WFC3: Spectroscopy and Operational Enhancements

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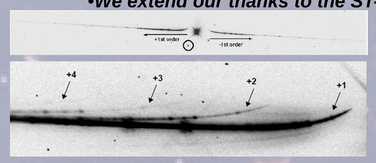
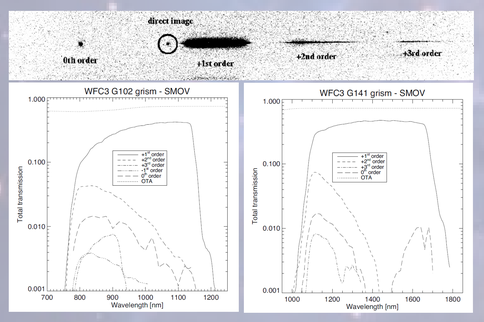
WFC3 Slit-less Spectroscopy (GRISMs)

- **WFC3 provides low resolution slit-less spectroscopy in the low background ultraviolet and near infrared**
  - **UVIS G280 Grism → λ/δλ ~70 over 190 - 450 nm (with some response to <180nm)**
  - **IR G102 Grism → λ/δλ ~210 over 800 – 1150 nm**
  - **IR G141 Grism → λ/δλ ~210 over 1075 – 1700 nm**
- **ESA's ST-ECF supported the WFC3 Grisms during instrument ground testing, commissioning, and in Cycles 17 and 18. They have provided documentation, simulation and analysis software (aXeSim and aXe), calibration, and user support.**
  - **With the end of the ECF in December 2010, these responsibilities at now at STScI**
  - ***We extend our thanks to the ST-ECF team for their years of outstanding work*.**





- **UVIS Grism has significant order overlap and full CCD bandpass background**
  - **It has been used successfully with relatively bright emission line targets**
- **IR Grisms have excellent primary order energy concentration and out of band rejection**
  - **Successfully used in Cycles 17 and 18 plus a key component of the MCT observations of SN1a**
  - **Broad range of science programs in Cycle 18 (see Table below)**

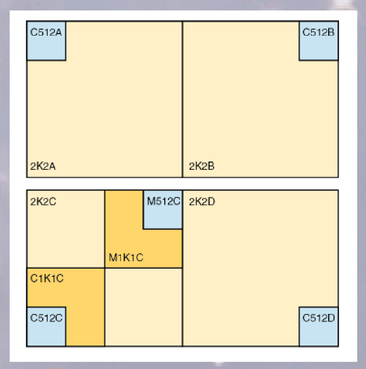
ID	PI	Orbits	Title
12177	Van Dokkum	248	3D-HST: A Spectroscopic Galaxy Evolution Treasury
12181	Deming	115	The Atmospheric Structure of Giant Hot Exoplanets
12190	Koekemoer	32	WFC3/IR Spectroscopy of the Highest Redshift Black Hole Candidates
12203	Stanford	30	Rest Frame Optical Spectroscopy of Galaxy Clusters at 1.6<z<1.9
12217	Lucas	6	Spectroscopy of faint T dwarf calibrators: understanding the substellar mass function and the coolest brown dwarfs
12230	Swain	18	The effect of radiation forcing on an exoplanet atmosphere
12247	Tanvir	18x3	Identifying and studying gamma-ray bursts at very high redshifts
12251	Berta	24	The First Characterization of a Super-Earth Atmosphere
12283	Malkan	280p	WFC3 Infrared Spectroscopic Parallel Survey WISP: A Survey of Star Formation Across Cosmic Time
12314	Apai	24	Mapping Brown Dwarfs: The Evolution of Cloud Properties Through the L/T Transition

Spatial Scans for Enhanced S/N WFC3 Spectroscopy

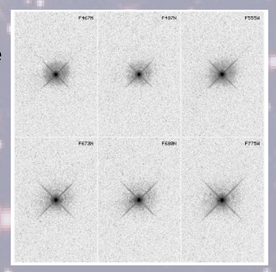
- STScI and the HST Project are developing a scanning capability that allows the light from astronomical objects to be trailed across the WFC3 detectors in a predictable and repeatable manner during exposures.
- This, if it works as expected, will enable significantly increased S/N observations – especially for infrared spectroscopy of bright sources
  - The default mode of operation will be to move a user defined distance in the cross-dispersion direction.
  - Rates up to 1 arc second per second will be supported in Cycle 19 (higher rates may become possible in future cycles).
  - Testing is planned for Feb-April 2011 and the TAC will be informed of the outcome.
  - Modest overheads combined with the accurate timing information inherent in the MULTIACCUM readouts of the IR detector should make this a powerful capability for infrared spectroscopy of bright time variable sources.
- More details are available in the WFC3 STAN at **www.stsci.edu/hst/wfc3/documents/newsletters/STAN_01_06_2011**

Subarray Improvements

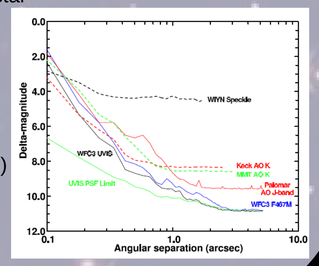
- **Improved sub-arrays defined for WFC3 starting in Cycle 18**
  - Support some of ACS/HRC parameter space with 1024 x 1024 subarrays in UVIS
  - IR subarrays supported for GRISM
- **Cycle 19 Enhancement**
  - Image Header limitation of 100 will increase to 304 in Cycle 19
    - Note: each IR readout produces a header



High Contrast Imaging

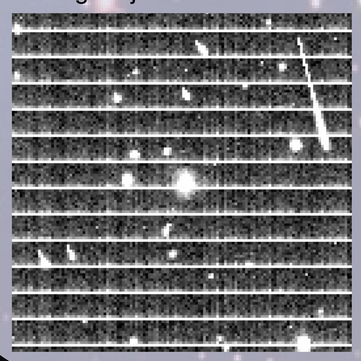


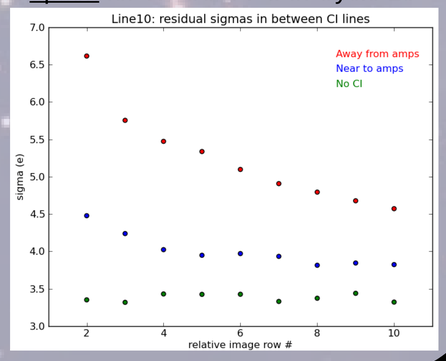
- Cycle 18 calibration program 12354 characterized the profile of the WFC3 Point Spread Function to explore high contrast imaging.
- UVIS F487N, F467N, F680N, F555W, and F775W plus IR F128N
  - Carefully dithered to measure contrast out to ~2 arc seconds.
- WFC3 is capable of detecting sources at ~1 arc sec with Δmag ~10
  - For UVIS, these calibrations specifically examine the case of a carefully dithered 12th magnitude star
- **Observers considering observations of high contrast sources sources should examine the 12354 dataset and our analysis.**
  - Early results in posters 254.37 & .41
  - UVIS: WFC3 ISR 2011-03 (Gilliland and Rajan)
  - IR results to be published soon

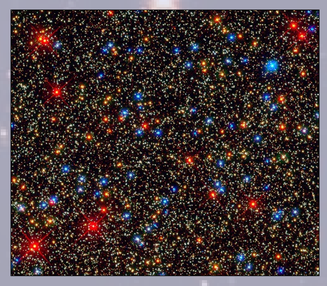


CCD Charge Injection and CTE Mitigation

- WFC3 was installed during solar min thus radiation damage to the CCDs is 2-3 times that seen in the first years of ACS (2002-2004)
- The WFC3 e2v CCDs have a charge injection gate that permits ~17,000 electrons to be placed into every N^{th} row
  - With N=10, this appears to restore CTE to pre-flight levels
  - Injected row has readnoise ~20e- but returns to 4-5e- in rest of rows
- Charge Injection will become an option for WFC3/UVIS in Cycle 19







For more on WFC3 at this conference, see posters 254.37, 254.38, 254.39, 254.40, and 254.41.

For further information:

http://www.stsci.edu/hst/wfc3
and
http://www.stsci.edu/hst/wfc3/documents/ISRs

Abstract

The Wide Field Camera 3 was installed into the Hubble Space Telescope in May 2009. Our presentation discusses the performance of the WFC3 near infrared slitless spectroscopy mode, improvements to the definition and use of detector subarrays, and recent experiments aimed at determining the limits of high contrast imaging. We also discuss the implementation status of a new mode to achieve very high signal to noise observations of bright sources in the infrared channel via controlled motion of the telescope. This offers the potential for high S/N photometry and spectroscopy of very bright targets with excellent time resolution.