physical sciences

RADIATION

Pinning down subcosmic rays

Scientists studying cosmic rays have wondered whether very low-energy rays, so-called subcosmic rays, might exist. These would be atomic nuclei of various elements and would possess energies in the range between one million and 100 million electron volts.

Direct search for such rays is impractical because the sun's influence would tend to deflect them away from the earth's neighborhood. Now Drs. Joseph Silk and Gary Steigman of the Institute of Theoretical Astronomy in Cambridge, England, propose an indirect method in Physical Review Letters for Sept. 15.

If such nuclei came into one of the interstellar clouds of neutral hydrogen, they say, the nuclei would pick up electrons from the hydrogen. The electrons would be captured in highly excited states and would give off energy in the form of X-rays as they cascaded down to less excited states.

The result would be that hydrogen clouds with such subcosmic rays coming through them would give off a series of X-ray frequencies related to the nuclei present in the subcosmic rays. Drs. Silk and Steigman conclude that such frequencies in the range between 1,000 and 10,000 electron volts should be bright enough to find.

Recent observations show that there is a galactic X-ray background flux in the range between 1,400 and 18,000 electron volts. Although the detectors are unable to separate specific frequencies in this range, Drs. Silk and Steigman suggest that the data below 2,000 electron volts could be unresolved magnesium and silicon lines.

X-RAY ASTRONOMY

New point sources

In 1967 X-ray detectors on a balloon flown from Mildura, Australia, recorded evidence of several point sources of X-rays with energy above 20,000 electron volts in the region of the galactic center. The signal was somewhat smeared together, however, and it has taken a thorough mathematical analysis to determine the number and locations of the sources.

The experimenters, a group from the Center for Space Research and department of physics at Massachusetts Institute of Technology, led by Dr. W. H. G. Lewin, report in Nature for Sept. 13 that the new sources number four, and they designate them M1, M2, M3 and M4.

The new sources all lie near the galactic equator. In longitude they spread over about 30 degrees on both sides of the zero meridian of galactic longitude. The intersection of the equator and the zero meridian is the direction of the galactic center.

X-RAY ASTRONOMY

Centaurus X-2 found again

The X-ray source designated Centaurus X-2 has a history of ups and downs (SN: 8/16, p. 130). It was not detected by a rocket flight that looked at its neighborhood in 1965. It apparently flared up sometime between then and April 1967, when it was detected as a strong and variable source of low-energy X-rays, (2,000 to 20,000 electron volts). It apparently burned out between May and September 1967 since it was undetectable to a rocket flight in the latter month.

Now it has been found again, report four Indian scientists, Drs. U. R. Rao, E. V. Chitnis, A. S. Prakasarao and U. B. Jayanthi of the Physical Research Laboratory at Ahmedabad in the August Astrophysical Journal Letters. The evidence was gathered by two rocket flights from the Thumba Equatorial Rocket Launching Range in Trivandrum, India, in late 1968. At that time the source appeared about one-twentieth as bright as it had at the height of its 1967 flare.

LASERS

New modulator

It has often been said that the beams of light put out by lasers could be used to transmit messages as radio waves do. The problem in achieving such message transmission has been to find a means of modulating the laser light, or continuously changing the shape of the light waves so that messages can be coded onto them.

One approach is to pass the laser light through a transparent crystal whose light transmission properties can be altered by electric forces. Applying a changing voltage to the crystal will produce corresponding changes in the crystal and ultimately in the light waves passing through.

Drs. Alton F. Armington and John J. O'Connor of the Air Force Cambridge Research Laboratories report that they have succeeded in growing a large crystal of cuprous chloride that they call highly promising for this purpose.

Previous growers of cuprous chloride crystals have used the so-called Czochralski method, which involves drawing them from a solution of molten cuprous chloride. But when such crystals were cooled they came out with internal cracks that rendered them unfit for laser modulation. Drs. Armington and O'Connor got around this by developing a method of growing cuprous chloride crystals at room temperature in a solution of silica gel.

MOLECULAR ASTRONOMY

Radio waves from dust

Interstellar space contains large clouds of dust, which according to different theorists may be graphite, ice or some metal. Dr. M. M. Litvak of the Lincoln Laboratory of Massachusetts Institute of Technology suggests in Nature for Sept. 13 that if the dust happens to resemble a semiconductor it may be a source of millimeter radio waves, or even signals in the far infrared.

If the material has an electrical conductivity between 0.01 and 10 mhos (a measure of conductivity, the opposite of an ohm) per centimeter, he says, then dense clouds or condensations within them may produce a significant amount of blackbody radiation at millimeter and submillimeter wavelengths.

If the conductivity of the material could be more than 10 mhos per centimeter, says Dr. Litvak, the main radiation frequency would shift to the far infrared. "The strong far infrared emission at 100 micrometers from the galactic center is likely to be such a case," he says.