Space Telescope Users Committee

8th May 2014

Matt Mountain

courtesy Amy A Simon-Miller,
courtesy Amy A Simon-Miller,
Science With the Hubble Space Telescope IV

Looking to the Future

Accademia Dei Lincei, Rome
March 17–20, 2014
HST continuing to innovate ....

Hubble extends parallax stellar distance measurements 10 times deeper into our galaxy

Probing the first billion years and placing constraints on Dark Matter

placing new constraints on Dark Energy, and the number of neutrino species

HST + General Relativity = Frontier Fields

developing new techniques to find water on exo-planets
For Cycle 22, Hubble received the second highest number of proposals in its history 1135
Requested proposal size distribution for Cycle 22:

- 50% of proposals < 30 orbits

Includes 4 Pure Parallels for 1050 Orbits
Submitted Cycle 22 Programs across the Globe
Hubble 2020 assessment

NASA has:

1) Commissioned the NASA Engineering and Safety Center (NESC) to undertake a detailed lifetime analysis of HST, which shows HST can remain fully operational and scientifically competitive to 2020.

2) Charged the NASA Astrophysics Cosmic Origins Program Assessment Group (COPAG) to carry out a study of the scientific advantages and synergies if a minimum one-year overlap between HST and JWST can be achieved.

3) Separated HST from the usual Senior Review process, giving HST its own, non-competitive senior review to assess the continued cost-effectiveness of the mission.

Reliability of Systems

- NESC reliability estimates for Hubble’s instruments and primary subsystems support a 2020 vision for the observatory.
- The impending failure of Gyro 5 does not substantively change the overall gyro lifetime assessment.
### JWST Full Scale Model

<table>
<thead>
<tr>
<th>Component</th>
<th>Measured (RMS SFE)</th>
<th>Uncertainty (RMS SFE)</th>
<th>Total (RMS SFE)</th>
<th>Requirement (RMS SFE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 Primary Segments (Composite figure)</td>
<td>23.7 nm</td>
<td>8.1 nm</td>
<td>25.0 nm</td>
<td>25.8 nm</td>
</tr>
<tr>
<td>Secondary</td>
<td>14.5 nm</td>
<td>14.9 nm</td>
<td>20.8 nm</td>
<td>23.5 nm</td>
</tr>
<tr>
<td>Tertiary</td>
<td>17.5 nm</td>
<td>9.4 nm</td>
<td>19.9 nm</td>
<td>23.3 nm</td>
</tr>
<tr>
<td>Fine Steering</td>
<td>14.7 nm</td>
<td>8.7 nm</td>
<td>17.1 nm</td>
<td>17.5 nm</td>
</tr>
</tbody>
</table>

**Substantial technical progress**

**all optics completed**
4 instruments for wide range of science
all delivered to Goddard Space Flight Center

NIRCam
MIRI
NIRSpec
NIRISS
Completed first cryogenic tests of the Instrument Science Interface Module (ISIM), two instruments and of STScI’s instrument control software.
Completed integration of all four instruments in ISIM.
first test of all STScI instrument software
JWST schedule - 13 months of funded schedule reserve available

Spacecraft
- Spacecraft Component Development
- Spacecraft Fabrication and Assembly
  - Sunshield Des. & Development
  - Flight Sunshield Fabrication, Assembly and Test
  - I & T
  - Spacecraft panels to I&T
  - Spacecraft Structure to I&T

Science Instruments
- ISIM Integration
- ISIM Cryo Testing & Detector Changeout
  - OTIS
  - OTIS one month from critical path

Telescope
- Segment Gear Motor replacement
- Optical Telescope Element Fabrication and Testing
- OTE
- OTE one month from critical path

OTIS = Optical Telescope + ISIM

OTE = Optical Telescope Element

K months of critical path (mission pacing) slack

ISIM Integration

Northrop-Grumman
Goddard Space Flight Center
Ball Aerospace
ATK
Johnson Space Center
Guiana Space Center

ISIM one month from critical path
3 weeks
JWST schedule - 13 months of funded schedule reserve available

Spacecraft

- Spacecraft Component Development
- Spacecraft Fabrication and Assembly
- Sunshield Des. & Development
- Flight Sunshield Fabrication, Assembly and Test

Science Instruments

- ISIM Integration
- ISIM Cryo Testing & Detector Changeout

Telescope

- Segment Gear Motor replacement
- Optical Telescope Element Fabrication and Testing

OTE = Optical Telescope Element
OTIS = Optical Telescope + ISIM

- k months of critical path (mission pacing) slack
- ISIM one month from critical path
- 3 weeks
2013
analyze full science instrument data from CV2, & support tests

2014
First integrated Science Operations Center software released - workshops for JWST science community

2015
final verification for instrument tests (CV3), & STScI onboard JWST commands extensively tested

2016
250+ onsite shifts at GSFC to support ISIM CV1 test

test of the SOC wavefront sensing and control at JSC - communication test with DSN

2017
Time Allocation process, planning & scheduling of first JWST observations.

2018
STScI software system 7 million lines of code
Proposal Tools

Mosaic tool

Archive and pipeline

approximately 3.5 million lines of code can be reused
As a result of synergies with HST, JWST science operations are seeing between 10% and 15% cost saving. Also substantially reduces risk for JWST.

approximately 3.5 million lines of code can be reused.
<table>
<thead>
<tr>
<th></th>
<th>FY15 PBR</th>
<th>versus FY14 enacted</th>
</tr>
</thead>
<tbody>
<tr>
<td>NASA</td>
<td>17,460.6</td>
<td>-185.9M</td>
</tr>
<tr>
<td>SMD</td>
<td>4,972.0</td>
<td>-179.2M*</td>
</tr>
<tr>
<td>Astrophysics</td>
<td>607.3</td>
<td>-60.7M*</td>
</tr>
<tr>
<td>JWST</td>
<td>645.4</td>
<td>-12.8M* ✓</td>
</tr>
<tr>
<td>HST</td>
<td>75.3</td>
<td>-23M*</td>
</tr>
</tbody>
</table>

* EPO still not included
Public interest in HST
Relative to FY13 Post-Sequester
(How much recovery from Sequester?)

Relative to FY14 Omnibus
(Administration priorities vs. Congress priorities)

Relative to FY14 Request
(Evolution of Administration priorities)

Relative to notional FY15 budget in FY14 Request
(Deviation from NASA pre-planning)

Change in Then-Year Dollars for FY 2015 Request

Sources: FY 2014 and 2015 budget requests; FY 2014 Omnibus Appropriations. Does not include additional funding proposed in FY 2015 Opportunity, Growth, and Security Initiative. (c) 2014 AAS
Possible Funding HAC and SJC, CJS subcommittee appropriations bills for FY 2015

- CJS mark-up FY15 appropriations bill in **subcommittee** on **April 30th**
- CJS mark-up in **full committee** the week of **May 5 (today)**
- Possible action on House floor late May/early June
- Possible action on Senate floor prior to July 4 recess
- **CJS full committees** mark-up probably occur within one day of subcommittee mark up

### CJS Subcommittee

**The U.S. House of Representatives**
**COMMITTEE ON APPROPRIATIONS**
**Chairman Hal Rogers**

**UNITED STATES SENATE**
**Committee on Appropriations**
**BARBARA A. MIKULSKI, CHAIRWOMAN**

**Conference**

**Final, conferenced bill: ?**
AFTA = Astrophysics Focused Telescope Asset

2.4 meter aperture design is based on use of NRO-donated Telescope
WFIRST/AFTA Key Features

- Hubble’s power
- Hubble’s resolution and image clarity
- 100x larger field of view than Hubble
- 2.4 meter telescope donated from NRO
- Coronagraph - “proof of concept” for “Life Finding” telescope
The Hubble way

414 individual pointings
the WFIRST/AFTA way