

HIGH-ENERGY PHYSICS

# Evidence for 'Pentaquark' Particle Sets Theorists Re-Joyce-ing

*Three quarks for Muster Mark?* Every physicist's favorite *Finnegans Wake* passage might need a little updating. Several experiments around the world seem to have created an exotic particle containing five quarks rather than the two or three that make up all other quarky matter. If true, this new particle, dubbed the theta-plus ( $\Theta^+$ ), might help physicists banish the last remaining shadows in quantum chromodynamics (QCD), the theory that describes quarks and the forces that bind them together.

QCD does not forbid five-quark particles. But all known quarky matter is made up of three-quark ensembles known as baryons or quark-antiquark pairs known as mesons, and years of looking for bizarre four- and five-quark ensembles left scientists empty-handed and puzzled. "Where are the collections of quarks not

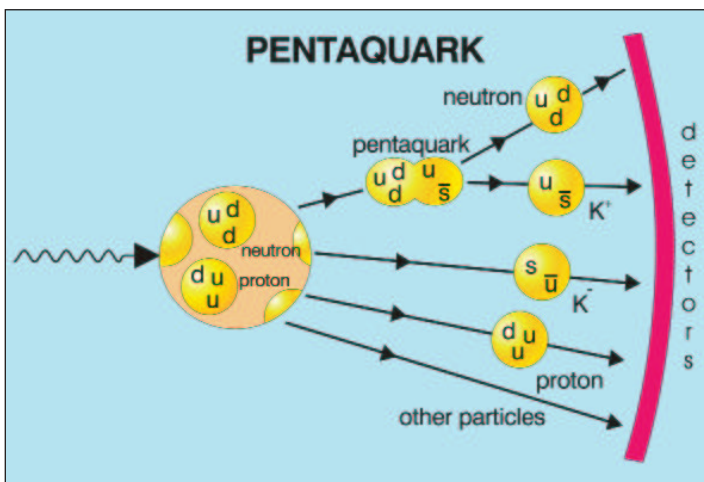
nuclei will fleetingly recombine into new species of particles that will leave their signature on the more conventional baryons and mesons that come into being when they decay. All three groups report that the debris from the collisions point back toward  $\Theta^+$  particles.

"The fact that all the labs are reporting similar results is a relief," says Takashi Nakano, who heads the Japanese effort. "I have been feeling much better since I heard about JLab and ITEP results. But I cannot be 100% sure for a while until we get more experimental evidence." Goldman is similarly cautious. "It looks to be a very strong case. One is tempted to believe these things, but it is still possible that there's an error," he says.

Ken Hicks, a physicist at Ohio University, Athens, who works on both the Japanese and American experiments, says it's possible that the new particle might be some sort of bound "molecule" made up of a two-quark meson and a three-quark baryon. He hopes that scattering electrons off the new particle—a tricky prospect that's beyond the reach of current experiments—will eventually give physicists a clear enough picture of the particle's shape to prove that the  $\Theta^+$  is indeed a

single particle rather than a composite. According to Goldman, figuring out the precise shapes of exotic particles like the  $\Theta^+$  can "fill in the last major chink" in the armor of quantum chromodynamics. Physicists know that quark-matter particles aren't always spherical, yet they routinely ignore that change of curvature in their QCD calculations. If "pentaquark" states are not spherical, Goldman says, then physicists can finally figure out what their models were getting wrong and fill in the missing details. And although it might disappoint those who like the nice, neat three-quark rule, physicists are pleased that quarks are finally showing their quirky side.

—CHARLES SEIFE



**Newcomers.** Jolted by collisions, quarks inside atomic nuclei recombined into bursts of particles that appear to include exotic five-quark specimens.

organized into [three-quark baryons] or mesons?" asks Terrance Goldman, a physicist at Los Alamos National Laboratory in New Mexico.

Now scientists at three laboratories think they finally have spotted a five-quark beastie. The first experiment, at the SPring-8 accelerator facility near Osaka, zaps a carbon target with high-energy light. A second, at the Jefferson National Accelerator Facility (JLab) in Newport News, Virginia, sends light into deuterium or hydrogen targets. The third, at the Institute of Theoretical and Experimental Physics (ITEP) in Moscow, smashes mesons into xenon nuclei. In each case, researchers hope jolted quarks inside atomic

## Royal Society: Taxonomists Endangered

British taxonomists and other conservation scientists are an endangered species, says the United Kingdom's Royal Society. Systematic biology and taxonomy are being squeezed out of many universities, and recent funding boosts at the Kew Gardens and the Natural History Museum are not enough to make up for a decade of lean budgets, the society concluded in a statement issued last week, which also faulted government recommendations for transforming taxonomy into a digital science.

The society decided to sound its warnings after the House of Lords and the British government issued reports on the state of systematic biology and biodiversity. Both bodies said the Global Biodiversity Information Facility, an international clearinghouse based in Denmark, should take the lead in developing an online database of worldwide biodiversity.

But the society says the database should begin as a pilot project at a major museum or botanic collection. Taxonomy "is not just stamp collecting," says society president Robert May. "Whether you're talking about answering basic problems in evolution or practical questions on climate change, you can't begin unless you know what's there."

—GRETCHEN VOGEL

## Japan Seeks Answers to Rise in Misconduct

TOKYO—Japanese culture is contributing to the growing number of scientific misconduct cases, according to a new report by the Science Council of Japan. Believed to be the country's first comprehensive look at the issue, the report says that Japanese scientists feel the same pressure to publish as do their colleagues around the world. But it notes that a cultural reluctance to confront eminent scientists engaged in questionable activity, combined with the bonds formed through lifetime service to a single institution, has exacerbated the problem. The report recommends that universities and institutes replace unwritten rules on misconduct with clear guidelines and that allegations be investigated by third-party committees run by national ministries or scientific societies.

Calling the report a first step, Kiyoshi Kurokawa, dean of the School of Medicine at Tokai University and a vice president of the council, says that "further activities pertaining to this are very important."

—DENNIS NORMILE

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