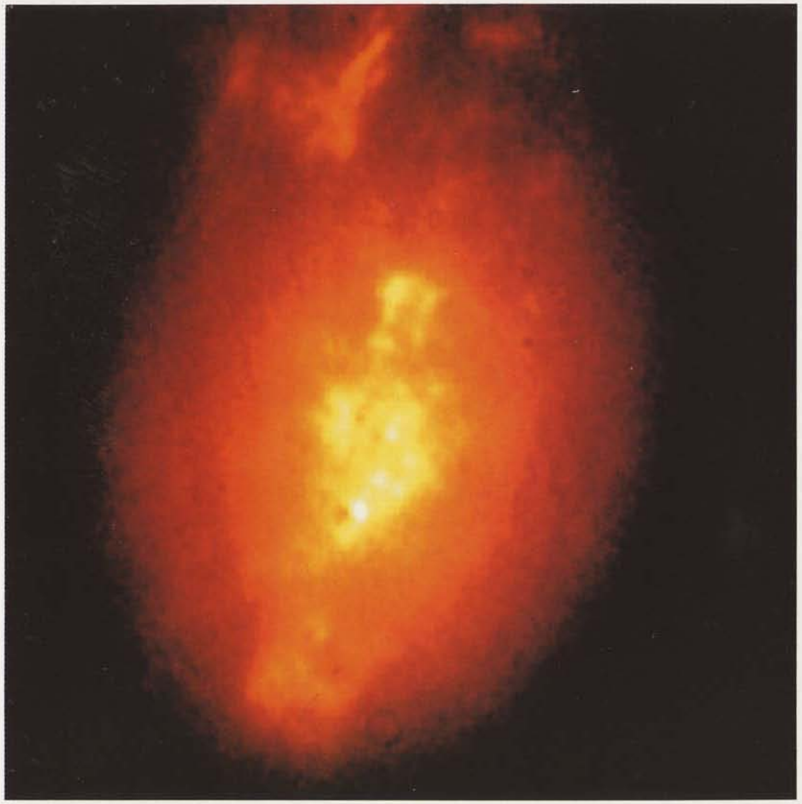
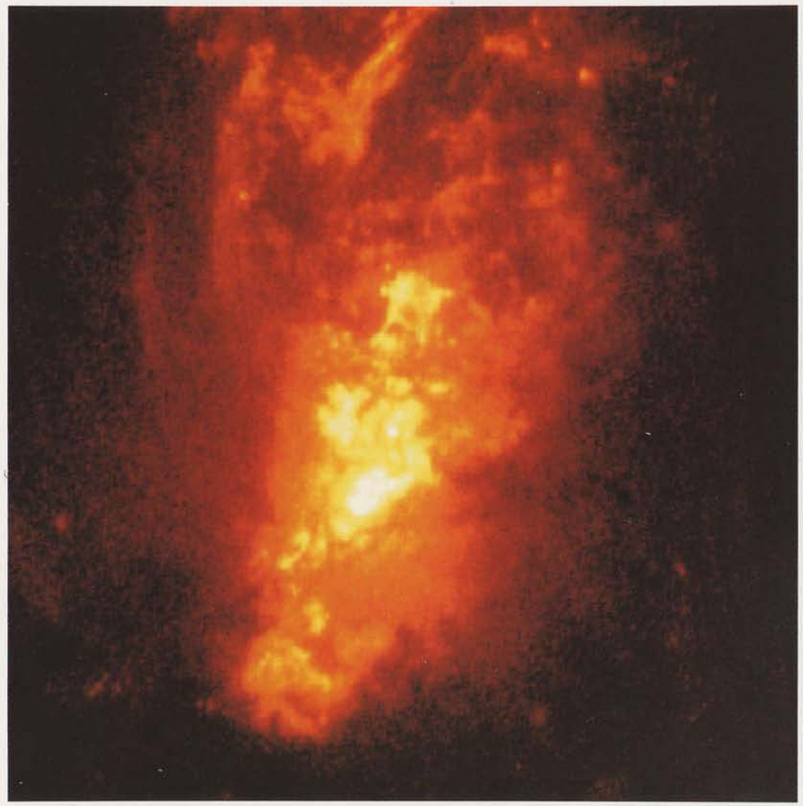
National Aeronautics and
Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Hubble's Improved Vision Reveals Central Region of Active Galaxy



Faint Object Camera (FOC) image
before servicing mission



COSTAR-improved FOC image
after servicing mission

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Hubble Reveals Central Region of Active Galaxy

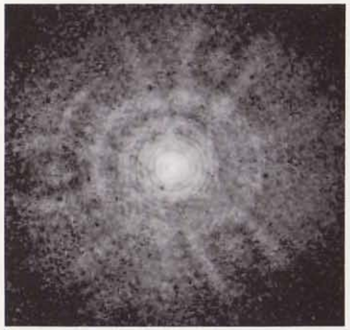
On the front: NASA's refurbished Hubble Space Telescope (HST) has provided this outstanding image of the nuclear region of the galaxy NGC 1068. This galaxy is about 60 million light-years away and is the prototype of a class of active galaxies known as Seyfert Type 2. An active galaxy's core shines with the brightness of a billion solar luminosities and fluctuates over the period of a few days, inferring that energy is being released from a region just a few light-days in size. The most likely source for this enormous amount of energy is a supermassive black hole with a mass of 100 million stars like the Sun.

Front left: Previous observations with HST's Faint Object Camera (FOC) showed a number of hot gaseous clouds ionized, or heated, by the intense radiation from the nuclear source. This diverging beam of emission, or "cone," is caused by the shadowing effect of the radiation of the active nucleus by opaque gas and dust clouds orbiting the suspected black hole.

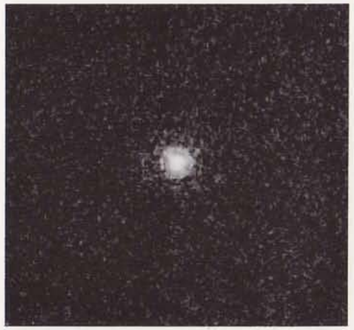
Front right: A view of the same field with the corrected FOC, whose vision has been improved by the mirrors in the Corrective Optics Space Telescope Axial Replacement (COSTAR) that astronauts installed during the STS-61 HST First Servicing Mission in December 1993. The new observations show with unprecedented clarity a much more extensive double cone of emission, believed to be shaped by radiation from the active nucleus. A wealth of new detail also is revealed in this core region. The knots and streamers of emission will enable the geometry of this core region to be understood and will offer new information on the nature of the clouds.

The FOC was provided by the European Space Agency (ESA). COSTAR was developed by Ball Aerospace of Boulder, Colo., under contract to Goddard Space Flight Center in Greenbelt, Md. Hubble is managed by Goddard for the Office of Space Science at NASA Headquarters in Washington, D.C.

The HST servicing mission was carried out from the Space Shuttle, Endeavour, which flew into space December 2, 1993, from Kennedy Space Center in Florida and returned to Earth on December 13. The 11-day mission featured a record five spacewalks to service HST.



Before COSTAR



After COSTAR

NEW OPTICS RESTORE HUBBLE'S VISION
Above left: An FOC image of a star taken prior to the HST servicing mission. Spherical aberration causes the broad halo around the star.
Above right: Following deployment of COSTAR, the FOC fully meets its pre-launch expectations. Most of the starlight now is concentrated at the center of the image, and the blurry "skirt" of light is completely gone. This gives HST dramatically improved sensitivity and ten times better resolution than ground-based telescopes.

For The Classroom

The Corrective Optics Space Telescope Axial Replacement (COSTAR) uses mirrors to correct the light from the telescope mirror before it reaches the scientific instruments.

Why would scientists use mirrors instead of lenses to make the corrections?

The mirrors in COSTAR are small, about the size of a nickel. One of each pair of mirrors (M1) is a relatively simple concave spherical shape. The other mirror of a pair (M2) is more complicated – it is described as similar to a potato chip.

Have students experiment with mirrors:

What happens to your image when you look into a concave mirror?
What happens to your image when you look into a convex mirror?
What happens to your image when you look into two mirrors taped at right angles to each other?

Have students try mirror writing: Write a word on a piece of paper. Stand a mirror on the paper so that the letters are reflected in the mirror. Copy the reflected word on another piece of paper. Ask a friend to read the word. This should prove difficult because the letters are upside down and back-to-front. Hold a mirror so that the word will be reflected and appear normal.