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Characterization of Color Centers in diamond for quantum sensing

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Nitrogen-vacancy (NV) centers diamond are versatile quantum systems that combine single photon emission and spin-dependent fluorescence. These properties have made NV centers central in advancements in quantum information and quantum sensing. In particular, NV-based magnetometry leverages the Zeeman Effect to achieve high spatial resolution and sensitivity through the detection of fluorescence. Furthermore, the chemical inertness and biocompatibility of diamonds makes the NV-based magnetometer an ideal sensor for both non-biological and biological sensing applications.

Recently **femtosecond lasers** have emerged as a promising tool for creating NV centers in diamond. This project aims to investigate the quality of NV centers produced by illuminating diamond with a 515 nm laser, exploring the impact of laser parameters during both defect creation and the subsequent annealing process. Comparisons may also be made with NV centers fabricated using **focused ion beam** and **high temperature irradiation** techniques.

The characterization will focus on the fluorescence properties of NV centers under varying fabrication conditions. Techniques will include **hyperspectral confocal microscopy** for wavelength-resolved studies, **fluorescence lifetime imaging microscopy** (FLIM) for temporal analysis

Moreover, **Optically Detected Magnetic Resonance** (ODMR) experiments shall be performed to assess their magnetic field sensing capabilities. The magnetic sensitivity of NV centers will be quantified, and the most sensitive configurations will be tested in a proof-of-concept application.

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