Nature's building blocks brought to life

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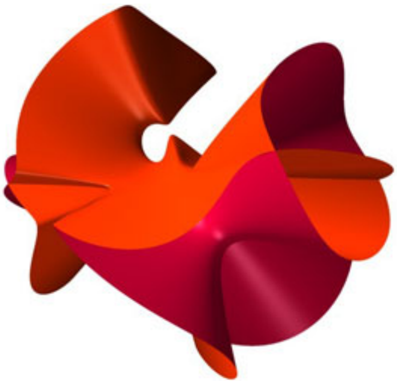


Slices of the Fano variety V6. Courtesy: Tom Coates

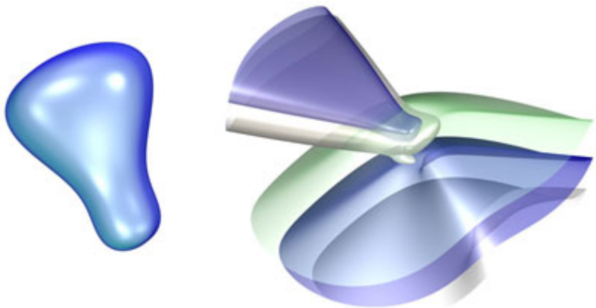
« Previous | Next »

These colourful shapes are part of a project launched last week to create a periodic table of shapes to do for geometry what Dmitri Mendeleev did for chemistry in the 19th century. The three-year project could result in a useful resource for both mathematicians and theoretical physicists to aid calculations in a variety of fields from number theory to atomic physics. But those hoping to buy the wall chart may need to invest in a bigger house as there are likely to be thousands of these basic building blocks from which all other shapes can be formed.

"The periodic table is one of the most important tools in chemistry. It lists the atoms from which everything else is made, and explains their chemical properties," says project leader Alessio Corti, based at Imperial College in the UK. "Our work aims to do the same thing for three-, four- and five-dimensional shapes – to create a directory that lists all the geometric building blocks and breaks down each one's properties using relatively simple equations."

The scientists are looking for shapes, known as "Fano varieties", which are basic building blocks and cannot be broken down into simpler shapes. They find Fano varieties by looking for solutions to a variety of string theory, a theory that seeks to unify quantum mechanics with gravity. String theory assumes that in addition to space and time there are other hidden dimensions and particles can be represented by vibrations along tiny strings that fill the entire universe.

According to the researchers, physicists can study these shapes to visualize features such as Einstein's space–time or subatomic particles. For the shapes to actually represent practical solutions, however, researchers must look at slices of the Fano varieties known as Calabi–Yau 3-folds. "These Calabi–Yau 3-folds give possible shapes of the curled-up extra dimensions of our universe," explains Tom Coates, another member of the Imperial team.



Calabi-Yau 3-folds

Coates says that the periodic table could also help in the field of robotics. These machines are operating in increasingly higher dimensions as they develop more life-like movements. Robot engineers could use the new geometries discovered for the project to help them develop the increasingly complicated algorithms involved with robotic motion.

The periodic table project is an international collaboration between scientists based in London, Moscow, Tokyo and Sydney, led by Corti at Imperial College London and Vasily Golyshev in Moscow. Given the large time differences involved, the team communicates using social media including a project blog, instant messaging and a Twitter feed. Team member Al Kasprzyk, based at the University of Sydney, says, "These tools are essential. With some of us at working in Sydney while others are asleep in London, blogging is an easy way to exchange ideas and keep up to speed."

About the author

James Dacey is a reporter for *physicsworld.com*