Hubble Facts

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771
(301) 286-8955

FS-2002-1-034-GSFC

The NICMOS Cryocooler:
REACTIVATING A HUBBLE INSTRUMENT

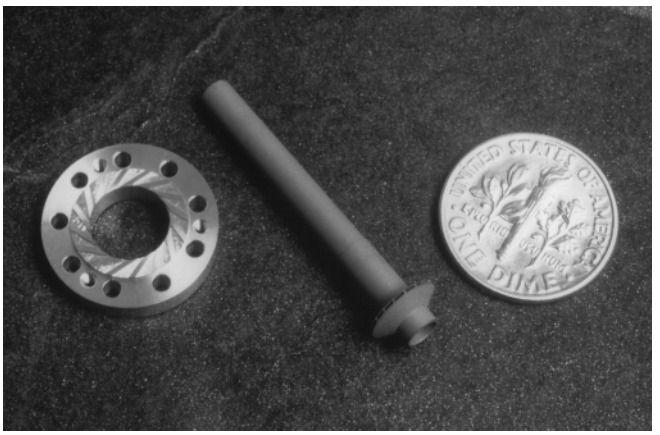
The Near Infrared Camera and Multi-Object Spectrometer (NICMOS), dormant since January of 1999, will be reactivated by a high tech cooling system, the NICMOS Cryocooler.

Installed on Hubble in February of 1997, NICMOS used infrared vision to probe dark, dusty, never-before-seen regions of space with the optical clarity that only Hubble can provide. Its infrared detectors operated at a very cold temperature (minus 352 degrees Fahrenheit, which is minus 272 degrees Celsius, or 60 degrees Kelvin). To keep the detectors cold, NICMOS was encased in a thermos-like container filled with solid nitrogen ice. Unfortunately, the nitrogen ice was consumed more quickly than planned due to a very small heat leak. In anticipation of this shortened lifespan, NICMOS's subscribed observations were tripled in order to get the most usage of this instrument before it ran out of coolant. In 1999—with its supply of ice exhausted—NICMOS became dormant.

Teamwork and a Tiny Turbine

Scientists and engineers at NASA's Goddard Space Flight Center in Greenbelt, MD, devised a way of adding a new, high-tech refrigeration device to NICMOS to re-cool its detectors and other components. The Hubble team developed the NICMOS Cryocooler—a state-of-the-art, mechanical, cryogenic cooler that is expected to return NICMOS to active duty.

Using non-expendable neon gas as a coolant, this closed system delivers high cooling capacity, extremely low vibration and high reliability. It employs a miniature cryogenic circulator to remove heat from NICMOS and transport it to the cryocooler. The system uses a tiny turbine turning at up to 400,000 rpm (over 100 times the maximum speed of a typical car engine). The NICMOS Cryocooler is virtually vibration-free—which is very important for Hubble. Vibrations could affect image quality in much the same way that a shaky camera produces blurred pictures.



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The new cryogenic system is expected to re-cool the NICMOS infrared detectors to about minus 334 degrees Fahrenheit (minus 203 degrees Celsius or 70 degrees Kelvin). This is an ideal temperature for the detectors and will make NICMOS more sensitive to incoming light, thereby allowing it to collect more light. Engineers expect it to increase the life span of NICMOS to more than 5 years.

Fast Track to Reality

In 1998, the Hubble team successfully demonstrated this new cooler technology aboard the Space Shuttle

Discovery on STS-95. This was the first on-orbit test of a high performance, high efficiency, mechanical cryocooler. The test took place less than 18 months after development began—an extremely short time for successfully developing a new space technology.

Retrofitting NICMOS with the new cryocooler will more than double its lifetime—ensuring a greater scientific return on the original investment. This revolutionary technology paves the way for exciting advances in infrared astronomy on Hubble and beyond.

Earthly Applications

In the case of NICMOS, the cryocooler is replacing the solid nitrogen cooler that originally encased the instrument. But this advanced type of cryocooler can replace both liquid and solid nitrogen-based cooling systems—on Earth as well as in space.

The cyrocooler offers earthly benefits in electronics manufacturing, medical imaging, and magnetic field detection. One particularly important application is in brain imaging. Magnetic encephalograms, which measure brain waves, allow doctors to determine if the various parts of the brain are functioning properly. This new cooler technology could make such brain imaging equipment more "user friendly," compact and affordable.

FOR ADDITIONAL INFORMATION CONTACT:
Nancy Neal
Goddard Space Flight Center
Office of Public Affairs
(301) 286-0039