COS
Monthly Status Review
January 22, 2003
GSFC

Agenda

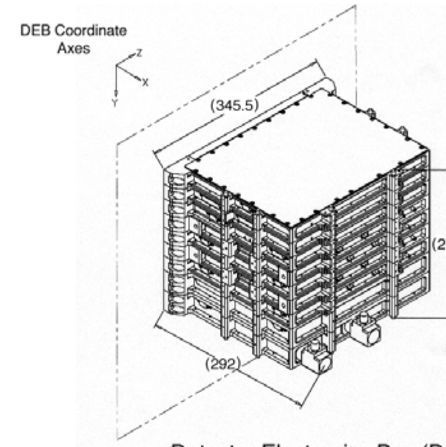
Progress Summary Since Last Monthly	J. Andrews
UCB FUV Detector Programmatic Status	J. Andrews
UCB FUV Detector Technical Status	J. Andrews
Software/Ops	J. Andrews
Schedules	J. Andrews
FUV Detector Swap	J. Green
Upcoming Events/Activities	J. Andrews
CU Issues & Resolution Plan	J. Andrews
STScI Presentation	T. Keyes
BATC Presentation	R. Higgins
Financial Splinter	GSFC/Ball/CU

Progress Summary Since Last MSR

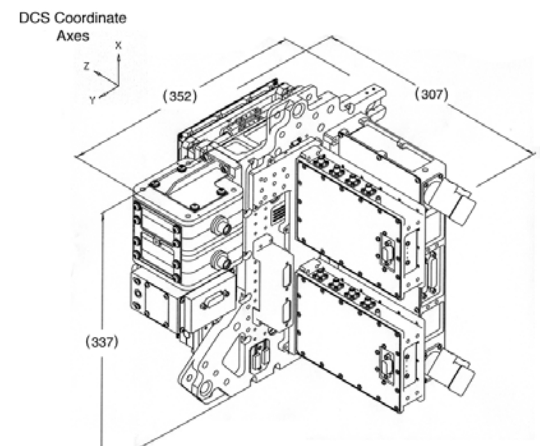
- Completed FUV-02 characterization at UCB.
- Received FUV-02 at CU on 1/4/03.
- Completed FUV-02 qual-vibe at Ball (1/6 – 1/8/03).
- Started FUV-02 TV at CU (1/10/03).
- Started re-characterization of Cal/FF sub-system with new lamps.

Overview of FUV Detector Assemblies

- **DEB** - (**D**etector **E**lectronics **B**ox)
  - **DCE** (**D**etector **C**ontrol **E**lectronics))
  - **TDCs** (**T**ime**-to-D**igital **C**onverters)
  - **HVPS** (**H**igh **V**oltage **P**ower **S**upply)
  - **LVPC**(**L**ow **V**oltage **P**ower **C**onverter)
- **DVA** - (**D**etector **V**acuum **A**ssembly)
  - **VHA** (**V**acuum **H**ousing **A**ssembly)
    - Detector Door Mechanism
    - Ion Pump Assembly
  - **DBA** (**D**etector **B**ackplate **A**ssembly)
    - **Amplifiers**
    - **HVFM (H**igh **V**oltage **F**ilter **M**odule)



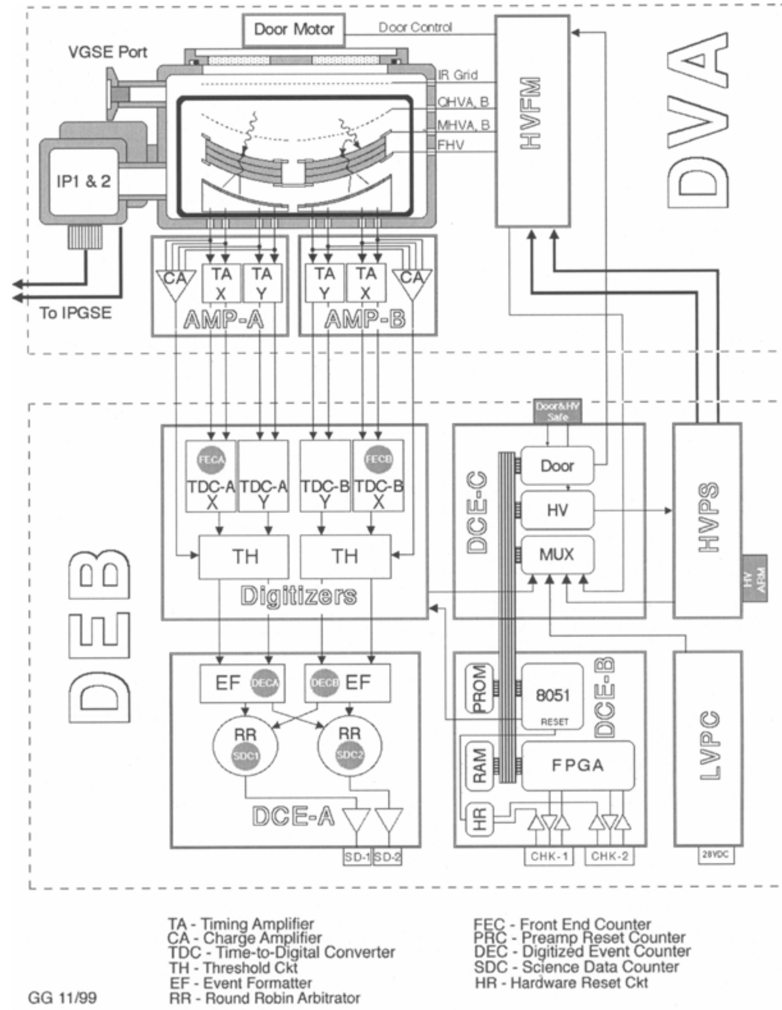
Detector Electronics Box (DEB)



Detector Vacuum Assembly (DVA)

FUV Detector Subsystem Block Diagram

- UCB is under contract to deliver 1 flight FUV detector subsystem (FUV-01) and 1 flight-spare detector subsystem (FUV-02).



FUV Detector Overview

- FUV-01 was delivered to Ball on Wednesday, July 31st.
- FUV-01 has operated flawlessly since its integration into the instrument and has accumulated > 72 hours of instrument level run-time (>50% of that time was with HV on).
- FUV-02 is in final stages of qualification program:
  - Vacuum seal has been fixed with shaped o-ring.
  - Fix has been qual-vibed using ETU VHA.
  - DEB and DVA have completed vibration testing at Ball.
  - Sub-system is almost done with 6-cycle TV test at CU.
  - Unit should be available for delivery to Ball by January 27th.

FUV Detector Verification Testing Summary

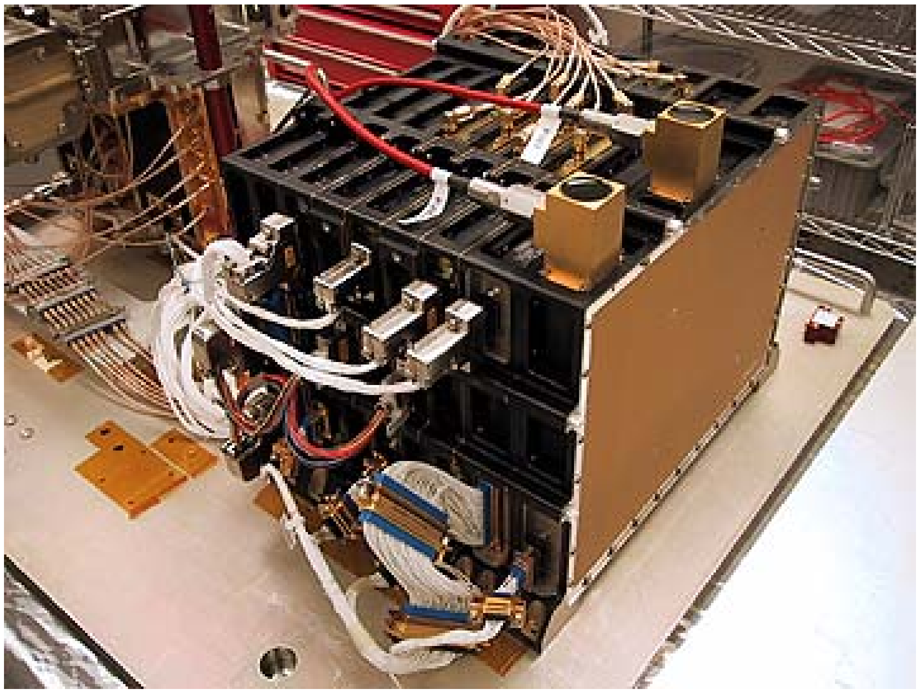
Unit	Functional Testing	Performance Testing	EMI/EMC	Sine Burst	Random Vibe	Thermal-Vac	Contamination Certification
FUV-01 DVA	C	C	@SS	A - C	A - C	@SS	@SS
FUV-01 DEB	C	C	@SS	Q - C	Q - C	@SS	@SS
FUV-01 SS	C	C	C	@Comp	@Comp	8-cycles	C
FUV-02 DVA	C	C	N/R	Q - C	Q – C	@SS	@SS
FUV-02 DEB	C	C	N/R	A - C	A - C	@SS	@SS
FUV-02 SS	C	C	N/R	@Comp	@Comp	6-cycles	P
DVA Surrogate (1)	C	N/R	N/R	C	C	N/R	N/R
DVA Surrogate (2)	C	N/R	N/R	C	C	C	N/R

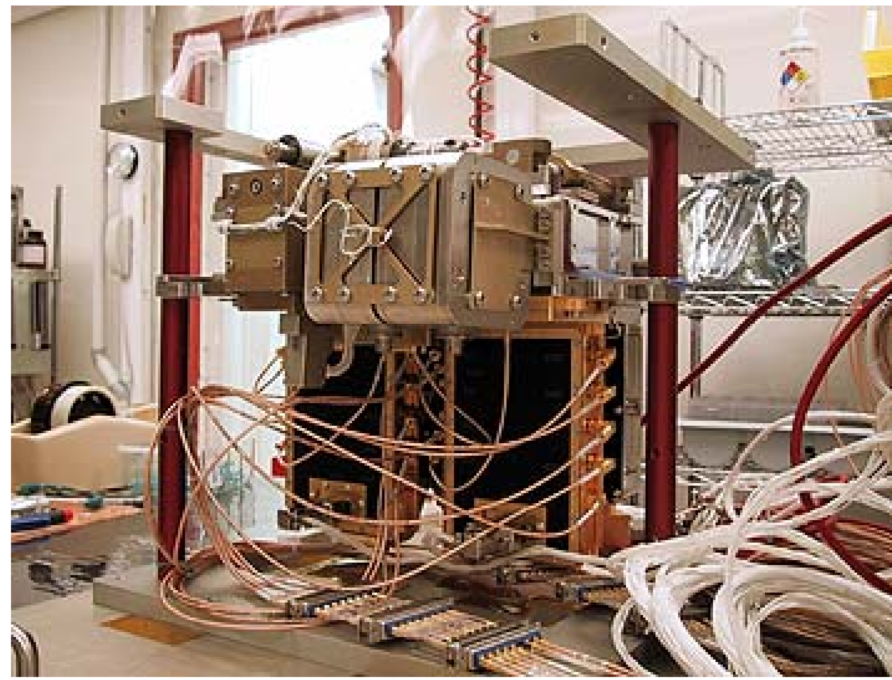
C	Complete
@Comp	At Component
@SS	At Subsystem
A	Acceptance Levels
Q	Qualification Levels
N/R	Not Required
P	Planned
(1)	Old Door Mechanism
(2)	New Door Mechanism

— ETU DVA w/shaped o-ring qual vibed at NASA Ames
— DVA-02 saw qual-level vibe at Ball
— FUV-02 completing 6 cycle T/V at CU
— DEB-01 saw 1-axis workmanship vibe at Ball
— FUV-02 contamination certification planned at Ball

COS FUV Detector Systems

- Detector DEB
- Detector Head

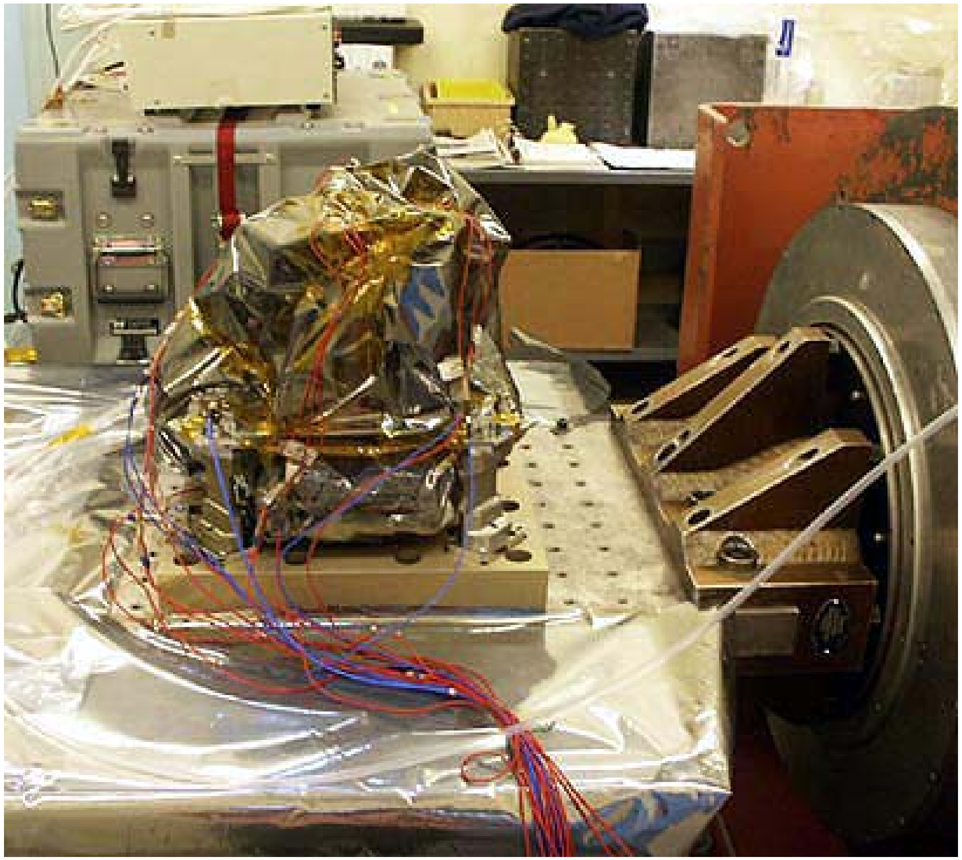




FUV02, Flight Backup Detector Status/Actions

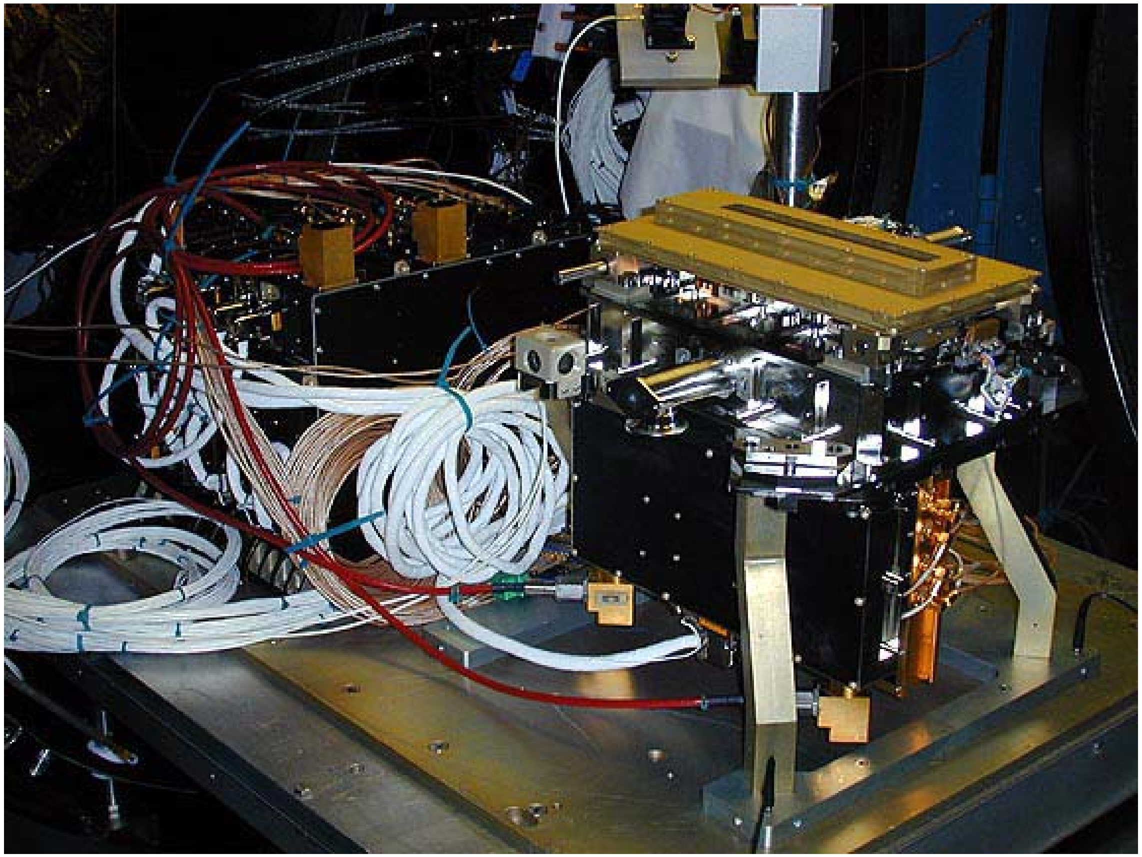
- Resolved VHA seal leak issue using shaped "O" ring
- Performed 40 successful door/motor open close cycles
- Qual-level vibration on ETU VHA confirmed o-ring solution
- Installed detector into DVA
- Re-installed in test chamber, performed QDE test
- Detector Mini scrub completed
- QDE calibration and full functional test done
- Deep flat field test done
- Packed and shipped to CU 1/3/03
- Vibration test and post vibration functional complete
- Thermal vacuum test at CU in progress
- Cleanliness certification and delivery to Ball next and final step

FUV02, Flight Backup Detector Vibration



Completed qualification level shake test at Ball with no detector anomalies and successful post shake functional test.

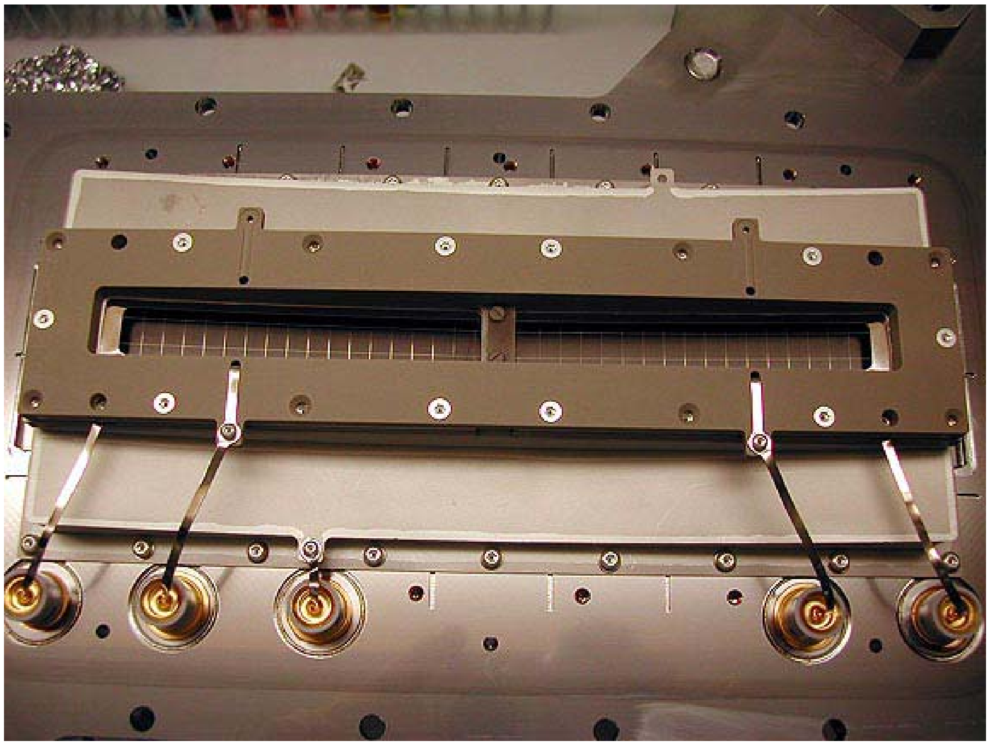
FUV02, Flight Backup Detector, thermal vac



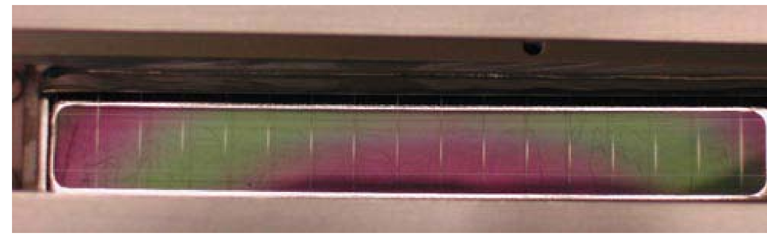
Thermal vac test in progress. Hot & cold soaks (+50 °C to -25 °C) done, +40 °C to 0 °C cycles underway. TQCM readings at 40°C are low (6.3 Hz/hr). Door openings/closings with motor and actuator firings all done successfully.

FUV02, Cathode Tested after Mini-Scrub

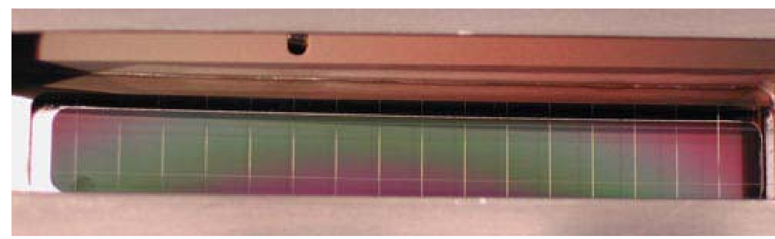
FUV02 detector with QE grid installed



New CsI cathode, A side



New CsI cathode, B side

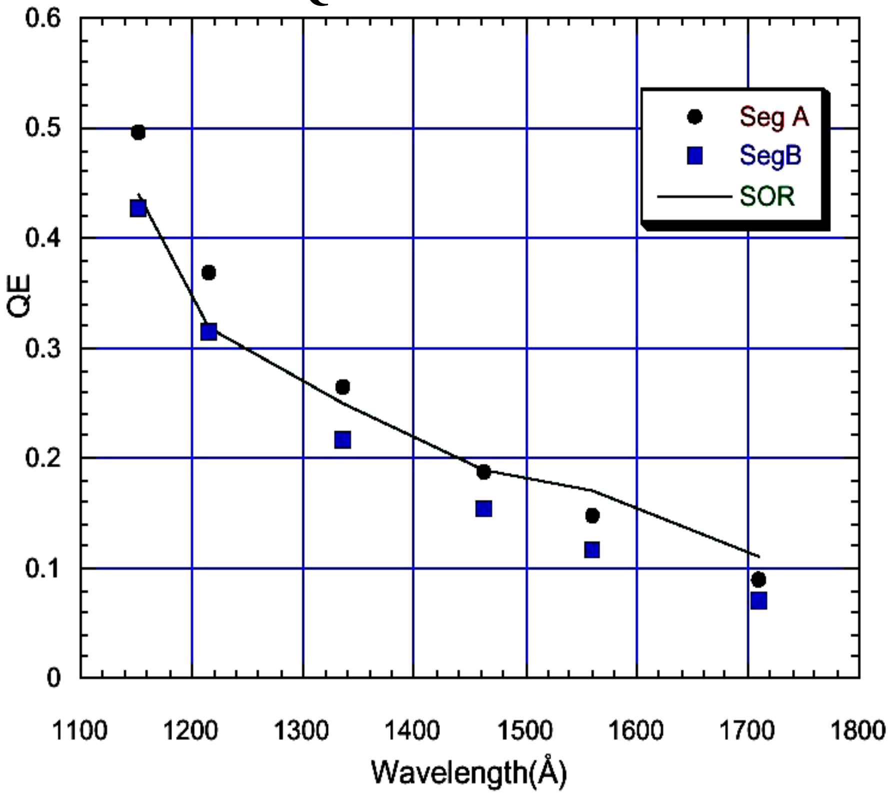


New cathode is in accord with the best CsI we have previously done on COS microchannel plates

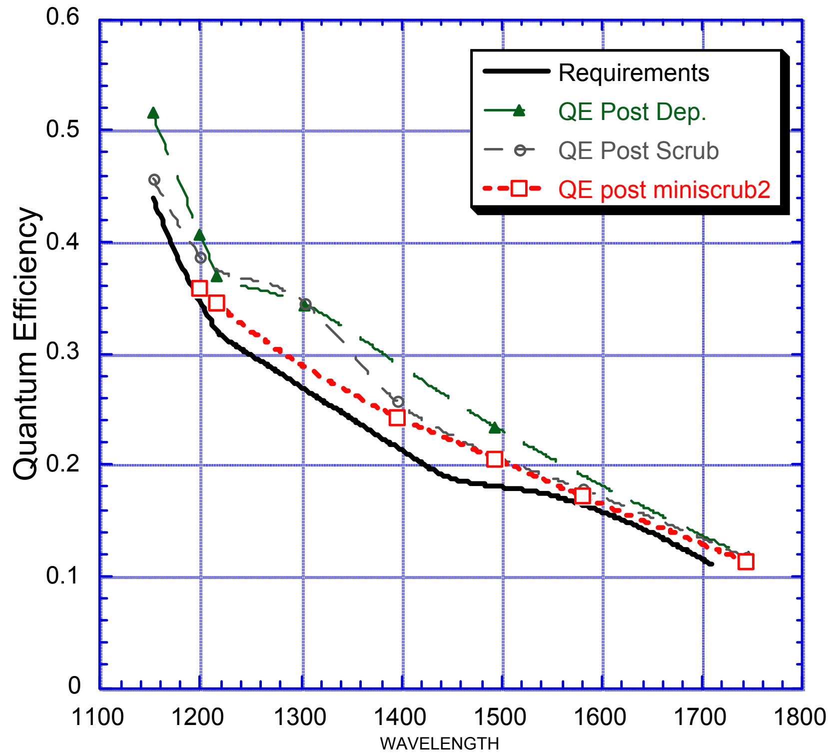
FUV02 New Photocathode QE measurements

QE for FUV02 is better than FUV01 specifically at long wavelength

QE for FUV01



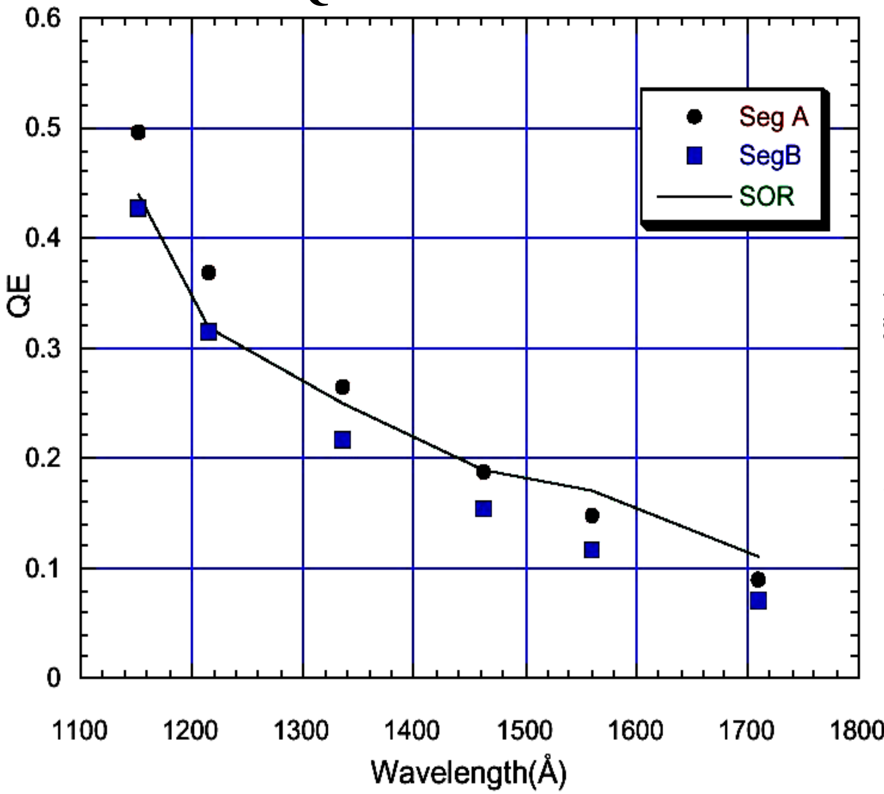
QE for FUV02 Seg B



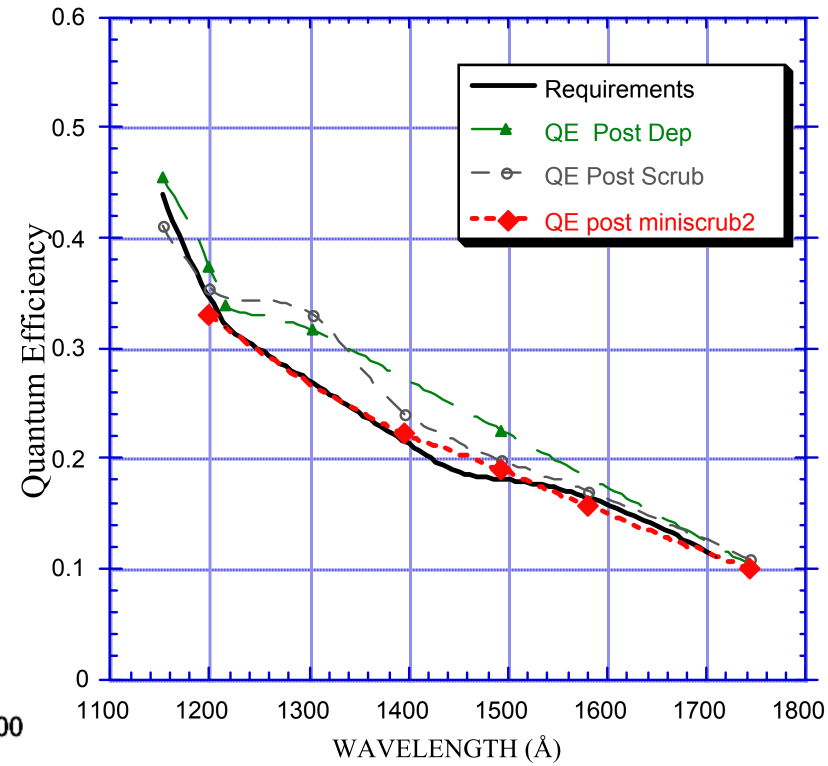
FUV02 New Photocathode QE measurements

QE for FUV02 is better than FUV01 specifically at long wavelength

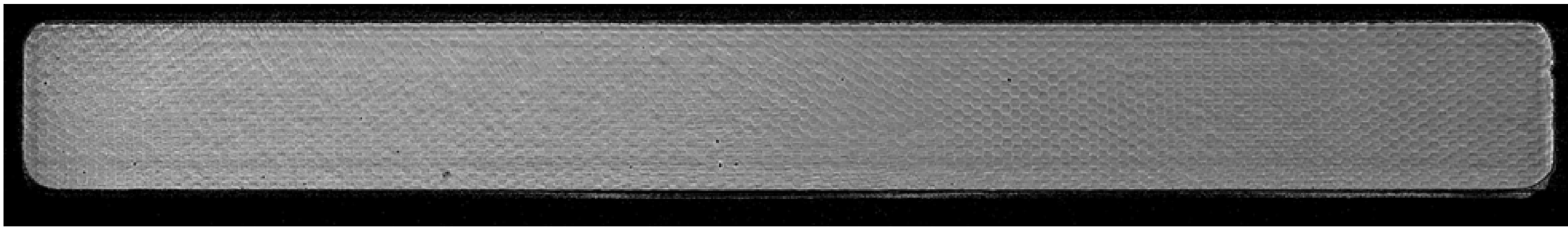
QE for FUV01

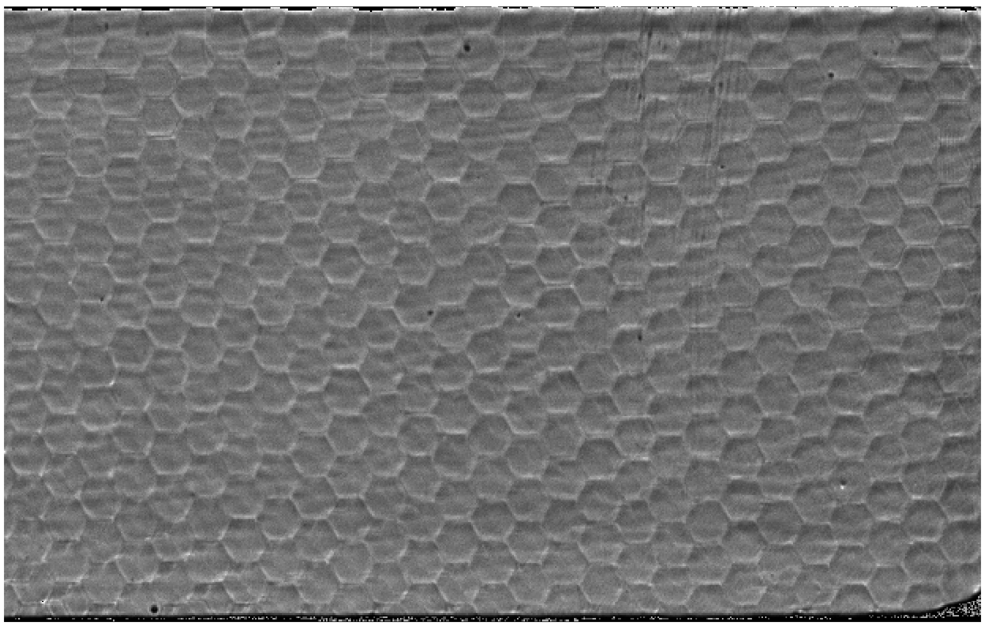


QE for FUV02 Seg A



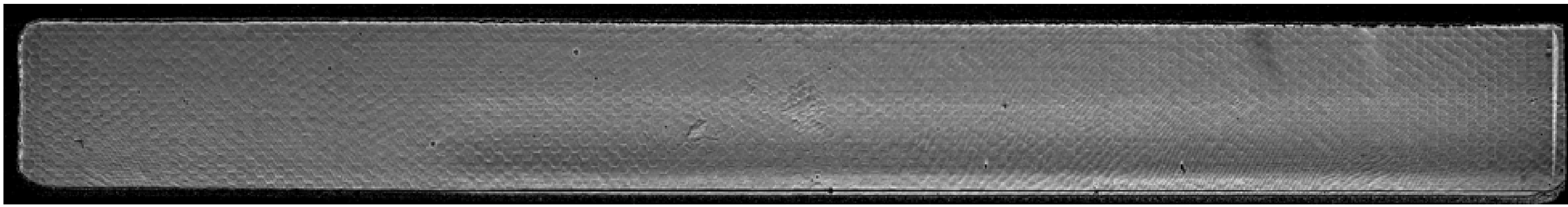
FUV02, Flight Backup Detector Deep Flat - B

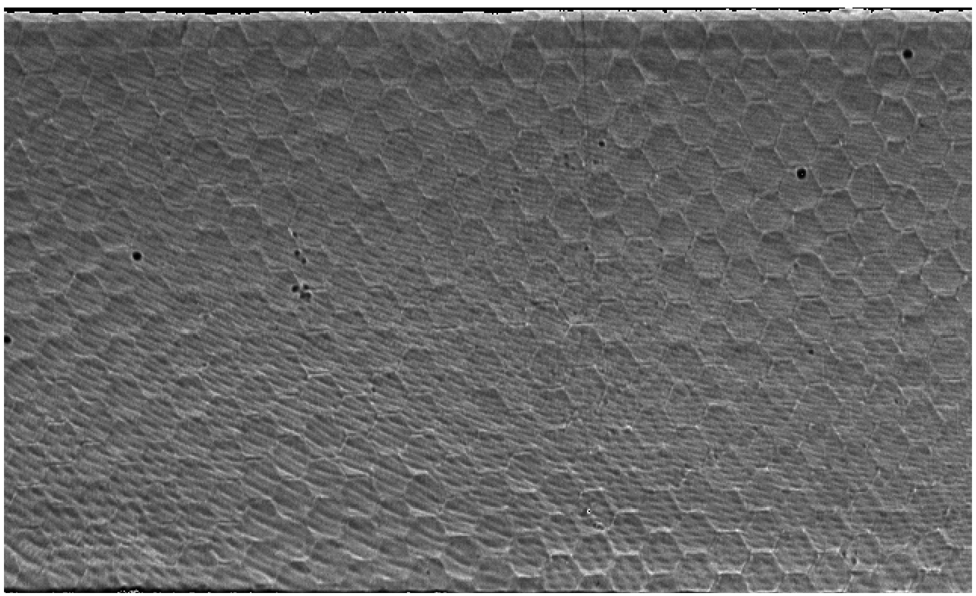




Deep flat fields show MCP hexagonal modulation as expected. These are correctable with flat field normalization techniques to allow high S/N observations

FUV02, Flight Backup Detector Deep Flat - A





Side A has hexagonal modulation like B. However there is also some Moire pattern. Again, correctable with flat field normalization to a significant degree.

Software/Ops Update

- Brownsberger and Béland continue their presence at Ball supporting the SW/OPS efforts – both are qualified COS instrument operators.
- CEDAR has been stable for some months, is supporting instrument I&T, and is ready to support upcoming I&T activities.

COS Schedule Milestones for CU/UCB

Task	Status
CALCOS Software Development	On-going. Completion by ~ TV-2 mos
Cal/FF SS Retest	1/03
Deliver FUV-02 to Ball	1/03
Complete COS TV Procedure	2/03
Support Sys. Functional at Ball	2/03
Support GSFC Activities	3/03 – 4/03
Science Cal Prep	2 – 5/03

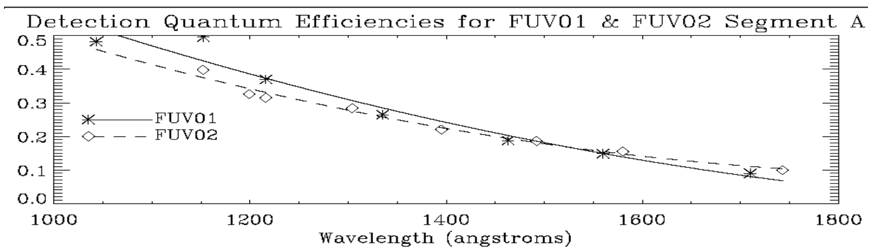
FUV Detector Swap

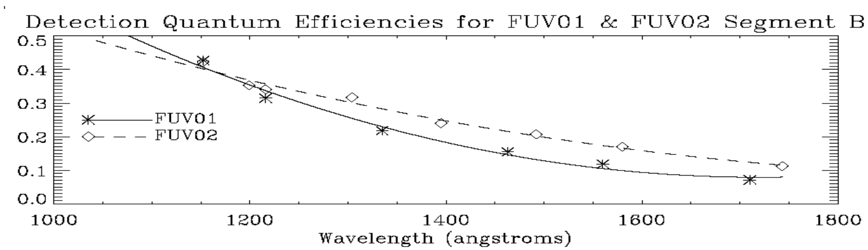
- IDT has polled the science team and conducted extensive internal discussions concerning the merits of swapping the detectors.
- The issues examined include:
  - Instrument sensitivity improvements (large FUV-02 advantage)
  - Maximum achievable S/N (small FUV-01 advantage)
  - Detectability of faint ISM lines (tie)
  - Exposure time requirements with regard to key GTO and likely GO program (FUV-02 advantage)
  - Detector electronic reliability (small FUV-01 advantage, confidence from run time)
  - Mechanical reliability (equal)
  - Cost and schedule (FUV-01 advantage)

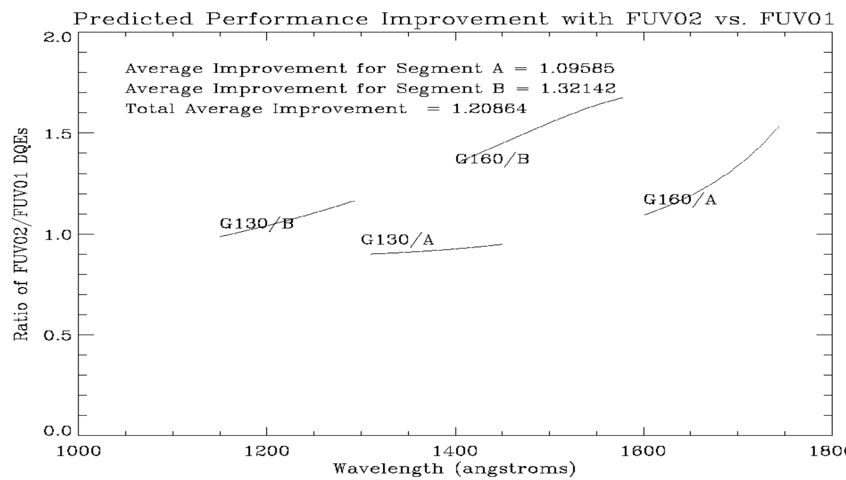
Recommendation: Designate FUV-02 as flight and swap after FUV-01 HOMS alignment verification.

DQE Comparison

- FUV02 DQE:
  - Decisively better on segment A
  - Similar on segment B



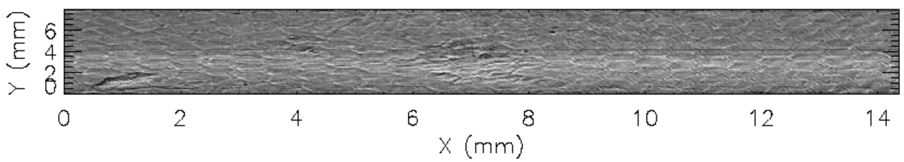




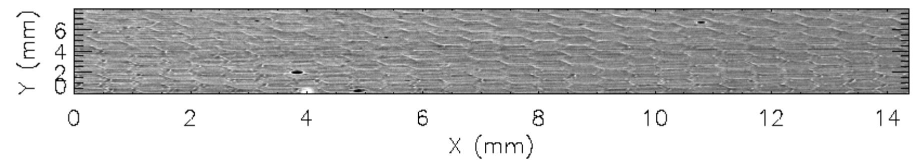
- G130M shows modest net gain
- G160M shows large (30-50%) net gain
- G140L spectrum appears on segment A; performance essentially unchanged

Flat-field characteristics

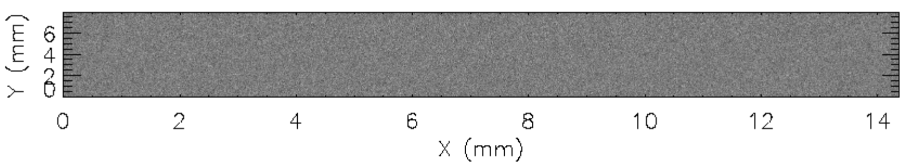
FUV02 Segment A
Intensity



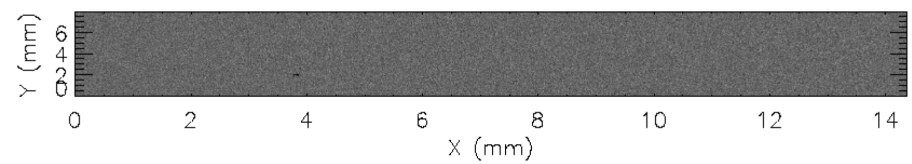
Segment B
Intensity



FUV02 Segment A
Residuals



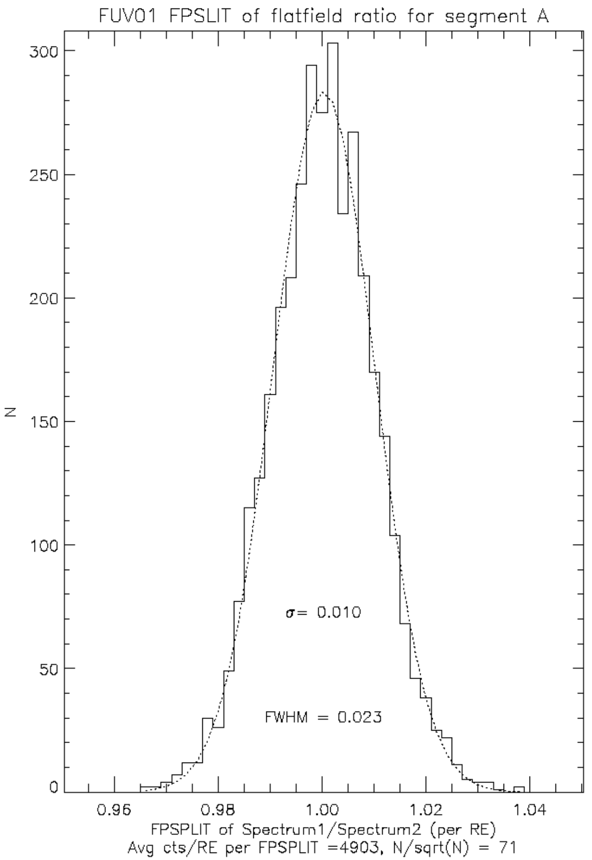
Segment B
Residuals

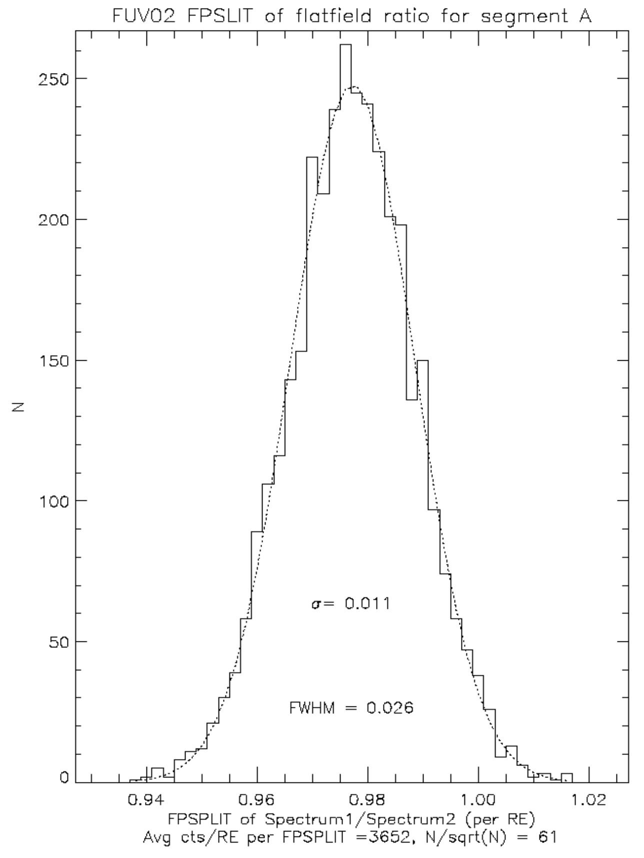


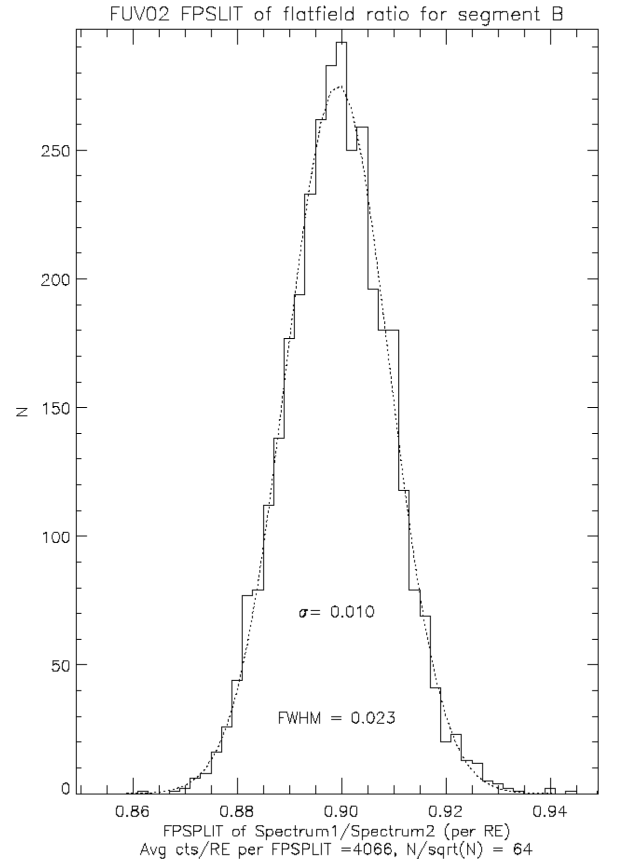
- FUV02 flat-field appears stable and well-behaved on both segments
  - Segment B is cosmetically clean
  - Segment A has several “rough” areas and dead spots, some of which are in the science region
    - Rough areas flat-field out like other fixed pattern noise
    - Residuals are similar to FUV01 segment A
    - Also can perform FP-SPLITs to improve S/N

Flat-field residuals

- Deep time-tag flat-fields were separated into two high-S/N exposures and divided





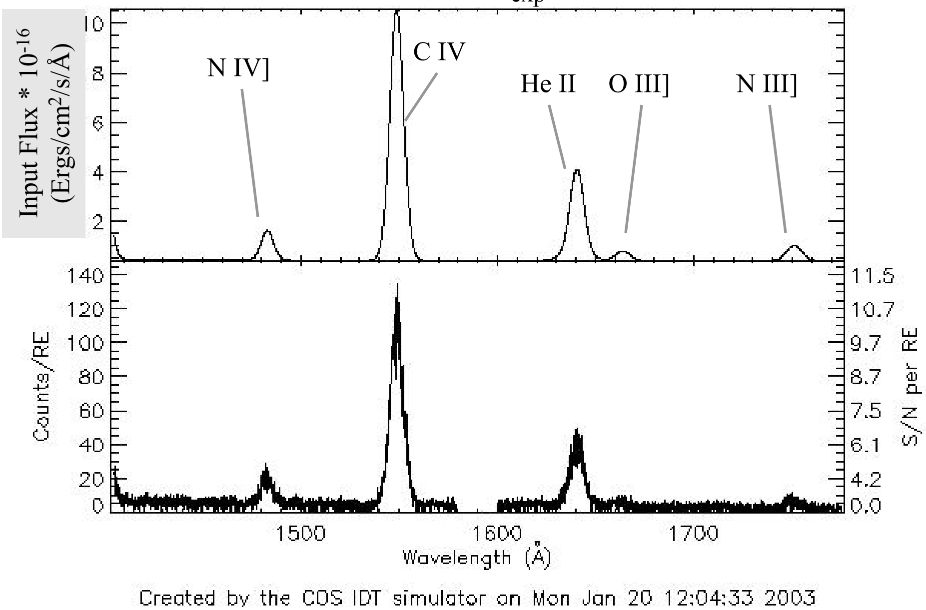


Benefit to GO community

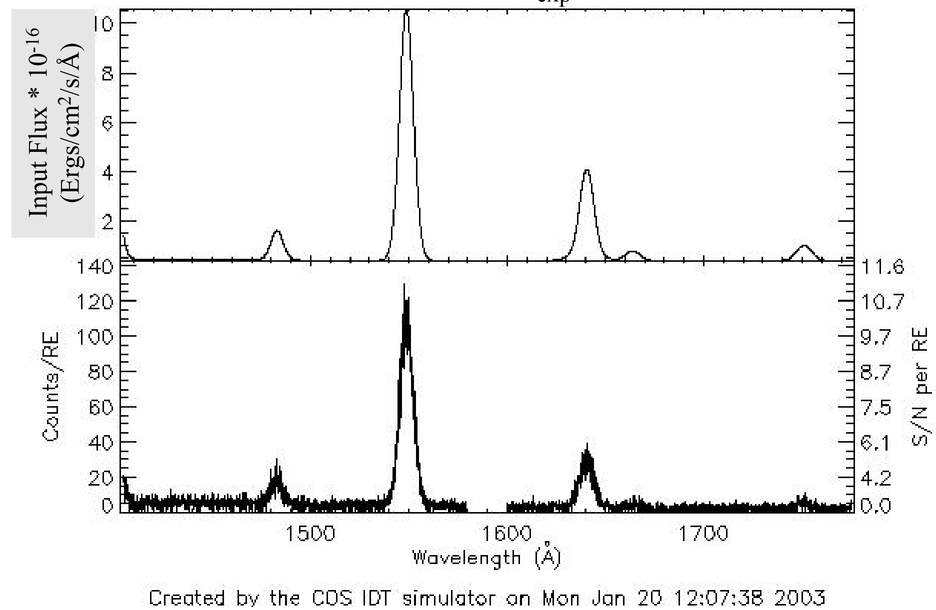
- STScI estimates COS usage at ~1000 orbits per year (~20-25% of science orbits)
- With largest sensitivity gains over STIS in the FUV, estimate that ~500 orbits/yr would be spent on FUV science
  - DRM programs show:
    - 25% use G130M only (e.g., HeII Gunn-Peterson, Lyα in nearby starbursts)
    - 40% use G130M and G160M (e.g., Lyα forest to z~0.5; Local Group PNe; ISM absorption lines)
    - 15% use G160M only (e.g., Wolf-Rayet stars and other ISW systems; CVs, X-ray binaries, fluorescent H_2 in YSO jets)
    - 20% use G140L (e.g., extinction studies, QSO snapshots, SNRs)
  - Modest throughput gain for G130M and large gain for G160M (especially at C IV λλ1550) will result in ~20% net efficiency gain for FUV projects
- <u>~100 orbits/yr</u> will be made available for additional programs or higher S/N

Active galactic nucleus comparison

AGN – FUV01 G160M, t_{exp}= 15,000 sec



AGN – FUV02 G160M, t_{exp}= 10,000 sec



- NGC1068 C IV peak emission flux scaled by 1/2000 to 1e-15 ergs/cm²/s/Å
- FUV02 provides same S/N per resolution element in 33% less time

COS GTO Program To Study the Low Redshift Intergalactic Medium

- Roughly 210 GTO orbits devoted to low-z IGM studies
  - Programs require relatively flat S/N from 1200–1700 Å
    - Measure redshifted Lyα, Lyβ, and metals to a uniform equivalent width limit
    - Detect zero-redshift (i.e., Milky Way halo) N V, Si IV, and C IV lines to complement existing FUSE O VI data (~150 sightlines)
  - Current plan devotes ~2/3 of exposure time to G160M observations (1/3 devoted to G130M) due to lower throughput of G160M versus G130M
    - Improvement of 30-50% in QE between 1500 and 1700 Å leads to increased efficiency
  - Savings of ~65 orbits possible for this COS GTO program alone
    - Allows ~25% more sight lines to be observed
    - Allows higher S/N to be obtained
- 1000 orbit QSO-IGM Treasury Program to be proposed will benefit 5-fold
  - Additional extragalactic science programs will also benefit
    - Studies of star-forming galaxies
    - Studies of higher redshift IGM

Upcoming Events/Activities

- Complete FUV-02 TV test.
- Delivery FUV-02 to Ball.
- Support FUV detector swap if agreed to.
- Complete Cal/FF sub-system testing.
- Complete COS TV test procedure.
- Support I&T at Ball and GSFC.

Issues

- None