Time	Coherence	Qubit	Material	Host	Date	Reference	Source	0
20 ms	T_1	HY/e[a]	^{28}Si/SiGe	2D	2021-12	1	p4	1
50 µs	T_1	LD/e	GaAs/AlGaAs	2D	2003-11	2	abstract	2
0.85 ms	T_1	LD/e	GaAs/AlGaAs	2D	2004-07	3	p4	3
1 s	T_1	LD/e	GaAs/AlGaAs	2D	2008-01	4	p4 and Fig. 3c the leftmost blue point	4
0.6 s[b]	T_1	LD/e	Si/SiGe	2D	2009-08	5	Fig. 5	5
40 ms	T_1	LD/e	Si/SiO_2	2D	2010-03	6	p4 and Fig. 4 the leftmost red point	6
2.8 s	T_1	LD/e	Si/SiGe	2D	2011-04	7	p3 and Fig. 3	7
1 µs	T_1	LD/e	InAs	1D	2012-10	8	Fig. 4d	8
2.6 s	T_1	LD/e	Si/SiO_2	2D	2013-06	9	p3	9
85 ms	T_1	LD/e	GaAs/AlGaAs	2D	2014-12	10	p2 and Fig. 3	10
3.7 ms	T_1	LD/e	GaAs/AlGaAs	2D	2016-07	11	p3 and Fig. 2	11
0.17 s	T_1	LD/e	Si/SiGe	2D	2016-11	12	Fig. 6	12
10 s	T_1	LD/e	GaAs/AlGaAs	2D	2017-10	13	Fig. 2 the lowest green point	13
50 ms	T_1	LD/e	Si/SiGe	2D	2018-02	14	p1 and ED Fig. 3b	14
2.8 ms[c]	T_1	LD/e	^{28}Si/SiO_2	2D	2018-08	15	p4 and Fig. 3a	15
0.15 s[d]	T_1	LD/e	^{28}Si/SiO_2	2D	2018-08	15	p2 and p4	16
57 s	T_1	LD/e	GaAs/AlGaAs	2D	2018-08	16	p3 and Fig. 4a	17
1 s	T_1	LD/e	^{28}Si/SiO_2	2D	2018-10	17	p2	18
1.5 ms	T_1	LD/e	GaAs/AlGaAs	2D	2019-04	18	Fig. 2	19
0.16 s[e]	T_1	LD/e	Si/SiGe	2D	2019-04	19	Fig. 2	20
5 s[f]	T_1	LD/e	Si/SiGe	2D	2019-04	19	p4	21
0.13 s	T_1	LD/e	^{28}Si/SiGe	2D	2019-11	20	p4	22
1 s	T_1	LD/e	^{28}Si/SiGe	2D	2020-03	21	p6 and Fig. 4a	23
3.7 ms	T_1	LD/e[g]	^{28}Si/SiO_2	2D	2020-04	22	p2	24
90 ms	T_1	LD/e	Si/SiO_2	2D	2020-06	23	Fig. 1c	25
9 s	T_1	LD/e	Si/SiO_2	1D	2021-03	24	p3 and Fig. 3a the leftmost blue point	26
1.3 ms	T_1	LD/e	Si/SiGe	2D	2021-06	25	p1 for Q3	27
10 ms	T_1	LD/e	Si/SiO_2	1D	2021-09	26	p2 and Fig. 2a	28
1.6 s	T_1	LD/e	^{28}Si/SiO_2	2D	2022-03	27	p4 and Fig. 3c	29
5 ns	T_1	LD/h	GaAs/AlGaAs	1D	2016-11	28	p4 and SM pS5	30
86 µs	T_1	LD/h	Ge/Si	1D	2018-10	29	p3 and Fig. 3c the leftmost point	31
60 µs	T_1	LD/h	GaAs/AlGaAs	2D	2019-02	30	abstract and Fig. 4	32
9 µs	T_1	LD/h	Ge/SiGe	2D	2020-01	31	p3 and Fig. 2f	33
1.2 ms	T_1	LD/h	Ge/SiGe	2D	2020-07	32	p4 and Fig. 3a	34
32 ms	T_1	LD/h	Ge/SiGe	2D	2020-08	33	p3	35
16 ms	T_1	LD/h	Ge/SiGe	2D	2021-03	34	Fig. S5 dot 3	36
3 ms[h]	T_1	LD/h	BLG	2D	2021-12	35	p5	37
3.7 µs	T_1	LD/h	Ge/Si	1D	2022-01	36	SM p13 and SFig. 7.1d	38
6 s	T_1	LD/i	Si:P	imp	2010-09	37	p2	39
0.7 s	T_1	LD/i	Si:P	imp	2012-09	38	p3	40
1.8 s	T_1	LD/i	Si:P	imp	2013-06	39	Fig. 3	41
3 s	T_1	LD/i	^{28}Si:P	imp	2016-10	40	p3	42
1.3 s	T_1	LD/i[i]	^{28}Si:P	imp	2016-10	41	p4	43
30 s	T_1	LD/i	Si:P	imp	2017-03	42	Fig. 2b the lowest point	44
9.3 s	T_1	LD/i	Si:P	imp	2018-03	43	p3 and Fig. 1f	45
1.3 s	T_1	LD/i	Si:P	imp	2018-11	44	p3 and Fig. 2b	46
4.2 s	T_1	LD/i	Si:P	imp	2019-01	45	p3	47
9.8 s	T_1	LD/i	Si:P	imp	2019-05	46	Fig. 2c	48
5 ms	T_1	LD/i	^{28}Si:B	imp	2020-07	47	p3 and Fig. 3b	49
3.4 s	T_1	LD/i	^{28}Si:P	imp	2021-01	48	p6 and SFig. 3c	50

TABLE I-1. Spin coherence times (part 1). Superscripts stand for the following. [a]: EO qubit. [b]: *(estimated)* Fig. 5 the lowest point. [c]: At 1.1 kelvin. [d]: At 0.1 kelvin. [e]: With micromagnet. [f]: No micromagnet. [g]: At 1 kelvin. [h]: The reference states '...the relaxation time is on the order of milliseconds'. We use 3 ms as a representative value, as it corresponds to the 'load phase' in the measurement cycle. [i]: Qubit defined in the rotating frame.

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[1] Jacob Z. Blumoff, Andrew S. Pan, Tyler E. Keating, Reed W. Andrews, David W. Barnes, Teresa L. Brecht, Edward T. Croke, Larken E. Cumberland, Jacob A. Fast, Clayton A. C. Jackson, Aaron M. Jones, Joseph Kerckhoff, Robert K. Lanza, Kate Raach, Bryan J. Thomas, Roland Velunta, Aaron J. Weinstein, Thaddeus D. Ladd, Kevin Eng, Matthew G. Borselli, Andrew T. Hunter, and Matthew T. Rakher. Fast and high-fidelity state preparation and measurement in triple-quantum-dot spin qubits. *arXiv:2112.09801 [quant-ph]*, December 2021. URL `http://arxiv.org/abs/2112.09801`. arXiv: 2112.09801.

[2] R. Hanson, B. Witkamp, L. M. K. Vandersypen, L. H. Willems van Beveren, J. M. Elzerman, and L. P. Kouwenhoven. Zeeman Energy and Spin Relaxation in a One-Electron Quantum Dot. *Physical Review Letters*, 91(19), November 2003. ISSN 0031-9007, 1079-7114. doi:10.1103/PhysRevLett.91.196802. URL `https://link.aps.org/doi/10.1103/PhysRevLett.91.196802`.

[3] J. M. Elzerman, R. Hanson, L. H. Willems van Beveren, B. Witkamp, L. M. K. Vandersypen, and L. P. Kouwenhoven. Single-shot read-out of an individual electron spin in a quantum dot. *Nature*, 430(6998):431–435, July 2004. ISSN 0028-0836, 1476-4679. doi: 10.1038/nature02693. URL `http://www.nature.com/doifinder/10.1038/nature02693`.

[4] S. Amasha, K. MacLean, Iuliana P. Radu, D. M. Zumbühl, M. A. Kastner, M. P. Hanson, and A. C. Gossard. Electrical Control of Spin Relaxation in a Quantum Dot. *Physical Review Letters*, 100(4), January 2008. ISSN 0031-9007, 1079-7114. doi: 10.1103/PhysRevLett.100.046803. URL `http://link.aps.org/doi/10.1103/PhysRevLett.100.046803`.

[5] Robert R. Hayes, Andrey A. Kiselev, Matthew G. Borselli, Steven S. Bui, Edward T. Croke III, Peter W. Deelman, Brett M. Maune, Ivan Milosavljevic, Jeong-Sun Moon, and Richard S. Ross. Lifetime measurements (T1) of electron spins in Si/SiGe quantum dots. *arXiv preprint arXiv:0908.0173*, August 2009. URL `https://arxiv.org/abs/0908.0173`. arXiv:0908.0173.

[6] M. Xiao, M. G. House, and H. W. Jiang. Measurement of the Spin Relaxation Time of Single Electrons in a Silicon Metal-Oxide-Semiconductor-Based Quantum Dot. *Physical Review Letters*, 104(9), March 2010. ISSN 0031-9007, 1079-7114. doi: 10.1103/PhysRevLett.104.096801. URL `https://link.aps.org/doi/10.1103/PhysRevLett.104.096801`.

[7] C. B. Simmons, J. R. Prance, B. J. Van Bael, Teck Seng Koh, Zhan Shi, D. E. Savage, M. G. Lagally, R. Joynt, Mark Friesen, S. N. Coppersmith, and M. A. Eriksson. Tunable Spin Loading and T 1 of a Silicon Spin Qubit Measured by Single-Shot Readout. *Physical Review Letters*, 106(15):156804, April 2011. ISSN 0031-9007, 1079-7114. doi:10.1103/PhysRevLett.106.156804. URL `https://link.aps.org/doi/10.1103/PhysRevLett.106.156804`.

[8] K. D. Petersson, L. W. McFaul, M. D. Schroer, M. Jung, J. M. Taylor, A. A. Houck, and J. R. Petta. Circuit quantum electrodynamics with a spin qubit. *Nature*, 490(7420):380–383, October 2012. ISSN 0028-0836, 1476-4687. doi:10.1038/nature11559. URL `http://www.nature.com/doifinder/10.1038/nature11559`.

[9] C. H. Yang, A. Rossi, R. Ruskov, N. S. Lai, F. A. Mohiyaddin, S. Lee, C. Tahan, G. Klimeck, A. Morello, and A. S. Dzurak. Spin-valley lifetimes in a silicon quantum dot with tunable valley splitting. *Nature Communications*, 4, June 2013. ISSN 2041-1723. doi: 10.1038/ncomms3069. URL `http://www.nature.com/doifinder/10.1038/ncomms3069`.

[10] P. Scarlino, E. Kawakami, P. Stano, M. Shafiei, C. Reichl, W. Wegscheider, and L. M. K. Vandersypen. Spin-Relaxation Anisotropy in a GaAs Quantum Dot. *Physical Review Letters*, 113(25):256802, December 2014. ISSN 0031-9007, 1079-7114. doi: 10.1103/PhysRevLett.113.256802. URL `https://link.aps.org/doi/10.1103/PhysRevLett.113.256802`.

[11] T. A. Baart, N. Jovanovic, C. Reichl, W. Wegscheider, and L. M. K. Vandersypen. Nanosecond-timescale spin transfer using individual electrons in a quadruple-quantum-dot device. *Applied Physics Letters*, 109(4):043101, July 2016. ISSN 0003-6951, 1077-3118. doi: 10.1063/1.4959183. URL `http://aip.scitation.org/doi/10.1063/1.4959183`.

[12] D. M. Zajac, T. M. Hazard, X. Mi, E. Nielsen, and J. R. Petta. Scalable Gate Architecture for a One-Dimensional Array of Semiconductor Spin Qubits. *Physical Review Applied*, 6(5), November 2016. ISSN 2331-7019. doi:10.1103/PhysRevApplied.6.054013. URL `https://link.aps.org/doi/10.1103/PhysRevApplied.6.054013`.

[13] A. Hofmann, V. F. Maisi, T. Krähenmann, C. Reichl, W. Wegscheider, K. Ensslin, and T. Ihn. Anisotropy and Suppression of Spin-Orbit Interaction in a GaAs Double Quantum Dot. *Physical Review Letters*, 119(17), October 2017. ISSN 0031-9007, 1079-7114. doi:10.1103/PhysRevLett.119.176807. URL `https://link.aps.org/doi/10.1103/PhysRevLett.119.176807`.

[14] T. F. Watson, S. G. J. Philips, E. Kawakami, D. R. Ward, P. Scarlino, M. Veldhorst, D. E. Savage, M. G. Lagally, Mark Friesen, S. N. Coppersmith, M. A. Eriksson, and L. M. K. Vandersypen. A programmable two-qubit quantum processor in silicon. *Nature*, 555(7698): 633–637, February 2018. ISSN 0028-0836, 1476-4687. doi:10.1038/nature25766. URL `http://www.nature.com/doifinder/10.1038/nature25766`.

[15] L. Petit, J. M. Boter, H. G. J. Eenink, G. Droulers, M. L. V. Tagliaferri, R. Li, D. P. Franke, K. J. Singh, J. S. Clarke, R. N. Schouten, V. V. Dobrovitski, L. M. K. Vandersypen, and M. Veldhorst. Spin Lifetime and Charge Noise in Hot Silicon Quantum Dot Qubits. *Physical Review Letters*, 121(7), August 2018. ISSN 0031-9007, 1079-7114. doi:10.1103/PhysRevLett.121.076801. URL `https://link.aps.org/doi/10.1103/PhysRevLett.121.076801`.

[16] Leon C. Camenzind, Liuqi Yu, Peter Stano, Jeramy D. Zimmerman, Arthur C. Gossard, Daniel Loss, and Dominik M. Zumbühl. Hyperfine-phonon spin relaxation in a single-electron GaAs quantum dot. *Nature Communications*, 9(1):3454, August 2018. ISSN 2041-1723. doi:10.1038/s41467-018-05879-x. URL `http://www.nature.com/articles/s41467-018-05879-x`.

[17] K. W. Chan, W. Huang, C. H. Yang, J. C. C. Hwang, B. Hensen, T. Tanttu, F. E. Hudson, K. M. Itoh, A. Laucht, A. Morello, and A. S. Dzurak. Assessment of a Silicon Quantum Dot Spin Qubit Environment via Noise Spectroscopy. *Physical Review Applied*, 10(4), October 2018. ISSN 2331-7019. doi:10.1103/PhysRevApplied.10.044017. URL `https://link.aps.org/doi/10.1103/PhysRevApplied.10.044017`.

[18] Takashi Nakajima, Akito Noiri, Jun Yoneda, Matthieu R. Delbecq, Peter Stano, Tomohiro Otsuka, Kenta Takeda, Shinichi Amaha, Giles Allison, Kento Kawasaki, Arne Ludwig, Andreas D. Wieck, Daniel Loss, and Seigo Tarucha. Quantum non-demolition measurement of an electron spin qubit. *Nature Nanotechnology*, 14(6):555–560, April 2019. ISSN 1748-3387, 1748-3395. doi:10.1038/s41565-019-0426-x. URL `http://www.nature.com/articles/s41565-019-0426-x`.

[19] F. Borjans, D.M. Zajac, T.M. Hazard, and J.R. Petta. Single-Spin Relaxation in a Synthetic Spin-Orbit Field. *Physical Review Applied*, 11(4):044063, April 2019. ISSN 2331-7019. doi:10.1103/PhysRevApplied.11.044063. URL `https://link.aps.org/doi/10.1103/PhysRevApplied.11.044063`.

[20] A. J. Sigillito, M. J. Gullans, L. F. Edge, M. Borselli, and J. R. Petta. Coherent transfer of quantum information in a silicon double quantum dot using resonant SWAP gates. *npj Quantum Information*, 5(1):110, November 2019. ISSN 2056-6387. doi:10.1038/s41534-019-0225-0. URL `http://www.nature.com/articles/s41534-019-0225-0`.

[21] Arne Hollmann, Tom Struck, Veit Langrock, Andreas Schmidbauer, Floyd Schauer, Tim Leonhardt, Kentarou Sawano, Helge Riemann, Nikolay V. Abrosimov, Dominique Bougeard, and Lars R. Schreiber. Large, Tunable Valley Splitting and Single-Spin Relaxation Mechanisms in a Si / Si x Ge 1 - x Quantum Dot. *Physical Review Applied*, 13(3):034068, March 2020. ISSN 2331-7019. doi:10.1103/PhysRevApplied.13.034068. URL `https://link.aps.org/doi/10.1103/PhysRevApplied.13.034068`.

[22] L. Petit, H. G. J. Eenink, M. Russ, W. I. L. Lawrie, N. W. Hendrickx, S. G. J. Philips, J. S. Clarke, L. M. K. Vandersypen, and M. Veldhorst. Universal quantum logic in hot silicon qubits. *Nature*, 580(7803):355–359, April 2020. ISSN 0028-0836, 1476-4687. doi:10.1038/s41586-020-2170-7. URL `http://www.nature.com/articles/s41586-020-2170-7`.

[23] Xin Zhang, Rui-Zi Hu, Hai-Ou Li, Fang-Ming Jing, Yuan Zhou, Rong-Long Ma, Ming Ni, Gang Luo, Gang Cao, Gui-Lei Wang, Xuedong Hu, Hong-Wen Jiang, Guang-Can Guo, and Guo-Ping Guo. Giant Anisotropy of Spin Relaxation and Spin-Valley Mixing in a Silicon Quantum Dot. *Physical Review Letters*, 124(25):257701, June 2020. ISSN 0031-9007, 1079-7114. doi:10.1103/PhysRevLett.124.257701. URL `https://link.aps.org/doi/10.1103/PhysRevLett.124.257701`.

[24] Virginia N. Ciriano-Tejel, Michael A. Fogarty, Simon Schaal, Louis Hutin, Benoit Bertrand, Lisa Ibberson, M. Fernando Gonzalez-Zalba, Jing Li, Yann-Michel Niquet, Maud Vinet, and John J.L. Morton. Spin Readout of a CMOS Quantum Dot by Gate Reflectometry and Spin-Dependent Tunneling. *PRX Quantum*, 2(1):010353, March 2021. ISSN 2691-3399. doi:10.1103/PRXQuantum.2.010353. URL `https://link.aps.org/doi/10.1103/PRXQuantum.2.010353`.

[25] Kenta Takeda, Akito Noiri, Takashi Nakajima, Jun Yoneda, Takashi Kobayashi, and Seigo Tarucha. Quantum tomography of an entangled three-qubit state in silicon. *Nature Nanotechnology*, June 2021. ISSN 1748-3387, 1748-3395. doi:10.1038/s41565-021-00925-0. URL `http://www.nature.com/articles/s41565-021-00925-0`.

[26] Cameron Spence, Bruna Cardoso Paz, Bernhard Klemt, Emmanuel Chanrion, David J. Niegemann, Baptiste Jadot, Vivien Thiney, Benoit Bertrand, Heimanu Niebojewski, Pierre-André Mortemousque, Xavier Jehl, Romain Maurand, Silvano De Franceschi, Maud Vinet, Franck Balestro, Christopher B äuerle, Yann-Michel Niquet, Tristan Meunier, and Matias Urdampilleta. Spin-valley coupling anisotropy and noise in CMOS quantum dots. *arXiv:2109.13557 [cond-mat]*, September 2021. URL `http://arxiv.org/abs/2109.13557`. arXiv: 2109.13557.

[27] A. M. J. Zwerver, T. Krähenmann, T. F. Watson, L. Lampert, H. C. George, R. Pillarisetty, S. A. Bojarski, P. Amin, S. V. Amitonov, J. M. Boter, R. Caudillo, D. Correas-Serrano, J. P. Dehollain, G. Droulers, E. M. Henry, R. Kotlyar, M. Lodari, F. Lüthi, D. J. Michalak, B. K. Mueller, S. Neyens, J. Roberts, N. Samkharadze, G. Zheng, O. K. Zietz, G. Scappucci, M. Veldhorst, L. M. K. Vandersypen, and J. S. Clarke. Qubits made by advanced semiconductor manufacturing. *Nature Electronics*, 5(3):184–190, March 2022. ISSN 2520-1131. doi:10.1038/s41928-022-00727-9. URL `https://www.nature.com/articles/s41928-022-00727-9`.

[28] Daisy Q. Wang, Oleh Klochan, Jo-Tzu Hung, Dimitrie Culcer, Ian Farrer, David A. Ritchie, and Alex R. Hamilton. Anisotropic Pauli Spin Blockade of Holes in a GaAs Double Quantum Dot. *Nano Letters*, 16(12):7685–7689, November 2016. ISSN 1530-6984, 1530-6992. doi:10.1021/acs.nanolett.6b03752. URL `http://pubs.acs.org/doi/abs/10.1021/acs.nanolett.6b03752`.

[29] Lada Vukušić, Josip Kukučka, Hannes Watzinger, Joshua Michael Milem, Friedrich Schäffler, and Georgios Katsaros. Single-Shot Readout of Hole Spins in Ge. *Nano Letters*, 18(11):7141–7145, October 2018. ISSN 1530-6984, 1530-6992. doi:10.1021/acs.nanolett.8b03217. URL `http://pubs.acs.org/doi/10.1021/acs.nanolett.8b03217`.

[30] Alex Bogan, Sergei Studenikin, Marek Korkusinski, Louis Gaudreau, Piotr Zawadzki, Andy Sachrajda, Lisa Tracy, John Reno, and Terry Hargett. Single hole spin relaxation probed by fast single-shot latched charge sensing. *Communications Physics*, 2(1):17, February 2019. ISSN 2399-3650. doi:10.1038/s42005-019-0113-0. URL `http://www.nature.com/articles/s42005-019-0113-0`.

[31] N. W. Hendrickx, D. P. Franke, A. Sammak, G. Scappucci, and M. Veldhorst. Fast two-qubit logic with holes in germanium. *Nature*, 577(7791):487–491, January 2020. ISSN 0028-0836, 1476-4687. doi:10.1038/s41586-019-1919-3. URL `http://www.nature.com/articles/s41586-019-1919-3`.

[32] N. W. Hendrickx, W. I. L. Lawrie, L. Petit, A. Sammak, G. Scappucci, and M. Veldhorst. A single-hole spin qubit. *Nature Communications*, 11(1):3478, July 2020. ISSN 2041-1723. doi:10.1038/s41467-020-17211-7. URL `http://www.nature.com/articles/s41467-020-17211-7`.

[33] W. I. L. Lawrie, N. W. Hendrickx, F. van Riggelen, M. Russ, L. Petit, A. Sammak, G. Scappucci, and M. Veldhorst. Spin relaxation benchmarks and individual qubit addressability for holes in quantum dots. *Nano Letters*, page acs.nanolett.0c02589, August 2020. ISSN 1530-6984, 1530-6992. doi:10.1021/acs.nanolett.0c02589. URL `http://arxiv.org/abs/2006.12563`. arXiv: 2006.12563.

[34] Nico W. Hendrickx, William I. L. Lawrie, Maximilian Russ, Floor van Riggelen, Sander L. de Snoo, Raymond N. Schouten, Amir Sammak, Giordano Scappucci, and Menno Veldhorst. A four-qubit germanium quantum processor. *Nature*, 591(7851):580–585, March 2021. ISSN 0028-0836, 1476-4687. doi:10.1038/s41586-021-03332-6. URL `http://www.nature.com/articles/s41586-021-03332-6`.

[35] Lisa Maria Gächter, Rebekka Garreis, Chuyao Tong, Max Josef Ruckriegel, Benedikt Kratochwil, Folkert Kornelis de Vries, Annika Kurzmann, Kenji Watanabe, Takashi Taniguchi, Thomas Ihn, Klaus Ensslin, and Wister Wei Huang. Single-shot readout in graphene quantum dots. *arXiv:2112.12091 [cond-mat, physics:quant-ph]*, December 2021. URL `http://arxiv.org/abs/2112.12091`. arXiv: 2112.12091.

[36] Ke Wang, Gang Xu, Fei Gao, He Liu, Rong-Long Ma, Xin Zhang, Zhanning Wang, Gang Cao, Ting Wang, Jian-Jun Zhang, Dimitrie Culcer, Xuedong Hu, Hong-Wen Jiang, Hai-Ou Li, Guang-Can Guo, and Guo-Ping Guo. Ultrafast coherent control of a hole spin qubit in a germanium quantum dot. *Nature Communications*, 13(1):206, January 2022. ISSN 2041-1723. doi:10.1038/s41467-021-27880-7. URL `https://www.nature.com/articles/s41467-021-27880-7`.

[37] Andrea Morello, Jarryd J. Pla, Floris A. Zwanenburg, Kok W. Chan, Kuan Y. Tan, Hans Huebl, Mikko Möttönen, Christopher D. Nugroho,

Changyi Yang, Jessica A. van Donkelaar, Andrew D. C. Alves, David N. Jamieson, Christopher C. Escott, Lloyd C. L. Hollenberg, Robert G. Clark, and Andrew S. Dzurak. Single-shot readout of an electron spin in silicon. *Nature*, 467(7316):687–691, September 2010. ISSN 0028-0836, 1476-4687. doi:10.1038/nature09392. URL `http://www.nature.com/articles/nature09392`.

[38] Jarryd J. Pla, Kuan Y. Tan, Juan P. Dehollain, Wee H. Lim, John J. L. Morton, David N. Jamieson, Andrew S. Dzurak, and Andrea Morello. A single-atom electron spin qubit in silicon. *Nature*, 489(7417):541–545, September 2012. ISSN 0028-0836, 1476-4687. doi:10.1038/nature11449. URL `http://www.nature.com/doifinder/10.1038/nature11449`.

[39] H. Büch, S. Mahapatra, R. Rahman, A. Morello, and M. Y. Simmons. Spin readout and addressability of phosphorus-donor clusters in silicon. *Nature Communications*, 4(1):2017, June 2013. ISSN 2041-1723. doi:10.1038/ncomms3017. URL `http://www.nature.com/articles/ncomms3017`.

[40] Juan P Dehollain, Juha T Muhonen, Robin Blume-Kohout, Kenneth M Rudinger, John King Gamble, Erik Nielsen, Arne Laucht, Stephanie Simmons, Rachpon Kalra, Andrew S Dzurak, and Andrea Morello. Optimization of a solid-state electron spin qubit using gate set tomography. *New Journal of Physics*, 18(10):103018, October 2016. ISSN 1367-2630. doi:10.1088/1367-2630/18/10/103018. URL `http://stacks.iop.org/1367-2630/18/i=10/a=103018?key=crossref.98ec61e6ec10441edccd31e67f4ab4ca`.

[41] Arne Laucht, Rachpon Kalra, Stephanie Simmons, Juan P. Dehollain, Juha T. Muhonen, Fahd A. Mohiyaddin, Solomon Freer, Fay E. Hudson, Kohei M. Itoh, David N. Jamieson, Jeffrey C. McCallum, Andrew S. Dzurak, and A. Morello. A dressed spin qubit in silicon. *Nature Nanotechnology*, 12(1):61–66, October 2016. ISSN 1748-3387, 1748-3395. doi:10.1038/nnano.2016.178. URL `http://www.nature.com/doifinder/10.1038/nnano.2016.178`.

[42] Thomas F. Watson, Bent Weber, Yu-Ling Hsueh, Lloyd C. L. Hollenberg, Rajib Rahman, and Michelle Y. Simmons. Atomically engineered electron spin lifetimes of 30 s in silicon. *Science Advances*, 3(3):e1602811, March 2017. ISSN 2375-2548. doi:10.1126/sciadv.1602811. URL `http://advances.sciencemag.org/lookup/doi/10.1126/sciadv.1602811`.

[43] M. A. Broome, S. K. Gorman, M. G. House, S. J. Hile, J. G. Keizer, D. Keith, C. D. Hill, T. F. Watson, W. J. Baker, L. C. L. Hollenberg, and M. Y. Simmons. Two-electron spin correlations in precision placed donors in silicon. *Nature Communications*, 9(1):980, March 2018. ISSN 2041-1723. doi:10.1038/s41467-018-02982-x. URL `http://www.nature.com/articles/s41467-018-02982-x`.

[44] Bent Weber, Yu-Ling Hsueh, Thomas F. Watson, Ruoyu Li, Alexander R. Hamilton, Lloyd C. L. Hollenberg, Rajib Rahman, and Michelle Y. Simmons. Spin–orbit coupling in silicon for electrons bound to donors. *npj Quantum Information*, 4(1), November 2018. ISSN 2056-6387. doi:10.1038/s41534-018-0111-1. URL `http://www.nature.com/articles/s41534-018-0111-1`.

[45] Matthias Koch, Joris G. Keizer, Prasanna Pakkiam, Daniel Keith, Matthew G. House, Eldad Peretz, and Michelle Y. Simmons. Spin read-out in atomic qubits in an all-epitaxial three-dimensional transistor. *Nature Nanotechnology*, 14(2):137–140, January 2019. ISSN 1748-3387, 1748-3395. doi:10.1038/s41565-018-0338-1. URL `http://www.nature.com/articles/s41565-018-0338-1`.

[46] Stefanie B. Tenberg, Serwan Asaad, Mateusz T. Mądzik, Mark A. I. Johnson, Benjamin Joecker, Arne Laucht, Fay E. Hudson, Kohei M. Itoh, A. Malwin Jakob, Brett C. Johnson, David N. Jamieson, Jeffrey C. McCallum, Andrew S. Dzurak, Robert Joynt, and Andrea Morello. Electron spin relaxation of single phosphorus donors in metal-oxide-semiconductor nanoscale devices. *Physical Review B*, 99 (20):205306, May 2019. ISSN 2469-9950, 2469-9969. doi:10.1103/PhysRevB.99.205306. URL `https://link.aps.org/doi/10.1103/PhysRevB.99.205306`.

[47] Takashi Kobayashi, Joseph Salfi, Cassandra Chua, Joost van der Heijden, Matthew G. House, Dimitrie Culcer, Wayne D. Hutchison, Brett C. Johnson, Jeff C. McCallum, Helge Riemann, Nikolay V. Abrosimov, Peter Becker, Hans-Joachim Pohl, Michelle Y. Simmons, and Sven Rogge. Engineering long spin coherence times of spin–orbit qubits in silicon. *Nature Materials*, 20(1):38–42, July 2020. ISSN 1476-1122, 1476-4660. doi:10.1038/s41563-020-0743-3. URL `http://www.nature.com/articles/s41563-020-0743-3`.

[48] Mateusz T. Mądzik, Arne Laucht, Fay E. Hudson, Alexander M. Jakob, Brett C. Johnson, David N. Jamieson, Kohei M. Itoh, Andrew S. Dzurak, and Andrea Morello. Conditional quantum operation of two exchange-coupled single-donor spin qubits in a MOS-compatible silicon device. *Nature Communications*, 12(1):181, January 2021. ISSN 2041-1723. doi:10.1038/s41467-020-20424-5. URL `http://www.nature.com/articles/s41467-020-20424-5`.