An Overview of the Active Photometric and Spectroscopic Modes on the Space Telescope Imaging Spectrograph

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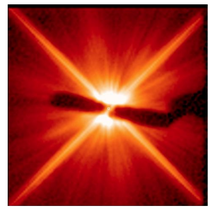
Abstract

The Space Telescope Imaging Spectrograph (STIS) is one of the oldest active instruments on the Hubble Space Telescope (HST). STIS was installed in 1997 and served the community until 2004, when it experienced a power failure. In 2009, it was revived during Servicing Mission 4 (SM4) and has been a productive scientific instrument ever since. In fact, it is responsible for a large fraction of total HST observing time (13% GO observations in cycle 24). STIS is an incredibly versatile and highly configurable instrument. Through numerous filters, gratings, and apertures, a large variety of unique photometric and spectroscopic modes provide access to high spatial resolution observations in the UV and optical wavelength regimes. This versatility ensures that STIS will have a continued vital role to play in UV and optical astronomy for years to come. In light of this, we provide an overview of the modes that are unique to STIS as well as those that may be of particular value to the astronomical community in upcoming cycles.

Coronagraphy

Currently, STIS contains the only operational coronagraph in space not trained on the Sun. The 50CORON Aperture consists of a number of occulting wedges and bars, including the recently commissioned BAR5 (seen right).



For more information on STIS Coronography, see Poster #443.17

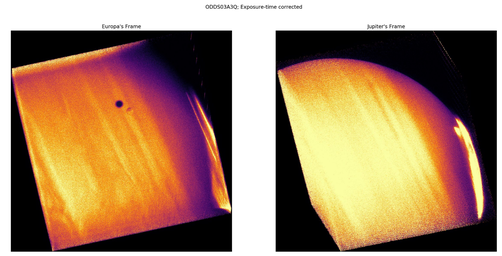
Spatial Scans with the CCD

Spatial scanning is now an available-but-unsupported mode on STIS. Spatial scanning allows for more photons to be collected before reaching the CCD full-well saturation, it allows for better averaging over variations in the flat field, and it can lead to much better IR fringe removal than non-scanned images. S/N ratios of 600-800 have been achieved in 1D extracted G750M/9336 spectra using this mode.

For more information on STIS Spatial Scanning, see Poster #443.07

Time-Tag

The STIS MAMA allows time-resolved observations through TIME-TAG mode. TIME-TAG mode tracks the collection time of each individual photon event at a time resolution of 125 microseconds.The figures below shows an image of Jupiter's aurora using TIME-TAG mode.



Imaging Modes

	Aperture	Filter	Field Of View (arcsec)	Detector
Visible	50CCD	Clear	52x2	STIS/CCD
	F28X50LP	Optical Longpass	28x52	
	F28X50OIII	[O III]	28x52	
	F28X50OII	[O II]	28x52	
	50CORON	Clear + Coronagraphic Fingers	52x52	
Ultraviolet	25MAMA	Clear	25x25	NUV- & FUV-MAMA
	F25QTZ	UV Near Longpass		NUV- & FUV-MAMA
	F25SRF2	UV Far Longpass		NUV- & FUV-MAMA
	F25MGII	Mg II		NUV-MAMA
	F25CN270	Continuum ~2700 Å		
	F25CIII	C III]		
	F25CN182	Continuum ~1800 Å		
	F25LYA	Lyman-α		FUV-MAMA
Neutral-Density-Filtered Imaging	F25NDQ1	ND=10^{-1}	13.4x9.7	ALL
	F25NDQ2	ND=10^{-2}	13.8x15.1	
	F25NDQ3	ND=10^{-3}	11.4x15.3	
	F25NDQ4	ND=10^{-4}	11.8x9.5	
	F25ND3	ND=10^{-3}	25x25	
	F25ND5	ND=10^{-5}	25x25	

Spectroscopic Modes

	Grating	Complete Spectral Range	Resolving Power	Detector
MAMA First Order Spectroscopy	G140L	1150-1730	960-1440	FUV-MAMA
	G140M	1130-1740	11,400-17,400	
	G230L	1570-3180	500-1010	NUV-MAMA
	G230M	1640-3100	9110-17,220	
CCD First Order Spectroscopy	G230LB	1680-3060	620-1130	CCD
	G230MB	1640-3190	5470-10,630	
	G430L	2900-5700	530-1040	
	G430M	3020-5610	5390-10,020	
	G750L	5240-10270	530-1040	
	G750M	5450-10140	4870-9050	
MAMA Echelle Spectroscopy	E140M	1144-1710	45,800	FUV-MAMA
	E140H	1140-1700	114,000	
	E230M	1605-3110	30,000	NUV-MAMA
	E230H	1620-3150	114,000	
MAMA Prism Spectroscopy	PRISM	1150-3620	10-2500	NUV-MAMA

Highlighted Scientific Use Cases

Category	Use Cases
Echelle Modes	• High precision radial velocities for binary orbits • Detailed abundance studies of narrow-lined hot stars • Abundances in cool metal poor dwarfs • Stellar wind line profiles
First Order Modes	• Absolute flux standards • Measuring SED of faint transients • Spatially resolved nebular spectroscopy • Extinction Curves
Spatial Scanning	• Diffuse Interstellar Bands (C60+ • Characterizing exoplanets and their atmospheres)
Coronagraphy	• Imaging Debris Disks
FUV Imaging	• Aurora of Giant Planets

Available-But-Unsupported Modes

STIS has a number of modes that are "available-but-unsupported". These modes are available for use by the scientific community, but they have limited calibration provided by the STIS team at this time.

Useful Links and Resources

- STIS Instrument Handbook (QR Code!)
- Time-Tag Imaging Examples: planetarylightshow.com
- STIS ISR 2017-03: Enabling Narrow(est) IWA Coronagraphy with STIS BAR5 and BAR10 Occulters
- More Spatial Scanning information: STIS STAN July 2018

http://www.stsci.edu/hst/stis/documents/handbooks/currentIHB/toc.html

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