Baseband control of spin qubits at zero magnetic field

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Single-electron spin qubits in semiconductor quantum dots provide a promising platform for quantum computing. Traditionally, such qubits are operated at a finite magnetic field, using resonant control with microwave pulses. A twofold major technological simplification of the platform would be achieved by operating the qubits (1) without a magnet, and (2) with baseband voltage pulses only. In this talk, based on our earlier study [1], I'll propose such a simplified architecture, which exploits the nontrivial spin dynamics induced by spin-orbit interaction. I will provide a roadmap of intermediate experimental milestones toward scaling up. The roadmap is based on recent progress with hole spin qubits in Germanium quantum wells. Joint work with Csongor Hunyady and Baksa Kolok.

[1] B. Kolok, A. Palyi, Protocols to measure the non-Abelian Berry phase by pumping a spin qubit through a quantum-dot loop, Phys. Rev. B 109, 045438 (2024).