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Electrical Manipulation of Nuclear Spins in Silicon

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The spin degree of freedom for donor nuclei in silicon have exceptionally long coherence times making them useful as either quantum bits (qubits) or long-lived quantum memories. Nuclear spins are hard to control in nanoscale devices since they are thought to only be coherently manipulated using magnetic fields, which are hard to confine. In this collaboration, researchers in IRG3 identify two new physical mechanisms that allow for manipulation of nuclear spins using only *electric* fields. They demonstrate for the first time all-electric control of nuclear spins in silicon, thus enabling new paths towards scalable quantum computing based on ultra-coherent donor nuclear spins in silicon.

1. A.J. Sigillito, *et al.,* "Electrically driving nuclear spin qubits with microwave photonic bandgap resonators." arXiv:1701.06650.

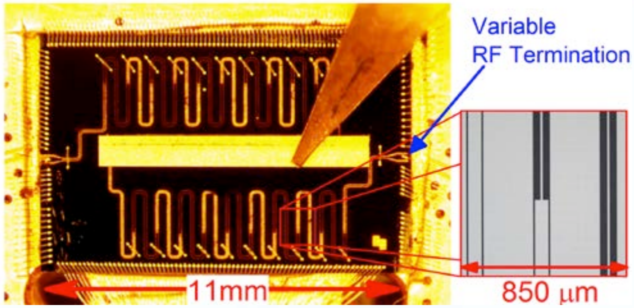

Fig. 1 Optical micrograph of a superconducting photonic bandgap microresonator. This resonator geometry was a key advancement that enabled the study of electrically driven NMR

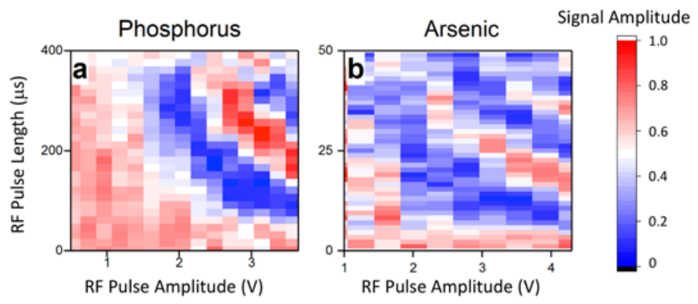

Fig. 2 Density plots showing coherent manipulation of ^{75}As and ^{31}P nuclear spins using only RF electric fields. Rabi oscillation" between the two spin states appear as the electric field control pulse amplitude or length is varied.