physical sciences

PLASMA PHYSICS

Why Tokamaks are better

One of the most serious problems that physicists working toward controlled thermonuclear fusion have to face is plasma diffusion. When they attempt to contain a plasma of ions and electrons within a magnetic field, the plasma diffuses across the field and escapes.

In at least some plasmas, says Dr. Shoichi Yoshikawa of Princeton University, it is clear that diffusion is caused by fluctuations in the magnetic field and in the density of the plasma. Nevertheless, the Soviet plasma device called Tokamak exhibits a very low rate of diffusion even though it is likely to have the same fluctuations as similarly shaped devices such as Stellarators, which have much higher diffusion rates (SN: 4/11, p. 373).

In the Aug. 10 PHYSICAL REVIEW LETTERS Dr. Yoshikawa investigates the difference and concludes that the diffusion is caused not only by fluctuations but also by a geometrical factor involving the length of magnetic field lines and the radius of the device. The geometric factor is more favorable in Tokamaks and contributes to a much lower diffusion rate for them, he says.

PHYSICAL CHEMISTRY

Thioformaldehyde in the lab . . .

Thioformaldehyde (H_2CS) is a molecule chemically related to formaldehyde (H_2CO). Although a trimer, a system of three thioformaldehyde molecules bound together, has been known for some time, isolation and study of the monomer or single thioformaldehyde molecule has not been definitely reported until now. But in the Aug. 14 SCIENCE Drs. Donald R. Johnson and Francis X. Powell of the National Bureau of Standards say that they have made the monomer and studied the spectrum of the radio microwaves it absorbs.

They found that monomeric thioformaldehyde could be made by passing an electrical discharge through methane (CH_4) and reacting the products with molecules that contain sulfur. An alternative, which they finally judged most efficient, is to subject the compound dimethyldisulfide (CH_3SSCH_3) to a radio-frequency discharge at low pressures.

Assuming that the geometry of a thioformaldehyde molecule is similar to that of a formaldehyde molecule, and that therefore thioformaldehyde would rotate in ways similar to formaldehyde, they calculated the microwave spectrum that thioformaldehyde would absorb as molecules went from one rotational state to another.

For the isotope of thioformaldehyde that contains sulfur 32, they calculated seven lines ranging in frequency from 1,046.48 to 34,350.74 megahertz. Six of the lines were observed in the laboratory, and in each case observation closely matched calculation.

MOLECULAR ASTRONOMY

. . . but not in space

Formaldehyde has been detected now in about 50 locations in our galaxy. The widespread appearance of formaldehyde gives reason to expect that the related compound thioformaldehyde might be found in the proportions of one molecule of thioformaldehyde to 40 molecules of formaldehyde, since the ratio of cosmic sulfur to cosmic oxygen is one to 40.

Drs. N. J. Evans II, Charles H. Townes, H. F. Weaver and D. R. W. Williams of the Radio Astronomy Laboratory of the University of California at Berkeley report in the Aug. 14 SCIENCE that they cannot find any thioformaldehyde. They looked for absorption of background radio waves at a frequency of 1,046.48 megahertz, characteristic of thioformaldehyde molecules.

They suggest that their failure to find thioformaldehyde in the expected abundance may mean that the relative abundances of formaldehyde and thioformaldehyde do not depend simply on the relative abundances of the elements that make them up. If there is a step in the manufacture of these compounds in which carbon monoxide (CO) and carbon sulfide (CS) are important, then the low abundance or nonexistence of thioformaldehyde in interstellar space may come about because the ultraviolet light there is more likely to break down carbon sulfide than carbon monoxide.

PLANETARY ASTRONOMY

Jupiter's low-frequency spectrum

In recent years observations have shown radio waves from Jupiter at frequencies of 10 and 4.7 megahertz. In addition to this, the Soviet astronomer Dr. V. I. Slysh suggested that fairly strong radiation at 200 kilohertz observed by several earth satellites also comes from Jupiter. On this basis Dr. Slysh hypothesized that Jupiter emits a continuous spectrum over the range from 200 kilohertz to 20 megahertz and that the brightness of this radiation declines steadily from low frequency to high.

Richard R. Weber and Dr. Robert C. Stone of the Goddard Space Flight Center used the Radio Astronomy Explorer Satellite to search for the proposed low-frequency spectrum. To be sure that they were observing signals from Jupiter, they took note of occasions when the moon passed between the satellite and Jupiter and counted only the signals that were cut off at that time.

They report in the Aug. 8 NATURE that they saw no evidence for the sort of spectrum Dr. Slysh proposes. Their observation allows them to set a limit on the possible brightness of Jupiter's radiation from 0.54 to 5.4 megahertz. At the low end of the range, this limit is no more than one-twentieth the brightness suggested.

They conclude that it is unlikely that Dr. Slysh's 200-kilohertz radiation comes from Jupiter and that Jupiter's spectrum in this range is more complicated than the straight line suggested by him.

NUCLEAR PHYSICS

Powerful Van de Graaff accelerator

A new tandem or double Van de Graaff accelerator, capable of accelerating protons to an energy of 30-million-electron-volts, has been completed and is now operating at Brookhaven National Laboratory.

The machine can also accelerate atomic nuclei or heavy ions. According to Dr. Maurice Goldhaber, director of the laboratory, the energies the machine can give to heavy ions are sufficient to make them fuse into previously unknown radioactive nuclei.