EDITORS' CHOICE

edited by Gilbert Chin

ASTRONOMY

Seismology of the Stars

The Sun exhibits rapid and periodic variations in its luminosity. These oscillations are produced in the outer layers, where slight imbalances between gas pressure and gravitational force result in radial expansions and contractions. There are two primary modes: the low-radial-order pressure modes (p modes) and the higher-radial-order gravitational modes (g modes). The type and complexity of these modes relate to the diameter, mass, temperature, age, magnetic field strength, and environment around the star, making asteroseismology particularly valuable for understanding stellar dynamics and evolution.

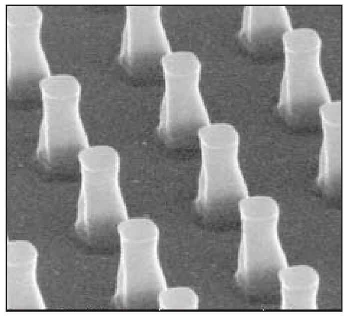
Two types of pulsating stars, δ Scuti and γ Doradus, lie at the intersection of the main sequence and the instability curve (on which most pulsators live) on a color-versus-magnitude diagram of stellar evolution. Handler and Shobbrook have conducted a spectroscopic and photometric survey of 26 candidate pulsators in the southern skies, using telescopes in South Africa, Australia, and Chile. They found six bona fide γ Doradus stars (bringing the total number known to 20) and one δ Scuti. In a separate paper, Handler *et al.* describe one star, HD 209295, that showed both δ Scuti p-mode and γ Doradus g-mode oscillations, the first time this has been observed. The g-mode oscillations appear to be induced tidally by a secondary component that may be a neutron star or white dwarf. This binary system has an eccentric orbit, which is unexpected because a compact degenerate secondary tends to circularize the orbit rather quickly; HD 209295 may be a relatively young binary system that is on its way to becoming an x-ray binary. — LR

Mon. Not. R. Astron. Soc. **333**, 251; 262 (2002).

APPLIED PHYSICS

Tilting at Towers

Within a localized volume, the anisotropic molecules of a nematic liquid crystal will tend to orient in one general direction, called the director. For electro-optical devices, the orientation of the director is established by rubbing the substrate, which creates microscopic aligned grooves that interact with the liquid crystal molecules. Macroscopic features, such as short posts attached to the substrate, can also create localized variations in director alignment; several stable orientations may exist, but it can be difficult to switch between them.



Micrograph of the post lattice.

Kitson and Geisow use tall posts or towers that induce a tilting of the director relative to the substrate. A lattice of these posts produces a small tilt in one direction, creating a device that has two stable states, differing only in director orientation. By applying a voltage pulse, they can switch between the bistable states, rendering the features either light or dark. Unlike other liquid crystal devices, the pattern remains stable after the current is shut off. — MSL

Appl. Phys. Lett. **80**, 3635 (2002).

APPLIED PHYSICS

Muffling Magnetic Ringing

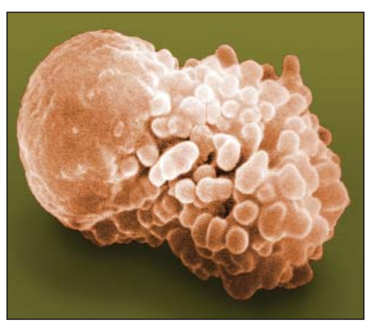
The storage state of binary information in magnetic elements is distinguished by the orientation of the magnetization, which can be switched by application of a magnetic field pulse. However, at both onset and offset of the pulse, the magnetization oscillates, or rings. With the decreasing size of magnetic elements and the increasing demand for faster switching rates, ringing is problematic and presents a limiting factor in switching speed. In a system in which the magnetization precesses around a static magnetic field in response to a magnetic pulse that lasts for about a nanosecond, Schumacher *et al.* show that the ringing can be suppressed by adjusting the pulse duration to match the natural frequency of precession. This coherent suppression may allow the development of devices with stable and ultrafast magnetization reversal. — ISO

Appl. Phys. Lett. **80**, 3781 (2002).

ECOLOGY/EVOLUTION

Size for Breeding

The function of sperm—the fertilization of eggs—is uniform across the animal kingdom. Nevertheless, there is a bewildering variety of sperm size and morphology. It has been suggested that some of this variation arises via the selective force of sperm competition, whereby sperm from multiple males compete to fertilize eggs. In nematode worms, which have amoeboid sperm, correlative evidence suggests that sperm competition may lead to the evolution of larger sperm, which crawl faster, thereby increasing their chances of a successful fertilization. In an experimental test of this idea, LaMunyon and Ward tracked the evolution of sperm size over 60 generations in populations of the nematode worm *Caenorhabditis elegans* differing in the level of multiple mating permitted; competition resulted in a 20% increase in the size of the amoeboid sperm. — AMS



C. elegans **sperm (left) and competing nucleated and anucleate sperm from the tobacco budworm moth (right).**

Proc. R. Soc. London Ser. B 10.1098/rspb.2002.1996 (2002).

CLIMATE SCIENCE

A Preindustrial Sulfur Archive

Carbonyl sulfide (OCS) is the most abundant sulfur-containing gas in the atmosphere, and it is an important component in the cycling of carbon disulfide and dimethylsulfide. Uncertainties in estimating the sources and sinks of OCS make it difficult to identify trends in its atmospheric budget and to assess whether anthropogenic sources are perturbing the natural cycle. Aydin *et al.* have extracted air samples from the Antarctic Siple Dome C ice core and mea-

CONTINUED ON PAGE 1573

CREDITS: (BOTTOM IMAGES) C. LAMUNYON; (TOP) KITSON AND GEISOW, *APPL. PHYS. LETT.* **80**, 3635 (2002)

CONTINUED FROM 1571

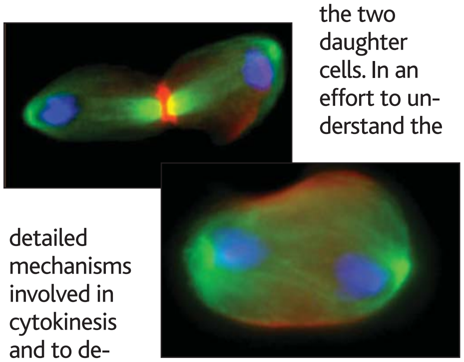
sured the OCS concentration of air from 1620 to 1700. They find that atmospheric concentrations of OCS have increased by approximately 25% since preindustrial times. They also observed differences of about 15% in samples from 200 and 300 years ago, indicating either that there are large natural variations in the OCS cycle or that human perturbation of the cycle occurred then as well, perhaps because of biomass burning. — HJS

Geophys. Res. Lett. **29**, 10.1029/2002GL014796 (2002).

CELL BIOLOGY

Divide and Rule

Cell division requires the allocation of two sets of chromosomes to daughter cells and also the physical separation (cytokinesis) of the two daughter cells. In an effort to understand the detailed mechanisms involved in cytokinesis and to develop a system in which new components in the machinery of cytokinesis can be identified, Somma *et al.* have used RNA interference (RNAi) to disrupt a variety of proteins in cultured *Drosophila* cells. Ablation of specific gene products led to distinctive phenotypes: for example, blocking the assembly of the central spindle, inhibiting the accumulation of actin at the equator of the cell, and interfering with the assembly and disassembly of the contractile ring. Having established the reliable recognition of phenotypes, future work will focus on the identification of genes involved in this fundamental cellular process. — SMH



Dividing cells stained for DNA (blue), actin (red) and tubulin (green); wild-type (left) and syntaxin1A-disrupted (right).

Mol. Biol. Cell. 10.1091/mbc.01-12-0589 (2002).

BIOMEDICINE

Converging Checkpoint Signals

Eukaryotic cells are under continual assault by a wide variety of DNA-damaging agents. Cells cope with DNA damage by activating checkpoint pathways that delay cell cycle progression until the damage can be repaired. Identifying the molecular players in these checkpoint pathways and their interactions is a major goal of current cancer research.

Taniguchi *et al.* approach this problem by characterizing the phenotype of cells from patients with two inherited diseases that predispose to cancer, Fanconi anemia (FA) and ataxia telangiectasia (AT). Although they share some clinical signs, these diseases are thought to reflect distinct deficiencies in repair: FA cells are sensitive to DNA cross-linking agents, whereas AT cells are sensitive to ionizing radiation. Studying cells from a rare subtype of FA (D2) that shows heightened sensitivity to both forms of DNA damage, the authors find that the protein FANCD2, which is ubiquitinated in response to DNA cross-linking agents, is phosphorylated by the AT protein kinase ATM in response to ionizing radiation and as a prelude to activation of a damage checkpoint. — PAK

Cell **109**, 459 (2002).

HIGHLIGHTED IN *SCIENCE*'S SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT

Science's stke www.stke.org

Distinctly Similar Infection Signals

The Toll-like receptors 2 and 4 (TLR2 and TLR4) function in detection of bacterial infection, responding to lipopolysaccharide from Gram-negative bacteria or peptidoglycan from Gram-positive bacteria, respectively. Although the two receptors generate similar signaling outputs, evidence is accumulating that responses to the two are notably distinct. Carl *et al.* found that activation of either TLR2 or TLR4 enhanced expression of the secretory interleukin-1 receptor antagonist sIL-1Ra. In both cases, the transcription factor PU.1 was required for a full response, and pharmacological inhibition of the p38 stress-activated protein kinase showed that the kinase was required for full transcriptional activation. Nevertheless, the promoter regions required for the responses to TLR2 or TLR4 were different, and the p38-dependent response mapped to distinct regions of the promoter. The authors conclude that TLR2 and TL4 must activate different DNA binding proteins and that, even when using similar pathways (through p38 and PU.1), signals from the two receptors result in distinct gene regulatory responses. — LBR

J. Biol. Chem. **277**, 17448 (2002).

CREDIT: SOMMA *ET AL.*, *MOL. BIOL. CELL* 10.1091/MBC.01-12-0589 (2002)

Science

Converging Checkpoint Signals

Science **296** (5573), 1573.
DOI: 10.1126/science.296.5573.1573b

Science (print ISSN 0036-8075; online ISSN 1095-9203) is published by the American Association for the Advancement of Science, 1200 New York Avenue NW, Washington, DC 20005. The title *Science* is a registered trademark of AAAS.