

SCIENCE NEWS OF THE WEEK

CERN Stores Highest Energy Antiprotons

In a famous poem of some years ago Dr. Edward Teller meets his mirror image, Dr. Edward Antiteller. They shake hands, and "all the rest is gamma rays." That is, being matter and antimatter, they annihilate each other on contact, producing a large blob of pure energy.

What the poem didn't say was that given enough energy those gamma rays (for the technical minded they are virtual, not real, photons) could turn themselves into almost any particle in physics. Teller and Antiteller were presumably standing still when they shook hands. If they had run at each other, there would have been more energy in the collision.

A major goal of physicists around the world is to produce more new kinds of particles, not with Tellers and Antitellers but with protons and antiprotons. Certain possibilities seem imminent as the European international CERN laboratory announces that it has succeeded so well in producing proton-antiproton collisions at the highest energies ever in a laboratory that it will begin a small experimental program with them. Among things that may come are a better understanding of the behavior of quarks, a crucial test of the new unified field theories and a study of the little-understood "Centaurus" events, heretofore seen only rarely among the cosmic rays.

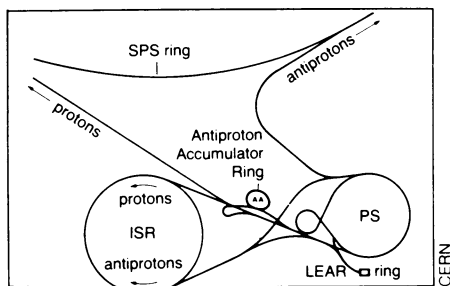
The energies involved are 270 billion electron-volts (270 GeV) for the proton and the same for the antiproton, or 540 GeV available for the production of new physics. These collisions take place in what was up to now one of the world's two most energetic proton accelerators, the Super Proton Synchrotron (SPS). Perhaps now it might be called the Super Antiproton Synchrotron as well.

With these latest high-energy collisions CERN broke its own record for proton-antiproton collisions by a factor of 5 or 10. CERN is the only laboratory in the world that has managed proton-antiproton collisions of this kind. Fermilab in Illinois, which has the other accelerator comparable to the SPS, has a similar program, but it goes much more slowly because of American budget restrictions. The 12 European nations that own CERN are more generous.

CERN's pursuit of colliding antiproton beams has had a surprisingly swift success. Antiprotons do not come easily in Geneva or anywhere else in our corner of the universe. They have to be made in collisions of protons with fixed targets at a rate about one per million protons; they have to be carefully managed to prevent them from meeting protons prematurely; they have to be formed into bunches and beams that the accelerators will accept.

That means they must be "cooled." Antiprotons are made with a wide range of momenta. Cooling means to change the momenta of a gang of antiprotons, to bring them closer to the average value so that the range of momenta is small enough for the fine-tuned accelerators to accept.

Cooling was the great obstacle to overcome in the management of beams of antiprotons. There are two methods, and CERN made them both work in a very short time (SN: 9/30/78, p. 234). Now there are beams of protons and antiprotons waltzing around the SPS. In the same configuration of electric and magnetic fields they go in opposite directions, and they can be made to meet at two locations when desired. Experiments are being installed



around those points to observe what happens in the collisions.

With 540 GeV available in each collision physicists are fairly unanimous in expecting some great physics out of these collisions. After all, the heaviest particles now known are the upsilons with about 10 GeV rest mass. Between that and 540 GeV there's plenty of room for something new.

One group of particles that is being looked for immediately is the so-called W and Z particles or intermediate vector bosons. These Ws and Zs are central to the new unified theories of particle physics that are being developed. The best regarded theory, the Weinberg-Salam theory, predicts certain properties for these particles. If they are found with those properties, it will be a triumph for the theory. If they are found with different properties, the theory will have to be rethought. If they are not found, there is a possible loophole: The theory does not predict their masses. The best educated guesses are 70 to 100 GeV, well within the range of these experiments. If the Ws and Zs don't show, it is possible to say they are heavier than 540 GeV, but it would be hard for most physicists to believe. □

Reagan wants to end both DOEs

President Ronald Reagan expects to have a legislative proposal to abolish the Education Department before Congress within two weeks. By mid-November, similar termination orders will be proposed for the Energy Department.

"We do not need an Energy Department to solve our basic energy problem," the President said in a recent television address. "As long as we let the forces of the marketplace work without undue interference, the ingenuity of consumers, businesses, producers and inventors will do that for us."

The White House estimates that by 1984, \$1.5 billion could be saved via the agency's termination, including a reduction of 4,400 federal jobs. Already nearly 2,000 agency employees have lost their jobs.

Similarly, by eliminating the Department of Education less than two years after it was created, the President said, "We can not only reduce the budget but ensure that local needs and preferences, rather than the wishes of Washington, determine the education of our children."

Reagan also indicated that he planned to eliminate several smaller agencies, boards and commissions. It is no secret that the Council on Environmental Quality and Consumer Product Safety Commission have been proposed for such a "hit list."

Energy Secretary James Edwards predicts the administration proposal for abolishing his agency would win congressional approval within four to six months, though the dismantling itself could take another year to 18 months.

Others are less sanguine, suggesting that there might be quite a struggle before Congress will allow the energy agency to succumb. For instance, Senator James McClure, an Idaho Republican and chairman of the Senate Energy Committee, warns that dismantling DOE would "send the wrong psychological signal" to other countries about this nation's willingness to tackle its energy problems.

Even if the Energy Department is abolished, many of its programs would continue—perhaps again under the direction of the same agencies from which they had been pirated four years ago when President Jimmy Carter created the agency. The White House has already earmarked those programs it deems indispensable. Among them: the Strategic Petroleum Reserve (SPR); nuclear-defense program; civilian nuclear-power programs such as waste management, uranium enrichment and breeder-reactor research and development; "carefully targeted" conservation programs; and basic scientific and engineering research for certain new energy technologies. □