Hubble Facts

HST Program Office

Goddard Space Flight Center
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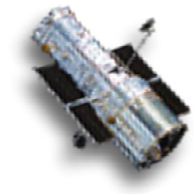


Space Telescope Imaging Spectrograph (STIS)

Essentials of the Instrument:

Installed on HST	**Feb. 1997 (SM2)**
Function	**High/medium/low resolution 2-D spectroscopy, imaging, coronagraphy**
__ range	**1150-10300 Å**
Optical Elements	**Gratings, filters, prism**
Detectors	**1024^2 MAMA (2), 1024^2 CCD**
Field(s) of View	**Wide variety of slit widths & heights for 25^2 and 52^2 arcsec MAMA, CCD fields of view**
Spectr. resolution	**R=500-1.1E5**
Enhancement factor over predecessor instrument (if any)	**512x over GHRS, FOS due to spatial multiplexing**
Cost	**$162M (FY00$)**
Current status/health	**Operational, but no electrical redundancy**

Capabilities of STIS

STIS is a highly efficient, all-purpose spectrograph with many available observing modes across nearly a decade of wavelength from the far-ultraviolet (FUV) to the far-red/near-infrared. In 1997 it introduced 2-D spectroscopy to HST and made programs previously infeasible (due to observing time limitations) achievable. STIS also contains limited imaging capability, as well as a coronagraphic mode. Tabulated below is a top-level listing of the instrument's spectroscopic modes. All

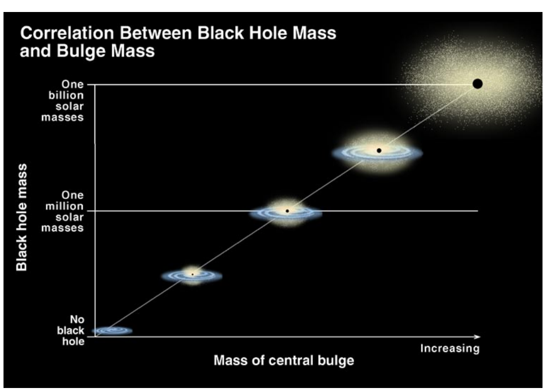
Grating	Sp. Range (Å)	Å Per tilt	Resolving power
G750L	5240-10270	5030	530-1040
G750M	5450-10140	570	4870-9050
G430L	2900-5700	2800	530-1040
G430M	3020-5610	286	5390-10020
G230LB	1680-3060	1380	620-1130
G230MB	1640-3190	1155	5470-10630
G230L	1570-3180	1610	500-1010
G230M	1640-3100	90	9110-17220
G140L	1150-1730	610	960-1440
G140M	1140-1740	55	11400-17400
E230M	1570-3110	800	30000
E230H	1620-3150	267	114000
E140M	1150-1710	620	45800
E140H	1150-1700	210	114000
Prism	1150-3620	2470	2900-25

gratings down to G230MB utilize the CCD detector, and those below feed either the FUV MAMA detector (G140L,M, E140M,H) or the NUV MAMA (G230l,M, E230M,H, prism). The "per tilt" column lists the wavelength coverage in a single exposure; rotation of a mechanism brings the next piece of spectrum onto the detector.

Several aspects of the detectors are noteworthy. The MAMAs are high-technology photon-counting devices developed specifically for low-noise FUV/NUV applications in the STIS science program, and were later used as proven heritage designs and spare hardware on ACS and COS. The CCD was coated to have sensitivity to as blue wavelengths as possible (< ~2000A) in addition to a near-IR response, to provide alternative observing modes in the NUV as well as backup capabilities should the NUV MAMA fail.

Science Highlights

The ability of the STIS long-slit to provide Doppler velocities simultaneously at separate space points in a galaxy's core has



been the key to the efficient detection and characterization of supermassive black holes (SBH) at the centers of galaxies using HST. STIS revealed that the SBH mass is tightly correlated with the mass of the stellar bulge of the parent galaxy, i.e., the birth/growth of SBHs is related to the properties of bulges.

STIS was the first instrument to measure the composition of an extra-solar planet's atmosphere when it detected sodium, and later an extended hydrogen exosphere, in the atmosphere of the Jovian-size planet revolving about the star HD209458.

STIS data have produced over 400 papers in the refereed scientific literature.

STIS Status and Prospects

STIS is performing nominally at the current time, and is carrying out the 23% of orbits allocated to it during the Cycle 12 observing program. Phosphorescence induced by particle radiation on the NUV MAMA detector window produces an undesired background which has been present since 1997 and is slowly increasing as the detectors warm along with other instruments in the telescope's aft shroud. The MAMA detectors themselves are performing nominally. The CCD detector is slowly degrading as a result of radiation particle hits over time. Specifically, the number of unannealable "hot pixels" is substantial and growing, and the pixel-to-pixel "charge transfer efficiency" during CCD readouts degraded from its initial state of ~0.99999 to ~ 0.9997 after the first 4.5 years on orbit.

The biggest threat to STIS lies not in its detectors, but in its electronics. All HST instruments are built with a fully redundant electronics chain—"Side 2"—in addition to the primary "Side 1." On May 16, 2001, STIS lost operations on Side 1, presumably to a shorted tantalum capacitor in a low-voltage power supply board. Operations were successfully restored on Side 2, and have continued uninterrupted ever since. However, STIS is now an electrically *no-fault-tolerant* instrument: there will be no return to Side 1 should Side 2 develop problems. However, there is no known specific threat to Side 2.