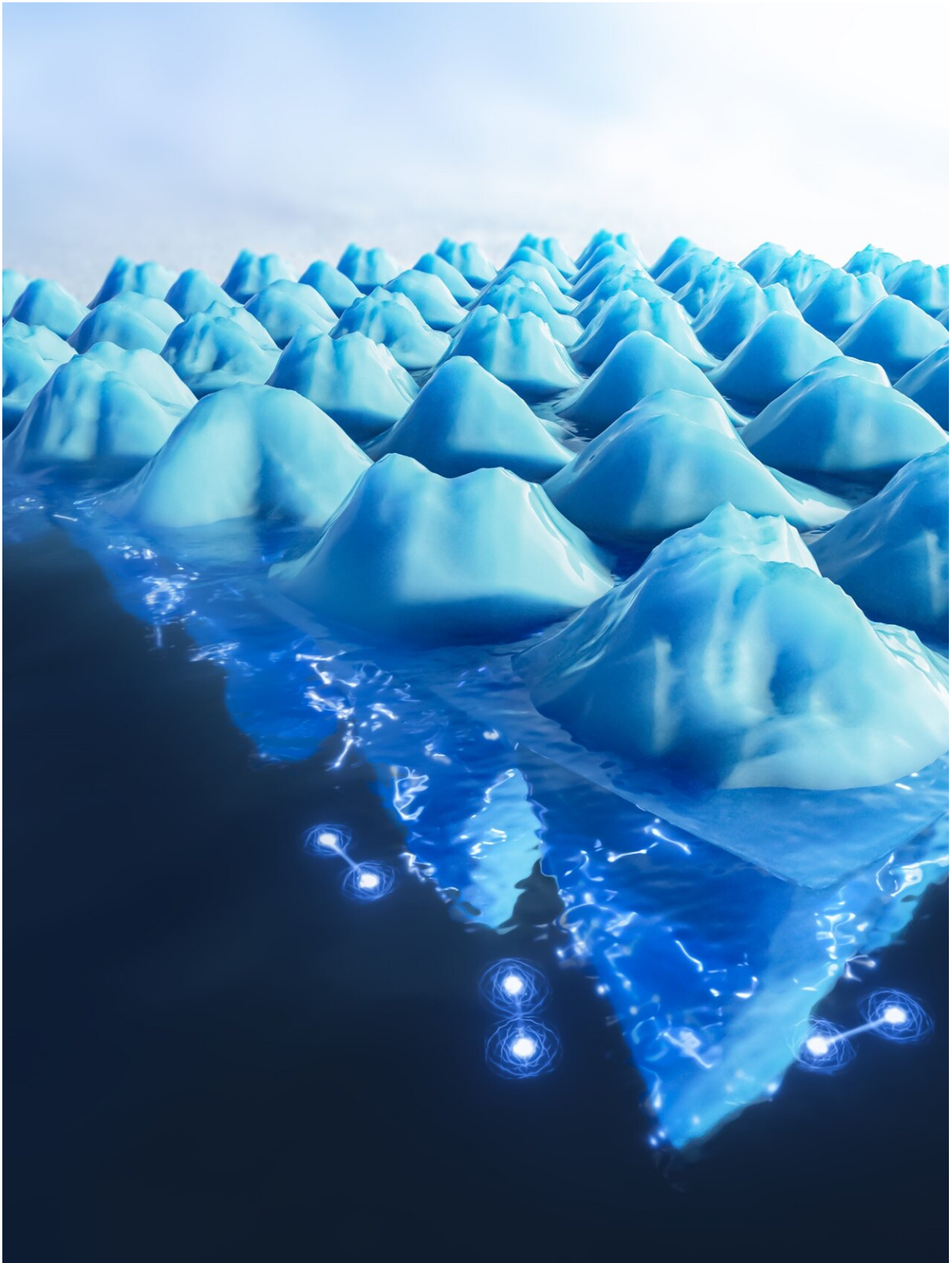


Quantum materials quest could benefit from graphene that buckles

August 12 2020, by Todd Bates



Simulated mountain and valley landscape created by buckling in graphene. The bright linked dots are electrons that have slowed down and interact strongly.
Credit: Yuhang Jiang

Graphene, an extremely thin two-dimensional layer of the graphite used in pencils, buckles when cooled while attached to a flat surface, resulting in beautiful pucker patterns that could benefit the search for novel quantum materials and superconductors, according to Rutgers-led research in the journal *Nature*.

Quantum materials host strongly interacting electrons with special properties, such as entangled trajectories, that could provide building blocks for super-fast quantum computers. They also can become superconductors that could slash [energy consumption](#) by making power transmission and [electronic devices](#) more efficient.

"The buckling we discovered in graphene mimics the effect of colossally large magnetic fields that are unattainable with today's magnet technologies, leading to dramatic changes in the material's [electronic properties](#)," said lead author Eva Y. Andrei, Board of Governors professor in the Department of Physics and Astronomy in the School of Arts and Sciences at Rutgers University-New Brunswick. "Buckling of stiff thin films like graphene laminated on flexible materials is gaining ground as a platform for stretchable electronics with many important applications, including eye-like digital cameras, energy harvesting, skin sensors, health monitoring devices like tiny robots and intelligent surgical gloves. Our discovery opens the way to the development of devices for controlling nano-robots that may one day play a role in biological diagnostics and tissue repair."

The scientists studied buckled graphene crystals whose properties change

radically when they're cooled, creating essentially new materials with electrons that slow down, become aware of each other and interact strongly, enabling the emergence of fascinating phenomena such as superconductivity and magnetism, according to Andrei.

Using high-tech imaging and computer simulations, the scientists showed that graphene placed on a [flat surface](#) made of niobium diselenide, buckles when cooled to 4 degrees above absolute zero. To the electrons in [graphene](#), the mountain and valley landscape created by the buckling appears as gigantic magnetic fields. These pseudo-magnetic fields are an electronic illusion, but they act as real magnetic fields, according to Andrei.

"Our research demonstrates that buckling in 2-D materials can dramatically alter their electronic properties," she said.

The next steps include developing ways to engineer buckled 2-D materials with novel electronic and mechanical properties that could be beneficial in nano-robotics and quantum computing, according to Andrei.

The first author is Jinhai Mao, formerly a research associate in the Department of Physics and Astronomy and now a researcher at the University of Chinese Academy of Sciences.

More information: Evidence of flat bands and correlated states in buckled graphene superlattices, *Nature* (2020). [DOI: 10.1038/s41586-020-2567-3](#) , www.nature.com/articles/s41586-020-2567-3

Provided by Rutgers University

Citation: Quantum materials quest could benefit from graphene that buckles (2020, August 12)
retrieved 24 April 2024 from

<https://phys.org/news/2020-08-quantum-materials-quest-benefit-graphene.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.