PHYSICS

Time Symmetry Tested

In the world of particles within the atomic nucleus, physicists have tested the theory of whether or not time can "run backward." The answer, so far, is time is symmetrical.

➤ TIME DOES not go backward so far as is now known in the jumbled world of particles within the atomic nucleus.

Experiments to test the "invariance of time reversal" were reported to the American Physical Society meeting in New York by one team of physicists who in 1956 helped to show the "conservation of parity" does not always hold true.

The scientists found no evidence indicating time was not symmetrical, but believe greater refinement of their low-temperature measuring technique could eventually reveal time reversal effects not detectable in experiments performed to date.

The time reversal tests were made by Dr. Ernest Ambler, Dr. Raymond W. Hayward, Dr. Ralph P. Hudson and Dale D. Hoppes of the National Bureau of Standards. The same team, in collaboration with Dr. C. S. Wu of Columbia University, demonstrated that parity is not conserved in the beta decay of radioactive cobalt. These 1956 tests confirmed theoretical work of Drs. T. D. Lee and C. N. Yang, both now at the Institute for Advanced Study, Princeton, N. J., for which they were awarded the 1957 Nobel Prize in Physics. (See SNL, Nov. 9, 1957, p. 293.)

Non-conservation of parity means that in certain nuclear reactions, nature makes a distinction between left-handed and right-handed rotations. This is a distinction in space, which had previously been thought symmetrical.

Invariance of time reversal implies that time is symmetrical in physical processes, that it is not possible for time to "run backward."

To test the validity of this theory, the Bureau scientists studied the emission pattern of radioactive manganese-52. This disintegration includes the simultaneous emission from the manganese nucleus of a beta particle, or negatively charged electron, and a neutrino, a virtually massless particle without a charge.

They determined the relative proportions of the emitted beta particles having a spin either in the same or the opposite direction as that of the neutrino emitted at the same time.

The emission pattern thus obtained was analyzed in terms of certain quantum mechanical equations for beta particles that contain time as a variable, thus allowing time reversal invariance to be tested.

To obtain the emission pattern, the manganese-52 was first cooled to within two-hundredths of a degree of absolute zero, which is 459.7 degrees below zero Fahrenheit. The small magnets of the atomic nuclei could then be lined up to face in the same direction by a strong magnetic field. Counters at various angles to the sample detected gamma and beta radiation emitted simultaneously.

ATOMIC-AGE-CAMERA—An especially designed pin-hole camera, weighing 29 pounds, made from lead and uranium, is used for seeing into areas too "hot" for other detection devices. It carries two types of film: one for conventional light negatives and the other, an X-ray film, for recording atomic radiation. Designed by General Electric engineer John Payne, it is in use at the Knolls Atomic Power Laboratory, Schenectady, N. Y.

PHYSICS

Nucleus' Electrical Field "Blows Up" Its Neighbor

➤ THE TINY electrical field associated with one nucleus is sufficient to "blow up" a neighboring nucleus to a larger size.

This theory to account for the reaction rates of nitrogen nuclei was presented to the Physical Society meeting by Dr. Gregory Breit of Yale University. He developed it to explain observations that nitrogen nuclei are more likely to react at lower energies than would be expected from the reaction yields at higher energies.

When the electrical field of one nucleus blows up another nucleus to a larger size, the particles of the latter are in states more favorable for ready transfer to the other nucleus.

This explanation, Dr. Breit said, applies to collisions in which the nuclei are deflected through large angles.

Dr. Breit also reported improvements in the classifications of different nuclear reactions according to the probability they will occur. The improvements give a better correlation with the theory of the nucleus that pictures its structure as somewhat resembling an onion, with several layers, or shells.

Dr. Breit's theories are based on experimental studies made by a group headed by Dr. A. Zucker of Oak Ridge National Laboratory, Oak Ridge, Tenn. Dr. M. E. Ebel of the University of Wisconsin collaborated with Dr. Breit.

Two scientists, Dr. W. C. Koehler and M. K. Wilkinson, from the Oak Ridge National Laboratory, reported on developments concerning the magnetism of crystals at very low temperatures using neutrons as probes. They tested the dibromides and dichlorides of manganese, iron and cobalt. These materials are antiferromagnetic. Instead of behaving the way most materials do, with atomic forces lining up spins of the nuclei in the same direction, the spins are aligned in opposite, or anti-parallel directions.

By applying external magnetic fields to samples of these crystals at temperatures near absolute zero, the scientists discovered a new type of antiferromagnetism in which the magnetic structure as a whole grows along various axes of the crystal.

Dr. E. O. Wollan, also of the Laboratory, worked with Drs. Koehler and Wilkinson in the neutron studies.