A New Generation of Nitrogen-Vacancy Center Experiments for Correlated Sensing

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Quantum sensing with point defects in crystals, such as the nitrogen-vacancy (NV) center in diamond, has become a powerful tool with diverse applications across the sciences. NV sensing techniques usually resolve target signals by averaging over many measurements made either across time with a single NV center, or across space with ensembles of NV centers. As an alternative sensing modality, correlated sensing instead examines the shot-to-shot correlations between measurements conducted simultaneously on several individual quantum sensors. Correlated sensing reveals the spatial structure of a target signal, and thereby provides unique insights into the target signal's source. Recent works demonstrating correlated sensing with NV centers have however only conducted simultaneous measurements on up to three NV centers. In this talk I describe a new apparatus for performing simultaneous measurements on many NV centers, and I present experimental data showcasing the apparatus in action with over a dozen NV centers. I show that we can resolve correlations in the spin states between pairs of NV centers, and I set out a path towards further scaling up this approach to ∼100 NV centers. Finally, I discuss potential applications of this technique, with a focus on sensing correlated signals from condensed matter systems.