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Characterization of the Si:Se+ spin-photon interface

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Ionized chalcogen donors in silicon, such as S+, Se+, and Te+, offer excellent spin qubit properties on par with the commonly studied group V hydrogenic "shallow"donors such as phosphorus. These deep chalcogen donors have the additional advantage of spin-selective, mid-infrared optical access to their lowest excited valley-orbit states. By coupling this optical transition to silicon photonic cavities this provides a natural means of connecting qubits within a cavity-QED architecture. Here we characterize key features of this optical transition in Si:Se+, including the transition dipole moment, radiative efficiency, phonon sideband, and orbital excited state lifetime. These results inform the viability of Si:Se+ as a spin-photon interface within a silicon photonics quantum platform.

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