Gamma rays from the cosmos: But where?

Gamma-ray astronomy is a very new science. Currently it is more or less in the stage of looking to see what's there. One of the phenomena very conspicuously there is sudden bursts of strong gamma rays coming from somewhere in the cosmos. (Gamma rays are physically the same electromagnetic radiation as X-rays but are much more energetic, having energies into the millions of electron-volts.)

The bursts are recorded by four Vela satellites, which orbit the earth in a circle 140,000 miles in diameter. Sixteen bursts were recorded in the three years between July 1969 and July 1972 and several more since then, including one as recent as May 7. Their existence is reported in the June 1 Astrophysical Journal Letters by Ray W. Klebesadel, Ian B. Strong and Roy A. Olson of the Los Alamos Scientific Laboratory.

Unless they happen to be switched to some other activity, all four Velas record each burst. The Los Alamos group is sure that they are dealing with gamma rays and not with bursts of charged particles; the time lag between the arrival of a burst at one Vela and its arrival at another is proper for objects moving at the speed of light, and the structure of each burst is the same from Vela to Vela. If the bursts were charged particles they would undergo significant alteration as they crossed the Vela orbit since they would be passing through a large part of the earth's magnetosphere, and the magnetic field there would disturb them.

The arrival times at the four satellites can be used to determine something about the direction from which the gamma rays come. (The detectors on the satellites are not themselves directional.) The Los Alamos group can say therefore that the sun is not the source, but the directional information is not good enough to say what else may be.

In fact the gamma-ray bursts were not 100 percent unexpected. The search had begun by looking for bursts that followed the appearance of supernovas. None were found at the proper times, and it was only when the search was extended to all times that the recorded bursts were found. Even though they do not correlate with visible supernovas, there may still be a connection say the Los Alamos observers: ". . . it is possible that there are supernovas, not necessarily bright in the optical region . . . whose rate of occurrence may exceed those which are optically visible." Other possibilities are black holes, white dwarfs, magnetic stars, neutron stars or flare stars. □

Among first photos from Kitt Peak's new telescope

Speed with which detailed optical images are obtained by the new 158-inch Mayall telescope at the Kitt Peak National Observatory in Arizona is shown by comparison of these two photos of the Trifid nebula. The one on left was taken by Kitt Peak's 80-inch telescope and required 60 minutes exposure. The one on right, taken by the new 158-inch instrument, required 18 minutes exposure. It is among the first astronomical photographs taken by the new telescope. The telescope (SN: 3/10/73, p. 149) will be dedicated in ceremonies June 19-20 in Tucson.

A 10-laser system for fusion research

One of the newest ideas in thermonuclear fusion research is to use a laser to induce fusions among the nuclei in a pellet of fuel. A year ago a group from the Lawrence Livermore Laboratory announced a scheme for laser-induced fusion whereby a fuel pellet would be irradiated simultaneously from all sides to produce by implosive compression the conditions necessary for fusion (SN: 5/20/72, p. 328). Now the laboratory announces plans to build a $20 million, 10-laser system for use in such a scheme.

Each of the 10 lasers would have an energy of 1,000 joules, which is already several times that of any known laser with the other characteristics necessary for fusion work. Together they would deliver 10,000 joules to a fuel pellet at the same instant. At a conference on laser engineering and applications at Livermore last week, John Trenholme of LLL described design concepts for a 1,000-joule prototype.

The prototype will have glass mixed with neodymium as the lasing material. (At the moment only neodymium-glass or carbon dioxide seems capable of producing the energies required. The Los Alamos Scientific Laboratory is working on carbon dioxide.) The Livermore laser would be 40 feet long. It would have six light-amplifying units with neodymium-glass disks of nearly elliptical shape ranging in size from two by three and a half inches to one by two feet. (The largest neodymium-glass disks now used are about five inches in diameter.) Each of the largest disks will require 250 cubic inches of glass, which has to have optical properties accurate to one light wavelength—a precision comparable to that of an astronomical telescope. The laser's pulses will last one ten-billionth of a second, giving it a power of 10 million megawatts.

A building to house the unit is under construction at Livermore and is expected to be completed in less than a year. Meanwhile a request for $9.7 million to start the 10-laser facility is contained in the current Federal budget. □

Australians report two possible black holes

Some astrophysicists believe that the condensed component in some X-ray binary sources may be a black hole. At least two candidates for such status have been noted in the past year (SN: 1/13/73, p. 28). Now from Australia come more possible candidates: A report from Mt. Stromlo Observatory given at a meeting of the Australian Society of Astronomers suggests the source 2U0900—40 and possibly source 2U1700—37.

Whether or not such an object is a black hole depends on its mass. If the mass is less than a certain limit it will instead be a neutron star. The amount of the limit varies from one to several times the mass of the sun, depending on how it is calculated. The mass of 2U0900—40's condensed object is calculated to be between 2.6 and 3.1 solar masses, which would make a borderline case in many astrophysicists' estimation. □