National Aeronautics and
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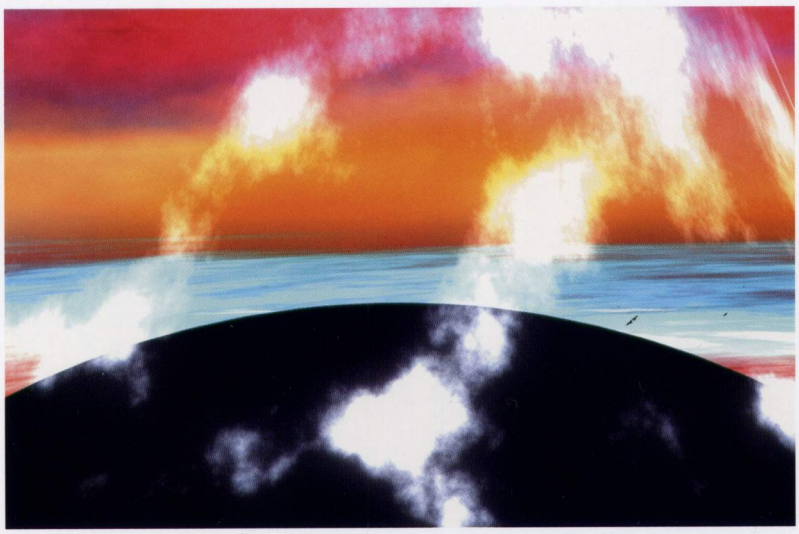
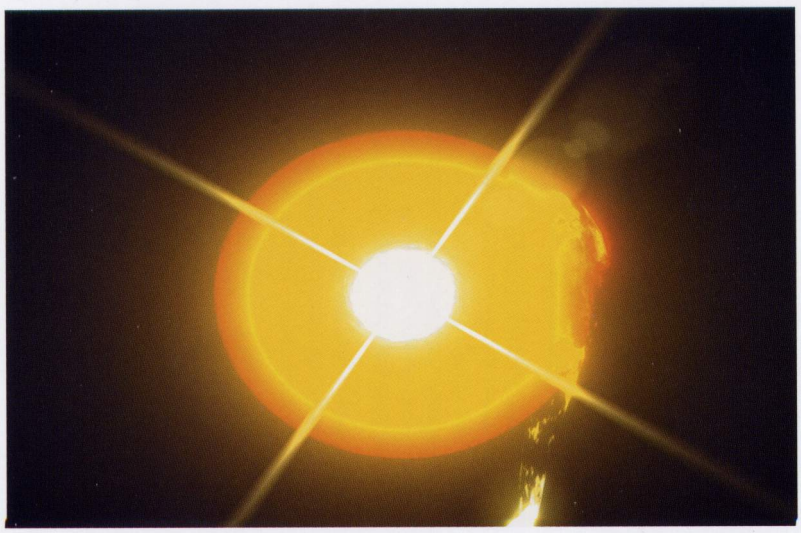
New Class of Mysterious Gamma-Ray Objects Discovered





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When we gaze into the night sky, the faint stars reveal only a small fraction of the light in the heavens. Celestial objects also shine in an invisible palette of colors unknowable to us because the light can't be seen by the human eye. However, this unseen light can be detected by sophisticated instruments placed in spacecraft and in telescopes on the ground.

By viewing the universe in this new light, we have fathomed some of its deepest secrets, as well as discovered new mysteries. An example is the field of gamma-ray astronomy. Gamma rays, although invisible to the human eye, are in fact the most powerful form of light, far more energetic than visible light, ultraviolet radiation and X-rays.

The exotic world of gamma-ray astronomy took another surprising turn with the revelation that half of the previously unidentified gamma-ray sources in our own galaxy, the Milky Way, actually comprise a new class of mysterious objects. The gamma rays emitted by these mystery objects are a hundred million times more powerful than visible light.

Of the 120 unidentified gamma-ray emitting sources in our galaxy, about half lie in a narrow band along the Milky Way plane. These may be well-known classes of objects that simply shine too faintly in other types of light to identify. The other half of the unidentified galactic sources are closer to Earth and make up the new class. These lie just off the Milky Way plane and seem to follow the Gould Belt, a ribbon of nearby massive stars and gas clouds that winds through the Milky Way plane.

What objects could be emitting gamma rays in the Gould Belt? Possibilities are black holes acting as particle accelerators, the massive stars themselves, and clusters of oddball pulsars, among other theories.

This sequence of images is taken from a computer animation illustrating one of these possibilities: black holes in our galaxy could be a source of mysterious gamma-ray glows near the galactic plane. A black hole is an object with gravity so strong that nothing, not even light, can escape once it crosses the black hole's point of no return, called the event horizon. However, some matter can escape if it merely passes close to the event horizon without crossing it.

In the first picture (top), the event horizon is the black spherical surface at the bottom. Gas (in white) is swirling around the event horizon at high speed, accelerated by the black hole's tremendous gravity. Particles in the gas collide violently with each other, releasing gamma rays.

The second picture (middle) pulls up and away from the black hole, revealing the accretion disk in white, blue, and red, which is material spiraling into the black hole like soap suds swirling around a bathtub drain. The black hole is in the center of the accretion disk, with a jet of gas, represented by a white streak, streaming away from it toward the top of the image. When black holes swallow large amounts of matter, they are sloppy eaters, often ejecting jets of material from their poles at high speed. This process is poorly understood, but the gamma rays are produced by high speed collisions between particles in the jets.

In the third picture (bottom), the observer has moved so that the line of sight is directly down one of the jets. Like looking directly into a searchlight beam, the intense gamma-rays flare brightly, outshining the accretion disk. If some black holes in our galaxy are oriented so that one of their jets is pointed directly at us, we would see it as a bright, gamma-ray glow. This is why scientists believe one possibility for the gamma-ray objects in our galaxy may be black holes with a jet pointed our way.

These new objects were discovered using NASA's Compton Gamma-Ray Observatory spacecraft, launched aboard the Space Shuttle Atlantis on April 5, 1991. The highly-productive spacecraft exceeded its expected mission life by four years, and it will be guided to a controlled reentry over the Pacific ocean in the summer of 2000. Compton was part of NASA's Structure and Evolution of the Universe (SEU) science theme.

RELATED WEB LINKS

Information about the Compton Gamma Ray Observatory:
http://cossc.gsfc.nasa.gov/cossc/PR.html

How gamma radiation is generated in the Universe:
http://imagine.gsfc.nasa.gov/docs/introduction/gamma_generation.html

How gamma rays are related to other types of light:
http://imagine.gsfc.nasa.gov/docs/introduction/emspectrum.html

More about black holes and gamma-ray bursts:
http://imagine.gsfc.nasa.gov/docs/science/science.html

SCIENTIFIC NOTABLES

http://imagine.gsfc.nasa.gov/docs/teachers/blackholes/starchild/page17.html

The following activity is designed as practice with the use of scientific notation.

Working with large numbers such as galactic distances can be very timeconsuming. It is often more useful to express large numbers in terms of powers of 10 known as scientific notation.

Example: 1,000,000 = 1.0x106 (106 means 10x10x10x10x10x10 =1,000,000)

Notice that the decimal place has been moved 6 places to the left leaving only 1 number in front of the decimal.

1. The Sun is 150,000,000 kilometers from Earth. Convert 150,000,000 into scientific notation.

2. One light-year equals 9,500,000,000,000 kilometers. Convert 9,500,000,000,000 into scientific notation.

IMAGE CREDIT: NASA/Honeywell Max Q Digital Group, Dana Berry

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