

## A precessing binary pulsar?

Astronomers know of two pulsating binary X-ray sources: Centaurus X-3 and Hercules X-1. One of the hypotheses that has been put forward is that matter is continuously transferred from one member of the binary to the other and that the X-rays are produced as this matter falls onto the receiving body.

Kenneth Brecher of the University of California at San Diego objects that although this model can explain the X-ray luminosity of Her X-1, it cannot explain the other properties, which are suspiciously like those of a radio pulsar. They include a pulsation period of 1.24 seconds, roughly equal to the average for radio pulsars, and the presence of an interpulse.

Brecher suggests that Her X-1 and maybe Cen X-3 are true X-ray pulsars.

In addition to its 1.4-second cycle, Her X-1 has a 1.7-day orbital period, and a cycle of 36 days during which it is undetectable for 27 days. Brecher suggests that this 36-day cycle can be explained by supposing the source is a slightly oblate neutron star emitting a pencil beam parallel to its spin axis and that this beam precesses in and out of our line of sight.

## Interstellar carbon ratio

A most useful astrophysical datum about a celestial body is the ratio of carbon 12 to carbon 13 in it. This can tell observers which of several possible chains of nuclear fusion has produced the matter in the object. In the case of interstellar clouds the ratio can throw light on the question whether the interstellar matter is the result of processes in stars or whether it was processed independently, perhaps in the original big bang itself.

Radio observations of the past three years seemed to indicate that the ratio was four to one, more or less, and this led to a suggestion that the cloud matter was produced by what is called the carbon-nitrogen-oxygen bi-cycle rather than the hydrogen-helium cycles common in stars.

In the Sept. 15 *ASTROPHYSICAL JOURNAL LETTERS* Paul A. Vanden Bout of the University of Texas at Austin reports an optical measurement that sharply contradicts the radio one. The ratio is 75 to 1 with a margin of error between 60 and 100. The terrestrial value is 89 to 1, and this leads to the conclusion that the interstellar matter, like the earth, comes originally from stellar "cooking."

## Radiative electron capture

A new phenomenon, the emission of unusually energetic X-rays when accelerated beams of heavy ions strike a target, is reported in the Oct. 2 *PHYSICAL REVIEW LETTERS*. The observation was made by a group of seven physicists from Massachusetts Institute of Technology and Brookhaven National Laboratory led by H. W. Schnopper of MIT. The observers explain the phenomenon by suggesting that the projectile ion captures an electron from the target directly into one of its inner electron shells, the K shell. Conditions that favor this "radiative electron capture" also exist in the solar corona, some X-ray stars and controlled-fusion experiments, and the experimenters suggest that these X-rays may give useful data in those fields.

## Toxic metals along roads

The lead industry and others are still trying to claim that toxic metals emitted into the air from automobiles are harmless. While there is still doubt about the harm to humans of breathing the contaminated air, there appears to be less doubt that dangerous amounts of the metals get into roadside soil.

Now the Interior Department's Fish and Wildlife Service reports that analysis of earthworms taken from soil 10, 20, 40, 80 and 160 feet from U.S. Highway 1 and from the Baltimore-Washington Parkway, both in Maryland, show high levels of several toxic metals. Lead and zinc were in quantities that would be fatal to birds that consumed the earthworms, even when the worms were 160 feet from the roads in the case of zinc. Other metals found in the worms were nickel and cadmium.

The FWS researchers say the metals evidently came from auto emissions. Zinc is used in motor oil, lead in gasoline, cadmium in tires and nickel in both gasoline and oil.

Lead at levels higher than the 200 parts per million (ppm) level known to be fatal for mallard ducks was found only within 10 feet of the roads and in lesser amounts beyond 10 feet. Cadmium was not found at known lethal levels at any distance from the roads. Nickel was found at 34.5 ppm 10 feet from the roads, but toxicity levels for nickel are not known.

## Removing unwanted nutrients

Eutrophication is the process of a body of water filling with solid materials. This natural process is speeded up greatly in modern civilizations by the addition of nutrients that cause excessive plant growth. Usually, there is a single "limiting nutrient" that initiates eutrophication—all other nutrients already being in sufficient supply. In many cases, the limiting nutrient is phosphorus.

The Environmental Protection Agency reports that studies in progress at Shagawa Lake in Ely, Minn., since 1966 indicate that tertiary treatment of sewage can remove 99 percent of phosphorus and that the removal will result in the halting of eutrophication. Thus EPA and the city of Ely will now build a \$2.3 million treatment facility.

The six-year study included a pilot treatment plant and 150,000-gallon floating test basins in the lake itself. The new, full-scale, tertiary treatment plant will use chemical precipitation to remove phosphorus.

## Mercury ions eliminated with iron

Inorganic and elemental mercury are not serious problems in waterways, because their toxicity is relatively low. The problem comes when mercury ions are converted to highly toxic organic forms by anaerobic bacteria or other organisms. Mercury ions, originally from various industrial sources, generally diffuse from sediments into the water, where the conversion to organic forms takes place.

The Midwest Research Institute reports that a study it has completed for the Environmental Protection Agency shows that putting a layer of iron—in the form of crushed auto bodies—over the sediments, then putting a layer of sand over the iron appears to prevent diffusion of mercury ions into the water. The iron reduces the mercury ions to elemental mercury, says MRI.