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Research Project

Quantum sensing and imaging of core-shell magnetic nanotubes

Third-party funded project

Project title Quantum sensing and imaging of core-shell magnetic nanotubes

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Organisation / Research unit

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Nanoscale magnetic structures with non-trivial spin-textures are of great practical interest for applications in compact classical data storage or in quantum-technologies such as spin-qubits or quantum sensors. Recent cantilever and nanoSQUID magnetometry experiments on ferromagnetic nanotubes (NTs) carried out by the Poggio group suggest the existence of non-trivial magnetic vortex states. Despite their potential usefulness, these magnetic configurations remain underexplored due to limitations in conventional sensing and imaging approaches. Here, we propose to gain further insight into these nanometer-scale magnetic structures using scanning quantum sensors based on nitrogen vacancy (NV) centers in diamond recently developed in the Maletinsky lab⁴. On the one hand, our study will benchmark these quantum sensing tools against state-of-the-art, classical imaging approaches. On the other hand, the experiments will shed new light on magnetic configurations and reversal in nanometer-scale magnets. These insights may, in turn, have an impact on quantum-technologies, either in the application of strong nanomagnets for spin-manipulation and magnetic resonance force microscopy, or in the resonant enhancement of weak magnetic fields for quantum sensing.

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Published results

3891184, Wyss, M.; Mehlin, A.; Gross, B.; Buchter, A.; Farhan, A.; Buzzi, M.; Kleibert, A.; Tutuncuoglu, G.; Heimbach, F.; Fontcuberta i Morral, A.; Grundler, D.; Poggio, M., Imaging magnetic vortex configurations in ferromagnetic nanotubes, 2469-9950 ; 2469-9969, Physical Review B, Publication: JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

4474120, Vasyukov, Denis; Ceccarelli, Lorenzo; Wyss, Marcus; Gross, Boris; Schwarb, Alexander; Mehlin, Andrea; Rossi, Nicola; Tütüncüoglu, Gözde; Heimbach, Florian; Zamani, Reza; Kovács, Andras; Fontcuberta i Morral, Anna; Grundler, Dirk; Poggio, Martino, Imaging Stray Magnetic Field of Individual Ferromagnetic Nanotubes, 1530-6984 ; 1530-6992, Nano Letters, Publication: JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

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