

vector sum of the charged reaction products and the angle the sum made with the K_2^0 beam. The angle would be zero for two-pion decay; in general, not zero for a three-body decay.

The apparatus used is shown in Fig. 1. The reaction products were shaped into a neutral beam by a lead collimator four feet long. This collimator was followed by a sweeping magnet and then another four-foot collimator. A lead shield was placed in front of the first collimator to attenuate gamma rays in the beam.

The detector for decay products consisted of two spectrometers, each composed of two spark chambers separated by a magnetic field. The second of the two spectrometers, which follows the magnet, allows the particle momentum to be determined. The spark chambers were triggered on a coincidence between water-Cerenkov and scintillation counters placed immediately past the spectrometers.

The authors performed one experiment with K_2^0 decaying, and another with K_1^0 decaying. (The K_1^0 were produced by inserting two inches of tungsten into the K_2^0 beam.) They found identical results in both mass and angular spread from the decay of K_2^0 and K_1^0 , so they concluded that both reactions produced one π^+ and one π^- . Out of a total of 22 700 K_2^0 decays they found 45 ± 9 events producing two pions. This yields a branching ratio of $(2.0 \pm 0.4) \times 10^{-3}$. The authors state that the presence of the two-pion decay mode implies that K_2^0 is not a pure eigenstate of CP .

Since the *Physical Review Letters* report, there has been great activity among particle physicists, planning further experiments to check the results of the Princeton group and looking for possible explanations of their discovery. One possibility is that CP has not been violated after all. If the K meson interacts with other matter when it decays into π^+ and π^- , then the other matter could have the opposite eigenvalue under CP . Then CP would be conserved during the decay. Unfortunately, this necessitates the introduction of an entirely new interaction, aside from the previously known electromagnetic, gravitational, weak, or strong interactions. Another

possibility is that a new particle was created during the decay, with opposite eigenvalue under CP . Still another possibility is the creation of a new kind of pion—one which obeys Fermi-Dirac statistics instead of Bose-Einstein statistics.

Meanwhile, however, the most probable explanation of the discovery that K_2^0 decays into π^+ and π^- , is that the product of charge conjugation and parity has not been conserved during the decay. And, if one assumes the CPT theorem to be correct (one can also question the validity of this) then time would not be reversible in the interaction. Prior to the two-pion decay-mode discovery, theoreticians assumed time reversibility and found a one-to-one relationship between the rate of the forward reaction and the inverse reaction (making π^+ and π^- into K_2^0). If time reversal is not invariant, the relationship is no longer simple. Another simple relationship—between K^0 and $\bar{K}^0$, and K_1^0 and K_2^0 —appears to be *gone with the pions*.

With the apparent overthrow of CP invariance, theoreticians are again in a state comparable to the one in 1957—the validity of right-left symmetry is again in question—space seems asymmetrical.

This most recent violation of conservation laws leaves physicists pondering a difficult but vital problem:

- Given: (1) C violation
(2) P violation
(3) T violation

Required: New conservation laws. Quickly.

Space experiments

The National Aeronautics and Space Administration is currently considering proposals for experiments to be carried on manned and unmanned space flights during the next five-year period. Room for experiments is available on Gemini and Apollo manned flights, weather satellites, sounding rockets, the X-15 research plane, orbiting observatories, and balloons. A full description of the flights and deadlines for proposals can be obtained from NASA's Office of Space Science and Applications.

Experiments may be run on Gemini

and Apollo earth-orbit missions beginning in 1966, and on early Apollo lunar-landing missions, scheduled to begin before 1970.

Satellites available include TIROS and Nimbus weather observatories, orbiting astronomical, solar, and geophysical observatories, and satellites to evaluate communication techniques.

Proposals are received on a continuous basis for experiments to be carried by sounding rockets, balloons and the X-15. Deadlines for the other projects fall on various dates through June 30, 1967.

Computer available

The National Center for Atmospheric Research in Boulder, Colorado, is making computing time available on its CDC 3600. Problems will be accepted from scientists at nonprofit research institutions; some problems will be run cost-free while others will be charged computation costs.

Applications and information concerning the machine's characteristics and coding requirements can be obtained from Dr. Glenn E. Lewis, Director of the NCAR Computing Facility, National Center for Atmospheric Research, PO Box 1470, Boulder, Colorado.

Astrogeology laboratories

A facility is being constructed at Flagstaff, Arizona, whose primary purpose will be basic lunar research and lunar geologic mapping. Research projects planned include infrared emission of the moon, lunar photometry, lunar terrain analysis, and microtopography of the moon. The geologic analysis of the moon will result in the mapping of roughly nine million square miles of lunar surface.

A 14 000-square-foot building is scheduled for completion by the end of December. It will house the Astrogeology Branch of the US Geological Survey. The branch, whose work is supported by the National Aeronautics and Space Administration, is directed by Eugene M. Shoemaker. The new facility will contain supporting laboratories for the Survey's 30-inch reflecting telescope at Anderson Mesa.