physical sciences

THEORETICAL PHYSICS

Variable Planck's constant

An atom emits or absorbs light when one of its electrons moves from one orbit to another. Experiment shows that a given electron can inhabit only certain discrete orbits and not those that lie between the permitted ones.

When an electron jumps between permitted orbits, it emits or absorbs a burst or quantum of light with an energy equal to the difference between the energies that the electron possesses in the two orbits. The energy of the quantum is proportional to the frequency of the light; the constant of proportionality is called Planck's constant.

Planck's constant appears to be a fundamental constant of nature. Experiment shows it is the same for all matter near the earth. However, there is no theoretical reason why it should have exactly the value it has, so some physicists speculate on the consequences of its having different values in other parts of the universe.

If Planck's constant varies, says Dr. Martin O. Harwit of Cornell University in the Nov. 28 NATURE, light from distant objects should not be absorbed by gas in our galaxy, since their quanta would not match ours. A recently published spectrum of the Crab nebula pulsar, he says, seems to show no absorption. If further investigation confirms this, it could mean that Planck's constant for pulsars differs from Planck's constant for interstellar gas.

SOLID STATE

Strain-induced electric fields

Solid-state theorists have proposed that a nonuniform mechanical strain in a metal might generate an electric field, since it would displace some atoms with respect to others and disturb the neutral electrical balance of the material.

An effect of this kind has been blamed for the failure of an experiment that tried to measure the gravitational force on an electron by dropping it down a copper tube. The purpose of the copper was to shield the electrons from electrical forces, but, ironically, gravitational strain in the copper is supposed to have generated just what the copper was intended to guard against.

In the Nov. 30 PHYSICAL REVIEW LETTERS, Drs. Yehuda Goldstein and M. Cohen of the Hebrew University of Jerusalem and Benjamin Abeles of RCA Laboratories in Princeton, N.J., report that they have succeeded in inducing such a field in superconducting aluminum through the strain produced by applying acoustic waves of 9.3 gigahertz frequency.

The aluminum was in an aluminum-lead junction. Since the electric field fluctuated in tune with the acoustic wave, it generated a radio wave that was detected by a microwave detector.

THEORETICAL PHYSICS

CPT and baryon symmetry

Theoretical physicists have a grand principle of symmetry in the universe that they call by the initials CPT. It says that there are equal amounts of matter and antimatter (C); that nature makes no distinction between left and right (P), and that a particle going forward in time is indistinguishable from its antiparticle going backward (T).

Unfortunately this scheme breaks down in a very small way. In a few of the activities of elementary particles, the C and P principles are violated. In JETP LETTERS for Sept. 20 Dr. V. A. Kuz'min of the Lebedev Physics Institute in Moscow suggests that this violation may be connected with the violation of another symmetry principle, baryon symmetry.

Baryons are a class of heavy particles including neutrons and protons. Experiment shows so far that the numbers of baryons and antibaryons in the universe should be equal. Dr. Kuz'min presents a mathematical argument to show how violation of CP could lead to an asymmetry of baryons and antibaryons and proposes a search for interactions in which baryon symmetry might be broken.

PLANETARY PHYSICS

Ice in the Venus clouds

Many suggestions have been made regarding the composition of the clouds that obscure the surface of the planet Venus. One of the most popular suppositions is that they are mainly carbon dioxide. Others propose various compounds of bromine or other halogen elements. Now there is evidence for at least a small amount of water ice.

In the September ICARUS, Dr. Brian O'Leary of Cornell University reports that as Venus passed between the earth and the sun in 1969, it showed an anomalous brightening amounting to about 0.07 of an astronomical magnitude. This, he says, is precisely the behavior that would be expected if the tops of the Venus clouds contained a small percentage of hexagonal water-ice crystals. The observations, he says, are not conclusive, but "provocative enough to conclude there is strong evidence that some of the Venus cloud tops contain water ice."

SUPERFLUIDS

Paired rotons

A roton is a kind of vortex or ring of helium atoms that can form in superfluid helium at temperatures near absolute zero.

Rotons move through the bulk of the superfluid very much as if they were particles of some kind. Recent work at the Massachusetts Institute of Technology seems to show that rotons can also exert forces on each other, forces that can sometimes bind them together in pairs.

Drs. T. J. Greytak, Robert L. Woerner, James F. Yan and Robert F. Benjamin report in the Nov. 30 PHYSICAL REVIEW LETTERS that in studying the formation of rotons by laser light they have found that the energy necessary to form two rotons is less than twice that needed to form one.

Such a result indicates that the rotons are formed in bound pairs since the energy of a bound pair of any kind of particle is less than the sum of two. The bond represents energy that must be supplied to pull the pair apart, energy that is given up whenever a pair comes together. The MIT group calculates the roton binding energy to be the equivalent of 0.37 degree of the Kelvin temperature scale.