PHYSICS

Anti-Proton Discovered

When this strange particle strikes an ordinary proton, both are completely annihilated. The discovery is expected to spur a new era in nuclear research.

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➤ EVIDENCE that the strangest nuclear particle, the anti-proton, actually exists was announced by Dr. Ernest O. Lawrence of the University of California, Berkeley, and simultaneously by the Atomic Energy Commission.

Annihilation of matter would result from the explosion caused by a meeting of the anti-proton with its opposite number, the proton. Protons are hearts of hydrogen atoms.

Theoretically possible, the anti-proton has been announced several times in recent years, only to meet disproving evidence. Yet scientists still believed in the possibility of finding in cosmic rays or creating in giant accelerators this negative counterpart of the proton.

Now the newest contestants for the honor of finding an incontestable anti-proton are Drs. Owen Chamberlain, Emilio Segre, Clyde Wiegand and Thomas Ypsilantis of the University of California. They were aided by Herbert Steiner and Dr. Edward J. Lofgren.

They created the negatively charged particle in the bevatron, the University's huge cyclotron of improved design. This machine, shown on the cover of this week's SCIENCE NEWS LETTER, is capable of accelerating particles of relatively heavy masses to energies measured in billions of electron volts.

New Research Era

A new era of nuclear research, rivaling that which led to the atomic bomb, is foreseen by Dr. Lawrence as the result of the anti-proton creation.

The antiproton is a heavy particle of the same mass but of opposite electrical charge from the proton, which is one of the fundamental particles found in all atomic nuclei.

The particles are created when protons, the nuclei of hydrogen atoms, are fired in the bevatron at an energy of 6.2 billion electron volts. When one of these protons hits a neutron, part of the original energy of the projectile particle is converted into two new particles — an anti-proton and a proton. Nearly a billion volts goes into each new particle.

The existence of such particles has been suspected for a generation. Physicists have based their calculations on a belief in antiprotons. But the particles had never been identified, and the long lag had caused some physicists to doubt the reality of antiprotons.

One of the major results of the discovery is to eliminate doubt about one of the basic tenets of atomic physics. By clearing the nuclear air, physicists may now be able to forge ahead to new ground. Studies of the action of the particles may lead to new insight into the nucleus.

As Dr. Lawrence, Nobelist and cyclotron inventor, stated it: "Recalling that at the beginning of the past quarter century the discovery of the positive electon set off the remarkable developments in nuclear physics that followed, one cannot help but wonder whether the discovery of the antiproton . . . likewise is a milestone on the road to a whole new realm of discoveries in high energy physics that are coming in the days and years ahead."

Charged atomic particles occur, according to theory, in pairs with electric charges of opposite sign. The meeting of two such particles, alike except for their charges, results in an explosion which turns the material particles into bursts of energy. This has been found to be true when an electron, which has a negative charge, meets its positively charged twin, a positron. Such meetings have been recorded on photographic film. Tracks caused by the oppositely charged particles vanish in the record of an explosion, and different kinds of tracks, evidence of waves of energy, are found leaving the site of the collision. A much greater explosion would result from annihilation of the larger particles, proton and anti-proton.

Protons, which are much heavier nuclear particles than electrons and positrons, are always found carrying positive charges only. Yet there should theoretically be similar particles with negative charges. Physicists have named these anti-protons and have guessed that they may exist outside earth's atmosphere. Tracks ascribed to anti-protons were found in cosmic ray studies reported in 1951 by Dr. J. G. Retallack of Indiana University, Bloomington, Ind. In April, 1954, Dr. Bruno Rossi of Massachusetts Institute of Technology reported to the American Physical Society a "most unusual" cosmic ray photograph in which he believed he had found evidence of the anti-proton.

In the same year the annihilation of matter seemed to have been signalled in a burst of cosmic ray energy of ten million billion electron volts discovered by Prof. Marcel Schein and colleagues of the University of Chicago in a photographic emulsion flown to 100,000 feet altitude.

Prof. Schein concluded that this extraordinary event was the actual annihilation of "anti-matter," an anti-proton that came in from outer space.

There is no known "practical" application of the anti-proton discovery. No one can imagine now, for example, how antiprotons could be used to generate energy, as neutrons do in fission.

The discovery does not change the familiar planetary model of the atomic nucleus. The discoverers pointed out that antiprotons do not "live" in nuclei, as do protons and neutrons. They can "live" only outside nuclei.

Prior to completion of the Bevatron, the only previous source of anti-protons was believed to be cosmic rays. It is suspected that anti-protons are rare, however, in cosmic rays, and this rarity is the reason they had not been identified earlier in nature.

The experiments so far, University of California sources report, have been done with a variety of radiation counters. Attempts are now being made to detect antiprotons on photographic emulsions and in cloud chambers placed in the bevatron beam. Such photographs might help to clarify mysterious uninterpretable cosmic ray events photographed in the past.

Devise Maze

Essentially, the Berkeley scientists devised a series of selecting instruments which formed a kind of "maze" through which only particles with those characteristics predicted for the anti-proton could go.

The scientists had to find a particle with a negative charge and a mass equal to that of the proton.

The charge was determined automatically, since the particles were in the beam of negative particles bent outside the bevatron magnet.

The mass was determined by measuring the momentum and velocity of the particles. The momentum was obtained by the curvature of the particles in two magnetic fields.

Velocity was measured by 1. a "stopwatch" timing of the flight of anti-protons between two counters; and 2. the use of a novel fused quartz Cerenkov counter developed by Drs. Chamberlain and Wiegand.

The scientists said the mass of the particles they have observed is equal to that of the proton, with an error of five per cent. The anti-protons are stable in a vacuum, and do not decay (disintegrate) spontaneously. Mesons, on the other hand, have a short lifetime, and quickly decay.

The anti-proton does annihilate (vanish, giving rise to some other form of energy) when it comes into contact with matter. When, for example, the anti-proton comes into contact with a proton, the two particles immediately transform into mesons, which quickly disappear.

The discovery verifies the electrical charge symmetry of nature — for each known charged particle there is a particle of equal mass with opposite charge.

The first evidence for anti-protons came in bombardments on Sept. 21. About 50 antiprotons have been observed. The scientists decided the evidence was conclusive after bombardments on Oct. 17.

Science News Letter, October 29, 1955