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Nanodiamonds with Group IV color centers with tunable emission for Quantum applications

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Color centers have become a hot topic in recent times for their potential applications in quantum technologies particularly in the context of realizing quantum networks. Employing a scheme that relies on the coupling between single photons and atom-like transitions among spin states in a diamond colour center, it is possible to exploit both the strong coherence properties of photons and the easy control of spin states within the colour centers. In this work, we seek to ascertain the feasibility of using single photons from germanium vacancy (GeV) and Silicon vacancy (SiV) centers located within nanodiamonds, as the basis for a quantum network. The advantage of using nanodiamond-based GeV centers lies in the ease of photon extraction along with the ability to control the colour center more easily through external fields without sacrificing spectral purity. The superior conversion rate of GeV and SiV centres compared to nitrogen vacancy centres is also a strong point, as well as the larger splitting of the spin levels compared to silicon vacancy centres, which makes control of the spin qubit easier. The project will involve selection of ideal nanodiamonds through the characterization of optical properties such as photoluminescence and second order correlation. We will examine the scope of a novel wavelength tuning strategy involving piezoelectric ZnO coatings. We are also part of a few collaborations; Single photons from Silicon vacancies or Quantum dots will be used to develop quantum memristors with colleagues from University of Trento, Time tagging data from single photon sources will be used to assess randomness of photon arrival times with a collaborator at Dublin city university, the effect of a magnetic ion on Nitrogen vacancy centers in bulk diamond will also be studied and other collaborations within L2n are also ongoing.

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