

The sudden creation of a high-speed electron in the decay can be thought of as the rapid acceleration of an electron initially at rest—a process that's accompanied by radiation, as shown in the figure. Through that so-called electron inner bremsstrahlung, theory predicts that nearly all neutron decays produce low-energy photons. But every so often, an inner bremsstrahlung photon should carry a significant and detectable fraction of the 782 keV released in the decay.

Fifteen years ago, researchers at NIST in Gaithersburg, Maryland, heard about an experiment in preparation at the Institut Laue–Langevin (ILL) in Grenoble, France, to try to measure radiative neu-

tron decay. They realized that their own superconducting magnet, previously used in measurements of the neutron's lifetime, was ideally suited for them to make their own attempt, which entailed monitoring a neutron beam for the characteristic signature of radiative decay: a proton, electron, and photon all produced at the same time.

The challenge was to distinguish the radiative-decay photons from an overwhelming background of photons from other sources, such as the external bremsstrahlung that's produced when protons and electrons decelerate in a particle detector. In their RDK experiment (not an abbreviation but a play on the

words “radiative decay”), the NIST team and its collaborators used a magnetic field to direct the charged particles away from the path of the neutron beam. As a result, the decay protons and electrons could be efficiently detected without the external bremsstrahlung ever reaching the photon detector.

The ILL experiment measured only an upper bound on the prevalence of radiative decay.¹ Then, in 2006, the RDK collaboration, led by Jeffrey Nico, found that out of every 1000 neutron decays, 3.1 ± 0.3 produced a photon with energy between 15 keV and 340 keV, the range over which their detectors were sensitive.²

Now Nico and his colleagues have re-

PHYSICS UPDATE

These items, with supplementary material, first appeared at www.physicstoday.org.

TWO KINDS OF DWARF PLANETS

Between 30 AU and 50 AU from the Sun lies a disk of ancient icy objects known as the Kuiper belt. Most of the objects are just a few tens of kilometers across; they never coalesced with other objects to form planets. But there are exceptions. Astronomers estimate there are a few hundred dwarf planets in the Kuiper belt. Thanks to ground-based observations using adaptive optics

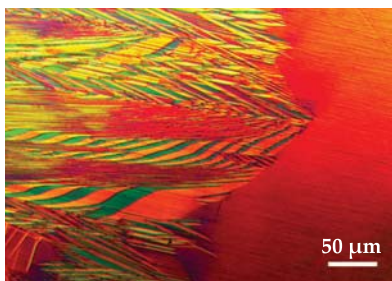
and the visit to Pluto last year by *New Horizons*, the properties of five of the Kuiper belt dwarfs—Eris, Haumea, Orcus, Pluto, and Quaoar—are becoming clearer. In particular, Amy Barr of the Planetary Science Institute in Tucson, Arizona, and Meg Schwamb of Academia Sinica in Taipei, Taiwan, have reexamined each planet's density and the mass ratio of each to its principal moon. Barr and Schwamb found that the planets fall into two groups. Pluto (shown here) and Orcus each have mean densities below 2 g/cm^3 and a large moon. Eris, Haumea, and Quaoar each have mean densities above 2 g/cm^3 and a small moon. Given that the dwarf planets formed initially by accreting building blocks made from the same mix of ice and rock, Barr and Schwamb propose that the distinction between the two groups arose from the nature of the collisions that created the planet–moon systems. Pluto and Orcus captured their respective moons in relatively gentle collisions that preserved the bodies' compositions and sizes. The other systems were created in collisions that were so violent that the planets lost some of their ice and the moons were formed anew from collision ejecta. (A. C. Barr, M. E. Schwamb, *Mon. Not. R. Astron. Soc.* **460**, 1542, 2016.)



NASA/JHUAPL/SWRI

THIS PHASE-TRANSFORMING METAL NEVER GETS OLD

Three years ago, Richard James and his coworkers at the University of Minnesota discovered a metallic film—an alloy of zinc, gold, and copper—that seemed to flout the rules of materials



science. When chilled to about -40°C , it collapsed from a high-symmetry crystalline phase, austenite, to a low-symmetry one, martensite. The phase change reversed itself just as abruptly when the film was reheated.

(The microscope image shows martensite, left, advancing into austenite, right, as the alloy is cooled.)

Such phase transformations normally take a mechanical toll; typical metals show wear and tear after just a few cycles across the phase transition. But the Minnesota group's alloy, $\text{Zn}_{45}\text{Au}_{30}\text{Cu}_{25}$, remained pristine through tens of thousands of cycles. Aided by one of the world's brightest x-ray sources, James and collaborator Sherry Chen (Hong Kong University of Science and Technology) now think they've figured out why.

Diffraction experiments that Chen performed at Lawrence Berkeley National Laboratory's Advanced Light Source show that the alloy's austenite and martensite lattices, despite having vastly different symmetries, can arrange themselves to match up almost perfectly at shared edges. As a result, austenite can grow within martensite, and vice versa, without introducing strain at the interfaces. And it's interfacial strain that causes ordinary metals to crack and form dislocations during phase transformations. If $\text{Zn}_{45}\text{Au}_{30}\text{Cu}_{25}$'s lattice attributes can be replicated in other alloys—and James and his coworkers suspect they can—they could potentially guide the design of efficient multiferroic switches, microelectromechanical actuators, sensors, and other devices. (X. Chen et al., *App. Phys. Lett.* **108**, 211902, 2016.) —AGS

ANCIENT METEORITE IS IN A CLASS OF ITS OWN

More than four-fifths of the asteroids recovered on Earth as meteorites are ordinary chondrites—iron-poor rocks that contain small