astronomy

ASTROPHYSICS

Long-term pulsar variations

When pulsars were first discovered, the fascinating thing about them was the speed of their pulsations. Repetition rates of once in a few seconds or even in fractions of a second were recorded.

These observations fit well with the hypothesis that pulsars are neutron stars. Neutron stars are supposed to be extremely small and dense, and because of their dimensions, cyclic changes in them that could give rise to radio pulsations should occur at very fast rates.

In the May 17 NATURE PHYSICAL SCIENCE Dr. K. H. Hesse of the Mullard Radio Astronomy Laboratory of Cambridge University reports long-period fluctuations in pulsars that do not fit the neutron-star model so well. He studied recorded data from the seven strongest pulsars (CP 0328, CP 0808, CP 0834, CP 0950, CP 1133, HP 1506 and CP 1919) at 81.5 megahertz taken over periods between 15 and 34 months. Graphing the mean intensities of the pulsars—the average of the 10 largest pulses in a day—from day to day he finds evidence for intensity fluctuations with rates between zero and six cycles per year superimposed on the quick cycles. These variations, he writes, have time scales on the order of tens of millions of seconds, while characteristic processes in neutron stars take times on the order of seconds or less.

A theoretical model that could give such long-term variations in neutron stars has been developed by Dr. Malvin Ruderman of Columbia University. It postulates a neutron star with a superfluid core and solid shell. Motions of vortices in the core could give long-period oscillations. But, Dr. Hesse notes, other scientists have raised criticisms of this model. Precession of the star's rotation is a less likely explanation, he says.

PLANETARY ASTRONOMY

Jovian magnetism

A method developed to search for magnetic white dwarf stars by looking for circular polarization in their light has been applied to the planet Jupiter. If the interpretation of the result is correct, it yields some surprising information about the planet's magnetic field. The method depends on a theory called graybody magneto-emission, developed by Dr. James C. Kemp of the University of Oregon. It predicts that light emitted by a body with a strong magnetic field will have a small percentage of circular polarization.

Observations of Jupiter by Dr. Kemp and John B. Swedlund of the University of Oregon and Drs. Robert E. Murphy and Ramon D. Wolstencroft of the University of Hawaii reported in the May 21 NATURE show circular polarization in the light reflected by Jupiter. Depending on the details of how the planet's magnetic field affects the reflected light, the field strength could be as low as 1,000 gauss or as high as 10,000, they figure. Either number is a good deal higher than the 10 to 100 gauss postulated to account for certain features of Jupiter's radio emission.

Furthermore they report a pronounced polar effect: The polarization goes clockwise in the north and counterclockwise in the south. The northern component is the stronger and dominates the whole-planet average.

GRAVITATION

When black holes collide

The apparatus that Dr. Joseph Weber of the University of Maryland has set up to record gravitational radiation has been recording about one burst of gravity waves a day in recent months. The bursts appear to come from the center of the galaxy.

The observations lead Dr. S. W. Hawking of the University of Cambridge to suggest that the center of the galaxy is converting mass to gravitational radiation at the rate of 20,000 times the sun's mass every year. This rate requires an efficient method of converting mass to energy. Dr. Hawking suggests collisions of black holes.

Black holes are supposed to be bodies that have collapsed under the influence of their own gravity until they are so dense that their gravity is too strong for any matter or light to escape (SN: 12/26/70, p. 480). If two of them collide, part of their mass will be converted to gravitational radiation. Dr. Hawking figures that if two holes of equal mass collide, anything up to about six-tenths of the mass of one of them could become radiation.

He imagines a situation where there were a lot of black holes at the beginning. First they collide in pairs; then the resulting heavier holes collide with others, and so on. Each collision produces a burst of radiation, and the heavier ones produce longer and stronger bursts. This, he suggests, could explain Dr. Weber's observations.

PLANETARY ASTRONOMY

Formation of the Allende meteorite

Meteorites are samples of the rest of the solar system that land on earth without any need of sending expensive space expeditions to fetch them. Since they have been wandering in interplanetary space for some time, they can yield information about the early history of the solar system.

Study of the Allende meteorite, which fell in Mexico's Chihuahua state in 1969, indicates that "the Allende meteorite consists of virgin planetary material," according to Drs. H. W. Green II, S. V. Radcliffe and A. H. Heuer of Case Western Reserve University.

Chondrules, small droplets of mineral matter, in the meteorite show evidence of having been damaged by radiation from the protosun—whatever the sun was at the beginning of the solar system. This damage has not been annealed out, indicating, according to the investigators, that formation of the parent body from which the meteorite came proceeded by cold accretion at temperatures less than 500 degrees K. rather than by warmer processes as others have suggested.

The crystal structure of the olivine matrix, in which the chondrules are embedded is so perfect, the researchers report in the May 28 SCIENCE, that it and other properties suggest the olivine condensed directly from a circumsolar plasma out of which the planets are supposed to have formed. The meteorite's low concentration of water and some other volatile substances, they say, may be a further indication that the meteorite formed from circumsolar plasma deficient in these substances. Or it could be an indication of cold accretion under conditions unfavorable to entrapment of those substances.