will be written by the principal author of the technical report itself and reviewed mainly within the collaboration. Then, each will be put on the Web when the technical report gets submitted to a journal.

Like any literary debut, the group's first efforts have been deconstructed by the critics. "I certainly welcome" their intentions, says Michael Riordan, a particle physicist at the Stanford Linear Accelerator Center and the author of several books, including *The Hunting of the Quark*. "But I caution that [translating physics to English is] not so easy to do." The writers' style in the first reports, he says, "assumed the reader already knew what they were talking about."

Getting the message beyond the scientific community to the wider public could be difficult. "The main issue," says Teri Ann Doerksen, who uses science articles as an aid for teaching composition at Hartwick College in Oneonta, New York, "is one I see in composition papers all the time"—expecting too much of the readers. "If you can't gauge your audience, you have no way to figure out what level of detail you need to go into when you define your terms," says Doerksen. Weerts admits that the expositions are "not totally plain English yet," but predicts that as D0 blazes the trail, other groups will follow.

Within Fermilab, at least, the idea already seems to be winning new adherents. Members of a competitor group, called CDF, have announced that they will write lay versions of not only technical publications but major conference presentations as well. "I wouldn't be surprised if other groups do this also," says Alfred Goshaw, a CDF spokesperson-elect at Duke University. "It's such an obviously good idea."

–James Glanz

PHYSICS

In Search of the Cleansing Axion

Few particles offer so much as the axion: Its proponents claim it will iron out a wrinkle in the Standard Model—physicists' description of nature's fundamental particles and forces—while solving the mystery of the universe's missing mass. First, however, this elusive beast must be discovered. Physicists are keenly awaiting the results of two experiments—one just analyzing its first data and the other just starting up—which may finally answer the question of whether these ghostly particles really exist. "If the axion is discovered, it would be an extraordinary triumph for theoretical physics," says Frank Wilczek of Princeton's Institute for Advanced Study.

The axion was proposed nearly 20 years ago to overcome a problem in quantum chromodynamics (QCD), a central plank of the Standard Model that describes how quarks—the building blocks of protons and neutrons—are held together by gluons. QCD requires that the interactions between quarks and gluons be symmetrical under time reversal—they must work identically if time runs backward—and that they have handedness symmetry, too: Left- and right-handed quarks and gluons must be treated equally. In 1978, Wilczek and, independently, Steven Weinberg of the University of Texas, Austin, realized that a new particle would be required to guarantee the symmetry of quark-gluon forces. Wilczek had seen a detergent called Axion and thought it sounded like a good name for a particle. "When it appeared that one needed a particle to clean up a problem with the axial baryon number current of QCD, it was impossible to resist," he says.

Since then, numerous attempts to detect axions have all ended in failure. Wilczek says part of the problem is that physicists searching for axions in particle collisions or nuclear transitions were looking in the wrong place. Now, they are looking to cosmology and astrophysics: Current theories of the formation of the universe predict that the primordial fireball spawned axions in huge numbers, and we should, theorists argue, be awash in a soup of axions each weighing just a few microelectron volts. There could be as many as a million million axions per cubic centimeter around us, so although they are very light, they could make up a large proportion of the invisible 90% of the mass of the universe.

Axion proponents are pinning their hopes on two experiments to detect this axion soup. Both are based on an idea first proposed in 1983 by Pierre Sikivie of the University of Florida. "The principle is that an axion may convert to a photon in a large, externally applied magnetic field," says Sikivie. "The conversion probability is very small but gets enhanced if the conversion occurs inside a cavity tuned to resonate at the [photon] frequency set by the axion mass."

LLNL

In the can. The bottom cylinder is the cavity that catches axions in Livermore's detector.

One of the experiments involves one Russian and six U.S. institutions and is based at Lawrence Livermore National Laboratory (LLNL) in California. "Basically, the experiment is a radio receiver," says physicist Karl van Bibber, co-leader of the LLNL-based effort. The receiver is a copper cavity, cooled to 1.3 kelvins and bathed in the strong magnetic field from a 6-ton superconducting magnet. The researchers tune the cavity so that its resonant frequency matches the frequency of the photon an axion should transform into, and if one does, it would be detected electronically.

The experiment has now been running for a year, and the team expects to finish analyzing the first data this month, says van Bibber. They have some candidate axion signals, but if these do not pan out, the researchers hope to at least set some limits on the number of axions around us, or on the chance that they convert into photons. Van Bibber says they plan to increase the experiment's sensitivity 10-fold next year, putting all favored axion models within reach.

Meanwhile, across the Pacific, Seishi Matsuki and his team at the Institute for Chemical Research at the University of Kyoto in Japan are in the process of starting up a rival axion experiment that is even more technologically challenging. "We visited his lab in early December ... and it is really a fantastic project," says van Bibber.

Matsuki's experiment also relies on converting axions to photons in a resonant cavity, but he plans to detect the photons with Rydberg atoms, in which electrons are pushed to the outermost orbitals, almost out of reach of the nucleus's pull. If any axions convert into photons, these are absorbed by Rydberg atoms in a beam passing through the cavity. The beam then passes through an electric field that will ionize only those atoms that have absorbed a photon. "Thus, ions are detected as a signal of axions," says Matsuki. First, the group is searching for axions with masses of about 10 microelectron volts. "It will take about 3 months to complete the measurements with the present experimental sensitivity," says Matsuki.

Van Bibber says even agnostics who are not "sold on axions until they are found" are eagerly awaiting the results of the two experiments: "It is encouraging to us that even those people are strong supporters of our experiment."

–Andrew Watson

Andrew Watson is a science writer in Norwich, U.K.