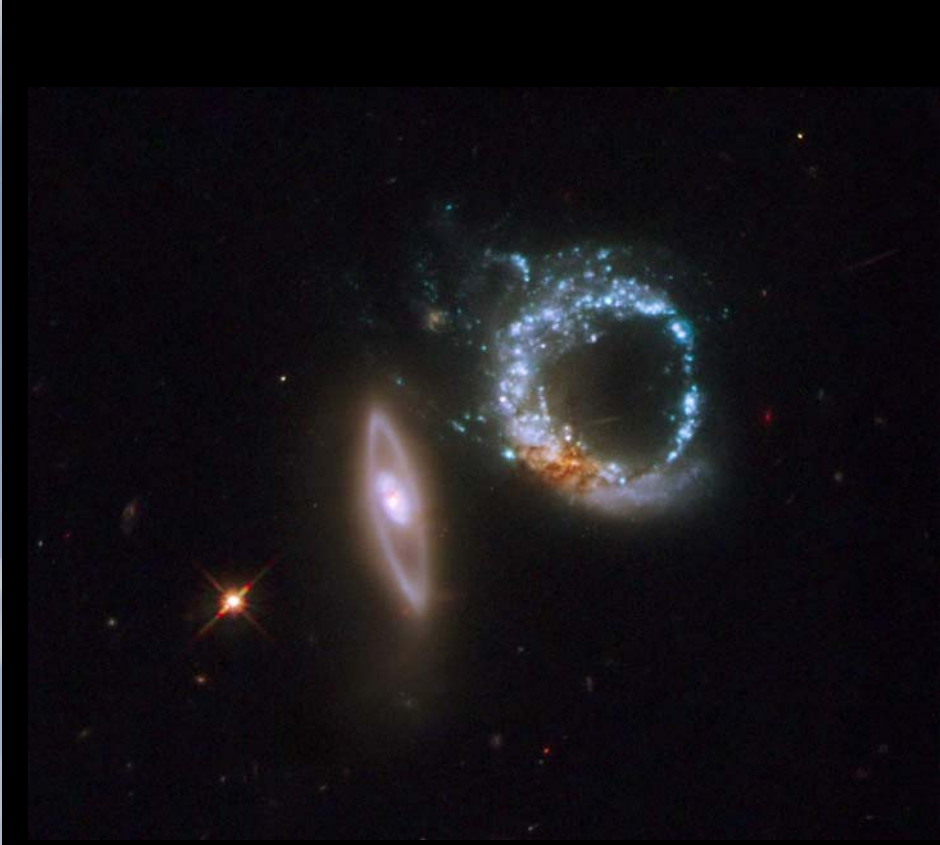


Briefing to the STUC

David Leckrone

November 13, 2008

Hubble As A Public Observatory

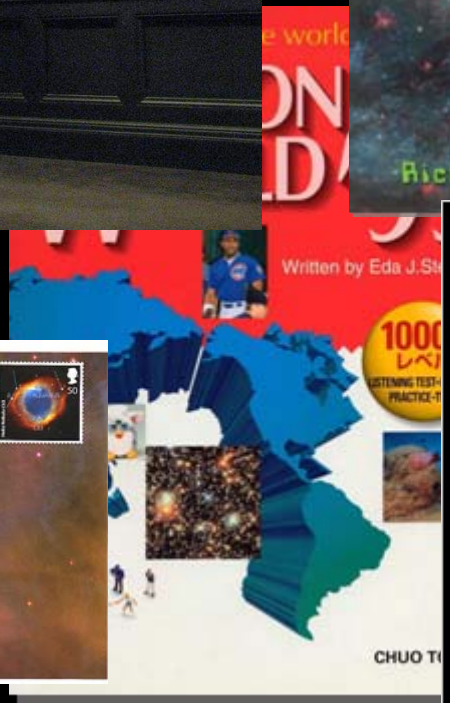
- **HST completed 100,000 orbits on August 11, 2008**
- **4385 different PI's and Co-I's have been awarded observing time or funding for archival research over the first 17 cycles of the HST General Observer program**
- **Oversubscription of available observing time averages 5.6:1**
- **860,000 exposures on 27,000 targets have yielded 33 Tbytes of science data**
- **8821 scientists worldwide are registered users of the Hubble data archive**
- **7724 different authors have written refereed papers using HST data**
- **On average, 14 scientific papers per week based on Hubble data currently appear in refereed scholarly journals**

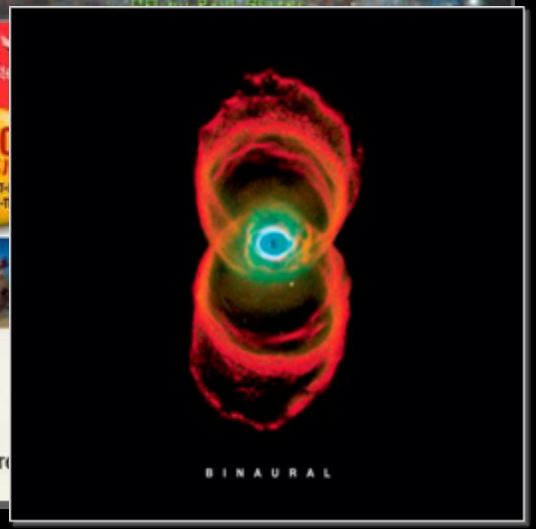
The collective brainpower of thousands of astronomers around the world uses Hubble's cutting-edge tools to revolutionize our understanding of the universe.


EXPLORATIONS
A workbook of musical starting points for specialist instrumental teaching and learning
TRUMPET/CORNET
Richard Duckett & Gary J. Price


Images from the Hubble Space Telescope named in honor of distinguished American astronomer
Edwin Powell Hubble
Edwin Hubble
33USA

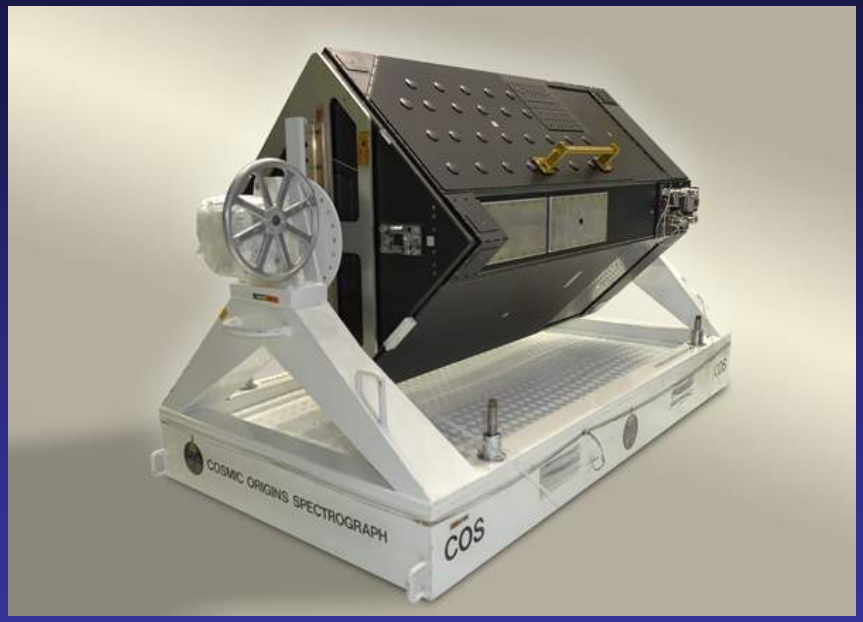

The Sky at Night



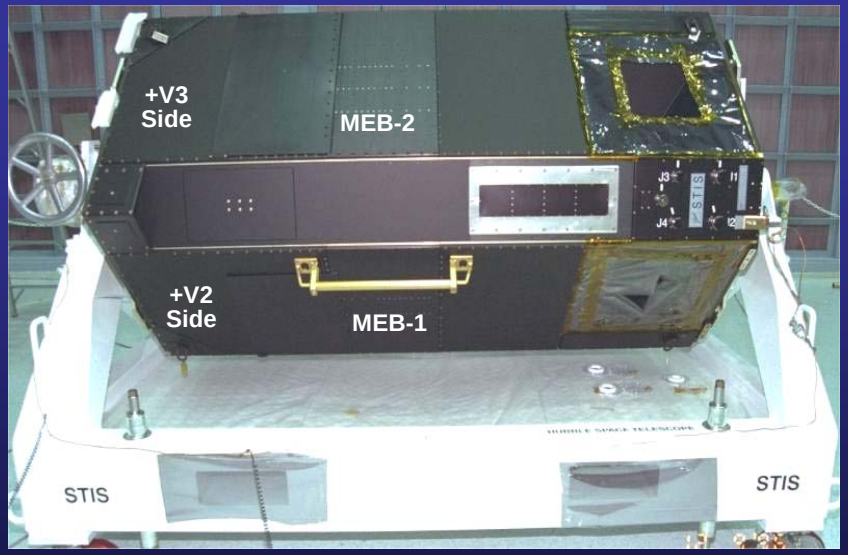

BINAURAL

The Scientific Instruments of SM4

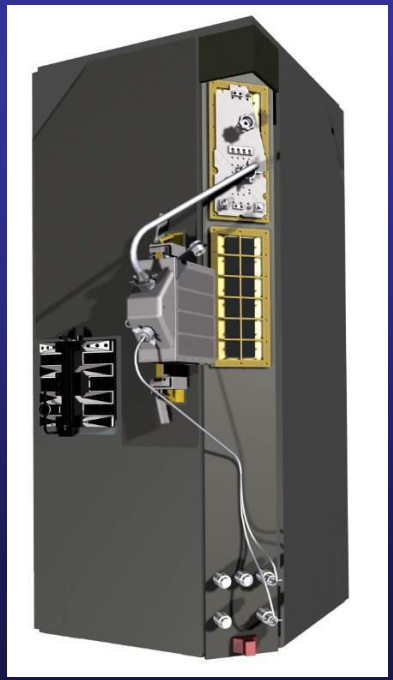
WFC-3 (new)



COS (new)



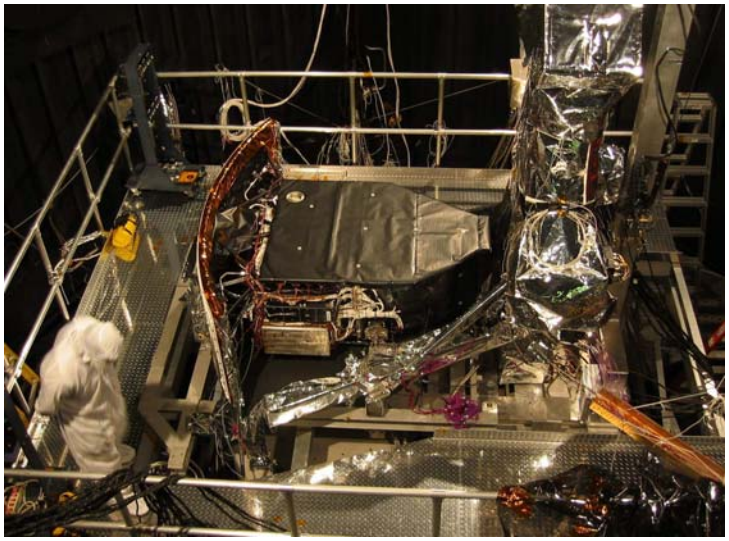
STIS-R (repaired)

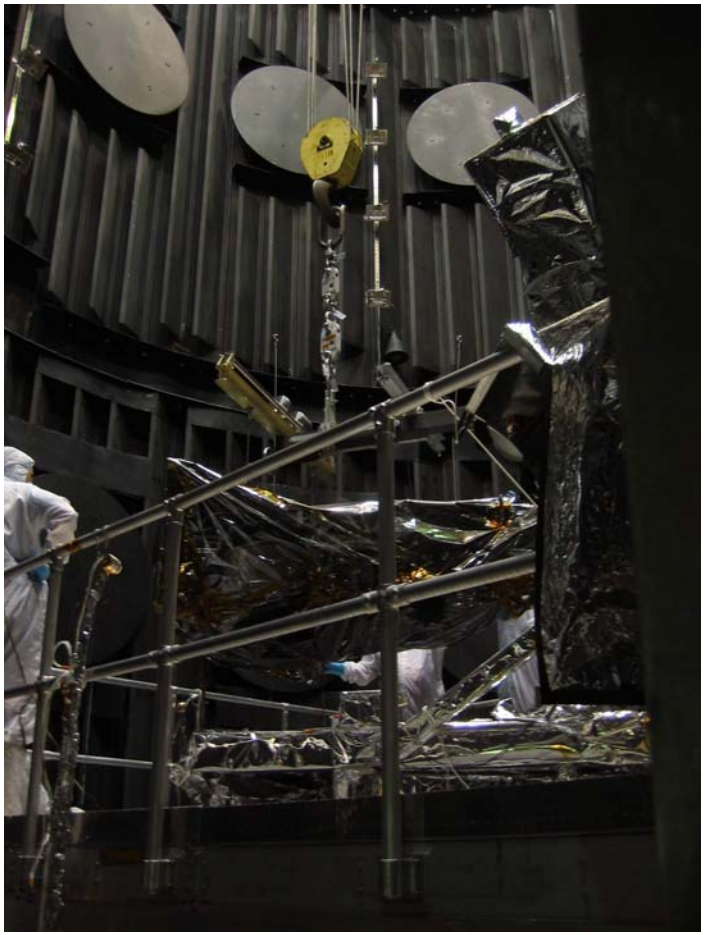


ACS-R (repaired)

WFC3 Integrated for T-V #3 and a Comprehensive Science Calibration

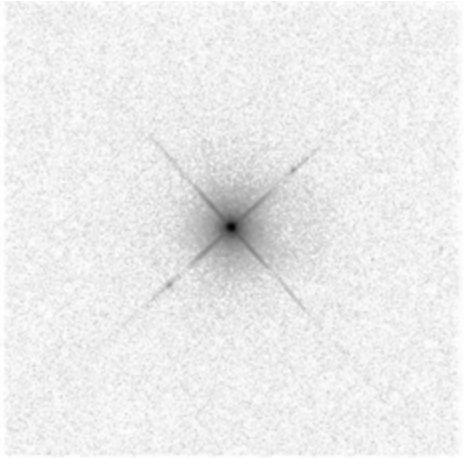
The fully assembled instrument





Setting up in vacuum chamber with HST optical simulator

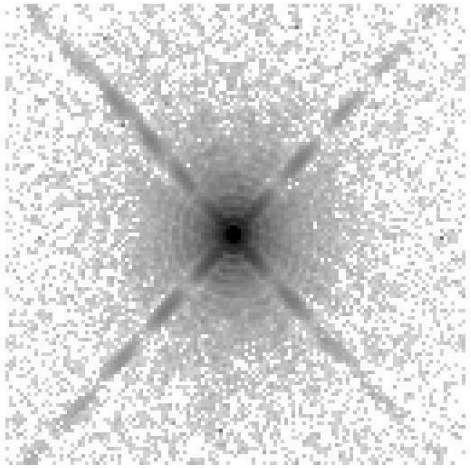
WFC-3 Optical Performance
(Encircled Energies in Given Diameter)



250nm, 5 dex log, 16 arcsec

71% in 0.20 arcsec

Spec = 70%



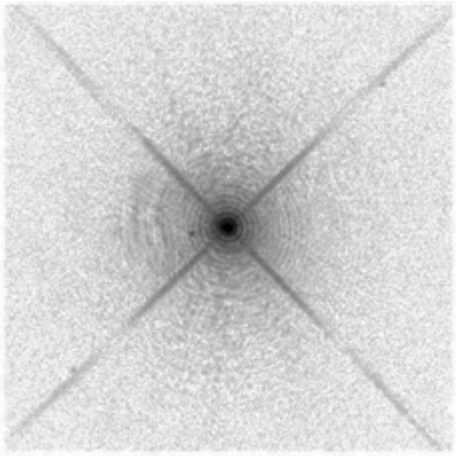
1.06µm, 5 dex log, 16 arcsec

58% in 0.25 arcsec

Spec = 56%

72% in 0.37 arcsec

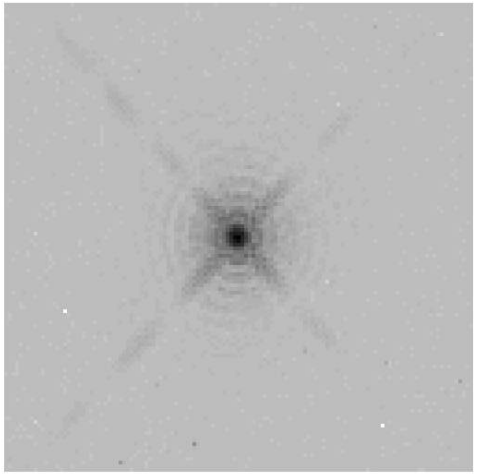
Spec = 72%



633nm, 5 dex log, 16 arcsec

80% in 0.25 arcsec

Spec = 75%



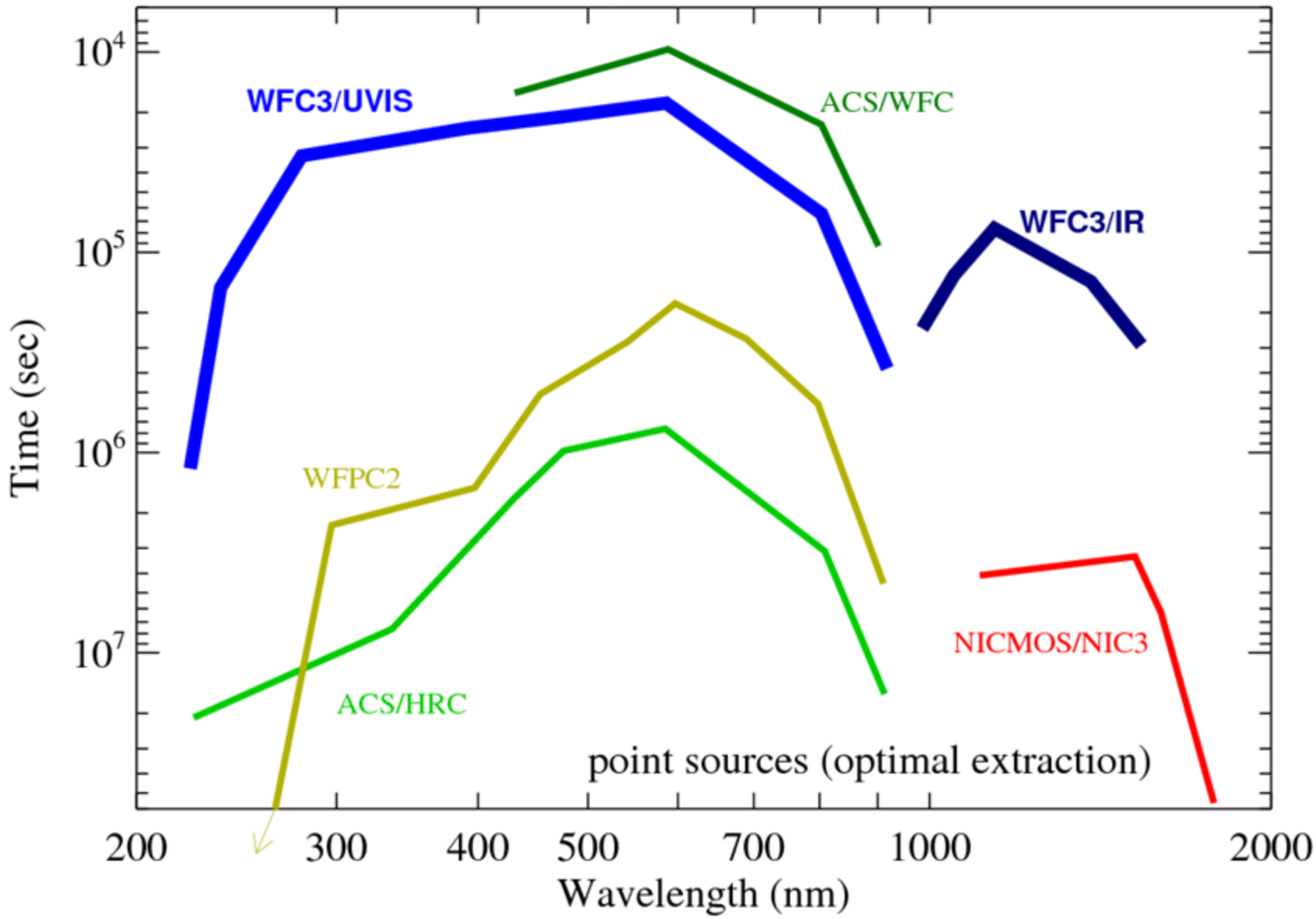
1.6µm, 5 dex log, 16 arcsec

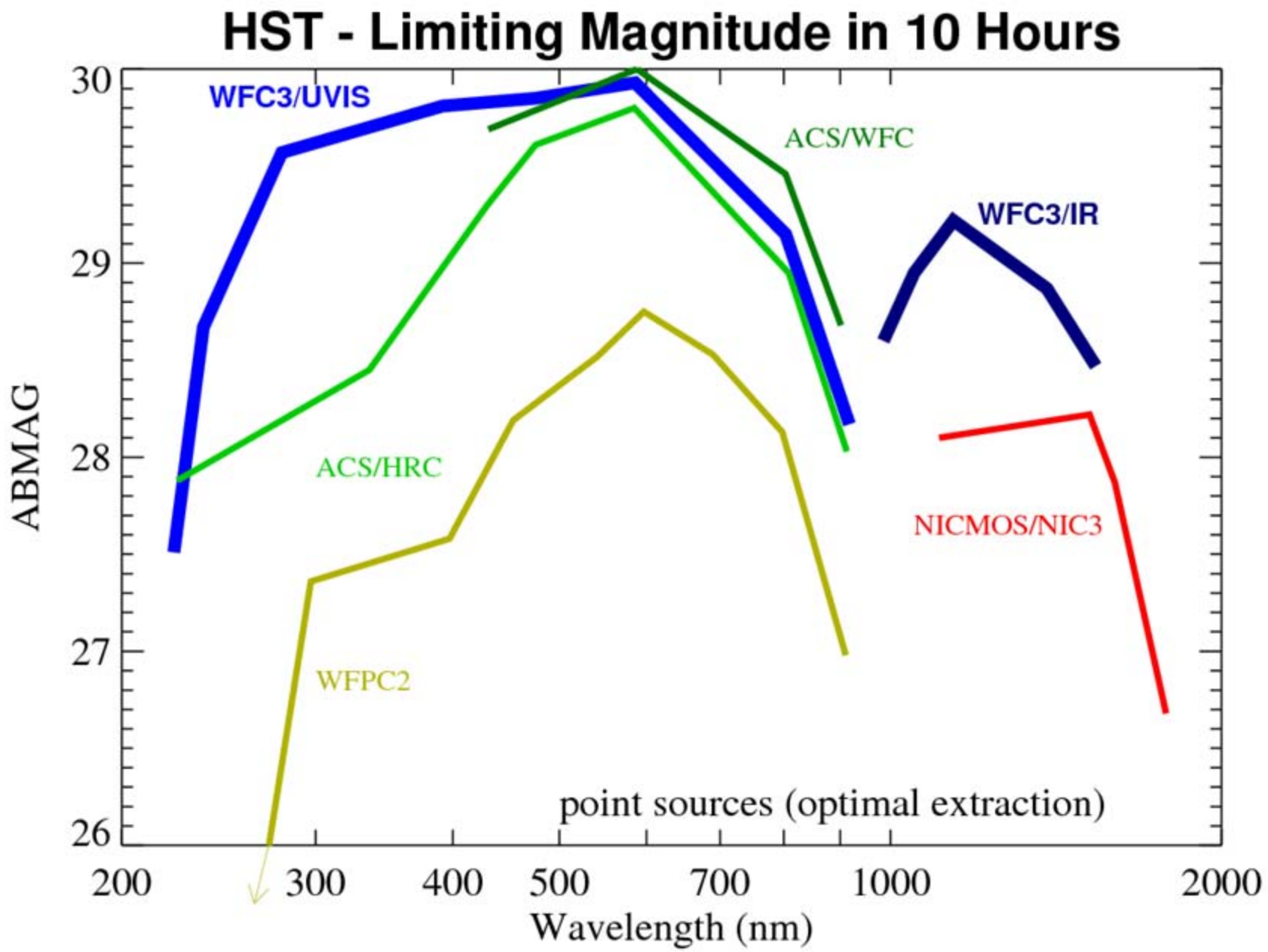
46% in 0.25 arcsec

Spec = 48%

78% in 0.60 arcsec

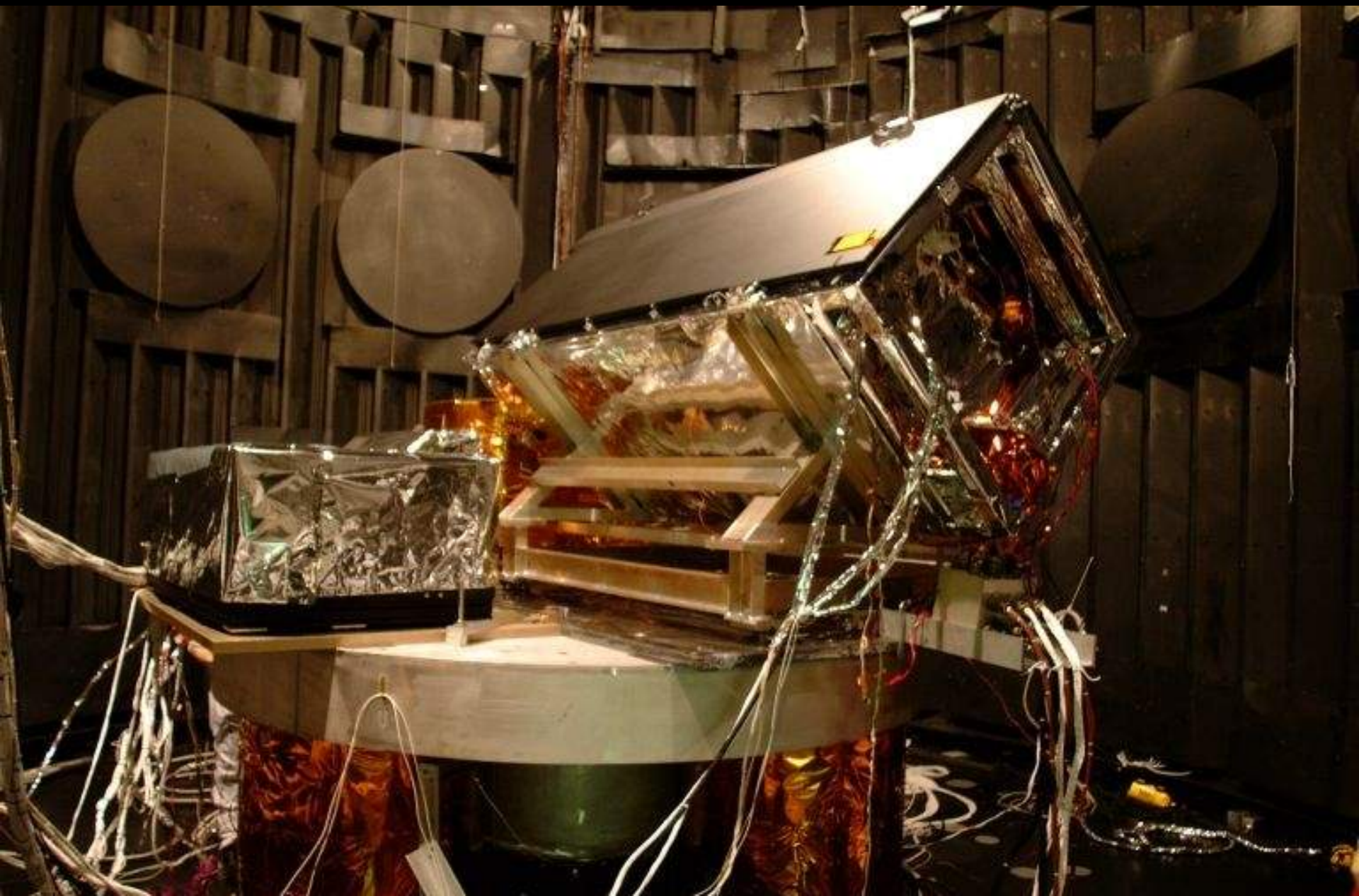
Spec = 75%


HST - Time to Survey 100 arcmin² to ABMAG=28
Time (sec)
10⁴
10⁵
10⁶
10⁷
WFC3/UVIS
ACS/WFC
WFC3/IR
WFPC2
ACS/HRC
NICMOS/NIC3
point sources (optimal extraction)
200
300
400
500
700
1000
2000
Wavelength (nm)

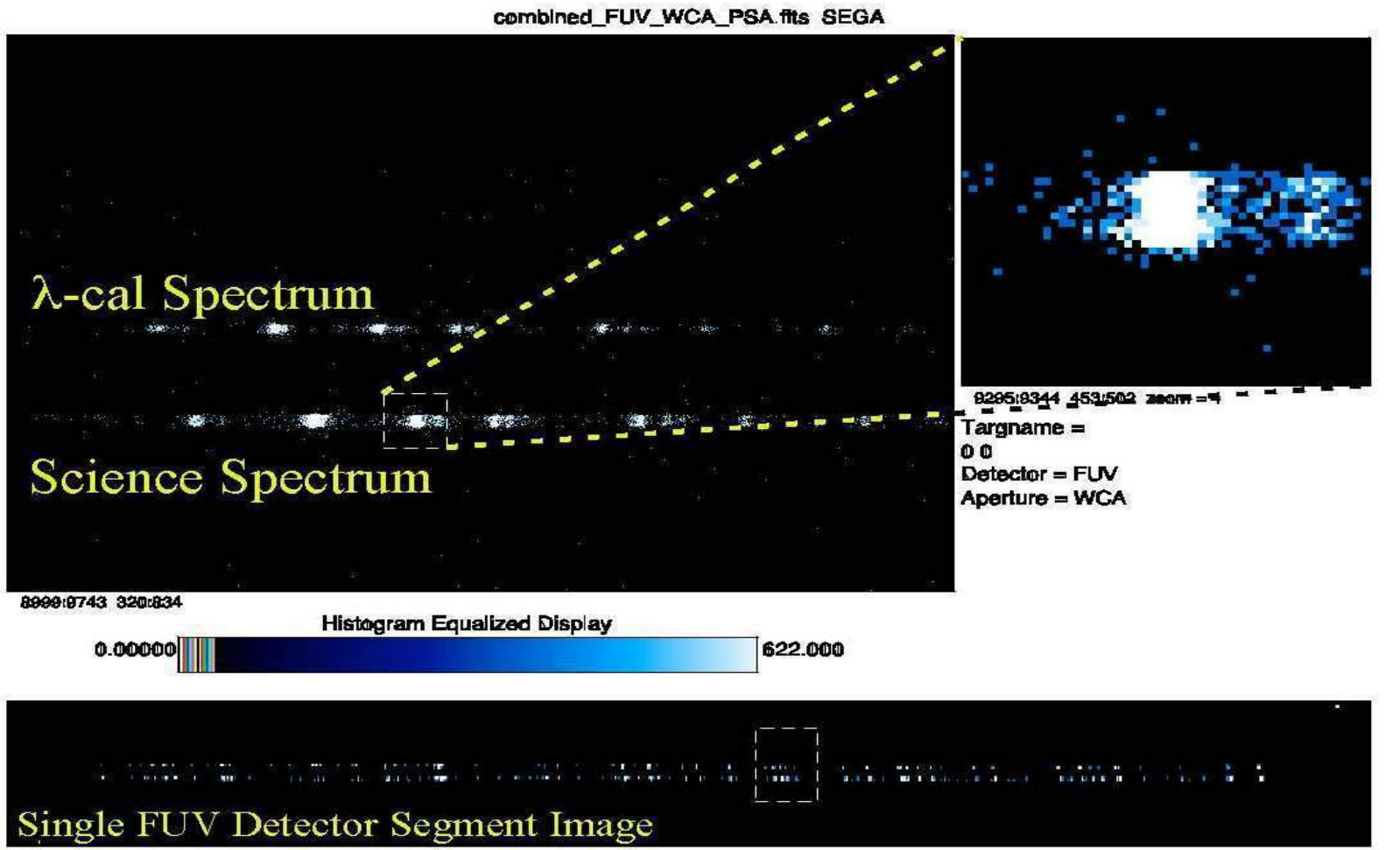

HST - Limiting Magnitude in 10 Hours
WFC3/UVIS
ACS/WFC
WFC3/IR
ACS/HRC
NICMOS/NIC3
WFPC2
point sources (optimal extraction)
ABMAG
Wavelength (nm)
30
29
28
27
26
200
300
400
500
700
1000
2000

WFC3 Arrives At KSC, Is Loaded Into Launch Protective Enclosure (WSIPE) On SLIC

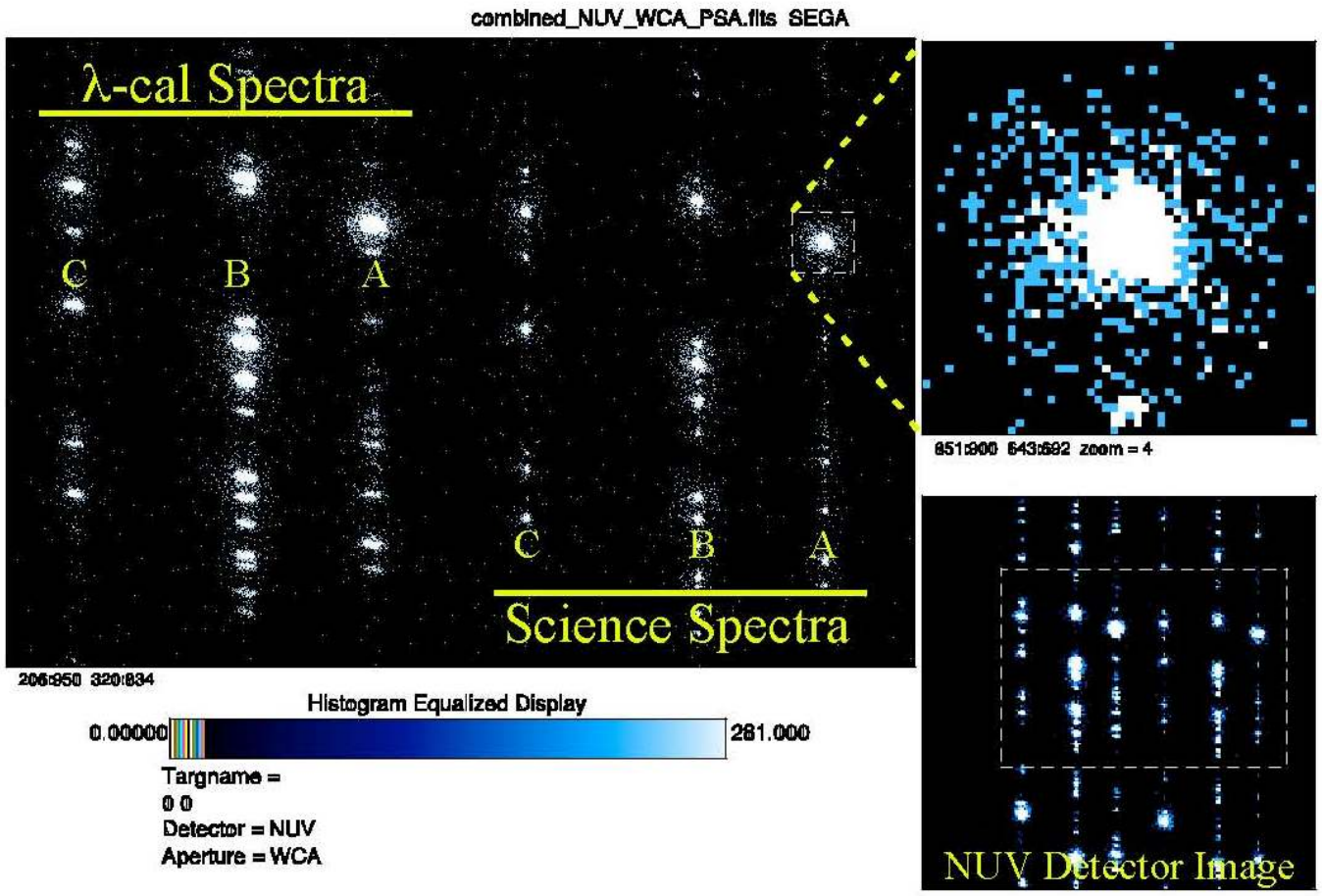
COS In SES Thermal-Vac Chamber



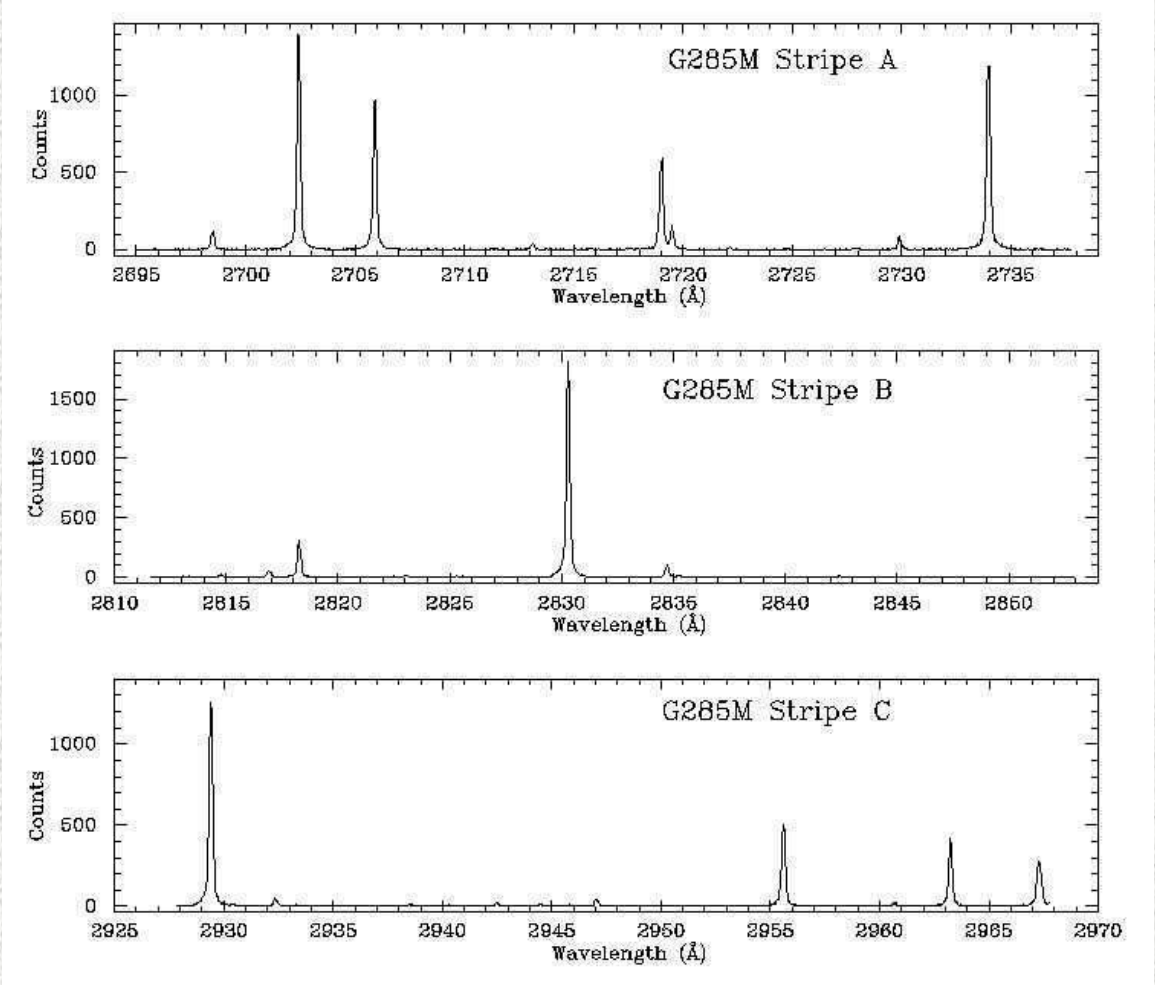
FUV Spectrum: Science data and cal data simultaneously



NUV spectrum science data and cal data simultaneously



Cosmic Origins Spectrograph
Hubble Space Telescope

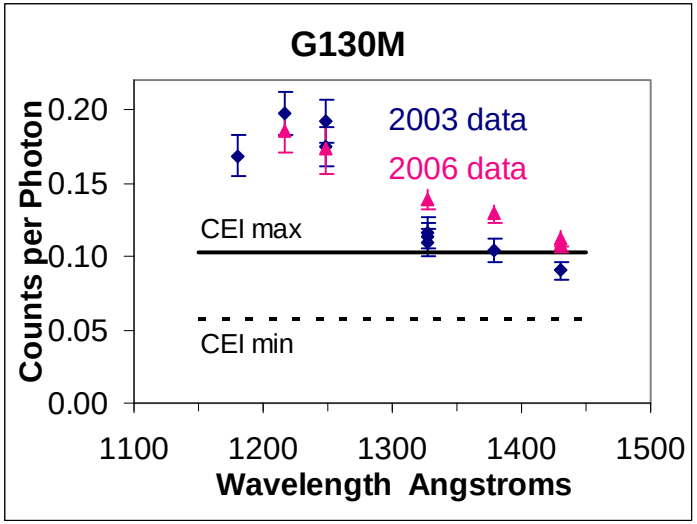


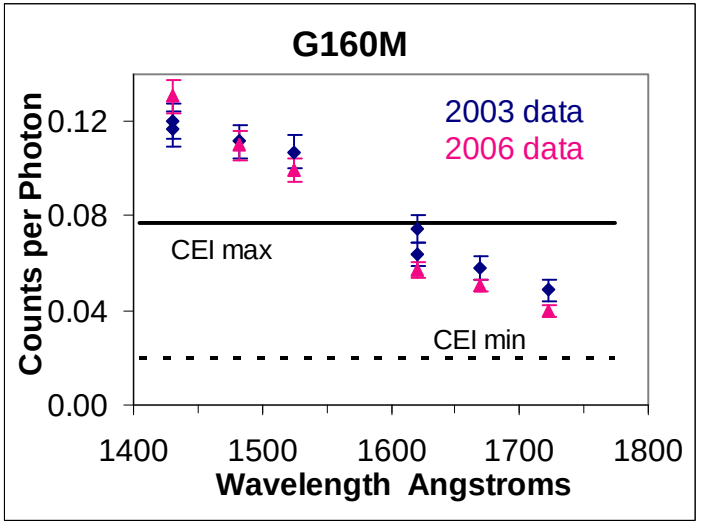
Single grating tilt yields 3 stripes

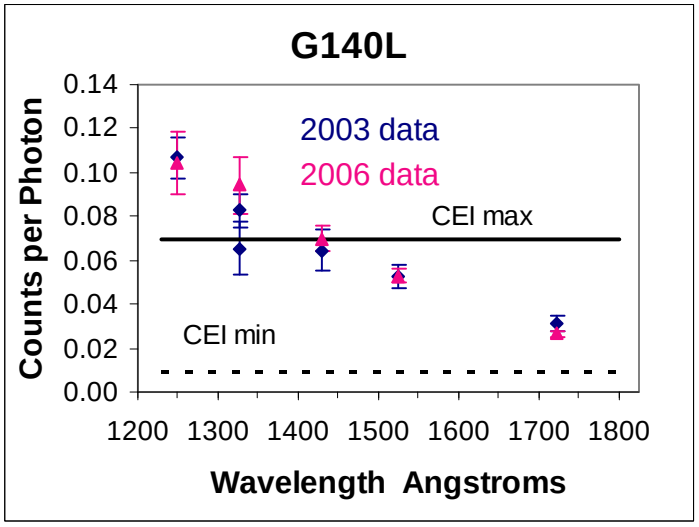
Resolution
R ~ 20,000

Sample COS wavelength calibration spectrum for near-ultraviolet channel measured under ambient conditions in dry nitrogen purge

Thermal Vacuum Sensitivity Calibration Results: COS FUV Channels

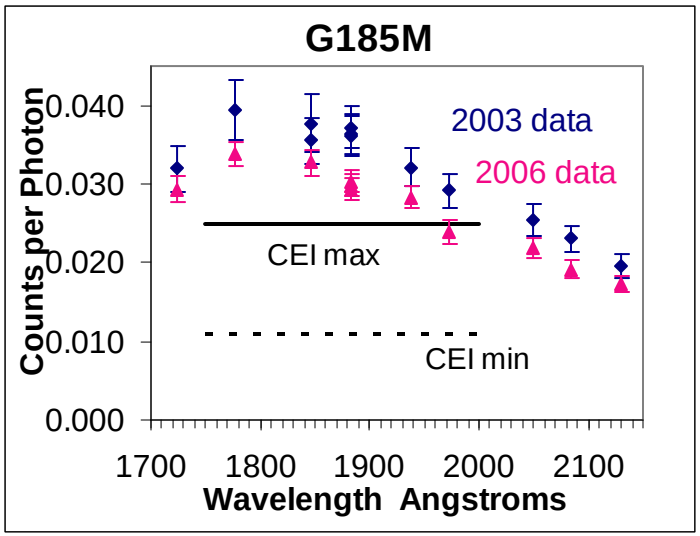


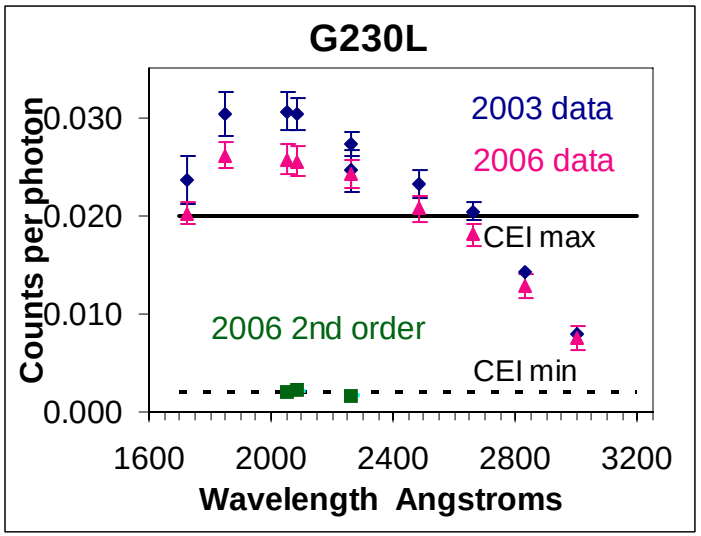


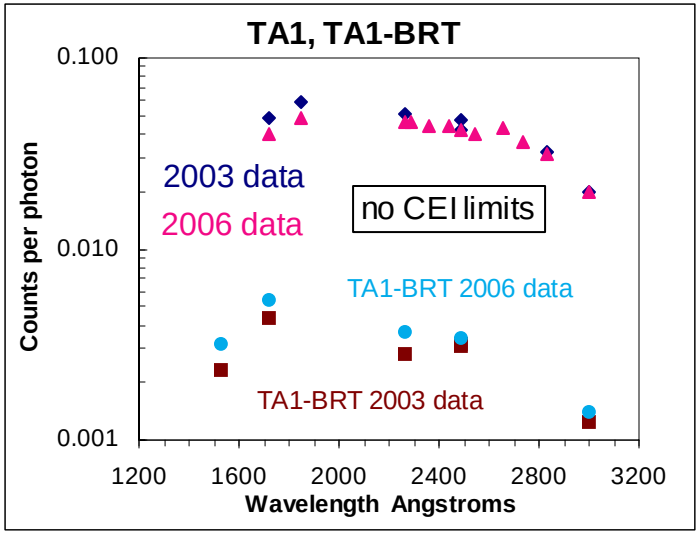


- All FUV channels meet CEI sensitivity requirements.

Thermal Vacuum Sensitivity Calibration Results: COS NUV Channels (1/2)

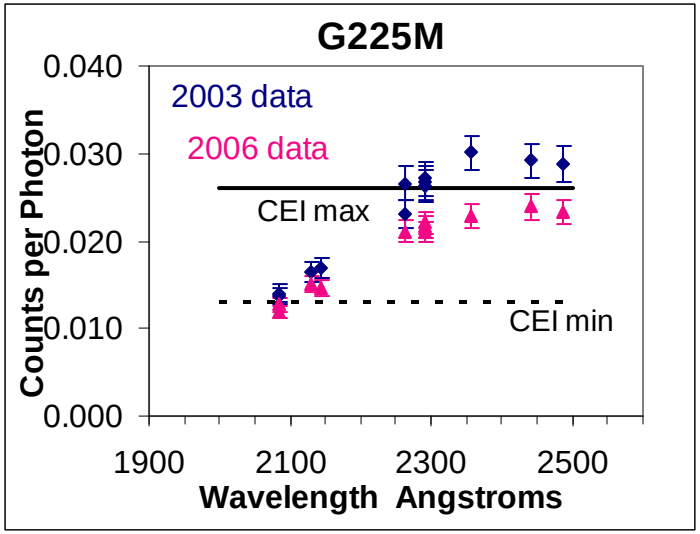


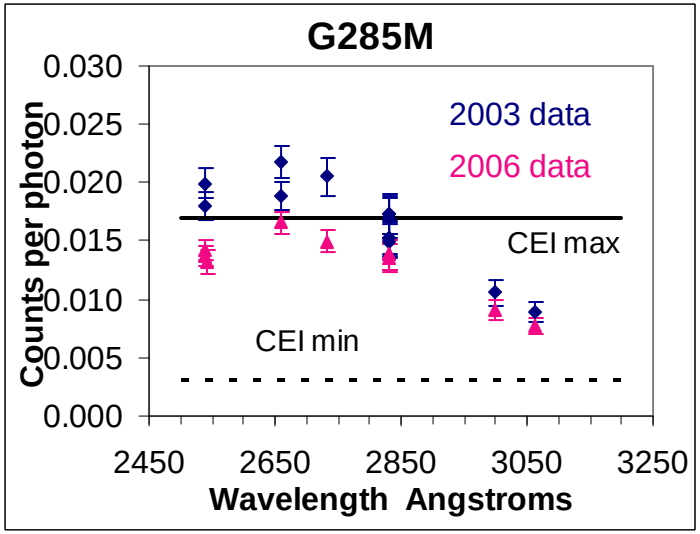




- G185M and G230L (Al/MgF_2) meet CEI requirements

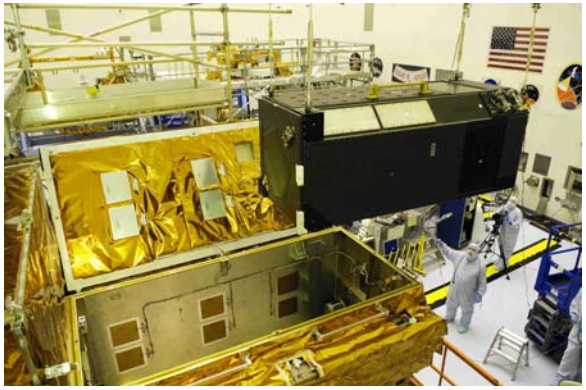
Thermal Vacuum Sensitivity Calibration Results: COS NUV Channels (2/2)

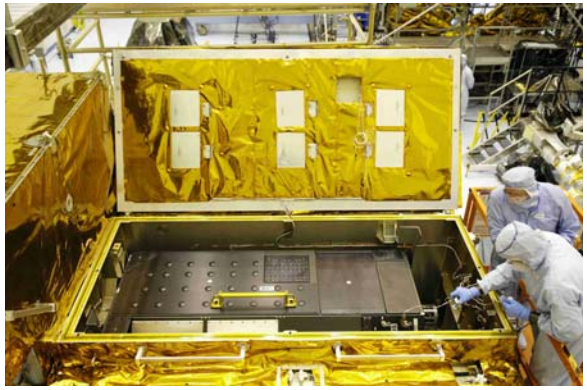




- Bare aluminum gratings show substantial performance changes inconsistent with witness coupon measurements.
- Waiver No. IN0090-W-026 submitted 4/23/08

COS Goes Into Its Launch Carrier (ASIPE) On ORU Carrier At KSC





Summary: we have a lot to be grateful for

- WFC3 and COS are superb performers
- We are well prepared for STIS-R and ACS-R
- Cycle 17 program is scientifically compelling and fully exploits the “full tool box” of instruments
- We are fortunate that the CU/SDF-A failure occurred before SM4
- We have the World’s best engineering, management and scientific talent
- We have unwavering support
- We are well postured for a highly successful SM4 in the Spring


Rod Ogrodki

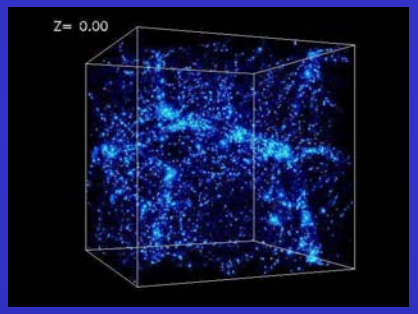
Backup

MISSION GOAL: ***When the astronauts leave Hubble for the last time, it will be at the apex of its capabilities - better than it has ever been before.***

WFC3 + ACS + NICMOS = Most powerful imaging ever

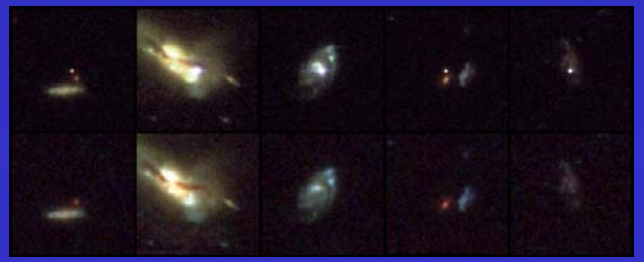
COS + STIS = Full set of tools for astrophysics

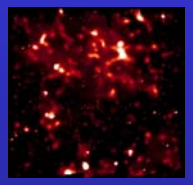
The architecture of the universe

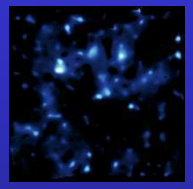


The life story of galaxies

The mysteries of dark matter and dark energy

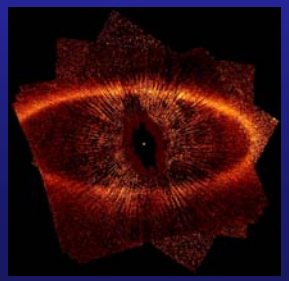


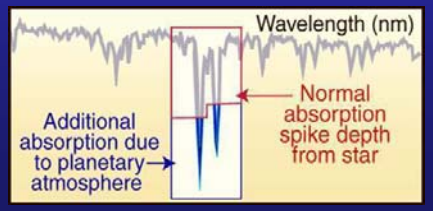




The birth and death of stars

Recipes for building planets





Why Are We Doing This?

....."We are privileged to be the first generation of homo sapiens to gain a clear and deep view of the visible universe. And what we see 'out there' is staggering in its beauty, awesome in its scale and shocking in the way it has upended our preconceived notions about how nature works. You don't have to be a scientist to grasp this. Any thinking person who has come in contact with Hubble images and Hubble discoveries seems to find exhilaration in the notion that our place in the grand scheme of things is now better defined than in all of prior human history."

- D. Leckrone
from introduction to
“Hubble: The Mirror on the Universe”
by R. Kerrod and C. Stott
2008