physical sciences

Gathered at the 1970 annual meeting of the American Physical Society in Chicago last week

ATOMIC PHYSICS

Measuring the magnetic moment

Much of the great success physicists have had in understanding the workings of atoms has come by measuring the strengths, or energies, of various interactions that take place within them. One of the most important is the interaction between spinning charged particles.

A spinning ball of charge acts like a tiny electromagnet, the strength of which is known as its magnetic moment.

Four scientists from the Massachusetts Institute of Technology, Drs. P. F. Winkler, F. G. Walther, M. T. Myint and D. Kleppner, report that they have measured the ratio of the electron and proton magnetic moments more precisely than has been done before—to an accuracy of one part in 100 million. The figure they obtained for the ratio is 658.210705 ± .000006.

Their precise measurement of one of nature's fundamental constants may increase knowledge of other ones, say the scientists, like a crossword puzzle in which filling in the letters of one word can help complete the spaces for other words.

ASTRONOMY

Another look at gamma source

Last year astronomers discovered the first point source of gamma rays, in the constellation Sagittarius (SN: 9/27, p. 277). There had been speculation for a decade that certain stars or nebulae might emit this extremely energetic radiation.

The source was located with equipment flown in balloons from Parkes, New South Wales. The source is directly overhead in the sky in Australia.

One of the members of the team that made the discovery, Dr. Glenn M. Frye Jr. of Case Western Reserve University, reports that additional balloon flights are planned to locate the position of the source more precisely. A clock accurate to one part in 100 million will be carried along to see if the source is winking on and off like the pulsars.

PARTICLES

Vector meson dominance

A comprehensive theory of subatomic particles will have to provide a unified explanation of the different classes of forces they respond to. In the hope of getting to such a theory physicists study examples of connections between different forces such as the behavior of photons when they strike atomic nuclei.

Photons are carriers of the electromagnetic force, yet when they strike nuclei, they behave like vector mesons, carriers of the strong nuclear force.

In explanation of this, a theory called vector meson dominance has grown up, which says that, on approching the nucleus, the photon turns into a vector meson. If such a transformation does in fact happen, it would be a key to a theory uniting the strong and electromagnetic forces, could explain the structure of neutrons and protons and help solve the puzzles of nuclear structure.

Recently the theory has been under fire from experimenters who found results at odds with its predictions (SN: 8/30, p. 164), but Dr. Bernard Margolis of McGill University reports that accurate calculation of the latest experiments supports the theory. The shadows of various nuclei that a photon beam casts come out correctly, he says, if one assumes that photons turn to vector mesons as they interact with nuclei and then turn back to photons.

LOW TEMPERATURE PHYSICS

Helium molecules in the superfluid

When liquid helium is cooled to temperatures less than four degrees above absolute zero it becomes a superfluid. That is, it flows without friction, can go through holes too small for ordinary fluids, and in certain conditions can be induced to flow uphill.

The key to understanding this behavior lies in the microscopic structure of the superfluid. Drs. W. A. Fitzsimmons, J. W. Keto, M. Stockton and L. J. Smith of the University of Wisconsin propose a new experimental tool for this study.

Optical experiments show, they say, that neutral helium molecules, two atoms bound together, the usual constituents of helium gas, also form part of the substructure of superfluid helium. Ordinarily much more dramatic changes could be expected with a change of state, and they suggest that following them the apparently normal bound atoms around in the abnormal state will be a useful way of studying the structure of the superfluid.

PARTICLES

Magnetic monopoles and lightning

A magnetic monopole would be an object that had only one pole of magnetic charge instead of the two possessed by ordinary magnets. Monopoles have never been seen, but their hypothetical existence is important to basic physical theories, and they have been searched for in almost every conceivable place.

Dr. D. R. Tompkins of the University of Georgia suggests another: looking for them in lightning strokes. A lightning stroke consists of two movements, a leader stroke from the cloud to the earth and a return stroke from earth to the cloud. The leader, which is not visible, generally follows a stepwise path. It leaves a trail of ionized gas behind, and the bright return stroke runs back up this path to the cloud.

Dr. Tompkins points out that a magnetic monopole passing through the atmosphere would also leave an ionized path behind, but it would be straight instead of zigzag. Under proper conditions, he thinks, a return lightning stroke might follow such a path. This would be a clue to the existence of monopoles, he says.