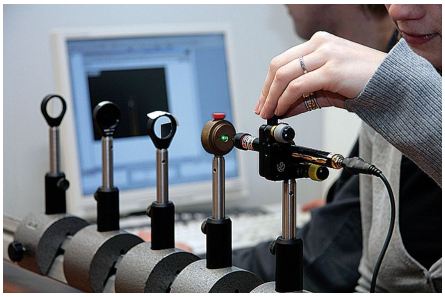
research highlights

PHYSICS EDUCATION

Labs in the lab

Phys. Rev. X **10**, 011029 (2020)



Credit: PvE / Alamy Stock Photo

Most scientists can remember boring undergraduate lab classes. You knew what the experiment should do because you had already learned about it in the lecture: the main task was to get everything to work. Now, Emily Smith and collaborators show that lab classes that aim to teach experimentation skills are arguably better than traditional content-reinforcement labs.

One half of a cohort of students took lab classes that closely followed the lecture course and aimed to demonstrate its content. The other half were given lab classes that did not follow lecture material, but instead taught experimental skills as an end in their own right. As the semester progressed, less direction was given, forcing students to design their own experiments and make their own decisions.

Exam results were the same for both streams, but students taking the experimental skills labs reported significantly higher engagement with the classes and better long-term attitudes towards experimental physics. *DA*

https://doi.org/10.1038/s41567-020-0848-2

ECOLOGY

Dance of the honeybee

Nat. Commun. **11**, 625 (2020)

The waggle dance is a movement performed by honeybees, which encodes spatial information about foraging sites. The orientation and duration of the dance tells other bees the location of resources. But Bees have more ways of guiding fellow foragers — for example through olfactory cues — and the role of dance compared to odours is unclear. Matthew Hasenjager and colleagues have now found that bees use dance to communicate the location of new feeding sites and rely on olfactory information to remind each other of existing sites.

The team used social network analyses to investigate the relative importance of the different ways in which honeybees communicate information. They constructed a network for each type of signal and compared them to experimental observations to see which network best represented bee interactions. They found that dance plays a key role when bees discover new foraging locations. The findings might aid understanding of which factors led to the evolution of honeybee dance communication. *ED*

https://doi.org/10.1038/s41567-020-0849-1

IMAGING

To see a quantum bird

Sci. Adv. **6**, eaay2652 (2020)

The spatial correlations of entangled photon pairs lie at the heart of many quantum applications — most famously in secure communication protocols. But they can also be used to distinguish a signal from a background, which can be extended to imaging applications. Thomas Gregory and colleagues have now implemented a full-field quantum imaging method where correlations help separate an object from a thermal background.

Gregory and colleagues illuminated an object — the silhouette of a bird — with one half of an entangled photon pair while the other passed through free space. The two photons arrived at distinct areas of the electron-multiplying charge-coupled device camera, and the team could then use a simple AND operation between pixels to learn which signals came from the quantum source and which were background or noise — even when they overlaid a cage illuminated by an uncorrelated thermal light source onto the bird image. This contrast enhancement through quantum illumination could be extended to other applications like LIDAR. *NM*

https://doi.org/10.1038/s41567-020-0850-8

QUANTUM ANOMALOUS HALL EFFECT

Free from doping

Science https://doi.org/dmwz (2020)

The quantum Hall effect was originally observed in two-dimensional electron systems subjected to a magnetic field. Crucially, the magnetic field leads to nontrivial band topology and breaks time-reversal symmetry. A ferromagnetically ordered topological insulator simultaneously satisfies these two requirements so that the effect can occur even without an external field; this is referred to as the quantum anomalous Hall effect. Yujun Deng and co-workers have now reported the observation of this anomalous effect in an intrinsic magnetic topological insulator $MnBi_2Te_4$.

A quantized anomalous Hall response has been observed previously in a doped topological insulator. Doping endows the material itself with magnetism, but there is a caveat — the dopants act as impurities that limit the quality of the material. $MnBi_2Te_4$ is a topological insulator with intrinsic magnetic order from the Mn^{2+} ions, allowing the study of the quantum anomalous Hall effect in pristine crystals. Deng and co-workers showed that a quantized Hall response can be achieved under more relaxed conditions. *YL*

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ACCELERATOR PHYSICS

Of mice and muons

Nature **578**, 53–59 (2020)

Due to the muon's larger mass compared to the electron, synchrotron radiation losses would be much lower at muon than at electron colliders, allowing for more compact colliders. However, the quality of muon beams is not good enough yet to be used in such a machine. Part of the reason lies in the production mechanism of muons: by shooting protons onto a target, pions are created that can decay further into muons. Thus, the brightness of the muon beam is too low to collide it with its antiparticles.

The MICE collaboration demonstrated ionization cooling, where muons are passed through an absorber material, losing momentum through ionization. The trick to increasing the beam brightness is then that the lost momentum is only restored in the direction of the beam by radio-frequency cavities. These results represent a milestone for the development of muon colliders. *SR*

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David Abergel, Elizaveta Dubrovina, Yun Li,
Nina Meinzer and Stefanie Reichert