physical sciences

PARTICLE PHYSICS

Proton dipole moment

One of the basic hypotheses of particle physics is that nature should be symmetrical with regard to three basic characteristics of particle interaction: electric charge, parity (right or left handedness), and direction of motion in time (SN: 9/14, p. 265).

Over the last decade, however, there has been growing evidence that in certain kinds of interactions nature prefers certain combinations of charge and handedness over others. Physicists are now trying to find out if there is an asymmetry in time reversal also. So far they haven't found one.

The latest contribution deals with the electric dipole moment of the proton. One of the consequences of the validity of time-reversal symmetry is that elementary particles should not have dipole moments; that is, their charge should be evenly distributed over a hypothetical sphere and not unbalanced toward one side or the other.

Drs. G. E. Harrison, P. G. H. Sandars and S. J. Wright of Oxford University report that if the proton dipole moment exists at all, it is no larger than about one 100-billion-billionth proton charge times a centimeter. In PHYSICAL REVIEW LETTERS for June 9 they say that this is more than 100,000 times as small as the previous determination. In the attempt to prove that the proton has no dipole moment at all, they are trying to make their experiment 100 times as sensitive as it now is.

X-RAY ASTRONOMY

The size of Cyg XR-1

Celestial X-ray sources come in two varieties: star-sized and extended or nebular. An example of the stellar sort is Sco X-1 (SN: 5/17, p. 471), whose X-ray emission comes from an area of the sky only 20 seconds wide, and which has been identified with a faint blue star.

Other X-ray sources can be identified with either optical stars or optical nebulae.

An exception of major interest is Cyg XR-1 in the constellation Cygnus. It has a high-energy X-ray spectrum like the Crab nebula, but is also highly variable like Sco X-1. It has no optical identification so the only way to classify it will probably be by measuring its size.

Dr. Franklin W. Floyd of Massachusetts Institute of Technology reports in the June 7 NATURE that he has determined an upper limit of 1.4 minutes. This is nebular size, but future work will attempt to find out if the object is smaller.

SOLID STATE

Work functions and light

Some time ago, Dr. T. E. Fisher observed a large decrease in the work function of gallium arsenide when the sample was cooled in liquid nitrogen. This is the measure of the amount of energy that has to be supplied to eject an electron from the surface.

Now Drs. A. Y. Cho and J. R. Arthur of Bell Telephone Laboratories find a similar effect in gallium phosphide, but the change becomes much less if the sample is kept in the dark. They suggest therefore that irradiation with light is a major cause of the shift in work function. For N-type gallium phosphide, which has an excess of electrons, they find a decrease just as Dr. Fisher did for N-type gallium arsenide. But for P-type gallium phosphide, which has a deficiency of electrons, they find an increase in work function upon cooling. Their interpretation is that the incident light causes changes in the number of electrons on the surface and this alters the work function.

These work function changes involve changes in the distribution of electrons and holes in the material. The distribution of electrons and holes in these substances affects their functioning when they are made into transistors.

PULSARS

High-frequency search

A search for pulsars broadcasting at a frequency of 1,400 megahertz was conducted by Drs. G. Bourgois, M. Guelin and Nguyen Quang Rieu of Meudon Observatory.

Most pulsar signals have been found at lower frequencies, but this group hoped to find pulsars whose signals had passed through clouds of ionized hydrogen. The hydrogen renders lower-frequency pulsar signals indistinguishable from background, and it has been suspected that this is why there seemed to be no pulsars in certain parts of the sky.

They report in the June 7 NATURE that in a third of the galactic plane, from two degrees above the galactic equator to two degrees below, no high-frequency pulsars were found.

PLANETARY ASTRONOMY

Formation of moon and planets

The moon is a light body compared to the planets that orbit near the sun, and it seems to lack a heavy core. On the whole its chemical composition is similar to that of the sun, unlike that of the terrestrial planets, which are heavy with metals.

One interpretation of the discrepancy, put forth by Dr. Harold C. Urey of the University of California, San Diego, is that the moon is an older body, made of relatively unchanged solar material, while the terrestrial planets are younger and have somehow lost non-metallic material and been enriched in metals.

Now Dr. Egon Orowan of Massachusetts Institute of Technology argues that it might be the other way around. The planets would be older and would have condensed first out of a cloud of solar material surrounding the sun.

Heavy metals, he says, are likely to be the first to condense out of such a cloud. He goes on to argue, in the May 31 NATURE, that the ductility of heavy metals, especially of iron, would cause particles of them to stick together by a kind of cold welding process. When a large enough lump of iron had been built up, other substances would begin to stick to it, and finally its gravitation would draw more and more material to it. Pressure would ultimately melt the metal core.

The moon in this theory would have condensed later out of matter left over after the earth had formed.