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Defects in diamond: Quantum computing and atomic magnetometry

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Owing to their remarkable stability, colour centers in diamond have already found an application in quantum cryptography. In this talk I will discuss recent progress regarding spin-based quantum information processing and atomic magnetometry. In particular, it is possible to place single impurity atoms into isotopically modified diamond with high degree of control²³. We demonstrate the generation and precise tomography of bi- and tripartite nuclear and electron nuclear spin entanglement, for the first time in solid state system⁴. It proves that the quality of entanglement is excellent fostering their potential use in quantum applications like quantum teleportation protocols. We show that scalable quantum logic elements can be realized by exploring long range magnetic dipolar coupling between individually addressable single electron spins⁵. Furthermore, we experimentally demonstrate an ideal quantum non-demolition measurement of the nitrogen nuclear spin associated with nitrogen-vacancy centre.

¹In collaboration with Fedor Jelezko, Univ. of Stuttgart.

²G. Balasubramanian et al., Nat Mater 8, 383 (May, 2009).

³N. Mizuochi et al., Phys. Rev. B 80, 041201(R), (2009).

⁴P. Neumann et al., Science 320, 1326 (Jun 6, 2008).

⁵P. e. a. Neumann, Nature Physics, in press, (2010).