physical sciences

ELECTROMAGNETICS

Another mass-frequency effect

Theory predicts two effects that can change the frequency of an electromagnetic wave. One is motion of the source or receiver. The other is a field of gravitational forces surrounding the source.

In 1968 Drs. Dror S. Sadeh, S.H. Knowles and Benjamin Au of the Naval Research Laboratory found a third effect, not predicted by theory. The frequency of radio waves passing near the sun was lower than the frequency of the same wave when it passed some distance from the sun (SN: 8/17/68, p. 156). They attributed this to an effect of mass on frequency.

While still trying to convince the world of that discovery, Drs. Sadeh and Au report in the Dec. 27 NATURE another effect of mass on frequency.

The experiment involved comparing the ticks from two cesium clocks about 300 miles apart. The ticks from one were sent to the other by radio, and the time lag between them caused by the transmission should have stayed constant if the radio frequency did.

The lag was found to vary in a daily cycle. This, say Drs. Sadeh and Au, can mean a frequency change caused by some influence of the sun.

This is not the same as the effect reported in 1968, because in this experiment the distance between the sun and the path of the radio wave did not change.

ASTROPHYSICS

Sources of gravitational radiation

When Dr. Joseph Weber of the University of Maryland announced his discovery of gravitational waves, waves involving gravitational forces in the same way as radio waves involved electromagnetic forces, he suggested that the source of the waves he observed might be close encounters between pairs of stars (SN: 6/21, p. 593). Two approaching stars would accelerate each other and produce bursts of radiation like those showing up in Dr. Weber's recorders.

The most likely place for such encounters is in dense clusters of stars.

Nevertheless, Dr. George Greenstein of Yeshiva University presents, in the December ASTROPHYSICAL LETTERS, a theoretical study that makes the clusters unlikely sources.

Assuming that a cluster ought not to contain more than one-hundredth the mass of the galaxy, Dr. Greenstein finds that any clusters he can construct that would produce the signal Dr. Weber sees would collapse into blobs in a few hundred years. It is highly improbable that such a short-lived object should be discovered at random.

PARTICLES

Electrons versus classical theory

Physicists treat the behavior of subatomic particles according to two different kinds of theory: classical, when the activity involves large distances, and quantum theory in spaces smaller than an atom.

There is a borderline case in which the wrong theory may be applied, say Drs. Helmut Schwartz of the Rensselaer Polytechnic Institute and Hans Hora of the Max Planck Institute for Plasma Physics in Garching, West Germany. It is the use of classical theory to explain the behavior of electrons in electromagnetic waves, a situation important in plasma physics.

Classical theory says electrons in an electromagnetic wave vibrate in tune with the wave while they are in it, and stop vibrating when they leave it. In the Dec. 1 APPLIED PHYSICS LETTERS, Drs. Schwartz and Hora report an experiment showing that a beam of electrons put through a crystal illuminated by a laser beam not only vibrated in the beam but maintained the vibration after leaving it.

When the electron beam was imaged on an alumina screen some distance after it had crossed the light beam, it showed spots the same color as the laser light, indicating that the electrons continued to vibrate. Quantum theory may explain it, write Drs. Schwartz and Hora, but they do not have a detailed theory yet.

PLANETARY ASTRONOMY

Jupiter's magnetic field

The radio waves emitted by Jupiter lead astronomers to believe that the planet, like the earth but unlike Mars and Venus, has a magnetic field. If so, and if the field is that of a simple two-poled, north-south magnet like the earth, radio waves coming from Jupiter should be circularly polarized.

In 1964 Dr. G.L. Berge of the University of Nevada found such a polarization at 21.2 centimeters wavelength. It was small—four percent lefthanded in one place, two percent righthanded in another—but it enabled him to say that Jupiter's field was directed opposite to that of the earth.

Observations by Drs. Bruce Gary and Samuel Gulkis of the Jet Propulsion Laboratory at California Institute of Technology, reported in the December ASTROPHYSICAL LETTERS, raise a conflict. Drs. Gary and Gulkis observed at 13 centimeters wavelength and found less than half the polarization that Dr. Berge's observations led them to expect.

Drs. Gary and Gulkis suggest that the discrepancy may arise because Jupiter's magnetic field varies from time to time, or because Jupiter is surrounded by asymmetric belts of trapped radiation. They believe that more observations are needed before definite conclusions about the field can be drawn.

ASTRONOMY

Mirror for Australian telescope

The blank for a 150-inch mirror that will be the major part of a new British-Australian telescope has arrived at the factory of Sir Howard Grubb Parsons and Co. in Newcastle-upon-Tyne, England, where it will be ground. It was cast at Toledo, Ohio, by Owens Illinois, Inc., and is the first blank of such size to be made from a new low-expansion glass ceramic called Cer-Vit (SN: 4/12, p. 354).

Grinding is expected to take two years. The telescope should be finished by 1974.