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Quantum sensing: the promise, the challenge, and the path ahead

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Abstract

With the promise of improved accuracy, stability, sensitivity, and smaller size, quantum sensors have the potential for significant advantages over traditional technologies. Achieving these ends requires overcoming non-trivial challenges including maintaining the delicate quantum state, operating in realistic noise environments, and developing practical, extensible technologies.

I will give an overview of our quantum technologies, highlighting quantum sensing with solid state systems. Spin defects in solids, such as the nitrogen-vacancy color center in diamond, can be initialized into pure quantum states, can be coherently controlled, and can have relatively long-lived quantum coherence at room temperature. The semiconductor-like platform has advantages through manufacturability and the intrinsic vector nature of the sensors. Bringing devices to fruition requires outperforming established technologies. Despite comparable theoretical sensitivity limits to atomic and superconducting systems, the performance of solid-state quantum sensors to date has lagged behind these more mature alternatives.

We combine tailored diamond growth and quantum control together with classical engineering to create fieldable magnetometers, which outperform competitive technologies.