HAND-DRAWN ORGANIC PHOTOVOLTAICS

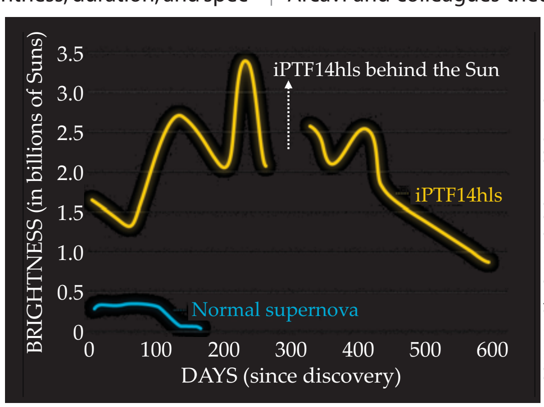
Over the past three decades, organic LEDs have gone from promising prototypes to commercial digital displays and light sources (see PHYSICS TODAY, November 2008, page 26, and February 2013, page 10). Perhaps it's little surprise that organic photovoltaics (OPVs) are starting down a similar path. OPVs offer the promise of flexible, large-area, and low-cost solar cells and photodetectors. In the lab, test samples are usually prepared by spin-coating: A small amount of solution containing a mix of organic semiconductors is placed on a substrate, and the substrate is spun rapidly to spread the solution into a thin film. The process wastes much of the material, however, and the range of film thicknesses it can produce is limited. Keisuke Tajima and colleagues at the RIKEN Center for Emergent Matter Science in Japan now report a simple, low-cost, less wasteful alternative: drawing on the substrate with a felt-tip marker containing an OPV solution. The figure shows a glass substrate on which parallel lines have been drawn three times; each pass deposited about 90 nm of material. The resulting films are noticeably nonuniform, especially perpendicular to the lines. Nonetheless, the researchers found that pen-coated OPV devices behaved similarly to or slightly better than spin-coated devices of comparable film thickness. (K. Suzuki et al., *AIP Adv.* **7**, 115002, 2017.) —RJF

HOW AN ORGANIC MOLECULE FORMS IN SPACE

Among the growing number of complex organic molecules detected in space, methyl isocyanate (CH_3NCO) is especially intriguing. In the lab, the molecule takes part in the synthesis of short amino-acid chains known as peptides. Conceivably, the same reactions could have occurred during the prebiotic evolution of the molecules of life. But for that pathway to work, CH_3NCO first has to form. Identifying the molecule's formation mechanisms is the topic of a computational investigation by Liton Majumdar of the University of Bordeaux and his collaborators. Methyl isocyanate is an industrially important (and highly toxic) chemical used in the manufacture of pesticides. In the cold vacuum of interstellar space, chemical reactions most likely take place either in the gas phase or on the surface of dust grains. Majumdar and his colleagues computed chemical reaction rates for reactions involving CH_3NCO and included them in a network of thousands of reactions used for modeling the chemistry of interstellar gas and dust. The simulations demonstrated that CH_3NCO forms efficiently only on grain surfaces. What's more, the range of favorable conditions that the researchers investigated included the surfaces of icy comets and the cool, dusty envelopes of protostars. Both are locations where CH_3NCO has been spotted. (L. Majumdar et al., *Mon. Not. R. Astron. Soc.* **473**, L59, 2017.) —CD

A BAFFLING, LONG-LIVED SUPERNOVA

The vast majority of the thousands of supernovae observed so far are easily categorized based on their brightness, duration, and spectrum. At first the supernova iPTF14hls, which was detected in sky survey images from the Intermediate Palomar Transient Factory telescope in September 2014, seemed to check all the boxes for qualifying as a type II-P supernova. In particular, its optical spectrum contained hydrogen absorption lines, suggestive of an expanding shockwave triggered by the collapse of a massive star into a neutron star. But then iPTF14hls did something strange: It kept shining. Type II-P supernovae typically exhibit constant luminosity for about 100 days before fading, as shown in blue on the graph; iPTF14hls glowed for more than 600 days and, as the graph illustrates, peaked in brightness several times. Also unlike the behavior of other type II-P explosions, the velocity and temperature of the light-emitting region remained relatively constant.



ADAPTED FROM LAS CUMBRES OBSERVATORY/S. WILKINSON

The puzzling supernova, about 500 million light-years away in the constellation Ursa Major, was monitored by Las Cumbres Observatory, a global network of telescopes whose longitudinal distribution ensures continuous coverage. Using the observations, Iair Arcavi and colleagues tried to find a model that could explain the prolonged episode. They weighed the possibility that iPTF14hls was the climactic final stage of a pulsational pair-instability supernova, a theorized but never observed event in which an extremely massive star sheds layers in repeated episodes before exploding and collapsing into a black hole (see PHYSICS TODAY, July 2007, page 17). The researchers even found evidence of a prior outburst on a 1954 photographic plate from the Palomar Observatory Sky Survey. But the pair-instability model can't account for the tremendous energy output of iPTF14hls and its bounty of hydrogen, which should have been largely lost in prior eruptions.

The Las Cumbres network continues to monitor the supernova, which has faded considerably. Unless iPTF14hls brightens or a similar event emerges, the mechanism driving this extraordinary cosmic fireworks show may remain a mystery. (I. Arcavi et al., *Nature* **551**, 210, 2017.) —AG PT