The Shuttle Mission
Enabling Science & Exploration

HST 1st Servicing Mission
Life Sciences
Space & Microgravity Sciences

Joe Rothenberg
Scott M Smith
Howard Ross
1960’s – LST(HST) envisioned as a facility class observatory with servicing to maintain and improve scientific efficiency

Shuttle enabled LST mission concept

1970’s Design formulation
- 15 year LST mission
- 2 ½ yr upgrades 5 year ground return
- Shuttle $12M per flight @ 26 flights/year

1980’s
- Decision 3 yr on-orbit upgrade/servicing of HST
HST 1st Servicing Mission
Prelaunch Environment

- Keeping it sold through budget crisis
- Set stakeholders expectations for success
- Very optimistic about what it could/would do without talking about difficulty
- Did not conduct end-to-end optical performance test

“Conscious expectation of the unexpected”
HST 1st Servicing Mission
The Unexpected & Consequence

The Unexpected

- Spherical aberration!
- Solar Array jitter!

The Consequence

- Lost confidence in NASA
- I received a career changing assignment (Direction TBD)
- Shuttle was the key to enable restoring HST optical performance and NASA reputation
HST 1st Servicing Mission
The Plan to Fix HST

- Assemble Team, understand and validate problems
  - Independent measurements and reviews

- Develop Communicate and get by-in to Plan
  - Independent review and assessment
  - Made stakeholders partners & communicated to them weekly
  - Targeted Dec 1 1993 for launch readiness

- Understand what HST could do and maximize science
  - Early Release Observations – amazing results
  - Routine science releases ASAP

- Ensure follow-on Instruments were fully funded
  - Don’t eat the next generation
HST 1st Servicing Mission
Pre SM 1 Science Capability
HST 1st Servicing Mission
The Team

- GRC/GSFC/HQ/JPL/JSC/KSC/MSFC
- STSci
- ESA/CSA
- HST Instrument Teams
- US & European contractor community
HST 1st Servicing Mission
Shuttle Program Challenges

- Shuttle mission EVA typically 1 day
- Requirements grew from 2 to 8 hardware elements
- EVA’s needed evolved from 1 to 4 days
- Crew historically assigned at L-1 year
- Understanding the mission complexity and having assigned crew earlier
HST 1st Servicing Mission

HST Program Challenges

- Major effort to understanding and replicating on-orbit configuration *(Most important decision we made)*

- Attracting quality staff to National embarrassment

- Keep Team focused on launch readiness

- 18 Independent Reviews

- Typical cost/technical/scheduled challenges
HST 1st Servicing Mission
Wide Field Camera Install

A Second Look: Replacing the Wide Field and Planetary Camera
Image Credit: NASA, 1993
HST 1st Servicing Mission
Post SM 1 Images
HST 1st Servicing Mission
Key lesson Learned

- Test as you plan to fly AKA test, test & retest
  - Electrical fusing was found under sized
  - Initially trained with wrong replacement instrument configuration
  - Tool location on-board shuttle would not have worked

- Review Teams can help

- Communications via “Top Ten” kept stakeholders on-board

- Simulations and training critical to success
  - Closure of aft door
  - Configuration readiness for emergency Shuttle de-orbit

- Setting success expectations important
HST 1st Servicing Mission
Concluding Remarks

- Shuttle critical to the initial mission concept, optical performance recovery and in particular the scientific success of HST

- After 5 servicing missions
  - HST scientific return is 1000 more efficient than launch configuration
  - Current life expectancy is >25 years

- If you are asked to take on the number 1 priority for your organization – DO IT!
HST 5th Servicing Mission
Final Servicing Mission
Jupiter and Io
Hubble Ultra Deep Field Survey