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Where I work
Fabio Deelan Cunden

Photographed for *Nature*
by Cosimo Sanitate.

The blue 'string art' here is an example of a ruled surface, a complex shape that you can generate by moving a simple straight line. The white object is a Clebsch surface, another complex surface that is based on simple equations. On the lower left are red dice of different shapes, which I selected because they provide a primitive example of what I study at the University of Bari, Italy — probability and randomness.

Specifically, I'm interested in chaotic systems. With one of these, if you pick two points that are very close, they will diverge once the system evolves. To understand this, first think of a billiards table. This is a regular, nonchaotic system. If you hit two balls at similar angles from similar starting points, you can predict that they'll end up near the same pocket. But if you add an obstacle in the middle, such as a pint glass, the system becomes chaotic and you can't predict the balls' paths.

I study chaos at the quantum level, where atoms and subatomic particles interact. At this scale, our 'billiards table' is called a quantum dot. Imagine it as a sort of box, where some electrons behave like the billiard balls. I seek to understand the chaotic motion of these electrons using random matrix theory, a type of mathematics. I'd also like to apply this approach to describe aspects of the folding of proteins and of a form of artificial intelligence called machine learning.

I often find I need some social interaction for inspiration, such as conferences or coffee with other researchers. The pandemic has made this impossible, but since I started here last December I've found an alternative in MuMa, the university's Museum of Mathematics, where I'm sitting, just upstairs from my office. It's filled with mathematical objects and ancient books by giants such as the astronomer and physicist Galileo Galilei. When I'm stuck, I head to MuMa and see others' ideas. It makes me feel part of a chain going all the way back to Galileo.

Fabio Deelan Cunden is a mathematician and theoretical physicist at the University of Bari, Italy. **Interview by Amber Dance**.