ASTRONOMY

Bouncing black holes

In attempts to deduce the nature of the many kinds of strange radiation sources in the sky, it is frequently said that theory knows no way for a black hole to pulse, and so pulsing sources should not be black holes. Now, proving that nothing can long be unknown to theoretical physics, such a theory is provided by Robert C. Gilman of the Smithsonian Astrophysical Observatory. It is published in the observatory's Special Report 369.

Gilman arrives at his prediction by applying one of the basic principles of quantum physics, the Heisenberg uncertainty principle, to the gravitational collapse process that makes black holes. Physicists lack a comprehensive quantum theory of general relativity that would tell them how gravity acts in the world of elementary particles. Yet, quantum effects must be important in the world of a black hole where such things as protons and neutrons will be jammed together very closely. In the absence of a full theory, one can still apply particular quantum principles to general relativistic processes.

He finds that a black hole will not simply collapse to some size within its Schwarzschild radius (the size at which its gravity is strong enough to cut it off from the rest of the universe) and stay there, as the usual theory supposes. Instead, it will pulse back and forth across the Schwarzschild radius, interacting with its surroundings. The pulse period can range from 3.6 milliseconds for an object with the sun's mass to 1.4 weeks for one 100 million times as massive. Astrophysically, this means that black holes could play a role in changing or pulsing bodies such as supernovas, quasars and X-ray pulsars.

Identifying Cygnus X-1

A celestial source of X-rays or other invisible emanations cannot, of course, be seen by eye. The first step in attempts to identify X-ray sources with visible objects is simply directional. A visible object lying as close as possible to the direction from which the X-rays come is chosen as a likely candidate. To make the identification more certain, it is good to find a characteristic of the X-ray emanations that corresponds to an observable physical characteristic of the optical object.

Such a piece of evidence to strengthen the identification of the X-ray source Cygnus X-1 with the binary star HDE 226868 is reported by S. S. Holt, E. A. Boldt and P. J. Serlemitsos of the Goddard Space Flight Center and L. J. Kaluzienski of the University of Maryland (ASTROPHYSICAL JOURNAL 203: L63). It is a modulation of Cygnus X-1's X-rays in the 3-6 kilo-electron-volt range that corresponds to the 5.6 day orbital period of HDE 226868 and has an intensity minimum at the time when HDE 226868's dark companion is farthest from the earth. This suggests very strongly that the X-rays do in fact come from HDE 226868's dark member.

Silicates and infrared absorption

A laboratory result that will complicate attempts to determine the composition of interstellar dust clouds is reported by Kenrick L. Day of the University of Arizona (ASTROPHYSICAL JOURNAL 203:L99). Absorption of 20-micrometer wavelength infrared by two silicates, olivine and enstatite, believed to inhabit the clouds, changes with temperature, being 65 percent greater at 80°K than at room temperature. This finding will complicate attempts to interpret composition by comparing absorption of 10-micrometer infrared with that of 20-micrometer infrared. On the other hand, the band structure of the silicate spectra is more sharply defined at low temperature. Thus, when high dispersion spectra of the clouds become available, it should be easier to determine what silicates are there.

SPACE SCIENCES

Casting call for shuttle crews

In about July, the National Aeronautics and Space Administration will send out the call for a new batch of astronauts for the era of the space shuttle. Of the 73 pilots and scientists selected since the process began in April 1959, only 21 pilot-astronauts and 9 scientist-astronauts remain. The agency hopes to pick about 30 more, to report early in 1978.

There will be two categories for the newcomers: pilots, who will command and fly the shuttle itself, and mission specialists, who will work primarily with payloads. Criteria are still being refined, but pilot applicants are expected to need 1,000 hours of flight time, preferably as test pilots or in high-performance jets. An engineering-related bachelor's degree will be a requirement, with an advanced degree desirable for pilot applicants. There will be no minimum age requirement (the educational specs take care of that), and an upper figure of 35 will probably be flexible. Pilot applicants must have no vision defects, while mission specialists may have glasses-correctable defects.

Women will be eligible, probably in the mission specialist category, although they will not be formally excluded as pilots, and NASA plans an active search for minority applicants.

Meanwhile, NASA has chosen astronauts Fred W. Haise Jr. and Charles G. Fullerton to command and pilot the first shuttle approach and landing test late this year, in which the shuttle's orbiter stage will be released from an aircraft to glide to earth. The second test will be flown by Joe H. Engle and Richard H. Truly. Haise, who was on the aborted Apollo 13 lunar mission, is the only space veteran of the four.

CO_2 glaciation at the Martian poles

The possibility that the frozen polar caps of Mars were formed by glaciation of carbon dioxide has been suggested by two University of Michigan geologists. Their theory, based on laboratory studies of the flow characteristics of frozen CO_2, attempts in part to explain the roughly concentric, scalloped markings photographed on the caps by Mariner 9 as well as the apparent layered structure of the southern cap.

The laboratory studies, according to Bruce R. Clark and Rosemary P. Mullin in the forthcoming ICARUS (27:215), indicate that CO_2, perhaps contained in a sediment layer about 100 meters down, could maintain its frozen state if the pressure were about 5.1 bars or more. Its shear resistance, however, would be low enough to have allowed an original deposit 10 to 15 kilometers thick to spread of its own weight to the present size and estimated thickness of the polar caps.

As this subsurface flowing produced an irregular surface topography, the slopes facing toward the equator would receive more of the sun's heat, thus allowing increased sublimation or nondeposition to produce a pole-centered appearance.

Marisat 1 is in orbit

Marisat 1, first entry in a planned three-satellite maritime communications network, was successfully placed in orbit on Feb. 19. Now in position in a geosynchronous orbit over the Atlantic at longitude 15°W, the satellite is expected to begin commercial operations about April 1, following checkout.

The U.S. Navy will use about 75 percent of the capacity of the satellites (Marisat 2, Pacific-bound, is scheduled for launch May 27), while the rest will be used by a variety of passenger and cargo ships and off-shore drilling platforms. Many of these civilian users are already carrying the necessary communications equipment, purchased or leased from COMSAT General, which manages the system for a four-company consortium.