 14, 408
[6] L. Thiel et al., Science 364, 973.