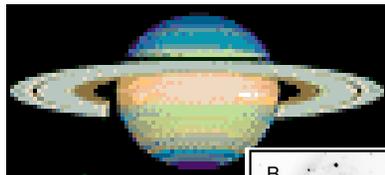
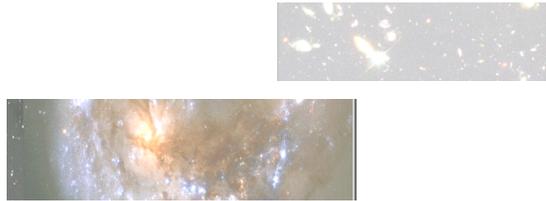
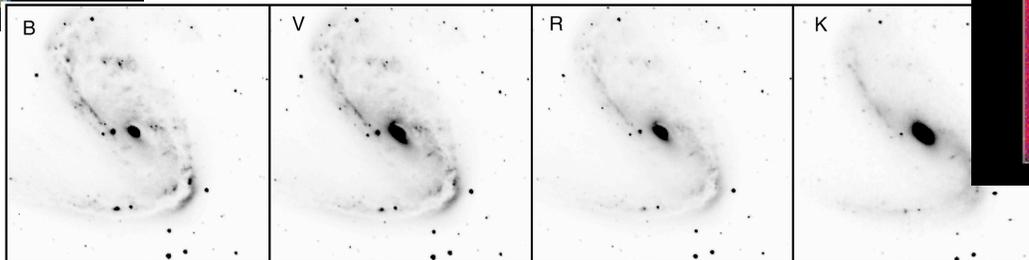
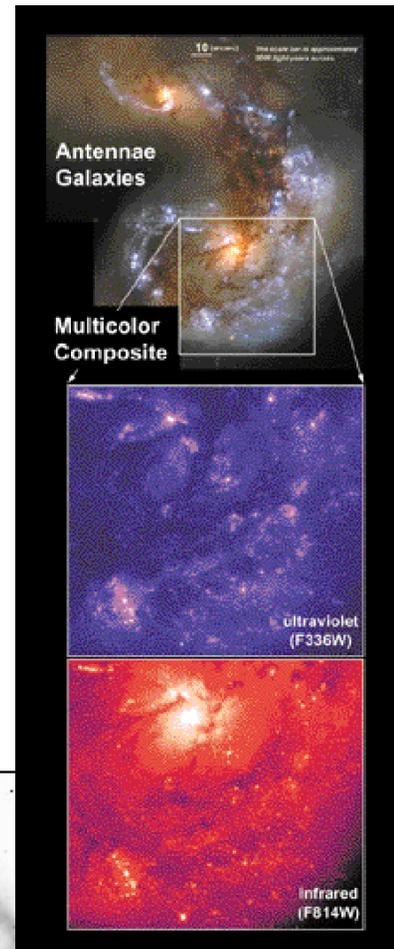




# HST WFC3 Status



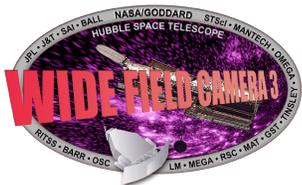
Ed Cheng  
Instrument Scientist



"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

OS WFC3 Status



# Summary



- Instrument development is proceeding well.
  - The optical bench is at Ball for integration.
    - Returns to GSFC ~ August 2002 for integration with enclosure.
  - Flight detectors are in-hand and being characterized.
  - All filters are in-hand and being installed.
- We are on-schedule for February 2004 launch.
  - Schedule contingency 29% of time to need date.
    - Relative to January launch.
- We are on-budget.
  - Budget contingency 38% of budget to complete.
    - Relative to January launch.

"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

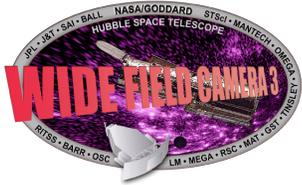


## Scientific Mandate



- Build upon HST's unique imaging capabilities.
  - Ensure an imaging capability through 2010 (**lifetime**).
  - Address on-orbit CCD degradation issues (**photometry**).
  - Radial bay operation not thermally constrained (**efficiency**).
- Provide a wide field and wide spectral range imaging capability, especially at the extremes of HST wavelength coverage.
  - Statistical studies of rare objects require large field-of-view.
  - “Panchromatic” approach to observations.
  - Complementary capabilities to ACS.

"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."



# Key Scientific Capabilities

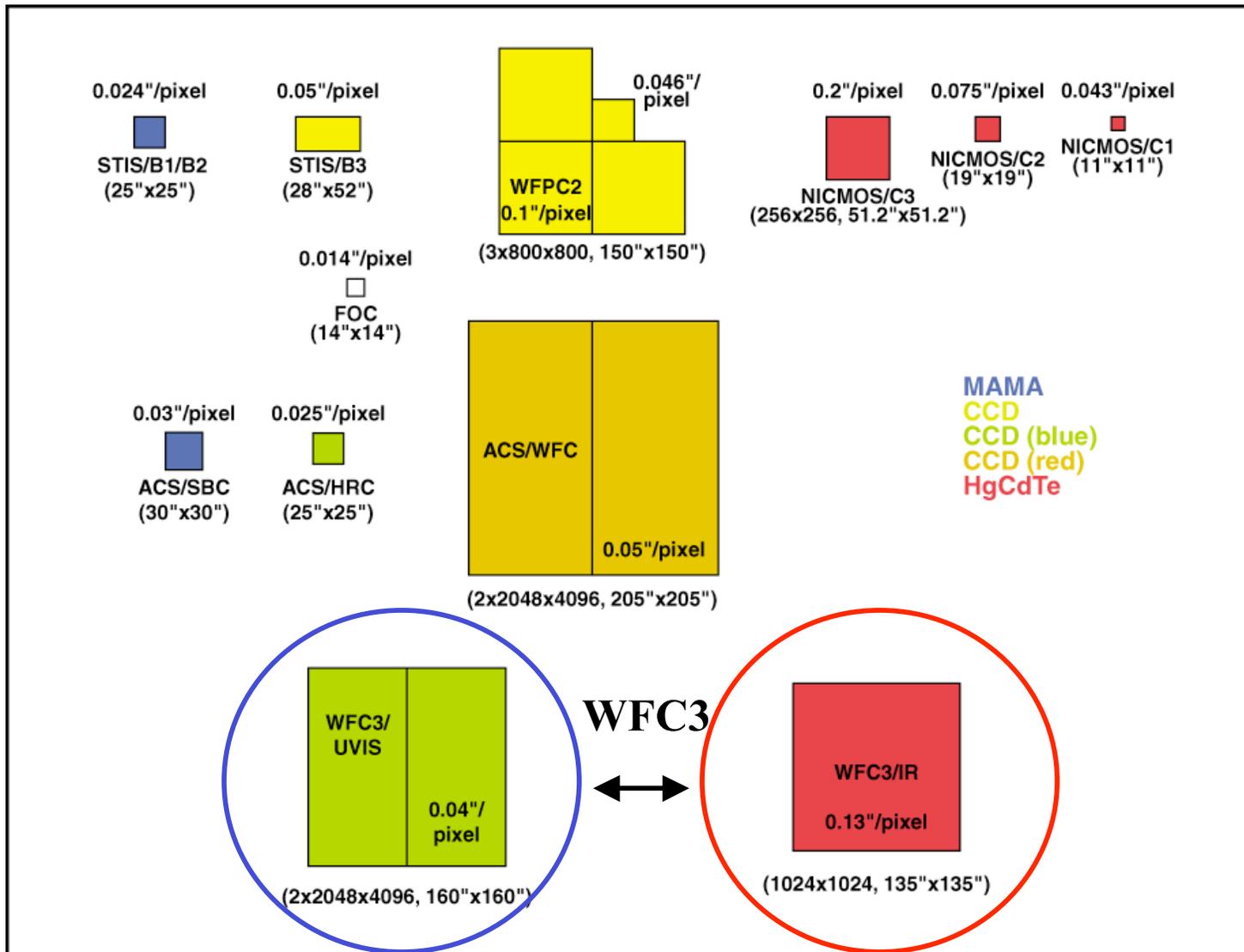


- Panchromatic coverage.
  - 200 to 1700 nm.
  - Widest coverage for any instrument on HST.
- Uniquely capable in the near-UV.
  - 200 to 400 nm.
  - Higher NUV “discovery efficiency” (throughput x FOV) than other HST instruments by 13 to 30x.
- Uniquely capable in the near-IR.
  - 800 to 1700 nm.
  - Discovery efficiency higher than NICMOS3 by 15x (100x over NICMOS2).
- Large and diverse set of filters.
  - 48 UVIS, 16 IR, especially narrow and intermediate band.
  - Significant improvement on STIS and ACS complement.

"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."



# HST Imaging FOV



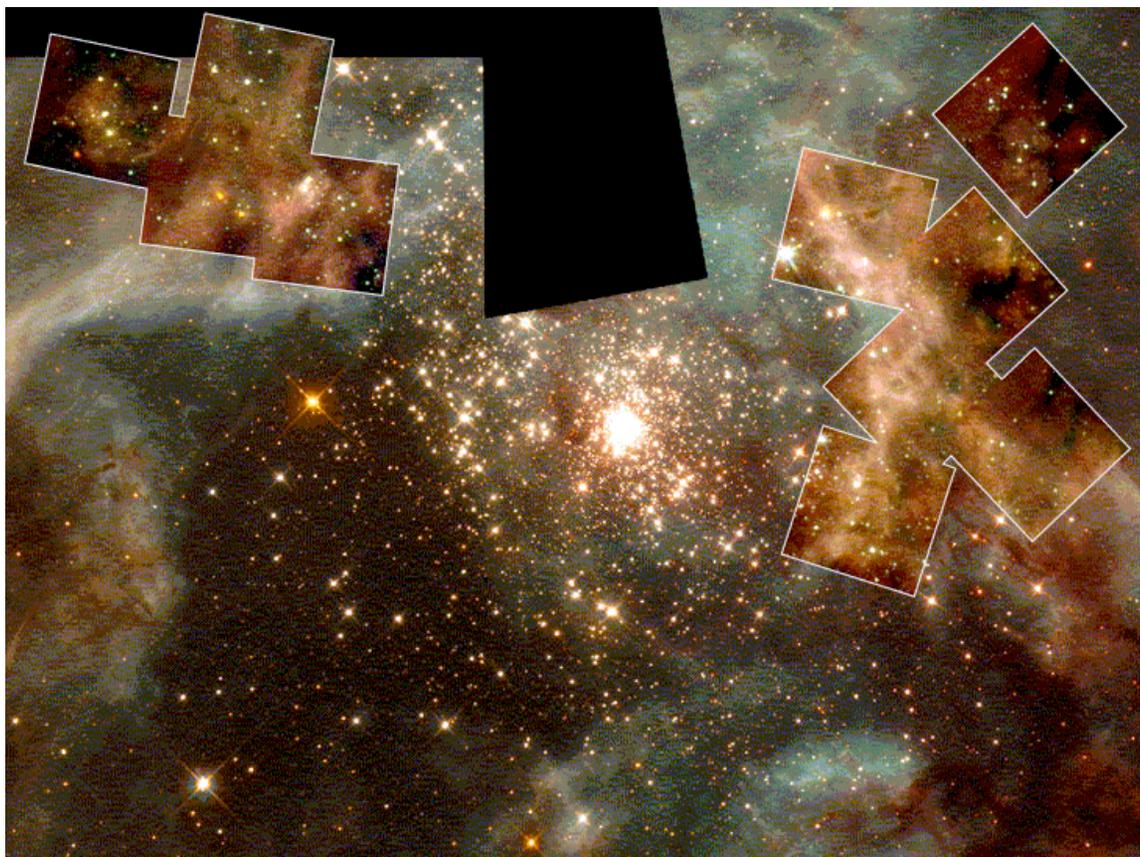
"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

OS WFC3 Status



# Wide Field Coverage Improves Survey Efficiency



30 Doradus (vis and IR)

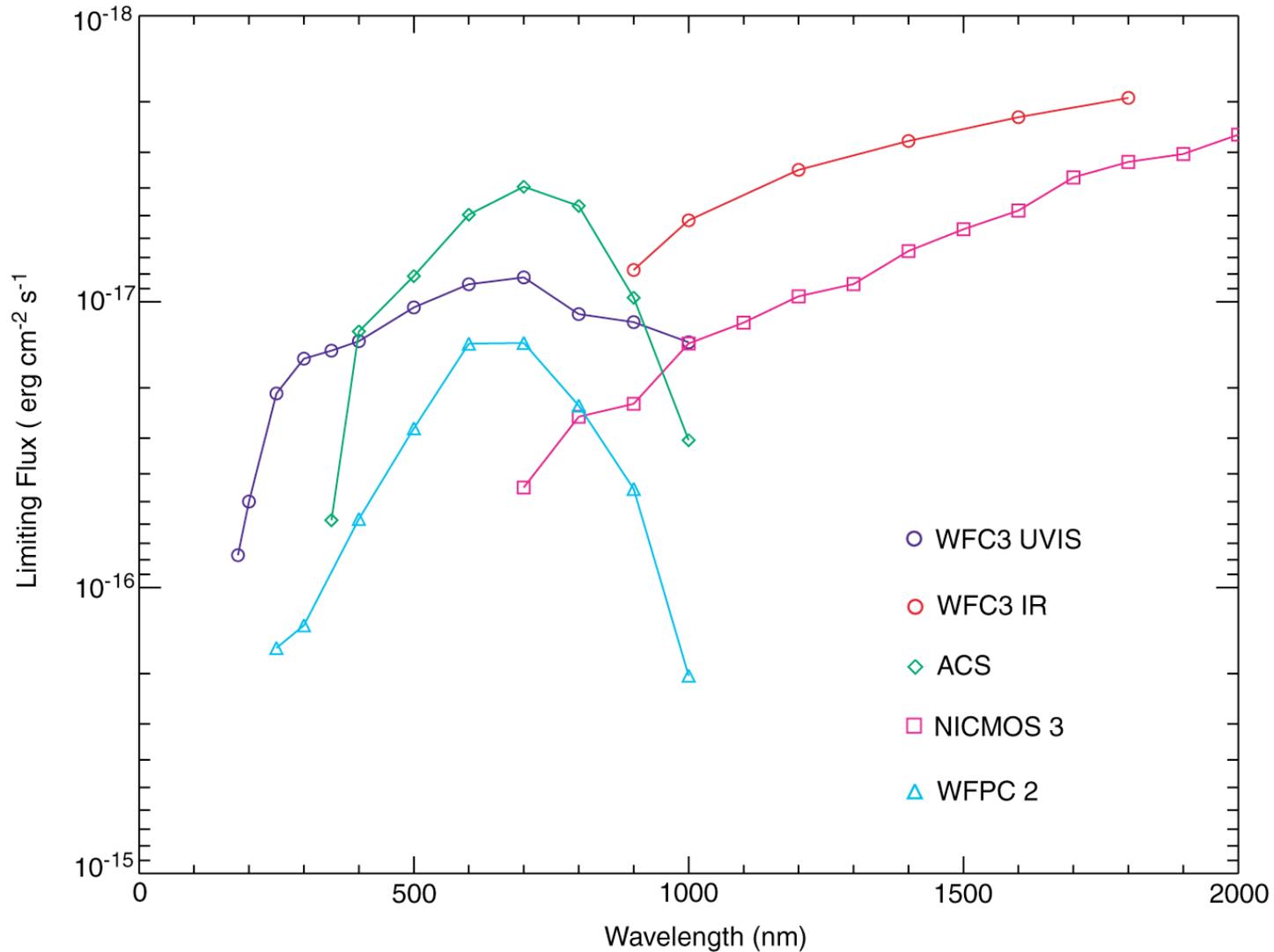
"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

OS WFC3 Status



# WFC3 Improves HST Imaging Sensitivity



"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

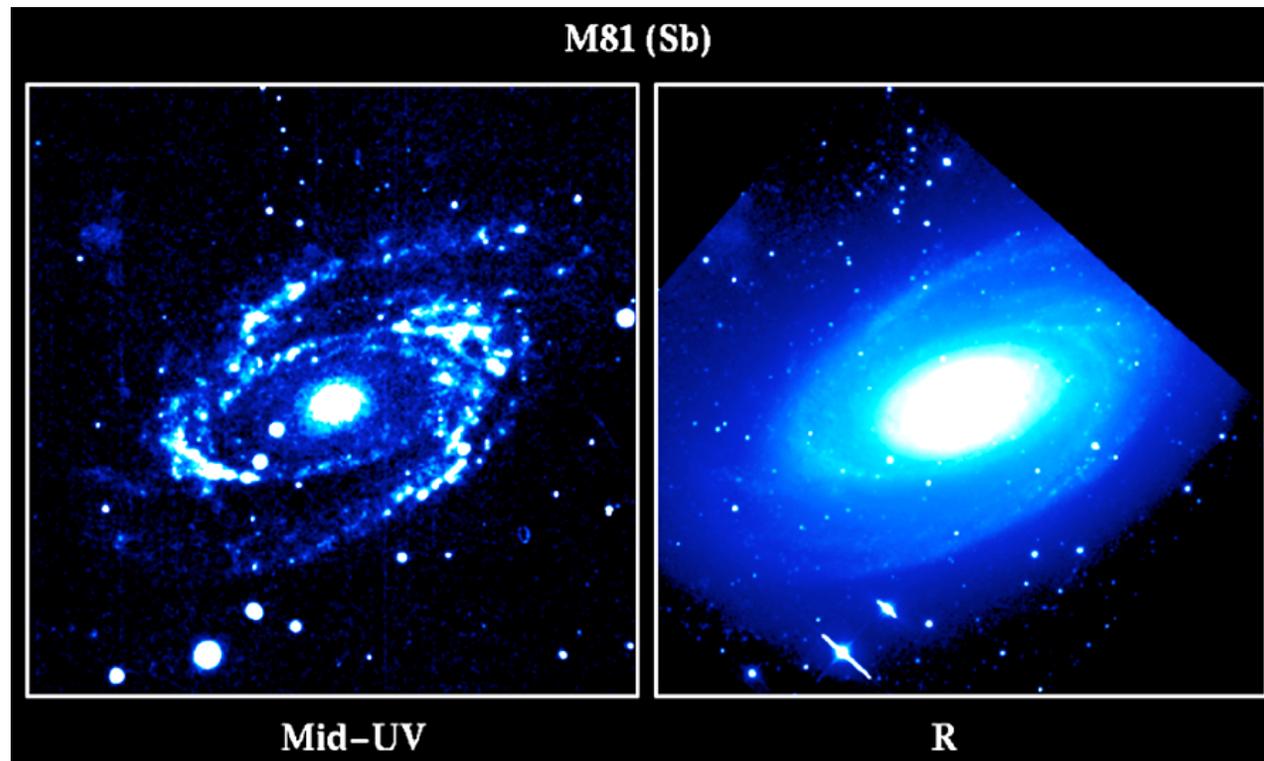
OS WFC3 Status



# The Panchromatic Galaxy



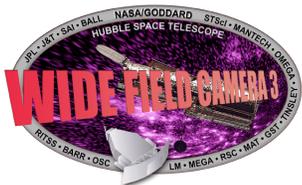
A synoptic view of galaxy evolution requires knowledge over a wide spectral band.



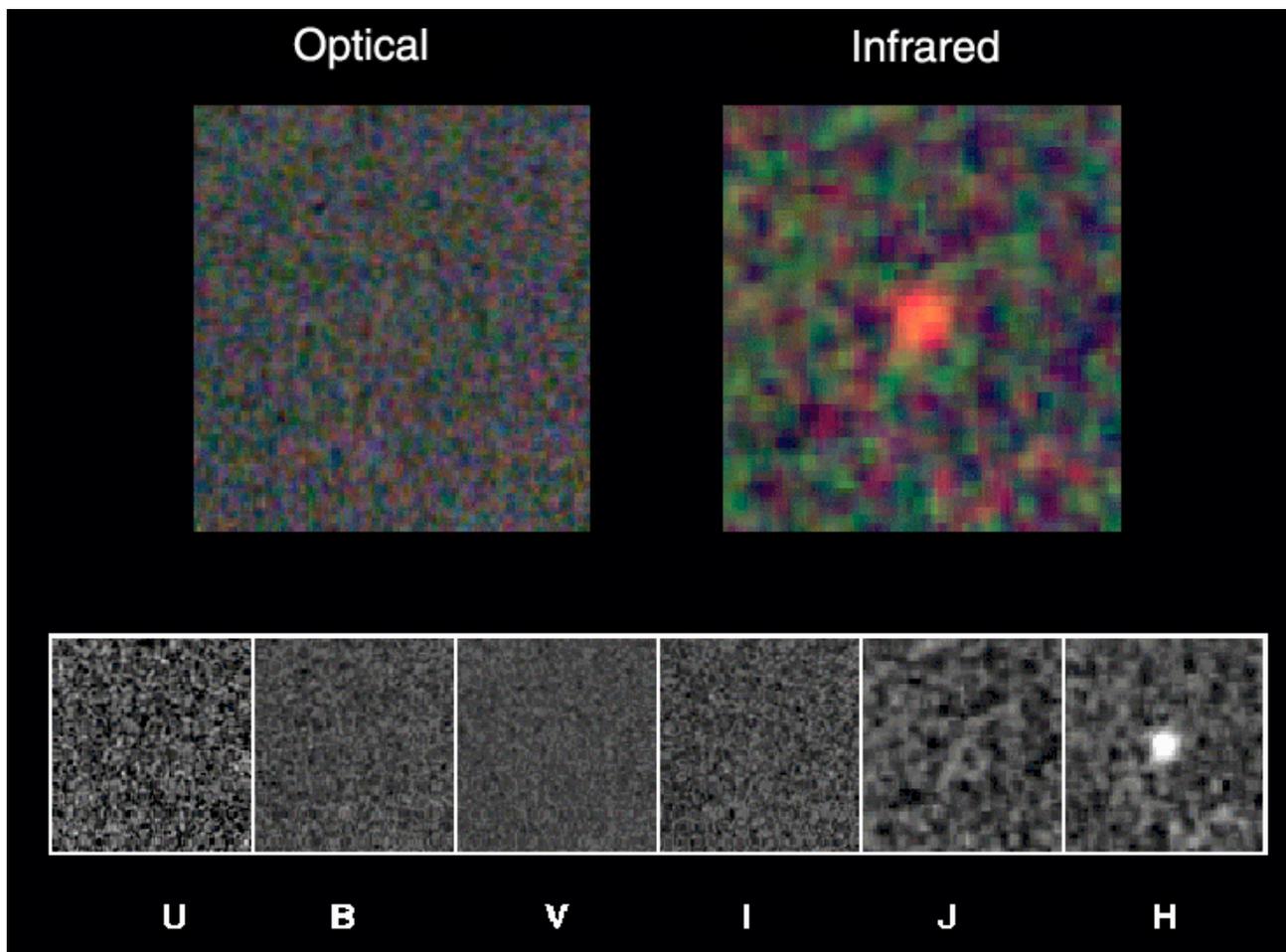
"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

OS WFC3 Status



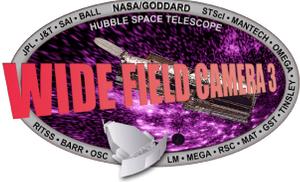
# The Near-IR Universe



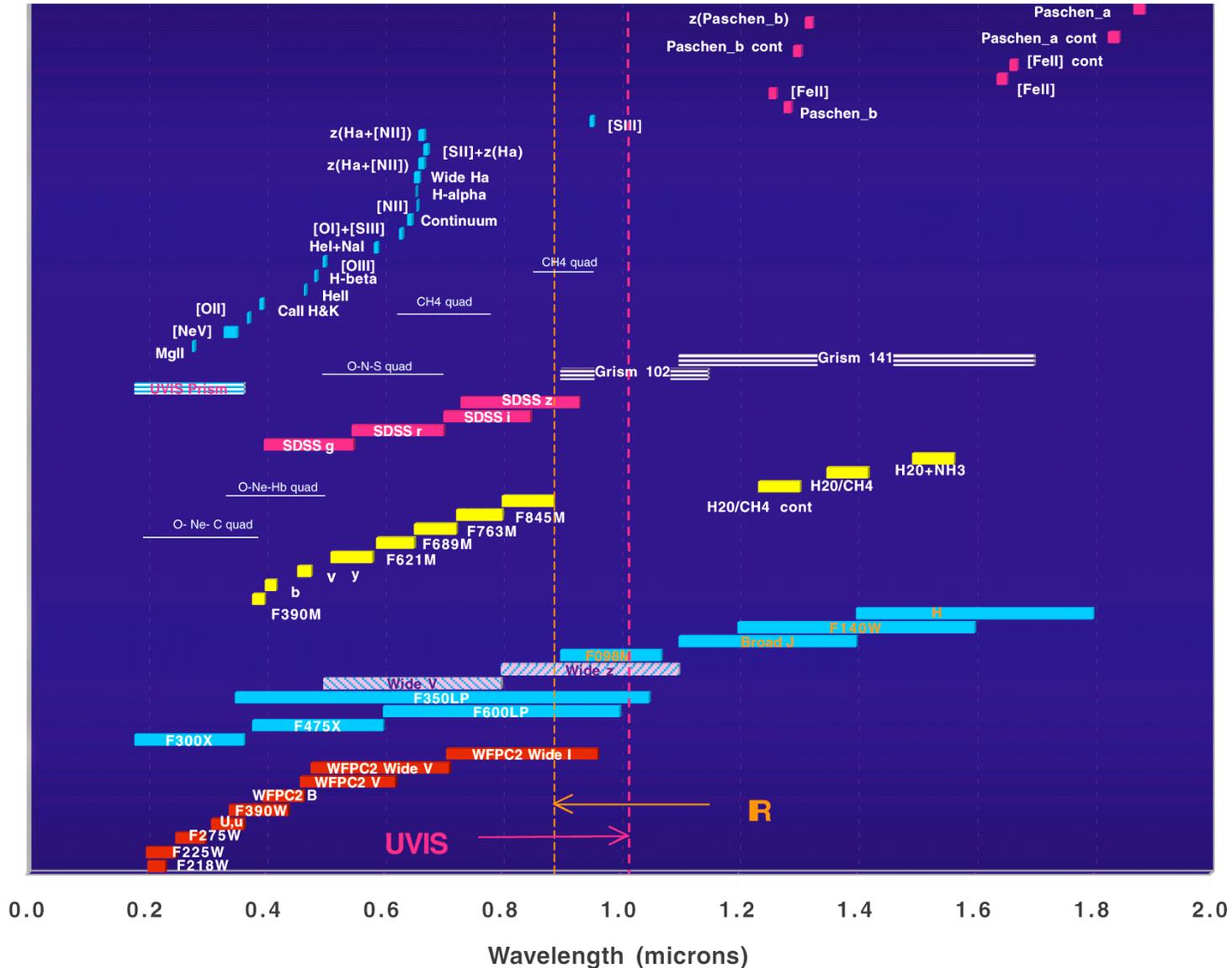
"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

OS WFC3 Status



# WFC3 Filter Complement



0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0

Wavelength (microns)

"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

OS WFC3 Status

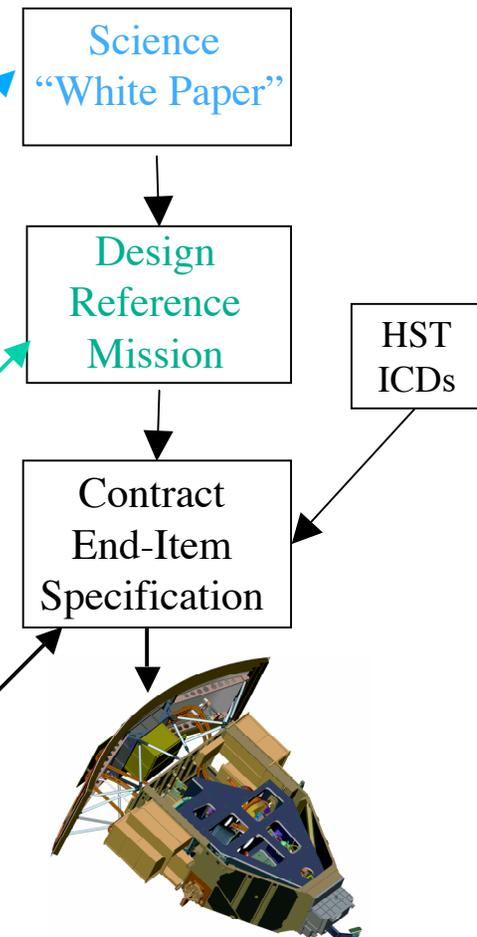


# Scientific Requirements Flowdown

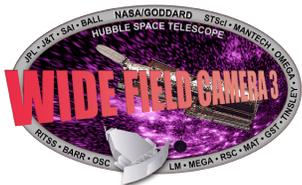


White Paper/DRM/CEIS process replaces the traditional CEIS Part 1/Part 2 process.

- More traceability to scientific performance.
- Scientific requirements are more clearly specified
- Better distinction between engineering/technical requirements and scientific requirements.
- The scientific case for WFC3 is spelled out in a detailed WFC3 Science “White Paper”.
  - Created by the WFC3 SOC and the SIPT.
  - Addresses the scientific need for panchromatic, UV, and IR capabilities.
- Design Reference Mission is created from White Paper.
  - 43 HST observation proposals.
  - Forms the basis for quantitative evaluation of instrument performance.
  - Instrument changes are evaluated against the DRM proposals
- The CEIS specifies an instrument that optimally executes the White Paper/DRM programs.
  - Includes engineering specifications from ICDs.



"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."



# Scientific Oversight Committee



SOC Member		Affiliation
<b>Bruce</b>	<b>Balick</b>	<b>University of Washington</b>
<b>Howard</b>	<b>Bond</b>	<b>Space Telescope Science Institute</b>
<b>Daniela</b>	<b>Calzetti</b>	<b>Space Telescope Science Institute</b>
<b>Marcella</b>	<b>Carollo</b>	<b>Columbia University</b>
<b>Michael</b>	<b>Disney</b>	<b>University of Wales At Cardiff</b>
<b>Michael</b>	<b>Dopita</b>	<b>Institute Of Advanced Studies Mt. Stromlo &amp; Siding Spring Observatory</b>
<b>Jay</b>	<b>Frogel</b>	<b>Ohio State University</b>
<b>Donald</b>	<b>Hall</b>	<b>University of Hawaii</b>
<b>Jon</b>	<b>Holtzman</b>	<b>New Mexico State University</b>
<b>Gerard</b>	<b>Luppino</b>	<b>University Of Hawaii</b>
<b>Patrick</b>	<b>McCarthy</b>	<b>Carnegie Observatories</b>
<b>Robert</b>	<b>O'Connell (Chair Person)</b>	<b>University of Virginia</b>
<b>Francesco</b>	<b>Paresce</b>	<b>European Southern Observatory</b>
<b>Abhijit</b>	<b>Saha</b>	<b>National Optical Astronomy Observatory</b>
<b>Joseph</b>	<b>Silk</b>	<b>University of California, Berkeley</b>
<b>John</b>	<b>Trauger</b>	<b>Jet Propulsion Laboratory</b>
<b>Alistair</b>	<b>Walker</b>	<b>NOAO CTIO</b>
<b>Brad</b>	<b>Whitmore</b>	<b>Space Telescope Science Institute</b>
<b>Rogier</b>	<b>Windhorst</b>	<b>Arizona State University</b>
<b>Erick</b>	<b>Young</b>	<b>University of Arizona</b>

"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

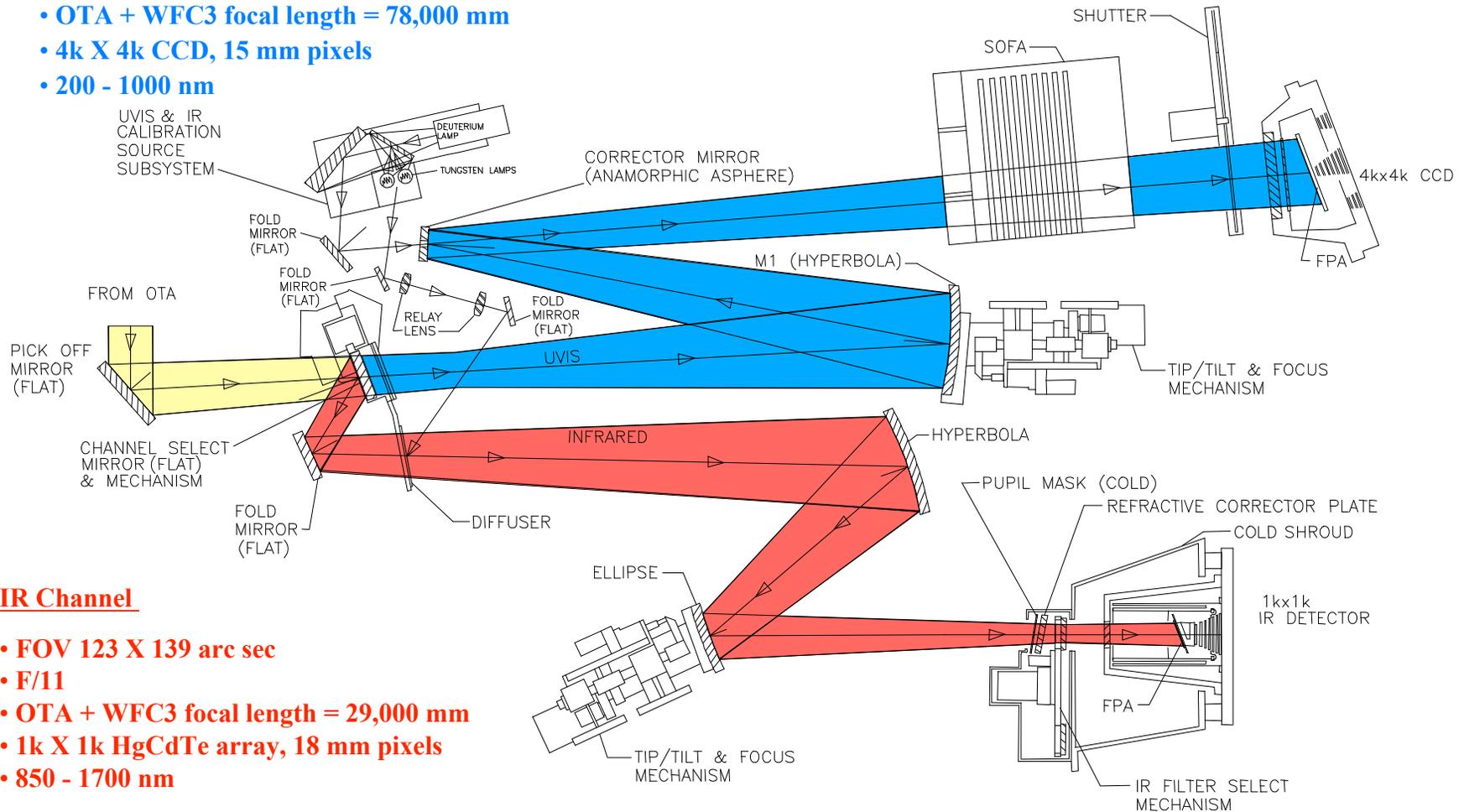


# Optical Paths: UVIS and IR



## UVIS Channel

- FOV 160 X 160 arc sec
- F/31
- OTA + WFC3 focal length = 78,000 mm
- 4k X 4k CCD, 15 mm pixels
- 200 - 1000 nm



## IR Channel

- FOV 123 X 139 arc sec
- F/11
- OTA + WFC3 focal length = 29,000 mm
- 1k X 1k HgCdTe array, 18 mm pixels
- 850 - 1700 nm

"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

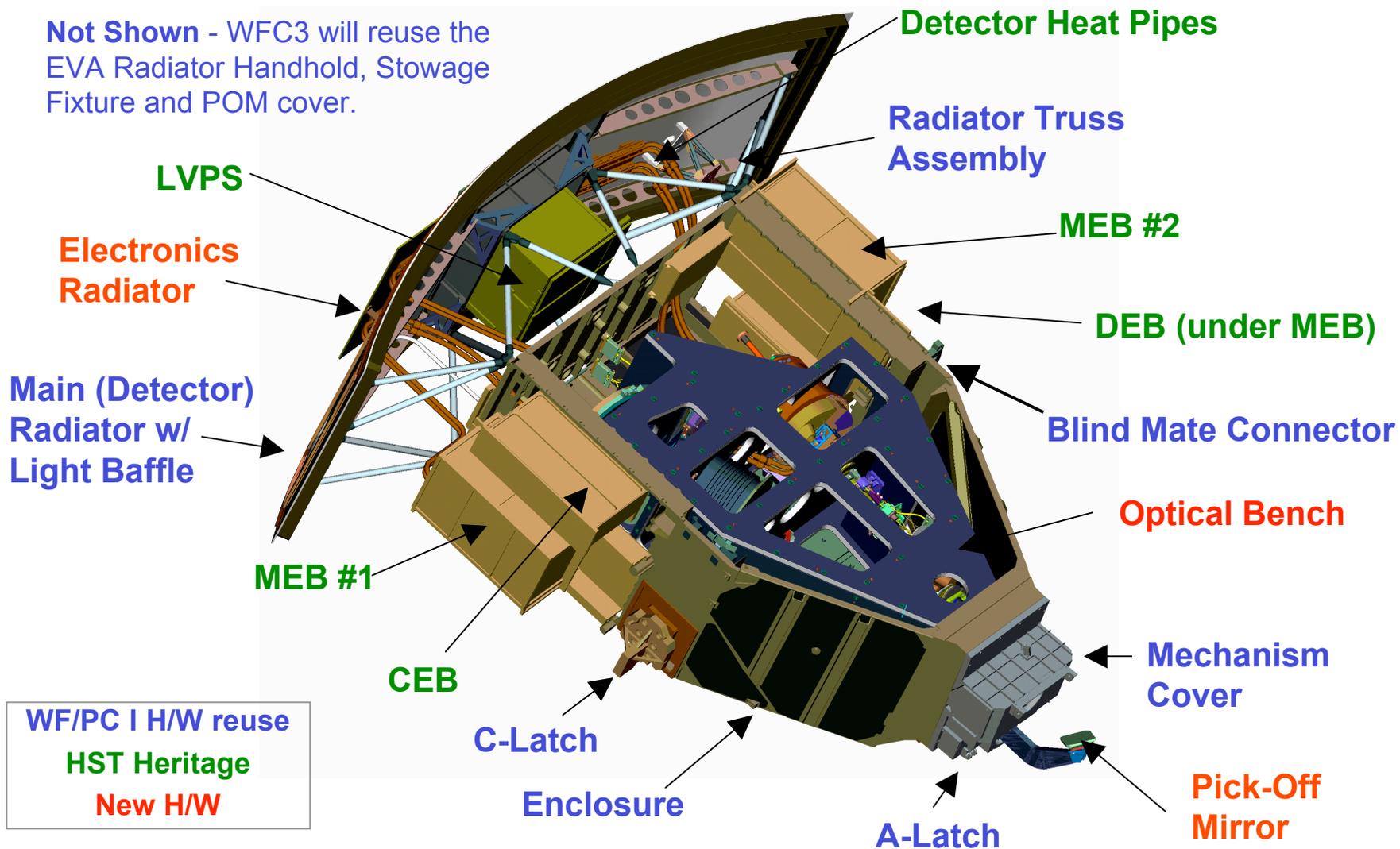
OS WFC3 Status



# WFC3 Configuration / Heritage



Not Shown - WFC3 will reuse the EVA Radiator Handhold, Stowage Fixture and POM cover.



WF/PC I H/W reuse  
HST Heritage  
New H/W

"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

OS WFC3 Status

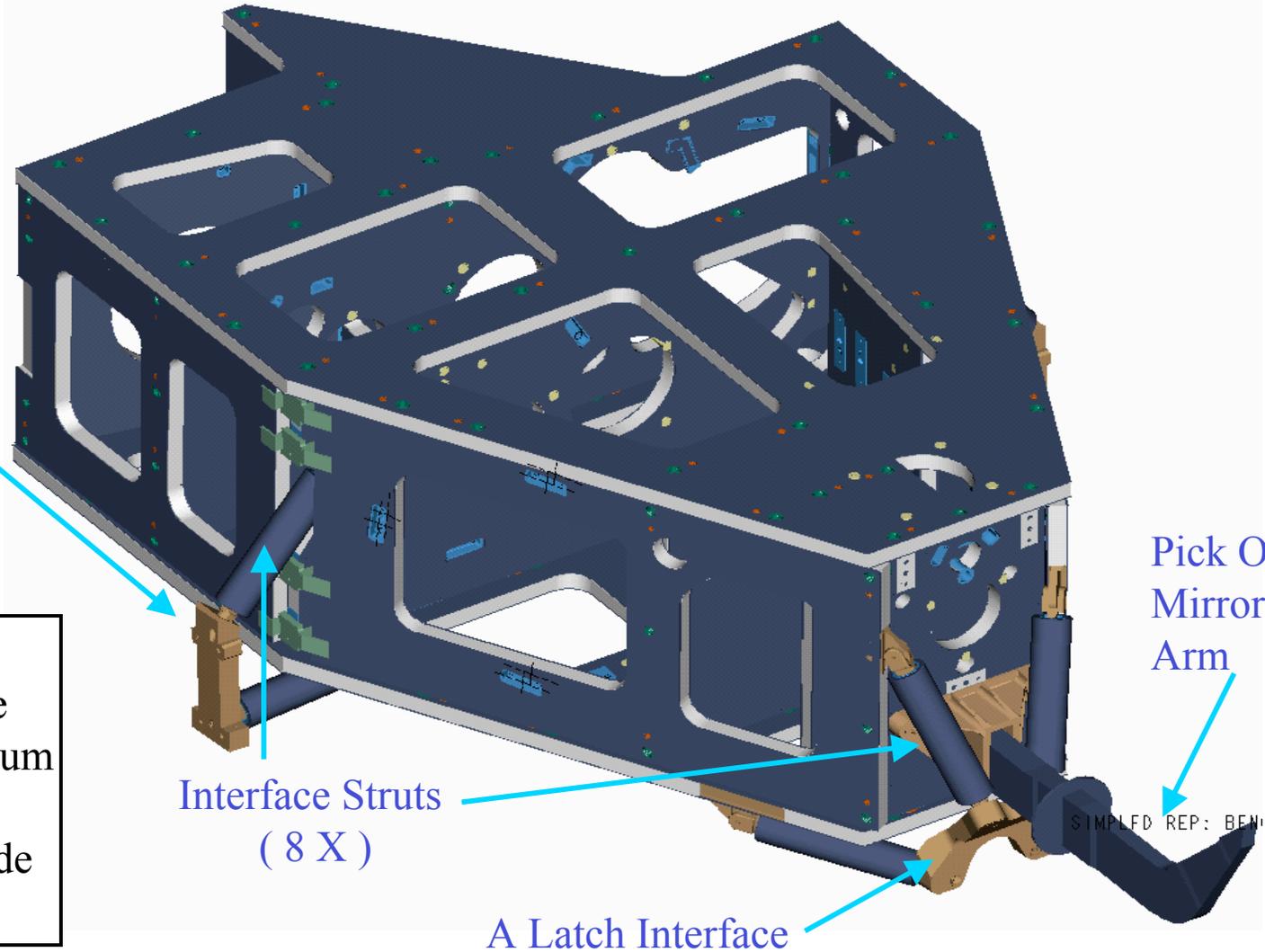


# New Optical Bench for WFC3



B - Latch  
Interface  
Bracket

Optical Bench  
Graphite Cyanate  
Siloxane/Aluminum  
honeycomb;  
bulkheads and side  
panels



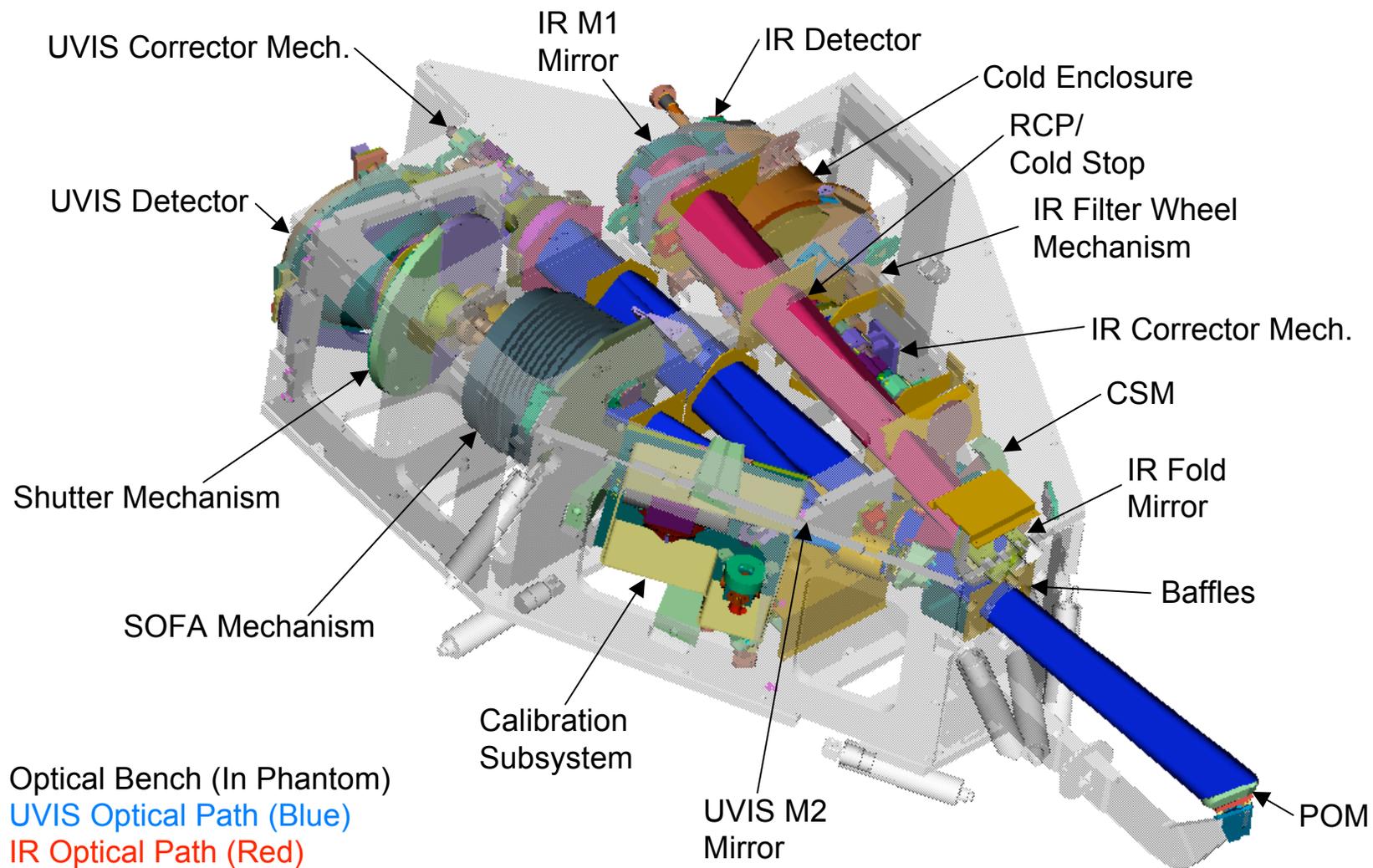
"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

OS WFC3 Status



# Detailed Optical Bench Layout



"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

OS WFC3 Status



# The Optical Bench At Ball



"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

OS WFC3 Status



# Filters Bonded Into 6 of 12 SOFA Filter Wheels



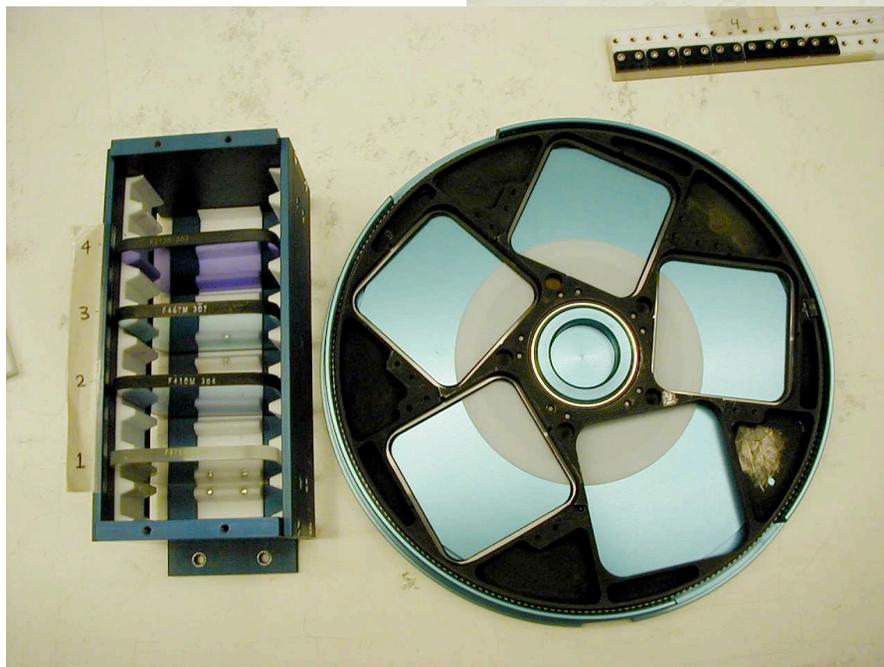
Bonding Dams installed on two wheels

Filters ready for installation



Bonding fixtures for clamp pads

Filters installed



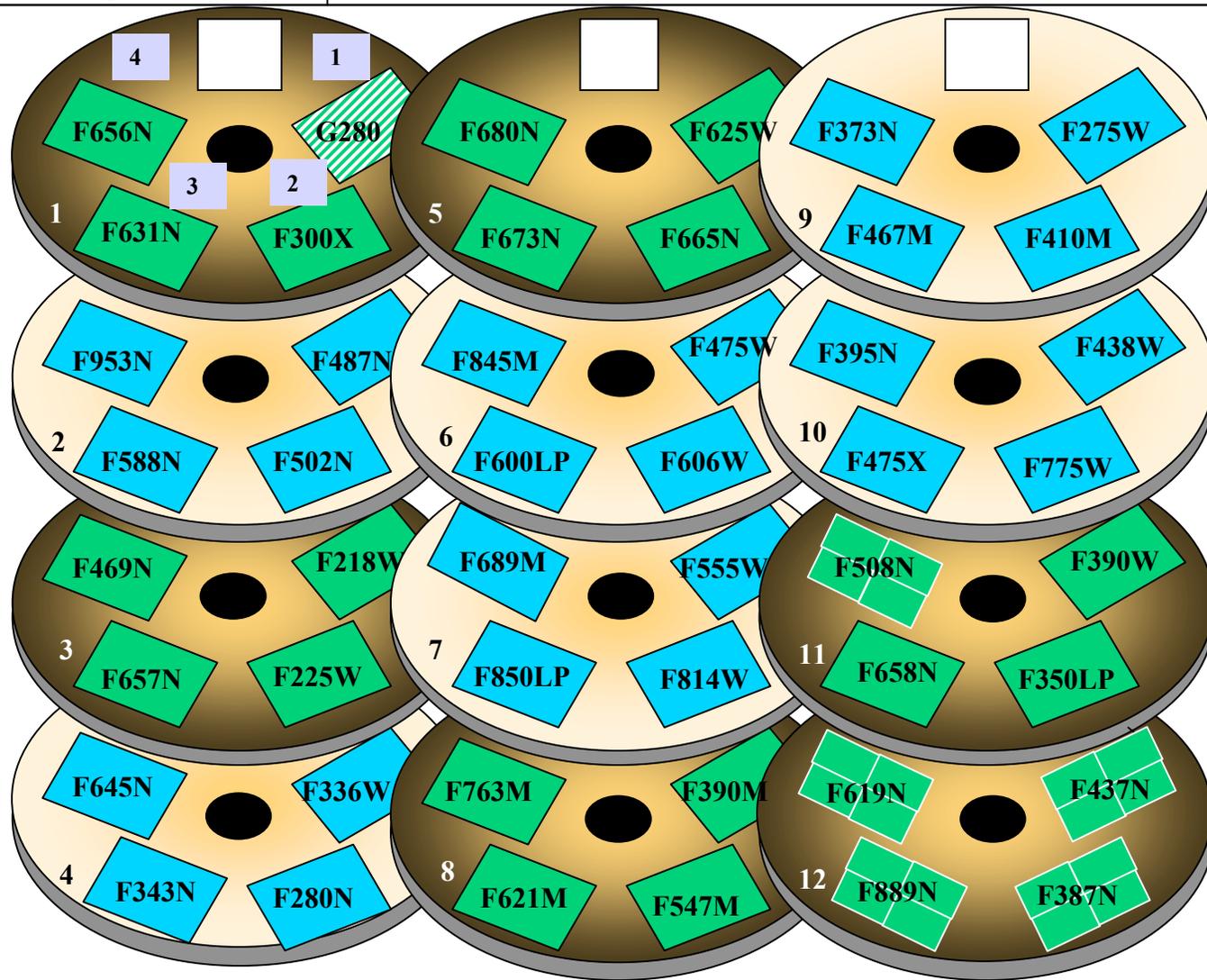
"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

OS WFC3 Status



# SOFA Filters Installation In Progress

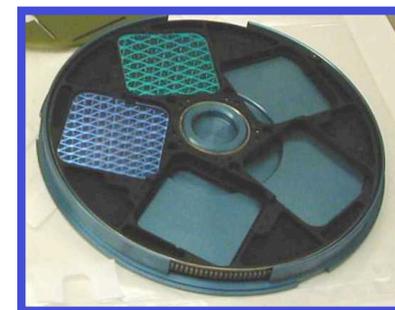


## All UVIS filters

- Have been delivered from vendors, Barr & Omega,
- Characterized at JPL and
- Delivered to Ball for bonding into flight wheels

 **Filters Bonded**  
(6 wheels)

 **Filters Not Bonded**  
(6 wheels)



Looking in from the OTA toward the CCD

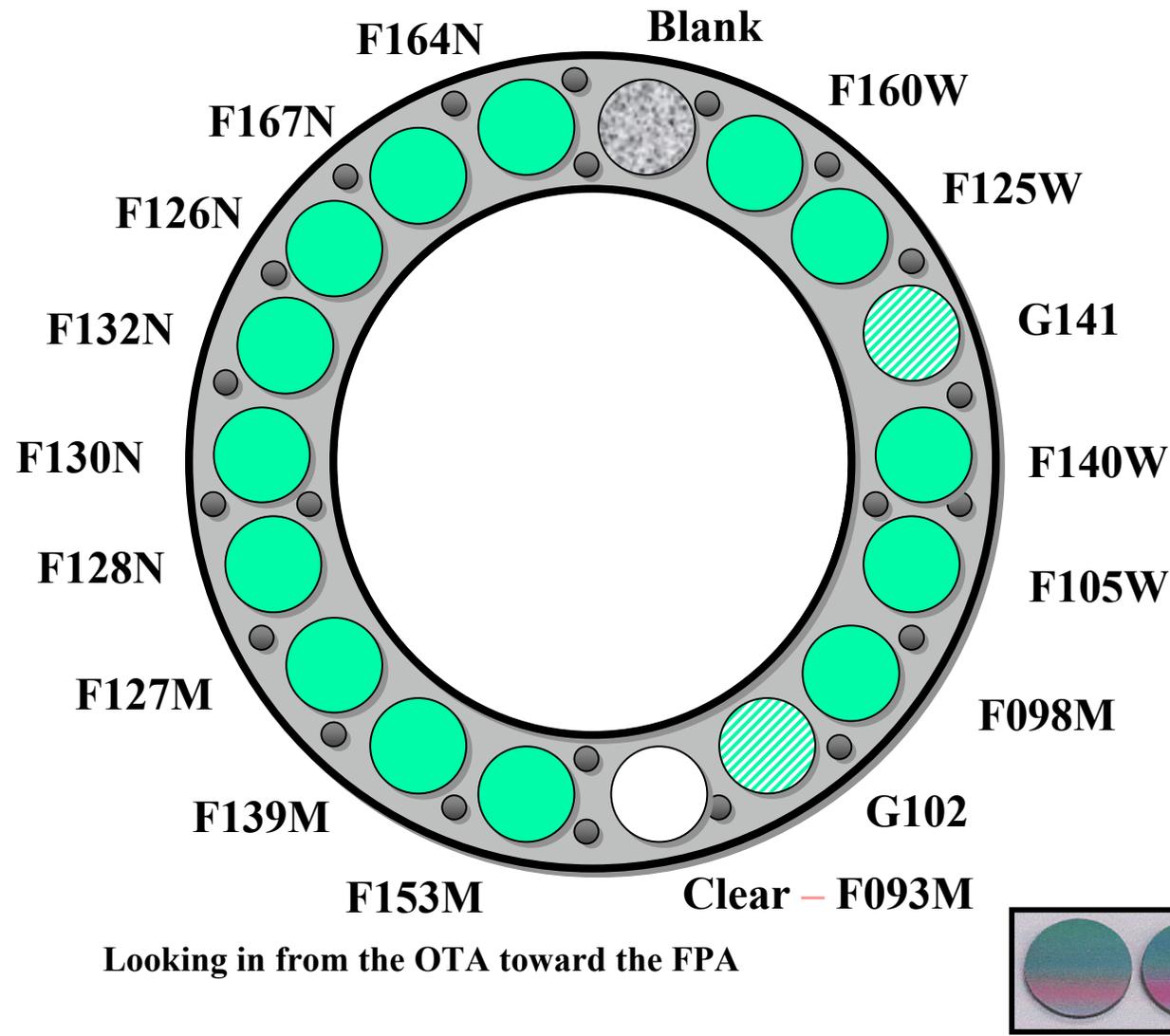
"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

OS WFC3 Status

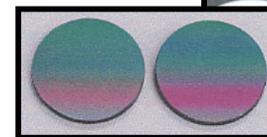


# IR Filters Ready For Installation



## All IR filters

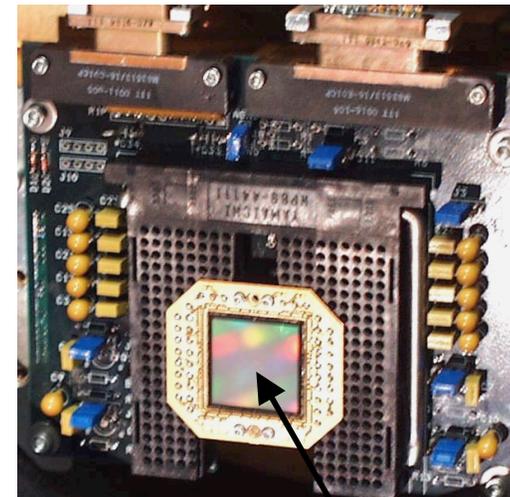
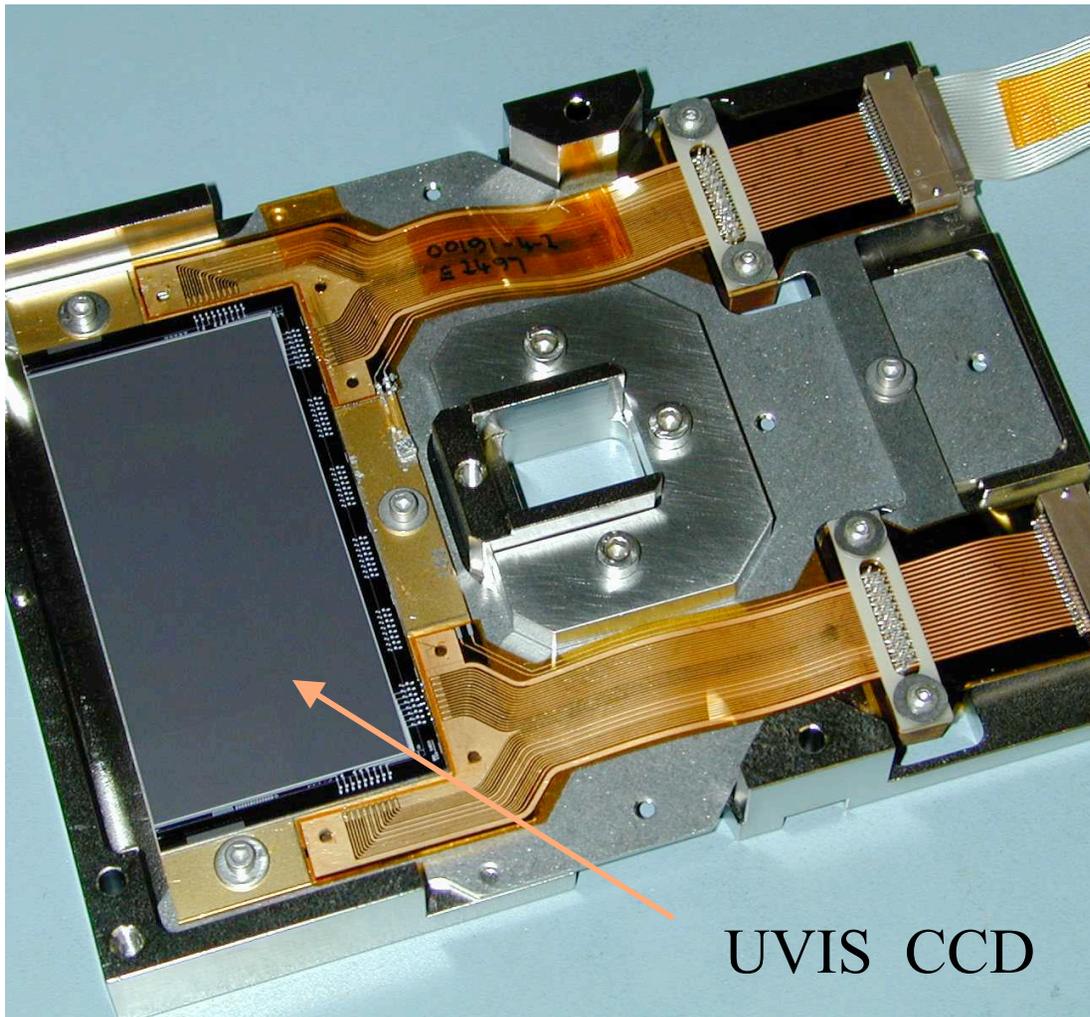
- Have been delivered from vendors, Barr & RGL
- Characterized at GSFC and
- Delivered to Ball for bonding into the flight bezels / wheel



"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."



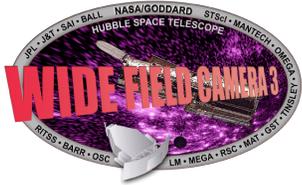
# WFC3 Flight Detectors



"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

OS WFC3 Status



# Flight Detectors are In-Hand

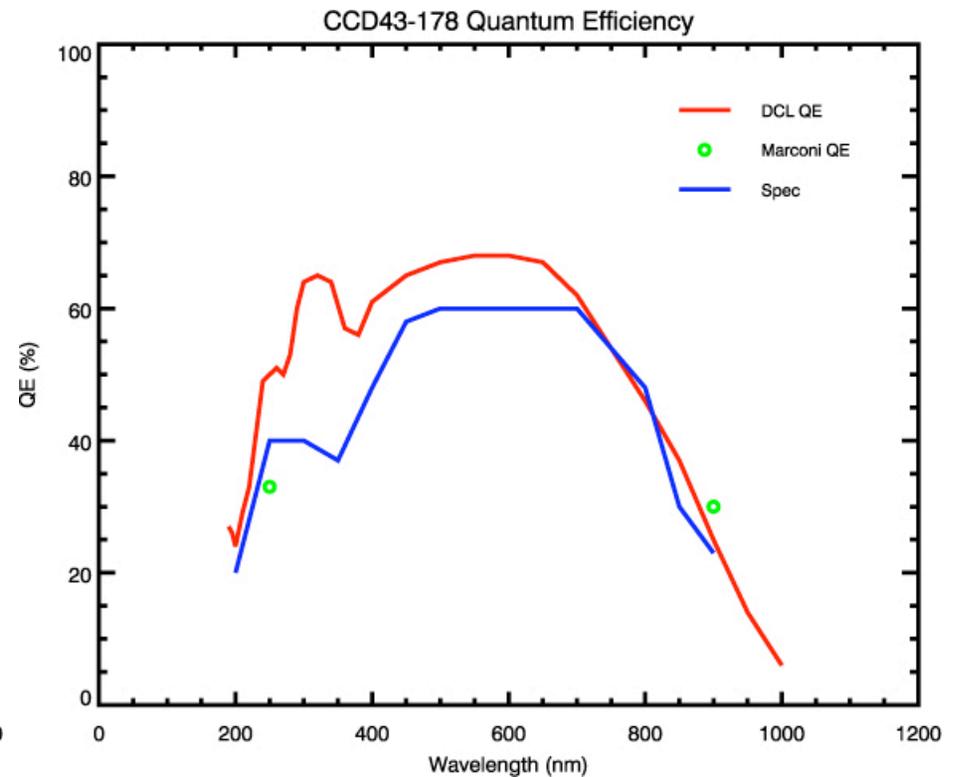
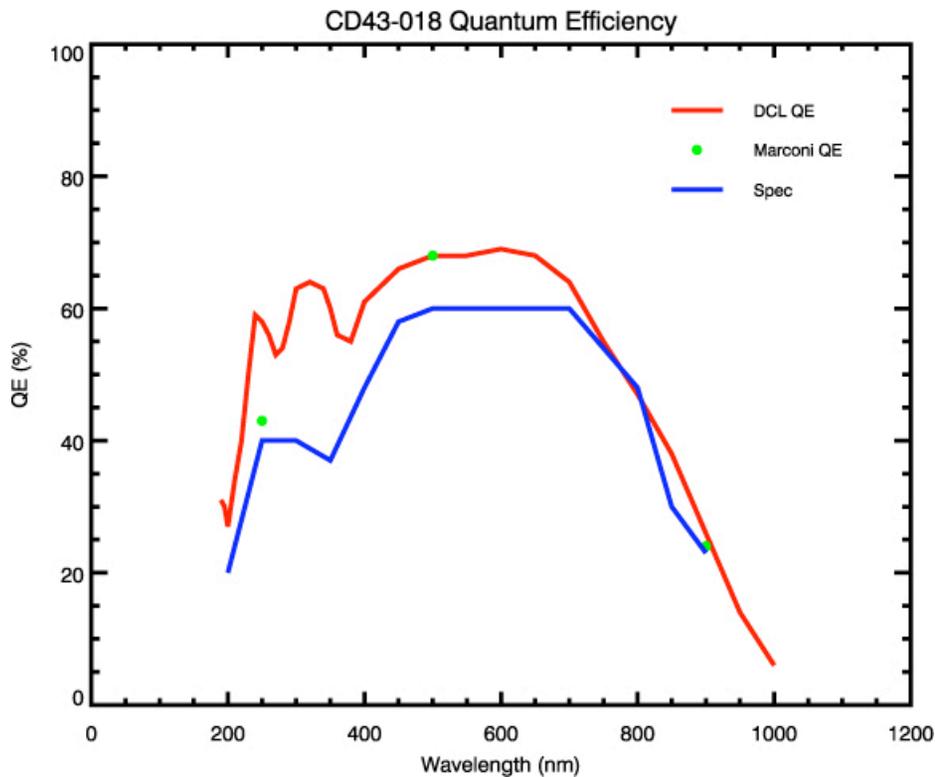


- Marconi 2K x 4K CCD detectors.
  - 2 required per focal plane.
  - 6 flight CCDs ordered.
  - 6 flight CCDs in-house.
  - Excellent performance - meets or exceeds specifications.
    - 2 additional devices on order for spares, one in-house.
- Rockwell Scientific 1K x 1K HgCdTe detectors.
  - 1 required per focal plane.
  - 3 flight detectors ordered.
  - 3 flight detectors are in-house.
  - Good performance - meets or exceeds most specifications.
    - Detailed operational optimizations being investigated.
    - Some performance concerns have led to ordering a backup batch.

"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."



# Marconi CCDs Exceed Expectations for High UV QE



Pair Number 1 flight CCDs versus the Specification

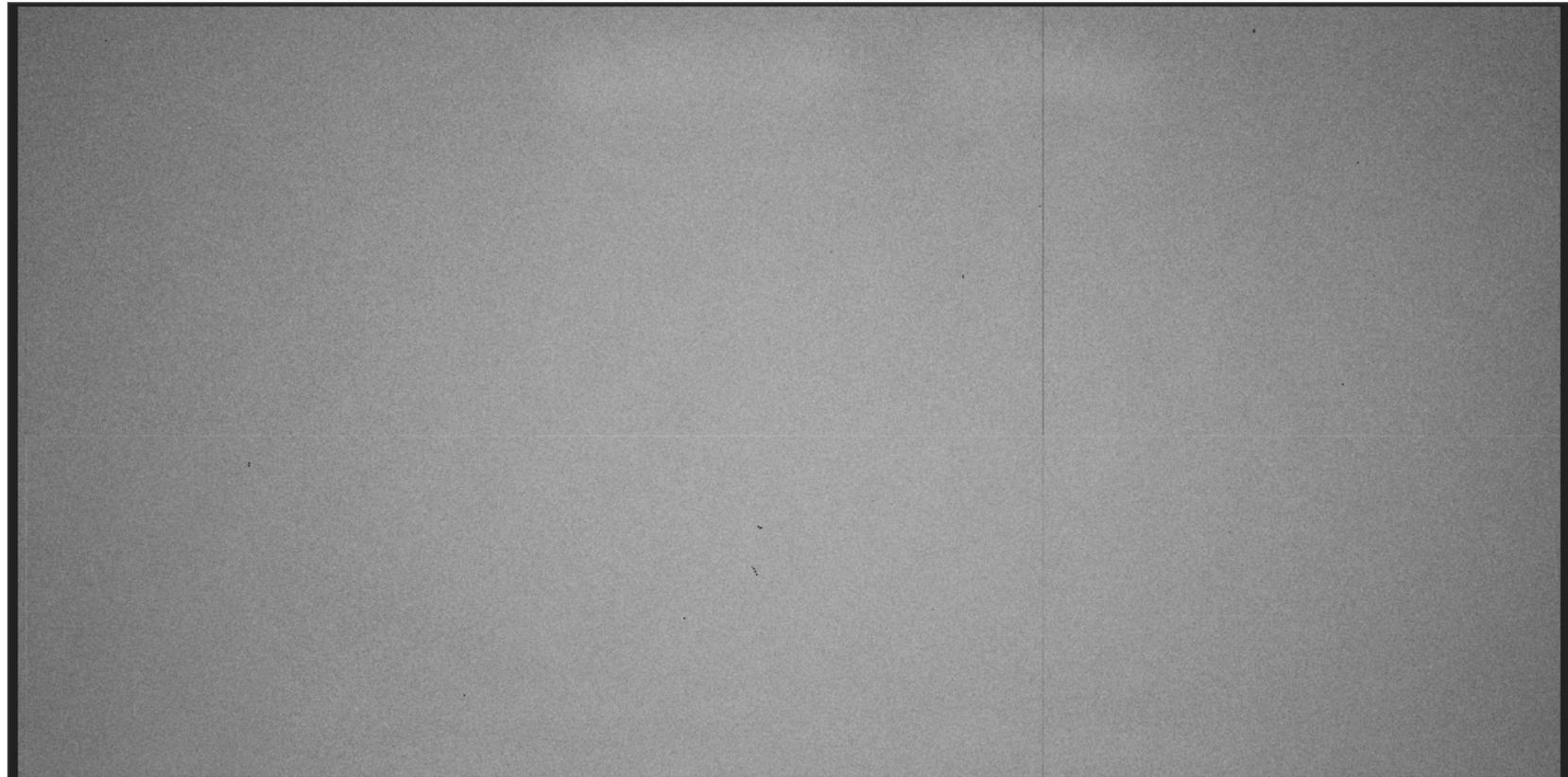
"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

OS WFC3 Status



# Marconi CCDs Have Extremely Uniform Spatial Response

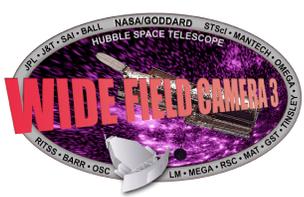


550 nm Flat Field for CCD43-018

"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

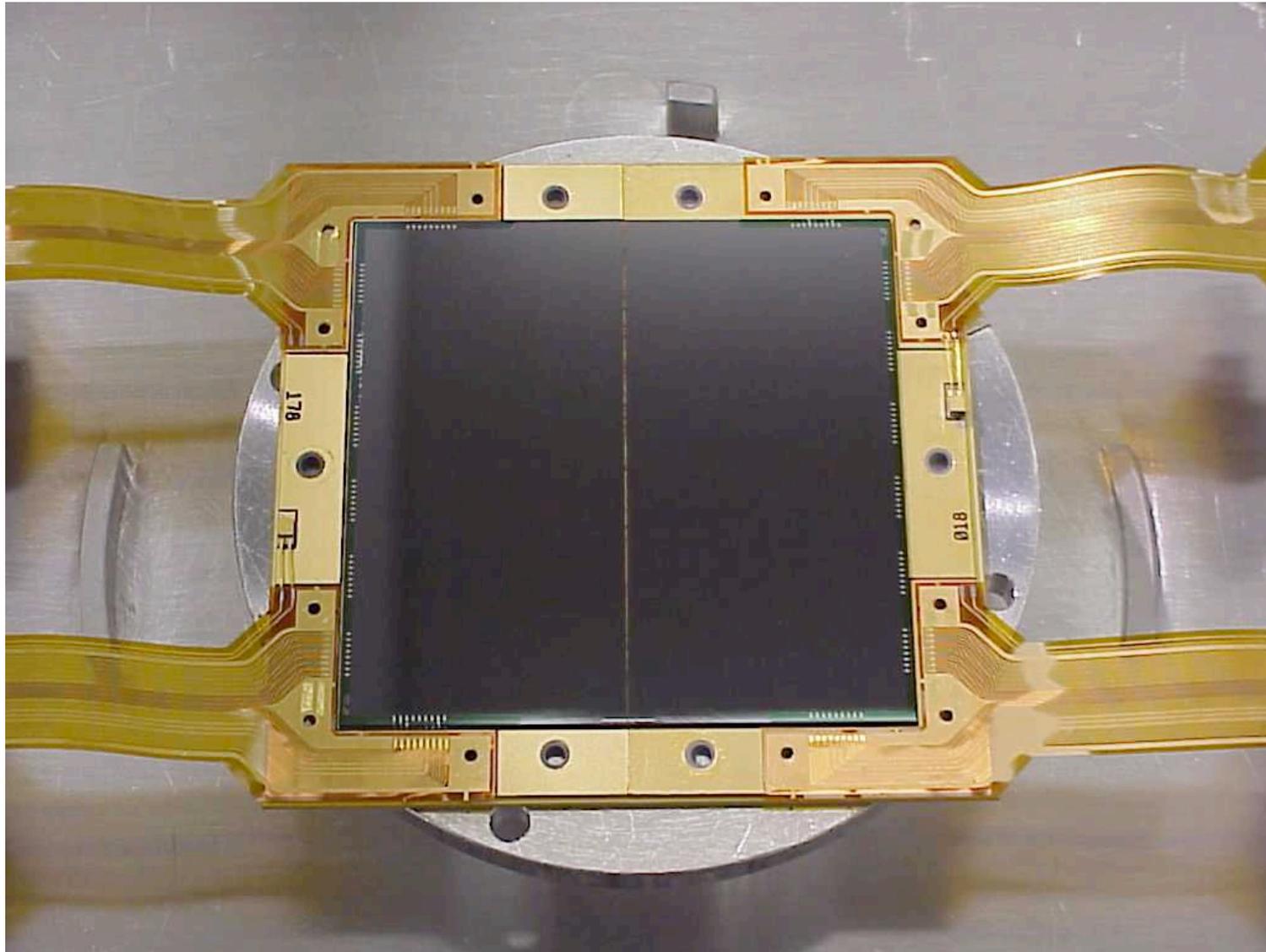
February 25, 2002

OS WFC3 Status



# UVIS-1

## CCD Pair Bonding Is Complete



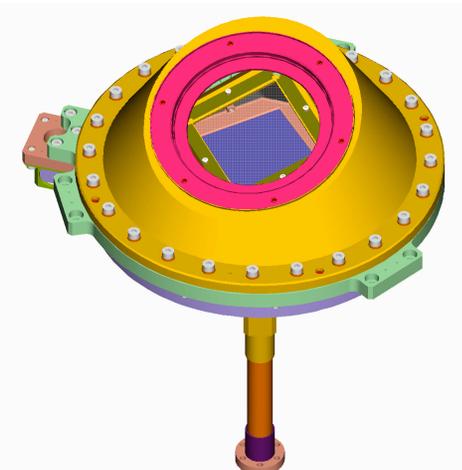
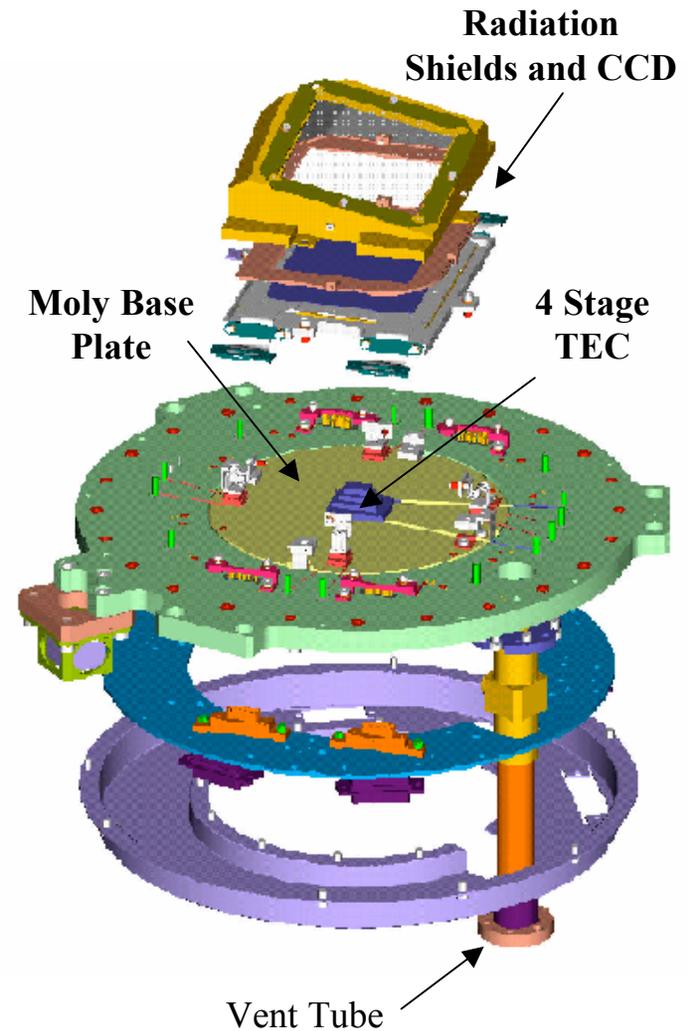
"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

OS WFC3 Status



# UVIS Detector Assembly



"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

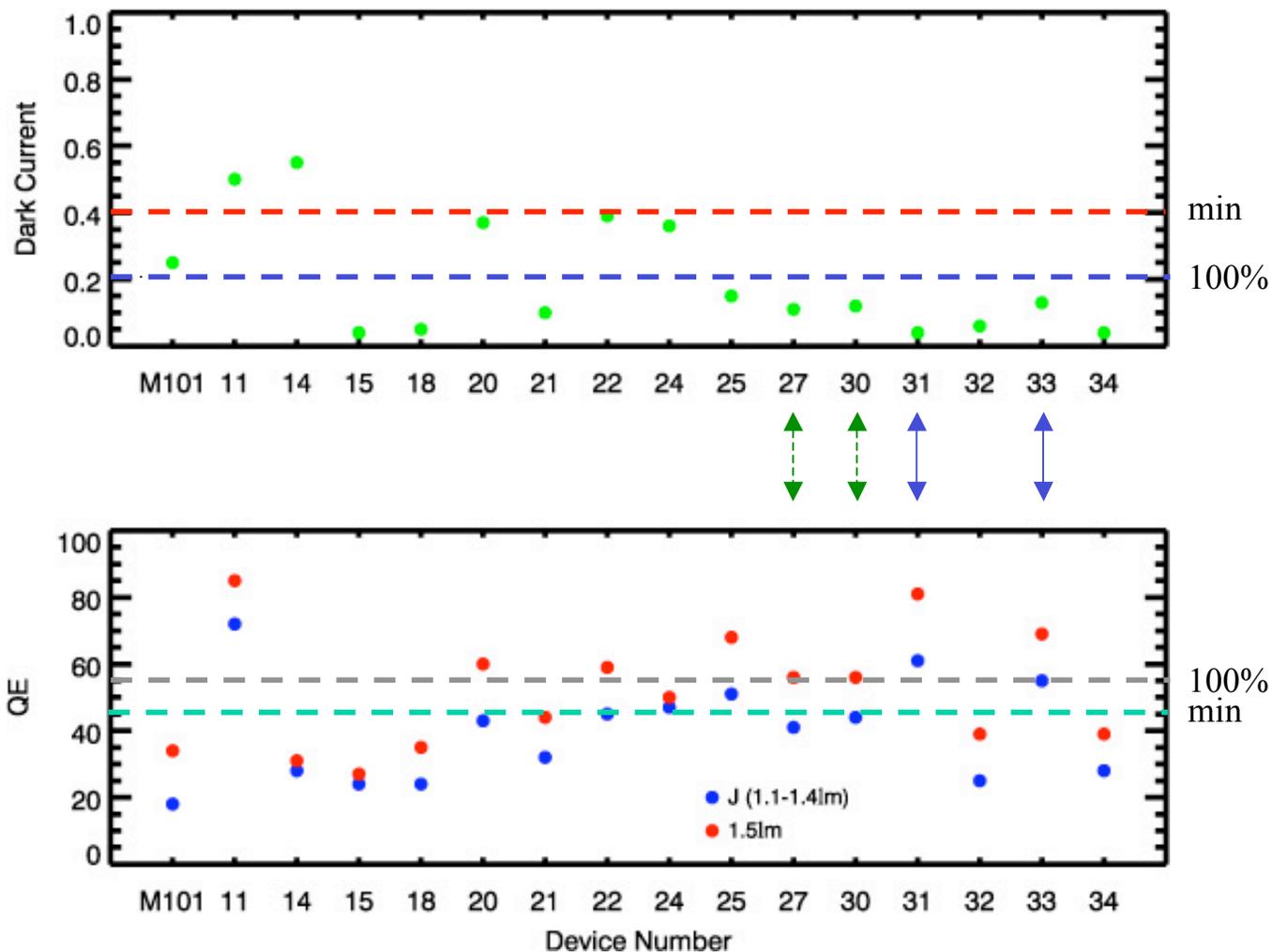
OS WFC3 Status



# IR FPA Dark Current and QE Performance Trends



The dark current and QE performance of the detectors showed dramatic improvement over the course of the program



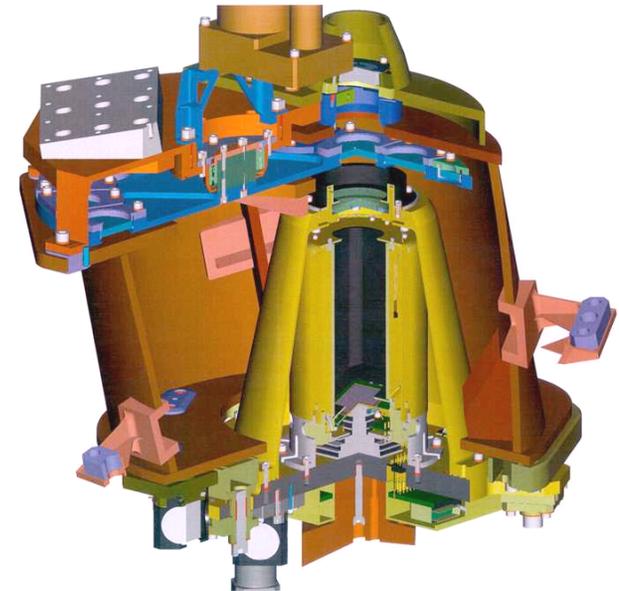
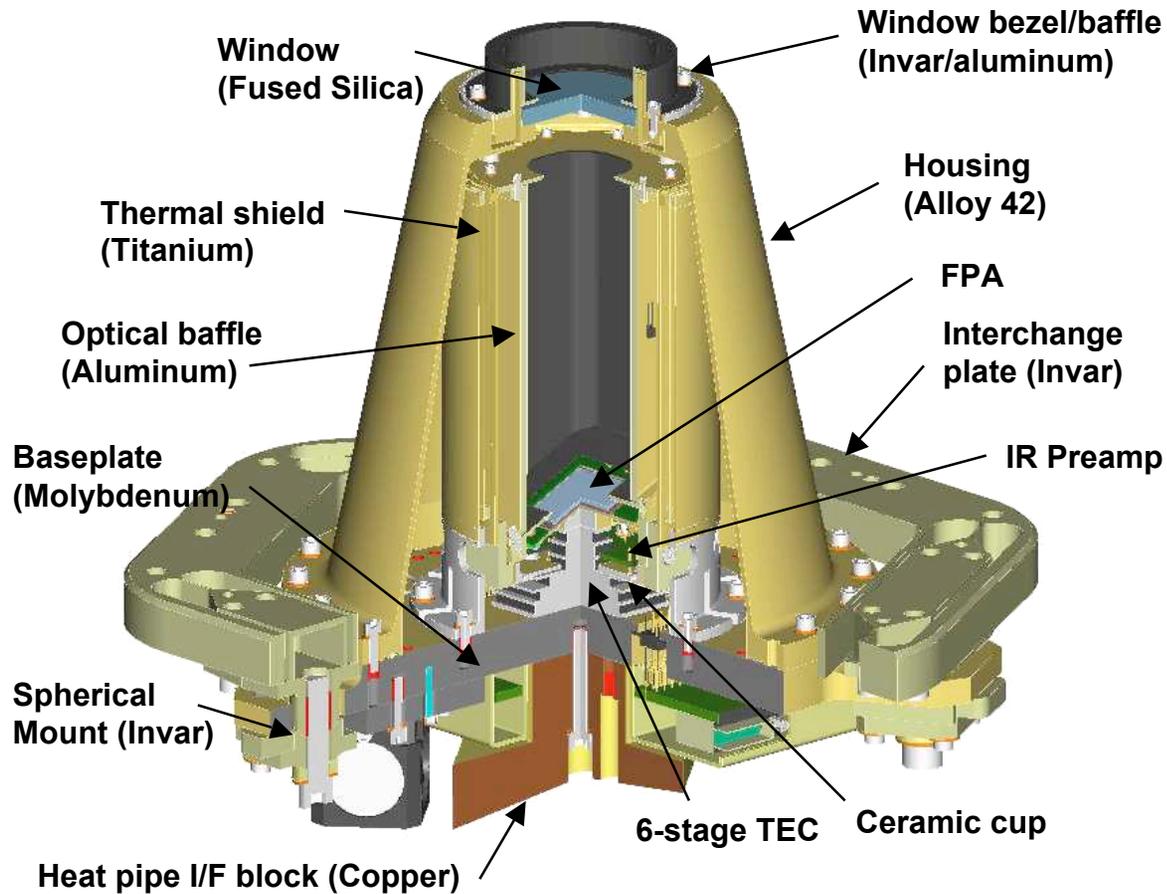
"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

OS WFC3 Status



# IR Detector Assembly



**Detector Assy Mounted to Cold Enclosure**

**Not Shown: Electrical interface board & cover, Vent tube**

"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

OS WFC3 Status



# Flight Hardware Ready for Integration



Optical baffle assy



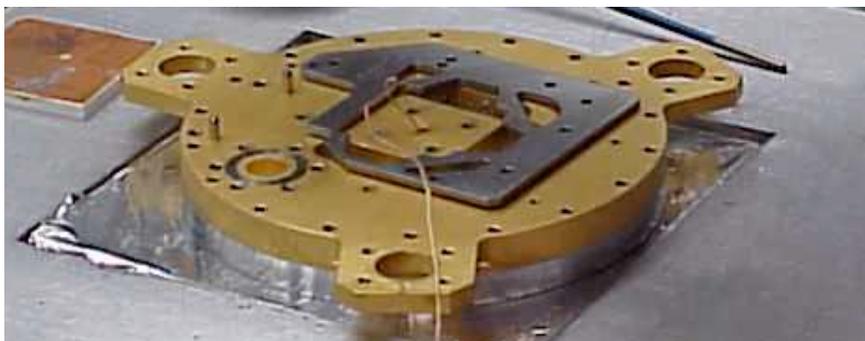
Thermal shield assy



Window/bezel assy



Vacuum housing

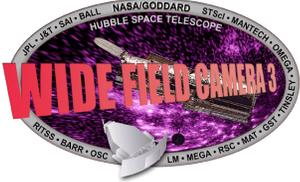


Baseplate

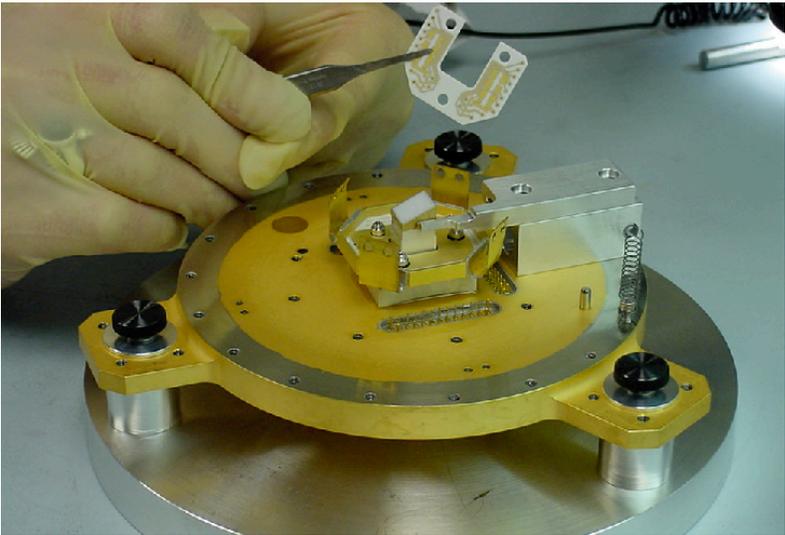
"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

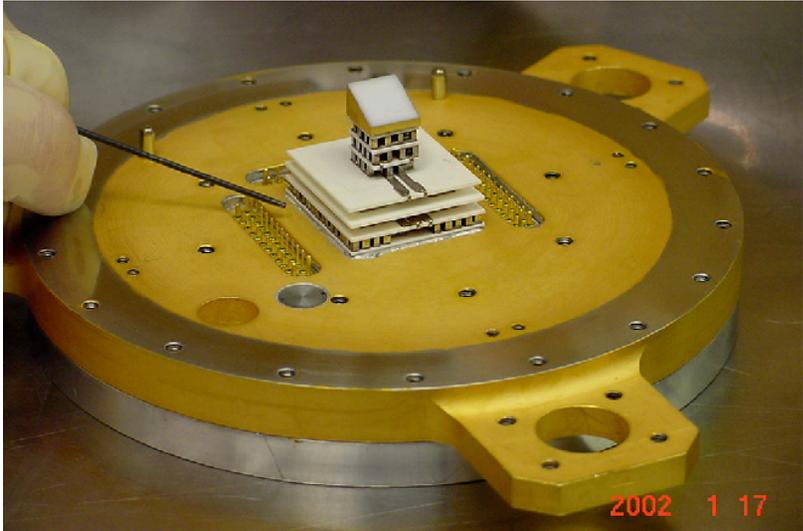
OS WFC3 Status



# IR Detector Baseplate



Surrogate unit base assembly prior to installing MUX



Qualification unit base assembly prior to installing ceramic cup

"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

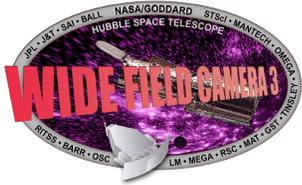


# IR Detector Concerns



- Readout noise higher than expected.
  - Approximately 40 vs. NICMOS 30-35 e-/single difference.
  - Unlike NICMOS, averages down by  $\sqrt{N_{\text{read}}}$ .
    - Demonstrated for at least a factor of 4.
  - Determining the source of the excess noise to see if it can be eliminated in the final build.
- Short wavelength QE less than expected.
  - Approximately 20% at 1  $\mu\text{m}$  instead of 45%.
  - QE before cutoff at 1.7  $\mu\text{m}$  exceeds spec (80% vs. 55%).
  - Trapping process now understood and will be eliminated in the final build.

"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."



## IR Detector Assessment

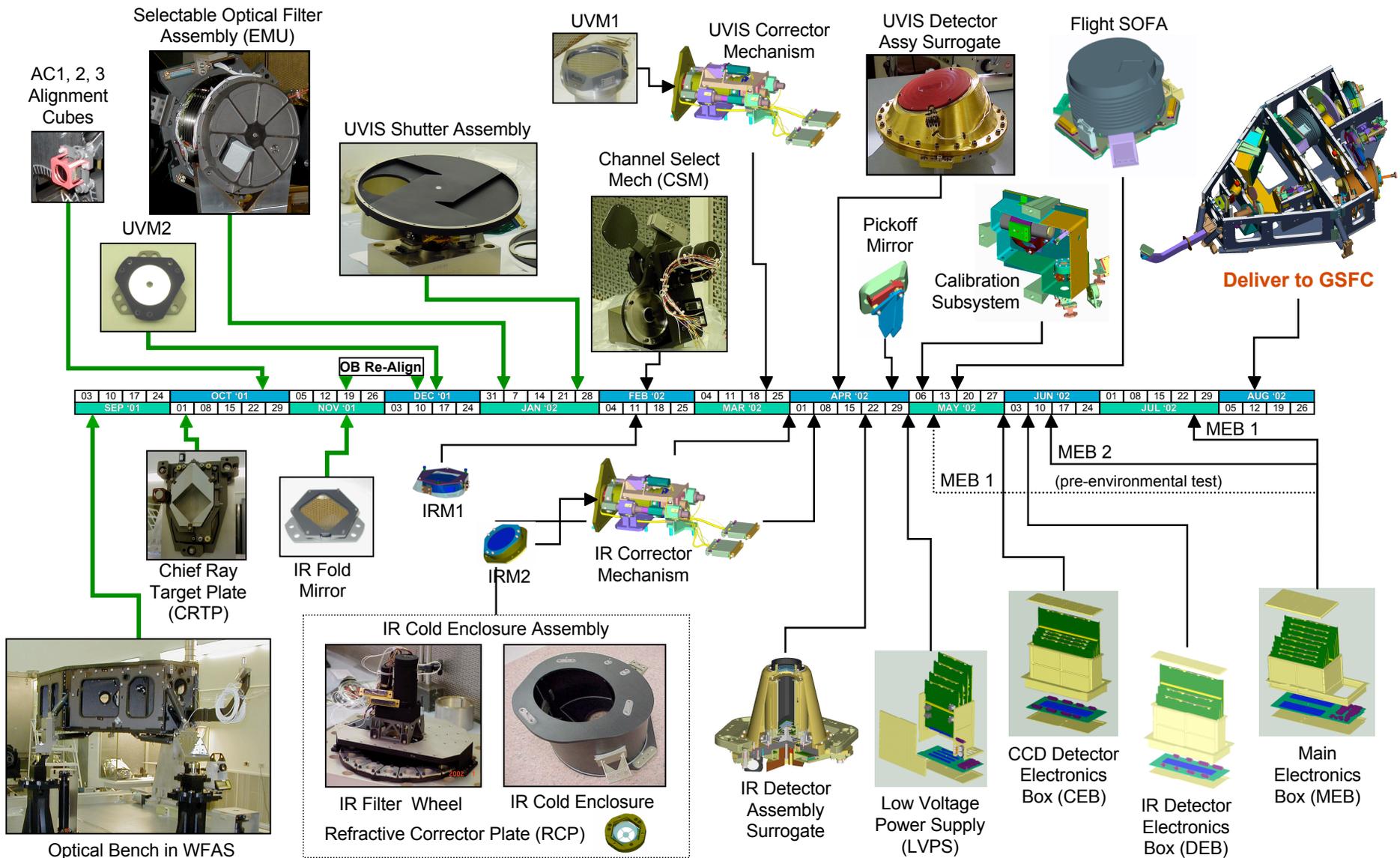


- WFC3 and HST Project agree to proceed with an additional backup build to fix at least the QE issue.
- SOC ranked these issues as tractable concerns, and supports the resolution plan.
- The impact is a flight IR detector enclosure delay by 4 months.
  - Flight detectors have always been decoupled from the instrument buildup until final I&T at GSFC, so impact to the budget will be minimized.
  - This delay can be accommodated within the project schedule with no impact to delivery.

"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."



# Optical Assembly Integration Flow



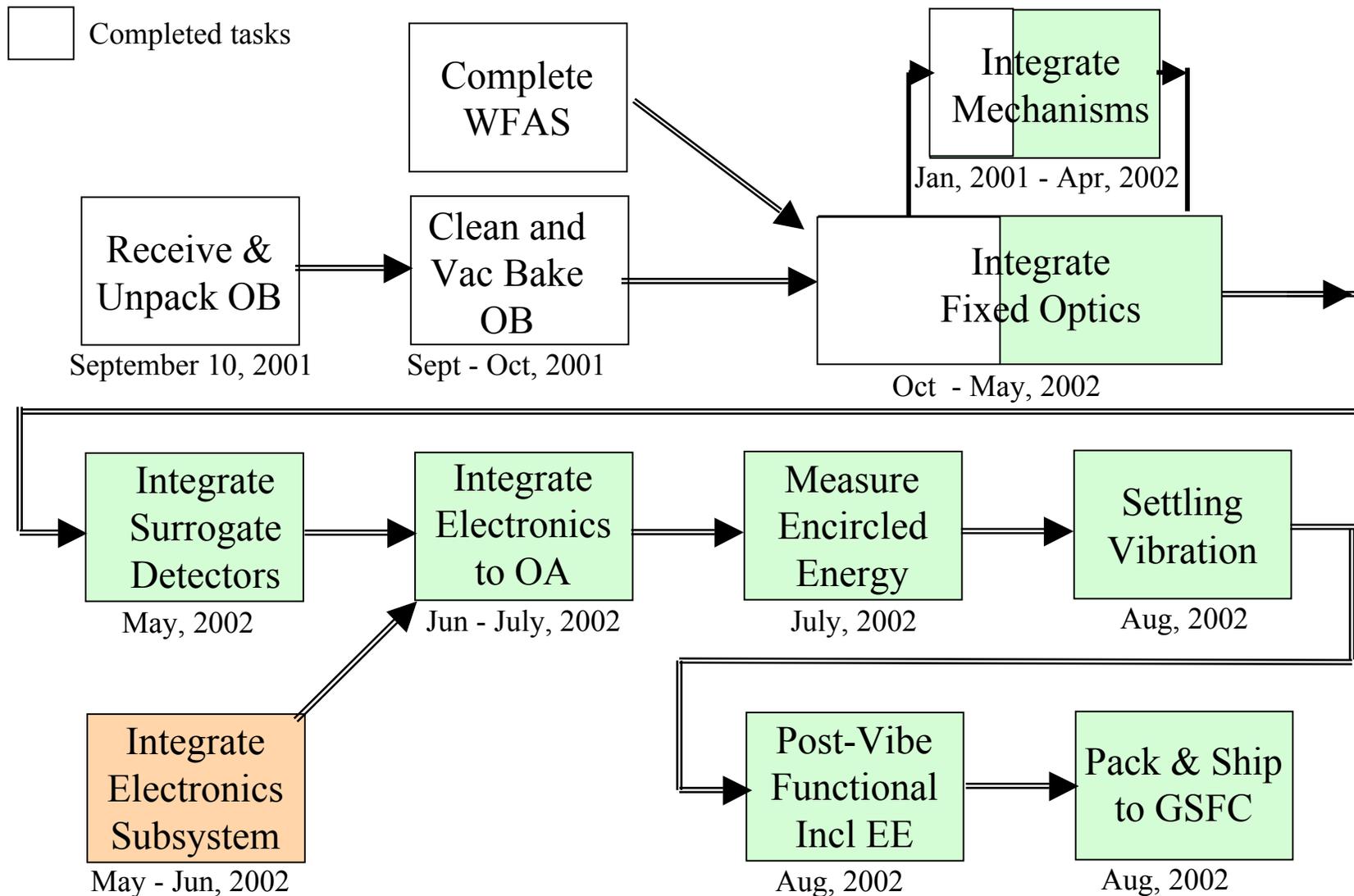
"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

OS WFC3 Status



# Optical Assy I&T at Ball



"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

OS WFC3 Status



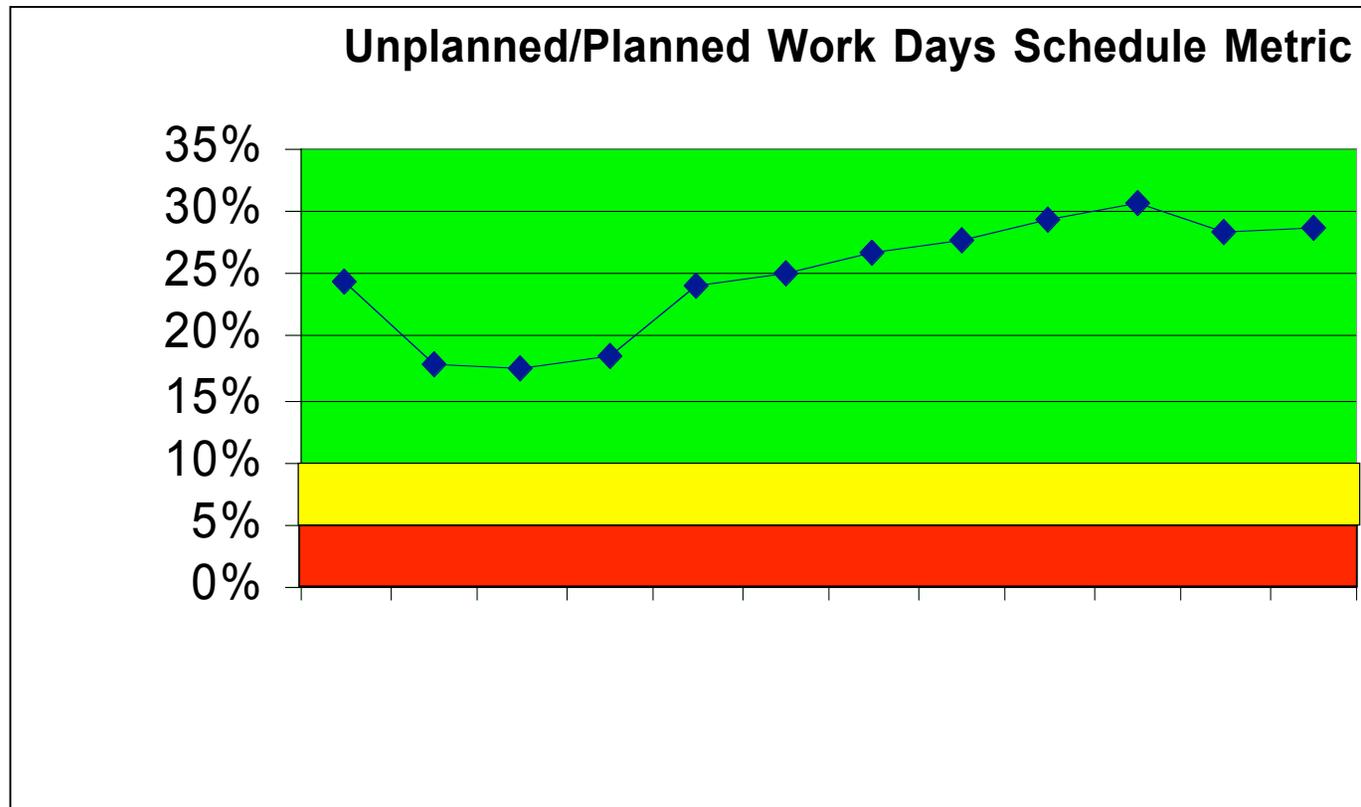
# Schedule Metric is Very Healthy



Schedule metric value for December is at 28.61% against a January 15, 2004 Launch Readiness Date.

This reflects -20 days of float for the Electronics.

(Value = number of unplanned working days divided by planned working days)



"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."



# Schedule Metric Definitions



- **Schedule Metric** calculated to measure level of program schedule reserve. It is defined as unplanned/planned work days.
- **Unplanned work days** are the work days between the projected instrument delivery date (4/15/03) and the Project need date (8/15/03) for a January 15, 2004 LRD plus the 40 work days of HST I&T contingency. The unplanned work day calculation does not include weekends or holidays.
- **Planned work days** are the work days between the "date computed" and the projected instrument delivery date to the Project (4/15/04). Weekends and holidays are not planned work days except during the six (6) weeks of TV/TB testing when the five (5) weekends or ten (10) work days are counted.
- **GREEN** is metric value greater than 10% and implies a healthy condition.
- **YELLOW** is metric value between 5 - 10% and implies closer scrutiny than normal advised - Project will develop a formal resolution or workaround plan.
- **RED** is metric value less than 5% and will trigger a specific HST Project level review which may then recommend a Descope Review.

"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."



## Financial Metric is Very Healthy



- Total WFC3 actual cost through December 2001 is \$57M.
- Total capped cost is \$65M + \$10.4M contingency for a total of \$75.4M.
- Added launch delay cost of \$3.5M (from original July 2003 plan to the current January 2004 baseline).
- Of the total \$10.4M contingency, \$4.4M has been reserved for optical bench delays, optical stimulus cost growth, and Ball cost growth.
- Remaining \$6M contingency is for \$16M remaining cost.
  - 38% of remaining cost.

"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."



## WFC3 Summary



- Instrument integration is proceeding very well.
- Expect the completed optical bench to return to GSFC in the August 2002 time-frame.
  - Integration into the enclosure, and instrument-level testing will occur at GSFC.
- IR detector optimization continues.
  - One existing device being packaged for flight.
  - Second device being used to continue the characterization effort.
- Backup IR detectors being constructed to eliminate some known problems with the existing devices.

"Data contained herein is exempt from ITAR regulations under CFR 125.4(13) -- data approved for public disclosure."

February 25, 2002

OS WFC3 Status