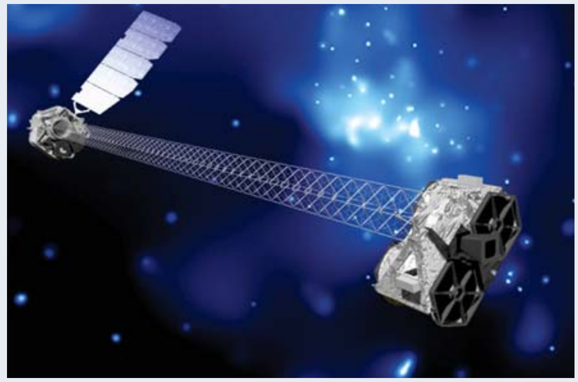
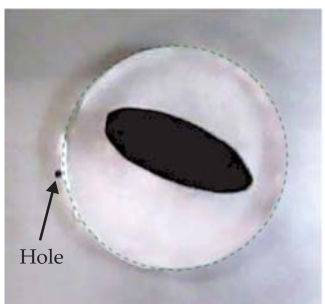
A NEUTRON STAR, NOT A BLACK HOLE



By the time infalling material nears a black hole's event horizon or a neutron star's surface, it flows so vigorously that it glows in the x-ray spectrum. The x rays exert outward radiation pressure on the infalling material. At a critical value—the Eddington limit—the radiation and gravitational pressures balance, and further infall no longer boosts the luminosity. In the 1980s astronomers discovered, in the Milky Way and nearby galaxies, point-like x-ray sources whose luminosities exceed the Eddington limit for neutron stars by at least an order of magnitude. Dubbed ultraluminous x-ray sources (ULXs), the sources were presumed to harbor black holes of masses around $10M_\odot$—that is, three times as large as the maximum possible neutron star mass (here, $M_\odot$ is the mass of the Sun). The first neutron-star ULX was discovered in 2014. Now a second ULX has been found whose x-ray emission, being coherently pulsed, can originate only from a neutron star. That's because the all-important separation between a pulsar's rotation axis and its magnetic poles requires a surface, which black holes lack. The 0.42 s pulsations in the ULX NGC 7793 P13 ("P13" for short) were discovered by Felix Fürst of Caltech and his colleagues in observations made with NASA's *NuSTAR* orbiter (depicted here). Accounting for a neutron star's super-Eddington luminosity is not necessarily a challenge. If the neutron star's magnetic field is strong enough, infalling material can be funneled onto its magnetic poles while radiation escapes sideways. The trouble is, in P13's case the field strength implied by the luminosity is so high that the magnetic funnel must be narrow. But a narrow funnel would yield sharply peaked pulses; P13's are sinusoidal. Just how the two sources, and possibly others, evade the Eddington limit remains a mystery. (F. Fürst et al., *Astrophys. J.* **831**, L14, 2016.) —CD

LEIDENFROST FOR SOLIDS



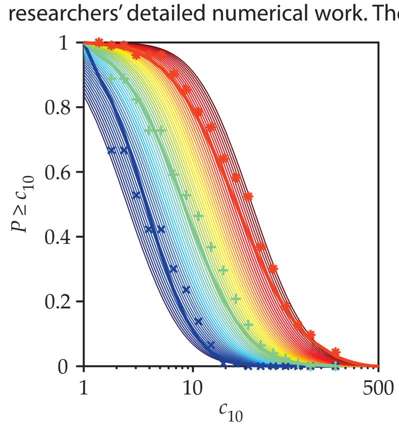
Anyone who has sprinkled water into a hot pan has seen the Leidenfrost effect in action. A thin layer of vapor forms between the super-boiling-point surface and the droplets, causing them to levitate and skid across the pan (see PHYSICS TODAY, June 2006, page 17). Now Nicolas Vandewalle, Stéphane Dorbolo, and Baptiste Darbois Texier at the University of Liège in Belgium have demonstrated that an analogous phenomenon can occur when solids sit atop a surface heated beyond their melting point. Using a Petri dish as a mold, the researchers created disks of water ice. They then placed a disk on a heated aluminum plate. By using a video camera to track the motion of a black foam ellipse placed atop the ice disk, the researchers were able to analyze the disk's translation and rotation. At a range of plate temperatures between 4 °C and 35 °C Vandewalle's team found that the ice disk moved around randomly, essentially gliding across a thin film of meltwater above the plate. To gain more control over the ice's motion, the researchers drilled a 2 mm hole in the plate just beside the disk (see image). Water flowed along the perimeter of the disk and emptied into the hole at a rate equal to the rate of melting. The viscous drag of the ice by the flow of the meltwater stream caused the disk to rotate. The faster the ice melted, the faster the disk spun. (S. Dorbolo, N. Vandewalle, B. Darbois Texier, *Phys. Fluids* **28**, 123601, 2016.) —AG

YOUR MOST IMPACTFUL PUBLICATION CAN COME AT ANY TIME

An international research team led by Albert-László Barabási (Northeastern University) has just published a wide-ranging study of how the impact of a scientist's oeuvre varies over the course of a career. To gauge a publication's impact, the researchers considered the cumulative number of citations it received in the first 10 years after publication, a metric called c_{10}. One unexpected discovery came when they analyzed the probability that a scientist's nth paper was their most impactful one and found that all papers were equally likely to have the largest value of c_{10}.

The flat probability distribution is in accord with the disheartening hypothesis that a scientist's ability is immaterial to a publication's success. But Barabási and colleagues found that possibility inconsistent with other trends in their data—for example, that scientists who pen specific papers with truly high impact are likely to produce other important work. Instead, the researchers found, the impact of a scientific publication is well modeled as a product of a scientist-independent luck factor and a quantifiable scientific ability, Q.

The figure below shows the significance of Q according to the researchers' detailed numerical work. The y-axis indicates the probability that a paper will have a c_{10} value at least as great as that given on the x-axis. Ability, as measured by Q, increases from violet to red. The colored shapes fitted by bold lines give real-world data for three scientists.



The ability that helps determine the impact of a scientist's career may be influenced by education and other factors. For now, the dependence of Q on such factors remains unknown. (R. Sinatra et al., *Science* **354**, 596, 2016.) —SKB PT