physical sciences

Gathered at the meeting of the American Physical Society in Miami Beach

COSMIC RAYS

Constant for a long time

Scientists estimate that the St. Severin meteorite was exposed to cosmic rays for 12 million years before it landed on the earth.

Dr. Robert M. Walker of Washington University in St. Louis and two co-workers checked out fossil cosmic ray tracks in the meteorite to trace the history of cosmic rays during that period (SN: 5/11, p. 452). They calculated a set of graphs of track density versus depth in the meteorite and compared these with radioactive dating experiments by other scientists.

From agreements between their calculations and experimentally determined values, they conclude that the heavy galactic cosmic ray flux has remained unchanged for 12 million years.

ASTROPHYSICS

Rotation and gravitational collapse

Some of the speculation about what kind of objects pulsars might be involves rotating bodies undergoing gravitational collapse. This process is one of the few known ways possible to generate the enormous energies put out by such bodies. It has also been suggested for quasars, which put out energy in the same range of size. The rotation could cause the pulsar's beat.

A major theoretical question has been whether the two activities are compatible—whether rotation will stop collapse at some point or collapse will crush rotation.

A calculation reported by Dr. Jeffrey M. Cohen of the National Aeronautics and Space Administration Institute for Space Studies shows that rotation cannot stop the collapse of a spherical shell supported by centrifugal forces unless the shell radius equals 9/8 of the Schwarzschild radius. The Schwarzschild radius is a critical value calculated from the equations of general relativity. It represents the size at which the gravitational forces of a collapsing body become so strong that they prevent the escape of any matter or radiation at all.

Bodies that appear as bright as pulsars and quasers should not be below or near the Schwarzschild radius, indicating that collapse could take place without being squelched by rotation in those stars.

GEOPHYSICS

Cosmic rays and the earth's shock front

The Southwest Center for Advanced Studies in Dallas has a cosmic ray anisotropy detector on board the Interplanetary Monitoring Platform F satellite. This instrument has detected six cases in which the count of low energy cosmic ray particles increased in close association with the sudden beginnings of magnetic storms.

These circumstances aroused the curiosity of Drs. R. A. R. Palmeira, F. R. Allum, K. G. McCracken and U. R. Rao. They examined the records of sudden magnetic storm commencements for more than five stations between May, 1967 and April, 1968.

They report that in almost every case in which a solar flare increase preceded the sudden commencement of a magnetic storm, and the cosmic ray intensity was high at the time of the sudden commencement, there was a short-lived increase in the counting rate of cosmic ray particles with less than 10 million electron volts energy. In every case where the cosmic ray intensity had returned to normal after the solar flare before the magnetic storm began, there was no such increase.

They interpret the increase in the low energy particles as representing solar cosmic ray particles that are reflected from and swept by the shock wave that precedes the earth in its passage through the solar wind.

ELECTRICITY

Checking Coulomb's law

Coulomb's law is the mathematical formula by which the electric force between two charged bodies is calculated. Among other things, it declares that the force will be inversely proportional to the square of the distance between the bodies.

Since Coulomb determined the formula early in the 19th Century, physicists have wondered about the exactness of the square—whether nature really provided them with an exactly even two for the exponent or did it just appear so because Coulomb's experimental procedure was unable to determine the number more closely.

From time to time, as techniques have improved, redeterminations have been attempted. An experiment in 1936 by Drs. S. J. Plimpton and W. E. Lawton showed the number to be two within an uncertainty of two billionths. Now, 32 years later, technical possibilities have improved enough for a trial at bettering this accuracy.

The trial was made by Drs. P. D. Cochran and P. A. Franken of the University of Michigan. They report that the exponent is two within an accuracy of nine thousand-billionths, enough, they say, to rule out suggestions that a discrepancy in Coulomb's exponent could be responsible for differences between theory and observation in wavelength shifts in certain atomic light emissions.

SOLID STATE PHYSICS

Deformation by vibration

The deformation of solid metals and alloys by absorption of vibrational energy has been studied by W. H. Sproat and colleagues at the Lockheed Georgia Research Laboratory, Marietta.

They find that application of ultrasonic vibrations causes deformation at room temperature. It takes less energy than it does with heating alone to lower the level of stress at which the crystal structure will yield.

They believe the vibration-induced plasticity comes from differing absorption of energy by imperfections in the crystal lattice and at grain boundaries. This leads to removal of obstacles in the crystal structure that impede plastic flow.