Materials for Quantum Technologies: a Roadmap for Spin and Topology

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Qubit type	Spin Coherence time	Single qubit gate operation time	Single qubit gate error
Si and Ge gate-defined QDs	Si electron (T_2^{CPMG}): 28 ms[1] Ge electron (T_2^{Echo}): 0.158 ms[2]	Si: 2.5 ns[3] Ge: 0.41 ns[4]	Si: 0.04%[5] Ge: 0.01%[6]
Donor based Si	Electron (T_2^{CPMG}): 0.56 s[7]; Nuclear (T_2^{CPMG}): 36 s[8]	Electron: 100 ns [8] Nuclear: 25 µs [9]	–
III-V QDs	Electron (T_2^{CPMG}): 100 µs [10] Nuclear (T_2): 20 ms [11]	Electron: 1 ps [12] Nuclear: 1 µs [11] Electro-nuclear: 100 ns [13]	Electron: 1% [10] Nuclei: 3% [11]
NV centre in diamond	Electron (T_2^{CPMG}): 0.6 s [14] Nuclear (T_2^*): 1.9 mins [15]	Electron: 10 ns; [16] Nuclear: 50 µs [16]	Electron: 0.01% [17] Nuclei: 0.09% [18]
G4 defects in diamond	Electron (T_2^{CPMG}): 0.3 ms [19] Nuclear (T_2^{XY8}): 2 s [19]	Electron: 125 ns [20] Nuclear: 50 µs [19]	Electron: 0.1% [19] Nuclear: 2% [19]
Defects in SiC	Electron (T_2^{CPMG}): 5 s [21] Nuclear (T_2^*): 9.9 ms [22]	Electron: ~100 ns [23] Nuclear: 12.7 µs [24]	Electron: 0.02% [24] Nuclear: 3.3% [22]
Defects in hBN	Electronic Ensemble (T_2^{CPMG}) : 4 µs [25] Electronic single (T_2^{CPMG}): 1 µs [26]	Electron: 50 ns [26]	–

Table S1: *Semiconducting spin qubits and their individual figures of merit. CPMG: Carr-Purcell-Meiboom-Gill, Echo: Hahn-Echo pulse sequences. T2*: Inhomogeneous dephasing time measured by Ramsey.*

Qubit type	Coherence time (T2)	Single qubit gate operation time	Size	Operational temperature	Initialization and readout efficiency
Skyrmion (helicity)[27,28]	–	180 fs	3 nm	Up to 3.8 K	–
Skyrmion (helicity)[29]	~ 1 µs	–	–	Up to 2.5 K	Electric field of 296 mV/µm
Skyrmion (presence)[30]	–	3.2 ns	–	–	–
Meron (polarity)[31]	–	1 ps	3 nm	Up to 3 K	–
Domain wall (chirality)[32]	~ 1 µs	0.1 ns	5 nm	Up to 100 mK	–

Table S 2: *Comparison of critical FOMs for the development of skyrmion-based quantum technologies, also including the corresponding values for meron- and domain wall-based approaches.*

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