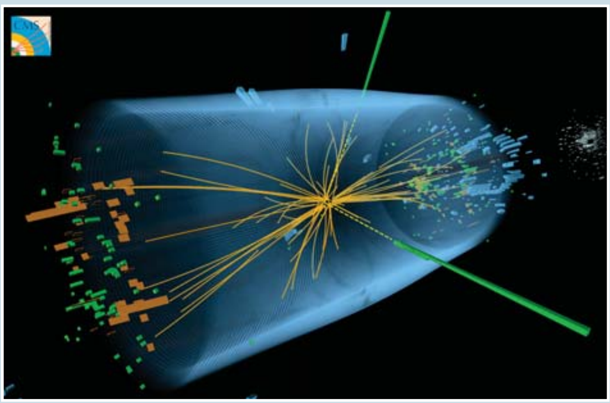
physics update

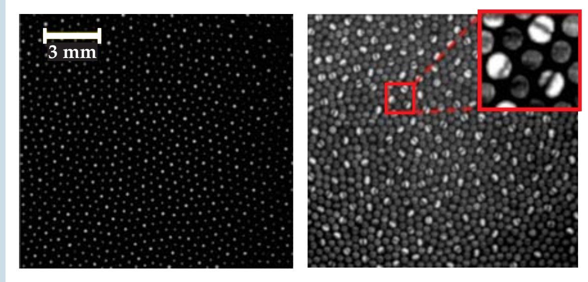
These items, with supplementary material, first appeared at http://www.physicstoday.org.

A Higgs particle has been spotted. Fifty years ago a number of theoretical physicists suggested a way to augment the developing standard model of particle physics with a new mechanism that involved a particle since dubbed the Higgs boson. That particle interacts not only with gauge bosons, as in its original formulation, but also with quarks and other fundamental fermions, endowing those entities with mass. A half-century after its proposal, the elusive Higgs, or something much like it, has now been observed. In a symposium and press conference held at CERN last month, ATLAS and CMS collaboration scientists affirmed that they had seen the particle at a mass of about 125 GeV. At the end of 2011, the two groups had announced tantalizing hints of the Higgs—resonance peaks three standard deviations above background (see PHYSICS TODAY, February 2012, page 16). In the intervening months, the groups have doubled their data and



now report peaks of five sigma above background. Around the same time, the CDF and D0 groups at Fermilab announced that their experiments—lower in energy and with different detection capabilities—are consistent with the CERN results. Now CERN physicists need to check the particulars of the particle's production and decay rates (one particular decay is shown here), which are well predicted by the standard model. They may find that they have discovered a novel particle that gives mass as the standard model Higgs does, but that heralds physics beyond the standard paradigm. (See a fuller treatment in PHYSICS TODAY next month.) —SKB

When a dusty plasma gets dirty. In a dusty plasma—whether in a laboratory or in outer space—free electrons, ions, and highly charged microscopic particles coexist in a background of neutral gas. In a laboratory version, the particles typically are uniform spheres that with the proper application of an electric field arrange themselves in a two-dimensional crystal structure. The dusty plasma then serves as a model for various condensed-matter systems. (See the article by Robert Merlino and John Goree in PHYSICS TODAY, July 2004, page 32.) But what happens if the spherical dust was not purified and is nonuniform in size? Physicists at the Max Planck Institute for Extraterrestrial Physics in Garching, Germany, have now found out. Introducing impurities—in the form of odd-sized particles—into their dusty plasma, the researchers first



focused their camera on the dust layer as they normally would and saw the nearly regular structure shown in the left panel. Upon defocusing, however, an entirely new layer of particles was revealed to exist just beneath the main layer (right panel). What's more, the new particles showed interference fringes (stripes in the inset) that often rotated, presumably as the particles moved. Further experiments showed that the lower layer contained the impurities, which had come together to form two-particle dimers. The layers of uniform spheres and of impurities were distinct and easily distinguished. As the number of impurities increases from zero, the pristine crystal layer gradually transitions to a completely disordered state. The technique should be useful in studying problems like the liquid–gas phase transition and glass jamming. (M. Chaudhuri et al., *Appl. Phys. Lett.* **100**, 264101, 2012.) —SGB

A puzzling pair of planets. In our solar system, the changing character of the planets with increasing distance from the Sun makes sense in terms of standard planet-formation theory: small rocky planets near the Sun, which would have largely stripped them of their volatiles, and icy gas giants in the solar system's frigid outer reaches. But in recent years the discovery of many "hot Jupiters"—gas giants orbiting close to their stars—has generated theories of how planets might migrate far from where they're formed. Now a team analyzing data from NASA's *Kepler* telescope, shown here, has unveiled different evidence of possible planetary migration. *Kepler* monitors some 150 000 stars for periodic dimming that might indicate planets transiting across their faces. The team discovered two very dissimilar planets orbiting a solar-mass star (Kepler-36) in almost identical orbits. One appears to be a rocky super-Earth, denser than Earth with four times its mass. The other looks like a hot mini-Neptune, half as massive as its namesake and less dense than water. Although the unlikely pair's orbital radii (roughly 20 million km) differ by only 10%, one planet is eight times as dense as the other. If they were formed far apart, it's not obvious that the generally invoked migration mechanisms could explain their current proximity. Perhaps they were both formed close