# physical sciences

## Gathered at the meeting of the American Physical Society in Washington, D.C., last week

PARTICLES

### First Adone results

When a beam of accelerated electrons strikes a beam of accelerated positrons, says Dr. Giorgio Salvini of the Guglielmo Marconi Institute of Physics at the University of Rome, three things may happen. The electrons and positrons may bounce off each other elastically; they may annihilate each other and form pairs of gamma rays; or they may form two or more other particles and antiparticles.

At Frascati, near Rome, Dr. Salvini and his colleagues are operating what is momentarily the world's most powerful apparatus for colliding beams of electrons and positrons, the Adone storage ring, whose total energy (half in each beam) is 2.8 billion electron-volts.

Dr. Salvini told the meeting that the first results of collisions that produce gamma rays and those that produce pairs of mu mesons go exactly according to the theory of quantum electrodynamics, the particle physicist's description of electromagnetic activities. They thus confirm the validity of that theory for processes of higher energy than was previously certain.

Collisions that produce pairs of pi mesons, says Dr. Salvini, yield more of them than expected, and those that produce more than two particles show what seems to be a highly complex situation. In both these cases the theory of the strong nuclear force is involved rather than quantum electrodynamics. The results are still so new that theoretical explanations have not yet been worked out, he says.

PLASMAS

### Self-generated magnetic fields

One of the methods of producing hot plasmas of ions and electrons such as those used in studies aiming at controlled thermonuclear fusion is to vaporize and ionize solid pellets with beams of laser light.

This is a violent procedure. It produces a plasma that expands explosively. The temperature (a few million degrees) and pressure (100,000 atmospheres) in a laser plasma approximate those in the interiors of some stars, and a few thermonuclear fusions have been observed to take place in some laser plasmas.

Experiments at the Naval Research Laboratory by Drs. John A. Stamper, Stephen O. Dean and Edgar A. McLean have shown another stellar characteristic in laser plasmas, self-generated magnetic fields. A lucite plastic fiber in an atmosphere of nitrogen or helium served as the target for a 2 billion-watt laser. Magnetic fields were generated at the target and carried outward by the explosion. Within half an inch of the target the fields were several thousand times the earth's field; at one and a half inch the field was comparable to the earth's.

The fields appear to be generated by electric currents in the plasma that are driven somehow by energy from the laser light. Exactly how is under study, and elucidating the mechanism, the investigators say, will add to our understanding of the interactions between radiation and matter.

SOLID STATE

### Locating crystal impurities

Many of the technologically important properties of solids depend on imperfections in their crystals, especially atoms of a foreign substance. Often such imperfections are deliberately introduced.

Since foreign atoms have no place in the lattice structure of a given crystal, they often stand in between the orderly rows of atoms of the substance.

The exact location of the impurities determines, for example, how a given crystal will behave as a semiconductor. It is thus important to know where the impurities are. Dr. John A. Davies of the Chalk River Nuclear Laboratory in Chalk River, Ontario, described a method of using fast beams of positively charged particles as probes.

If such a beam enters a crystal in a direction within a certain angle to the rows of atoms, the repulsive electric force between the atomic nuclei and the charged particles will tend to channel the beam through the space between rows. Thus the beam will not strike any of the normal atoms, but it is likely to strike any impurities that might occupy the space between rows.

The location of a given impurity can be accurately determined, says Dr. Davies, by triangulation with two or more probe beams entering the crystal from different sides.

ELECTRICITY

### Testing Coulomb's law

Coulomb's law is the experimentally determined description of the force between two electrically charged bodies. It says that the force is directly proportional to the charges of the bodies and inversely proportional to the square of the distance between them.

The latter point, the so-called inverse-square characteristic, introduces many simplicities into electromagnetic theory. If the exponent on the distance is slightly more or less than two, a new, extremely complex theory would have to be developed. As experiments become more accurate, Coulomb's law is periodically retested.

A recent test performed at Wesleyan University by Drs. James E. Faller, Henry A. Hill and E. R. Williams made use of the fact that if the inverse-square is precisely true, the charge on a spherical conductor will arrange itself evenly over the outer surface of the sphere. If the sphere is hollow, a body placed within it will feel neither electrical forces nor any tendency for charge to flow to it from the outer sphere.

The experiment used a series of five concentric spheres. A radio signal of four megahertz frequency was used to induce a rapidly alternating charge on the outer sphere. In three days of running no tendency for charge to move to the innermost sphere was detected. Dr. Williams says this shows that the exponent cannot deviate from two by more than $6 \times 10^{-16}$.

This result also tends to prove that the rest mass of the photon, or light particle, is zero, or at most less than $1.6 \times 10^{-47}$ grams.