JASON: Who was it that said if you think you understand

quantum physics, you don't understand quantum physics?

[MUSIC PLAYING]

ERIC: Consciousness, intelligence--

JASON: Free will, determinism--

ERIC: Blackholes, protecting the planet from asteroids--

MASOUD: Heisenberg uncertainty principle--

ERIC: Atoms, ion traps, nuclear magnetic resonance,

superconductors, photons--

HARTMUT: Artificial

intelligence, machine learning--

JASON: Past and future, classical physics, time

travel, the whole thing.

I can tell it's going to get very hot as I start speaking.

So tell me if I start to look really shiny.

[MUSIC PLAYING]

JASON: Quantum physics puts everything into question.

ERIC: It defies every intuition you have about the

natural world.

PETE: Quantum is a very strange regime of physics.

JASON: Things can exist in this state of superposition,

where they can be ghosting on each other-- where they could

be this and that at the same time.

VADIM: Entanglement.

ERIC: Quantum entanglement.

SUZANNE: Two objects, if they're quantum mechanically

entangled, are still strongly related to each other, even

though they can be a vast distance apart.

HARTMUT: There's a notion of the multi-verse.

There's a whole family of Hartmuts in different states.

And they're going through different experiences and

different life trajectories.

MASOUD: The famous one is quantum tunneling.

ERIC: Tunneling.

PETE: Tunneling.

Tunneling.

GEORDIE: Tunneling is the slippage between universes.

ERIC: For a long time, people thought those effects only

existed in the microscopic domain.

HARTMUT: Like atoms, electrons, photons.

ELEANOR: But really, it's the theory of our universe.

ERIC: So if you want to build a quantum computer, you want

to incorporate those new phenomenon into information

processing.

JASON: Maybe quantum computation is one of those

instruments that's going to allow us to see quantum

effects at the human scale.

REPORTER: Google and NASA have teamed up to share one of the

world's first commercial quantum computers.

This machine, made by Canada's D-Wave, will be installed in a

NASA research center in California.

[MUSIC PLAYING]

JEREMY: This is the inside of one of our dilution

refrigerators.

All of this infrastructure is to basically operate the chip

at a temperature that's two orders of magnitude colder

than interstellar space.

The processor is a quantum computer.

REPORTER: --but uses things called cubits.

As well as being either one or zero, a cubit can also be both

at the same time, therefore bringing about a quantum leap

in terms of power.

JASON: Harnessing principles of reality that are, up until

very recently, completely not observable by us is just

fascinating in ways that I can't completely articulate.

GEORDIE; The overwhelmingly obvious killer app for quantum

computation is optimization.

JEREMY: Optimization problems are

extremely difficult problems.

HARTMUT: Actually, all Google server centers together will

not be capable of coming up with the best solution to

these optimization problems as they get larger.

So now, what is an optimization problem?

Here, I'll give you an example.

You want to do a trip through South America and you want to

visit a number of cities.

And then you ask, what is the cheapest ticket I can get to

visit, let's say, 20 cities?

And you can, of course, different routes

and different airlines.

And imagine I list all the different options I have from

different routes to travel to these cities.

ERIC: We currently, as a civilization, generate vast

amounts of data.

It could be climate data, genomic data.

But it's very difficult to generate useful insights,

oftentimes, from that data.

HARTMUT: If you can solve optimization problems better,

you have an important resource at your hand.

SERGIO: I think, at least, it teaches us that we shouldn't

be naive about the world, that we shouldn't think about the

world as a simple machine.

It forces us to consider more sophisticated notions of how

the reality around us is actually [? set. ?]

ELEANOR: I can't ask it how long I'll live or

the meaning of life.

Really, we don't know what the best questions

are to ask that computer.

That's exactly what we're trying to understand now.

PETE: To me, the most important

question is, are we alone?

And I have a feeling that quantum computers, as they

mature, are going to help us answer that question.

HARTMUT: This is, of course, a more

long-term research endeavor.

And there are still tremendous obstacles and big questions.

Some of those will be addressed in D-Wave, some will

be addressed at NASA, and some at Google.

ELEANOR: I wasn't sure I would be able to experiment with a

quantum computational device in my lifetime.

And now, I'm confident that I will be able to.

GEORDIE: How amazing it is that we, with our monkey

heritage and monkey brains and monkeys fingers, have somehow

lucked into a brain that allows us to ask legitimate

questions about the nature of physical reality.

That's so cool.

JASON: It's that human risk to go forth into that unknown

frontier, whether it's space exploration or quantum

exploration.

We do it because we must.

We do it because that's what it means to be human.