ASTRONOMY

Quasars Are 'Crazy'

Quasars are newly discovered heavenly objects, rating the "mostest." They are the most distant, brightest, most violent, heaviest and most puzzling sources of light and radio waves.

By ANN EWING

➤ QUASARS, newly discovered heavenly objects, are believed to hold a key to the structure of the universe.

Even if they did not promise this clue, however, the fascinating quasars would be eagerly studied by astronomers because they are the "mostest." They are the most distant, brightest, most energetic, heaviest and most puzzling sources of radio and light waves yet found.

Perhaps one-fourth to one-third of all the objects in the sky sending out radio waves are quasars, although only a dozen have so far been positively identified with visible sources.

Scientists now believe gravitational collapse gives these peculiar objects their tremendous energies. The power given off by a quasar is 100 times the total energy output rate of a giant galaxy, yet each object is one-sixth the size of a galaxy, or less.

Appear as Point Source

Quasars appear star-like in photographs, not fuzzy around the edges as a galaxy does. Their very ordinary appearance helped to delay their discovery, since most astronomers took them to be ordinary faint stars with which the sky is peppered.

The name quasar is an abbreviation of "quasi-stellar," which is what the radio sources were first called because they were neither stars nor galaxies. A typical galaxy is a vast collection of a hundred billion or so stars, with a mass equal to that of some hundred billion suns.

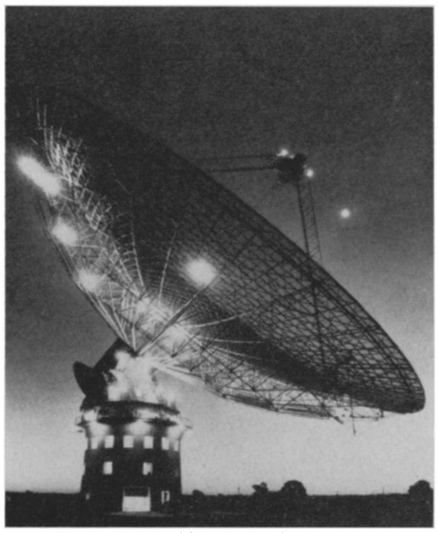
Gravitational collapse can occur when the core of such a galactic mass—perhaps a million to a hundred million stars—is packed into a relatively small volume of space, such as a few hundred light years, one light year being six million million miles.

The reason for suggesting gravitational collapse is that no one has yet been able to think of another method that would result in the overly generous outpouring of energy that quasars radiate.

They are believed to have maintained the rate of 100 times that of a galaxy for at least a million years. This is an extremely short lifetime on an astronomical scale. The sun, for instance, has an estimated lifetime of ten billion years.

If a quasar is collapsing, then it is likely that the gravitational fields on its surface are so strong that only Einstein's general theory of relativity can be used to describe what is occurring.

Astronomers have known for many years that there were definite "hot spots" in the sky, from which extremely high energies in radio waves were being emitted. However, most of these hot spots could not be connected with visible stars or galaxies.



Australian News and Information Bureau

LISTENING TO QUASARS—This powerful radio telescope, 210 feet in diameter and the second largest steerable antenna in the world, has been tuning in on radio waves from the strange heavenly objects called quasars. It works both night and day. The moon can be seen in the upper right in this nighttime photograph.

The reason for this was that radio telescopes, even the very largest, do not give a sufficiently accurate position of a radio source so that optical astronomers can point their telescopes at the desired location. Large telescopes, especially the 200-inch giant atop Mt. Palomar in California, have such a narrow field of view that they must be aimed precisely to photograph the correct object.

A way out of this impasse was seen by Dr. Cyril Hazard, who was then working in England at the University of Manchester's Jodrell Bank, where the world's largest steerable radio telescope is located. He suggested that as the moon passed in front of some of these radio sources, their position could be determined very accurately since the moon's position is precisely known.

He did this first for the source called 3C-212. The 3C stands for the third Cambridge University (England) catalogue of radio sources, which contains about 500 listings.

Dr. Hazard then moved to the University of Sydney. With his co-workers, including scientists from the Commonwealth Scientific and Industrial Research Organization, also in Sydney, he used the new Australian radio telescope, 210 feet in diameter and the world's second largest, to check on the exact positions of other sources as their radio waves were blotted out when the moon passed between them and earth. The first quasar for which this was done was 3C-273, which has been the most extensively studied source, with 3C-48.

The scientists have now found accurate positions for several more of the strong radio sources, bringing the total to a dozen quasars, most of which have been identified with a faint light source.

A quasar's light is faint only because the object is several billion light years away. Actually quasars are the brightest objects known.

All quasars so far identified have been pinpointed in photographs taken by the 200-inch Hale telescope.

Scientists are now fairly sure that most, if not all, of these objects are among the most distant yet found. One of them, 3C-147, has a measured red shift of 54.5%, the largest known. This makes it the farthest-away object thus far located, a large fraction of the radius of the universe.

Indeed, 3C-147 is so far away that astronomers hesitate to give a figure in light years, believing that the usual relationship of red shift and distance may not hold true over such vast spaces. Red shift is the displacement of spectral lines toward the red caused by movement of the light source away from earth. The relationship that has previously held is the greater the shift, the farther the distance.

Although a definite distance cannot be quoted for 3C-147, there is little doubt that it is several billions of light years away. This means that observations of the universe have now been extended to include a large fraction of the space and matter that can be seen.

Because of this, many astronomers believe it should soon be possible to tell the structure and nature of the universe.

Origin of Universe

As of now, scientists cannot decide between three theories concerning the origin of the universe:

1. An explosive beginning and a continuing expansion.
2. A steady state, in which matter is continuously being created.
3. An alternately expanding and contracting, or pulsating, universe.

One of the most puzzling features of at least two of the quasars is that their brightness varies regularly. Studies of old photographs have shown that this rhythmic pulsation occurs every 13 years for 3C-273. For another quasar, the brightness has been observed to change within a year.

The puzzle is how such pulsations over a large body can take place in much less time that it takes light to travel across it.

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