physical sciences

SOLID STATE

More on chemical neutrons

Some months ago Drs. T. J. Grant and W. J. Cobble of Purdue University reported an experiment in which electrons and neutrons appeared to be chemically bound to each other. When they irradiated a crystal of lithium fluoride with a beam of neutrons, some of the neutrons were trapped in the crystal, and they interpreted this to mean that the neutrons were being chemically bound to electrons that reside in the so-called color centers of the crystal.

Attempts by other researchers to observe the same effects have so far failed (SN: 1/24, p. 92).

Drs. W. Beall Fowler and T. P. Martin of Lehigh University have checked the theoretical bases on which the prediction of a binding force between neutrons and electrons might rest. In the March 16 Physical Review Letters, they report that such a force could result from an effect of one particle's spin on that of the other or from a slight separation of positive and negative charges within the neutron. In both cases, they report their calculation shows the resulting force is too weak to account for what Drs. Grant and Cobble reported.

Drs. Fowler and Martin can find no fault with the Grant-Cobble experiment and are at a loss to explain the observed trapping of neutrons. They urge further experimentation, especially with better understood alkali halide crystals, such as potassium chloride.

PARTICLES

A new resonance

Resonances are short-lived particles that appear from time to time when other particles collide. Study of them may help elucidate the behavior of the forces between the colliding particles. Several dozen are now known and a new one, called Z*, with a mass about 1,900 million electron volts, is reported in the March 16 Physical Review Letters by Drs. Sadayuki Kato, Peter Koehler, Theodore B. Noyey and Akihiko Yokosawa of Argonne National Laboratory and George B. Burleson of Northwestern University.

RADIO ASTRONOMY

Longest baseline results

Long-baseline interferometry combines radio telescope observations made at widely separated observatories. When it is successful it resolves the details of celestial objects as well as would a single telescope as large as the distance between the actual ones used.

In November the longest-baseline observation ever attempted was run between the National Radio Astronomy Observatory at Green Bank, W. Va., and the Crimean Astrophysical Observatory at Simferopol in the U.S.S.R. Observations of quasars were made at wavelengths of 6 centimeters and 3 centimeters (SN: 11/8, p. 437).

The data have now been reduced, and the 6-centimeter results were excellent, says Dr. Barry Clark of NRAO. Information derived from them has been added to data previously acquired at that wavelength.

Observations at 3 centimeters had not been done before, and the astronomers had hoped that the shorter wavelength would give new information about the structure of the sources. But the receivers turned out too insensitive to give more than what Dr. Clark calls a marginal result.

Still, the experiment shows that such long distance interferometry can be done at such a short wavelength, and Russians and Americans are cooperating on construction of more sensitive receivers, with which they hope to do better in the fall.

PARTICLE PHYSICS

Helicity of the antineutrino

Neutrinos and antineutrinos are massless, chargeless particles emitted in many nuclear and particle physics processes, especially the beta decay of nuclei. The current theory of neutrinos predicts that these particles, unlike any others, always have their spin axes aligned with the direction of their motion.

Depending on which way the spin turns, the particle can be compared either to a left-handed or right-handed screw, and this combination of spin and forward motion is called helicity. Theory says a neutrino has the helicity of a left-handed screw and an antineutrino that of a right-handed one.

The left-handed helicity of the neutrino was confirmed experimentally in 1958. In the March 9 Physical Review Letters Dr. J. C. Palathingal of the University of Michigan reports an experiment confirming the right-handed helicity of the antineutrino.

When a nucleus of mercury 203 decays to thallium 203, it emits an electron and an antineutrino, and a little later a gamma ray. In some cases, the gamma rays have characteristics that are related to the helicity of the antineutrino, and measuring the characteristics, says Dr. Palathingal, enabled him to determine that the helicity was right-handed.

NUCLEAR STRUCTURE

Shell model with two centers

One of the ways by which nuclear physicists have sought to understand the structure of atomic nuclei is using the so-called shell model, which arranges the neutrons and protons in concentric shells like the layers of an onion.

Although the shell model has contributed much to current knowledge of nuclei, it has never been able to deal with nuclear fission very well since it arranges its shells around a single center. When a nucleus is in the process of dividing into two nuclei a single-center model no longer fits.

Drs. D. Scharnweber, U. Mosel and Walter Greiner of the University of Frankfurt am Main have developed a two-center shell model, in which the two centers represent the daughter nuclei that are coming into being.

The two-center model, they say in the March 16 Physical Review Letters, correctly reflects the processes that go on during fission, and they hope it may be of use in understanding exactly what occurs at the instant of division.