physical sciences

PULSARS

Runaway stars

Many of the stars in the galaxy form part of binary or multiple-star systems in which two or more stars are bound together by gravitational forces and revolve around each other.

If one star in a binary happens to explode as a supernova, and the explosion blows sufficient mass out of the system, the system will become unbound. The second star will fly off with high velocity.

Such a star is called a runaway. If the supernova explosion leaves behind a remnant of the exploded star—and the theory of pulsars says that they are in fact such supernova remnants—then the remnant will become a runaway too.

Study of the distribution of pulsars in the galaxy leads Drs. J. Richard Gott III of Princeton University, James E. Gunn of California Institute of Technology and Princeton University and Jeremiah P. Ostriker of Princeton University to suggest that the pulsars are likely to be runaway remnants of exploded binaries.

They suggest particularly that two pulsars associated with the Crab nebula, NP 0527 and NP 0531, were once part of a multiple-star system in the constellation Gemini. On this basis they predict what the apparent motion of 0527 across the sky will be and appeal to future observation to uphold or destroy their hypothesis.

X-RAY ASTRONOMY

Variations of Sco X-1

The X-ray source Sco X-1 in the constellation Scorpius is identified with an optical object of variable brightness. Studying the records of optical observations of this object, Drs. Robert E. Wilson and Laurence W. Twigg of the University of South Florida find, and report in the May 23 NATURE, a characteristic pattern that repeats from time to time and looks much like a total eclipse.

They do not think it is an eclipse because it lasts too long even for a dark companion in actual contact with the bright star. Another possibility is that the magnetic field of the star is trapping interstellar matter and drawing it to the surface of the star. This could happen from time to time as an interstellar cloudlet drifted into range.

ACOUSTICS

Sound 100 miles high

The rockets that launched the Apollo 12 and 13 space capsules generated sound waves in the atmosphere 100 miles above the earth's surface. The waves, at far too low a frequency to be heard, were recorded by instruments at the Bermuda station of the Lamont-Doherty Geological Observatory of Columbia University.

According to Dr. William Donn of Lamont-Doherty such acoustical shock waves are generated by a so-called overpressure produced as the rocket nose presses against the air. The difficulty is that current theory says no overpressure should form in an atmosphere as thin as it is 100 miles high. Furthermore, theory does not explain how such a wave gets transmitted through an atmosphere where a molecule has to travel 500 feet before it encounters another. Dr. Donn and his associates are working their way through the theory to see what they have to change to explain their observations. The job will take months, he says.

SUPERCONDUCTIVITY

Phonons in tantalum

For superconductivity, which is the ability to pass electric currents without resistance, to exist in a metal, the conduction electrons in the metal must form pairs that act together. Normally such pairs are impossible since electrons all have negative electric charge and tend to repel each other.

Under certain conditions the interposition of a third element can change the balance of forces between two electrons so that they do form a pair, and superconductivity is possible.

The most widely accepted theory of superconductivity says that the mediating agent is a vibration of the metal's crystal lattice, a so-called phonon. But for certain classes of metals, including those called transition metals, experimental and theoretical considerations have led a number of physicists to insist that some other agent besides phonons has to be invoked.

Tantalum is a transition metal. In PHYSICAL REVIEW LETTERS for May 18 Dr. L. Y. L. Shen of Bell Telephone Laboratories presents evidence that he says shows that phonons alone are sufficient to produce superconductivity in tantalum. He bases his contention on an experiment in which he observed how electrons tunnel from a sample of tantalum through an insulating layer to another sample of tantalum.

QUASARS

Redshift questions

The faster a quasar, or any other astronomical object, happens to be moving away from the earth, the more will the wave lengths of the light it emits be shifted toward the red end of the spectrum.

The actual quasar spectra are complicated, showing both bright lines where the emission of a particular wave length is enhanced and dark lines that indicate some gas is absorbing a particular wave length from the quasar emission.

The emission and absorption lines tend to have different redshifts, and because of this, astronomers find it hard to believe that the source of the light and the absorbing gas could be parts of the same object. Some suggest that the quasars are throwing clouds of gas behind them as they go; others suggest that interstellar gas in galaxies encountered by the light on the way is doing the absorbing.

To see if galactic gas is responsible Drs. Carl Heiles of Arecibo Observatory in Puerto Rico and George K. Miley of the National Radio Astronomy Observatory in Green Bank, W.Va., looked at the radio emissions of quasars for evidence of absorption by neutral hydrogen, which is the major component of interstellar gas in galaxies. They found no such absorption and conclude in the May ASTROPHYSICAL JOURNAL LETTERS that gas in galaxies is not producing the quasar absorption lines.