physical sciences

Thermal properties of Ganymede

The satellites of Jupiter were among the first objects discovered by astronomical telescopes. The long-standing interest in them is heightened in the age of astronautics by the idea that they may be useful landing places for instruments to study the largest planet.

Aside from the moon, the inner satellites of Jupiter are the only bodies in the solar system that regularly undergo eclipses. An eclipse of the third Jovian satellite, Ganymede, on March 17, allowed a group of astronomers to measure some thermal properties of Ganymede and draw some conclusions about its surface and atmosphere.

The work was done at the Mauna Kea Observatory of the University of Hawaii by Drs. D. Morrison, D. P. Cruikshank, R. E. Murphy and T. Z. Martin of the University of Hawaii and J. G. Beery and J. P. Shipley of the Los Alamos Scientific Laboratory. It is reported in the Aug. 1 ASTROPHYSICAL JOURNAL LETTERS.

Infrared measurements at 20 microns wavelength as the eclipse progressed enabled the astronomers to measure a quantity called the thermal inertia of Ganymede. From it the observers conclude that Ganymede's surface is highly porous and that if Ganymede has an atmosphere, the pressure at the surface is not more than one millibar (1/1000 of the earth's atmosphere).

Interstellar silicon monoxide

The gas cloud Sagittarius B2, in the constellation Sagittarius near the center of the Milky Way galaxy, is the home of chemical activity that produces a wide variety of compounds (SN: 6/5/71, p. 382).

The latest chemical substance to be found in Sgr B2 is silicon monoxide (SiO). The discovery is reported in the Aug. 1 ASTROPHYSICAL JOURNAL LETTERS by Drs. R. W. Wilson and A. A. Penzias of Bell Telephone Laboratories at Holmdel, N.J., K. B. Jefferts of Bell Labs at Murray Hill, N.J., and Marc Kutner and Patrick Thaddeus of Columbia University.

The astronomers used the National Radio Astronomy Observatory's 36-foot radio telescope at Kitt Peak, Ariz. They observed radio emission from Sgr B2 that has a frequency of 130,246 megahertz—when the redshift due to the cloud's motion has been subtracted. The observers identify this with a SiO line at 130,268 megahertz, assuming that the line is blueshifted because the SiO is moving at 53 kilometers per second with respect to the rest of the cloud.

To detect high-frequency gravity waves

One of the problems faced by physicists attempting to study gravitational waves is that equipment following the design used by Dr. Joseph Weber of the University of Maryland for the original discovery of these waves cannot be used for high-frequency waves.

In the June 5 JETP LETTERS, Drs. V. B. Braginskii and M. B. Menskii of Moscow State University propose using what they call a gravitational electromagnetic resonance to detect gravitational waves of lengths between 1 and 1,000 centimeters (30,000 to 30 megahertz frequency).

The device would be an annular (ring-shaped) waveguide for electromagnetic waves—one in which the waves would fill the entire ring or the greater part of it. At two points on the ring 90 degrees apart, the electromagnetic waves would be drawn off continuously and the difference in phase between these two signals would be measured.

If a plane polarized gravitational wave comes along perpendicular to the plane of the waveguide and has a frequency equal to twice the frequency at which the electromagnetic waves made the circuit of the ring, the phase difference between the two extracted electromagnetic signals should pulsate in an identifiable way.

Exciting ultrasonic waves with electrons

Several theoreticians have predicted that the passage of fast charged particles through liquids, solids or compressed gases should excite ultrasonic vibrations in those media. Two years ago Drs. B. L. Beron and Robert Hofstadter showed that electrons do it in a piezoelectric ceramic material.

Now a group of physicists at the Kharkov State University in the Ukraine have shown it can be done in a metal. The experiments are reported in the May 20 JETP LETTERS by Drs. I. A. Borshkovskii, V. D. Volovik, I. A. Grishaev, G. P. Dubovik, I. I. Zalyubovskii and V. V. Petrenko.

They bombarded duraluminum plates with electrons of 80,000 and 225 million electron-volts energy.

They use their data to estimate the proportion of the signal recorded by Dr. Joseph Weber's gravity-wave detectors (which are large aluminum bars) that could be caused by charged mu mesons from the cosmic rays.

To excite two of Dr. Weber's detectors simultaneously as a gravity wave ought to do would require two coincident mu meson showers of the proper intensity. The Kharkov physicists estimate that this would happen no more than once in a thousand years.

Explaining anomalous losses in plasmas

Some of the experiments in tokamaks and other devices designed to confine plasmas in thermonuclear fusion experiments have shown that electrons escape from the confining magnetic fields faster than theory says they ought to (SN: 6/26/71, p. 434).

In the July 26 PHYSICAL REVIEW LETTERS Dr. Tihiro Ohkawa of the Gulf General Atomic Co. in San Diego suggests that perturbations in the magnetic field may be responsible for these anomalous losses.

The experiments in question attempt to confine plasmas in toroidal or doughnut-shaped spaces, and the aim is to keep the electrons and ions as close to the center line of the doughnut as possible. The particles, however, move in banana-shaped orbits. Gradually the centers of these orbits move across the thickness of the doughnut, and the particles escape.

Dr. Ohkawa suggests that the rate of this banana diffusion may be enhanced, and the experimental results explained, if there is a distortion in the shape of the magnetic field caused by imperfections in construction or if a magnetohydrodynamic turbulence causes a twist in the field lines. He suggests that future fusion devices will have to be very carefully engineered to minimize the possibility of such imperfections.