Diamond light matter quantum interface

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Applications in quantum communications require the ability to connect the state of long-living matter qubits to optical photons for generation of entanglement over long distances. Here we discuss a novel quantum interface connecting quantum states of optical photons and spins in diamond. Among many colour centres in diamond, the negatively charged silicon-vacancy (SiV) and germanium-vacancy (GeV) centre stand out due to its desirable optical properties. In particular, near transform-limited photons can be created with high efficiency due to the strong zero-phonon line emission that constitutes~70% of the total emission. SiV and GeV centers can also be created with a narrow inhomogeneous distribution that is comparable to the transform limited optical line width. These optical properties, due to the inversion symmetry of the system, which suppresses effects of spectral diffusion, recently enabled demonstration of two-photon interference from separated emitters that is a key requirement for many quantum information processing protocols. Interfacing coherent optical transitions with long-lived spin qubits will be the main topic of this talk. Prospects for realizing coherent quantum registers based on optically controlled GeV centers will be discussed