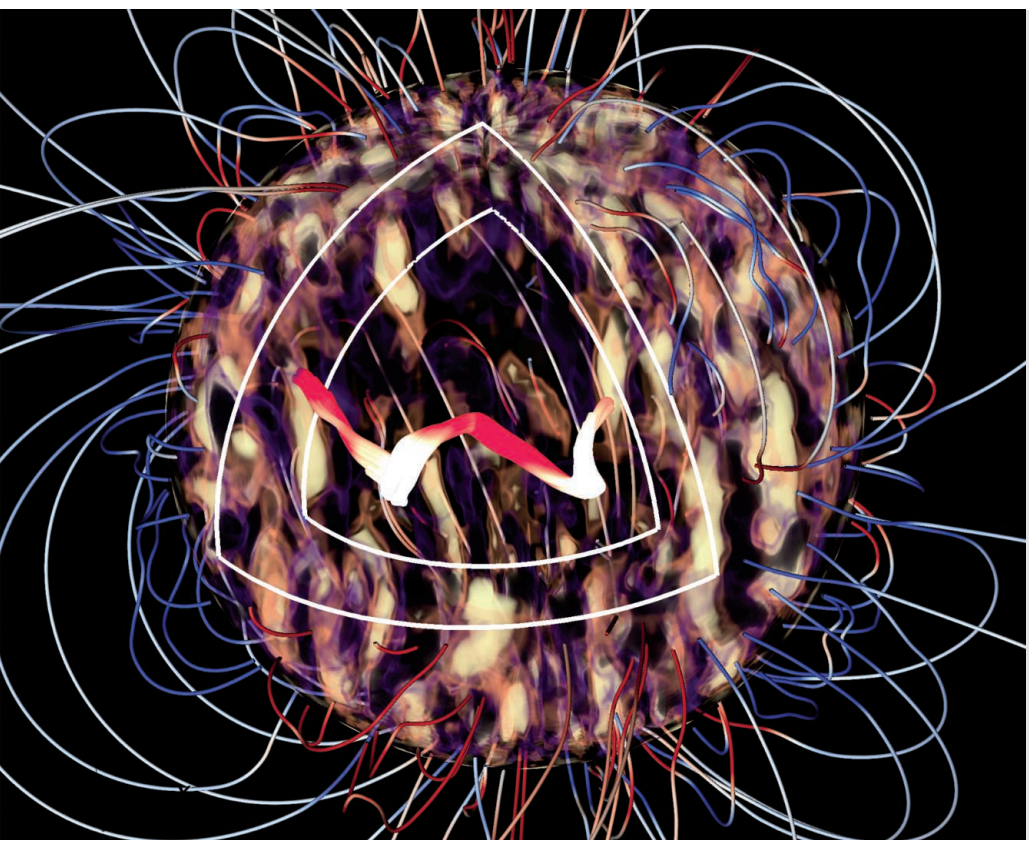
RESEARCH

Heat-resistant quantum oscillations in graphene

Krishna Kumar et al., *p. 181*

IN *SCIENCE* JOURNALS

Edited by **Stella Hurtley**



CREDIT: (BOTTOM) STRUGAREK *ET AL.*

STELLAR ACTIVITY

Is the Sun a solar-type star?

The Sun's activity, including sunspot activity, varies on an 11-year cycle driven by changes in its magnetic field. Other nearby solar-type stars have their own cycles, but the Sun does not seem to match their behavior. Strugarek *et al.* used magnetohydrodynamic simulations to show that stellar activity periods should depend on the star's Rossby number, the ratio between the inertial and Coriolis forces. Turning to observations, they found that solar-type stars, including the Sun, follow this relation. The results advance our understanding of how stars generate their magnetic fields and confirm that the Sun is indeed a solar-type star. —KTS

Science, this issue p. 185

Three-dimensional nonlinear simulation of a regular magnetic cycle of the Sun

SPINTRONICS

Diamonds to the rescue

Keeping track of spin transport inside a spintronic device is challenging. Du *et al.* came up with a method involving diamond nitrogen-vacancy (NV) centers, which can act like tiny, very sensitive magnetometers. The authors placed diamond nanobeams containing the NV centers in close proximity to the sample. This allowed them to measure the spin chemical potential of spin waves—so-called magnons—with nanometer resolution in the material yttrium iron garnet. Because NV centers are also sensitive to temperature, the method may be of use in spin caloritronics. —JS

Science, this issue p. 195

NEUROSCIENCE

The brain circuits of a winner

Social dominance in mice depends on their history of winning in social contests. Zhou *et al.* found that this effect is mediated by neuronal projections from the thalamus to a brain region called the dorsomedial prefrontal cortex. Selective manipulation of synapses driven by this input revealed a causal relationship between circuit activity and mental effort–based dominance behavior. Thus, synapses in this pathway store the memory of previous winning or losing history. —PRS

Science, this issue p. 162

ALZHEIMER'S DISEASE

Amyloid impairs synaptic trafficking

The accumulation of amyloid-β (Aβ) in Alzheimer's disease leads to synaptic loss and dysfunction. Park *et al.* found that a soluble form of Aβ impeded Ca^{2+} clearance from neurons, which activated the kinase CaMKIV. CaMKIV phosphorylated synapsin, causing it to dissociate from synaptic vesicles and actin, which impaired neuronal vesicular transport. Thus, targeting CaMKIV activity might provide a strategy to suppress the pathological effects of Aβ.
—LKF

Sci. Signal. **10**, eaam8661 (2017).

COGNITION

Making a plan

Until recently, planning for the future has generally been considered to be unique to humans. Studies in the past 10 years have suggested that apes and

scrub jays are also able to make such plans. However, these studies—especially those in the birds—have been questioned. It has been argued that planning in foraging and natural tasks is not the same as planning in a more general way. Kabadayi *et al*. tested ravens with tasks designed to specifically assess their general planning abilities (see the Perspective by Boeckle and Clayton). Confirming their forward-planning abilities, the birds performed at least as well as apes and small children in this complex cognitive task. —SNV

Science, this issue p. 202; see also p. 126

HEPATITIS C VIRUS

New York City rats provide a gift to virologists

Despite the development of curative drugs for hepatitis C virus (HCV) infection, global eradication of HCV will likely require a prophylactic vaccine. Progress toward a vaccine has been impeded by the absence of mouse models suitable for studying the immune response to HCV. Billerbeck *et al*. found that a HCV-related virus isolated from New York City rats produces an infection in laboratory mice that shares several immunological features with human infections (see the Perspective by Klenerman and Barnes). Their initial analyses of the infected mice revealed that acute clearance of the virus was dependent on T cells but not on natural killer cells. —PAK

Science, this issue p. 204; see also p. 129

CHEMISTRY

A triple search for coupling reactions

Coupling reactions are, in principle, good candidates for high-throughput discovery: Simply mix a diverse set of reagents and then look for products that combine two or three of their masses. In practice, however, numerous different products might have masses that are too similar to distinguish quickly. Troshin and Hartwig circumvented this problem by screening three pools of reagents in parallel that shared the same reactive functionality but differed in mass by carefully chosen increments. Specific products could then be identified in a noisy distribution by their distinctive expected mass differences across the three pools. —JSY

Science, this issue p. 175

DEVELOPMENTAL BIOLOGY

Intergenerational transcription taming

Parents provide genetic information that guides the development of the offspring. Zenk *et al*. show that epigenetic information, in the form of the repressive mark H3K27me3, is also propagated to the offspring and regulates proper gene expression in the embryo. Preventing the propagation of maternally inherited H3K27me3 led to precocious gene activation and, ultimately, embryo lethality. —BAP

Science, this issue p. 212

DENDRITIC CELLS

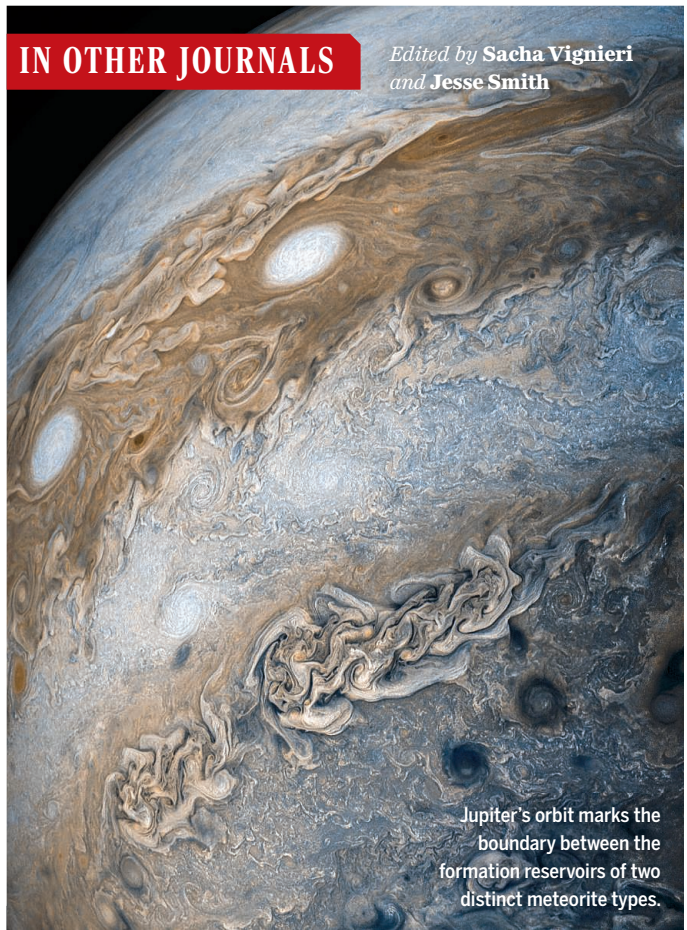
Divided, they conquer

Dendritic cells (DCs) play a crucial role in priming T cell–driven antiviral responses. Silvin *et al*. examined the paradox of how virus-infected DCs retain the ability to drive adaptive immune responses. In response to endocytic viruses, they found CD1c$^+$ DCs to be susceptible to infection and death, whereas CD141$^+$ DCs were not. Viral resistance of CD141$^+$ DCs was conferred by expression of the endocytic guanosine triphosphatase RAB15. Transfer of antigen from infected CD1c$^+$ DCs by CD141$^+$ DCs allowed the latter to prime T cell responses. This division of labor between DC subsets that separates antigen acquisition from antigen presentation provides a solution to this long-standing puzzle. —AB

Sci. Immunol. **2**, eaai8071 (2017).

IN OTHER JOURNALS

Edited by **Sacha Vignieri** *and* **Jesse Smith**



Jupiter's orbit marks the boundary between the formation reservoirs of two distinct meteorite types.

CREDIT: NASA

COSMOCHEMISTRY

Meteorites formed in two reservoirs

Meteorites are rocky debris left over from the formation of the solar system, which later fall to Earth. Kruijer *et al.* measured tungsten and molybdenum isotope ratios for a variety of iron meteorite groups and showed that they separate into two sequences—just like stony meteorites are already known to do. Because iron meteorites require parent bodies that grew massive enough to form metal cores, this dichotomy implies two separate regions in the early solar system where planetesimals formed. The authors speculate that the two reservoirs were respectively within and outside the orbit of Jupiter. If that is correct, the giant planet must have formed rapidly, before the meteorite parent bodies did. —KTS

Proc. Natl. Acad. Sci. U.S.A. 10.1073/pnas.1704461114 (2017).

NEUROSCIENCE

Mechanisms for maintaining mental maps

When an animal runs around, some hippocampal neurons are selectively active in specific locations called their place fields. A maplike representation created from many such place fields serves as a navigation mechanism. How such hippocampal maps stabilize is still unknown. Roux *et al*. investigated a discrete form of high-frequency neuronal oscillations called sharp wave ripples. In a spatial learning task, they focally silenced a

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ECOLOGICAL NETWORKS

Modularity limits disturbance effects

The networks that form natural, social, and technological systems are vulnerable to the spreading impacts of perturbations. Theory predicts that networks with a clustered or modular structure—where nodes within a module interact more frequently than they do with nodes in other modules—might contain a perturbation, preventing it from spreading to the entire network. Gilarranz *et al*. conducted experiments with networked populations of springtail (*Folsomia candida*) microarthropods to show that modularity limits the impact of a local extinction on neighboring nodes (see the Perspective by Sales-Pardo). In networks with high modularity, the perturbation was contained within the targeted module, and its impact did not spread to nodes beyond it. However, simulations revealed that modularity is beneficial to the network only when perturbations are present; otherwise, it hinders population growth. —AMS

Science, this issue p. 199; see also p. 128

MAGNETISM

Making an oxide-layered antiferromagnet

Antiferromagnetism, a state of matter where ordered neighboring spins point in opposite directions, can be engineered in layered heterostructures, which affords control over their properties. Doing so in oxide heterostructures is tricky because the necessary ferromagnetism of the constituent layers may not survive thinning to nanometer thicknesses. Chen *et al*. overcame this materials challenge by finding and growing the right combination of substrate, magnetic, and insulating layers to engineer antiferromagnetic coupling. The resulting superlattices, consisting of alternating layers of a ferromagnetic oxide and an insulating material, exhibit layer-by-layer switching of magnetization. —JS

Science, this issue p. 191

PROTEIN FOLDING

Exploring structure space to understand stability

Understanding the determinants of protein stability is challenging because native proteins have conformations that are optimized for function. Proteins designed without functional bias could give insight into how structure determines stability, but this requires a large sample size. Rocklin *et al*. report a high-throughput protein design and characterization method that allows them to measure thousands of miniproteins (see the Perspective by Woolfson *et al*.). Iterative rounds of design and characterization increased the design success rate from 6 to 47%, which provides insight into the balance of forces that determine protein stability. —VV

Science, this issue p. 168; see also p. 133

GRAPHENE

Heat-loving quantum oscillations

The shape of the Fermi surface in a conductor can be gleaned through quantum oscillations—periodic changes in transport properties as an external magnetic field is varied. Like most quantum properties, the phenomenon can usually be observed only at very low temperatures. Krishna Kumar *et al*. report quantum oscillations in graphene that do not go away even at the temperature of boiling water. Although "ordinary," low-temperature quantum oscillations die away, another oscillatory behavior sets in that is extremely robust to heating. These resilient oscillations appear only in samples in which graphene is nearly aligned with its hexagonal boron nitride substrate, indicating that they are caused by the potential of the moiré superlattice that forms in such circumstances. —JS

Science, this issue p. 181

ELECTRONICS

Plasmons probe the quantum response

Electronic systems are typically considered as classical Fermi liquids, and the quantum mechanical interactions and processes are usually only accessed at very low temperatures and high magnetic fields. Lundeberg *et al*. used tunable plasmons to probe the quantum response of the electron gas of graphene (see the Perspective by Basov and Fogler). They studied shape deformations of the Fermi surface during a plasmon oscillation, as well as many-body electronic effects. —ISO

Science, this issue p. 187; see also p. 132

NEUROLINGUISTICS

Distinct neural patterns for two languages

People fluent in more than one language can be something of an enigma to observers. Perhaps counterintuitively, available data suggests that multiple language processing occurs in a common system in the human brain. Xu *et al*. challenged this interpretation with a fine-grained multivoxel pattern analysis of functional magnetic resonance imaging data. Chinese-English bilingual subjects processed the two different languages using independent systems of brain cells, whose physical locations in the brain overlapped. Thus, each language in these individuals uses its own set of neurons. —PLY

Sci. Adv. 10.1126/sciadv.1603309 (2017).

DNA REPAIR

Not-so-sweet DNA damage repaired

Glyoxal and methylglyoxal, byproducts of sugar metabolism that are present in all cells, can react with, and thus damage, DNA. Indeed, glycation of guanine (G) is as prevalent as the major product of oxidative damage in DNA, 8-oxo-dG. Richarme *et al*. show that both prokaryotes and eukaryotes have dedicated systems that specifically repair glycation damage (see the Perspective by Dingler and Patel). The parkinsonism-associated protein DJ-1/Park7 and its bacterial homologs Hsp31, YhbO, and YajL direct the enzymatic repair of damaged glycated bases in DNA. The proteins also clean up the more vulnerable pool of free nucleotides in the cell, which are more susceptible to glycation than the nucleotides within DNA. —SMH

Science, this issue p. 208; see also p. 130

TRANSPLANTATION

Curbing culprits of chronic rejection

De novo donor-specific antibodies generated after organ transplantation can lead to chronic rejection. Nayak *et al.* sought to understand the mechanisms leading to the production of these antibodies in lung transplantation. Mouse models and data from human patients revealed that expression of the transcription factor Zbtb7a in alveolar macrophages acts as a crucial mediator. Patients eventually diagnosed with chronic rejection had

higher expressions of this transcription factor early on. Preventing macrophages from expressing Zbtb7a ameliorated models of obliterative airway disease and prevented chronic rejection of lung transplants in mice. Thus, interrupting macrophage presentation of donor antigens may help to prevent the generation of these destructive antibodies. —LP

Sci. Transl. Med. **9**, eaal1243 (2017).