CONTENTS

Items	51
Sources	1
Reading time	~71 min read

CURRENTSOTA

Physical qubits	1,180
2Q fidelity	99.99%
Logical qubits	96 LQ

Quantum hardware SOTA table →

Jul 30, 2026 · Daily Brief

Jul 30, 2026 Daily Brief

51 items · 1 sources | PDF | This issue's roundup is free

01 Highlights

01 · Highlights

HRL Laboratories published a paper in Nature demonstrating an 18-qubit silicon spin quantum processor that operates autonomously without real-time control from room-temperature electronics and performs error correction operations [11]. This advance achieves autonomous quantum computing with integrated cryogenic CMOS control on a silicon-based platform for the first time, offering a new path for large-scale scaling of silicon spin qubits [11].

02 Hardware

Silicon Spin Qubits

— HRL Laboratories demonstrated an 18-qubit silicon spin quantum processor that, by integrating a custom cryogenic CMOS chip, achieves autonomous operation without real-time control from room-temperature electronics and performs error correction operations [11]. This is the first time silicon spin qubits have achieved autonomous error correction under integrated cryogenic control, significantly reducing interconnect complexity compared to previous schemes that relied on external control equipment, potentially paving the way for scaling to thousands of qubits [11]. This result is at the SOTA frontier of this roadmap, but reaching fault-tolerant computation still requires improvements in fidelity (current two-qubit gate fidelity not disclosed, SOTA is 99.99% [SQC]) and scale [11].

— A University of California research team optimized the Si/SiGe heterostructure design, achieving a valley splitting of 5 meV, exceeding previously reported values [27]. Valley splitting is a key challenge for scaling silicon spin qubits; higher valley splitting facilitates consistent initialization, operation, and readout, and this progress addresses that bottleneck [27].

Superconducting Qubits

— IBM demonstrated sub-threshold scaling of the surface code on a heavy-hexagonal superconducting processor, solving the challenge of hardware connectivity mismatching the surface code through co-designed code embedding and control [6]. This is the first demonstration of surface code sub-threshold scaling on superconducting hardware with non-square-lattice connectivity, implying that IBM's fixed-coupler architecture can also support fault-tolerant computation, but practical application still requires improved fidelity and reduced error rates (current Λ value not disclosed, SOTA is Google Willow's $\Lambda \approx 2.1$) [6].

Trapped-Ion Qubits

— ZuriQ secured $25.5 million in seed funding to advance its 2D trapped-ion quantum computing architecture and is collaborating with Infineon on manufacturing [14]. 2D trapped-ion systems promise to overcome the scaling bottleneck of traditional 1D chains, potentially increasing qubit density and connectivity for trapped ions, but it is still in an early stage and needs to verify fidelity and manufacturability [14].

Topological Quantum Materials

— Researchers synthesized TaSiAs nanowires, achieving a 4- to 11-fold increase in conductivity compared to bulk material, with stability maintained under a silica shell encapsulation, demonstrating coherent electron transport [26]. This new material may be used in next-generation quantum computing, but there is still a long way to go before device integration [26].

---

03 Algorithms

03 · Algorithms and Software

— Horizon Quantum and Quantum Machines are collaborating to develop embedded calibration technology, aiming to deploy calibration software directly within quantum hardware control systems for real-time, lightweight calibration [12]. This is expected to reduce quantum computer downtime and improve availability, which is particularly important for cloud quantum service providers [12].

— Researchers at the Indian Institute of Science proposed a noise-aware quantum resource allocation framework that reduces the number of measurements required for reliable quantum computation by 58%, total error by 73%, and

energy consumption by 62% [21]. This directly addresses the high cost of algorithm execution in the NISQ era, making more complex algorithms feasible on near-term hardware [21].

— A University of Oxford team designed stacked linear combinations of unitaries (stacked LCUs), providing a tunable trade-off between quantum gate complexity and classical simulation cost, potentially mitigating the barren plateau problem in variational quantum circuits [22]. This construction provides a new tool for demonstrating quantum advantage, but actual advantage still needs to be verified on specific problems [22].

— Researchers at the SQMS Center generalized Grover's search to multi-level quantum systems (qudits), breaking through the previous limitation that applied only to dimensions that are powers of two [23]. This can reduce circuit depth and resource requirements, holding significant importance for emerging qudit hardware platforms [23].

— An IET research team developed an experiment tracking protocol for quantum software development, identifying dimensions, circuit parameters, measurement results, and noise characteristics specific to quantum programs [24]. This helps improve the reproducibility of quantum software research, filling a gap in quantum software engineering [24].

— Researchers developed the MPStab simulator, combining stabilizer techniques and tensor networks to extend the range of classically simulable quantum systems [25]. This helps define the boundary of quantum advantage and can be used to verify near-term quantum devices [25].

— The open-source software atommovr was released for simulating atom rearrangement processes in neutral atom arrays [30]. As neutral atom processors scale up, efficient rearrangement becomes critical, and this tool can help optimize experimental design [30].

— A quantum journal paper studied the performance of dynamic codes under noisy readout, proposing design methods for dynamic codes tailored to hardware with noisy readout [31]. Readout error is a key bottleneck in quantum error correction, and this research provides guidance for code design on actual hardware [31].

04 Industry

04 · Industry and Ecosystem

— IonQ completed the acquisition of SkyWater Technology, gaining the largest semiconductor foundry on U.S. soil, in a transaction valued at

$1.8 billion [15]. This enables IonQ to vertically integrate the manufacturing of trapped-ion quantum processors, accelerating scaled production and potentially reshaping the quantum computing manufacturing landscape [15].

— Four quantum companies (Infleqtion, Aliro Technologies, Tensora, Bandelier Technologies) joined the ABQ-Net quantum network testbed to validate defense and security technologies [16]. This marks the first open-access entangled quantum network in the U.S. beginning to open to commercial users, potentially accelerating the development of quantum network applications [16].

— Riverlane and the Unitary Foundation launched the Deltakit community fund to support open-source quantum error correction software development [17]. This will foster a thriving QEC software ecosystem, lower barriers to entry, and accelerate progress in error correction technology [17].

— QED-C and CQN jointly released a roadmap for quantum network applications, gathering input from over 50 experts [13]. This roadmap provides technical guidance for the development of the quantum internet, helping to coordinate research directions across industry and academia [13].

- EY announced it will deploy an on-premises quantum computer at its facilities [43]. This reflects an early bet by professional services firms on the potential of quantum computing, potentially driving application exploration in the financial and business sectors [43].
- GlobalFoundries received $300 million in CHIPS Act funding for silicon photonics research [47]. Silicon photonics is a key enabling technology for photonic quantum computing, and this investment will enhance U.S. competitiveness in photonic quantum computing manufacturing [47].
- Israel is promoting the establishment of a national quantum R&D center to unite industry [49]. This demonstrates Israel's recognition of the strategic value of quantum technology and may accelerate the commercialization of quantum technologies in the country [49].
- IQM quantum computers registered 183,619 new shares from an employee stock ownership plan [44]. This reflects IQM's talent incentives but has no direct technical impact [44].

05 Other

05 · Academic Frontiers

— Researchers at the University of Chicago defined non-local order parameters for two-dimensional symmetry-protected topological (SPT) phases via entanglement [19]. This provides a new perspective for understanding SPT phases and may aid in developing topological quantum computation schemes [19].

— A Peking University team studied many-body periodic orbits in periodically driven spin systems, finding that the quasi-particle band structure dominates a long-lived prethermalization regime, whose lifetime can be engineered via band dispersion [20]. This offers a new method for controlling thermalization in driven quantum systems, with potential applications in quantum simulation [20].

— A quantum journal paper studied the relationship between stabilizer rank, Barnes-Wall lattices, and magic state monotones [28]. This contributes to a deeper understanding of quantum resource theories and may be used to optimize quantum circuit compilation [28].

— Another quantum journal paper proposed modulator-assisted Zeno control for energy transport in quantum batteries [29]. This provides a new scheme for efficient charging of

quantum batteries, though practical application is still far off [29].

— A philosophy paper, *Tractatus Quanticus*, attempts to revise Wittgenstein's worldview from the perspective of quantum mechanics [18]. This falls under quantum foundations research and has limited impact on technological development [18].

06 Impact

06 · This Week's Impact

— Silicon Spin Qubit Community: HRL's autonomously operating processor validates the cryogenic CMOS integration route, potentially prompting more institutions to invest in this direction, but attention is needed on whether its fidelity can reach fault-tolerance thresholds [11].

— Quantum Error Correction Software Developers: The launch of the Deltakit fund will directly support open-source QEC tools; developers can watch for project call announcements [17].

— Trapped-Ion Manufacturers: IonQ's acquisition of SkyWater may trigger a wave of manufacturing vertical integration; other

trapped-ion companies may need to consider similar strategies to remain competitive [15].

— Quantum Network Startups: The release of the QED-C roadmap and the opening of ABQ-Net provide a technology validation platform for quantum network applications, which related enterprises can leverage to accelerate product development [13][16].

— Quantum Algorithm Researchers: The noise-aware resource allocation framework and stacked LCUs provide new tools for NISQ algorithms; algorithm demonstrations on near-term hardware may benefit from these methods [21][22].

07 Other

07 · Editor's Note

The most striking development this week is HRL Laboratories' progress on silicon spin qubits, integrating cryogenic CMOS control with silicon quantum dots for the first time to achieve autonomous quantum computation and error correction. This marks an important step for silicon-based quantum computing moving from laboratory demonstration toward engineering, as silicon spin qubits have long been known for compatibility with semiconductor processes, but

the complexity of control electronics has been a major obstacle to their scaling. If HRL's scheme can prove sufficiently high fidelity, it could change the standing of the silicon spin roadmap in the quantum computing race.

Meanwhile, industrial consolidation and investment remain active: IonQ's acquisition of SkyWater, ZuriQ's substantial funding, and GlobalFoundries' government funding all indicate that quantum computing is shifting from pure research toward building manufacturing and supply chains. However, breakthroughs in hardware metrics still need to be viewed cautiously—many advances are still in early stages and remain years away from practical application.

---

08 Other

References

1 Quantum in the Palm of Your Hand: The Evolution of Superconducting Qubits

2 Physicists Solve a Big Quantum Mystery. Now, Old Results Don’t Add Up.

3 Chemical and Pharmaceutical Giants Partnering with Quantum Technology Companies for Product Development

4 IQT The Quantum Dragon Podcast Episode 87 – Your entropy isn't random enough.

5 Intel's U.S. Advanced Packaging Enables Next-Generation AI Semiconductors

6 Surface code scaling on heavy-hex superconducting quantum processors

7 Artificial intelligence for representing and characterizing quantum systems

8 Weight-four parity checks in a spin-shuttling architecture

9 A digitally controlled silicon quantum processing unit

10 The quantum bus goes round and round

11 HRL Laboratories Demonstrates Self-Running Silicon QPU in Nature Benchmark

12 Horizon Quantum and Quantum Machines Partner to Advance Real-Time Quantum Calibration

13 QED-C and Center for Quantum Networks Release Quantum Networking Roadmap

14 ZuriQ Secures $25.5M Seed Round and Advances 2D Trapped-Ion Fabrication with Infineon

15 IonQ Clears Final Regulatory Hurdle to Complete Acquisition of SkyWater Technology

16 Four Quantum Firms Join ABQ-Net to Validate Defense and Security Technologies

28 Stabilizer Ranks, Barnes Wall Lattices and Magic Monotones

29 Modulator-Assisted Zeno Control of Energy Transfer in Quantum Batteries

30 atommovr: An open-source simulation framework for rearrangement in atomic arrays

31 Dynamical codes for hardware with noisy readouts

32 Bizarre new material discovered in Hiroshima bombing debris

33 Hundreds of ancient, never-before-seen ‘earthworks’ discovered in the Amazon

34 A unique cellular trick may explain octopus intelligence

35 Astronomers spot best-yet example of a wandering supermassive black hole

36 Rescue mission to save NASA’s Swift space telescope is imperiled in orbit

37 Neuroscientists pinpoint how smells bring back childhood memories

38 Avocado flowers switch sex daily—now we know why

39 The ultimate science summer reading list

40 Math’s acclaimed ‘einstein tile’ finds a new home among physicists

41 HRL Shows Self-Operating Silicon Quantum Processor That Performs Error Correction

42 The Growing Quantum Security Challenge Facing Bitcoin and Digital Assets

43 EY Announces On-Site Quantum Computing

44 IQM Quantum Computers Registers 183,619 New Shares Following ESOP 1 Subscriptions

45 QED-C Roadmap Outlines Technology Requirements for Future Quantum Networks

46 Horizon Quantum Partners With Quantum Machines to Improve Quantum Computer Operations

47 GlobalFoundries Secures $300 Million CHIPS Award for Silicon Photonics Research

48 Scientists Say New Chip Architecture Could Tackle a Barrier to Scaling Quantum Computers Towards 1 Million Qubits

49 Israel Pushes For National Quantum R&D Center to Unite Industry

50 AI Finds New Weaknesses in Cryptographic Algorithms, Anthropic Says

51 Behind the scenes at the Ontario Summer Games

References

[1] Quantum in the Palm of Your Hand: The Evolution of Superconducting Qubits

[2] Physicists Solve a Big Quantum Mystery. Now, Old Results Don’t Add Up.

[3] Chemical and Pharmaceutical Giants Partnering with Quantum Technology Companies for Product Development

[4] IQT The Quantum Dragon Podcast Episode 87 – Your entropy isn’t random enough.

[5] Intel’s U.S. Advanced Packaging Enables Next-Generation AI Semiconductors

[6] Surface code scaling on heavy-hex superconducting quantum processors

[7] Artificial intelligence for representing and characterizing quantum systems

[8] Weight-four parity checks in a spin-shuttling architecture

[9] A digitally controlled silicon quantum processing unit

[10] The quantum bus goes round and round

[11] HRL Laboratories Demonstrates Self-Running Silicon QPU in Nature Benchmark

[12] Horizon Quantum and Quantum Machines Partner to Advance Real-Time Quantum Calibration

[13] QED-C and Center for Quantum Networks Release Quantum Networking Roadmap

[14] ZuriQ Secures $25.5M Seed Round and Advances 2D Trapped-Ion Fabrication with Infineon

[15] IonQ Clears Final Regulatory Hurdle to Complete Acquisition of SkyWater Technology

[16] Four Quantum Firms Join ABQ-Net to Validate Defense and Security Technologies

[17] Riverlane and Unitary Foundation Launch Deltakit Community Fund for Open-Source QEC

[18] European Union’s Tractatus Quanticus Revises World as Facts, From Some Viewpoint

[19] University of Chicago Team Defines SPT Phases Via Entanglement

[20] How Peking University Engineers Control Prethermalization via Band Structure

[21] Mandal Indian Institute of Science: Researchers Halve Quantum Algorithm Shots and Cut Energy Use by 62%

[22] University of Oxford Team Designs Stacked LCUs for Tunable Quantum Trainability

[23] Superconducting Quantum Materials and Systems (SQMS) Center: Researchers Extend Grover’s Search to More Efficient Multilevel Quantum Systems

[24] Iet Research Develops Experiment Tracking Protocol for Quantum Software Development

[25] Researchers Present MPStab Simulator for Exploring Limits of Classical Quantum Computation

[26] Researchers Synthesise TaSiAs Nanowires for Next-Generation Quantum Computing

[27]

University of California Si/SiGe Qubits Hit 5 meV Valley Splitting

[28] Stabilizer Ranks, Barnes Wall Lattices and Magic Monotones

[29] Modulator-Assisted Zeno Control of Energy Transfer in Quantum Batteries

[30] atommovr: An open-source simulation framework for rearrangement in atomic arrays

[31] Dynamical codes for hardware with noisy readouts

[32] Bizarre new material discovered in Hiroshima bombing debris

[33] Hundreds of ancient, never-before-seen ‘earthworks’ discovered in the Amazon

[34] A unique cellular trick may explain octopus intelligence

[35] Astronomers spot best-yet example of a wandering supermassive black hole

[36] Rescue mission to save NASA’s Swift space telescope is imperiled in orbit

[37] Neuroscientists pinpoint how smells bring back childhood memories

[38] Avocado flowers switch sex daily—now we know why

[39] The ultimate science summer reading list

[40] Math’s acclaimed ‘einstein tile’ finds a new home among physicists

[41] HRL Shows Self-Operating Silicon Quantum Processor That Performs Error Correction

[42]

The Growing Quantum Security Challenge Facing Bitcoin and Digital Assets

[43] EY Announces On-Site Quantum Computing

[44] IQM Quantum Computers Registers 183,619 New Shares Following ESOP 1 Subscriptions

[45] QED-C Roadmap Outlines Technology Requirements for Future Quantum Networks

[46] Horizon Quantum Partners With Quantum Machines to Improve Quantum Computer Operations

[47] GlobalFoundries Secures $300 Million CHIPS Award for Silicon Photonics Research

[48] Scientists Say New Chip Architecture Could Tackle a Barrier to Scaling Quantum Computers Towards 1 Million Qubits

[49] Israel Pushes For National Quantum R&D Center to Unite Industry

[50] AI Finds New Weaknesses in Cryptographic Algorithms, Anthropic Says

[51] Behind the scenes at the Ontario Summer Games