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## UNUSUAL SATELLITE DATA - A BLACK HOLE?

Data from an American-British-European satellite, the International Ultraviolet Explorer (IUE), suggest the possibility of a massive black hole at the center of some groups of stars in our Galaxy called globular clusters.

Six of these clusters, three of them X-ray sources, have been the subject of close examination by a group of scientists headed by Dr. Herbert Gursky and Dr. Andrea Dupree, both of the Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass.

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IUE was launched by NASA into a modified synchronous orbit near the equator last January, in cooperation with the European Space Agency (ESA) and the British Science Research Council (SRC), to study a wide range of celestial objects in the ultraviolet (UV), one of the most important regions of the electromagnetic spectrum.

Dr. Gursky says the onboard ultraviolet instrumentation provided surprises for him and his colleagues by being able to penetrate the background denseness of the clusters 15,000 light years away - a light year is the distance light travels in one year, 9.5 trillion kilometers (six trillion miles) - so that they could actually see to the core.

What they see there, according to Dr. Gursky, is probably radiation from a group of 10 to 20 bright blue stars that orbit the core. He says: "These stars may well be orbiting a massive black hole the size or mass of one thousand solar systems."

However, Gursky emphasizes that the existence of a black hole is by no means certain; the dynamics of the stars must be studied first to see how they rotate in relation to the center of the million-star cluster. This may give a better indication of what it is that provides the necessary gravitational pull that holds them in orbit.

If the stars are indeed orbiting a massive black hole, Dr. Gursky believes they are right on the edge of it. If not, they may be providing their own gravitational equilibrium.

A black hole is a star or group of stars which have undergone gravitational collapse to the point where neither light nor matter can escape (see glossary).

What surprised the observation team, says Dr. Gursky, was the fact that the short-wavelength instrumentation could so clearly cut through the million-star cluster.

He said: "For the first time we are seeing in a clean way the center or core of those globular clusters and we were surprised. You can see the clusters in visible light, there are lots of red giant stars there, which mask what is going on in the center. Now we have a tool, IUE's shortwave Ultraviolet, capable of going for the first time right to the core through the whole cluster."

Dr. Gursky says they will continue to observe the six globular clusters, which are like miniature galaxies. However, he feels they won't get a definite answer until NASA's Space Telescope is placed in orbit from the Space Shuttle in 1983. This telescope will be able to use much more powerful instrumentation, including the short wavelength of the ultraviolet spectrum, to study the blue stars in more detail.

Whether massive black holes are indeed at the center of the clusters is an open question, but astronomers generally agree that the concept of black holes helps them explain puzzling phenomena in the universe that cannot be explained in any other way.

For example, how else could one explain the dynamics of the strong X-ray source, Cygnus X-1, a binary star system composed of a visible and invisible companion star? The X-rays are generally interpreted as coming from the system as the result of a companion star, a black hole that is compressing material from the visible star's atmosphere prior to its complete disappearance into the black hole. The Cygnus X-1 black hole was estimated to be 10 times the mass of our Sun, but less than one millionth of its diameter.

Recently, another team composed of Princeton University and University College, London, astronomers announced they had used NASA's Copernicus satellite to find what appears to be a black hole in the constellation Scorpio. Copernicus, managed by NASA's Goddard Space Flight Center in Greenbelt, Md., was launched from Cape Canaveral, Fla., in 1972.

A paper on the Gursky team results was given at a meeting of the American Astronomical Society at the University of Wisconsin, Madison, last month (June 28), by Dr. L. W. Hartmann, of the Center for Astrophysics. Other members of the investigating team are: Dr. J. H. Black, University of Minnesota; Drs. R. J. Davis and J. C. Raymond, all of the Center for Astrophysics, and Dr. T. A. Matilsky, of Rutgers University.

Goddard Space Flight Center is responsible for the design, integration and testing of IUE, and provides the U.S. ground support facilities. ESA built the solar array and the Madrid ground facilities. Britain's SRC, in collaboration with University College, London, provided the four television camera detectors for transforming the spectral displays into video signals for transmission to the ground.

(END OF RELEASE. BACKGROUND INFORMATION FOLLOWS.)

A photograph to illustrate this news release will be distributed without charge only to media representatives in the United States. It may be obtained by writing or phoning:

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ASTRONOMICAL GLOSSARY

Black Holes

Believed to be the final stage in the collapse of a dying star which was very massive. The collapsed star's material is so densely packed -- even more so than a neutron star -- and the gravitational force so great that even light waves are unable to escape from the surface of a black hole.

All external evidence of its presence disappears.

Because black holes emit no light or other radiation, their existence -- predicted by the laws of relativity -- cannot be confirmed by direct observation, but it can be inferred. Astronomers have identified a powerful X-ray source in the constellation Cygnus. Some suspect the source, which has been labeled Cygnus X-1, may be just such a black hole.

## Globular Clusters

Globular clusters are in effect miniature galaxies, each containing tens of thousands of tightly packed stars. They are found outside the plane of the galactic disk in the surrounding region of space known as the galactic halo. Our galaxy contains at least 150 globular clusters, scattered at random throughout the spherical volume of the halo. All globular clusters are believed to be very old, nearly as old as the galaxy. According to one theory, the globular clusters were the first stars to appear in the galaxy, but were left outside the disk as the parent cloud from which our galaxy was formed contracted. Since the galaxy is believed to be about 10 billion years old, that must also be the age of the globular clusters.

## Pulsars and Neutron Stars

Discovered in 1967, pulsars emit radio signals whose pulsations are extremely precise. The evidence suggests that pulsars are fast-spinning neutron stars.

These are compact bodies of densely packed neutrons (atomic particles having no electric charge), believed to form when a large star burns up its fuel and collapses. Containing the mass of a star in a sphere 10 miles in diameter, they are so closely packed that a spoonful of material from the center would weigh a billion tons. A neutron star, or pulsar, has been located in the center of the Crab Nebula, a glowing cloud which is still expanding from a supernova reported by the Chinese in 1054.



### Red Giant

An aging star approaching the end of its life is called a Red Giant. The beginning of the end comes when the star has exhausted much of the hydrogen near its core and starts to burn the hydrogen in its outer layers. This process causes the star to gradually turn red and swell to 100 times its previous size, pouring out prodigious amounts of energy. Betelgeuse, in the constellation Orion, is such a red giant visible to the naked eye. What happens after its hydrogen is consumed depends on the size of the star. A small star contracts and becomes a white dwarf. A large star becomes a supernova, blowing its innards into space.