Measuring the sun's gravitational redshift

One of the predictions by which Einstein's general relativity differs from classical theories of gravity is the redshift of light by strong gravitational fields. The characteristic emission or absorption lines of atoms or molecules are shifted toward the red if the emission or absorption takes place in a strong field.

The redshift effect of the earth's field on gamma rays was measured some years ago. Confirmation of the effect of the sun's field on its light is reported by J. L. Snider of Oberlin College in the March 27 PHYSICAL REVIEW LETTERS. His measurement of the potassium absorption line at 7,699 angstroms shows a shift of 1.01 ± 0.06 times the predicted 16.3 milliangstroms. The only previous measurement, he says, was of the sodium D1 line by J. W. Brault in 1962. It gave agreement within five percent. Other lines in the solar spectrum appear to originate at levels where there is much up-and-down motion, which causes Doppler shifts that obscure or cancel the gravitational effect.

Identifying Centaurus X-3

A few weeks ago astronomers from American Science and Engineering Inc., who work with the X-ray satellite Uhuru, proposed that the variable X-ray source Centaurus X-3 is a binary system (SN: 3/18/72, p. 185). In International Astronomical Union Circular 2396 Jerome Kristian, R. J. Brucato and J. A. Westphal of the Hale Observatories and the Soviet astronomer I. S. Shklovsky propose that Cen X-3 is identical with the eclipsing variable star LR Cen.

The identification depends on a close correspondence of period and phase: Cen X-3's period is 2.08712 days; LR Cen's was measured in 1927 at 2.0956 days. If the identification is true, it means that the period has shortened somewhat in 45 years, possibly by a shift of mass from one component to another.

However, J. L. Elliot of the Smithsonian Astrophysical Observatory and William Liller of the Harvard College Observatory find, in recent photographs of LR Cen, no evidence for a change of period. They argue that LR Cen has nothing to do with the X-ray source, but admit the alternative possibility that the measurement of the eclipse period of the X-ray source is inaccurate by the difference.

A new phase of solid helium

As solids are cooled toward absolute zero, they sometimes undergo phase changes. Various kinds of order may appear, or an order already present may be altered.

Solid-state physicists have believed that at a temperature near two millidegrees K. solid helium 3 would undergo a phase transition to a state of antiferromagnetic order.

D. D. Osheroff, R. C. Richardson and D. M. Lee of Cornell University have done an experiment in which helium 3 was selfcooled to below two millidegrees K. in an apparatus called a Pomeranchuk compression cell. They report in the April 3 PHYSICAL REVIEW LETTERS that the expected antiferromagnetism does not appear. An ordered state fundamentally different from the antiferromagnetic appears at 2.7 millidegrees K. At lower temperatures, they add, there is evidence for yet another phase change.

Mercury and arsenic in lake sediments

Scientists now believe that mercury in fish is not a recent problem (SN: 3/18/72, p. 187), but two Argonne National Laboratory researchers have found evidences of increases of mercury and another toxic metal, arsenic, in lake sediments. D. N. Edgington and M. M. Thommes took several cores from the bottom of Green Bay where ferromanganese nodules containing arsenic had been found. Cores varied in length from 26 to 120 centimeters; 18 or more elements were detected in each sample. The majority of the trace elements showed little surface enrichment or increase.

But in the top five centimeters of a representative core the researchers found 90 micrograms per gram of arsenic and 3.4 micrograms of mercury. Concentrations of the two were only 27 and 1.6 respectively at a core depth of 33 and 38 centimeters. They also found greater amounts of zinc, copper and possibly antimony, chromium and tungsten in the upper portions of the core samples. The researchers say the evidence does not permit them to determine whether the increases in arsenic are due to natural geochemical processes or man's activities.

They reported their evidence last week at Madison, Wis., at the 15th Conference on Great Lakes Research.

Mercury absorption by fish tissue

The potential for harm from mercury in marine and freshwater fish will depend on what tissues of the fish absorb the mercury and how long the mercury is retained.

Edward J. Massaro and F. J. Giblin of the State University of New York at Buffalo administered methyl-mercury chloride intragastrically to rainbow trout at intervals from one hour to 300 days. After administration of the dose, 19 tissues and organs were analyzed for methyl-mercury content. The results, Giblin told the Great Lakes Research conference in Madison, "are not encouraging in view of the world's need for fish as a source of protein."

The mercury was taken up rapidly by blood, spleen, gills, liver and kidneys, reaching maximum concentration in an hour to seven days. But concentrations in those organs and tissues also declined rapidly after the maximum was reached. Skeletal muscle, the edible part of the fish, appeared to act as a reservoir for mercury, absorbing it slowly but retaining it longer. After 100 days, 70 percent of the original dose remained in the fish, and more than 70 percent of this was in the skeletal muscle.

Computer modeling thermal effects

Four University of Vermont investigators have developed and tested a computer model that can predict the thermal effects of a nuclear generating plant. The model takes into account such variables as volume, temperature and rate of flow of water circulated through the plant's cooling system, the currents and temperature of the lake, wind velocity and cloud cover. The model describes conditions in three locations: the discharge channel; the mixing area near the outlet, where the warm water mixes with lake currents; and the heated plume that is carried by currents out into the lake. The Vermont researchers, Richard W. McLay, Mahendra S. Hundal, Frank Martinek and E. B. Henson, tested their model by comparing its predictions with observations at the Ginna Nuclear Power Plant on Lake Ontario.