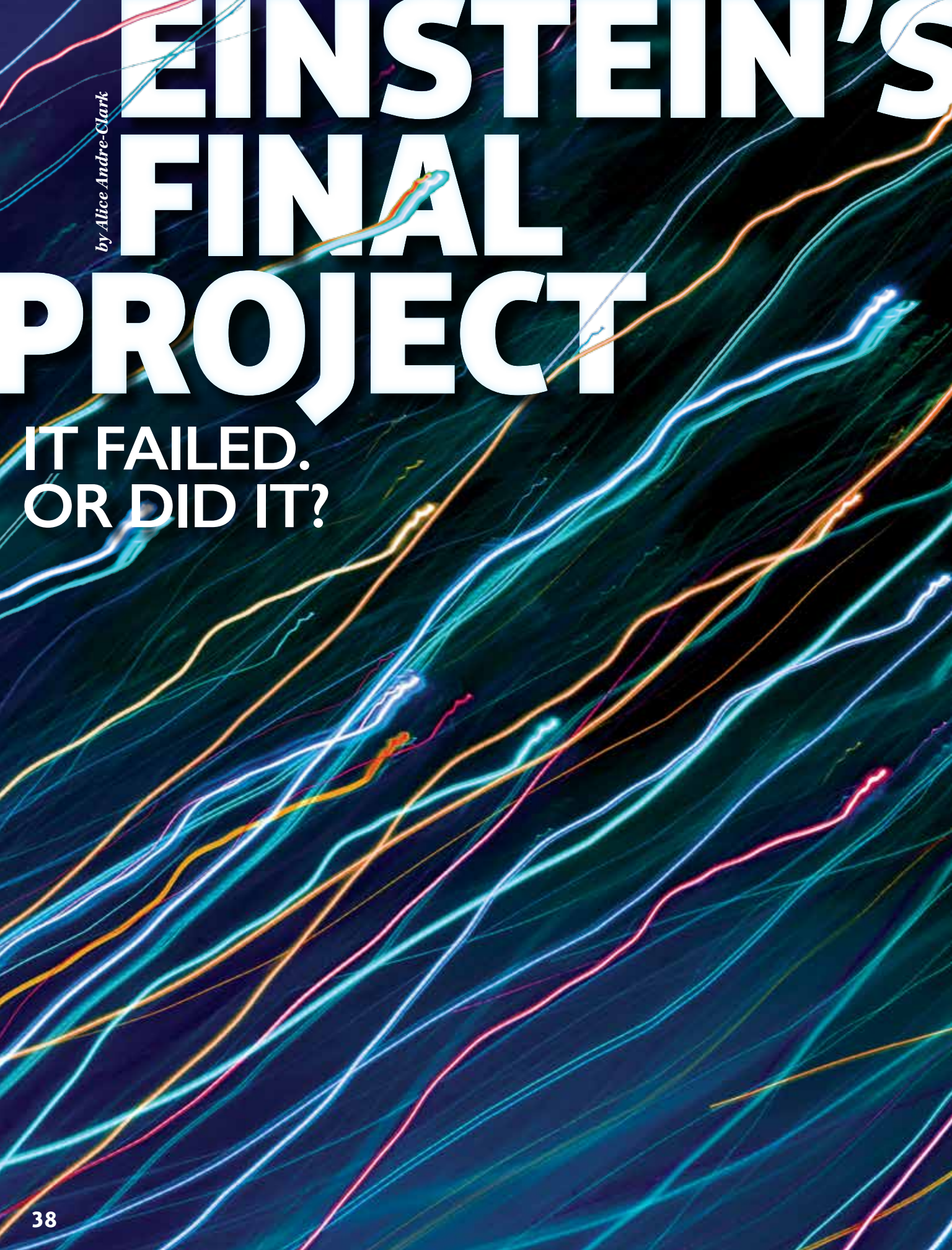
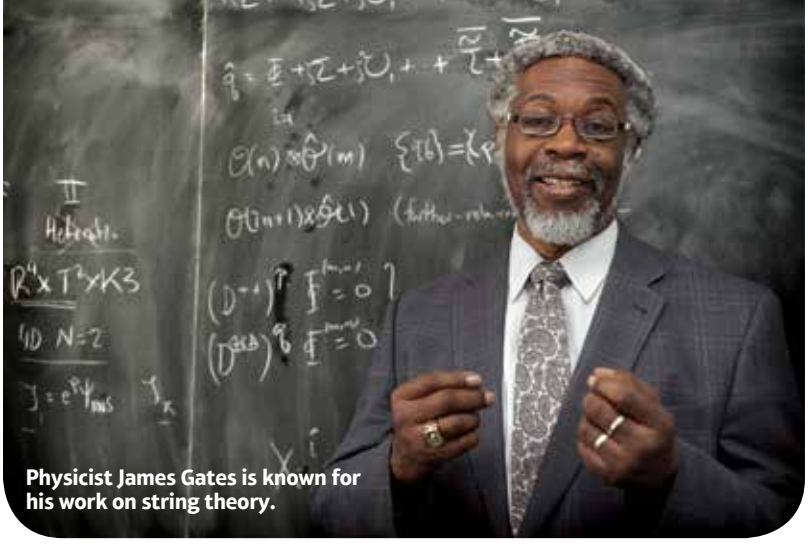
EINSTEIN'S FINAL PROJECT

by Alice Andre-Clark

IT FAILED. OR DID IT?





Physicist James Gates is known for his work on string theory.

Albert Einstein was wasting his time, claimed physicists of the mid-twentieth century. Einstein spent the last decades of his life seeking a "theory of everything"—a set of equations describing all the forces in the universe. He didn't succeed, but physicists are now hot on the trail of string theory, the idea that tiny, vibrating strings create every force.

THREE STRONG FORCES, ONE WEAKLING

Just four fundamental forces cause everything that happens in the world we perceive. One is electromagnetism. It powers lightning, lasers, cell phones, and computers. Another is the strong nuclear force that holds together particles within atoms. Breaking those bonds is what makes atomic bombs so devastating. A third is the weak nuclear force, which provides us with the sun's life-giving radiation.

The fourth force, gravity, attracts all physical bodies to one another, causing your dropped pencil to fall to the ground and Earth to orbit the sun. Every time you move, you feel gravity's effects, so you might not realize how weak it is—about 10 septillion times less powerful than the weak nuclear force. Try picking up a metal object with a small magnet, and watch the magnet overcome the gravitational pull of the entire Earth!

TWO PIECES DON'T FIT TOGETHER

Relativity does a great job describing how gravity shapes the movement of big, heavy objects like stars and planets. Another theory, quantum mechanics, explains how the other three forces work together. It has been extremely useful for predicting the movement of particles smaller than atoms. With one good set of equations for heavy objects, and another for tiny ones, most situations are covered.

However, the two theories present pictures of the universe that don't fit together very well. Relativity describes a continuous, predictable space-time fabric, while in quantum mechanics, unconnected blobs of light and other particles move more randomly. Scientists also struggle to understand objects that are both heavy and tiny, like the center of a black hole, or the universe itself at the time of the Big Bang.

STRINGS AND BRANES

Enter string theory, a set of equations explaining the heavy and the tiny. According to string theory, every particle in the universe is made up of wiggly little (very, very little) strings, as well as branes (short for membranes), sheets of the same stretchy material that come in two or more dimensions. String theory says that each of the four fundamental forces is caused by different patterns in the vibrations of strings and branes.

HIDDEN DIMENSIONS AND THE MULTIVERSE

If string theory is true, our universe may have some bizarre secrets. We observe four dimensions (including time), but many string theorists think there are actually 11 dimensions! Where are these hidden dimensions? One possibility is that they're "compactified"—rolled up into bundles too small and tight for us to see. Our universe could also be trapped inside a 3D brane, while higher dimensions appear only on other brane universes.

Other universes? Yes, many cosmologists believe we live not just in a universe, but in a multiverse. Other brane universes may be lurking just millimeters away from ours. We won't be able to see them though. Some string theorists believe that light can't move from one brane to another—but that gravity can. This may help explain why gravity is so weak: much of its force escapes our brane.

What's even stranger is that you might not be the only you. If the multiverse turns out to be infinite, universes are likely to repeat themselves. In other universes, exact copies of you may reside on identical Earths, wearing the same shirt, reading this very article this very moment. Other universes could be almost exactly like ours—say, one in which you're nearly the same you, but green-haired, ambidextrous, or (inexplicably) reading another magazine instead of this one.

This version of **Alice Andre-Clark** is a writer working in three dimensions in New Jersey. She hopes that the copies of herself working elsewhere in the multiverse are wearing nicer shirts.