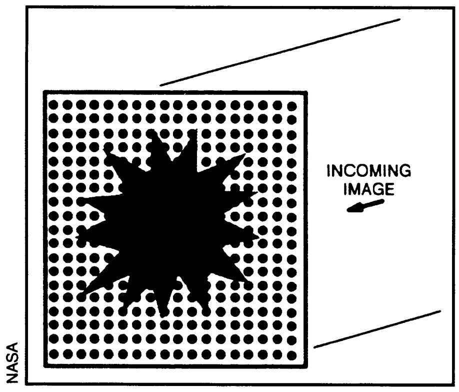
Glitches Trouble Hubble's New Camera



Drawing depicts an image from one of the four electronic light detectors on Hubble's wide-field and planetary camera.

Four months after astronauts replaced the Hubble Space Telescope's main camera with a newer model, scientists are down to the nitty-gritty of monitoring the camera's behavior as it points at distant stars and galaxies. But Hubble scientists discovered more than a month ago that two problems with the electronic light detectors on the wide-field and planetary camera could weaken some Hubble observations, SCIENCE NEWS has learned.

The signals produced by the camera's four charge-coupled devices (CCDs) in response to incoming starlight vary by as much as 10 percent. Specifically, faint stars of intermediate brightness appear about 10 percent dimmer if they are imaged at the top of any of the CCDs rather than at the bottom, says Hubble investigator John J. Hester of Arizona State University in Tempe.

This variability won't prevent the camera from imaging Cepheid variable stars in distant galaxies, a much-touted project that will provide better estimates of the age and size of the universe, Hester says. But imaging isolated stars or galaxies — those that have only a dim background — in order to analyze their true brightness may prove more difficult, he adds.

NASA may delay such observations until researchers fully understand how to correct for or diminish the variation, says Hubble senior scientist David S. Leckrone of NASA's Goddard Space Flight Center in Greenbelt, Md.

A second, though lesser, concern focuses on the behavior of individual CCD picture elements, or pixels, damaged by cosmic rays or other energetic radiation in space. Radiation damage causes a small percentage of pixels to emit higher-than-average amounts of "dark current" — a spurious signal produced even when no light falls on the detector.

Astronomers expect such damage and routinely subtract the unwanted dark current to obtain an accurate CCD image, Hester notes. But in monitoring damaged pixels on the new camera, Hubble scientists have found that the dark current produced by these elements varies over time. This may force the researchers to measure dark currents every few days rather than once a month, Hester says.

The camera's special optics, which correct for Hubble's infamous optical flaw, continue to produce spectacularly sharp images, NASA scientists emphasize. "We're still blowing people away with the data we're getting," Hester says.

John Trauger of NASA's Jet Propulsion Laboratory in Pasadena, Calif., who led the new camera's design team, says the recent findings merely indicate the need for further calibration of the camera and should not pose a problem for observers. "Everything we've seen has a solution," he asserts. "When you launch an instrument, you need to allow time to learn about how it behaves in the environment of space," he notes.

Trauger says that periodically warming the CCDs to room temperature should restore most of the radiation-damaged pixels to their original state. He adds that NASA plans to operate the camera at about 10°C colder than its current operating temperature of −78°C. Past experience indicates that this should dramatically reduce the variability of dark current and lower the top-to-bottom variation of the CCDs.

However, colder temperatures may make it easier for contaminating material to deposit on the CCDs, reducing sensitivity to the ultraviolet.

Hester admits to feeling "a bit embarrassed" that extensive ground testing failed to identify the spatial variations in the CCDs. But he says that if testing had revealed the problem, the most likely solution — running the solid-state detectors at a colder temperature — would remain the same.

Hester notes that although the CCDs on the old wide-field and planetary camera had similar sorts of problems, they received less attention than the overriding issue of Hubble's blurry optics.

It's because of Hubble's successful repair that the detailed behavior of the CCDs now makes a difference, he says.

— R. Cowen

Brain images reveal cerebral side of music

The world may seem brighter with a song in your heart, but what's in your head? Scientists using imaging technology have begun to illuminate how a melody makes a musical impression in the brain.

Brain areas involved in hearing, recall, and even vision — particularly those in the right hemisphere — coordinate musical perception and memory, say Robert J. Zatorre, a neuroscientist at the Montreal Neurological Institute, and his colleagues.

"Depending on how musical information is being processed, one or more sets of brain regions may be activated," Zatorre argues.

His group studied 12 right-handed adults, none of whom had played music professionally. Volunteers underwent positron emission tomography (PET) scanning as they performed four tasks: listening to a sequence of noise bursts; listening to a series of unfamiliar, eight-note melodies; listening to the same melodies and determining whether the pitch of the second note was higher or lower than that of the first note; and listening to the melodies once more and noting whether the pitch of the last note rose or fell relative to the first note.

PET images recorded blood flow in participants' brains during each task. The researchers subtracted PET data on the first task from data obtained on the second task to isolate brain activity associated with listening to melodies. They then subtracted that information from the results of each of the pitch-comparison tasks to highlight activity linked to specific musical judgments.

Simply attending to melodies produced blood flow increases in the part of the brain's right temporal lobe that plays a role in hearing, as well as in an area at the back of the right hemisphere previously associated with vision, the researchers report in the April JOURNAL OF NEUROSCIENCE.

Since all volunteers kept their eyes closed during the trials, the latter finding may signify the generation of visual images, consciously or unconsciously, in response to the music, Zatorre suggests. Another PET study of musical perception observed no changes in visual structures (SN: 7/11/92, p.21).

Additional portions of the brain's outer and inner layers, again mainly on the right side, displayed blood-flow jumps during pitch comparisons. First and last note comparisons, which made the greatest demands on volunteers' memory, produced changes in the temporal lobe, suggesting the operation of a brain system devoted to short-term memory for sounds, Zatorre says.

— B. Bower