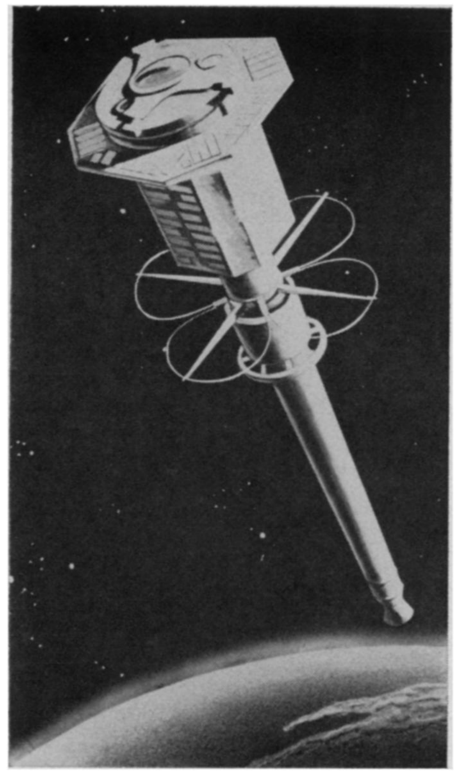
A Science in Search of Itself

Gamma-ray astronomers so far have little data but are convinced their wavelength will pay off.

by Ann Ewing



NASA

Explorer II counts rays from space.

Gamma-ray astronomy is struggling to become a science.

Since the possibility of detecting gamma rays from space was first suggested in 1958, there has been a growing interest in the field, but results have been limited.

Gamma rays, carrying no electric charge, are unaffected by magnetic fields in space and, therefore, do not swerve in their travels. Thus they can give undistorted information directly related to the physical processes causing them—an inviting prospect for scientists interested in high energy reactions.

In many ways, the results of all experiments performed to date to detect gamma rays from space have been disappointing. As an astronomical field, it is still in its infancy, and has not come of age as have both X-ray (SN: 7/1) and ultraviolet astronomy (SN: 5/27).

No discrete astronomical source of gamma rays has yet been pinpointed, although all of the likely candidates—strong emitters of radio, optical and X-radiation—have been scanned from the Northern Hemisphere, and others are now being looked at in the southern sky.

Gamma rays, a familiar and deadly result of nuclear explosions, are extremely pentrating electromagnetic radiation. They have a much higher frequency and, therefore, more energy than light waves or even X-rays, being about 1,000 times as energetic as medical X-rays.

To observe primary gamma radiation, it is necessary to place instruments above all or most of the earth's atmosphere, either by balloons, rockets or satellites.

Since gamma rays are not charged, and are beyond the visible spectrum, they cannot be measured directly but only by studying their interactions with matter. The study is complicated by the fact that these interactions must be clearly identified as having resulted from gamma ray impact, in an environment that contains thousands of other types of particles, including secondary gamma rays produced by reactions in the atmosphere.

Gamma rays are, therefore, detected with devices that selectively record an image each time a gamma ray interacts with the material in the detector to form a negative or positive electron. The observing instrument can be either a spark or bubble chamber, or possibly a cloud chamber or nuclear emulsion in which other particles are screened out.

Scientists know many ways in which gamma rays can be generated; by collisions of electrons with photons of light or with a gas, or by the collisions of high energy protons with gas.

Gamma rays can also be produced by the fusion of neutrons and protons to form deuterium. This interaction and other processes of nuclear synthesis may be important at the time of a supernova, which could then be a powerful gamma emitter.

If even a small fraction of the gamma radiation resulting from the burning of hydrogen after a supernova has imploded can penetrate through the surrounding material, a very large burst of gamma rays should be observed during the first hour or so. However, supernovas are rare, only about one every 100 years within any galaxy.

Some scientists have speculated that the intensity of gamma rays, as well as of X-rays, from supernovas within the Milky Way could be sufficiently high to cause genetic changes not only in human beings but also in plants and animals. Though supernovas within the Milky Way galaxy have been observed, the intensity of gamma rays reaching earth from such an event cannot be easily calculated.

One of the most definitive experiments during which gamma rays have been sought was also the first from a satellite, Explorer 11 launched April 27, 1961, in a 300- to 1,000-mile orbit. It contained a gamma-ray telescope designed and built by two Massachusetts Institute of Technology physicists, Drs. William L. Kraushaar and George W. Clark.

Neither the satellite instrument nor any of the more recent experiments have given positive evidence of gamma rays originating beyond the solar system.

But on the basis of other measurements, Dr. Carl E. Fichtel of the National Aeronautics and Space Administration's Goddard Space Flight Center, Greenbelt, Md., and his co-workers, have set the upper limit to gamma radiation as less than one gamma ray impinging on one square inch of earth's area per day.

Scientists attending the American Physical Society meeting in Washington in April 1966 were told that a point source of gamma rays had been discovered by University of Rochester cosmic ray physicists, who called it Cygnus GR-1. Excitement concerning the discovery was shortlived, however, since the team decided a few months later that the statistics were not as reliable as had been thought.