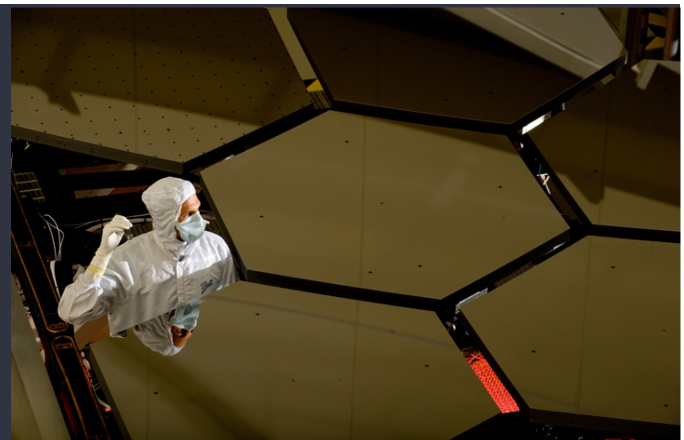
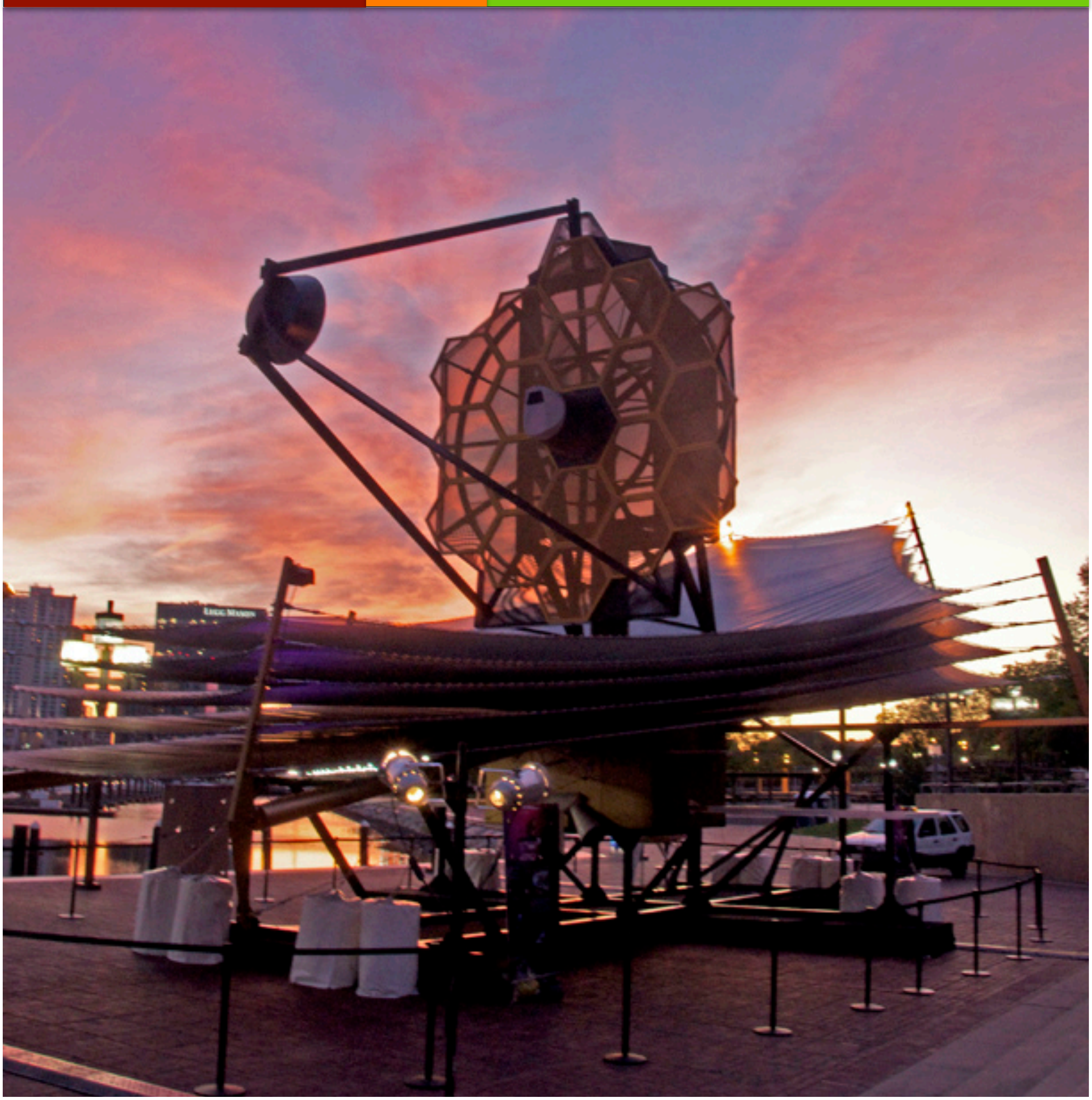
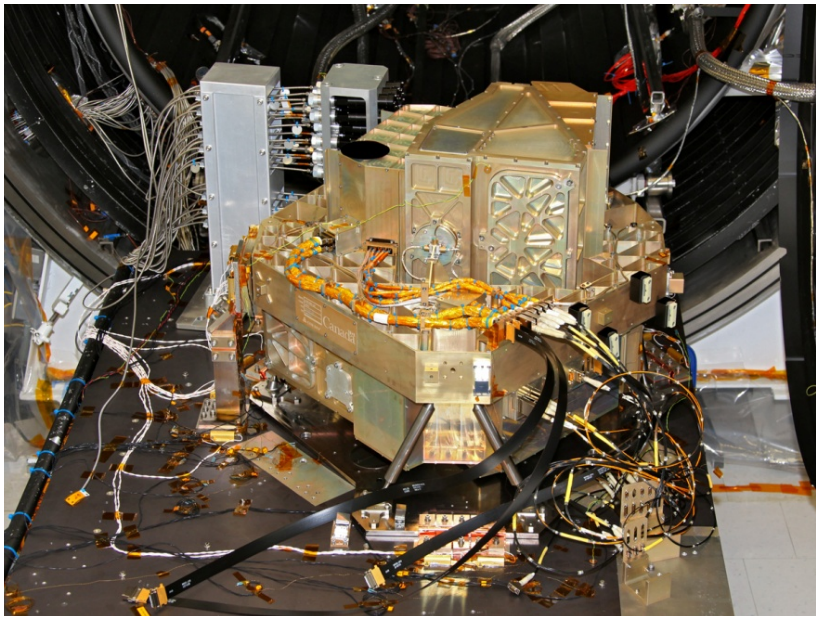
Webb Update

Winter 2012







JWST & NIRISS

by René Doyon

Flight hardware for the FGS and NIRISS. All the new optical components needed for NIRISS are currently under manufacture, and will be tested and integrated into the Pupil and Filter Wheels in the spring of 2012. Photo by John Brebner.

The Canadian Space Agency (CSA) is providing a new science instrument that enhances the capabilities of the JWST Observatory while also being simpler to build and operate than the recently-discontinued Tunable Filter Imager (TFI). TFI was discontinued after it became clear that various technical issues associated with operating the Fabry-Perot etalon at cyrogenic temperatures were unlikely to be resolved in time to meet the instrument's delivery schedule. The reconfigured hardware has been renamed the Near InfraRed Imager and Slitless Spectrograph (NIRISS). The NIRISS configuration eliminates the etalon and re-populates the dual wheel of the TFI with spare broad-band filters from NIRCam, several carefully defined new filters, and three dispersing elements (grisms). As with the TFI, NIRISS shares its optical bench with the Fine Guidance Sensor (FGS), but is functionally separate from it.

NIRISS extends the tools available onboard JWST to study distant Lyα emitters – one class of primeval galaxy – and the detection and characterization of exoplanets.

The full range of capabilities of NIRISS is implemented in terms of four observing modes:

1. Wide-Field Slitless Spectroscopy. This mode is optimized to detect faint emission-line objects such as high-redshift ($7 < z < 17$) Lyα emitters over the field of view of NIRISS. It uses the two G150 grisms to provide low-resolution spectra (R=150) between 1 and 2.5 microns in first order.

2. Single-Object Slitless Spectroscopy. This mode provides medium-resolution (R~700) spectroscopy of bright stars ($J > 5$) between 0.6 and 2.5 microns. It is expected to become a powerful tool for characterizing the atmospheres of transiting exoplanets around bright stars.

3. Aperture Mask Interferometry. NIRISS has a 7-hole aperture mask with non-redundant baselines (hence the term: non-redundant mask) to enable high-contrast imaging. This mode complements the coronagraphic capabilities of NIRCam and MIRI by permitting exoplanets to be detected and characterized at small separations from their host star. The technique can also be used to perform observations that probe the inner structure of young stellar objects and nearby active galactic nuclei.

4. Imaging. NIRISS is capable of broad- and medium-band imaging between 0.9 and 5 microns. Its suite of filters include seven of the eight broadband filters that NIRCam will use to search for Lyman break galaxies.

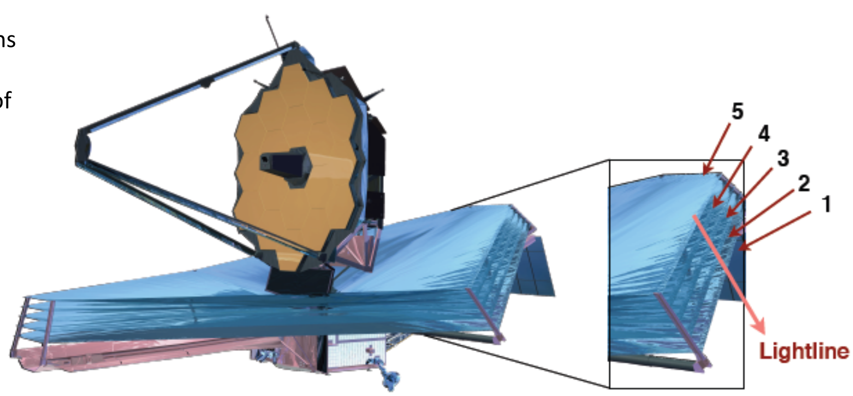
First Template Sunshield Layer Enters Testing

by Mark Clampin

The Layer 3 template membrane mounted in the test fixture at NeXolve. Several people seen in the picture provide the scale of the membranes size.

The James Webb Space Telescope (JWST) is a passively cooled telescope, which means that it does not use a reservoir of liquid cryogen to achieve the telescope's cryogenic operating temperature of ~40 K. Instead, JWST achieves its cryogenic operating temperature by shielding the telescope and science instruments from the sun with an array of five aluminum-coated kapton membranes, each the size of a tennis court. The membranes are shown schematically below, which also illustrates the relative alignment of the membrane layers. In order to prevent the telescope viewing the warmer layers 1 through 4, each layer is sized so that the telescope only sees layer 5, while the sun only sees layer 1 directly. Despite the size of each membrane layer, the lightlines or edges must each meet ±50 mm tolerances. The 3-D shape is also important with steep gradients at the interface to the spacecraft bus. The relative spacing between layers must also be maintained to ensure that the sunshield thermal performance performs its job of passively cooling the telescope and science instruments.

JWST's unique sunshield technology has been developed using full and sub-scale prototypes. Just recently, ManTech NeXolve completed testing of the first of five full scale template membranes. These template membranes are full scale precursors for the flight membranes. They will permit the JWST Project to verify the size and 3-D shape of each of the membrane layers, once it is tensioned with cables. The first of these template membranes, layer 3, has recently been deployed and mounted on fixtures so that its shape could be measured with LIDAR. The layer 3 membrane is shown above, prior to being tensioned by the catenary cables that define the 3-D shape. Once tensioned the membrane's 3-D shape is measured to ensure it will meet its light-line alignment requirements. Following verification of layer 3's shape, the next template membrane to enter 3-D shape testing will be layer 5, which has the most demanding alignment requirements. The next major step for the template membranes after all five have completed shape measurement is the addition of holes for pins that will hold the folded membrane on its palette during launch. Further testing of the deployment of the stowed membranes will continue at Northrop Grumman to demonstrate the full sunshield deployment sequence.



Right: JWST's five membrane layers are sized so that the telescope only has a direct view of the coldest layer. This alignment of the edges is known as the light line.

JWST Programmatic Status Update

by Eric Smith

The President's budget request for fiscal year 2013 (FY2013) includes the recent replan recommended funds ($627.6M) for the James Webb Space Telescope. This is explicit acknowledgement both of the high priority Webb is for the Administration and NASA and the good cost and schedule performance of the program since the replan began. Following the receipt of the Independent Comprehensive Review Panel report in October 2010, NASA reorganized the JWST program to respond to recommendations in that report. That reorganization and restructuring of the project budget and schedule was completed throughout the Spring of 2011, reviewed by the independent JWST Standing Review Board, and by officials within the White House Office of Science and Technology Policy, Office of Management and Budget, and by Congressional staff during the Summer of 2011. In September 2011, NASA adopted the replanned mission budget, which supports an October 2018 launch with a development cost of $8B and total life cycle cost (5 years of operations and 2 years of data analysis) of $8.8B.

During the replanning period there was considerable progress made on mission hardware. In 2011 the telescope optics were completed and verified to meet the mission performance requirements at cryogenic temperatures, modifications to the giant thermal vacuum test chamber at the Johnson Space Center began, the equipment to assemble the mirror segments onto their backplane was delivered to the Goddard Space Flight Center, and the Integrated Science Instrument Module (ISIM) entered its integration and test phase. In fiscal 2012 this good performance has continued with the project meeting all milestones (and more than 50% of them ahead of schedule). This Spring will see the delivery of the MIRI instrument to ISIM integration and test, followed by the Fine Guidance Sensor in the Summer, the NIRCam in the Fall and finally NIRSpec in early 2013. Modifications to the JSC chamber will be completed this year, and the telescope backplane which supports the center section of the primary mirror will be completed as well.

The progress over the last 14 months provides confidence that the new management processes and procedures have corrected past deficiencies. This progress has also validated the reserves philosophy recommended by the review panel. To stay on top of Webb progress visit http://www.jwst.nasa.gov/status_main.html.

Would you like a colloquium at your university on JWST? How about a talk at a conference you are organizing? These JWST scientists are willing to give a talk. The JWST project has allocated some funding to pay the expenses for talks in the US; talks in other countries can also be arranged. In addition to the specific topics listed below, the speakers are also available to give JWST Mission Overview talks and talks at the general public level.

- Mark Clampin, GSFC, "Exoplanets with JWST"
- Rene Doyon, Universite de Montreal, "JWST NIRISS Science"
- Jonathan Gardner, GSFC, "JWST and Galaxy Evolution"
- Matt Greenhouse, GSFC, "JWST Mission Overview and Status"
- Heidi Hammel, AURA, "Planetary Exploration with JWST"
- Jason Kalirai, STScI, "Resolved Stellar Populations in the Near IR with JWST"
- Jonathan Lunine, Cornell University, "JWST, Exoplanets and the Solar System"
- John Mather, GSFC, "JWST Mission Overview and Status"
- Bernie Rauscher, GSFC, "JWST and it's HAWAII-2RG and SIDECAR ASIC Detector Systems"
- George Rieke, University of Arizona, "Debris Disks and the Evolution of Planetary Systems," or "The Place of JWST in the growth of Infrared Astronomy"
- Marcia Rieke, University of Arizona, "NIRCam for JWST: Exoplanets to Deep Surveys"
- Jane Rigby, GSFC, "Gravitationally Lensed Galaxies and JWST," or "AGN and JWST"
- George Sonneborn, GSFC, "Imaging and Spectroscopy with JWST"
- Massimo Stiavelli, STScI, "Studying the first galaxies and reionization with JWST"
- Amber Straughn, GSFC, "JWST and Galaxy Assembly"
- Rogier Windhorst, Arizona State University, "First Light, Reionization and Galaxy Assembly with JWST" or "JWST and Supermassive Black Hole Growth"

To arrange a talk, please email jwst-science@lists.nasa.gov or contact the speaker directly. For European universities and institutions interested in inviting speakers to give talks covering the full range of scientific topics addressed by JWST, please contact Pierre Ferruit (ESA Acting JWST Project Scientist, ESTEC, pferruit@rssd.esa.int).