physical sciences

PLANETARY PHYSICS

Origin of the trapped-radiation belts

For as long as the belts of trapped radiation surrounding the earth have been known, scientists have wondered whether the origin of their particles was terrestrial or interplanetary.

Until recently only electrons, protons and helium nuclei were known to be in the radiation belts. According to a report by Drs. Antonio Mogro-Campero and J. A. Simpson of the University of Chicago in the Dec. 7 PHYSICAL REVIEW LETTERS, data taken by the OGO-5 satellite in 1968 reveal the presence of nuclei of carbon, nitrogen and oxygen, and these nuclei give evidence of extraterrestrial origin.

The nuclei, with energies between 13 million and 33 million electron-volts, were found near the geometric equator. They are about 160 times as abundant as the same elements in the interplanetary medium. The detection of carbon and the ratio of two carbons to one oxygen are consistent only with extraterrestrial origin for at least these components of the radiation belts, say the two observers.

X-RAY ASTRONOMY

New strong source in Cetus

Equipment aboard a Black Brant rocket flown from Resolute Bay, Canada, Oct. 26, 1969, discovered an intense source of X-rays in the neighborhood of the constellation Cetus. Analysis of the data has located the object at right ascension 2 hours 14 minutes and declination plus 4 degrees 33 minutes with a probable error of 10 degrees, report Drs. P. G. Shulka and B. G. Wilson of the University of Calgary in the Dec. 12 NATURE.

The source called Cet-XR2, emanates X-rays in the energy range of 1.5 to 5.0 kilo-electron-volts with an intensity of 16.9 photons per square centimeter of detector per second. The investigators compared its spectrum with theoretically predicted ones for synchrotron emission, black-body radiation and thermal bremsstrahlung from a thin hot plasma. The actual spectrum of Cet-XR2 is most consistent with thermal bremsstrahlung.

FLUID PHYSICS

Liquid crystals and sound waves

In a liquid crystal the atoms are arranged in an orderly fashion resembling the order found in solid crystals, although a liquid crystal is not as rigid as a solid. Nematic crystals are a class of liquid crystals that have long threadlike shapes.

Drs. L. W. Kessler and S. P. Sawyer report in the Nov. 15 APPLIED PHYSICS LETTERS that when an ultrasonic wave is applied to certain nematic liquid crystals, it causes them to scatter light in such a way that the areas where the sound wave is active appear brighter than those where it is not.

A similar effect occurs when an electric field is applied to such crystals, and Drs. Kessler and Sawyer suggest that in both cases domain-like regions or swarms of atoms form and that differences in the index of refraction of light at the boundaries of these domains cause the scattering.

The physicists, from the Zenith Radio Corp. in Chicago, believe the ultrasonic effect will be useful as a means of visualizing the shapes of ultrasonic wave fields important in medical diagnosis and nondestructive testing.

PLASMA PHYSICS

Radiation from colliding waves

Theorists seeking to explain the intensity of the so-called Type II and Type III radio outbursts associated with sunspots have proposed that the bursts are caused by collisions of waves running through the plasma of the solar corona.

An experiment by Drs. Cecil A. Chin-Fatt and Hans R. Griem of the University of Maryland, reported in the Dec. 14 PHYSICAL REVIEW LETTERS, now lends strength to this supposition. It shows that laboratory plasmas produce anomalously bright radiation when waves collide in them.

A thermal plasma, one where the motions of the particles are governed mainly by their heat, gives off infrared bremsstrahlung—brake-radiation produced by electrons as they are slowed when they happen to approach other electrons. If a varying magnetic field is used to generate waves in the plasma, the infrared becomes about a thousand times brighter.

Drs. Chin-Fatt and Griem explain this by the coordinating effect of the waves. The waves cause large numbers of electrons to move in unison, and when two waves collide, all the electrons produce bremsstrahlung at once.

PULSARS

Runaway supernova remnants

According to theory pulsars are supposed to be neutron stars. In this view they are made by supernova explosions that severely condense the core of the exploding object.

There are two things wrong with this argument, says Dr. F. Curtis Michel of Rice University in Houston in the Dec. 12 NATURE. First, only two of the known pulsars (the Crab nebula and Vela) are associated with nebular remnants of supernovas. Second, supernova cores may have too much mass to form a gravitationally stable object like a neutron star; they may form continually collapsing objects, so-called black holes, instead.

A way to get around both problems, Dr. Michel suggests, is to suppose that pulsar neutron stars are runaway remnants of supernova cores. That is, when the supernova explodes, the core forms several objects, which may include neutron stars, black holes or both, and that some of these objects escape completely from the nebula left over after the explosion.

Dr. Michel gives a mathematical argument to show that the remnants can escape each other's gravity and points out that many of the known pulsars can be associated with supernova nebulas if it is assumed that they have escaped from those nebulas and are moving away at velocities on the order of 1,000 kilometers per second.