perimenters at Hermes, HERA's third detector, collided positrons with both protons and deuterium and compared the numbers of positively and negatively charged pions that emerged. The experiment "is based on the fact that scattering [a positron] on an up antiquark most likely results in a negative pion, while hitting a down antiquark would lead to a positive pion," says Antje Brüll of the Hermes team. The pion counts revealed an excess of down antiquarks.

The agreement between the Hermes results, reported in the 21 December 1998 *Physical Review Letters*, and the results from NuSea is "good," says Brüll. The two experiments found that down antiquarks outnumber up antiquarks by as much as three to two, implying that the up and down quark populations of the sea are similarly unbalanced. This "relatively huge" difference is not really understood, says Stirling. "It is a fundamental property of perturbative QCD that the sea would have to be 'flavor symmetric,' " says Thomas. The antidown-antiup imbalance "is telling us something vitally important about the … structure of the [proton]" beyond the range of perturbation theory, he says.

Thomas has proposed an explanation for this imbalance, called the meson cloud model, in which the proton fluctuates between being a pure proton and a mixture of a neutron plus a positively charged pi meson, and several other overlapping particle combinations allowed by quantum theory. Because a positive pi meson consists of an up quark and down antiquark, an experiment that "sees" the proton as a neutron plus a pion will record more down antiquarks than up antiquarks, according to Brüll. Both Hermes and the NuSea data "clearly favor the so-called meson cloud models," she thinks.

Not everyone is so enthusiastic, however. "There are many high-energy people who refuse even to imagine that pions could contribute" within a proton or in such a simplistic way, says Thomas. Stirling feels that, because physicists cannot count quarks directly but must rely on the debris of collisions, there may be some bias in the way debris from certain collisions rearranges into observable particles.

And the proton keeps turning up new surprises. Two months ago, Thomas published a new analysis of Fermilab neutrino-nuclei data and a CERN experiment that scattered muons from protons and found what might be another anomaly of the quark sea. In the 9 November 1998 issue of *Physical Review Letters*, Thomas and his collaborators, Csaba Boros, also in Adelaide, and Tim Londergan at Indiana University, Bloomington, claim that for momentum fractions of less than about 10%, the number of up antiquarks in the proton does not equal the number of down antiquarks in the neutron.

If true, this would send shock waves through the particle physics community, as researchers have always assumed that protons and neutrons are related by a simple interchange of up and down quarks and antiquarks. "The effect, if it holds up experimentally, is huge," says Thomas. "We know of no theoretical mechanism which could explain these data." According to Shaevitz, however, forthcoming data from two Fermilab experiments may contest Thomas's ideas.

The challenge ahead will be to fit this swath of unexpected results into the framework of QCD. "While QCD is an amazingly beautiful theory, most of its consequences remain inaccessible to [theorists]," says Sarada Rajeev of the University of Rochester. But the clues that experimenters have been able to tease out of the proton have put some of the answers within reach. Forthcoming experiments may serve up more clues, and perhaps more surprises. Dr. Seuss's Horton finally gets the dust speck's inhabitants to shout loudly enough to be heard, convincing all the doubters. Perhaps diviners of the proton's sea could use some similar inside help. **–ANDREW WATSON**

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NUCLEAR PHYSICS

Element 114 Lumbers Into View

The race to capture one of the biggest prizes in nuclear physics—an exceptionally long-lived superheavy element—appears to be over. In a cautiously worded e-mail to a close-knit group vying for the trophy, scientists at the Joint Institute for Nuclear Research in Dubna, near Moscow, this month unveiled evidence for the creation of a nucleus with 114 protons—the heaviest element yet forged.

If confirmed, the sighting would mean far more than just another entry in the periodic table. Element 114 appears to last for 30 seconds before decaying, a longevity that would verify predictions of an "island of stability" beyond the lighter, less stable nuclei glimpsed earlier. "This is the most exciting event in our lives," says Albert Ghiorso of Lawrence Berkeley National Laboratory (LBNL) in California, who has spent 35 years hoping his group would plant the flag on the fabled terrain. The finding, adds Sigurd Hofmann of the Institute for Heavy Ion Research (GSI) in Darmstadt, Germany, whose team many observers expected to get there first, "opens up a window to a quite new field of research."

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>
> —Albert Ghiorso

For a half-century physicists have used nuclear reactors and particle accelerators to forge new elements, beyond the 94 known to exist in nature. Like climbing taller and taller peaks, each successive effort has required vastly more energy and greater technological legerdemain. And for ever-more fleeting results: Although some transuranic isotopes last for years, an isotope of the last element created—number 112—is so unstable it sticks around a mere 280 microseconds. Theorists have predicted, however, that this trend toward instability would be reversed as additional protons and neutrons filled out nuclear shells. With a full shell of protons, element 114 should lie well within the stable island.

To make the element, the main contenders—GSI, LBNL, and Dubna in collaboration with Lawrence Livermore National Laboratory (LLNL) in California—plotted varying strategies (*Science*, 24 October 1997, p. 571). GSI went with cold fusion, a technique in which two medium-sized isotopes are fused in an accelerator—an approach that already secured their claim to bohrium (element 107), hassium (108), meitnerium (109), and the unnamed elements 111 and 112. Last spring Hofmann's GSI team tried to create element 113 but failed.

The Dubna-LLNL group took a different tack, heading straight for 114. Their hot-fusion approach involves smashing light elements into a heavy one like plutonium. For several weeks late last year, a team led by Dubna's Yuri Oganessian and Vladimir Utyonkov pounded a plutonium-244 target provided by LLNL with some 5×10^{18} atoms of a rare calcium isotope, calcium-48. Sifting the data from their detector, the team spotted what appears to be the unique signature of a decay chain starting with $^{289}114$, which hung around for 30 seconds before hiccuping an alpha particle to form an isotope of 112.

More work is needed to confirm the find, says Ghiorso, whose group will do follow-up studies. Says Dubna's Alexander Yeremin: "If at least one more event [is] found with similar characteristics, it will be good proof." In a sad footnote, isotope pioneer Glenn Seaborg, 86, suffered a crippling stroke a few months ago and may not comprehend the news, says Ghiorso. Seaborg, whose name graces element 106, would be thrilled by a discovery that, if verified, would open a terra incognita for nuclear science. **–RICHARD STONE**