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Investigation of radiation damage centers in highly isotopically enriched silicon-28 as potential single spin qubits accessible via spin/photon coupling

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The remarkable optical properties of highly isotopically enriched silicon-28, resulting from the near-elimination of inhomogeneous broadening mechanisms, has led to the optical control and measurement of the electronic and nuclear spins of ensembles of shallow donor impurities, resulting in some record solid state coherence times. [1.2] These optical transition unfortunately have too low a dipole moment and emission efficiency to allow for single spin readout using cavity QED. A different, deep donor, transition has been proposed for enabling a cavity QED based spin/photon platform using integrated silicon photonics, but it has the disadvantage of operating at the rather difficult wavelength of 2.9 microns. [3] Our recent discovery that well-known silicon radiation damage centers have remarkably narrow linewidths in silicon-28 [4] led us to investigate these centers as possible spin qubits. Some of these centers have the advantage of optical transitions in the 1.3 to 1.6 micron telecom bands. I will describe our recent unpublished results for one center which has long electron and nuclear spin coherence times, good emission efficiency, and an oscillator strength which should allow spin/photon coupling using cavity QED in an integrated silicon photonics platform.

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