Integrative Research Institute for the Sciences

and the Department of Physics

Seminar Announcement

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Lecture on

„Colour Centres in Diamond for Quantum Technologies: Past, Present & Future”

Time:	Friday, February 1, 2019, 3.00 pm
Location:	IRIS-Building, Seminar Room 007, Zum Großen Windkanal 6, 12489 Berlin

Interested persons are warmly invited.

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Colour Centres in Diamond for Quantum Technologies: Past, Present & Future

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Over the past decade colour centres in diamond have proven to be a valuable platform for quantum information processing and storage as well as quantum sensing applications, with the well-known nitrogen vacancy centre (NV) still spearheading the field. In recent years the negatively charged silicon vacancy centre (SiV) has emerged as a promising alternative to the NV for QIP applications, offering excellent optical properties with a dominant zero-phonon line as well as narrow inhomogeneous emitter distributions, enabled by the centre's inversion symmetry.

In combination with its large ground and excited state level splitting, this provides excellent separation of optical fine-structure components and sub-10-GHz inhomogeneous linewidths, even in dense ensembles, outperforming all other solid-state systems such as rare-earth-doped crystals. This unique feature allows for fundamental studies and applications in the fields of strong coherent light-matter interactions and single-photon nonlinearities, which so far have been reserved for systems such as single atoms coupled to optical cavities, ultracold Rydberg atoms, or cold as well as hot atomic vapours. In this talk, after reviewing the SiVs electronic structure and spin coherence properties at liquid helium as well millikelvin temperatures [1-3], I will present our recent work demonstrating resonant coherent manipulation, stimulated Raman adiabatic passage, and strong light-matter interaction via the four-wave mixing in such a dense ensemble of SiV centres using picosecond laser pulses [4]. These experiments pave the way for a number of optical quantum technologies requiring strong light-matter interactions such as broadband quantum memories or deterministic two-photon gates.

However, the SiV faces diametrically opposed challenges to the ones of the NV, offering excellent optical properties but lacking electron spin coherence at liquid helium temperatures or even in the millikelvin regime for non-ultrapure samples. Therefore, significant effort is currently made to identify new colour centres with further optimized properties, combining the strengths of the NV and SiV. In this context I will present our current spectroscopic work on one of the candidates, the SiV-homologue tin vacancy center (SnV) [5] and, to conclude, a group theoretical study pointing towards nickel vacancy centres as another promising class of defects for future experimental work.

References

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