Symmetry violation: Magnetic switch

Symmetry is an essential concept in physics. Not only because of a philosophic or aesthetic feeling that nature ought to be balanced, but because of theoretical and experimental evidence that in fact nature is symmetrical in many important respects. Three basic symmetry principles lie at the basis of particle-physics theory: that there are equal amounts of matter and antimatter in the universe (charge conjugation); that nature makes no distinction between left-handedness and right-handedness (parity), and that a particle going forward in time looks the same as an antiparticle going backward in time (time reversal). Other symmetry principles apply in particle physics and other branches of the science, some of them more easily definable in mathematical than in physical terms.

When the experimental facts are examined, it turns out that symmetries are sometimes broken. A principle that applies in general will be violated in one or two instances. Such symmetry breaking sometimes appears as a kind of nuisance, a blemish on the face of an otherwise beautiful theory. In other cases a judicious amount of (theoretical) symmetry breaking enables theorists to construct unified field theories that they could not have without it. Symmetry breaking is thus of crucial interest to physicists, and if there is some mechanism that turns it on and off, what it is and how it works would be important to know.

In the Dec. 13 NATURE Abdus Salam of Imperial College, London, and the International Center for Theoretical Physics in Trieste and J. Strathdee of the Trieste center propose that there is such a mechanism for at least a few cases and that it is magnetic. The particular case Salam and Strathdee deal with is a decay of the K-zero meson that violates both the charge and parity symmetries.

They make an analogy with superconductivity, which, as current theory sees it, is an example of spontaneous symmetry breaking. A high enough magnetic field will restore the symmetry and destroy the superconductivity. The field involved with the symmetry broken in superconductivity (the Cooper-pair field) is electrically charged, and it is apparent that a magnetic field can work on it. The K-zero field is electrically neutral, but Salam and Strathdee argue that a connection can be made through a higher-order effect where charge or the lack of it is not crucial. They calculate that a field between 10^9 and 10^{14} gauss would turn off the symmetry breaking in K-zero decay. Another, somewhat similar example, is the beta decay of the lambda particle, which, Salam and Strathdee figure, can be turned off by a field of 10^{16} gauss.

Such a field is many orders of magnitude beyond experimental capability, but strengths on that order may exist in pulsars, and Salam and Strathdee propose that—for what it's worth—symmetry-observing decays of K-zero mesons take place in pulsars. However, the numbers are dependent on the model of particle structure brought to the calculation so that there is a possibility of symmetry restoration at fields as low as one million gauss. This is within the range of future experimental possibility if techniques for laser-induced compression of matter can be properly improved. □

Descent into Antarctic volcano halted

Among Antarctica's awesome and rugged beauty, one of the most striking and yet at the same time incongruous sights is that of snow-covered and symmetrical Mt. Erebus, a 12,448-foot-high active volcano, issuing wisps of steam and smoke into the crystal clear Antarctic skies. Mt. Erebus rises gracefully above the ice-locked perimeter of Ross Island, its summit 22 miles north of both McMurdo Station and Scott Base, the U.S. and New Zealand scientific headquarters in Antarctica.

One of the more intriguing scientific projects planned for the 1974-75 research season in Antarctica, which begins each year around early December, was to have been a descent by an international group of volcanologists into the crater of Mt. Erebus. But now that project has been called off, a victim of Erebus's capricious activity.

Several months ago, the volcano began a period of intermittent eruptions. The activity has continued, and on Christmas Eve the attempt to descend into the crater was abandoned because of violent explosions. During one of three explosions on the night of Dec. 23 a lava bomb weighing more than a ton was hurled out. Shaun Norman, New Zealand leader of the 14-man joint French-New Zealand project, said the decision was made for the safety of the men. "It is a common sense decision," he said, according to a Reuter's dispatch from Scott Base. "It is not fair to expect men to go down into the inner crater during the present rate of volcanic activity." The party had been on Mt. Erebus for more than two weeks. □