PLANETARY SCIENCE

Condensation over Cthulhu

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On its journey to the Kuiper belt, the New Horizon spacecraft passed by Pluto in 2015, delivering stunning images of the Cthulhu region. The high-altitude mountain chains in its eastern part resemble the snow-covered alpine summits, but instead of water, this frost contains methane. However, in which form — methane-rich ice, methane diluted in nitrogen-rich ice or a mixture of both — and how these icy patches were deposited remained unclear.

Tanguy Bertrand and colleagues have now determined that the frost patches in the Cthulhu region predominantly consist of methane-rich ice. They studied the deposition with high-resolution numerical climate simulations, which suggest that, above a few kilometres in altitude, methane is enriched in the atmosphere. Mountains that reach these heights can

locally cool the air, triggering methane condensation and the formation of methane-rich ice. This process differs from snow formation on Earth's mountain tops, and could explain the origin of other methane-rich areas on Pluto. SR

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FLUID DYNAMICS

Balm for the bug

Phys. Rev. Fluids **5**, 102301 (2020)

We now know that talking in a confined space likely aids the spread of SARS-CoV-2, the virus leading to COVID-19. But the mechanism by which salivary droplets form during speech is far from clear. Case in point: we know that consonants create more droplets than vowels, but we don't know how. Now, a study by Manouk Abkarian and Howard Stone implicates saliva viscoelasticity and airflow as key factors in the process — and hints at how to stop it.

The pair imaged a speaker pronouncing a series of sounds and found that the action of pressing one's lips together to form a consonant creates a microscopic lubrication layer. This layer stretches into a thin vertical film, which becomes unstable and breaks up into filaments. The fast airflow that follows — in a 'pa' or a 'ba' — causes some of the filaments to break and whip outwards towards the unwitting listener.

In good news, the authors found that applying lip balm could impede the mechanism by breaking the filaments before they stretch, and reducing the cumulative number of droplets produced. AK

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SUPERCONDUCTIVITY

Nickel and dime

Phys. Rev. Lett. **125**, 147003 (2020)

Ever since superconductivity was discovered in a new structural form of doped NdNiO₂ — so-called infinite-layer nickelate — the race has been on to try and understand whether this material can shed light on the superconducting mechanism in cuprates and other strongly correlated oxides. In such materials, superconductivity arises when a parent magnetic compound is doped, and so the role of doping in the infinite-layer nickelates is an important question.

Now, Shengwei Zeng and collaborators have carried out a careful study of the superconductivity as a function of doping, and produced the phase diagram. They showed that it has a cuprate-like superconducting dome, but that the superconductivity was weakened slightly in the middle of the dome due to multiband effects. Outside of the superconducting region, the ground state was weakly insulating, indicating a substantial difference from the cuprates. So, is this new nickelate like the cuprates? Well, kind of. DA

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PHASE TRANSITIONS

Unmeltable

Phys. Rev. D **102**, 065014 (2020)

Phases of matter can often be classified by their broken symmetries. For instance, ferromagnets break rotational symmetry by having a particular magnetization direction. Heating up the magnet causes thermal fluctuations that destroy the long-range magnetic order. It seems natural that this symmetry restoration should happen once any system gets hot enough. Now, Noam Chai and co-workers have shown that some models defy this intuition.

At the critical point of a phase transition, fluctuations occur at all length scales, making the physical response scale invariant. The authors considered theories where this includes thermal energy scales, so that one non-zero temperature is equivalent to any other. They found that a class of finite-temperature 'biconical' models can have a broken symmetry. Applying the equivalence between different temperatures, their result demonstrates that — in theory — symmetry-broken phases of matter could persist to any temperatures. RB

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NANOPHOTONICS

A show of magnetic force

Nano Lett. **20**, 7627–7634 (2020)

For now, light-propelled spacecrafts remain science fiction, but optical tweezers routinely move microscale objects such as cells with the help of optical forces generated by the electric field of a focused laser beam. However, it is much more difficult to access the forces associated with the magnetic component of light. Martin Poblet and colleagues have now measured the magnetic forces generated by the near fields of a dielectric nanostructure by using photoinduced force microscopy.

The team designed a nano-antenna supporting a so-called anapole mode, which has a strong magnetic component to its near field. By choosing a silicon tip rather than a metal-coated one, they were able to map not only the stronger out-of-plane forces but also the in-plane magnetic forces with strengths up to 20 pN around the antenna. This provides a means to access and better understand optical magnetic forces at the nanoscale. NM

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