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GENTLE.NEWS

In Today's Edition

"Literature is the most agreeable way of ignoring life."

— Fernando Pessoa

Building out the Quantum Computing Toolkit

Building out the Quantum Computing Toolkit More quantum primitives can unlock new problem domains with a quantum advantage July 13, 2026 enlarge Quantum computers lack useful functionality without the right algorithms to facilitate their operation. Presently, there are few simple, standardized operations, known as “primitives,” in the quantum toolkit that can help deliver the unique quantum behaviors required for such computers to achieve results beyond classical systems. With that in mind, researchers at the U.S. Department of Energy (DOE)’s Brookhaven National Laboratory, Northeastern University, Google Quantum AI, and University of Texas at Austin (UT) came together to build a better quantum algorithm. The resulting quantum Hermite transform is the quantum equivalent of a well-used classical mathematical primitive with the added potential to expand quantum computing’s impact on real-world science, including artificial intelligence (AI) applications. “The quantum Hermite transform is a quantum algorithm that implements the Hermite transform on a quantum state,” said Ning Bao, an assistant professor at Northeastern University with a joint appointment in Brookhaven Lab’s Computing and Data Sciences Directorate. “It is structurally quite distinct from existing quantum primitives, which could lead to more quantum algorithms that solve unique problems.” Bao’s initial work on a DOE-funded project led to the interactions concerning the Hermite transform

Source: Brookhaven National Laboratory

that resulted in the team's collaboration. From classical math to quantum computing Hermite transforms are actively used across engineering and physics, especially to describe the energy levels of the quantum harmonic oscillator, a fundamental physics model that captures how particles vibrate in a predictable way. Hermite functions also underlie many Gaussian systems common in machine learning and data science. However, switching into this Hermite-based representation on a quantum computer is a slow and unwieldy slog. The research team solved the "slog problem" by constructing an efficient quantum circuit that performs the transform with only logarithmic overhead — one step versus many — even for extremely large quantum states. The quantum Hermite transform, or QHT, also relies on precise approximations of Hermite functions with the ability to "fast-forward" the harmonic oscillator, allowing a quantum computer to jump directly to the system's future state within a few operations. When combined with new methods the team developed to build specific quantum states, known as "state preparation," where qubits are placed in the proper starting configuration inside a quantum computer, QHT emerges as a practical, high-precision quantum primitive that offers a powerful new way to analyze and represent data. "Fast forwarding a quantum system means to directly compute its state at a specific moment in time," Bao explained. "If the time evolution is over a very long duration, this can give drastic savings on the amount of time needed to prepare a quantum state. Basically, I can either prepare it directly in a small amount of time or physically evolve it for a very long time." According to Bao, this work

Source: Brookhaven National Laboratory

matters because quantum computing suffers from a dearth of core algorithmic primitives, the “building blocks” that are essential to create more complex quantum algorithms. Quantum algorithms usually rely on variations of the same techniques, such as the quantum Fourier transform or stabilizer-based methods. In turn, these methods often get applied to similar problems. In principle, new primitives like QHT can expand the types of problems quantum computers tackle beyond engineering and physics research. An enhanced quantum algorithm toolkit that can take advantage of quantum effects to build more complex operations can move quantum systems into broader domain areas, including materials science, energy security, advanced scientific modeling, and AI. Moreover, QHT does so exponentially faster than known classical methods. Ideas that expand quantum possibilities Although the progress with QHT represents a multi-institutional effort, the research’s early seeds were planted at Brookhaven Lab. Bao originated the idea with Stephen Jordan at Google Quantum AI while leading a project funded by DOE’s Advanced Scientific Computing Research program. Ultimately, Bao and his Google colleagues joined forces with students at UT who were working on a related problem. The collaboration proved fruitful. “There was no specific aha moment,” he said. “We had a strategy that we thought was going to work, and many of the obstacles that we thought would get in our way resolved in relatively simple ways.” In creating the quantum Hermite transform, the team’s work further strengthens a core pillar of the DOE’s mission to advance algorithmic foundations of quantum computing. “Quantum computers are

Source: Brookhaven National Laboratory

powerful, but without quantum algorithms, the realm of applicability of this power is very limited," Bao added. "Having new primitives enables solving broader suites of problems, including those relevant to real-world science. The quantum Hermite transform is a root rather than an endpoint — another staple, reusable operation, like the quantum gate, that empowers quantum computers to realize their advantage over classical systems." The team presented the paper at the 58th Annual Association for Computing Machinery Symposium on Theory of Computing (STOC 2026) in Salt Lake City, Utah, on June 22-27, 2026. Brookhaven National Laboratory is supported by the Office of Science of the U.S. Department of Energy. The Office of Science is the single largest supporter of basic research in the physical sciences in the United States and is working to address some of the most pressing challenges of our time. For more information, visit science.energy.gov . Follow @BrookhavenLab on social media. Find us on Instagram , LinkedIn , X , and Facebook . Related Links Scientific paper: "Efficient Quantum Hermite Transform" Tags: algorithms artificial intelligence computing CSI quantum computing 2026-23007 | INT/EXT | Newsroom

Source: Brookhaven National Laboratory

Principal Investigator and Quality Assessment Reports Evaluate Umbra Synthetic Aperture Radar Data

Two new reports from NASA’s Commercial Satellite Data Acquisition (CSDA) program evaluate data from the Umbra X-band Synthetic Aperture Radar (SAR) satellite constellation for the NASA Earth science research and applications community. The results of these evaluations help to inform NASA program management and the user community about the quality of these commercial data for use in NASA science. NASA’s CSDA program released the Umbra SAR Principal Investigator Evaluation Summary and Umbra SAR Quality Assessment Reports in May 2026. (The cover of the Quality Assessment Report is shown at left.) The results of these evaluations help inform NASA program management about the quality of this commercial data for use in NASA science. At right, a collage of synthetic aperture radar images from Umbra. Credit: NASA CSDA program / © Umbra Lab Inc., 2026. All Rights Reserved The CSDA Umbra Synthetic Aperture Radar SAR Principal Investigator Evaluation Summary documents the findings of evaluation teams. The teams were given access to the Umbra archive as well as the ability to task the Umbra constellation for new acquisitions. The tasking capability allowed evaluation teams to test the utility of Umbra data in time-sensitive workflows and to monitor areas experiencing rapid change and/or emergent environmental conditions, such as harmful algal blooms.

Source: NASA

Although the Principal Investigator Evaluation Summary supports the use of Umbra SAR data for NASA Earth science research and applications overall, it noted several strengths and weaknesses of the Umbra X-band data. Strengths included access to a very high spatial resolution X-band SAR satellite constellation; taskable access to high temporal repeat opportunities with quick turnaround; imaging flexibility with a range of azimuth and incidence angles; and the company's Open Data Program. Conversely, the PI teams reported weaknesses, including issues with Umbra geolocation (noting large and small geolocation errors), limited software compatibility, metadata, and some missing technical documentation. Additionally, the CSDA Umbra Synthetic Aperture Radar SAR Quality Assessment Report documents the results of radiometric and geometric analyses performed by NASA subject matter experts (SMEs) enlisted to evaluate the fundamental quality of the Umbra data following the Joint NASA/European Space Agency (ESA) assessment guidelines (ESA-NASA, 2024). Performed mainly on the single-look complex (SLC) Level 1 data products in Sensor Independent Complex Data (SICD) format, along with some additional Level 2 products used in science usability assessments by the evaluation team, the CSDA SMEs found the spatial resolution of the data agreed with Umbra's specifications. However, the quality analysis results for geolocation accuracy did not universally align with the company's specifications. Given these results, the SME's concluded that "the overall positioning performance of the Umbra data did not meet the expected accuracy. Regarding the radiometric

Source: NASA

performance of the data, which was assessed in terms of absolute accuracy, stability, and sensitivity, the SMEs found the data “underperform[ed] relative to that of well-calibrated reference SAR systems.” About the CSDA Program The CSDA program was established to identify, evaluate, and acquire data from commercial sources that support the NASA Earth science research and application goals. NASA’s Earth Science Division recognizes the potential impact commercial satellite constellations may have in encouraging/enabling efficient approaches to advancing Earth System Science and applications development for societal benefit. Commercially acquired data may also provide a cost-effective means to augment and/or complement the suite of Earth observations acquired by NASA, other U.S. government agencies, and international partners. To read the reports in full, see the links under “Evaluation” heading on the CSDA’s Umbra commercial vendor webpage .

Source: NASA

New drug slows Alzheimer’s disease in mice

Researchers have developed an active ingredient that slows down the progression of typical Alzheimer’s symptoms in mice. This new substance protects nerve cells and could in future alleviate the suffering of Alzheimer’s patients. The active ingredient also shows anti-aging effects. “Compound 10” is how Ursula Quitterer refers to the chemical compound that her team has developed and which could slow down the progression of Alzheimer’s disease. Quitterer is professor of molecular pharmacology at ETH Zurich and has so far tested the active ingredient first on mice, revealing promising effects: the typical death of nerve cells seen in dementia is significantly slower, and the animals survive for longer. The new substance is the result of research that began almost 20 years ago, when Quitterer received tissue samples from patients of a doctor and colleague at the Ain Shams University Hospital in Cairo. These were samples of brain tissue that the doctor had removed during tumor surgery —both on people diagnosed with dementia and non-dementia patients. Quitterer set about working on these samples—but to understand what exactly she did with them, we first need a bit of background. Then, as now, the main focus of her research was a bodily enzyme that performs a vital role in many human cells: GRK2. As a regulatory protein, this enzyme helps cells respond correctly to signals, stress, and strain. As well as in the heart, for example, it is also active in the brain—where it

Source: Futurity.org

supports the function of nerve cells. Through molecular analyses of the tissue samples from Cairo and research on mice, Quitterer's team showed what an important role the enzyme GRK2 plays in dementia. The researchers recently published their findings in the journal Cell Reports Medicine . Two forms of the enzyme GRK2 occur in cells: a normal, functional form and a form that has been inactivated by the cellular metabolism. Quitterer and her team discovered that the inactivated form occurs in large quantities in the brain tissue of dementia patients. They were able to demonstrate the same thing in mice—specifically in a mouse model for Alzheimer's disease. The researchers also showed that the inactive form of this enzyme forms aggregates in brain cells in the event of dementia. These aggregates deposit on—and damage—the mitochondria (the "powerhouses" of the cells). "The GRK2 aggregates block the pores of the mitochondria, reducing the amount of energy they can supply and leading to a situation of stress inside the cells," Quitterer explains. In experiments on mice, the researchers also observed that the inactive GRK2 promotes the production of amyloid beta, a protein fragment that is considered a main cause of Alzheimer's. What's more, this leads to a self-perpetuating process: amyloid beta puts stress on the nerve cells and, in turn, this stress leads to the formation of more inactive and aggregated GRK2—creating a vicious circle that contributes to the progression of dementia. With a view to breaking this vicious circle, Quitterer and her colleagues developed several chemical compounds, which they tested in cell culture experiments and on mice. Here, compound 10 proved to be

Source: Futurity.org

particularly effective, preventing the GRK2 molecules from forming aggregates. As a result, the mitochondria work better, there is less deposition of amyloid beta in the cells, and the nerve cells maintain their function and do not die off. In the mice, the team also observed effects outside the brain. Compound 10 had a positive influence on heart function and aging processes. For example, the animals developed fewer grey hairs in old age. The researchers have applied for a patent on compound 10, and the basic research is now complete. “It took so long simply because everything takes so long in Alzheimer’s research,” explains Quitterer. As the researchers were investigating an age-related disease, they worked with older animals. For mice, this means an age of one and a half to two years. And it takes about one and a half to two years to complete each experiment from which conclusions can be drawn that then lead to the planning of the next experiment. “It’s all a great deal slower than in cancer research, for example.” Now, Quitterer and ETH Zurich are looking for a company that is interested in taking the next steps towards developing a drug. “Alzheimer’s is a very complex disease,” says Quitterer. Current medications do not cure the disease, but rather—at most—delay its progression by several months. “That’s why it’s so important that we’ve now identified a new target protein in the form of GRK2, as well as an active ingredient that operates via GRK2 and therefore via a different mechanism than existing Alzheimer’s drugs.” Using compound 10 in combination with other medications, it may one day be possible to

Source: Futurity.org

improve quality of life for patients. Source: ETH Zurich The post New drug slows Alzheimer’s disease in mice appeared first on Futurity .

Source: Futurity.org

What’s that smell? Tracking Yellowstone’s hydrocarbon history

What’s that smell? Tracking Yellowstone’s hydrocarbon history Subscribe to receive "Caldera Chronicles" articles via email By Yellowstone Volcano Observatory July 13, 2026 Hydrocarbons in Yellowstone? Yes indeed, there are oil seeps in the northeastern part of the park! These seeps are a consequence of the region’s long and complex geological history. Yellowstone Caldera Chronicles is a weekly column written by scientists and collaborators of the Yellowstone Volcano Observatory. This week’s contribution is from Phillip Kondracki, graduate student, and Lauren Harrison, assistant professor, in the Department of Geosciences at Colorado State University. The deep narrow canyon, with the rushing green river at its bottom and the sheer towering cliffs on its further side, forms an unusual setting for this little group of springs….all the springs and visible steam vents are confined to the lower parts of the area. Especially along the lower third of the slope, sulphur lining cracks and vents may be seen in many places. Breaking into fumaroles with the pick, one finds well-crystallized masses of it, mixed with bitumen of tarry appearance and odor. On the bench above the river’s edge, sinuous trails, resembling the marks of burrowing moles, follow the lines of cracks where the same products have been deposited. No evidence regarding the origin of this tarry substance in the fumaroles is at hand. A unique occurrence in Yellowstone Park, it seems to be best explained as a

Source: U.S. Geological Survey

distillate from organic matter buried in sediments.” – Allan and Day (1935) describing Calcite Spring hydrothermal deposits More than just thermal water discharges from Yellowstone’s hydrothermal system—there are gasses like water (H 2 O), carbon dioxide (CO 2), and hydrogen sulfide (H 2 S), minerals that precipitate from thermal waters as they cool (sinter, travertine, sulfur, orpiment, and many more), and, in some rare places, hydrocarbons. In other words, oil. The excerpt from geoscientists Eugene Allan and Arthur Day above describes Calcite Springs in the northeastern part of Yellowstone National Park, where these scientists found sulfur and bituminous hydrocarbons in the deposits around the spring. But where did this material come from and why is it only rarely observed in Yellowstone thermal waters? Hydrocarbons are chains of carbon and hydrogen atoms bonded to one another. They form the building blocks of petroleum, natural gas, oil, and coal, and they occur naturally from the thermal maturation of buried organic matter. Hydrocarbon seeps are common in the deep seafloor where the material is consumed by specialized organisms for energy (methanogenesis). Hydrocarbon seeps occur on land as well—a famous example is the La Brea tar pits in Los Angeles, California. In that location, oil discharged at the surface created asphaltic tar pits that trapped many plants and animals (including mammoths!) that scientists now study as an important fossil record of that time. Terrestrial seeps, including Calcite Springs and the La Brea tar pits, are typically found where faults or fractures form a pathway for hydrocarbons to ascend from a subsurface reservoir to the surface. Hydrocarbon

Source: U.S. Geological Survey

seeps can occur anywhere organic-bearing geologic units are buried. The thermal maturation of buried organic matter into hydrocarbons depends on temperature and proceeds through three stages: diagenesis, catagenesis, and metagenesis. Diagenesis is the first and lowest-temperature and -pressure stage. As sediments with organic material are shallowly buried they are compacted, water in the pore spaces between particles is expelled, and microbial action decomposes organic matter into methane and other hydrocarbons. At this stage, organic-rich sediments (usually from large land plants) can form peat or lignite. With continued burial of the sediments to greater depths, the pressure and temperature will increase. In a basin without volcanic activity to add extra heat, catagenesis will be achieved once the sediments are buried in several kilometers of overburden sediment and they reach temperatures of 50 to 150°C (122 to 302°F). This is the stage at which liquid petroleum, methane, and various types of coal can form. Hydrocarbons formed during catagenesis are the materials that power most of the energy needs of humans. The last stage, metagenesis, occurs where sediments are buried so deeply that the temperature and pressures climb high enough that hydrocarbons are “cooked off”, leaving only methane and carbon residue or high-grade coal called anthracite (the most energy-dense coal possible, and one that burns with little smoke or soot). With even higher pressures and temperatures, hydrocarbons are transformed into graphite. Just east of Yellowstone National Park is the Bighorn Basin, where there are many productive oil and gas wells. These hydrocarbons are thought to be sourced from Permian (the geologic period

Source: U.S. Geological Survey

299 to 252 million years ago) marine shales and other units (check out the Wyoming State Geological Survey's Oil and Gas interactive map at https://portal.wsgs.wyo.gov/arcgis/apps/webappviewer/index.html?id=d42f571b87fa4234b03d66ca7ae311a4). Permian organic-bearing marine shales likely exist in the subsurface underneath northeastern Yellowstone National Park as well and may be a source of the hydrocarbons that discharge at Calcite Springs. There are probably also some additions of hydrocarbons from buried Eocene (the geological epoch 56 to 33 million years ago) lake sediments to the hydrocarbons discharging at Calcite Springs. You may wonder if there are hydrocarbon seeps in other hydrothermal areas around Yellowstone National Park. Although some recent studies have found trace amounts of hydrocarbons in Yellowstone Lake, Lower Geyser Basin, and Norris Geyser Basin, there are no known surface discharges of oil like at Calcite Springs. This makes sense, as other hydrothermal areas within the Park are located within the caldera, where an active magmatic system is sustained , the heat flux is elevated , and volcanic activity has taken place for roughly the last 2.1 million years . All this heat and magmatism would likely have pushed any buried organic material in the subsurface into the third stage of hydrocarbon maturation, metagenesis, where it is transformed into graphite or was broken down into CO_2 and CH_4 that then discharged at the surface as volcanic degassing. The carbon cycle in action! Sources: Allen, E.T., Day, A.L. (1935) The Hot Springs of the Yellowstone National Park: Carnegie Institute of Washington Publication 466, 525 p. Clifton, C.G.,Walters,

Source: U.S. Geological Survey

C.C., Simoneit, B.R.T. (1990) Hydrothermal petroleums from the Yellowstone National Park, Wyoming, U.S.A. Applied Geochemistry 5, p. 169–191. https://doi.org/10.1016/0883-2927(90)90047-9 Related News Items per page 6 12 Label How many eruptions has Yellowstone had? January 19, 2026 How many eruptions has Yellowstone had? When trying to understand the behavior of a volcanic system like Yellowstone and the likelihood it will have another eruption, it is important to... Read Article The case of the missing sulfur dioxide at Yellowstone December 15, 2025 The case of the missing sulfur dioxide at Yellowstone Beneath Yellowstone's steaming geysers and fumaroles lies a chemical mystery: where did all the sulfur dioxide go? Read Article An Electromagnetic View of How Magma is Stored beneath Yellowstone January 13, 2025 An Electromagnetic View of How Magma is Stored beneath Yellowstone How can lightning and solar storms be used to map magma beneath Yellowstone? Through magnetotelluric imaging, which provides information about the... Read Article How much CO2 does Yellowstone emit? February 5, 2024 How much CO2 does Yellowstone emit? Assessing carbon dioxide (CO2) emissions at Yellowstone is a challenging task, but careful measurements reveal that the region collectively emits as... Read Article Scientists can now “sniff” Yellowstone gases in real time September 13, 2021 Scientists can now “sniff” Yellowstone gases in real time Much is known about how the chemical compositions of gases vary across the Yellowstone volcanic system, but how they vary in time has remained largely... Read Article Related News Items per page 6 12 Label How many eruptions has Yellow-

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Source: U.S. Geological Survey

The Tide Has Turned: Atlantic Mackerel Shows Signs of Improvement

Since 2017, NOAA Fisheries and the Mid-Atlantic Fishery Management Council have been trying to help the Atlantic mackerel population rebuild. The population has been struggling, but a recent stock assessment shows that the population is showing signs of improvement. We manage Atlantic mackerel under the Mackerel, Squid, and Butterfish Fishery Management Plan. In 2017, a benchmark stock assessment found that the mackerel population was dangerously low and overfishing was occurring. As a result, in 2019 we developed and implemented a 5-year rebuilding plan to help the mackerel population recover. That rebuilding plan was extended to 10 years after a 2021 management track assessment indicated the stock could not rebuild within the initial 5-year window. A 2023 management track assessment revealed the stock was no longer experiencing overfishing, but the mackerel population was still struggling to rebound. As a result, commercial possession limits and fishery specifications were reduced further. In September 2025, the Northeast Fisheries Science Center completed another management track assessment for mackerel using updated data through 2024. That assessment indicated the mackerel population is no longer low, and overfishing is still not occurring. Mackerel abundance from the 2024 spring bottom trawl survey was also near a record high. In 2024 egg production in U.S. waters was the highest

Source: NOAA Fisheries

since the 1980s, and estimated recruitment was the highest it’s been since 1983. While the mackerel population is showing signs of improvement, there is a substantial amount of uncertainty. Mackerel assessments have tended to overestimate terminal year recruitment in the past, and the abundance of older, larger fish in the mackerel population is low. However, the 2025 assessment results represent an improvement from the last few assessments. New Commercial Fishing Measures During its December 2025 meeting , the Council reviewed the results of the new assessment and advice from its Committees and Advisory Panels. The Council recommended increasing mackerel fishery specifications in 2026 and 2027 through Framework Adjustment 17 to the Mackerel, Squid, and Butterfish fishery management plan. In April 2026, NOAA Fisheries published an interim final rule implementing Framework 17. The new 2026 mackerel fishery specifications are almost all substantially higher than before. In particular: 2026 acceptable biological catch (15,134 metric tons) is 373 percent higher than 2025 (3,200 metric tons) 2026 annual catch limit (14,634 metric tons) is 368 percent higher than 2025 (3,126 metric tons) 2026 commercial quota (11,237 metric tons) is 1,195 percent higher than it was in 2025 (868 metric tons) Framework 17 also increased the commercial possession limits for vessels issued a federal mackerel permit. Commercial Mackerel Possession Limits by Permit Category Mackerel Permit Category Previous Possession Limit (lb/trip) New Possession Limit (lb/trip) Tier 1 limited access 20,000 lb 200,000 lb Tier 2 limited access 20,000 lb 135,000 lb Tier 3 limited access 20,000 lb

Source: NOAA Fisheries

100,000 lb Category 4 open access 5,000 lb 20,000 lb The increased fishery specifications and commercial possession limits implemented through this action will increase fishing opportunities for the commercial mackerel fleet. They will provide fishermen with relief from the reduced limits that have been in place since October 2023. New Recreational Fishing Measures In addition to increasing the commercial mackerel possession limits, Framework 17 also increased recreational mackerel possession limits. It established separate limits for private and for-hire recreational fishing. Recreational Mackerel Possession Limits Fishing Type Previous Possession Limit (per trip) New Possession Limit (per trip) Private recreational anglers 20 fish/person 25 fish/person For-hire (charter/party) vessels carrying customers 20 fish/person 50 fish/person (including captain and crew) For-hire (charter/party) vessels without customers 20 fish/person 25 fish/person These new possession limits will increase recreational fishing opportunities for mackerel, facilitating harvest of the increased specifications that were implemented for the fishery. The new limits were also responsive to feedback from the recreational fishing community. In particular, the new possession limit for for-hire vessels carrying customers is intended to address industry concerns that the previous limit discouraged people from booking mackerel trips. This resulted in a loss of business opportunities for the party/charter fleet. Next Steps and New Research Partnerships We will check the mackerel stock again in 2027. To address uncertainties in the assessment model and improve our understanding of mackerel population dynamics, we recently

Source: NOAA Fisheries

launched a new cooperative research initiative . Through this program, NOAA Fisheries scientists will partner with members of the fishing industry to collect and analyze data from mackerel through 2028. For more information, contact the Northeast Fisheries Cooperative Research Program.

Source: NOAA Fisheries

Activity Time - Word Search

Find the words below in the puzzle. Words go across or down only.

Words to Find:

I	A	L	Z	V	X	A	Q	D	U	B
B	A	R	D	X	Z	I	N	I	D	A
D	I	A	H	Y	J	P	E	J	J	O
V	U	G	U	V	Z	X	K	X	L	N
S	T	H	A	L	W	Z	K	S	G	N
Y	Q	T	C	M	P	J	G	W	G	L
X	A	Y	J	V	R	H	I	W	U	C
Z	S	S	X	C	K	X	A	Y	J	R
F	A	S	Y	T	L	F	Y	S	H	M
O	X	Y	H	P	W	K	P	M	S	X
J	W	O	H	S	H	H	Z	T	G	R