Hole sweet hole !

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***Abstract* — Holes embed an intrinsic spin-orbit coupling originating from the p-wave nature of valence-band states. As a result, their spin degree of freedom is "dressed" by an orbital component, such that hole spins can be coherently manipulated by means of a microwave voltage modulation applied to a gate electrode[1]. For the same reason, a hole spin can couple to the electric-field component of the photonic mode in a superconducting microwave resonator[2], opening interesting opportunities such as fast non-demolition readout and photon-mediated coupling between far-apart spin qubits. These practical advantages of holes come at cost though. Spin-orbit coupling makes hole spin qubits susceptible to charge noise thereby reducing their coherence. Finding regimes of operation where holes are protected against charge noise while preserving an efficient electrical control is therefore crucial. The existence of such operational sweet spots was recently demonstrated[3] opening at the same time new important questions: what is the anatomy of sweet-spot operation regimes and how does that depend on physical parameters? Can fast spin control be preserved under noise-resilient, sweet-spot conditions? For the sake of scalability, is it possible to simultaneously enforce sweet-spot operation on multiple hole spin qubits? We have addressed these questions in a recent work[4], which will be the main subject of this talk.**

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2. C. X. Yu et al., Nat. Nanotechnol. 18, 741–746 (2023).
3. N. Piot, et al., Nat. Nanotechnol. 17, 1072 (2022).
4. M. Bassi et al., (in preparation).