



James Webb Space Telescope Project Science Update for the JSTUC, June 14, 2021



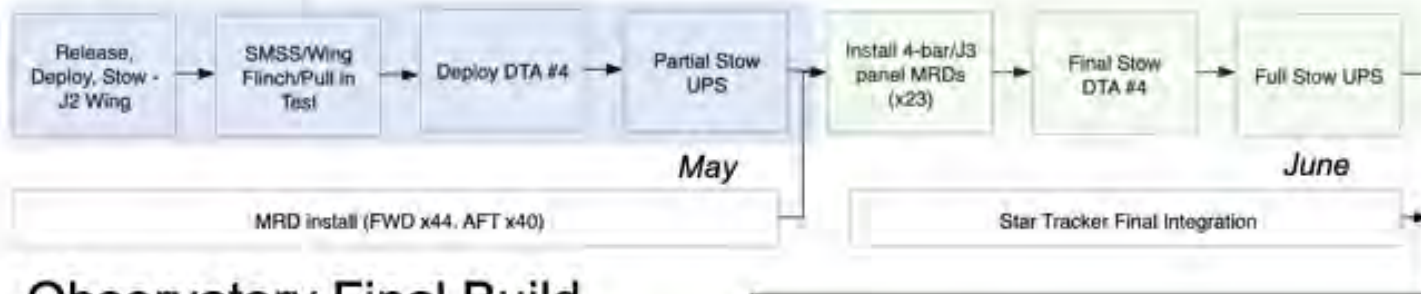
John Mather
JWST Senior Project Scientist
NASA's Goddard Space Flight Center

on behalf of 7.8 billion current humans, ~10,000 future observers, ~ 3000 engineers and technicians, ~ 100 scientists worldwide, 3 space agencies

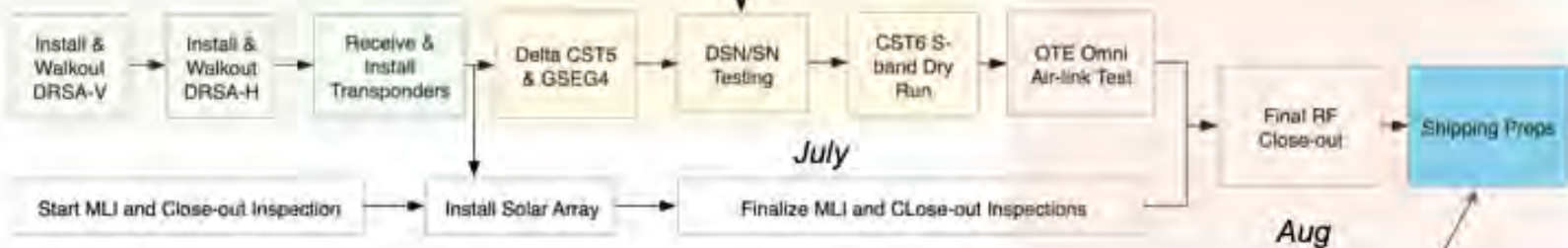


Remaining I&T Steps

Observatory Deployments

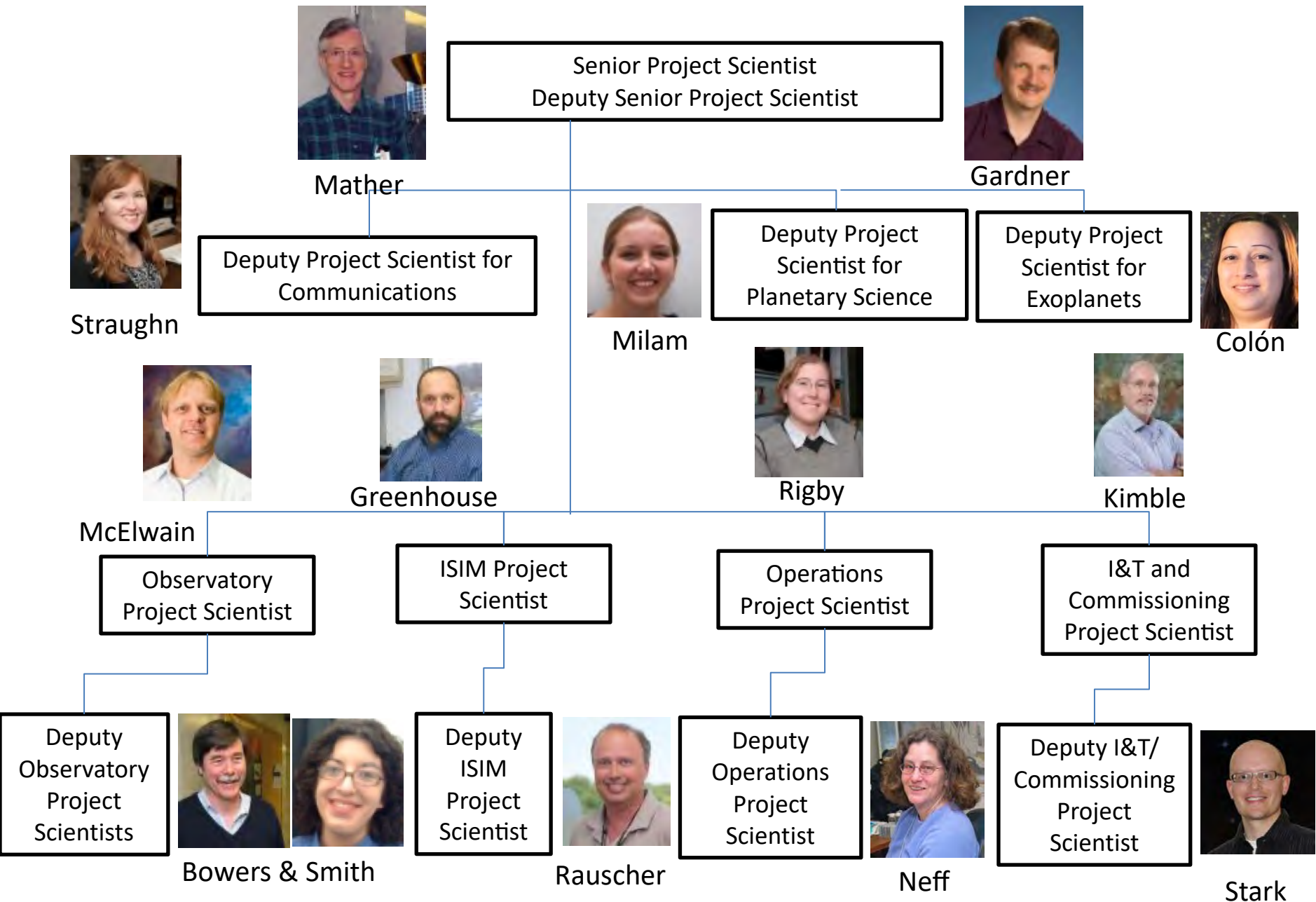


Observatory Final Build



Blue box indicates first time activity

From Eric Smith's monthly briefing



JWST Project Science Team at Goddard



GSFC Project Scientist Roles and Responsibilities

- Advise Project Manager (Mather, Deputy Gardner)
- Chair Science Working Group (Mather, Deputy Gardner)
- Defined and documented detailed scientific requirements
 - Scientific Requirements Document (SRD) ([Link to public version Rev A](#))
 - Space Science Review article (PDF online) ([link to free Springer version](#))
 - Science Requirements Analysis Board (SRAB) to manage possible changes (Gardner)
- Work side by side with management and engineering teams to ensure requirements are met.

Accountability for science performance of their mission elements:

- Telescope/Spacecraft/Sunshield (McElwain, Deputies Bowers & Smith)
- ISIM (Greenhouse, Deputy Rauscher)
- Integration, Test, & Commissioning (Kimble, Stark)
- Operations (Rigby, Deputy Neff)
- Planetary Science (Milam), Exoplanets (Colón)
- Deputy Project Scientist for Communications (Straughn)
- PI for NIRSpec detectors (Rauscher)

Also essential (not members of official GSFC PS team):

- PI for MIRI detector system, NASA Project Scientist for the MIRI (Ressler, JPL)



Project Science (GSFC) Activities

- Weekly coordination meeting with all Project Scientists (OSWG)
- Weekly tagups or telecons with:
 - Project Manager, Program Scientist (Smith, deputies Hasan & Sheth, with Gardner), each Project Scientist
- Project Science Team works with STScI
 - Extensive collaboration with STScI on all aspects of the ground system
 - Mather telecons with STScI Director and Mission Head (Sembach, Stiavelli)
 - Thursday telecons on operations
 - Participation at monthly Project-STScI "Roundtable" meetings
 - Outreach, coordinate events, materials, and web updates
 - Rehearsals of launch, deployments, commissioning, and normal operations
 - User training events (workshops and webinars for proposal preparation, eventually also for data analysis)
 - Extensive interactions with community documentation (JDox and "how-to" videos)
 - **Rigby & Neff organized NASA monitoring of proposal reviews, confirmed excellent process: Thanks STScI!**



JWST SWG Science Working Group

- Chair: Senior Project Scientist
- Reporting: Program Scientist (HQ), Project Manager (GSFC)
- Membership: IDS (Interdisciplinary Scientists), instrument leads, Telescope Scientist (TS), & ex officio (GSFC, ESA, CSA, STScI)
- Responsibilities
 - Advise on all matters affecting science
 - Requirements and goals
 - Advises SRAB on descopes, threats to requirements, requirements changes or requirements waivers
 - I&T questions – on request and presentation from Project Scientist team
 - Policy issues regarding GO, GTO, proprietary time, etc. (advisory to Program Scientist)
 - Coordinate GTO plan
 - Respond to specific questions from Program Scientist or Project Manager
 - Outreach: professional outreach, white papers, conferences, media outreach and public talks
 - Carry out research proposed at selection in 2002 (IDS's, TS)
- Meeting schedule (all organized by J. Gardner)
 - 3x/yr face to face (currently online)
 - Weekly telecons on rotating list of topics
 - Recent meetings: **Dec. 1 & 2, 2020 online; Mar 22 & May 07, 2021 online**
 - Larger science community, monthly telecon

JWST Science Working Group



John Mather,
Senior Project Scientist,
Chair



Rene Doyon,
CSA PS



Pierre Ferruit,
ESA PS



Jonathan Gardner,
Dep Sr PS



Matt Greenhouse,
ISIM PS



Heidi Hammel,
IDS



Randy Kimble,
I&T/commissioning PS



Simon Lilly,
IDS



Jonathan Lunine,
IDS



Mark McCaughrean,
IDS



Roberto Maiolino,
NIRSpec Science



Mike McElwain,
Observatory PS



Matt Mountain,
Telescope Scientist



George Rieke,
MIRI Science Lead



Marcia Rieke,
NIRCam PI



Jane Rigby,
Ops PS



Massimo Stiavelli,
IDS



Jeff Valenti
SOC



Chris Willott,
NIRISS Science



Rogier Windhorst,
IDS



Gillian Wright,
MIRI European Lead



JWST SWG Individual Responsibilities

- Instrument teams:
 - Rehearse, rehearse, rehearse! (remote for LRE's, Launch Readiness Exercises)
 - Simulated images and performance metrics for telescope focusing: multi-instrument, multi-field (MIMF)
 - Update plans for GTO observations and analysis
- Interdisciplinary Scientists:
 - Update plans for GTO observations and analysis
- Telescope Scientist:
 - Lead STScI telescope performance/analysis team
- Ex-Officio Members:
 - Working with managers, ensure organizations ready to launch
 - Rehearse, rehearse, rehearse!
 - Detailed planning of scientific commissioning: ice, contamination, stray light, focusing
 - Oversee scientific process issues
 - Proposal reviews (Rigby, Neff, et al.)
 - Participate in progress reviews, e.g. STScI software tools, flight hardware
 - Communications planning



Current Observatory Activities

(McElwain, Bowers, Kimble, Smith, Stark)



- **OTIS** = Optical Telescope Element + Integrated Science Instrument Module
 - OTIS is warm until after launch – few functional tests possible
- Monitoring contamination results from NGAS and GSFC team – continuing into shipment to launch site, and launch ops
- Rehearsals of everything, using the Online Test Bed (a digital twin) including:
 - Simulated errors - many types
 - Mid-course correction burns
 - Anomalies, including power outages and virus threats
 - bMOC (backup Mission Operations Control Center)
 - Mirror and instrument focusing including MIMF (multi-instrument multi-field wavefront sensing and control)
 - Instrument commissioning, including instrument teams (remotely)
 - Measurement and analysis of in-flight contamination of mirrors during cool-down
 - Measurement and analysis of stray light from zodi dust, galactic plane and center, telescope scattering and thermal emission



Operations Planning



- Rigby and Neff (Operations Project Scientist & Deputy) ensure readiness for launch, commissioning, and science operations
- Reviewed and contributed content to the JWST documentation (JDox) and the calls for proposals (now live at <https://jwst-docs.stsci.edu/>)
- Participating in rehearsals
- Planning commissioning activities to measure stray light background levels, thermal and optical stability, and any ice contamination
- Working with STScI to complete the pipeline and data analysis tools given the changing landscape of astronomical software
- Working with STScI on plans for user training, soliciting and evaluating proposals



Commissioning 1/2



- Project Science has multiple roles in commissioning:
 - Provide scientific advice to the project
 - Weigh in on key decisions
 - Help resolve anomalies and other performance issues
 - Provide science oversight during launch, deployments, and commissioning
 - Analyze & trend data
 - Track science performance
 - Communicate with stakeholders (including SWG and JSTUC)
 - Enforce compliance with data policies during commissioning
 - Support rehearsals
- PS & STScI have developed a plan to monitor and characterize science performance during commissioning (led by Kimble and Rigby for PS team, and S. Friedman at STScI.) Stakeholders include instrument development teams, telescope team, and systems engineering.



Commissioning 2/2



- Commissioning data policies:
 - Commissioning data will be embargoed until the end of the commissioning period, as per the 2010 HQ JWST policy document.
 - At the end of commissioning, the commissioning data go public in the archive.
 - Project Science will communicate the detailed policies to the commissioning team, and will enforce the embargo.
 - Spelled out in the JWST Science Data Management Plan (Rigby, in prep.)
 - We can halt papers submitted during the embargo, by working with arXiv and the journals.
 - Social media will be a challenge.
 - Some commissioning data merit publication.



SRAB (Science Requirements Analysis Board)

- Created May 2008 by Mather
- Board consists of the JWST Project Science Team
- Receives alerts on possible failures to meet scientific requirements
- Analyzes consequences, considers alternatives, solicits detailed feedback from the SWG
- Considered so far: wavefront (WF) sensing requirements, NIRCam wavefront accuracy, pointing stability requirements, MIRI sensitivity requirement, revisions to Science Requirements Document as result of TF (tunable filter) conversion to NIRISS, encircled energy stability requirement, field of regard, WF stability
- Many other topics remained as engineering issues with Project commitment to meet requirements: e/g: stray light and jitter, contamination



Communications

- Amber Straughn as Communications Scientist, with Laura Betz of PAO (NASA HQ PAO is overall in charge)
- Media coverage very positive
- Communications Implementation Plan up-to-launch now in work
- Working with HQ on commissioning communication plans



Summary and Conclusions – Still good!

- JWST science teams deeply and actively engaged in technical efforts worldwide
- All engineering teams have assigned scientific contacts
- Scientific performance codified in the Science Requirements Document (2003, latest revisions in July 2012) and published in Space Science Reviews (2006) still expected almost everywhere.
 - Image quality as expected
 - Stray light meets spec, thanks to serious work by many many people
 - Wavefront stability meets spec, thanks to JSC test, analyses, and repairs
 - Pointing stability supports image quality
 - Non-sidereal tracking enabled for non-linear track rates sufficient for solar system objects at or outside the orbit of Mars
 - Instrument payload (ISIM) compliant with all baseline science performance requirements, including sensitivity
- Appreciation for Project Management, Engineers, & Technicians for extraordinary and successful effort to meet all requirements