PHYSICS

Time: One-Way Street

The new discovery that time is not symmetrical under all circumstances upsets the validity of the long-standing theory of "invariability of time reversal"—By Ann Ewing

➤ TIME is sometimes a one-way street.

This discovery shatters a long-standing basic rule of physics, called "time reversal invariance." It shows that under certain circumstances time has only one direction of flow.

Until now scientists had thought that their laws would hold true whether time ran backward or forward. The new finding, however, indicates that this is not necessarily so.

It gives scientists a powerful tool for understanding the universe around us, from the tiny strange world of the atom's nucleus to the vast reaches of the cosmos.

Time reversal reverses time in the same sense that a motion picture projector does when a film is run backward. The same physical laws were believed to apply whether the film was run forward or backward.

Now the situation, with respect to time, is the same as it once was for parity, or handedness. In 1957, scientists discovered that nature makes a distinction between left-handed and right-handed rotations in the jumbled world of particles within the atomic nucleus. This is a distinction in space, which had previously been thought symmetrical.

The new discovery has shown that time is not symmetrical under all circumstances, as had been thought. Time reversal invariance is present in almost every theory of physics, including Einstein's general theory of relativity and quantum theory.

Experiments by a Princeton University team using the Brookhaven National Laboratory's giant particle accelerator have cast serious doubt on this concept. This is the first time physicists have published experimental evidence questioning the validity of the invariability of time reversal, although it has been questioned in theory.

The Princeton experiment did not test time reversal directly. The scientists brought its validity under doubt by discovering about 50 examples of a "forbidden" method of break-up in the sub-microscopic centers of atoms.

Specifically, they found that the neutrally charged K-2 meson decays into two pi mesons, one negatively and one positively charged, twice in every 1,000 times. This method of break-up is not allowed under the charge-parity, or CP, rule.

The invariability of time is a casualty of this apparent violation of the CP rule, because charge-parity and time reversal are closely linked in the CPT theory. Since CP and T (time) are linked together, violation of one means violation of the other, and they hang or fall together.

The CPT theory holds that reactions between nuclear particles cannot be distinguished from their time-reversed, anti-matter, mirror images.

The C, or charge, is a way of distinguishing matter from anti-matter. The P, or parity, tells right-handed from left-handed, and the T, or time, distinguishes the direction in which a motion picture film is projected.

The Princeton physicists who did the work are Drs. James H. Christenson, James W. Cronin, Val L. Fitch and René Turlay, who is on leave from the Center for Nuclear Studies, Saclay, France. Details of their work was reported to the American Physical Society in Physical Review Letters, 13:138, 1964.

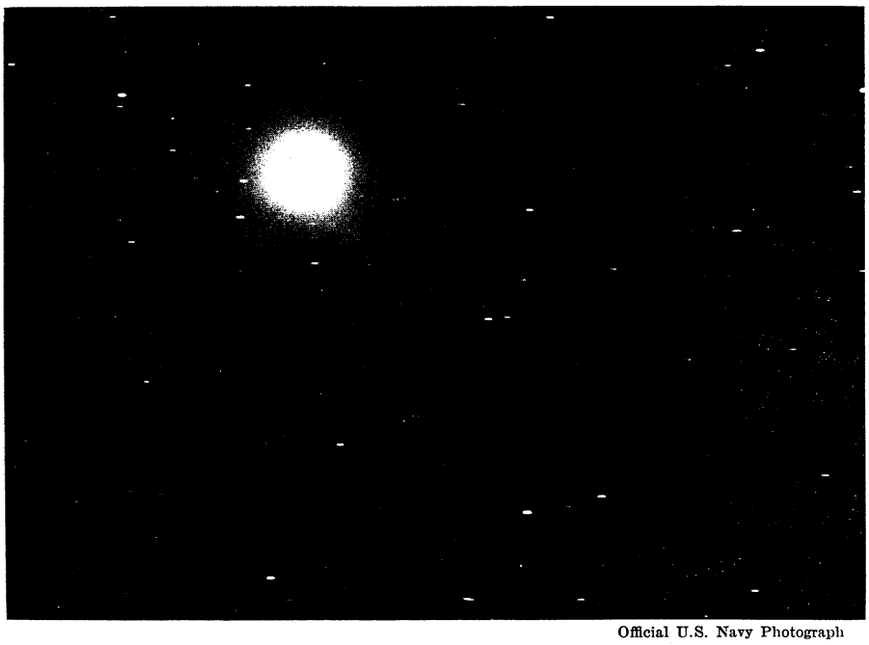
They are now doing a further experiment to confirm their discovery.

To obtain a beam of K-2 mesons whose break-up could be observed, the scientists placed a beryllium target in the path of protons hurtling around the Brookhaven accelerator with energies of 30 billion electron volts.

When the protons strike the target, they produce a shower of nuclear debris, including K-2 mesons, K-1 mesons and gamma rays.

This spray of particles passes through a hole in lead shielding, called a collimator, that shapes and directs it. The two pi mesons in the filtered K-2 beam can be identified by the tracks they leave in spark chambers and by their behavior in a magnetic field.

• Science News Letter, 86:99 Aug. 15, 1964



Official U.S. Navy Photograph

COMET—Ikeya is shown as photographed in a 30-minute time exposure with the 40-inch reflector at the U.S. Naval Observatory's Flagstaff, Ariz., station on July 17 (See Science News Letter, 86:89, 1964).

TECHNOLOGY

New Electron Microscope Works Like TV Scanner

➤ A NEW TYPE of electron microscope has been developed that uses a narrow beam of electrons to "scan" the specimen being observed, much as a TV camera uses light.

This scanning beam causes the specimen to "glow" invisibly, giving off more electrons. Its image can then be projected by another scanner onto a screen similar to that of a TV set.

This system provides a sharper image and deeper field of view than light microscopes and is less damaging to specimens than ordinary electron microscopes, whose beams go right through the items being observed. Called Micro-Scan, the new system was developed by Westinghouse Electric Corporation, Pittsburgh.

• Science News Letter, 86:99 Aug. 15, 1964

ENGINEERING

Microwave Relay Station Uses Remote Control

➤ A LONG-RANGE microwave rely station that can be transported by truck and set up by two men in an hour is now being developed for use by the U.S. Marine Corps.

Highly reliable and capable of being operated by remote control, it has a power output of 1,000 watts and operates on 24 channels simultaneously. Its line-of-sight range is 120 miles, and it can bounce messages over the horizon by using atmospheric reflection. Radio Corporation of America, Camden, N. J., is developing the set.

• Science News Letter, 86:99 Aug. 15, 1964