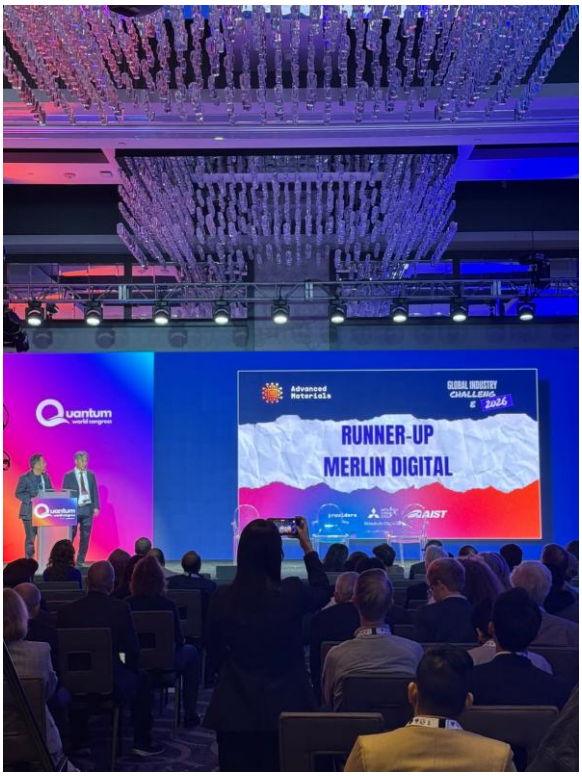
MEDIA KIT

Merlin Quantum · Runner-up, Global Industry Challenge 2026

Advanced Materials track set by Mitsubishi Chemical Group and AIST



The runner-up announcement at Quantum World Congress 2026, University of Maryland.



Eng. Hamad Al Ali (left), who leads the regional commercialisation of Merlin's quantum technology, at the Merlin Quantum stand, Quantum Innovation Summit, Dubai, September 2026.

The result in numbers

2nd	12 to 40	Minutes	7-14x	72	4
worldwide in Advanced Materials	qubits on an industrial resist	GPU training vs a published 173 hours	fewer evaluations to reach quality	qubits on hardware, past exact checking	quantum hardware vendors

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1. At a glance

Item	Detail
Award	Runner-up (second place worldwide), Advanced Materials track, Global Industry Challenge 2026
Track sponsors	Mitsubishi Chemical Group and the National Institute of Advanced Industrial Science and Technology (AIST), Japan
Organiser	Connected DMV, through the Potomac Quantum Innovation Center; platforms Aqora and qBraid
Presented	24 September 2026, Quantum World Congress, University of Maryland, College Park, USA
Winning entry	Scaling the Generative Quantum Eigensolver on an industrial EUV photoresist
Material	Tin-oxo cluster $Sn_2(\mu\text{-}O)_2$, the reactive core of metal-oxide EUV photoresists
Scale	12 to 40 qubits for the material's core calculation; workflow carried to 56 and 72 qubits; hardware measurements up to 143 qubits
Hardware	IBM Heron processors (ibm_fez, ibm_kingston, ibm_marrakesh); qualification runs on Rigetti, IQM and QuEra; NVIDIA CUDA-Q on GPU
Hardware record	About 45 hardware jobs across four vendors, 46 predictions frozen before their runs, 48 graded results
Headline results	Accuracy 74.0% to 90.4% as size grew; AI circuit-writer lifted 40.9% to 71.4%; all four resist formulations ranked correctly on hardware, within 0.3%
Team	Suhail Bachani (principal investigator), Mitul Sawlani, Zeena Furtado, Mohamed Jafrun
Regional commercialisation	Eng. Hamad Al Ali, leading commercialisation of the technology across the UAE and the region
Based in	Dubai, United Arab Emirates

2. The story in plain language

The chip-making problem

The most advanced chips are printed with extreme-ultraviolet (EUV) light. A thin film called a photoresist records the pattern: where light hits, the material changes chemically, and the pattern is then etched into silicon. As features shrink, the resist becomes one of the hardest parts of the process. It has to be sensitive enough to react to a small number of EUV photons, sharp enough to print clean edges, and stable enough to manufacture. Improving one usually worsens another.

Metal-oxide resists built around tin-oxo clusters are a leading answer because tin absorbs EUV light strongly. How such a resist behaves is decided by its electrons: how the cluster responds to a photon and how neighbouring clusters pass that energy on. Those electrons are strongly correlated, which is precisely the kind of problem where the cost of exact classical calculation grows exponentially. Merlin measured that growth on this material: the classical cost rose about 3.7 times for every 12 additional qubits of problem size.

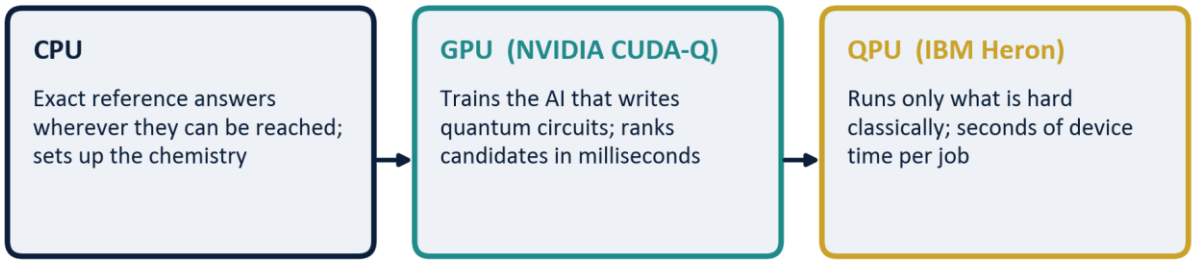
What the challenge asked

Mitsubishi Chemical and AIST asked teams to scale the Generative Quantum Eigensolver (GQE). In GQE, an AI model, similar in kind to the models that write text, proposes quantum circuits; the circuits are scored by how well they capture the molecule's energy, and the model learns to propose better ones. The published GQE work had demonstrated the idea on small molecules in simulation. The challenge was to show how far it scales, using NVIDIA's CUDA-Q platform.

What Merlin did differently

Instead of a textbook molecule, Merlin used the industrial resist core and kept the same material all the way through: classical computers for exact reference answers wherever they could be reached, GPUs to train the AI circuit-writer, and IBM quantum processors only for the parts that are hard classically. Every number in the entry was tied back to a decision a resist developer actually makes.

One material, end to end: CPU, GPU, quantum processor



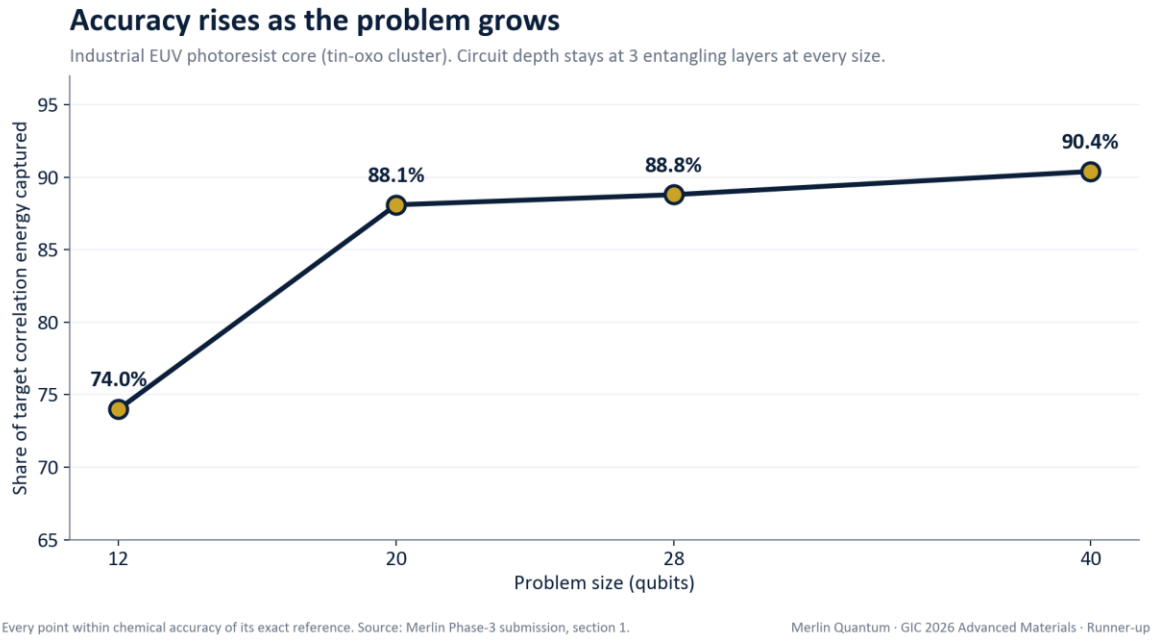
Every hardware result was predicted with error bars before the job ran, then graded against that prediction.

3. What Merlin achieved, and what each result means commercially

Result 1: accuracy rises as the problem grows

On the same material at 12, 20, 28 and 40 qubits, the share of the target correlation energy captured rose from 74.0% to 88.1%, 88.8% and 90.4%, each within chemical accuracy of its exact reference. The quantum circuits stayed at a constant depth of three entangling layers at every size; only the number of gates grew, and it grew linearly.

What it means: most quantum chemistry methods become less accurate, or too deep for real hardware, as problems grow. A method that holds shallow depth and improves with size is one that can be carried to industrial molecules on today's machines.



Result 2: the bottleneck found, then removed

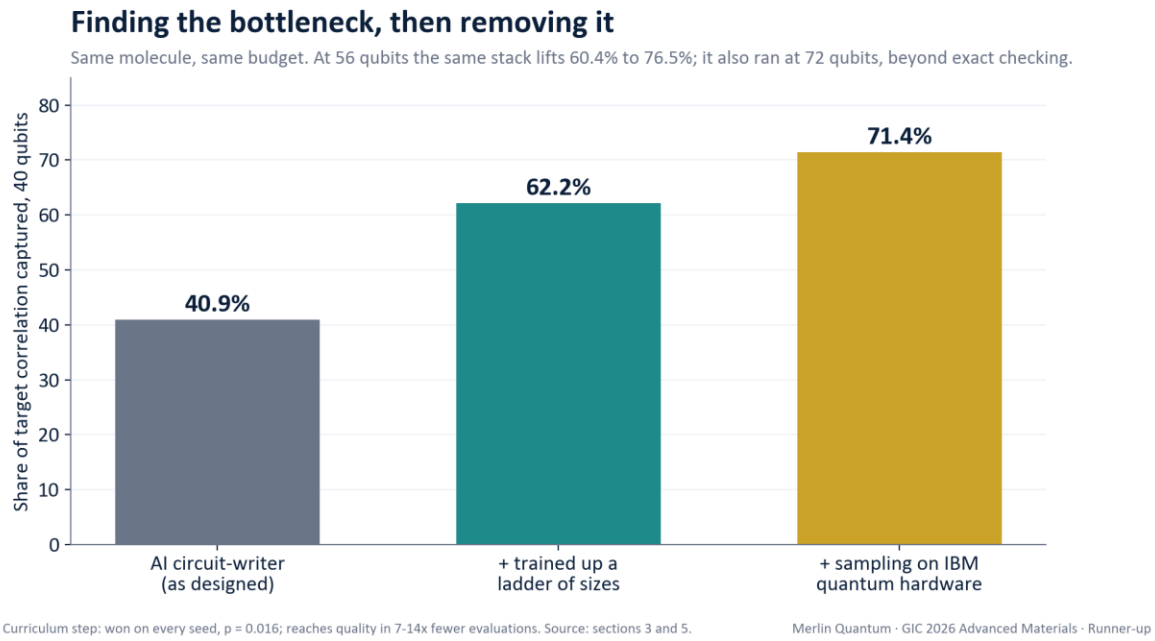
A controlled comparison on the same 40-qubit problem showed that the circuits themselves were capable (a deterministic search with the same building blocks reached 90.4%) while the AI circuit-writer reached 40.9%. The limit was the AI's search, not the quantum circuits. Merlin then trained the model on a ladder of growing problem sizes from the same material before the full problem, much as a student learns on smaller exercises first. Result: 62.2% on average, a win on every repeat with statistical significance ($p = 0.016$), and the quality level of the original reached within the first 8 evaluations instead of 56 to 112.

What it means: this turns scaling GQE into a training problem with a known fix, and cuts the number of expensive evaluations by 7 to 14 times. For anyone building on GQE, including the track sponsors' own research programme, that is a direct saving in compute cost and time.

Result 3: quantum hardware made the answer better

Merlin sampled the AI-designed state on IBM quantum processors and solved the chemistry within the space those samples picked out, a hybrid technique known as quantum-selected configuration interaction. Despite device noise, the result improved: 71.4% at 40 qubits (from 40.9%), and 76.5% at 56 qubits (from 60.4%). At 72 qubits, beyond the point where any exact classical check exists, the same pattern held, passing four tests set before the run.

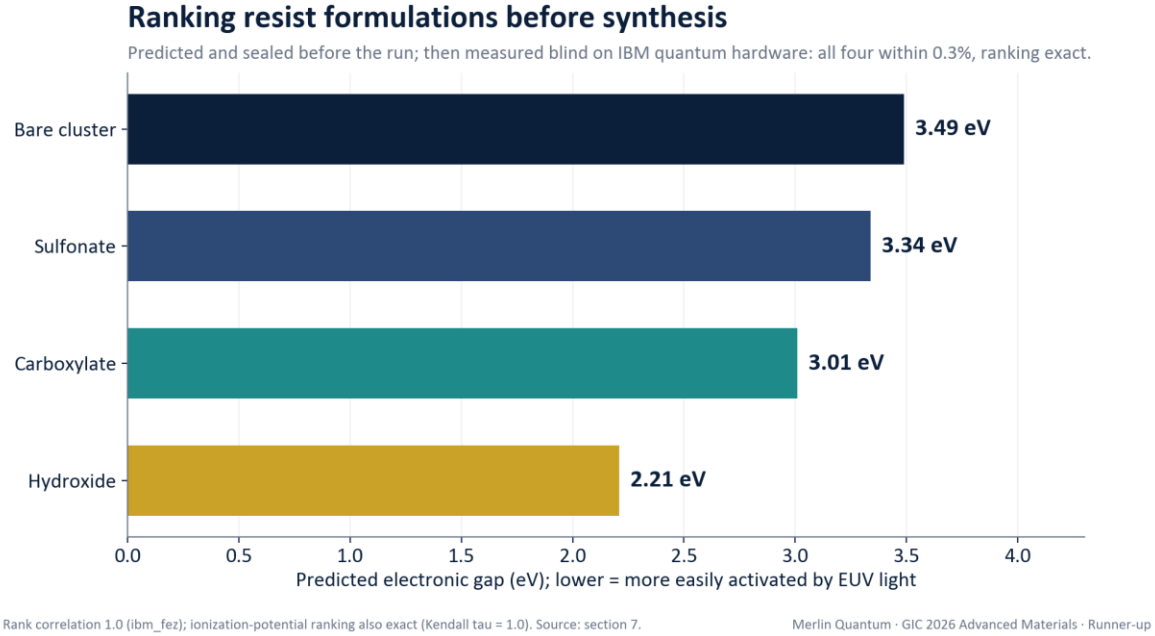
What it means: the processor contributed useful information rather than noise to be corrected away, and it kept doing so past the scale where classical verification ends. That is the regime practical quantum chemistry has to reach.



Result 4: a formulation screen, predicted then confirmed on hardware

Resist makers tune performance by changing the counter-ions around the tin cluster. Merlin calculated the electronic gap of the bare cluster and three formulations (sulfonate, carboxylate, hydroxide), which governs how readily each responds to EUV light, then sealed the predictions and measured them on IBM's ibm_fez processor. All four matched within 0.3% and the ranking was correct (rank correlation 1.0); a second ranking, by ionisation potential, was also correct.

What it means: this is the decision a resist developer makes before committing to synthesis and EUV exposure tests, which are slow and costly because EUV tool time is scarce. The hardware reproducing the predicted order shows the workflow runs faithfully on today's devices; the next step, and the purpose of a feasibility study, is testing the ranking against a customer's laboratory data.



Result 5: an advantage of route, stated and bounded

For a photoresist, the property that matters most is how it absorbs light (its absorption spectrum). The scalable classical route computes the system in 'imaginary time' and then converts to a spectrum, a conversion that is mathematically unstable: different spectra fit the same data. A quantum processor evolves the material in real time directly, so the spectrum follows from a Fourier transform with no conversion step. Merlin measured the spectrum on hardware (22 lines, median deviation 0.000–0.002 Hartree). The claim is bounded: at the sizes run, classical computers still reproduce these answers, which is how they were graded. On a 143-qubit film model, one standard classical simulator had not settled after an hour per step while the processor ran the series in one job; stronger classical methods were not tried, so this marks where the route starts to matter, not a result beyond classical computing.

What it means: a precise statement of where quantum hardware is the right tool, which is what an industrial buyer needs to plan around. A bounded, testable claim is more useful than a broad one.

4. How this moves quantum computing toward practical work

- **From benchmark molecules to industrial materials.** The target was a material behind a real manufacturing decision, and the output was a ranking a developer can act on.
- **A working hybrid workflow.** Each tool did what it is best at: CPUs gave exact answers where possible, GPUs trained the AI, the quantum processor handled what is classically hard. This is the hybrid architecture the industry expects practical quantum computing to take.
- **Verified answers, not claims.** Every hardware result was predicted with error bars before the job ran and graded against that prediction, misses included. The entry ships a repository that reproduces its reference results with one command in about ten minutes on an ordinary computer.
- **A realistic cost profile.** Total quantum processor time was minutes; production jobs used seconds each. That is the economics of a screening service, not a one-off record attempt.
- **Knowing the machine before using it.** A measured device-error model predicted which of 18 parallel experiments on a 108-qubit run would pass (17 of 18, as predicted) and located three hardware defects that the vendor's own calibration missed.

Commercial reach

The same workflow (measure accuracy against size, find the bottleneck, fix it, carry it to hardware, then run the customer's screen with predictions sealed in advance) applies wherever product performance is set by electron behaviour: photoresists and other semiconductor materials, catalysts, battery and energy materials, coatings, and molecular design in pharmaceuticals. Merlin offers it as a service to companies in these sectors.

5. Questions journalists ask

Is this 'quantum advantage'?

Merlin claims an advantage of route, stated and bounded: for a material's light-absorption spectrum, quantum hardware takes a direct path that the classical method has to approximate through an unstable conversion. At the sizes run, classical computers still reproduce the answers, which is how each one was checked. The entry did not claim that quantum hardware beats classical computers on total energy at 40 qubits or more, and says so.

What did the quantum computer actually do?

It measured properties of states designed by the AI model, including the gaps used to rank resist formulations and the material's absorption spectrum, and it supplied samples that improved the final chemistry result at 40, 56 and 72 qubits.

How do we know the results are right?

Each hardware result was predicted, with error bars, before the job ran, and graded against that prediction. Results within reach of exact classical calculation were checked against it. Job identifiers, raw data and grading scripts are in the submitted repository.

What about the 143 qubits?

143 qubits is the largest hardware measurement in the entry: a two-dimensional model of the resist film, used to show the workflow running at scale. One standard classical simulator had not settled after an hour per step; stronger classical methods were not tried, so Merlin does not describe it as beyond classical computing. The material's core chemistry calculation ran at 12 to 40 qubits, carried to 56 and 72.

Which hardware was used?

IBM Heron processors for the main results; qualification runs on Rigetti, IQM and QuEra machines; NVIDIA CUDA-Q on GPUs for training. Four quantum hardware vendors in total.

What does runner-up mean here?

Second place worldwide in the Advanced Materials track, judged against the criteria set by Mitsubishi Chemical Group and AIST.

What happens next?

Merlin is offering the workflow to semiconductor, chemicals and energy-materials companies, and extending it to other materials questions with industrial partners in the UAE, Japan and Europe. In the region, commercialisation is led by Eng. Hamad Al Ali.

6. About the challenge

The Global Industry Challenge is organised by Connected DMV through the Potomac Quantum Innovation Center, with Aqora (team formation and submission) and qBraid (compute access) as platform partners. The 2026 edition launched at CES in Las Vegas on 9 January 2026 and ran in three phases: team formation and application (to 5 April), conceptual design (to 17 May) and applied execution (to 19 July). Tracks: Advanced Materials (Mitsubishi Chemical Group and AIST); Energy Infrastructure (Quantum Computing Inc.; a U.S. federal agency); Dynamic Systems Forecasting (qBraid, MITRE and JonesTrading). Awards were presented at Quantum World Congress, 23–25 September 2026. The 2025 edition drew more than 600 innovators from over 60 countries.

7. Photos and visuals

High-resolution files are supplied in the photos and visuals folders. Credit: Merlin Quantum. Charts may be reproduced with the credit 'Source: Merlin Quantum'.

File	Caption
P1_trophy_on_stage_QWC2026.jpg	The runner-up trophy on stage at Quantum World Congress 2026.
P2_award_presentation_on_stage.jpg	The Merlin team receives the award on stage, Quantum World Congress, 24 September 2026. [Names, left to right: to be

	confirmed]
P3_announcement_Quantum_World_Congress.jpg	The runner-up announcement in the main hall, with the Mitsubishi Chemical Group and AIST track logos.
P4_trophy_closeup.jpg	The award: Connected DMV 2026 Global Industry Challenge, AIST & Mitsubishi Chemical, Runner-up, Merlin Digital.
P5_Merlin_stand_Quantum_Innovation_Summit_Dubai.jpg	The Merlin Quantum stand at the Quantum Innovation Summit, Grand Hyatt Dubai, 28–30 September 2026.
P6_Quantum_Innovation_Summit_Dubai_stage.jpg	Quantum Innovation Summit 2026, Dubai, hosted by the UAE Cyber Security Council and organised by Vernewell Group.
P7_Eng_Hamad_Al_Ali_Merlin_stand_QIS_Dubai.jpg	Eng. Hamad Al Ali (left), who leads the regional commercialisation of Merlin's quantum technology, at the Merlin Quantum stand, Quantum Innovation Summit, Dubai, September 2026.
V1 to V5 (visuals folder)	Accuracy rises with size; the bottleneck found and fixed; the formulation screen; the CPU–GPU–QPU workflow; the result in numbers.



The runner-up award.



The Merlin Quantum team at the Quantum Innovation Summit, Dubai.

8. Team, company and contacts

Challenge team: Suhail Bachani (principal investigator), Mitul Sawlani, Zeena Furtado, Mohamed Jafrun.

Regional commercialisation: Eng. Hamad Al Ali leads the commercialisation of Merlin's quantum technology across the UAE and the wider region, bringing the materials-screening workflow to industrial, government and enterprise partners.



Eng. Hamad Al Ali (left), who leads the regional commercialisation of Merlin's quantum technology, at the Merlin Quantum stand, Quantum Innovation Summit, Dubai, September 2026.

Merlin Quantum is the quantum applications division of Merlin Digital, headquartered in Dubai, UAE. It turns quantum computing into verified answers for industrial problems in materials, chemistry, energy and security, running hybrid workflows across classical, GPU and quantum hardware from multiple vendors, with every hardware result predicted in advance and graded against that prediction. merlinquantum.app

Coverage so far: Khaleej Times, 'Dubai quantum team ranks second in global advanced materials contest', 6 October 2026.

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