THIS WEEK IN Science

EDITED BY STELLA HURTLEY

## Glassy Crystals

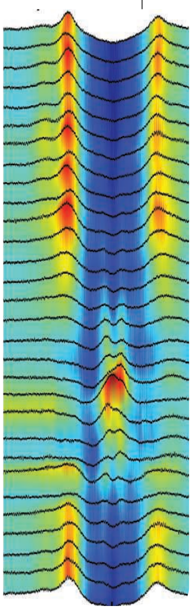
Glassy materials have been thought to possess little or no structure order, but recent experiments have confirmed ordering over short- and medium-length scales. When mixed in a 3:1 ratio, cerium and aluminum will form a glass because of the severe mismatch in size and electronegativity of the atoms. **Zeng *et al.*** (p. 1401) studied this metallic glass and found no evidence of long-range structural order. However, when the material was forced to crystallize at high pressure, a large single crystal was formed, which suggests that the glassy material must have had an undetected form of long-range order.

## A Measure of Separation

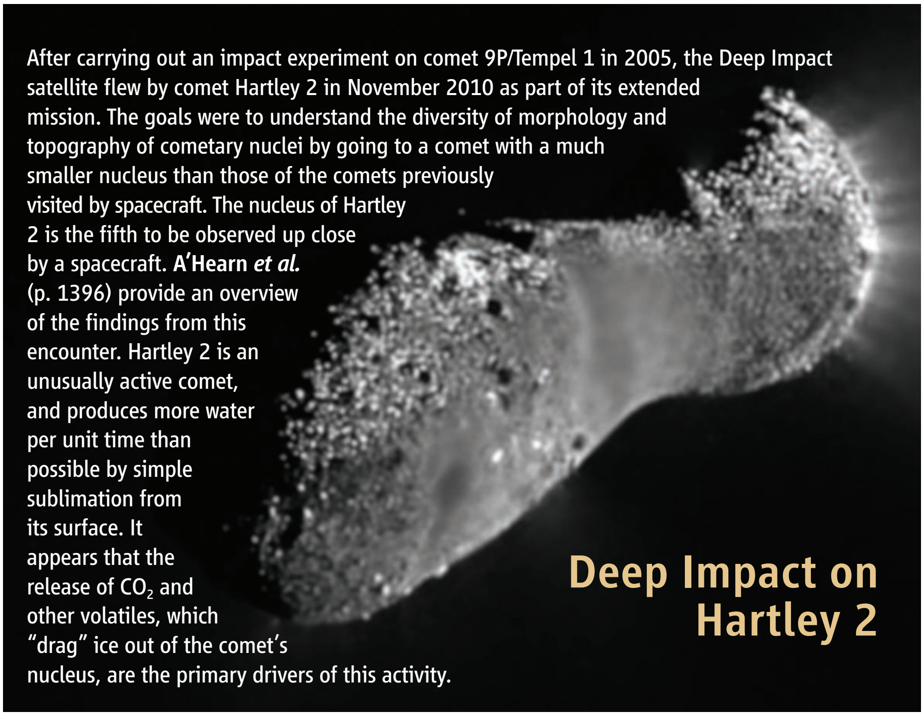
Under the right conditions, the optical response of two particles can be used to provide a measure of the separation between the particles. Because such an optical ruler is inherently one-dimensional, it cannot provide three-dimensional information about complex changes to the local structure or spatial environment, which limits real-world applications. **Liu *et al.*** (p. 1407; see the Perspective by **Sönnichsen**) designed and fabricated a nanostructure, the optical response of which can be used to determine spatial distance in three dimensions. The technique should be useful for monitoring structural changes in biological samples or chemical reactions.

## Iron Superconductor Symmetry

The mechanism and symmetry of electron pairing are central issues in superconductivity research. Despite intense investigation, the pairing symmetry in the recently discovered iron-based superconductors remains elusive. **Song *et al.*** (p. 1410) studied the simplest example, iron selenide (FeSe), by scanning tunneling microscopy and spectroscopy. A gap function and evidence of nodal lines was observed in high-quality stoichiometric and superconducting FeSe single crystalline films. When inhomogeneities were created (for example, by using magnetic fields), a twofold symmetry in the quasiparticle-excited states of the superconducting state was observed, which could be accounted for in terms of orbital ordering effects.



CREDITS (TOP TO BOTTOM): NASA/JPL/UMD/LINDLER; SONG ET AL.



## Deep Impact on Hartley 2

After carrying out an impact experiment on comet 9P/Tempel 1 in 2005, the Deep Impact satellite flew by comet Hartley 2 in November 2010 as part of its extended mission. The goals were to understand the diversity of morphology and topography of cometary nuclei by going to a comet with a much smaller nucleus than those of the comets previously visited by spacecraft. The nucleus of Hartley 2 is the fifth to be observed up close by a spacecraft. **A'Hearn *et al.*** (p. 1396) provide an overview of the findings from this encounter. Hartley 2 is an unusually active comet, and produces more water per unit time than possible by simple sublimation from its surface. It appears that the release of $CO_2$ and other volatiles, which "drag" ice out of the comet's nucleus, are the primary drivers of this activity.

## Saturn's Early Storm

Every saturnian year (~ every 30 Earth years) a storm erupts in the atmosphere of Saturn. Normally, it occurs after the summer solstice, but in December 2010 a storm was detected in Saturn's northern springtime hemisphere. This storm is the largest seen on Saturn to date and occurred about 20 years earlier than expected. **Fletcher *et al.*** (p. 1413, published online 19 May) determined its vertical structure using thermal-infrared images from the Very Large Telescope in Chile and infrared spectroscopy from the Cassini spacecraft. Atmospheric motions associated with the storm generated thermal anomalies that modified Saturn's atmospheric circulation. The storm has altered the atmospheric structure and composition from the deep atmosphere to the upper troposphere and may affect Saturn's northern hemisphere for years to come.

## The Quake That Rocked Japan

The 11 March 2011 magnitude 9.0 Tohoku-Oki megathrust earthquake just off the Eastern coast of Japan was one of the largest earthquakes in recorded history. Japan's considerable investment in seismic and geodetic networks allowed for the collection of rapid and reliable data on the mechanics of the earthquake and the devastating tsunami that followed (see the Perspective by **Heki**). **Sato *et al.*** (p. 1395, published online 19 May) describe the huge displacements from ocean bottom transponders—previously placed directly above the earthquake's hypocenter—communicating with Global Positioning System (GPS) receivers aboard a ship. **Simons *et al.*** (p. 1421, published online 19 May) used land-based GPS receivers and tsunami gauge measurements to model the kinematics and extent of the earthquake, comparing it to past earthquakes in Japan and elsewhere. Finally, **Ide *et al.*** (p. 1426, published online 19 May) used finite-source imaging to model the evolution of the earthquake's rupture that revealed a strong depth dependence in both slip and seismic energy. These initial results provide fundamental insights into the behavior of rare, very large earthquakes that may aid in preparation and early warning efforts for future tsunamis following subduction zone earthquakes.

## Ramping Up AMPK

The adenosine monophosphate (AMP)–activated protein kinase (AMPK) senses depletion of energy stores (the accumulation of AMP) and activates appropriate metabolic responses to control cellular and organismal energy balance. But its name does not tell the whole story. The energy status of a cell is reflected in the "adenylate charge" or ratio of the concentration of adenosine triphosphate (ATP) to those of adenosine diphosphate (ADP) and AMP.

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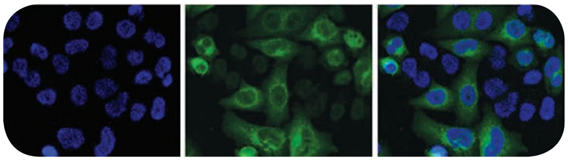
**Oakhill *et al.*** (p. 1433; see the Perspective by **Bland and Birnbaum**) show that activity of AMPK is also highly sensitive to the concentration of ADP, as well as that of AMP. Like AMP, ADP bound to AMPK and promoted its activating phosphorylation by other protein kinases. ADP also inhibited dephosphorylation of AMPK, which inactivates the kinase. Because AMP can be rapidly deaminated in cells, sensing of ADP, as well as AMP, may be critical for the control of AMPK, which regulates a broad spectrum of biological responses from metabolism and metabolic diseases to the growth of cancer.

## Molecular Clockwork

Although the basic transcriptional feedback loop that makes up the mammalian clock has been described, fundamental pieces of the clock's workings continue to be discovered. The oscillator depends on a transcriptional mechanism in which the transcription factor CLOCK-BMAL enhances transcription of its own inhibitor, PER. **Duong *et al.*** (p. 1436) clarified the biochemical mechanism by which PER inhibits its own transcription by purifying proteins that associated with PER. The protein PSF, a transcriptional corepressor protein was identified, which helped to recruit another protein, the SIN3–histone deacetylase complex (SIN3-HDAC) to the *Per1* promoter. The resulting histone deacetylation inhibits the transcription promoted by CLOCK-BMAL1. Depleting cells of PSF or SIN3-HDAC shortened the length of the circadian period, consistent with their roles as part of the fundamental clock mechanism.

## Coordinating Autophagy and Lysosome Regulation

Autophagy involves the degradation of intracellular proteins and organelles and is often promoted as a response to starvation that allows for the reuse of constituent amino acids. How do cells coordinate protein degradation and recycling processes? **Settembre *et al.*** (p. 1429, published online 26 May; see the Perspective by **Cuervo**) identified a biological mechanism that regulates, in a coordinated fashion, the function of two cellular organelles, autophagosomes and lysosomes, whose synergy is required for an efficient autophagic process. During starvation, cells activated a transcriptional program that controls all major steps of the autophagic pathway, including autophagosome formation, autophagosome-lysosome fusion, and substrate degradation. The transcription factor EB (TFEB), a master gene for lysosomal biogenesis, coordinated this program by driving expression of both autophagy and lysosomal genes. Furthermore, TFEB activity was regulated by the mitogen-activated protein (MAP) kinase ERK2, which implicates the kinase signaling pathway in the control of autophagy.



## An End to Plant Defenses

When defending against bacterial pathogens, plants make use of an innate immunity system that detects molecular signatures of bacteria. The plant defense response depends on receptors including the pattern recognition receptor FLAGELLIN-SENSING 2 (FLS2) and initiates a cascade of responses that deflect bacterial attack. However, always being on the defensive does not work out well for plants: Once activated, defense systems need to be turned off. Studying *Arabidopsis*, **Lu *et al.*** (p. 1439; see the Perspective by **O'Neill**) have now analyzed this shut-down protocol. Once FLS2 is activated by binding to bacterial flagellin and to coreceptors, it becomes the target for a ubiquitination cascade that results in its degradation.

## Keeping an Eye On Your Enemy

During binocular rivalry, different images presented simultaneously to two eyes alternate in consciousness so that, for example, we first see a face shown to the left eye and then a house shown to the right eye. The duration with which one stimulus is perceived is affected by a number of factors, such as its relative brightness, and is generally not under conscious control. **Anderson *et al.*** (p. 1446, published online 19 May) demonstrate that negative social information about a person increases the duration of "seeing" that person's face in a binocular rivalry protocol; other kinds of social information and negative information did not display this effect, illustrating the privileged link between human social evaluations and vision.

CREDIT: SETTEMBRE *ET AL.*





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