The EFSA assessment covered the three neonicotinoids of greatest concern to bee health — clothianidin, imidacloprid and thiamethoxam. The agency considered more than 1,500 studies, including all the relevant published scientific literature, together with data from academia, chemical companies, national authorities, non-governmental organizations (NGOs) and beekeepers' and farmers' associations. The assessment found that each of the three chemicals posed at least one type of high risk to bees in all outdoor uses.

The agency found that foraging bees are exposed to harmful levels of pesticide residues in pollen and nectar in treated fields and nearby contaminated areas, as well as in dust created when treated seeds are planted. It also concluded, on the basis of more limited evidence, that neonicotinoids can sometimes persist and accumulate in the soil, and so can affect generations of planted crops and the bees that forage on them.

"EFSA's advice is often criticized by interested parties such as NGOs and companies, but this is a good demonstration of how EFSA gives scientifically sound and impartial advice," says José Tarazona, head of the agency's pesticides unit.

A spokesperson for the global biotechnology firm Syngenta, which produces neonicotinoids, says that EFSA's conclusions are overly conservative. "When regulators make decisions about crop-protection products, what should matter is science, data and that the processes in place are respected and that the public interest is served," the spokesperson says. "Any further restrictions based on this report would be ill-conceived."

EU member states were scheduled to vote on the proposal to outlaw outdoor uses on 13 December, but postponed the vote partly because many wanted to wait until EFSA completed its evaluation.

Member states plan to discuss the EFSA assessment at a meeting of the commission's Standing Committee on Plants, Animals, Food and Feed sometime in March, says Păduraru. "The protection of bees is an important issue for the commission since it concerns biodiversity, food production and the environment." ■

SOLVIN ZANKL/NPL

Honeybees can be exposed to harmful levels of neonicotinoids in pollen, according to an EU review.

MATERIALS SCIENCE

Graphene is a surprise superconductor

Misaligned sheets of the carbon material can conduct electricity without resistance.

BY ELIZABETH GIBNEY

A sandwich of two graphene layers can conduct electrons without resistance if they are twisted at a 'magic angle', physicists have discovered. The finding could prove to be a significant step in the decades-long search for room-temperature superconductors.

Most superconductors work only at temperatures close to absolute zero. Even 'high-temperature' superconductors conduct electricity without resistance only at temperatures of up to around −140 °C. A material that displayed the property at room temperature — eliminating the need for expensive cooling — could revolutionize energy transmission, medical scanners and transport.

Physicists now report that arranging two layers of atom-thick graphene so that the pattern of their carbon atoms is offset by an angle of 1.1° makes the material a superconductor. And although the system still needs to be cooled to 1.7 degrees above absolute zero, the results suggest that it might conduct electricity much like known high-temperature superconductors — and that is exciting physicists. The findings were published in two *Nature* papers[1,2] on 5 March.

If confirmed, this discovery would be "very important" to the understanding of high-temperature superconductivity, says Elena Bascones, a physicist at the Institute of Materials Science of Madrid.

Superconductors come broadly in two types: conventional, in which the activity can be explained by the mainstream theory of superconductivity, and unconventional, where it can't. The latest studies suggest that graphene's superconducting behaviour is unconventional — and has parallels with that of other unconventional superconductors, called cuprates. These complex copper oxides have been known to conduct electricity at up to 133 degrees above absolute zero. And although physicists have focused on cuprates for three decades in their search for room-temperature superconductors, the underlying mechanism has baffled them.

In contrast to cuprates, the stacked graphene system is relatively simple and the material is well-understood. "The stunning implication is that cuprate superconductivity was something simple all along," says Robert Laughlin, a physicist at Stanford University in California.

Graphene already has impressive ▶

properties: its sheets are stronger than steel and conduct electricity better than copper. It has shown superconductivity before[3], but that occurred in contact with other materials, and the behaviour could be explained by conventional superconductivity.

Physicist Pablo Jarillo-Herrero at the Massachusetts Institute of Technology (MIT) in Cambridge and his team weren't looking for superconductivity when they set up their experiment. Instead, they were exploring how the orientation dubbed the magic angle might affect graphene. Theorists have predicted that offsetting the atoms between layers of 2D materials at this particular angle might induce the electrons that zip through the sheets to interact in interesting ways — although they didn't know exactly how.

The team immediately saw unexpected behaviour in its set-up. First, measurements suggested that the construction had become a Mott insulator[2]. These materials have all the ingredients to conduct electrons, but interactions between the particles stop them from flowing. Next, the researchers applied an electric field to feed a few extra charge carriers into the system, and it became a superconductor[1]. The existence of an insulating state so close to superconductivity is a hallmark of cuprates and other unconventional superconductors.

"These new experiments give cause for cautious celebration."

Although graphene shows superconductivity at a very low temperature, it does so with just one-ten-thousandth of the electron density of conventional superconductors that gain the ability at the same temperature. In conventional superconductors, the phenomenon is thought to arise when vibrations allow electrons to form pairs, which stabilizes their path and allows them to flow without resistance. But with so few available electrons in graphene, the fact that they can pair up suggests that the interaction at play in this system is much stronger than what happens in conventional superconductors.

Graphene-based devices will be easier to study than cuprates, which makes them useful platforms for exploring superconductivity, says Bascones. For example, 'tuning' cuprates to explore their different behaviours means growing and studying reams of different samples; with graphene, physicists can achieve the same results by simply tweaking an electric field.

Physicists cannot yet state with certainty that the superconducting mechanism in the two materials is the same. And Laughlin adds that it is not yet clear that all the behaviour seen in cuprates is happening in graphene. "But enough of the behaviours are present in these new experiments to give cause for cautious celebration," he says. ■

1. Cao, Y. *et al. Nature* http://dx.doi.org/10.1038/nature26160 (2018).
2. Cao, Y. *et al. Nature* http://dx.doi.org/10.1038/nature26154 (2018).
3. Ichinokura, S., Sugawara, K., Takayama, A., Takahashi, T. & Hasegawa, S. *ACS Nano* **10**, 2761–2765 (2016).

POLLUTION

China tests giant air cleaner to combat urban smog

Prototype produces clean air and offers an innovative solution to a public-health hazard.

BY DAVID CYRANOSKI

A 60-metre-high chimney stands in a sea of high-rise buildings in one of China's most polluted cities. But instead of adding to Xian's smog, this chimney is helping to clear the air. The outdoor air-purifying system, powered by the Sun, filters out noxious particles and billows clean air into the skies. Chinese scientists who designed the prototype say that the system could significantly cut pollution in urban areas in China and elsewhere.

The technology has intrigued researchers — especially in China, where air pollution is a daily challenge. Early results, yet to be published, are promising, says the project's leader, Cao Junji, a chemist at the Chinese Academy of Sciences' Key Laboratory of Aerosol Chemistry and Physics in Xian in central China.

"This is certainly a very interesting idea," says Donald Wuebbles, an atmospheric scientist at the University of Illinois at Urbana-Champaign, who has heard about the system but not seen it in action. "I am not aware of anyone else doing a project like this one."

The prototype, built with US$2 million in funding from the provincial government, has also caught the attention of the president of the Chinese Academy of Sciences, Bai Chunli, who visited the site last month. Cao says Chinese leaders are eager for solutions to air pollution because it creates such a widespread public-health problem. The Global Burden of Disease Study for 2015, a comprehensive effort to map the world's diseases, found that pollution contributed to 1.1 million premature deaths in China in that year alone.

Cao has submitted a proposal for another tower in Xian, this one 300 metres tall. He is also negotiating proposals with cities in Guangzhou, Hebei and Henan. But the technology has its sceptics, who say that there are much cheaper ways to reduce air pollution.

The concrete chimney sits on top of a

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