Hybrid quantum sensing

By
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Abstract

The ability to measure weak signals such as pressure, force, electric field and temperature with nanoscale devices and high spatial resolution offers a wide range of applications in fundamental and applied sciences. Quantum enhanced sensing provides a powerful tool for the precise measurement of these physical parameters. Hybrid sensors may provide unique advantages arising from different systems and thus provide superior performance.

In this talk, I will first present the construction of a hybrid classical-quantum sensor using color centers in diamond and piezoactive elements for the transduction and measurement of weak physical signals. Our theoretical analysis shows that this hybrid device can achieve significant improvements in sensitivity over the pure diamond-based approach in combination with nanometre-scale spatial resolution. Second, we propose a paradigm of adiabatic quantum parameter amplification which leads a quantum-quantum hybrid sensor to overcome the limitation of noise and decoherence on the achievable sensitivity. We demonstrate that it allows to achieve generic robust quantum sensing, namely it is robust against noise that may even acting on the same degree of freedom as the field. Furthermore, the proposal achieves entanglement-free Heisenberg limit sensitivity that surpasses the limit of classical statistics.


Short Biography

Dr. Jianming Cai is a physicist working in the field of quantum sensing and quantum technology, mainly focusing on solid state quantum spin system. He is a Professor in the School of Physics at Huazhong University of Science and Technology, Wuhan, China.

He completed his PhD degree from University of Science and Technology of China in 2007. He worked as Postdoctoral Fellow (2007-2011) at the Institute of Quantum Optics and Quantum Information, Innsbruck Austria. From 2011-2014, he was working in Prof. Martin B. Plenio’s group at Ulm University Germany as Marie-Curie IEF fellow. In 2014, he was appointed as Professor at Physics at Huazhong University of Science and Technology, Wuhan, China., where he runs Quantum Physics and Quantum Technology research group.