

Can a Circuit Follow Quantum Rules?



Built from *Schrödinger's Circuit: A Nobel for Making the Quantum World Visible* by Ejin Chung, Science & Technology Editor

Grades 4–8 · About 45 minutes · ★ everyone · ★★ older readers

Name _____

Date _____

1. Before You Read

★ Scientists sometimes study a question just because they are curious, with no plan to make money from it. Do you think that kind of science is worth doing? Why or why not?

★ Think of something you practiced for a long time before it paid off. How long did it take, and how did you keep going?

2. The Short Version

Read this first. Older readers: read the full article too.

Quantum rules are the strange rules that tiny things, like electrons and atoms, follow. For example, a tiny particle can slip through an energy barrier, a bit like a ball rolling straight through a hill instead of over it. This is called **tunneling**. Most people believed these rules only work for very small things, never for objects big enough to see.

The 2025 Nobel Prize in Physics went to three scientists, John Clarke, Michel Devoret and John Martinis, who showed otherwise. In the mid-1980s, they worked with an electrical circuit made of metal and big enough to see. They showed the whole circuit tunneling, and taking in energy only in fixed steps, like climbing stairs instead of a ramp. Billions of electrons acted together as one quantum object.

The hardest part was keeping the circuit quiet. Quantum behavior is "shy": any careless bump or stray noise makes it act normal again. So the team cooled the circuit to nearly the coldest temperature possible and shielded it from every disturbance.

That circuit is the direct ancestor of the **superconducting qubit**, the part inside many of the world's most famous quantum computers. Getting from the experiment to those computers took forty years.

Ejin's lesson: a curious question with no money plan grew into a whole industry. But today's quantum computers still make many errors and are not yet useful products. The prize honors the real foundation, not the hype.

3. Word Bank

Word	What it means
quantum	describes the strange rules that very tiny things, like electrons and atoms, follow
tunnel	to slip through a barrier instead of climbing over it, which quantum things can do
isolate	to keep something separate and protected from everything around it
qubit	a part that follows quantum rules; many quantum computers are built from them
hype	big excitement and promises about something, often more than it has shown so far

★ Use **isolate** in a sentence of your own.

4. Check Your Understanding

★ 1. What did the three scientists show about their electrical circuit?

★ 2. About how long did it take for the 1980s experiment to grow into the quantum computer industry?

○ 4 years ○ 14 years ○ 40 years

★ 3. Ejin says the hard part was not building the circuit. What was the hard part, and why did it matter?

★ 4. How does Ejin describe today's quantum computers?

○ finished products that everyone uses ○ scientific instruments that still make many errors ○ machines that never make mistakes

★★ 5. Ejin says nobody could have honestly written a request for money (a grant proposal) for this experiment. Why not? Use the article in your answer.

5. Ejin's Scoreboard: Results, Not Demos

Ejin keeps a public scoreboard. One column shows what the hype promised. The other shows what the data has actually delivered. Find three more claims or promises in the article and fill in the scoreboard. Then mark each one:

- **proven:** the article says the results are in, and it worked.
- **not yet:** testing has started, but the results that could prove it have not arrived.
- **we don't know:** the article says nobody can tell yet, or there is not enough information to decide.

What the hype promised	What has actually been shown so far	Score
<i>Example:</i> A whole circuit, big enough to see, can follow quantum rules.	<i>In the 1980s experiment, the whole circuit tunneled and took in energy in fixed steps. It won the Nobel Prize.</i>	proven
		☐ proven ☐ not yet ☐ we don't know
		☐ proven ☐ not yet ☐ we don't know
		☐ proven ☐ not yet ☐ we don't know

★★ Pick one claim you marked "not yet" or "we don't know." What result would move it to "proven"?

6. Think Deeper

★ Ejin says the Nobel Prize honors "the foundation under the hype." What is the foundation, and what is the hype? Why does Ejin keep them apart?

★★ Ejin ends with a score: "curiosity 1, common sense 0." What did common sense say about quantum rules, and why does Ejin say curiosity won?

7. Write Your Report

- **My answer:**
- **Reason 1 (from the article):**
- **Reason 2 (from the article):**
- **One thing the other side would say:**
- **My conclusion:**

For Teachers and Parents: Answer Key

Word bank sentence: Answers vary; check that the student uses isolate to mean keeping something separate and protected from its surroundings.

1. That a whole electrical circuit, big enough to see, could follow quantum rules: it tunneled through an energy barrier and took in energy in fixed (discrete) steps, with billions of electrons acting as one quantum object.
2. 40 years.
3. Isolating the circuit: cooling it to near absolute zero and shielding it from stray noise. It mattered because quantum behavior is "shy"; if anything disturbs the circuit carelessly, it goes back to behaving normally (classically).
4. Scientific instruments that still make many errors.
5. In the 1980s, the question "can a circuit be quantum?" had no product plan, no market and no clear use. Nobody could have promised honestly that it would matter decades later, so the science had to be worth doing for its own sake first.

Scoreboard (sample answers):

Claim	Shown so far	Score
Engineers can build electrical parts that keep quantum rules.	The experiment proved circuits you can design and wire together can still tunnel.	proven
The 1980s circuit led to real quantum computer hardware.	It is the direct ancestor of the superconducting qubit used in famous quantum computers.	proven
Quantum computers will become useful machines.	Today's machines are scientific instruments; the date for a useful machine keeps sliding.	not yet or we don't know
Quantum computers can work without many mistakes.	The article says error rates are still "brutal."	not yet

Accept "not yet" or "we don't know" for claims about useful quantum computers if the student explains that the machines are not yet products. Only the circuit experiment and its link to qubit hardware are "proven." **Follow-up:** error rates dropping far enough, or a quantum computer that works as a useful machine rather than a scientific instrument.

Think deeper: Open answers. The foundation is the real, proven science: circuits that follow quantum rules, built through forty years of careful experiments. The hype is the big promises about quantum computers, which still have high error rates and are not yet useful products. Ejin keeps them apart because a prize for the foundation does not prove

the promises. For the ★★ question, common sense said quantum rules only work for tiny things and could never show up in something you can see; the three physicists refused to believe the quantum world had a size limit, and their experiment proved them right.

Report: The best-supported answer is "no" or "not yet." Look for a clear answer, two reasons taken from the article (for example: today's quantum computers are scientific instruments, not products; error rates are still brutal; the date for a useful machine keeps sliding; the Nobel honors the foundation, not the hype), a fair statement of the other side (for example: the circuit experiment is proven and won a Nobel; it led directly to the qubits in famous quantum computers; governments now treat quantum computing as important infrastructure), and a conclusion that matches the answer.