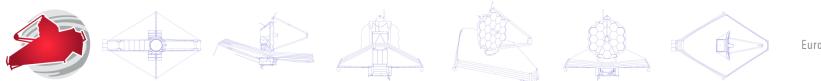


JWST Science Operations an Instrument Scientist View

Catarina Alves de Oliveira, JWST Instrument and Calibration Scientist (ESA)

Acknowledgements: the contents of this presentation are based on the results of work conducted by a large number of teams in Europe, USA, and Canada. Images/Diagrams credits: NASA, ESA, CSA, Astrium, Northrop Grumman, STScI.



The James Webb Space Telescope

International collaboration NASA, ESA, and CSA

Next space **observatory**, largely seen as 'the successor to Hubble Space Telescope'

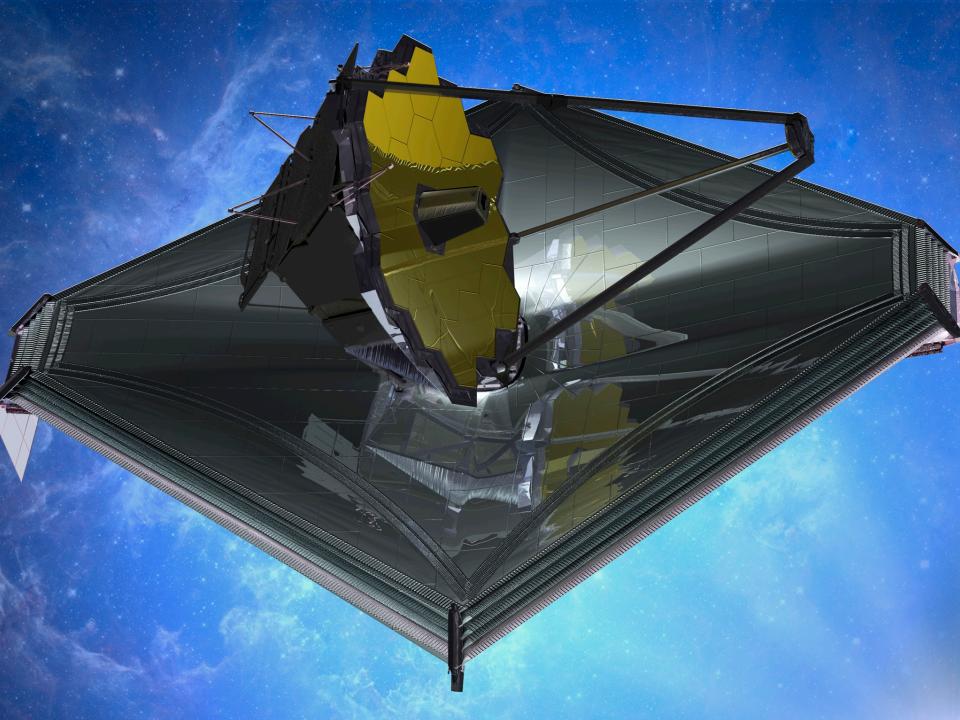
To be launched at the end of 2018, for a minimum mission duration of 5 years (10-year goal)

Space Telescope Science Institute (STScI) will operate JWST, with participation of 15 European staff









The James Webb Space Telescope

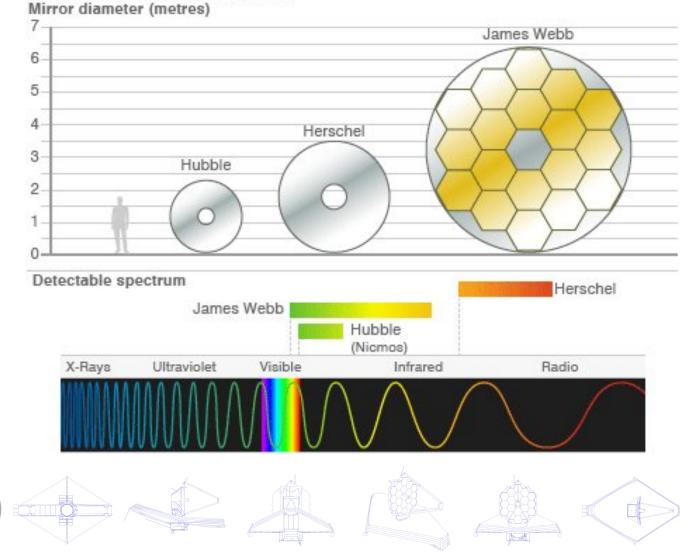


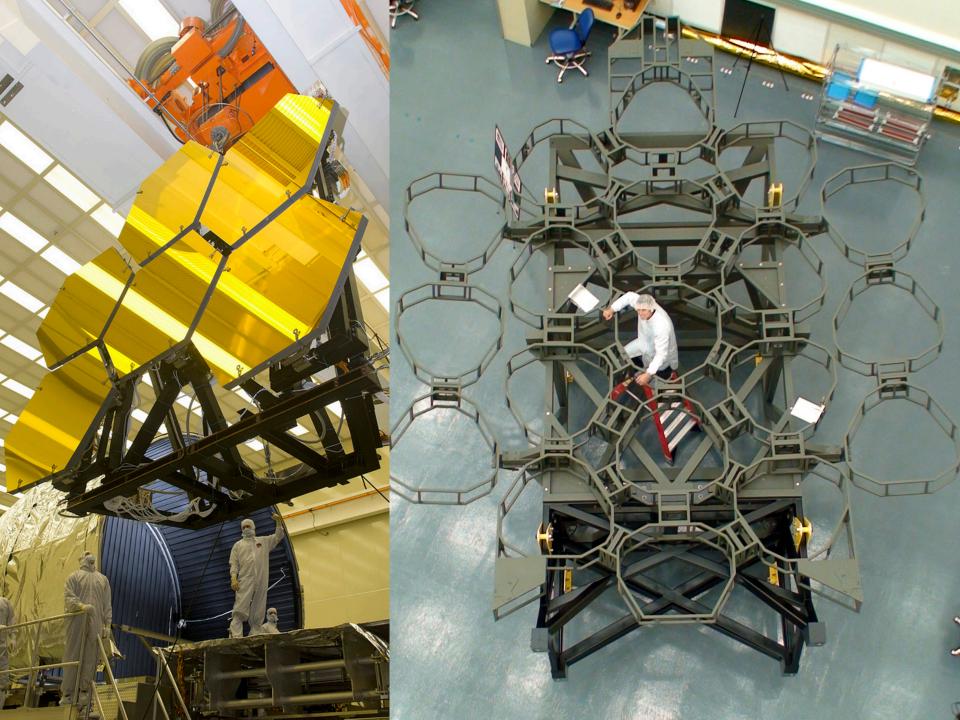


JWST fact sheet: mirror



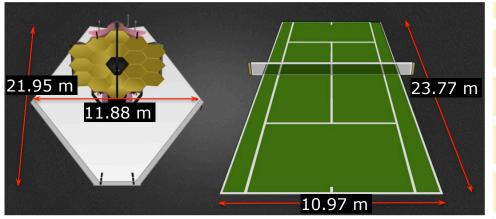
SPACE TELESCOPE COMPARISON

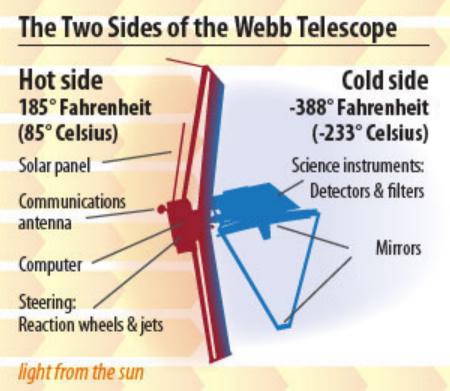




JWST fact sheet: sunshield





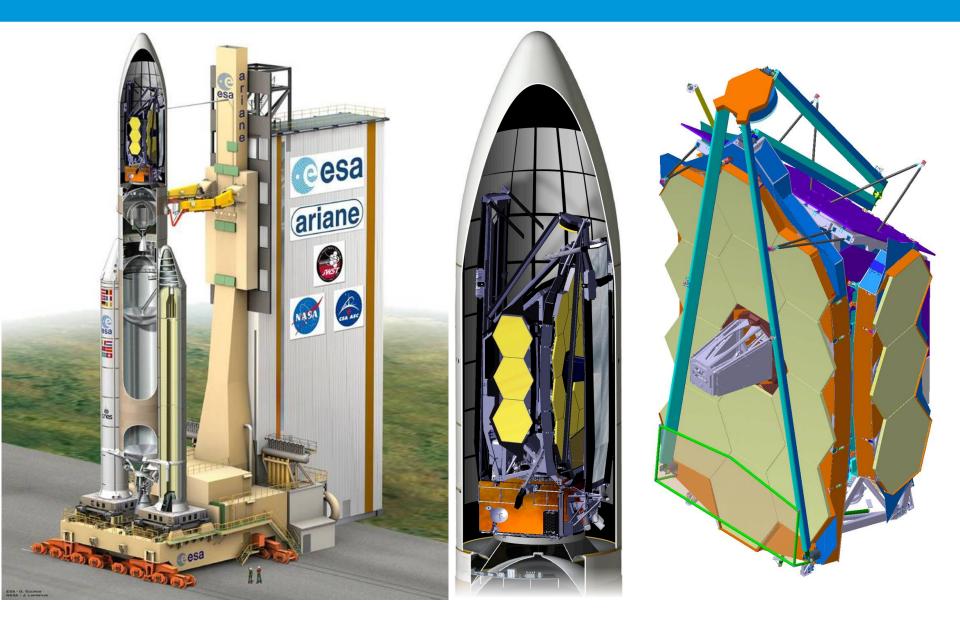


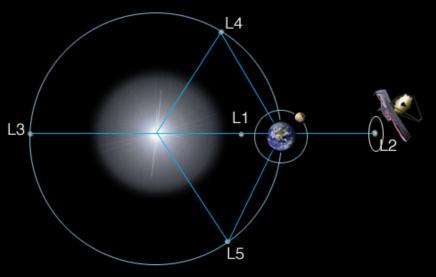


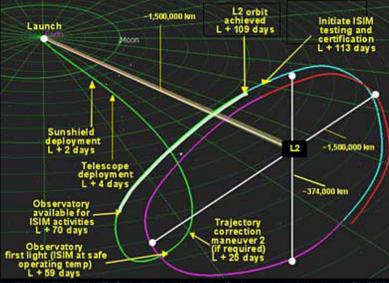


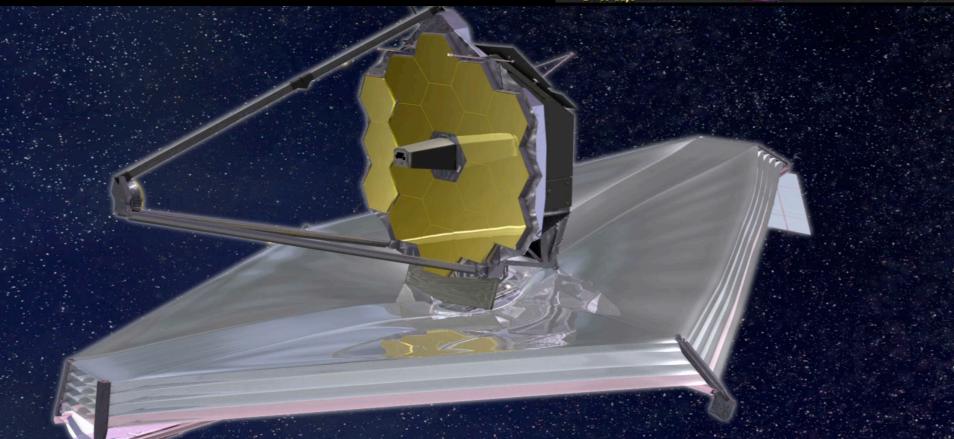
JWST fact sheet: deployment





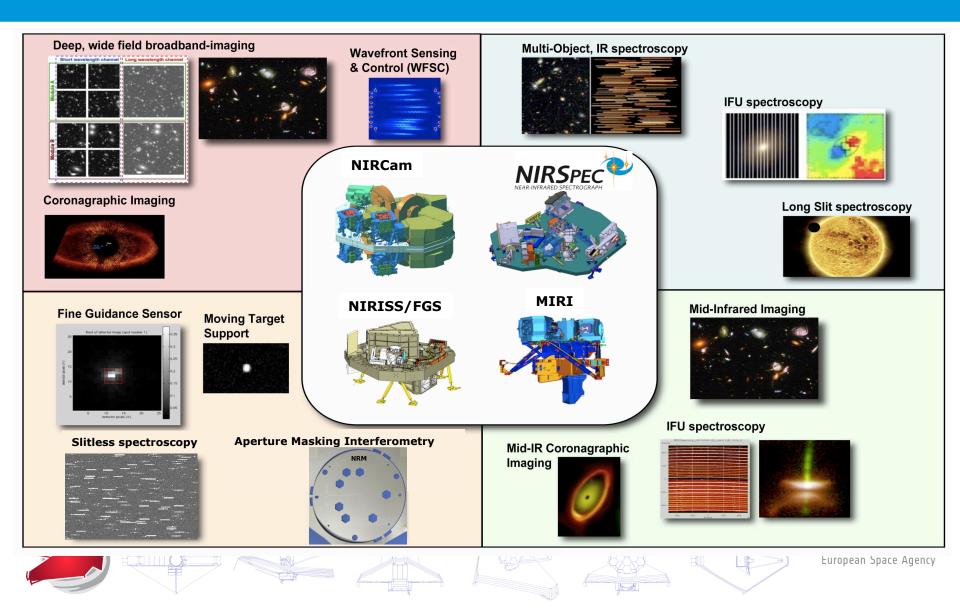




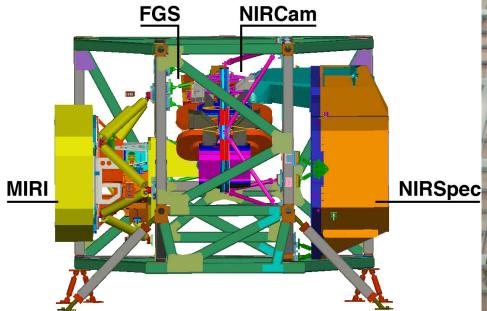


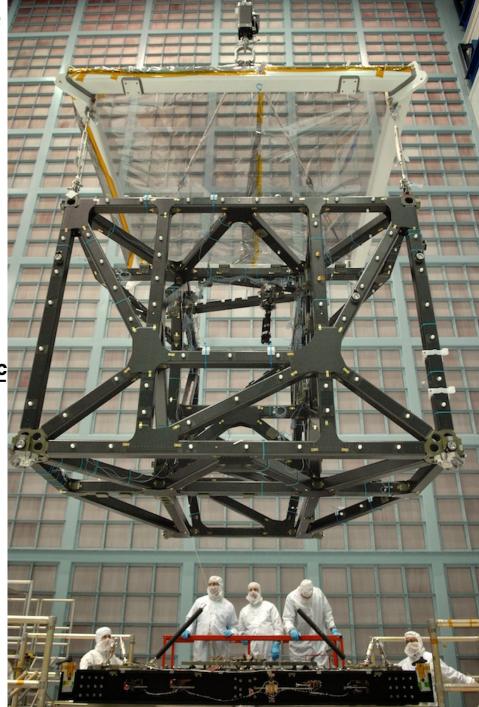
JWST fact sheet: instruments





Integrated Science Instrument Module (ISIM)





European contribution



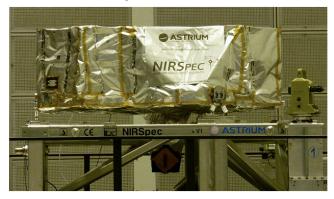


NIRSpec delivery: 06 September 2013





James Webb telescope: 'First starlight' instrument complete



More from

celebrates a year of

Jonathan

Mars rover

discoverv

UK government

excited by Sabre engine

Space penetrator

Ariane sizes up for

passes icy test

competition

Europe has reached another milestone in its contribution to Hubble's successor - the James Webb Space Telescope.

An industrial team led from Astrium in Germany has completed the build of the Near-Infrared spectrometer, one of four instruments that will go in JWST.

NirSpec's job will be to determine the age, composition, movement and distance of the objects in its field of view.

The expectation is that some of these targets will include the very first stars to shine in the Universe.

That would mean picking up light signals that have travelled across space for perhaps 13.6 billion light-years - something Hubble cannot do.

JWST will make it possible with a suite of next-generation

technologies, including a 6.5m primary mirror (more than double the width of Hubble's main mirror), and a shield the size of a tennis court to guard its keen vision against the light and heat from the Sun.

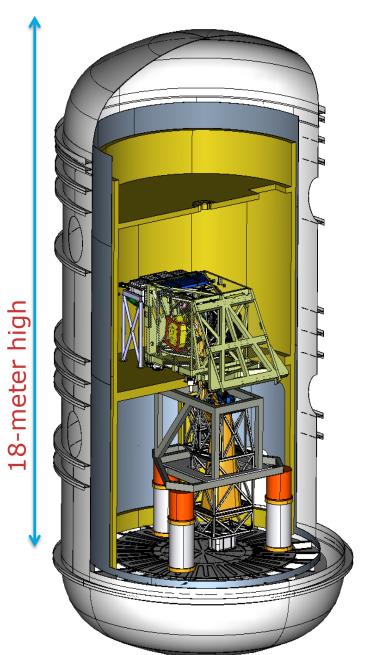
NirSpec is critical to this new capability, and represents 10 years of design

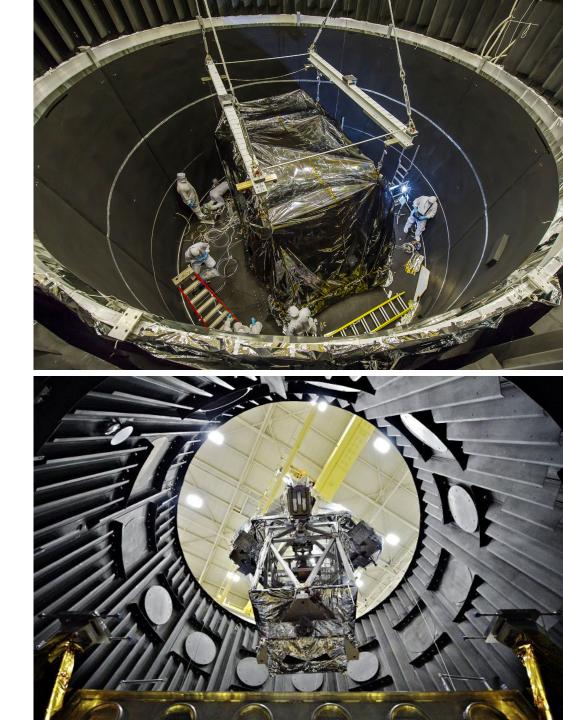




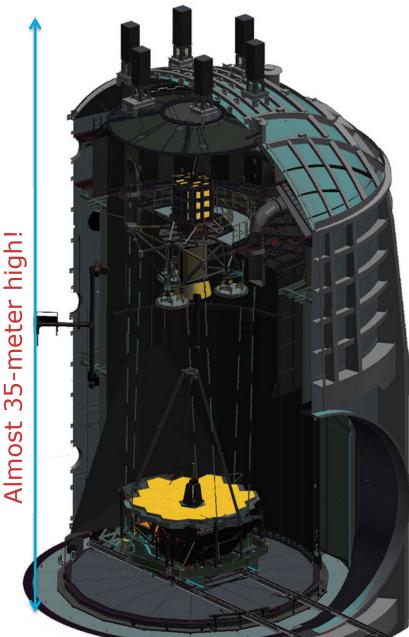
ace Agency

ISIM Testing Goddard Space Flight Center





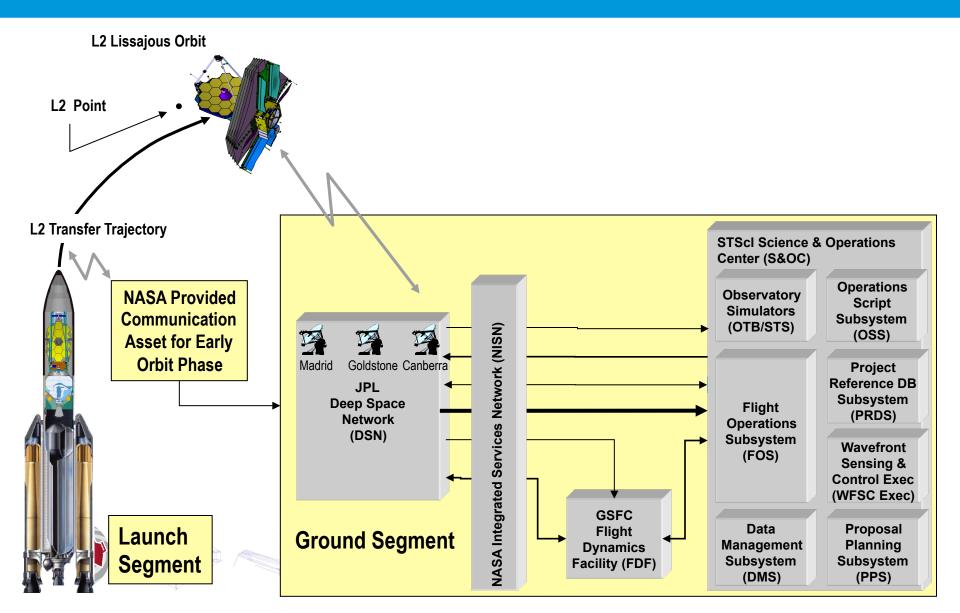
OTE Testing Chamber A, Johnson Space Center





Ground Segment

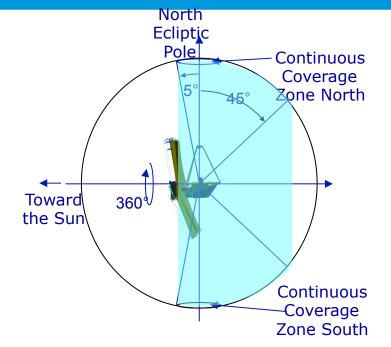


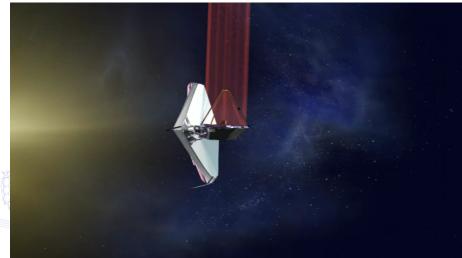


Observatory features



- 1. Autonomous Operations
- 2. Orbital constraints, target visibility
- 3. Roll constraints
- 4. Slew speed and accuracy

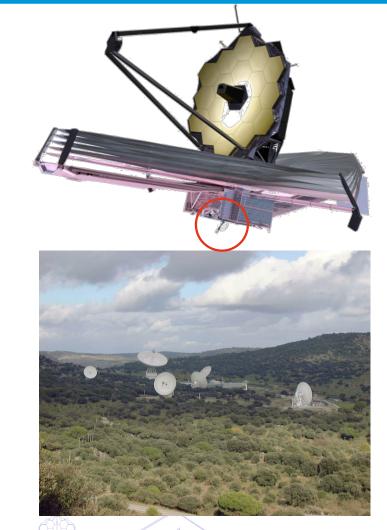




Observatory features



- 1. Autonomous Operations
- 2. Orbital constraints, target visibility
- 3. Roll constraints
- 4. Slew speed and accuracy
- 5. Data volume, uplink & downlink
 - a. Deep Space Network antennas in California, Spain, and Australia
 - b. downlink contact 4h every 12h



Observatory features



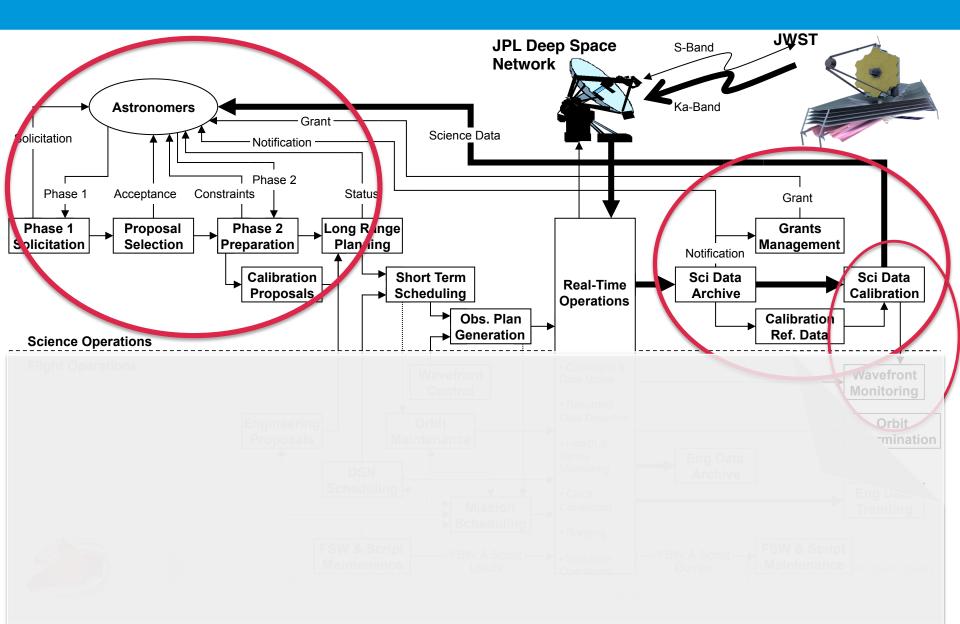
- 1. Autonomous Operations
- 2. Orbital constraints, target visibility
- 3. Roll constraints
- 4. Slew speed and accuracy
- 5. Data volume and downlink
- 6. Momentum management
 - a. radiation pressure on sunshield and trim flap
 - b. must be compensated by reaction wheels spin-up
 - c. eventually, reaction wheels must be slowed via thruster firing
- 7. Orbit maintenance
 - a. L2 is saddle point \rightarrow unstable orbit
 - b. "station keeping" through periodic thruster firings
- 8. Wavefront maintenance





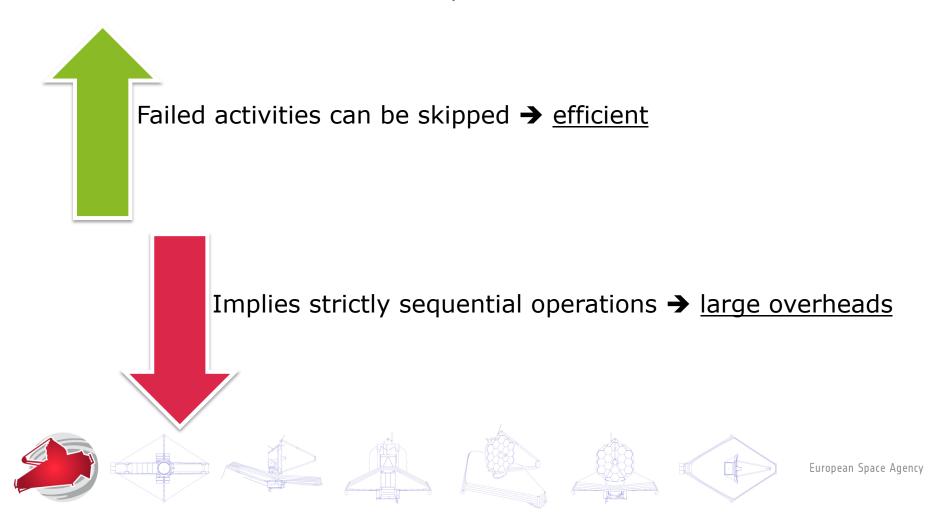
JWST Ground Segment Operations





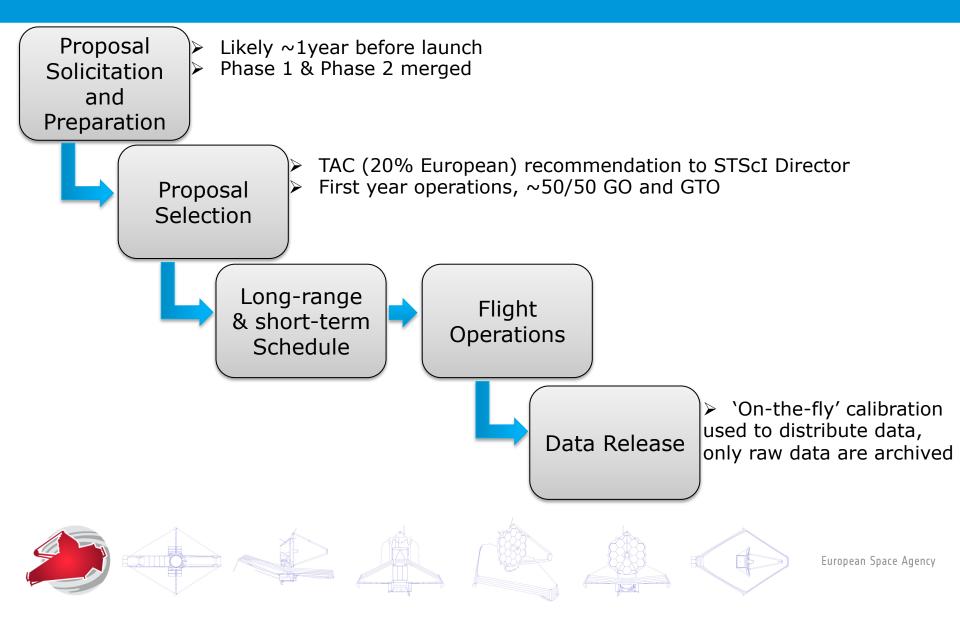


Command execution status determines when to execute the next command in a sequence



Proposals and Observation Planning

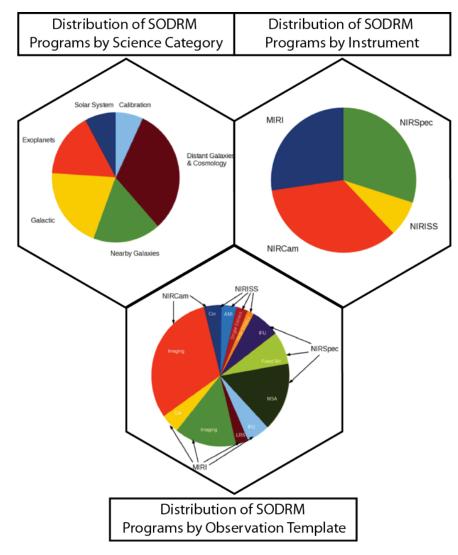




Science Operations Design Reference Mission (SODRM)



http://www.stsci.edu/jwst/science/sodrm/

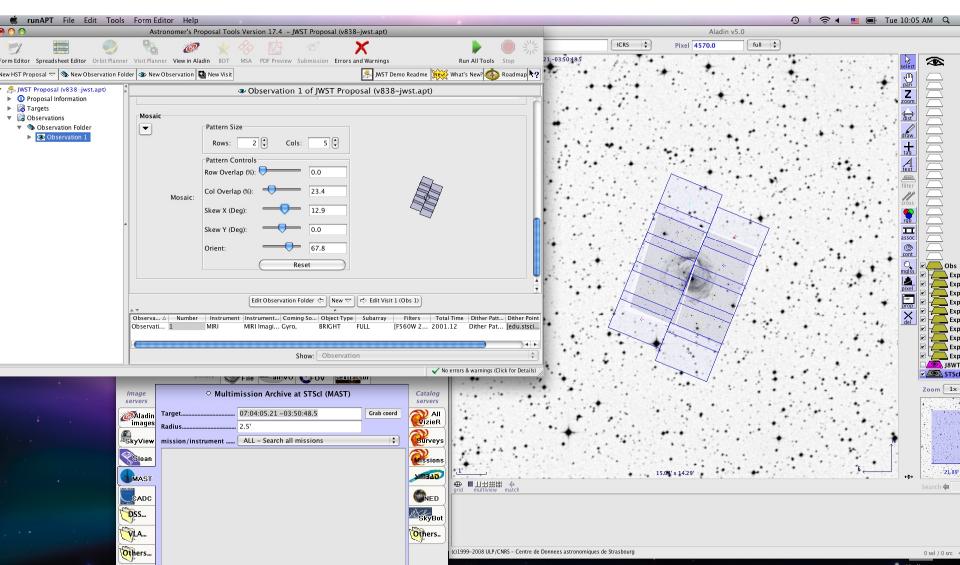


Category	Total Time [days]	Percentage of Total Time						
NIRCam Imaging	200.1	30.8%						
NIRCam Coronagraphy	25.2	3.9%						
NIRSpec Multi-Object Spectroscopy	102.2	15.8%						
NIRSpec Integral Field Slit Spectroscopy	43.5	6.7%						
NIRSpec Fixed Slit Spectroscopy	48.7	7.5%						
NIRIS Slitless Wide Field Spectroscopy	10.2	1.6%						
NIRISS Slitless Single Object Spectroscopy	17.3	2.7%						
NIRISS Aperture Mask Interferometry	22.7	3.5%						
NIRISS Imaging	1.7	0.3%						
MIRI Imaging	94.6	14.6%						
MIRI Coronagraphy	28.7	4.4%						
MIRI Low Resolution Spectroscopy	18.8	2.9%						
MIRI Medium Resolution Spectroscopy	35.0	5.4%						
Subtotal by Observation Type								
Category	Total Time [days]	Percentage of Total Time						
Total Imaging	296.4	45.7%						
Total Coronagraphy	76.6	11.8%						
Total Spectroscopy	275.7	42.5%						
Total	648.7	100.0%						

Astronomer's Proposal Tool (APT)



Example: MIRI



Astronomer's Proposal Tool (APT)



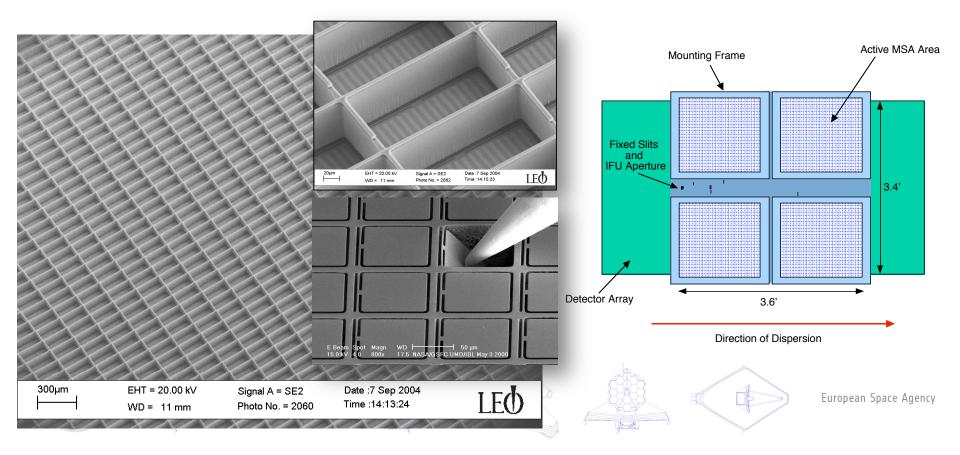
Download: http://www.stsci.edu/hst/proposing/apt

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NIRSpec: first MOS in space

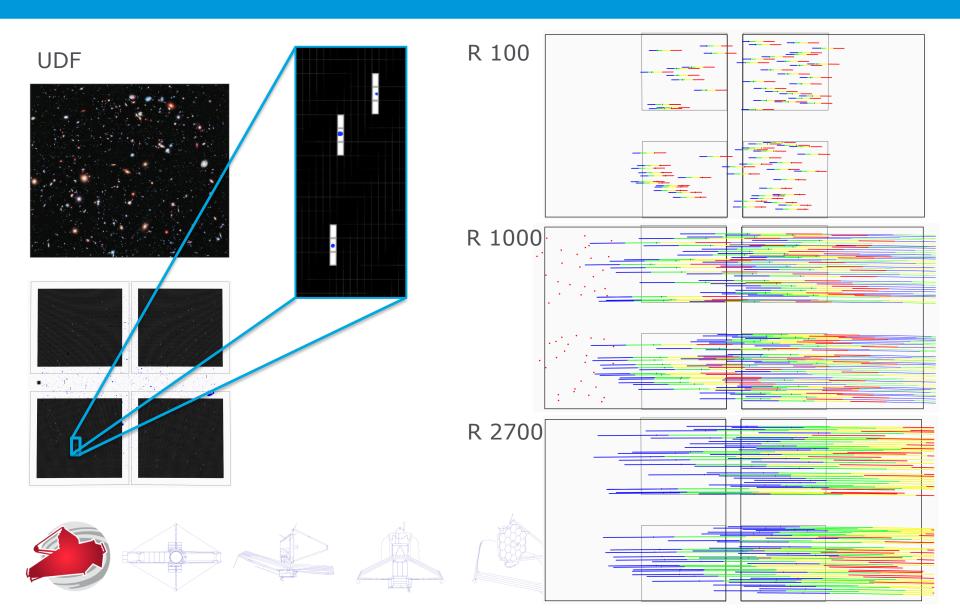


- 4 x 365 x 171 microshutters (0.2" x 0.46" over 3.4'×3.5')
- Up to ~100 objects observable simultaneously
- > Prism + 6 grating covering 0.6 5 μ m



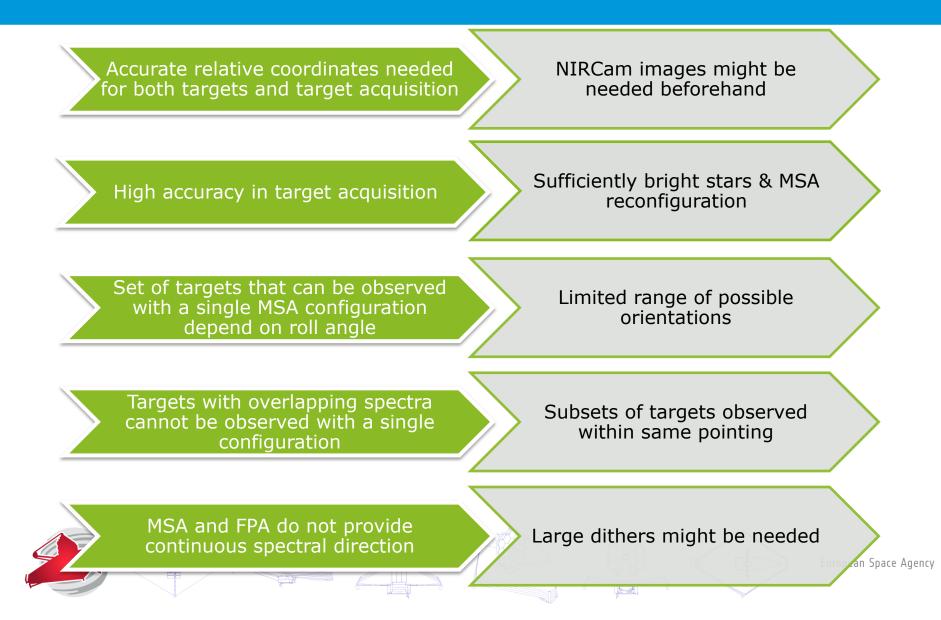
Observing Scenario





Planning NIRSpec Observations

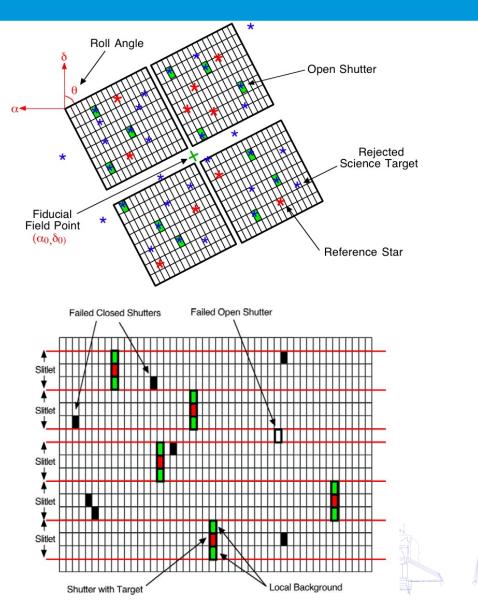




Typical Observing Strategy



European Space Agency



Challenges:

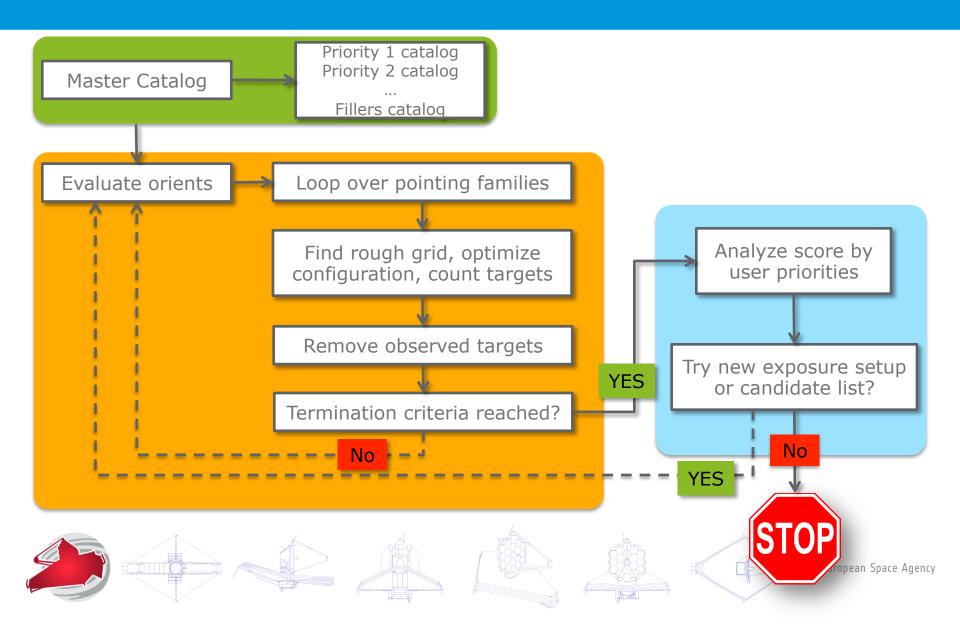
- Grid of MSA shutters is 'fixed'
- Too many targets to choose 'by-hand'
- Fixing a pointing based on one target, rule out observing many others



Need for an automated way to maximize observations of as many targets as possible

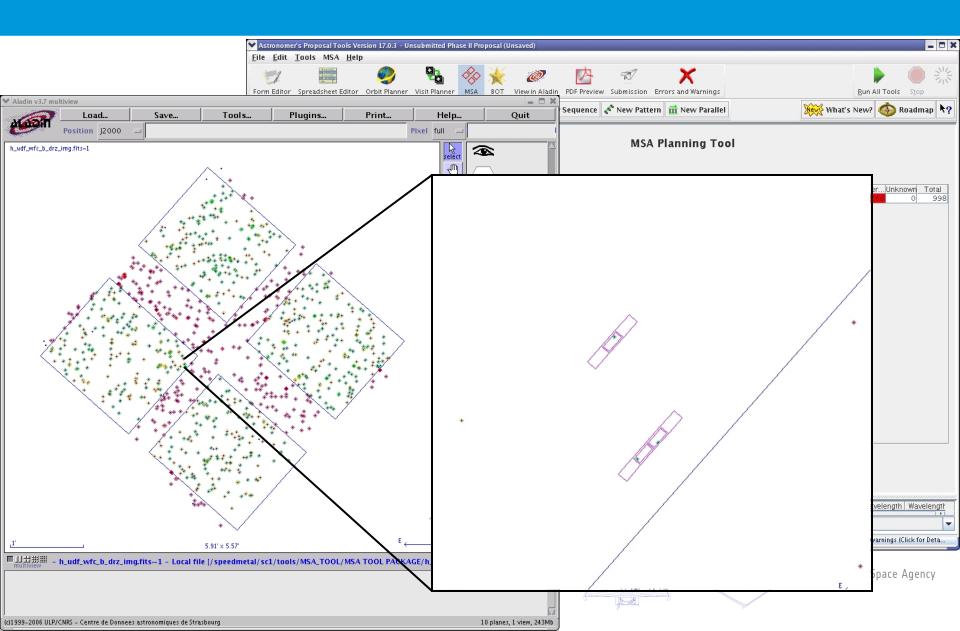
MSA Planning Tool





APT and the MSA Planning Tool







Thank you

Catarina Alves de Oliveira, JWST Instrument and Calibration Scientist (ESA)

Acknowledgements: the contents of this presentation are based on the results of work conducted by a large number of teams in Europe, USA, and Canada. Images/Diagrams credits: NASA, ESA, CSA, Astrium, Northrop Grumman, STScI.

