PHYSICS

Reaction Releases Energy

Discover new kind of nuclear reaction that brings nuclear particles sufficiently close to cause fusion. The negative mu meson that does this emerges unscathed with the excess energy.

➤ A NEW KIND of nuclear reaction that yields more energy than is put into it was reported for the first time to the American Physical Society meeting here by Dr. L. W. Alvarez of the University of California, Berkeley.

Only 15 examples of "catalyzed nuclear reactions" have been discovered so far, he said, the first one less than a month ago. The two types of nuclear reactions now known are those occurring when atomic particles are hurled at other atoms, seen in giant accelerators and in atomic bombs, and the thermonuclear reactions of which fusion of atoms in hydrogen bombs and in stars are an example.

The newly-found nuclear reactions somewhat resemble fusion but occur at low temperatures instead of the million degrees or so needed to make H-bombs go.

A negative mu meson is the key to the discovery. As a catalyst, it takes part in the reaction but is not affected itself. Its role is to help along a reaction that releases 5,400,000 electron volts of energy in a new way.

However, the lifetime of a mu meson is so short that the reactions it catalyzes are not very apt to happen. Scientists are sure to start hunting for other sub-nuclear particles with similar properties but longer lifetimes.

Dr. Alvarez and 11 associates found the new kind of thermonuclear-like reactions using the "bubble chamber" attached to the bevatron, the University of California's giant atom smasher located at the Radiation Laboratory. The bubble chamber, ten inches long, is filled with liquid hydrogen. Charged particles produced in the accelerator leave paths of bubbles when they pass through the liquid.

For several years, physicists have been studying what are called mesic atoms. The simplest of these is a hydrogen atom in which the electron circling the nuclear proton has been replaced by a negative mu meson. Since the mu meson is 210 times heavier than the electron, it circles the nucleus at a distance only 1/210th that of the electron, giving an electrically complete atom with a decidedly short life.

In two-millionths of a second, a mu meson turns into an electron and energy. Instead of teaming up with a proton, however, the Berkeley scientists discovered that the mu meson would much prefer to pair briefly with a deuteron, the nucleus of heavy hydrogen. In natural hydrogen, one atomic nucleus in 5,000 has a neutron stuck to its proton, and is called a deuteron.

When a mu meson latches onto a deuteron, the resulting short-lived particle ties up with a proton to form a mu mesic molecule. The mu meson has pulled together the deuteron and the proton, binding them very close to each other because the mu meson is so close to the nucleus.

Since they are held tightly together, the deuteron and the proton soon fuse to form helium three. The nuclear mass of helium three is less than the combined mass of the proton and the deuteron.

This mass is transformed into energy. The mu meson carries the energy—5,400,000 electron volts—away when it is ejected at the time of fusion.

The Berkeley scientists checked their theory by enriching the ordinary hydrogen in the bubble chamber with heavy hydrogen. They found an increase in the number of reactions, confirming their discovery of "catalyzed nuclear reactions."

They foresee no use for the mu meson in power reactors or bombs, but point out it would be "interesting" to find a much longer-lived particle like it. The Russian physicist Alikhanian has reported evidence of such a particle.

The possibility of catalyzed nuclear reactions was predicted theoretically by another Russian, Ya. B. Zel'dovitch.

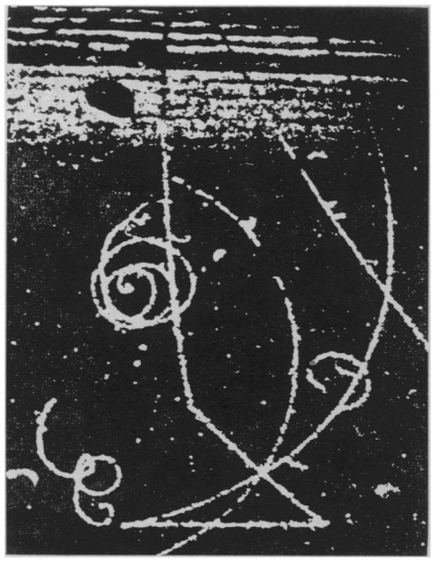
The photograph on the cover of this week's SCIENCE NEWS LETTER shows a catalyzed nuclear reaction recorded in a hydrogen bubble chamber. Beginning at upper right and streaking almost all the way across the picture in a gentle downward curve to the left is a mu meson. At the end of this track a mesic atom has been formed, and the mesic atom drifts slightly to the left, leaving a gap in the track. On the left side of the gap the mesic atom has fused a deuteron and proton into helium, with the ejection of the mu meson, which makes a short track upward and to the left. At the end of this short track, the meson stops and decays into an electron which starts toward the right and curves upward.

The scientists who participated in the research, besides Dr. Alvarez, were Drs. Hugh Bradner, Frank S. Crawford Jr., John A. Crawford, Paul Falk-Vairant, Myron L. Good, J. Don Gow, Arthur H. Rosenfeld, Frank Solmitz, M. Lynn Stevenson, Harold K. Ticho and Robert D. Tripp.

Science News Letter, January 5, 1957

Arteriosclerosis is the chief cause of *death* in the U. S.

Corn earworm damage is quite variable but averages about $50,000,000 a year.



MU MESON'S PATH—The photograph shows a sequence of two catalyzed nuclear reactions — two links in a chain-like reaction found in a hydrogen bubble chamber. At the center of the photograph, a mu meson generated by the bevatron enters the picture almost vertically. At the first bend in the track, a mesic atom has been formed, a deuteron and proton have been fused into helium, and the mu meson has been ejected on a track that zigs downward and sharply to the horizontal line. At that sharp angle in the track, another catalyzed reaction has taken place, and the meson is ejected horizontally across the picture. There the meson has come to rest, and decayed into an electron which makes a sweeping curve up and back out of the picture, crossing the entering track.

MEDICINE

Heart Disease Fight Extends Into Canada

➤ THE FIGHT against heart disease is being extended by formation of the National Heart Foundation of Canada.

The new foundation will eventually be a federation of provincial heart organizations stretching from coast to coast. As such, it will attempt to coordinate research in prevention and relief of heart disease and correlate the efforts of groups and individuals interested in reducing this disease.

In addition the foundation will aid in the development of measures and facilities for the diagnosis and treatment of heart disease and the rehabilitation of heart disease victims.

To promote its work, the foundation will foster fund raising campaigns in cooperation with its provincial groups.

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