SINCE LAST SC MEETING...

- Acted on FY2014 GAO recommendations (cost-risk study, performance evaluation plan change).
- Completed GAO entrance conference for FY2015 activity
- Successful House Science Committee hearing on JWST Progress (3/24)
- FGS/NIRISS rework completed and instrument reinstalled into ISIM
- NIRSpec rework completed, instrument ready for reinstallation into ISIM
- NIRCam rework completed, instrument ready for reinstallation into ISIM
- ISIM is now the critical path because of NIRCam Sensor Chip Assembly issues and NIRSpec microshutter control electronics boards needing replacement
- Flight Backplane center section, wings and secondary tower assembled at NGAS
- Pathfinder backplane now at JSC in preparation for testing
- Flight sunshield membrane manufacturing in full swing, 4 layers in process, one (layer 3) complete.
- ¾” NEA issue heading toward successful resolution by May
- STScI will be hosting first annual user training session for JWST.
- Aft Sunshield Unitized Pallet Structure (UPS) completed and Forward UPS being manufactured
- Spacecraft bus and many components being built and/or delivered
- MIRI Cryocooler flight Cold Head Assembly installed onto ISIM
- Cryocooler Compressor Assembly at higher level of assembly and incremental performance tests look good. Schedule is still the issue here.
YEARLY THEMES

• 2013: Instrument Integration: The Science instruments will be finished and begin their testing as an integrated science payload

• 2014: Manufacturing the Spacecraft: Construction will commence on the spacecraft that will carry the science instruments and the telescope

• 2015: Assembling the Mirror: The mirror segments, secondary mirror and aft optics will all be assembled into the telescope

• 2016: Observatory Assembly: The three main components of the observatory will be completed (instruments, telescope, spacecraft)

• 2017: Observatory Testing: The three main components of the observatory will be tested and readied for assembly (instruments, telescope, spacecraft) into a single unit

• 2018: Kourou Countdown: All parts of the observatory will be brought together, tested and readied for launch in Kourou, French Guiana
SIMPLIFIED SCHEDULE

- **Spacecraft Fabrication & Assembly**
- **Flight Sunshield Fabrication**
- **Cryocooler Assembly & Test**
- **Detector Changeout & ISIM Cryovacuum Test #3**
- **Panel Integration**
- **Spacecraft I & T**
- **Sunshield Integration**
- **Observatory I&T**

**OTIS = Optical Telescope + ISIM**

k months of project funded critical path (mission pacing) schedule reserve
FUNDED SCHEDULE RESERVE

1. Government Shutdown
2. Accommodate installation of thermal sensors for OTIS testing
3. Aft Unitized Pallet Structure remanufacture delay
4. Cryocooler Compressor Assembly manufacturing delays
5. NIRCam Sensor Chip Arrays, Microshutter electronics replacement

Months of Funded Schedule Reserve

Year

Launch

OTIS
SIMPLIFIED SCHEDULE

k months of project funded critical path (mission pacing) schedule reserve

Spacecraft panels to I&T

Panel Integration → Spacecraft I & T

Spacecraft Fabrication & Assembly

Flight Sunshield Fabrication

Sunshield Integration

Cryocooler Assembly & Test

Detector Changeout & ISIM Cryovacuum Test #3

OTIS = Optical Telescope + ISIM

OTIS

Backplane Assembly → Optics Integration

Science Instruments

Cryocooler

Telescope

Northrop-Grumman
Goddard Space Flight Center
Johnson Space Center
Guiana Space Center
“HALF TIME” ACTIVITY

All FGS/NIRISS rework successfully completed, instrument back in ISIM

All NIRSpec rework successfully completed, awaiting reinstallation

NIRSpec microshutter control electronics board damaged necessitating build of new boards, work in progress and not pacing further ISIM testing

Short in NIRCam Sensor Chip Assembly (grounding and procedural issue) and SCA, light-mask interaction reworked, NIRCam ready for installation

Heat Straps: During CV2, thermal performance of MIRI, FGS, and NIRSpec was as expected. NIRCam thermal performance was different than expected, still within spec., but out of family with the other measured thermal performance. This NIRCam performance prompted ISIM I&T to check torques on NIRCam thermal strap joints. Loose bolts found. At the time, human error was believed to be root cause. However, a subsequent check of all heat straps determined that many had loose bolts. Attachment fixtures are being redesigned. This is the pacing activity for ISIM.
ISIM HEAT STRAPS

ISIM Prime Configuration  Heat Strap Locations
ISIM INTEGRATION AND TEST

2013

- MIRI FGS Cryo-Vac Test # 1
- Tests procedures, MIRI, FGS/NIRISS performance
- Swap NIRCam detectors

2014

- Install NIRCam, NIRSpec
- Test verifies NIRCam & NIRISS, ISIM pre-vibration measurement baseline

2015

- Heat Strap reinstallation
- Vibration Test
- Acoustics Test
- Electromag. Tests

September

- MIRI FGS Cryo-Vac Test # 3
- NIRCam NIRSpec
- Measures post-vibration ISIM performance

Ambient Temperature Metrology
k months of project funded critical path (mission pacing) schedule reserve

OTIS = Optical Telescope + ISIM
TELESCOPE: BACKPLANE

Backplane Center Section, Wings and secondary tower assembled at NGAS
TELESCOPE ISSUES

• Working issue with Telescope wire harnesses showing nicks or cuts near their connectors.

• Fix to wire stripping and handling procedures put in place at the manufacturer. Project working remanufacturing schedule with vendor and Northrop-Grumman.

• Project evaluating the optimum sequence now for installing harnesses with the rest of the telescope build-up
**SIMPLIFIED SCHEDULE**

**Spacecraft**
- Spacecraft Fabrication & Assembly
- Flight Sunshield Fabrication

**Cryocooler**
- Cryocooler Assembly & Test

**Science Instruments**
- Detector Changeout & ISIM Cryovacuum Test #3

**Telescope**
- Backplane Assembly
- Optics Integration

**Panel Integration** → **Spacecraft I & T** → **Observatory I&T**

**OTIS** = Optical Telescope + ISIM

*k* months of project funded critical path (mission pacing) schedule reserve

Legend:
- Northrop-Grumman
- Goddard Space Flight Center
- Johnson Space Center
- Guiana Space Center
OTIS TEST FLOW
TELESCOPE: PATHFINDER

Pathfinder with Two Flight Spare Mirror Segments and spare Secondary Mirror heading in the JSC Chamber A
**SIMPLIFIED SCHEDULE**

- **Spacecraft Fabrication & Assembly**
- **Flight Sunshield Fabrication**
- **Cryocooler Assembly & Test**
- **Detector Changeout & ISIM Cryovacuum Test #3**
- **Panel Integration**
- **Spacecraft I & T**
- **Sunshield Integration**
- **Observatory I&T**

**Science Instruments**
- **Backplane Assembly**
- **Optics Integration**

**Telescope**

**OTIS** = Optical Telescope + ISIM

- **Northrop-Grumman**
- **Goddard Space Flight Center**
- **Johnson Space Center**
- **Guiana Space Center**
SPACECRAFT

• Spacecraft build proceeding well

• >99% of Observatory, by mass, now built, in fabrication, or ready for fabrication, >60% of Observatory mass is measured mass
SPACECRAFT: SUNSHIELD

All full-scale engineering deployment testing successful

Flight Sunshield manufacturing underway: Layer 3 complete, Layer 4 halfway through hole-punching, Layer 5 seamed, Layer 2 gores cuts

Completed Aft Unitized Pallet Structure
SIMPLIFIED SCHEDULE

k months of project funded critical path (mission pacing) schedule reserve

Spacecraft
- Spacecraft Fabrication & Assembly
- Flight Sunshield Fabrication
- Cryocooler Assembly & Test

Science Instruments
- Detector Changeout & ISIM Cryovacuum Test #3

Telescope
- Backplane Assembly
- Optics Integration

Cryocooler
- OTIS = Optical Telescope + ISIM

OTIS (Optical Telescope + ISIM)

Observatory I&T

Northrop-Grumman
Goddard Space Flight Center
Johnson Space Center
Guiana Space Center
CRYOCOOLER HARDWARE

Cold Head Assy (CHA)/Region 1
- Optics Module Stage (OMS)
  (6K heat exchanger)
- Heat exchanger Stage
- Assessor (HSA)
  (Recuperator, valves)

Cooler Tower Assy (CTA)/Region 2
- Refrig. Line Deploy. Assy (RLDA)

Cooler Compressor Assy (CCA)/Region 3
- PT Pre-cooler
- Coldhead
- JT Recuperator
- PT Compressor
- JT Compressor

Environmental Shield
- PT CCEs
- Bus Switch Assy

Cooler Control Electronics Assy (CCEA)/Region 3

Delivered
CCA COMPONENTS

Harness Installation with Splices

CCA Thermal Performance Test

Joule-Thompson Compressor Fit-Check
## TECHNICAL PERFORMANCE METRICS

<table>
<thead>
<tr>
<th>Performance / Resource Parameters</th>
<th>Capability / Requirement</th>
<th>Estimate or Predict 3-15</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensitivity Parameters</strong></td>
<td></td>
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<tr>
<td>NIRCam SI Sensitivity @ 2 microns (nJy)</td>
<td>Level 1</td>
<td>11.4</td>
<td>10.2</td>
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<tr>
<td>MIRI SI Sensitivity @ 10 microns (nJy)</td>
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<td>700</td>
<td>679</td>
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<td>Straylight (MJy/ster @ NIR 2 microns)</td>
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<td>0.091</td>
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<tr>
<td>Straylight (MJy/ster @ NIR 3 microns)</td>
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<td>0.066</td>
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<tr>
<td>Straylight (MJy/ster @ MIR 10 microns)</td>
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<td>3.9</td>
<td>0.74</td>
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<tr>
<td>Straylight (MJy/ster @ MIR 20 microns)</td>
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<td>OTE Transmission* Ap m^2</td>
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<tr>
<td><strong>Image Quality Parameters</strong></td>
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<tr>
<td>Strehl (NIR 2 microns)</td>
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<td>0.80</td>
<td>0.836</td>
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<tr>
<td>Strehl (MIR 5.6 microns)</td>
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<td>0.80</td>
<td>0.936</td>
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<tr>
<td>NIRCam Channel Wavefront Error (nm)</td>
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<td>125</td>
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<tr>
<td>NIRSpec Channel Wavefront Error (nm)</td>
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<td>218</td>
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<td>NIRISS Channel Wavefront Error (nm)</td>
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<tr>
<td>MIRI Channel Wavefront Error (nm)</td>
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<td>224</td>
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<tr>
<td>EE Stability at 2 microns Over 24 hours</td>
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<td>2.30%</td>
<td>0.81%</td>
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<tr>
<td>EE Stability at 2 microns Over 14 days</td>
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<td>3.00%</td>
<td>1.95%</td>
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<td>Image Motion rms for 15 sec Sliding Window for NIRCam (mas)</td>
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<td>6.6</td>
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<td><strong>Operations Parameters</strong></td>
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<td>Observing Efficiency</td>
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<td>70%</td>
<td>77.0%</td>
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<td>Slew Time for 90 Degree Slew with 5 RWAs (min)</td>
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<td>60.0</td>
<td>57.3</td>
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<td>Momentum Accumulation LV1 (Nms/d)</td>
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<td>22</td>
<td>18.10</td>
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<tr>
<td>Momentum Accumulation LV4 (Nms/d)</td>
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<td>23</td>
<td>18.50</td>
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<td><strong>Thermal Parameters</strong></td>
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<tr>
<td>Cryo Parasitic Margin (NIRCam)</td>
<td></td>
<td>60%</td>
<td>78.3%</td>
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<tr>
<td>Cryo Parasitic Margin (NIRSpec FPA)</td>
<td></td>
<td>60%</td>
<td>69.8%</td>
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<tr>
<td>Cryo Parasitic Margin (FGS/NIRISS)</td>
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<td>60%</td>
<td>65.5%</td>
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<td>ISIM Cavity Temperature (K)</td>
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<td>41K (TBR)</td>
<td>41.5</td>
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<td>Cryo-Cooler Line Load Margin (Pinch Point / Steady State)</td>
<td></td>
<td>63%</td>
<td>113%/146%</td>
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<tr>
<td>Cryo-Cooler OM Load Margin (Pinch Point / Steady State)</td>
<td></td>
<td>63%</td>
<td>114%/55%</td>
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<tr>
<td><strong>Data and Link Parameters</strong></td>
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<tr>
<td>S-Band Uplink Margin (dB)</td>
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<td>3.00</td>
<td>5.80</td>
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<tr>
<td>S-Band Downlink Margin (dB)</td>
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<td>3.00</td>
<td>3.90</td>
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<tr>
<td>Ka-Band Downlink Margin (dB)</td>
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<td>3.00</td>
<td>4.44</td>
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<tr>
<td><strong>Observatory Resources</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Observatory Wet Mass (kg)</td>
<td></td>
<td>6620</td>
<td>6050</td>
</tr>
<tr>
<td>Observatory CG Offset (mm)</td>
<td></td>
<td>19.8</td>
<td>19.8</td>
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<tr>
<td>Observatory Power Load (W)</td>
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<td>1808</td>
<td>1509</td>
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<tr>
<td>Observatory Power Generation (W)</td>
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<td>2055</td>
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<td><strong>I&amp;T Parameters</strong></td>
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<tr>
<td>JSC Timeline (Days)</td>
<td></td>
<td>120</td>
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<tr>
<td>Issue</td>
<td>Trend</td>
<td>Comment</td>
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<td>-------------------------------</td>
<td>-------</td>
<td>-------------------------------------------------------------------------</td>
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<tr>
<td>Cryocooler Cost, Schedule</td>
<td></td>
<td>Cryocooler compressor cost and schedule performance remain at historical levels</td>
<td></td>
</tr>
<tr>
<td>Low FY2015 UFE</td>
<td></td>
<td>Project managing reserves well so far in FY2015</td>
<td></td>
</tr>
<tr>
<td>¾” NEA, Spacecraft Radiator</td>
<td></td>
<td>Spacecraft Radiator work progressing on schedule. ¾” NEA redesigned, working to show sufficient margin.</td>
<td></td>
</tr>
<tr>
<td>Observatory Mid-IR Stray Light</td>
<td></td>
<td>Observatory predicted to meet Mid-IR stray light requirement.</td>
<td></td>
</tr>
<tr>
<td>Resolution of FGS-ISIM comm issue</td>
<td></td>
<td>New FPGA developed at to correct problem. One mounted on flight board, second in progress, third awaiting software update for validation prior to installation.</td>
<td></td>
</tr>
</tbody>
</table>
• FY 15 project reserves tight, began year at approximately the same percentage as last year.

• Critical path funded schedule reserve decreased from 11 to 10 months due to Sensor Chip Assembly and microshutter electronics work on ISIM. ISIM is now the critical path (still above plan however).

• Cryocooler (schedule, technical, cost).

• Potential OTE schedule impact from harness rework and remanufacture

• 3/4” Non Explosive Actuator, shock spectrum, design change, qualification

• NIRSpec microshutter control electronics repair progressing well
MILESTONE PERFORMANCE

Since the September 2011 replan JWST reports high-level milestones monthly to numerous stakeholders.

<table>
<thead>
<tr>
<th></th>
<th>Total Milestones</th>
<th>Total Milestones Completed</th>
<th>Number Completed Early</th>
<th>Number Completed Late</th>
<th>Deferred to Next Year</th>
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<tr>
<td>FY2011</td>
<td>21</td>
<td>21</td>
<td>6</td>
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<td>2</td>
<td>3</td>
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<tr>
<td>FY2013</td>
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<td>38</td>
<td>20</td>
<td>5</td>
<td>3</td>
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<tr>
<td>FY2014</td>
<td>36</td>
<td>23</td>
<td>10</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>FY2015</td>
<td>48</td>
<td>25</td>
<td>16</td>
<td>5*</td>
<td>0</td>
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</tbody>
</table>

7 of 11 deferred FY2014 milestones on cryocooler components

*Late milestones have been or are forecast to complete within the year. Deferred milestones are not included in the number-completed-late tally.
JWST EXCLUSIVE USE PERIOD
BACKGROUND

• NASA seeks to maximize the scientific return from all of its science missions

• The more people who have access to NASA data the more science studies will be performed using those data
  • Archival science products are more numerous now than general observer products (e.g., HST, Chandra)
  • Access to data fosters better informed proposals which increases science productivity

• JWST is a life limited mission
  • 5 year prime mission
  • 10 year consumables limit
JWST GENERAL OBSERVERS

• Like HST, JWST will select a pool of General Observers (GOs) yearly.
• Current science policy states GOs will have a 12 month exclusive use rights to their data (can be waived), and STScI Director can recommend different lengths for this period.
• In July of 2014, the STScI Director recommended the GO exclusive user period be set at 6 months based upon advice from the JWST Space Telescope Advisory Committee (JSTAC).
JSTAC

• STScI employs the JSTAC to provide the Director with advice on technical readiness, policies and other matters (see http://www.stsci.edu/jwst/advisory-committee)

• This committee performed a study that showed how changing to a 6 months exclusive use period would dramatically affect the amount of public data for Cycles 2 and 3 of the JWST proposal timeline
SUMMARY

• Changing the default exclusive use period for JWST general observers from 12 to 6 months can benefit the science community and NASA by making more data available to proposers earlier in the limited lifetime of JWST.

• The STScI Director recommended, the JWST SWG and NASA Astrophysics Subcommittee endorse this proposal.

• NASA is working with ESA and CSA and their advisory processes to ensure all agencies concur with such a change.
SCIENCE PLANNING TIMELINE

commissioning proposals

GO CP 2017Nov

GO Cy1 deadline 2018Feb

TAC 2018May

Cycle 1 science - April 2019 GTO & GO

September - CP release
December – proposal deadline
February 2020 – TAC
April 2020 – Cycle 2

launch 2018Oct

GTO Cy1 observations finalized No later than 2017Sep

GTO Prop deadline 2017Apr

GTO CP 2017Jan

7 mo

commissioning (through 4/19)
SCIENCE PREPARATIONS
SUMMARY

Challenges arising in critical manufacturing and I&T phases.
UFE tight in FY15 will require prudent fiscal control.
MIRI Cryocooler Compressor continues to be a schedule challenge
ISIM team preparing for cryovacuum test #3 and working heat pipe
connector issue before vibration testing.

Technical Performance Metrics look excellent for the mission

JWST team continues to execute to our Launch Readiness Date
commitments within budget.