Intel's cryoprober for quantum research is unlike any other tool

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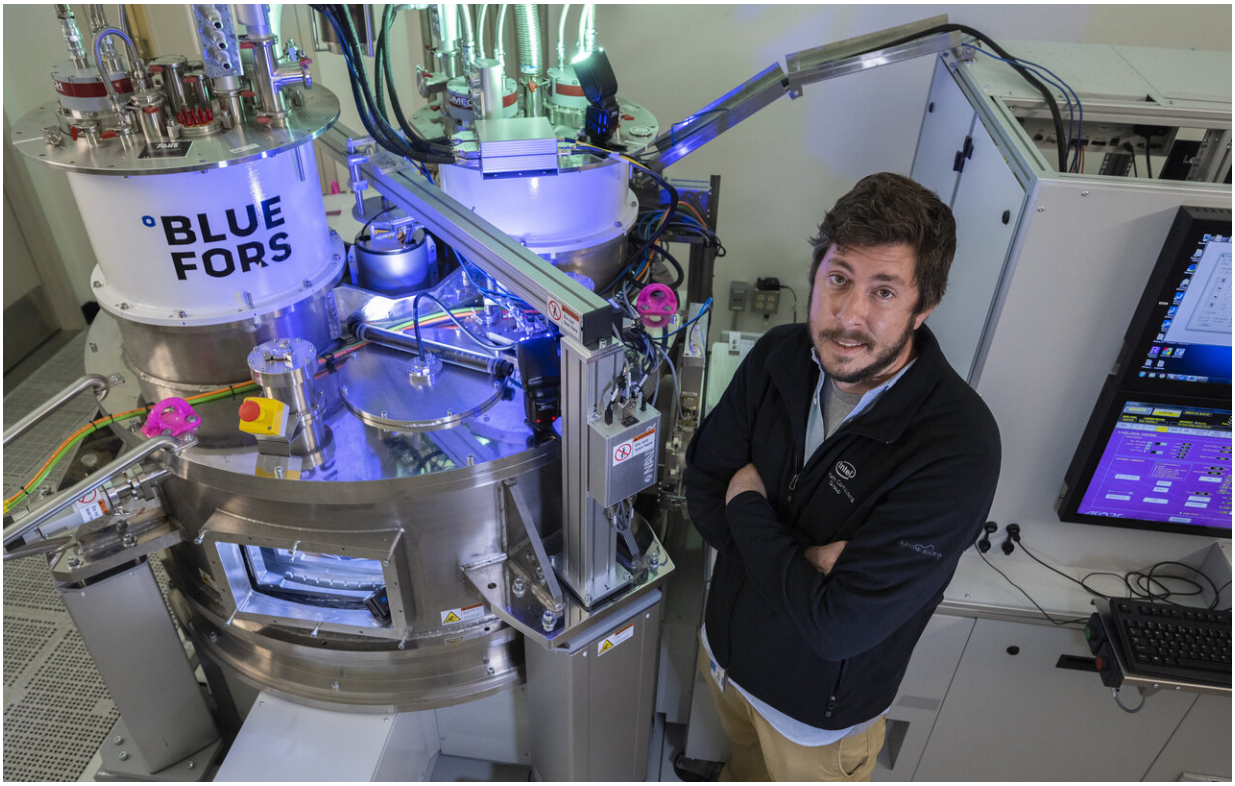

Otto Zietz, an Intel research engineer, stands with the quantum cryoprober at Intel's Jones Farm Campus in Hillsboro, Oregon. The tool can chill a 300-millimeter silicon wafer to almost absolute zero, a temperature low enough for quantum computing research. With its capacity to work with large wafers, Intel's cryoprober is the only tool of its kind in the world. Credit: Walden Kirsch/Intel Corporation

In the world of exotic high-tech tools—they can be as big as school buses and cost millions of dollars—one that sits in a lab at Intel's Ronler Acres campus in Oregon is truly unique.

It's called a quantum cryoprober. And no tool on Earth can do what it does. The cryoprober can plunge a 300-millimeter silicon wafer to the extraordinarily low temperature of 1.7 Kelvin—just a hair above absolute zero.

Intel's cryoprober is critical in the company's ongoing quantum computing research. The promise of quantum computing is to tackle enormously complex problems that are beyond even the reach of today's most powerful supercomputers.

At this week's meeting of the American Physical Society, researchers with Intel Labs and the Components Research Group are presenting 10 technical papers on quantum computing—including two that for the first time disclose technical results from cryoprober research.

Intel worked with the Finnish firms Bluefors and Afore to design and build the cryoprober. It arrived in Oregon last year, and after a shakedown period has been working steadily for the past six months.

The cryoprober has dramatically sped up the rate at which Intel engineers can perfect new microscopic computing devices like spin qubits and quantum dots. The super-low temps are necessary because—at least today—quantum computing devices only function in the extreme cold.

Ravi Pillarisetty, a research scientist at Intel, says the cryoprober has been able to speed Intel's research and testing from "a few quantum dots per week … to several hundred every day." This speed is thanks to its size. The cryoprober's heart—its vacuum can—is about 10 times more

spacious than a standard cryogenic system you might buy off the shelf for research purposes. This means it is roomy enough to fit the latest-generation dinner plate-sized silicon wafers, which can be jam-packed with quantum devices, as well as to accommodate the machine's parts that move and probe the super-chilled wafer.

Among other results, the cryoprober is helping researchers get closer to creating large arrays of qubits. Pillarisetty says Intel's vision is to create quantum computing devices that ultimately squeeze millions of individual qubits onto a single chip.

Intel is bringing the promise of commercial scale quantum computing closer to fruition, says Anne Matsuura, director of Quantum Applications and Architecture at Intel Labs, speaking at December's Intel Labs Day. A quantum computer, she says, could change the world in fields from health care, by helping design new drugs, to electronics, by helping invent new materials and chemicals.

"Intel is developing all components of the quantum computing stack," Matsuura said, including application, compiler, qubit control processor, control electronics and qubit chip device.

And Intel's research into making quantum computing scalable takes another step forward with one unique machine in Oregon.

Provided by Intel

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