**Quantum Electronics**

Inducing strong coupling

Quantum dots, or artificial atoms, are being pursued as prospective building blocks for quantum information processing architectures. Communication with other, distant quantum dots requires strong coupling between photons and the electronic states of the dots. Mi et al. used double quantum dots defined in silicon and embedded in a superconducting cavity to achieve such coupling. This demonstration in an industry-relevant material bodes well for the large-scale development of semiconductor-based quantum processors. —ISO

Science, this issue p. 156

**Cell Biology**

Phages build themselves a wall

The compartmentalization of DNA replication away from other cytoplasmic events is a key feature of the cell nucleus. Chaikeeratisak et al. studied the replication of the very large Pseudomonas bacteriophage 201a2-1 by using fluorescence microscopy and cryo-electron tomography. They found that the phage assembled a nucleus-like compartment when it infected a bacterial cell. The phage genome was completely enclosed by an apparently contiguous protein shell, within which DNA replication, recombination, and transcription occurred. Translation, precursor biosynthesis, and viral assembly occurred outside the structure. —SMH

Science, this issue p. 194

**Neuroscience**

Channeling pain through GPCRs

Mutations in Na$_{1.7}$ result in the absence of sensitivity to pain, but drugs targeting this sodium channel are not effective as pain relievers. Isensee et al. found that the absence of Na$_{1.7}$ altered the signaling efficiency of G protein–coupled receptors (GPCRs) in pain-sensing neurons of the spinal cord. Normally, pain-promoting serotonin receptor signaling is balanced by pain-relieving mu opioid receptor signaling. In mice lacking Na$_{1.7}$, the balance was shifted so that the opioid arm dominated, resulting in neurons that were less active and more responsive to pain-relieving signals. —NRG


**Quantum Fluids**

Observing peculiar vortices

When a vessel filled with a superfluid is rotated, the superfluid, instead of moving with the vessel the way water would, develops an array of whirlpools called vortices. The flow around a vortex is “quantized,” characterized by discrete, integer numbers. It has long been suspected that in a particular kind of superfluid—$^3$He at very low temperatures—it would be possible to observe vortices that are associated with half-integer numbers. Autti et al. observed the signature of these half-quantum vortices (HQVs) in the nuclear magnetic resonance (NMR) spectra of superfluid $^3$He confined in a porous medium. Pairs of HQVs caused the appearance of an additional NMR peak, whose position and dependence on the various parameters were consistent with theoretical expectations. —JS


**Medical Diagnostics**

Fast point-of-care detection of biomarkers

Many diseases can be diagnosed by detecting nucleic acid or protein biomarkers, but, with few exceptions, this detection requires complex and costly instruments. Du et al. adapted commercially available pregnancy kits for affordable and fast point-of-care diagnostics. In the detection method, nucleic acid is first amplified and then captured by a DNA oligonucleotide–human chorionic gonadotropin conjugate. The latter is detected by the commercial kits. The method allowed detection of just 20 copies of an Ebola virus template and could distinguish a melanoma-related biomarker from the wild-type sequence. It should be possible to adapt it for low-cost detection of other biomarkers in clinical settings. —JFU

CANCER BIOLOGY

Cancer and nerves: A tuf(t) partnership

Stomach tumor growth is accompanied by an expansion of surrounding nerves. Whether and how these two events are functionally related has been unclear. Studying mouse models, Hayakawa et al. showed that a molecular conversation occurs between nerves and the epithelial cells that give rise to cancer. This cross-talk relies in part on tuft cells, a mysterious cell type in the epithelial lining of the gastrointestinal tract. Tuft cells and nerves produce the neurotransmitter acetylcholine, which stimulates expression of nerve growth factor (NGF) in the gastric epithelium. NGF in turn acts to promote neuronal expansion and aberrant growth of gastric epithelial cells, which ultimately leads to cancer. Drugs that block NGF signaling inhibited gastric tumor growth in mice. —PAK

METEOROID STREAMS

Did Phaethon father the Geminids?

Meteor showers are caused by Earth passing through a stream of debris left by a comet. The Geminids shower seems to originate from (3200) Phaethon, but that is an asteroid, not a comet, with an unusual elliptical orbit that takes it close to the Sun. Hui and Li examined images of Phaethon as it passed the Sun in August 2016, showing that it generated a small tail. Although this comet-like behavior could feed the meteor stream, the mass of material ejected is far too small. If Phaethon is indeed a comet, it must have been much more active in the recent past. —KTS

Effects of drought on tree performance

Global climate change has many components, with temperature and precipitation dominating. Grossiord et al. experimentally compared the effects of temperature increase and precipitation reduction on pinyon pine trees in a warm semiarid site in New Mexico, USA. The 3-year experiment in open-topped chambers revealed that temperature increase on its own had little effect on tree physiology and morphology, whereas drought had pronounced effects: Low precipitation led to reductions in photosynthesis and needle growth, among other plant traits that the authors examined. In addition, there were no discernible synergistic effects of drought and increased temperature. It appears that reduced precipitation will be the driving force in any ecological change that results from changed plant performance. —AMS


MICROBIOTA

Gut communities form a history of connection

An individual’s gut microbial community is nested within a “cloud” of the shared microbiota of relatives, friends, and acquaintances. Unique combinations of selective pressures, including antibiotics and diet, shape an individual’s microbiota. Using gnotobiotic mice as a lens for humans, Griffin et al. observed the effect of plant-rich, calorie-restricted diets on microbiota establishment and metabolic responses in fecal transplant experiments. The calorie-restricted participants had far richer and more diverse communities that even lean people on western diets. Cohousing and cross-diet experiments in the mice showed the relative influences of microbial exchange and diet diversity on indicator species and the role a western diet may play in extirpation of key microbiota taxa. —CA


Sperm competition

Speedy sperm

Sperm compete with each other for a chance to fertilize an egg. Competition that is especially fierce when the sperm competing are from different individuals, as is the case for promiscuous species. Fisher et al. looked at sister species of Peromyscus, a well-studied genus of North American mouse, and found that differences in mating system are associated with differences in sperm morphology and reproductive success among hybrids. Specifically, in the promiscuous white-footed mouse, the section of the sperm containing energy-generating mitochondria is longer than it is in the monogamous old-field mouse. Genome mapping showed that the length of this midpiece is largely associated with a single gene, Prkar1a. —SNV

Nat. Comm. 10.1038/ncomms13652 (2016).

PLANTS AND CLIMATE

The Geminids meteor shower may originate from an asteroid rather than a comet.

Geminids meteor shower may originate from an asteroid rather than a comet.

Published by AAAS

13 January 2017 • Vol. 355 Issue 6321 145
Gut communities form a history of connection

Caroline Ash

Science 355 (6321), 144-145.
DOI: 10.1126/science.355.6321.144-f