programmes at the Environmental Protection Agency and NASA's Wide-Field Infrared Survey Telescope.

PLAYING CATCH-UP

Some of Droegemeier's colleagues hope that he would help to shift the Trump administration's thinking on climate change. "I'm certain he believes in mainstream climate science," says Rosina Bierbaum, an environmental-policy expert at the University of Michigan in Ann Arbor who has held multiple presidential-advisory roles. Bierbaum and Droegemeier worked on climate-change issues together while on the board of the University Corporation for Atmospheric Research in Boulder, Colorado. "He's an excellent communicator and really good at distilling complex issues," she says.

The OSTP has managed to keep working without a permanent director, developing strategies to monitor space weather and boost science, technology, engineering and mathematics education. But Koizumi says that Trump would benefit from having a science adviser to consult when making decisions on issues such as natural disasters.

Because the position has remained vacant for so long, "they'll be filling from behind" to get the OSTP fully staffed, says Phil Larson, a senior adviser in Obama's OSTP who is now assistant dean of engineering at the University of Colorado Boulder. "Now the question will be, will his voice be represented around the table in the discussions that are going on at the highest levels of the government?"

And serving as the top scientist in an administration that has been criticized for its science policy could be difficult in other ways. "Droegemeier's going to get all sorts of questions," says Pielke. "There's going to be a tremendous amount of pressure." He sees a probable analogue in the experiences of John Marburger, the physicist who advised president George W. Bush.

Marburger was sharply criticized for supporting government policies that were unpopular with the scientific community — such as Bush's decision to withdraw from the Kyoto Protocol on climate change and to restrict federally funded research on embryonic stem cells. "It's going to get tough pretty quickly for [Droegemeier]," Pielke says.

It is not clear whether the White House intends to appoint Droegemeier as an assistant to the president, a position held by several recent White House science advisers — including Holdren. The title, which is separate from that of OSTP director, essentially signals close ties to the president and his top aides. An OSTP spokesperson says that any decision about whether to give Droegemeier an additional title would be made after his confirmation by the Senate. ■

AP/SHUTTERSTOCK

Kelvin Droegemeier is an expert in extreme-weather events.

TOPOLOGY

Trove of exotic matter thrills physicists

Thousands of new 'topological' materials are emerging as researchers exploit new algorithms to scour databases.

BY ELIZABETH GIBNEY

The already buzzing field of topological physics could be about to explode. For the first time, researchers have systematically scoured entire databases of materials in search of ones that harbour topological states — exotic phases of matter that have fascinated physicists for a decade. The results show that thousands of known materials probably have topological properties — and perhaps up to 24% of materials in all. Previously, researchers knew of just a few hundred topological materials, and only around a dozen have been studied in detail.

"I'm shocked by the number," says Reyes Calvo, an experimental physicist at the nanoGUNE Cooperative Research Center in San Sebastián, Spain.

In July, several teams posted preprints[1,2,3] online detailing their scans of tens of thousands of materials and their predicted topological classifications, which are based on algorithms that use a material's chemistry and symmetry to calculate their likely properties. Two teams have already integrated their algorithms into searchable databases. "You can put in a compound name and, with one click, get whether there is topology or not. For me, this is wonderful," says Chandra Shekhar, a condensed-matter physicist at the Max Planck Institute for Chemical Physics of Solids in Dresden, Germany.

The resulting haul of topological materials could bring scientists closer to practical applications for these exotic phases, which could revolutionize electronics and catalysis. "The more materials with unusual properties we know, the more chance there will be of a breakthrough," says Oleg Yazyev, a physicist at the Swiss Federal Institute of Technology in Lausanne.

These materials derive their unusual features from their topology. In mathematics, topology is the study of objects with properties that remain unchanged when they are smoothly deformed and not torn. In materials, topology applies not to the shape of a solid object, but to the geometry of an abstract description of its electrons' quantum states. Their topological ▶

nature means these states are resistant to change, and thus stable to temperature fluctuations and physical distortion — features that could make them useful in devices.

Physicists have been investigating one class, known as topological insulators, since the property was first seen experimentally in 2D in a thin sheet of mercury telluride[4] in 2007 and in 3D in bismuth antimony a year later[5]. Topological insulators consist mostly of insulating material, yet their surfaces are great conductors. And because currents on the surface can be controlled using magnetic fields, physicists think the materials could find uses in energy-efficient 'spintronic' devices, which encode information in a kind of intrinsic magnetism of particles known as spin. But despite a decade of study, physicists have yet to find a topological insulator that has properties suitable for use in devices — for example, a material that is easy to grow, non-toxic and with tunable electronic states at room temperature.

The newly released catalogues classify all non-magnetic materials with known crystal structures by their topology, using methods published last year. Until now, physicists had largely relied on complex theoretical calculations to predict whether a specific material should harbour topological states. But in 2017, Andrei Bernevig, a physicist at Princeton University in New Jersey, and Ashvin Vishwanath, at Harvard University in Cambridge, Massachusetts, separately pioneered approaches[6,7] that speed up the process. The techniques use algorithms to sort materials automatically into databases on the basis of their chemistry and properties that result from symmetries in their structure. The symmetries can be used to predict how electrons will behave, and so whether a material is likely to host topological states.

"It's up to experimentalists to uncover new exciting physical phenomena."

Applying Bernevig's principles, a team led by researchers at the Beijing National Laboratory for Condensed Matter Physics scanned 39,519 materials and found more than 8,000 that are likely to have topological states. This includes both topological insulators and topological semimetals, which allow the study of new quantum phenomena and are being explored for use as catalysts. The team's database is available for anyone to access and can be search using a range of variables.

Bernevig and his colleagues also used their method to create a new topological catalogue. His team used the Inorganic Crystal Structure Database, filtering its 184,270 materials to find 5,797 "high-quality" topological materials. The researchers plan to add the ability to check a material's topology, and certain related features, to the popular Bilbao Crystallographic Server. A third group — including Vishwanath — also found hundreds of topological materials.

Experimentalists have their work cut out. Researchers will be able to comb the databases to find new topological materials to explore. "We now have a large database of candidate materials, and it's up to experimentalists to uncover new exciting physical phenomena," Yazyev says. ■

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AWARDS

Number-theory prodigy among winners of coveted maths prize

Fields Medals awarded to researchers in number theory, geometry and differential equations.

BY DAVIDE CASTELVECCHI

Number theorist Peter Scholze, who became Germany's youngest ever full professor at the age of 24, and geometrician Caucher Birkar — a Kurdish refugee — are among the winners of this year's Fields Medals, the most coveted awards in mathematics. The medals, which are given out every four years, were presented on 1 August; the other recipients were Alessio Figalli, whose research involves differential equations, and Akshay Venkatesh, who also works on number theory. The winners' names were announced in Rio de Janeiro, Brazil, at the opening of the International Congress of Mathematicians.

The Fields Medals, given out by the International Mathematical Union, are awarded to up to four mathematicians aged 40 or younger. For the first time in the medals' 82-year history, none of the awardees are citizens of the United States or France — two countries that together have netted nearly half of the medals so far. Maryam Mirzakhani, a winner in 2014, remains the only woman ever to receive the prize. (Mirzakhani died of cancer in 2017.)

PABLO COSTA/ICM2018

Fields medallists (left to right) Akshay Venkatesh, Peter Scholze, Alessio Figalli and Caucher Birkar.

Few observers doubted that Peter Scholze deserved a Fields Medal, or that he would win one this year. The 30-year-old became famous at 22 for finding a way to drastically shorten a book-length proof in arithmetic geometry.

Scholze is now a professor at the University of Bonn in Germany, and a director at the Max Planck Institute for Mathematics in the