

crystallography, but this requires relatively large crystals and high-quality data. Brázda *et al.* used electron diffraction to determine the absolute structure of an extremely radiation-sensitive crystal with micrometer dimensions (see the Perspective by Xu and Zou). In a strategy analogous to serial crystallography methods, many frames were combined to generate a complete dataset. Refinement incorporating dynamical effects differentiated the correct and incorrect molecular configuration. —MAF

Science, this issue p. 667;
see also p. 632

MEMBRANE TRANSPORT Transport control

The membrane protein P-glycoprotein protects cells by using energy from adenosine triphosphate (ATP) hydrolysis to expel chemical substances, including drugs. Inhibiting P-glycoprotein may thus ameliorate drug resistance. Structures of P-glycoprotein in the apo state and bound to substrate and inhibitor give insight into the transport mechanism, but a full picture requires access to substrates in the transport cycle. Dastvan *et al.* used double electron electron resonance spectroscopy to show that substrates enhance transport by stabilizing an asymmetric post-ATP-hydrolysis state. By contrast, inhibitors stabilize a symmetric state that impairs transport. —VV

Science, this issue p. 689

CHEMICAL PHYSICS Bonding's outer limit

In a Rydberg state, an atom has been very nearly, but not quite, ionized. This puts the electron relatively far from the nucleus, and two atoms in such a state can thus form a rather long-range bond. Hollerith *et al.* observed this phenomenon in fine detail by exciting pairs of ultracold rubidium atoms along the diagonal of an optical lattice. The authors resolved the vibrational state structure

spectroscopically and showed that the Rydberg dimers manifested bond lengths exceeding 700 nanometers. —JSY

Science, this issue p. 664

CANCER The secret life of cediranib

Anti-angiogenic agents are used to inhibit the formation of new blood vessels that supply nutrients and oxygen to tumors. However, recent findings suggest that they can have additional anticancer effects. The anti-angiogenic drug cediranib can sensitize tumors to poly(ADP-ribose) polymerase (PARP) inhibitors, which normally target tumors with defective DNA repair. Kaplan *et al.* determined that cediranib damages tumors both by interrupting their blood supply, inducing hypoxia, and by directly affecting pathways involved in DNA repair, sensitizing cancer cells to PARP inhibitors. —YN

Sci. Transl. Med. **11**, eaav4508 (2019).

IMMUNOLOGY Recall responses by human NK cells

One of the traditional dividing lines separating innate and adaptive immunity is the restriction of immune memory to adaptive immune cells. However, accumulating evidence in animal models has suggested that memory responses can be evoked in natural killer (NK) cells. Nikzad *et al.* asked whether human NK cells also exhibit memory responses. They analyzed NK cells recovered from humanized mice and NK cells found in the viral antigen-challenged skin of adult volunteers who had chickenpox as children. Antigen-specific recall responses by human NK cells were observed in both experimental systems. Thus, human NK memory responses contribute to host protection after vaccinations or natural infections. —IRF

Sci. Immunol. **4**, eaat8116 (2019).

IN OTHER JOURNALS

Edited by **Caroline Ash**
and **Jesse Smith**



The GRAVITY Collaboration used the Very Large Telescope, located in the Atacama Desert of northern Chile, to observe the star HR 8799 and one of its planets.

MUTATION DNA damage and parental age

Mutations in the sperm and eggs of humans have been attributed to errors in DNA replication. More than 75% of human germline mutations are paternal in origin. This is thought to be a result of male gametes undergoing more rounds of cell division than female gametes and thus having a greater probability of replication error. Gao *et al.* examined datasets of de novo mutations in the human germline and found that the mutation bias is not driven by spermatogenesis. They observed a surprising degree of C-to-G transversions and CpG transitions, indicative of DNA damage. The authors deduced that most mutations in early embryos are more likely to result from factors associated with maternal age at conception and accumulated damage in oocytes and embryos than from replication error. —LMZ

Proc. Natl. Acad. Sci. U.S.A. **116**, 9491 (2019).

KIDNEY DISEASE A pharmacological hat trick

The number of people with type 2 diabetes (T2D) may reach 510 million by the year 2030, a trend largely driven by the global rise in obesity rates. Because T2D often compromises kidney function, the number of people with kidney failure is also expected to rise dramatically. A new study suggests that a drug already in clinical use for T2D may provide multiple health benefits to such patients. Canagliflozin lowers blood glucose levels by blocking reabsorption of glucose in the kidney. In a large randomized trial of patients with T2D and chronic kidney disease, Perkovic *et al.* found that those receiving canagliflozin were 30% less likely to develop end-stage kidney disease and 20 to 30% less likely to develop cardiovascular disease than those receiving placebo. —PAK

N. Engl. J. Med. 10.1056/NEJMoa1811744 (2019).

PHOTO: G. HÜDEPÖHL (ATACAMA.PHOTO.COM)/ESO/CC BY



EXOPLANETS

Interferometry spots an exoplanet

Optical interferometry combines the light from multiple telescopes to reach very high angular resolution but is challenging to apply to high-contrast sources such as an exoplanet orbiting a star. The GRAVITY Collaboration observed the star HR 8799 and one of its planets, HR 8799 e, using an optical interferometer fed by four 8-meter telescopes. They detected the planet, measured its position more precisely than has been done using previous methods, and extracted a near-infrared spectrum that constrains the composition of its atmosphere. This is the first exoplanet to be detected with interferometry. Although HR 8799 e was already known, the interferometry technique could be used to refine the orbits and spectra of directly imaged exoplanets. —KTS

Astron. Astrophys. **623**, L11 (2019).

NEUROSCIENCE

Training for cognitive skills

Play your notes and nothing extra. Wait during your measures of rest. Watch the conductor and synchronize with your neighbors. Such attention and sensorimotor skills are key to performing music as part of a group, whether orchestral or choral or a marching band. Not everyone, however, has the time and interest to become a professional musician. Fasano *et al.* tested the effect of a short orchestral training program, spanning 10 sessions over 3 months, on a group of psychologically normal schoolchildren in Italy. Children in this brief program improved on measures of inhibitory control and hyperactivity. The results suggest new, and fun, ways to help children manage their own hyperactive behaviors. —PJH

Front. Psychol. **10**, 750 (2019).

ATOMIC PHYSICS

Superresolving atomic densities

Quantum gas microscopes provide information about the occupancy of individual optical lattice sites. However, the resolution is limited by the wavelength of the imaging light. Two related superresolution schemes now enable researchers to glean even finer details of the atomic density distribution. McDonald *et al.* and Subhankar *et al.* studied one-dimensional arrays of ultracold atoms. A well-chosen perturbation provided a narrow window onto a specific position; when information from different positions was pieced together, the researchers were able to reconstruct the atomic density with a resolution of a fraction of the optical wavelength. The schemes were effective in capturing atomic dynamics and are expected to be applicable to a wide range of atomic and molecular species. —JS

Phys. Rev. X **9**, 021001, 021002 (2019).

MUTUALISM

Size matters

A mutualistic relationship exists between species when they both benefit from the other's presence. Yet sometimes such relationships can become antagonistic. To understand how mutualisms are poised, Sun *et al.* investigated the interactions between a carrion beetle and its associated mite. The mites depend on the beetles to carry them to carcasses, where both species breed. The authors found that the beetles benefit from the

mites' presence because the mites raise the body temperature of the beetles, which allows small individuals to behave more competitively. Large beetles, because of their sheer size, already have a competitive advantage and gain little from the mites. Instead, the bigger beetles experience reduced fitness because they have to share breeding resources with the mites. Thus, whether the relationship between the two species is antagonistic or mutualistic depends entirely on differences between the beetles' sizes. —SNV

Evol. Lett. **3**, 185 (2019).



Burying beetles, *Nicrophorus vespilloides*, commonly carry mites.

ROBOTICS

UV light as your guide

Navigation by using global positioning satellites or magnetic fields or motion tracking by using inertial sensors or gyroscopes can be hindered in dense urban settings or suffer from poor resolution and drift. Dupeyroux *et al.* drew inspiration from desert ants, which use a combination of stride, visual cues of motion, and polarization of sunlight to track the positions of their nest and sources of food. They developed a robot equipped with a 2-pixel compass that was able to use ultraviolet (UV) light and path integration to maintain a straight heading under both clear and mixed sky conditions, with only a small deviation in overall angle, and was even able to determine its heading under a foliage canopy. The authors also developed a waterproof, single-pixel version of the sensor for use under water. —MSL

Rob. Auton. Syst. **117**, 40 (2019).