PHYSICS

New 'Strange' Particle

Omega minus, a rare subatomic particle that lives for only about a ten-billionth of a second, has been discovered by a team of 33 scientists using the Brookhaven accelerator.

➤ A NEW SUBATOMIC PARTICLE called the omega minus has been observed by a team of physicists at Brookhaven National Laboratory, Upton, N. Y.

Proposed on theoretical grounds, the Brookhaven experiment provided the first confirmation of this rare particle, Physical Review Letters, 12:204, 1964.

The omega minus, with negative electric charge, belongs to a family of "strange particles."

"Strangeness" is a term used in describing a property of hyperons that live only for about one ten-billionth of a second after they are produced. Although this seems a short time, on a nuclear time scale this is so enormously long that these particles are considered quasi-stable elementary particles in their own right, and not just "resonant states" of other known particles.

The heaviest previously known "strange particle" was the "cascade" hyperon (or xi), so called because it decays into a lambda particle that in turn decays into a proton, the decay being accompanied by a pimeson, a basic "carrier" of nuclear forces.

The omega minus observed now might be called a super-cascade particle, since it decays into the cascade particle, again accompanied by a pimeson. In each step in this strange particle cascading process, the "strangeness" changes by one until only a proton or neutron is left, whose strangeness is zero.

The cascade has strangeness minus 2 and decays in two steps, whereas the newly found omega has strangeness minus 3 and decays in three steps.

Unlike the more or less chance discovery of some of the other elementary particles, which have contributed to an increasingly complex picture of elementary particles and nuclear forces, the observation of the omega minus is significant in that it may be the keystone to an orderly arrangement of the previously known particles, reminiscent of the atomic table of the elements or of optical line spectra.

Making use of group theory, theoretical physicists, led by Prof. Murray Gell-Mann of California Institute of Technology and Dr. Yuval Ne'eman of Israel, now a visitor at the California Institute of Technology, produced such an arrangement and predicted the existence of a missing particle with properties of omega minus.

One possible example had been seen in a photographic emulsion exposed to cosmic rays about ten years ago by Professor Y. Eisenberg, then at Cornell University.

An intensive search for the omega minus was started a few months ago at several high-energy physics laboratories. At Brookhaven the Alternating Gradient Synchrotron produces protons of energies up to 33 billion electron volts. In order to obtain more easily controlled conditions, these protons were allowed to hit a target from which negative K-mesons were extracted.

A beam of about ten such particles was then allowed to enter Brookhaven's 80-inch liquid hydrogen bubble chamber every two and one-half seconds. In this chamber, the world's largest, liquid hydrogen at a temperature of minus 412 degrees Fahrenheit is permitted to "boil" for a small fraction of a second when the beam enters. The paths of electrically charged particles are thus outlined by tracks of bubbles that are immediately photographed.

One such photograph, out of 100,000, revealed the possible "signature" of the omega minus. Analysis by very accurate measuring machines and an IBM-7094 computer confirmed this signature.

The omega minus was produced in association with two K-mesons and weighs about 3,400 times as much as an electron, or 1,680 million electron volts, which is the reason why such large and complicated equipment is necessary to produce it, for a large mass requires much energy to create it. Large groups of physicists, engineers, mathematicians and technicians cooperated to produce the result.

As more examples of the omega minus are found in the future, properties of the particle will become known. Thus more light should be shed on a challenging problem of physics: the nature of the nuclear forces and the apparently very complex structure of the "elementary" particles.

The Brookhaven National Laboratory physicists who took part in the experiment, are: Virgil E. Barnes, Philip L. Connolly, David J. Crennell, B. Brian Culwick, William C. Delaney, William B. Fowler, Edward L. Hart, Paul V. C. Hough, Jack E. Jensen, Joshua K. Kopp, Kwan-Wu Lai, John L. Lloyd, Thomas W. Morris, Yona Oren, Robert B. Palmer, Albert G. Prodell, Dusan Radojicic, David C. Rahm, Clarence R. Richardson, Nicholas P. Samios, James R. Sanford, Ralph P. Shutt, John R. Smith, David L. Stonehill, Richard C. Strand, Alan M. Thorndike, Medford S. Webster, William J. Willis, and Steven S. Yamamoto. Three physicists from Syracuse University, Drs. Nahmin Horowitz and Jack Leitner, and Patrick E. Hagerty, a student, together with Georges W. London, a student from the University of Rochester, also participated in the experiment. The team was headed by Dr. Shutt, with Dr. Samios in direct charge of the experiment.

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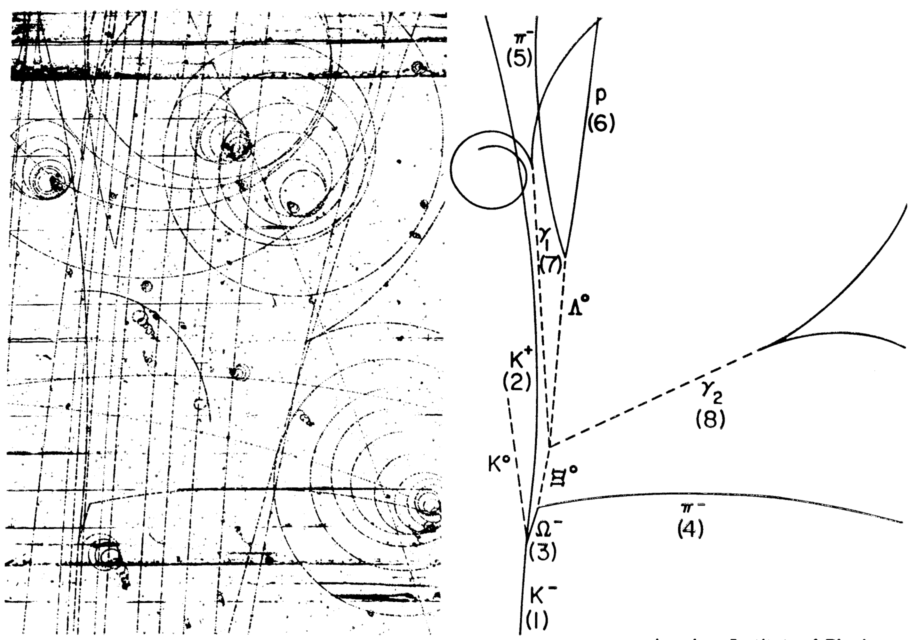

American Institute of Physics

OMEGA MINUS—This bubble chamber photograph shows the production of the omega minus particle. At right is a diagram of the paths of particles. A negative K-meson enters from the bottom (track 1) and collides with a proton. The collision produces the omega minus (track 3), a positive K-meson (track 2) and a neutral K-meson which like other neutral particles leaves no track because it has no charge. The omega minus decays into a negative pimeson (track 4) and a neutral xi. Decay products of the xi are neutral lambda and a neutral pimeson that decays instantaneously without leaving a track. The lambda decays into a negative pimeson (track 5) and a proton (track 6). The neutral pimeson decays instantaneously into two gamma rays which convert into electron-positron pairs.