COVERSIORY



WHREY'S STRANGEST' STARTUPYET

WILLIAM HURLEY'S NEW VENTURE AIMS TO RIDE THE WAVE OF THE MUCH-BALLEYHOOED QUANTUM COMPUTING REVOLUTION THAT COULD DISRUPT MULTIPLE INDUSTRIES AROUND THE GLOBE. SURE, THERE ARE PLENTY OF DOUBTERS -BUT HE ALREADY HAS **\$4 MILLION IN SEED** FUNDING IN THE BANK.

ew people have the cojones to found a compa 🖾 based VC 🖳 m. 🕮 round closed on Jan. 31. Bering services that don't yet exist based on technology that might never exist.

But, as Texas A&M University's Helmut Katzgra ber put it, "At the end of the day, it's Whurley" 🔢 as though it's self vident that the nickname for Austin serial entrepreneur William Hurley is synony 🕅 mous with preposterous.

Whurley concedes as much when describing his lat est venture, Strangeworks Inc., which will build quan tum computing software consisting of developer tools and a systems management platform.

Not crazy, clearly," said Whurley, 46, both of his index Bgers pointed at himself.

🕮 eventure capitalists at Lightspeed Venture Partners in Menlo Park, California, are betting Whurley is wily rather than wacky.

Bey led an oversubscribed \$4 million seed round in

While quantum computers for the masses might nev er materialize, many are wagering they will. Companies such as Google, IBM, Intel and Microsoft have teams of researchers toiling to improve their existing machines or build their 🕮st one. And investors have poured hundreds of millions of dollars into startups springing up around the nascent technology, which relies on the phenomena of quantum mechanics to operate.

Quantum mechanics describes the behavior and properties of atomic and subatomic particles and waves.

🖫 expected value of the worldwide quantum 🖾 m 🖭 puting market last year was \$2.7 billion, according to a July report by New York Based Persistence Market Research Pvt. Ltd. By the close of 2025, global revenue generated by the quantum computing sector will exceed \$23 billion, the report said.

Yet some physicists, like Katzgraber, are skeptical of Strangeworks that also included BoxGroup, a New York 🖭 such projections. 💷 tenured professor doubts quan 🖫



The Strangeworks team hunkered down at a favorite watering hole, Lustre Pearl East. From left: Jackson Sheehan, William Hurley, Justin Youens, David Cardona and Justin Crites.

ARNOLD WELLS / STAFF

tum computers ever will become a commodity. "I don't think that will happen in my lifetime," Katzgraber said.

Mathematician Gil Kalai goes further, while acknowledging he is in the minority: Genuine quantum computers are impossible. Full stop.

Mitigating risk

Whurley, who is a keynote speaker at this year's South by Southwest conference, knows the obstacles he faces. He remains unfazed, stating that being a successful entrepreneur is all about mitigating risk.

"In the early days of computing, you'd have to be an electrical engineer to program a computer because you had to understand the voltage at the gate level," Whurley said. "Now, most developers can't name the gates. Today, you have to be a physicist, or have a strong physics background, to program a quantum computer. No one even knows what the most signi that applications will be yet. "Here's the bet: By creating a quantum-computing ecosystem around new development tools, we'll be able to eliminate some of the complexity for developers and data scientists at large," he said. "Devy'll be able to do things on quantum computers that will change the world."

Whurley plans to formally launch Strangeworks during his SXSW keynote speech set for 2 p.m., March 13, in Ballroom D at the Austin Convention Center.

"We're humanizing the quantum computer; we're removing the barriers from quantum computing," he said.

He and his four colleagues intend to move Strangeworks on June 1 from the downtown Austin WeWork co-working space on Congress Avenue to new digs at 2922 E. Cesar Chavez St. —the current home of FloSports Inc. At 7,750 square feet, what's special about that location "is that we will be able to host quantum meetups right in the space," Whurley said. "This is cool because people can host a meetup, and then host a happy hour after at Lustre Pearl East [next door]."

Whurley said he plans to hire for "multiple positions" during the next 12 months to expand the physics, data-science and development teams.

Disrupting industries

During a lengthy conversation one recent February morning at We Work, Whurley didn't sit down. He paced back and forth, detailing his vision while repeatedly lamenting that he reserved a conference room without a whiteboard.

Others possessing a 6-foot-2inch, 200-pound frame might be intimidating. But Whurley is quintessentially Austin: approachable,

a lable, eccentric, humble. With a beard that connects to his sideburns and no mustache, Whurley esembles what an Amish farmer might look like if he embraced technology.

"I want Strangeworks to be a catalyst for world-changers," he said. "Instead of the company trying to directly change the world, we're going to make tools for world-changers like developers, data scientist, university students, geneticists, mathematicians, pharmaceutical researchers —you name it."

Whurley said the approach is a departure from what he did at his previous startup, Honest Dollar Inc.

"I founded Honest Dollar to address the savings crisis in America —it was, and remains, a big societal problem," he said. "We used technology to address that problem in a new creative way."

The company helped the self-employed and small business owners save for retirement. New York-based Goldman Sachs acquired Honest Dollar in 2016, a year to the day after its launch, for an undisclosed amount.

"After that experience, I realized there might be a better way" [to help change the world], Whurley said.

SXSW Chief Programming Officer Hugh Forrest called Whurley "a huge part of" the startup and tech scene in the Texas Capital.

"Honest Dollar was another big feather in his cap and it was so cool that Honest Dollar gained so much traction at SXSW 2016," Forrest said. Whurley's "keynote will align with one of the best traditions of SXSW, which is focusing on the next big thing long before it becomes the next big thing."

CONTINUED ON PAGE 6

CERKALERT: QUANTUM COMPUTERSEXPLAINED

Pretend you have a cat, a container olipoison, a radioactive substance, a Geiger counter and a hammer.

You put all those things in a steel box. Be are you close it, you arrange them so the Geiger counter detects the decay o the radioactive substance and tells the hammer to break open the poison container, killing the cat.

Why are you doing this to your cat? Because physics Nobel Prize winner Erwin Schrödinger said just that in 1935 to describe quantum mechanics.

Radioactive decay is impossible to predict. So you don't know when the cat will die. The only way to know i the cat is alive or dead is to open the box.

Schrödinger explained that, be be you open the box, "the cat is in a state that physicists call a superposition, with both an 'alive' component and a 'dead' component," said Scott Aaronson, David J. Bruton Centennial Prolessor of computer Science at The University of exas at Austin and director of s Quantum Information Center.

"In just the same way, an electron orbiting an atom's nucleus is in a superposition over all possible locations, until some interaction with the outside world — such as a scientist making a measurement — linces it into a definite state," Aaronson said.

OK. But why did you have to kill your cat?

Know that the Dine willingly ded her own demise, proclaiming, "Give me quantum mechanics or give me death!" be de she went into the box.

And know that she got both, at the same time, because that's how the world oll tomic and subatomic particles and waves — aka, quantum mechanics — works.

In theory, a Inctional and power in quantum computer would "exploit quantum mechanics to solve certain problems Inster" than even today's supercomputers — such as the Stampede2 supercomputer at UT, Aaronson said.

Those building a quantum computer propose "to harness nature to do computations in a undamentally different way," Aaronson said.

What hampers typical computers like the Stampede2 is that their binary digits, or bits, may have only two values: zero or one. Quantum bits, or qubits, are a superposition or bero and one values, Aaronson said.

Scientists use "amplitudes" to determine which is more likely: The qubit being a zero or the qubit being a one.

"While they're closely related to probabilities, amplitudes are not themselves probabilities — for one thing, because they're complex numbers," which can be negative, Aaronson said.

"More amplitude on the zero state, a example, means a higher likelihood of inding the result zero. The way amplitudes behave dimently from ordinary probabilities is the whole secret sauce that makes quantum mechanics interesting."

A quantum computer's qubits remain in superposition as long as they are isolated imm the outside world. But any interaction with the external environment that identifies the location or lectron orbiting an atom's nucleus, in example, would collapse that superposition.

Quantum computer researchers describe that phenomenon as "decoherence." To prevent qubit exposure to the external environment, researchers have built room-sized mezers to house the qubits at temperatures close to absolute zero, or minus 459.67 degrees Fahrenheit.

Wrong answers occur when quantum computers lose their coherence. Decoherence is the most challenging practical obstacle containting those building quantum computers, Aaronson said.

"The goal is to use quantum error correction to build qubits that maintain their coherence a long time."

- Mike Cronin

COVERSIORY



WILLIAMHURLEY, AKAWHREY

AGE: 46

FAMILY: Wife, Pamela; sons, Brooks, 21, founder of Chilligence Inc., Julian, 2, and Lincoln Tiberius, 6 months.

RESIDENCE: West Lake Hills

EDUCATION: Temple High School, Texas

KEY CAREER MLESTONES

20 18

- R Will publish book. "Endless Impossibilities." on quantum computing this summer
 - Launching Strangeworks Inc. during South by Southwest. He is a keynote speaker.
- Published book, "Quantum Computing for Babies"
- R Named a 2018 Eisenhower Fellow

20 17

- Launched the blog, Superposition:
- Herding Schrödinger's Cats Chair, IEEE Quantum Computing
- Working Group
- 2016
- Hosted President Barack Obama at SXSW. Whurley's startup, Honest Dollar, acquired by Goldman Sachs Group Inc.
- 20 15
- R Chaotic Moon acquired by Accenture PLC 2010
- 2006
- "Reluctantly" started using his Unix username, "Whurley," professionally

ARNOLD WELLS / STAF

CONTINUED FROM PAGE 5

Whurley met Adam Goldberg, a partner at Lightspeed Venture Partners, in June at a quantum-computing conference in Munich, Germany. Rey sat together on a panel that addressed what it would take for a traditional venture Imm to invest in the quantum-computing arena.

"Part of the beauty of Strangeworks is that its products will help the world cut through what's going on in this space," Goldberg said.

Physicists continue to wrestle with the hardware challenges preventing quantum computers from becoming mainstream. But "developers are far removed from" those struggles, he said. Re applications Whurley and his colleagues eventually help create would be "the ultimate prize," he said.

Companies are "pouring millions of dollars into using quantum computers because they want to harness them the moment they're available. If they're not in lockstep with the competition, they're behind," Goldberg said.

Rat's why "it makes sense to be close" to those working on quantum computers, said Bob Beauchamp, a Strangeworks investor and board chairman of Houston-based BMC Software Inc. Beauchamp served as the company's CEO for 16 years before stepping down in 2015.

"If the reality develops like many people think, it'll be the biggest game changer in the lifetime of computing," Beauchamp said. "My experience is when this many smart people focus on something, it's going to materialize in dramatically changing the way we live and work."

Ee activity around quantum computing reminds Beauchamp of the research into artificial intelligence between 15 and 20 years ago.

"Bere was a big marketing crazy; everyone was talking about it," he said. "But game-changing AI didn't exist at the time, so the marketing went away. But the research was still done and now it's paying o

Discovering a better way to make fertilizer, learning how to operate superconductors at higher temperatures and more electively scheduling airline lights are some of the potential bene is powerful quantum computers could deliver, said Scott Aaronson, the David J. Bruton Centennial Professor of Computer Science at Ille University of Texas at Austin and director of its Quantum Information Center.

"Two percent of the world's energy goes into the Haber process," said Aaronson, referring to the procedure that produces ammonia by combining nitrogen in the air with hydrogen. In turn, that ammonia is the foundation for the multibillion-dollar global nitrogen fertilizer industry

"No one understands the quantum mechanics of the Haber process; it just works," Aaronson said. "If we could understand that and found an improved method, it would pay for itself."

Software the key

The relationship among the quantum bits, or qubits, which compose a quantum computer is notoriously unstable. Another headache is the difficulty of knowing whether a quantum computer has provided the right answer to a problem.

Scientists and engineers at companies and universities are trying to construct machines with error-correction algorithms and higher "fault tolerance."

Experimentalists are working to achieve better control over their systems, so that they can ultimately implement the fault-tolerant protocols we already know and improved ones that we may come up with," said Andrew Childs, co-director of the Joint Center for Ouantum Information and Computer Science at the University of Marvland.

But "quantum computing won't take o T until software exists for it, said Bo Ewald, president of U.S. operations for Canada-based D-Wave Systems Inc., which claims to be the Ist commercial quantum computing company. Customers include Google Inc., Lockheed Martin Corp. and NASA.

Ewald served as president of then Minnesota-based supercomputing company, Cray Research Inc., and led the computing and communications division at Los Alamos National Laboratory in New Mexico.

Whurley's ellorts to develop applications and software tools aimed at subject-matter experts and computational scientists is precisely what the burgeoning sector needs, Ewald said

Yet, all this work could be for naught if mathematician Kalai is correct and true quantum computers are a fantasy.

"Quantum computers are based on building blocks," said Kalai from Jerusalem, where he is a mathematics professor at Hebrew University. He also teaches math and computer science at Yale University.

"Unfortunately, it is not possible to build strong enough building blocks," Kalai said. "It is like building a house from liquid blocks that cannot be controlled."

Still, Kalai is open to the possibility that he might be wrong.

"IBM and other companies are testing now technology for building strong enough building blocks," he said. 'Conclusions are expected in the very near future. My analysis indicates that these attempts will fail."

Kalai also said that "D-wave architecture does not rely on solid building blocks at all."

Even if he is mistaken, Kalai doubts that the age of quantum computing is near. He called constructing genuine, functional quantum computers in Ele years 'optimistic "

Maryland's Childs agreed that practical quantum computing is unlikely to occur in that timeframe, but believes "we might see reasonable evidence within the next we years that a quantum device is performing some computation that we don't know how to do classically."

But "there's a lot of basic research still to be done," Childs said. "I think it's great that industry is excited about the prospects of quantum computing, but I hope they'll take the long view."

Regardless, Whurley plans to continue "zigging when others are zagging," he said. Technology transitions "that used to take 10 years now take two," he added. He also is among those who expects "signi announcements" this year regarding quantum computing from Microsoft, Google "and possibly IBM."

"I believe the quantum-computing ecosystem race really starts in 2018. I want to make sure Strangeworks has already left the starting line. We want to build a large scale enterprise software company. We're f***ing here to stay." 💋

R Founded Honest Dollar Inc. R Co-founded Chaotic Moon LLC