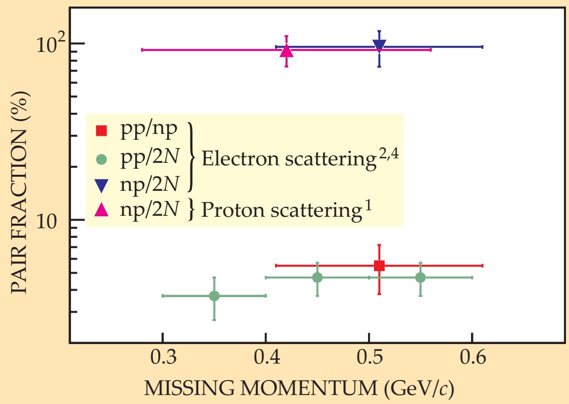


Figure 2. The fractions of correlated-pair combinations, as measured from electron- and proton-scattering experiments. At momenta above 275 MeV/c nearly all of the nucleons N ejected from carbon-12 are correlated. The data reveal a roughly 20-to-1 predominance of neutron–proton (np) pairs over proton–proton (pp) ones. The red square plots the inverse, pp/np, and other data points plot the number of pp or np pairs over the total number of nucleon pairs. Missing momentum refers to the difference between the virtual photon's momentum and that of the knocked-out proton. Horizontal bars signify the range of momentum averaged over, not uncertainties. (Adapted from ref. 2.)

pairing and a striking asymmetry in the data: Of the SRCs analyzed, the vast majority were neutron–proton pairs.[1]

Now a collaboration of 64 scientists, Piasetzky and Watson among them, from 31 institutions around the world has published what may be the most direct observation yet of those asymmetric correlations.[2] Instead of firing protons at carbon-12, the new experiment fired electrons, which interact with nuclei not via the strong force but through an electromagnetic interaction. The much different probe captured the same SRC physics.

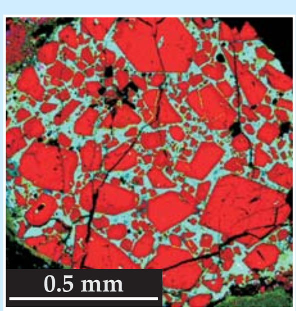
In concept the experiment is simple. An incident electron transfers a portion of its momentum through a virtual photon to a single proton in the ^{12}C nucleus, as sketched in figure 1. In execution, it's daunting. Preparation for the experiment, performed at the Thomas Jefferson National Accelerator Facility in Newport News, Virginia, spawned three PhD theses. Ramesh Subedi (Kent State), Ran Shneor (Tel Aviv), and Peter Monaghan (MIT) custom-built detector components, ran simulations to optimize the kinematics, and modified existing spectrometers to ensure they would actually work when sprayed with a 4.6-GeV electron beam of high luminosity (10^{38} cm^{-2} s^{-1}). The experiment took years to build and three months to run, with scientists continually monitoring the accumulating data.

In the "triple-coincidence" experiment, three separate detectors were positioned to measure the momenta of the scattered particles with subnanosecond time resolution over a range of kinematic settings above the nucleons' Fermi momenta. Two high-resolution spectrome-

physics update

Supplementary material related to these items can be found at www.physicstoday.org.

New chemical clues to Earth-like planet formation. Sodium is volatile. It easily burns and boils and diffuses. Meteorites are hardy, and the type known as chondrites are also primitive, dating back to the very early solar system. Chondrites contain a high density of so-called chondrules—roughly millimeter-sized spheres like the one shown here in polarized light—that were flash-melted at temperatures around 2000 K and subsequently cooled and incorporated into a meteorite's parent object, typically an asteroid. The heating mechanism is unknown but could involve shocks or lightning. Mostly made of silicate minerals such as olivine and pyroxene and of the metals iron and nickel, chondrules are expected to be deficient in volatile elements like sodium. But researchers at the Carnegie Institution of Washington, the US Geological Survey, and the American Museum of Natural History say it isn't so. Using electron microprobe spectroscopy, they studied 26 chondrules from the Semarkona meteorite that fell in India in 1940 and found significant sodium throughout. The only way that could happen, they say, is if the chondrules formed as closed systems at densities in the solar nebula (the disk of gas and dust from which the planets formed) that were far higher than previously thought. That way, the cooling droplets would be crowded together in an area of saturated sodium vapor. The required ambient densities range from 10 to hundreds of grams per cubic meter, far exceeding the standard assumption of 0.1 g/m^3 or less. At the much higher densities, astronomically tiny regions just a few thousand kilometers across can collapse under their own gravity. Thus chondrule formation seems to be intimately linked to planetesimal formation, the first step in making planets like Earth. (C. M. O'D. Alexander et al., *Science* **320**, 1617, 2008.) —SGB



Photoluminescence in nanoneedles. Silicon is the workhorse among semiconductors in electronics. In optoelectronics, where light signals are processed along with electronic signals, gallium arsenide is the workhorse light emitter—for example in LEDs and lasers—but getting GaAs to cooperate with Si remains challenging. Scientists at the University of California, Berkeley, have now grown GaAs needles that poke out of a Si substrate, and the needles emit bright photoluminescence at room temperature. About 3–4 μm long and tapering at a gentle 6- to 9-degree angle down to tips about 2–5 nm across, needles like the one shown here were grown to match the crystal structure of the Si despite a 4% lattice mismatch where they meet the substrate. Working in Connie Chang-Hasnain's lab, graduate student Michael Moewe says that he expects the needles to be valuable in several applications including atomic force microscopy; the sharp tips can be grown in arrays without additional etching or processing steps. Delivering light from a sharp tip