

# Surfing the Folds of Spacetime

Freelance physicist A. Garrett Lisi may have figured out the most important shape in the universe – other than a surfboard.

by **SCOTT DODD**

**fq(x)**  
**Readers' Choice**

FQXi Awardee: A. Garrett Lisi, independent

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Albert Einstein famously worked as a patent clerk while pondering the mysteries of space and time. If A. Garrett Lisi's own theories of the universe pan out, he might one day be remembered for spending his most productive years living in a jungle yurt.

Einstein took the clerk job because he couldn't get one in academia -- too lazy, the establishment thought. After earning his PhD in 1999, Lisi also had problems with the academic establishment: Most positions in university physics departments were going to researchers interested in superstring theory.

Being poor sucks. It's hard to figure out the secrets of the universe when you're trying to figure out where you and your girlfriend are going to sleep next month.

- A. Garrett Lisi

Lisi, though, had his own ideas about how the cosmos is put together, and he thought string theory was too "far out" and speculative. So he followed a career path that's best described as "unusual." And also pretty darn cool. That's Lisi, in a nutshell.

Lisi managed to keep working on physics, outside of academia, squeezing by on odd jobs instead. Until last year, that is, when he won a US\$77,280 grant from The Foundational Questions Institute, allowing him to more fully pursue his theories, even without an academic post.

## Is That an E8 in Your Pocket, Or....

Before FQXi, Lisi looked either for short-term, high-paying positions that required a lot of brainpower, or jobs that paid terribly but let him work outside and devote his brain to physics. He usually tried for something with waves or mountains nearby, to allow for plenty of surfing and snowboarding.



**DID WE MENTION HE LIVED IN MAUI?**  
**A. Garrett Lisi**

So his resume includes jobs programming an artificial intelligence to play poker and calculating interplanetary spaceship trajectories, as well as snowboard instructor, Maui hiking guide and bridge builder (when he slept in the jungle yurt).

"Being poor sucks," Lisi says. "It's hard to figure out the secrets of the universe when you're trying to figure out where you and your girlfriend are going to sleep next month."

But he still thinks he made the right choice. "It's worked out even better than I hoped."

Oh, and you heard right: The near-penniless physicist has even managed to find a long-term girlfriend along the way, and not in a surfer bar. He's not a fan of bars, actually – at least not when it comes to picking up women.

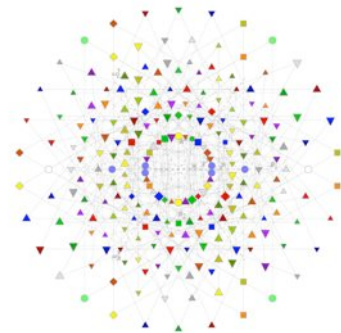
"If you're a nerd in want of affection, bars just aren't the place to look," Lisi says. "Noisy, full of drunk people, and if women are looking to hook up, it's not going to be with E8."

Ah, yes, E8. It seems that his girlfriend has some competition. E8 is what gives Lisi an outside shot to one day be remembered in the same way as Einstein, or at least as one of his successors.

## Calculus on Steroids

You see, it's possible that Lisi has figured out the most important shape in the universe. And it's not a tiny vibrating string.

Here's a picture of it (or, more accurately, a picture of a pattern that describes the shape):



**THE SHAPE OF THE SHAPE OF THE UNIVERSE? E8**

Recognize it? If Lisi's right, it should look like home. "I think our universe is this

beautiful shape," he says, "twisting around the four dimensions of spacetime we live in."

Or maybe it doesn't seem so familiar to you after all? You're not alone. Twentieth-century physics taught us that there's a whole lot about the basic structure of our universe that doesn't look the way we thought it did.



**WAVE THEORY EXPERT**

That's what leads to Lisi's work. Like many theoretical physicists, Lisi hopes to discover a so-called Theory of Everything, the elusive equation to unite Einstein's General Relativity with quantum mechanics. Relativity explains how the universe works on very large scales; quantum mechanics describes the world of tiny elementary particles. But while the two theories have passed many experimental tests on their own scales, they fail to mesh.

"The problem is, gravity doesn't work like the other interactions, and we don't know why we have the two hundred or so elementary particle fields that we do," Lisi says. So he's working on is a unified field theory that "combines gravity and all of these particles as parts of one field (a principal bundle connection) and describes the interactions via a single, beautiful, mathematical pattern."

That pattern is E8. It's a product of a branch of mathematics called differential geometry – or as Lisi sums it up, "calculus on steroids."

"In essence," Lisi explains, "I'm attempting to describe the universe as the dynamics of the most beautiful shape in mathematics, and it's working."

"This match is perfect, as far as I've been able to tell," Lisi continues. "It's still possible this theory will turn out to be wrong, and there are things about it I don't fully understand, but it's looking really good."

But you don't have to take his word for it. Check up on him yourself. Lisi maintains an online wiki at <http://differentialgeometry.org>, putting his theories and calculations out there for the entire world to see. It gets about 40 hits a day -- not bad for a site that's mostly equations, Lisi says. "The wiki is my augmented brain. It makes for a fantastic and very natural research notebook."



**HIKING A GLACIER At the FQXi Conference**

Lisi says he put his work online because he believes in the idea of the creative commons. "There is the slight possibility that others will take ideas in development and publish them as their own before I do, but I have something protecting me: my ideas are weird!"

### **But If That Doesn't Work Out....**

Lisi's ideas intrigue others in his field. He recently gave a talk about E8 to a packed room at the Perimeter Institute in Canada. "It's the most interesting theory about grand unification I've seen in a long time," said Perimeter researcher Lee Smolin, a leading theoretical physicist and FQXi Scientific Advisory Panelist.

John Baez, FQXi Member and professor of mathematics at the University of California Riverside, wrote about Lisi's work recently in his influential blog, "This Week's Finds in Mathematical

Physics." He calls Lisi a "cool dude who likes to ponder physics while living a low-budget, high-fun lifestyle."

"However," Baez said in an email for this story, "I have no idea if his E8 theory of physics actually works – that is, fits the known data. When I last studied it, lots of basic questions remained unanswered."

Lisi agrees that while his theory looks good now, "nature can have other ideas, and one needs to be cautious." He's working on a paper that will provide more details for his colleagues. Both Baez and Smolin said they're eager to read it.

After that, Lisi plans to keep pondering E8 during the next six months -- while snowboarding in Tahoe (his FQXi grant bought him a new laptop and a new snowboard). One day, Lisi says, maybe he'll settle down, maybe in a "Science Hostel" – another idea he's working on.



**CONVERTING POTENTIAL TO KINETIC ENERGY**

"It would essentially be a large house somewhere beautiful where theorists could live and work, emerging from their rooms to socialize or eat in the common areas when they felt like it." Yes, that would be ideal.

"Let me know if you have a big, spare house."