

Physical Sciences Notes

PHYSICAL CONSTANTS

New Value for Basic Constant

At least a million scientists will be making changes on the wallet-sized card they carry giving figures for selected physical constants. The changes will be made because a new value has been determined for the cycle, the ratio of the electron charge to Planck's constant, which relates the energy of a photon to its frequency.

The new measurement yields a changed value in the fine structure constant for hyperfine splitting in the ground state of atomic hydrogen. Although the revised figure differs only by 21 parts per million from the one now accepted, the change removes a discrepancy between theoretical and experimental values that has been one of the major problems of quantum electrodynamics.

The value reported in the Feb. 20 Physical Review Letters for the ratio of twice the electron charge to Planck's constant is 483.5912 megaHertz per microvolt with an error of plus or minus 0.0030. The ratio was measured using the Josephson effect by Drs. W. H. Parker and D. N. Langenberg of the University of Pennsylvania and B. N. Taylor, now at RCA Laboratories in Princeton, N.J.

MOLECULAR ACCELERATOR

'Moletron' Will Test Reactions

A new scientific tool called the "Moletron" has been developed by scientists at Princeton University. It generates beams of neutral atoms and molecules, permitting for the first time detailed studies of events in common gaseous chemical reactions.

The new tool opens the way to experiments with molecular beams at energies "substantially higher than have heretofore been possible," the Princeton scientists reported in the Feb. 24 Science.

Dr. John B. Fenn is the leader of the four-man research team that found a new way of accelerating molecular beams to kinetic energies into the range of up to ten electron volts.

Although this energy range is far below that generated in large or even small conventional atom smashers, which can put out millions or billions of electron volts, the Moletron nevertheless fills a major gap in the list of machines available to probe nuclear and molecular structure.

According to the report in Science, the accelerator uses a supersonic jet of mixed gases in a high vacuum container to generate molecular beams from one to ten electron volts. Favorable results have been obtained with 16 different molecular beams, including nitrogen, carbon dioxide, methane and sulfur dioxide.

Dr. Fenn said that the importance of the Moletron is due to the fact that it permits detailed investigation of changes in the energy, momentum and structure due to collisions of molecules with surfaces, or with other molecules, at precisely the energy range in which many chemical reactions and particle-surface interactions occur.

GEOPHYSICS

'Whistler' Waves in Van Allen Belts

The recurrent spilling out of high energy electrons from the Van Allen belts into the upper atmosphere,

long a puzzle to geophysicists, may result from the generation of low frequency "whistler" radio waves.

Two Scandinavian scientists, Dr. Carl Stormer and Prof. Hannes Alfvén, both proposed many years ago that high energy electrons could remain trapped indefinitely in the earth's magnetic field. However, experiments from satellites showed that Van Allen electrons were trapped only for a few hours before they were released to the atmosphere.

The Stormer and Alfvén theories had omitted the tiny interaction between the high energy electrons and whistler waves, which also travel through Van Allen regions. In 1961, two Russian theoretical physicists showed that high energy electrons in magnetic fields could sometimes generate whistlers, previously thought caused only by lightning flashes.

The Russian discovery implied that the Van Allen belts naturally contain the seeds of their own destruction. Drs. Charles Kennel and Harry E. Petschek of the AVCO Everett Research Laboratories in Massachusetts have suggested a compromise idea, which Dr. Kennel describes in the current Physics of Fluids (Nov., 1966).

Combining the above ideas, they found that it is possible to fill the Van Allen belts with electrons only up to a certain critical level. These electrons are trapped and do not violate the classical theories of Stormer and Alfvén.

However, when even only a few more electrons are added, whistler waves are generated without lightning, driving the extra electrons into the atmosphere.

ACOUSTICS

3-D Computer Movies of Inner Ear

A computer has been used to make three dimensional animated movies depicting the part of the inner ear that translates sound waves into audible sensations.

The movies were produced at Bell Telephone Laboratories by Robert C. Lummis, A. Michael Noll and Man Mohan Sondhi. The computer was programmed with a mathematical description of how the basilar membrane moves under certain conditions, it is reported in the current Journal of the Acoustical Society of America (Nov., 1966).

Using this program, the computer first calculated the movements of the basilar membrane in general, then produced a stereo-optical picture of what happens when a sound wave stimulates the membrane to perform its complicated movements.

The digital data was converted into line drawings on the face of a special cathode ray tube. A motion picture camera, also controlled by the computer, photographed the drawings, thus producing a movie. The 3-D effect is created by presenting a different picture to each eye.

When a person views the movie with stereoscopic glasses, both pictures appear to fuse and the minute difference in perspective is translated into a realistic depth effect.

One of the most significant advantages of the computer-generated motion pictures is that the complicated motions of the basilar membrane can be seen clearly and studied in detail. Small rapid changes can be slowed down and movements greatly exaggerated. The membrane moves so fast that to show clearly what happens when the spoken word "to" is heard takes two minutes of film time.