physical sciences

Experiment upholds time symmetry

Time reversal (T) invariance is one of the basic principles of particle physics. It states that nature makes no distinction between going forward in time and going backward in time. A particle going forward will look the same as its antiparticle going backward. In physicists' thinking T invariance is coupled with two other symmetry principles: electric charge (C) and left and right in space (parity, P).

Experiments have shown some violations of charge and parity symmetry, and so physicists have been looking for a corresponding violation of T symmetry. Another in a series of negative results is an experiment performed at Argonne National Laboratory by Jack Sandweiss of Yale University, et al and reported in the May 14 PHYSICAL REVIEW LETTERS.

Muons coming from the decay of K mesons were used in the experiment. When a magnetic field is applied in the direction of the muons' motion, their spins will precess. The precession is asymmetric. If T invariance holds, the assymetry will appear to undergo a reflection as if there were a mirror in the horizontal plane. Such a reflection was found, and the conclusion is that T invariance holds.

X-ray sources as twisted magnetic fields

A number of astrophysicists believe that the newly discovered binary sources of X-rays contain very collapsed objects such as neutron stars or black holes. In the theoretical model, the X-rays are generated by matter falling from the larger object in the binary onto the condensed body.

Because of the importance attached to the actual discovery of neutron stars or black holes, it is well to see whether the X-ray sources can be explained by some other model which does not depend on collapsed objects. In the May 14 NATURE PHYSICAL SCIENCE John N. Bahcall and Marshall N. Rosenbluth of the Institute for Advanced Study in Princeton and Russel M. Kulsrud of Princeton University present one.

The model requires two stars of rather ordinary size revolving about each other and rotating. The rotation period has to be different from the orbital period, and the stars have to have high magnetic fields. The two stars are linked by magnetic-field lines, and, as the stars move, the linked lines get twisted. This increases the magnetic energy stored in the field until instabilities set in and release the energy as heat which is radiated away as X-rays. The model is intended for objects like Cygnus X-1, which have irregular X-ray variations, rather than those like Hercules X-1, which have periodic variations.

Implanted muons monitor magnetic fields

Muons are proving very useful as probes in solid-state physics. Positive muons implanted in a metal behave very much like hydrogen nuclei. They can yield information about lattice structure and chemical reactions as well as about the behavior of hydrogen. Muons cause minimal radiation damage and avoid many of the difficulties of using implanted ions.

New evidence for the usefulness of implanted muons is presented in the May 21 PHYSICAL REVIEW LETTERS by M. L. G. Foy of the College of William and Mary, et al.

They show that the precessions of the spins of implanted muons can be measured, and from this the size of the internal magnetic fields in ferromagnetic materials can be determined. The experiment found an internal field for nickel of 150 gauss and for iron 4,000 gauss.

earth sciences

Antarctica still has its surprises

Uncharted mountain ranges, vast ice movements and errors in maps as little as two years old have been discovered in a study of satellite photos of Antarctica.

One previously unknown mountain group, west of the Prince Albert Mountains in Southern Victoria Land, is only 100 miles from the main American base at McMurdo Sound. "Personally," says William MacDonald of the U.S. Geological Survey, who spent eight years making photographic maps of the area from aircraft, "I was shocked." Another newly found block of mountains is in the Lambert Glacier area some 400 miles south of Australia's Mawson base. It appears on neither Australian nor U.S. charts.

The just-discovered features were found by MacDonald and by Rupert B. Southard Jr., also of the Geological Survey, in photos from the Earth Resources Technology Satellite (SN: 3/31/73, p. 214), launched last July 23. In addition to the mountains, the investigators found from a mere five percent of the ERTS Antarctic photos that at least 1,200 miles of the coastline needs revision in maps.

The study also revealed that the Ross Ice Shelf, site of McMurdo base, is about four miles farther north than it was previously thought to be. The Ronne-Filchner Ice Shelf was found to have moved about 10 miles northward in the last seven years, and the Erebus Glacier Tongue has advanced six miles since 1947, three of them since 1962.

Impact crater identified in earthly basalt

Evidence has been found which establishes the Lonar Crater in India as the only known impact crater in basalt on the earth, according to a four-man research team from the United States and India. As such, the scientists report in the May 25 SCIENCE, "Lonar Crater provides unique opportunities for comparison with lunar craters."

As long ago as 1896, geologists were noting the similarity of the 2,000-yard-wide crater to gigantic Meteor Crater in Arizona, but it was half a century before the general morphology of the Indian site was offered as an actual reason to believe that its origin was other than volcanic or from the ground collapsing away underneath.

Now, however, Kurt Fredriksson of the Smithsonian Institution and colleagues from the U.S. Geological Survey and the Geological Survey of India have found rocks in the crater's floor and around its rim showing the effects of a sudden shock, such as that of a meteorite impact.

Drilling from a barge in the shallow lake in the crater, the team recovered core samples from below the lake sediments containing coarse breccia—conglomerate rocks—with shatter coning, a sign of shock, and microbreccia with moderately shocked fragments. Strongly shocked fragments were found on the crater rim including signs of sudden heating. "Although this study is still in progress," the scientists report, "the results thus far offer definitive evidence that Lonar Crater is indeed an impact crater."

Water up or land down?

Either the sea is rising or the land is falling along the Texas-Louisiana coast. Between 1948 and 1959, the relative rise of the sea, based on tidal measurements, ranged from .005 feet to .04 feet along the coast. From 1959 to 1970, however, the rise ranged from .19 to 1.68 feet.

Sinking land could be due to oil, gas and water pumping, report R. Lawrence Swanson and Carroll I. Thurlow of the National Oceanic and Atmospheric Administration, as well as to the weight of the encroaching sea.