physical sciences

FIELD THEORY

Magnetic fields that split photons

Theorists postulate that extremely strong magnetic fields may exist near the surfaces of pulsars. Estimates reach into the thousands of billions of gauss.

If a pulsar field exceeds 44,000 billion gauss, say Drs. S. L. Adler, J. N. Bahcall, C. G. Callan and M. N. Rosenbluth of the Institute for Advanced Study in Princeton in the Oct. 12 PHYSICAL REVIEW LETTERS, it may split photons or light particles into pairs. They derive the theory governing such events and conclude that the probability of splitting depends on whether the photon is polarized parallel or perpendicular to the direction of the magnetic field. Perpendicularly polarized photons will not split; parallel polarized ones will split into predominantly perpendicularly polarized pairs.

Thus, they say, if photons in the energy range between one-half and one million electron-volts are emitted near the surface of a pulsar and the field there is at least 44,000 billion gauss, observers should see light polarized perpendicular to the plane containing the line of sight and the direction of the pulsar field.

ATOMIC PHYSICS

Laser excited by neutrons

Specialists working with gas lasers continually seek new methods for exciting large volumes of the working gas. The more gas excited, the larger the power output from the laser.

One method that looks promising in principle is excitation by nuclear reaction products. A group at the Moscow State University, Drs. V. M. Andriakhin, V. V. Vasil'nov, S. S. Krasil'nikov, V. D. Pis'mennyi and V. E. Khvostionov, report in the July 20 JETP LETTERS that they have achieved laser excitation in this way.

They irradiated a mixture of helium 3 and mercury gas with thermal neutrons, the slow-moving kind that come from reactors. The neutrons reacted with the helium to make tritium nuclei and protons. The recoiling reaction products excited the mercury. About 10 milliwatts of power was produced by a gas cylinder 60 centimeters long and 4 centimeters in diameter.

More power can be achieved with higher gas pressure, the Russian scientists suggest.

SPECTROSCOPY

Continuous ultraviolet from hydrogen

The most prominent features of the spectra of light emitted by atoms are bright lines of particular frequencies emitted when the atoms' electrons change from orbit to orbit. In a molecule, the rotation and vibration of the molecule are added to the electronic transitions, and the prominent features are bright bands. On close examination the bands are seen to be series of closely spaced lines.

In the ultraviolet range between 1,200 and 1,600 angstroms the prominent, and until now the only known, feature of the spectrum of molecular hydrogen (H_2) is a set of bands called the Lyman bands. Drs. Alexander Dalgarno and T. L. Stephens of the Harvard College Observatory and Smithsonian Astrophysical Observatory in Cambridge, Mass., and Gerhard Herzberg of the National Research Council of Canada report in the October ASTROPHYSICAL JOURNAL LETTERS that they have discovered a continuous spectrum of molecular hydrogen over the entire 1,200- to 1,600-angstrom range, in addition to the Lyman bands.

A study of the relationship between brightness and wavelength in the continuous spectrum leads them to believe that it is generated by changes in the vibration of the molecule. The hydrogen molecule vibrates as if its two atoms were bodies on the ends of a spring, they say.

PLASMA PHYSICS

Electromagnetic-acoustic resonance

If an electromagnetic wave enters a plasma of ions and electrons, the varying electromagnetic forces in the wave can cause the plasma particles to move.

They will move most efficiently, two physicists suggest in the Oct. 19 PHYSICAL REVIEW LETTERS, if the velocity of the electromagnetic wave in the plasma equals the velocity that an acoustical wave in the plasma would have. Such a case, a resonance between electromagnetic and acoustic modes of vibration, may be the means whereby the energy of magnetic disturbances on the surface of the sun is transformed into the mechanical energy of ions and electrons streaming into interstellar space.

In a solar flare an intense magnetic disturbance on the sun's surface is associated with a burst of particles that fly out into the solar wind. If the magnetic disturbance generates an electromagnetic wave that propagates into the plasma of the corona and if the resonance condition exists, electromagnetic energy from the magnetic field will be transformed into mechanical energy that will drive the particles.

Since the two velocities depend on the physical state of the plasma, they will not be equal in all cases. But Drs. A. Rogister of the European Space Research Institute in Frascati, Italy, and M. Dobrowolny of the Laboratori Gas Ionizzati in Frascati, say that when they are, the resonance should exist.

STELLAR ASTRONOMY

Novas observed by radio

A nova is the sudden expansion or explosion of a star, in which the star quickly becomes much brighter than it was before. Astronomers have studied novas in visible light for centuries. Now two novas have been observed by radio.

Drs. R. M. Hjellming and C. M. Wade of the National Radio Astronomy Observatory in Green Bank, W. Va., report in the October ASTROPHYSICAL JOURNAL LETTERS that they detected Nova Delphini of 1967 and Nova Serpentis of 1970 at 11.1, 3.7 and 1.95 centimeters wavelength. The results are consistent with thermal radiation from expanding envelopes of ionized gas, which novas are expected to have.

Drs. Hjellming and Wade believe that comprehensive radio data about recent novas will be a valuable complement to optical studies in the understanding of the phenomenon.