IMAGE SCIENCE & ANALYSIS GROUP
JOHNSON SPACE CENTER

Image Analysis Overview

Multilateral Imagery Working Group Technical Interchange Meeting

NASA Johnson Space Center
Image Science and Analysis Group (ISAG) (XI4)

http://isag.jsc.nasa.gov/

May 2018

Image Science and Analysis Group

- The JSC Image Science and Analysis Group (ISAG) provides expertise in all areas of imaging science:
  - Requirements development
  - Imagery acquisition planning and operations guidance
  - Imagery manipulation, mosaics and synchronized views
  - Component monitoring and surface inspections
  - 2D and 3D photogrammetric measurements
  - 2D and 3D high-precision motion tracking in video

- ISAG supports ISS, Orion, Space Launch System, Commercial Crew & Cargo Programs.

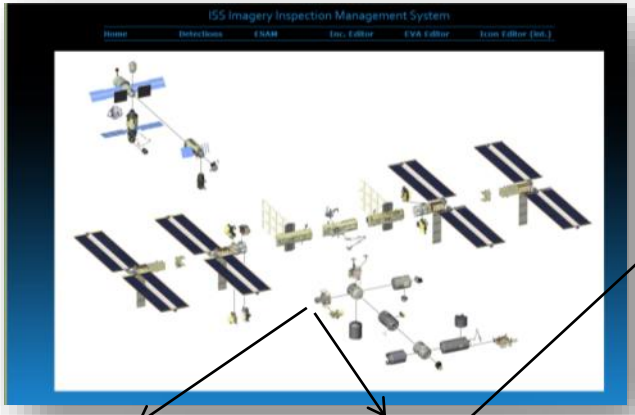
Image Science & Analysis Lab

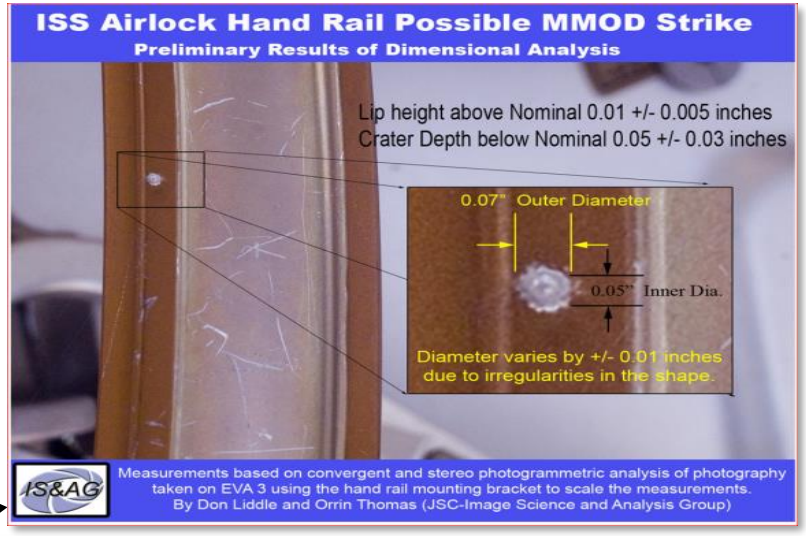
Image Science & Analysis Homepage

- Findings and Analyses are posted to the ISAG homepage
  - http://isag.jsc.nasa.gov/

Online Survey Findings Catalog

- ISS Inspection Imagery Management System (IIIMS) is used to catalog external inspection findings.
  - http://isag.jsc.nasa.gov/IIIMS-public/





Element	View	Detection Type	SubSystem Owner				
US_Airlock	nadir	Any	Any	Go Filter	Count: 2	New Detection	
Issue ID, Owner	**Mission, Element, View**	**Title, ISAG Docs**	**Type, SharpEdge, XPath**	**IFI #, PRACA #, Docs**	**Comments**	**User, Modified Time**	
79 ATCS	AF-20A/STS-130 US_Airlock Nadir	Possible MMOD Strike on Center Airlock O2 Tank next to Handrail. doc	MMOD Strike No Yes	TBD TBD	sharp edge should be no because of soft goods	rscharf 5/15/2011 12:00:00 PM	
88 TBD	AF-1E/STS-122 US_Airlock Nadir	MMOD strike on US Airlock handrail adjacent to hatch. doc	Sharp Edge Confirmed Yes	TBD TBD	sharp edge is marked with a wiretie, but not repaired or covered.	rscharf 5/15/2011 12:00:00 PM	

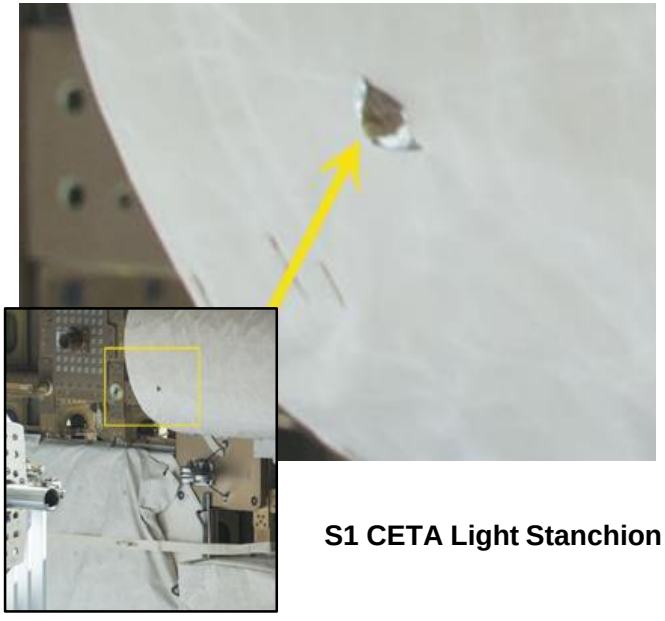
Routine Imagery Acquisition

Subject	Type	Frequency
• Crew choice downlink (Earth Obs, Leisure)	Internal Crew Photo	Daily
• EVA Video (Helmet Cam and GoPro)	External Video	Periodic
• Soyuz Pre-departure Survey	Crew, SSRMS, EHDC	Undock -3 Weeks
• External Survey of ISS – External TV	External Video	6 Months
• External Survey of ISS – Internal Crew	Internal Crew Photo	Yearly
• S1-3 HRS Radiator Damage Inspection	External Video	2 Months
• FGB Solar Array Retraction Inspection	External Video	2 Months
• Port HRS Radiator Inspection	Internal Crew Photo	Yearly
• STBD HRS Radiator Inspection	Internal Crew Photo	Yearly
• Port Solar Array Wing Mast and Blankets	Internal Crew Photo	Yearly
• STBD Solar Array Wing Mast and Blankets	Internal Crew Photo	Yearly

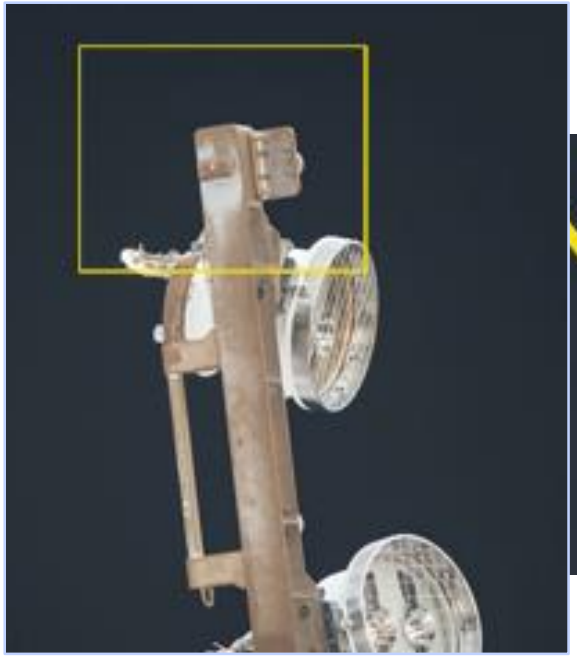
External Survey Observations Highlights

May 2015 – May 2018

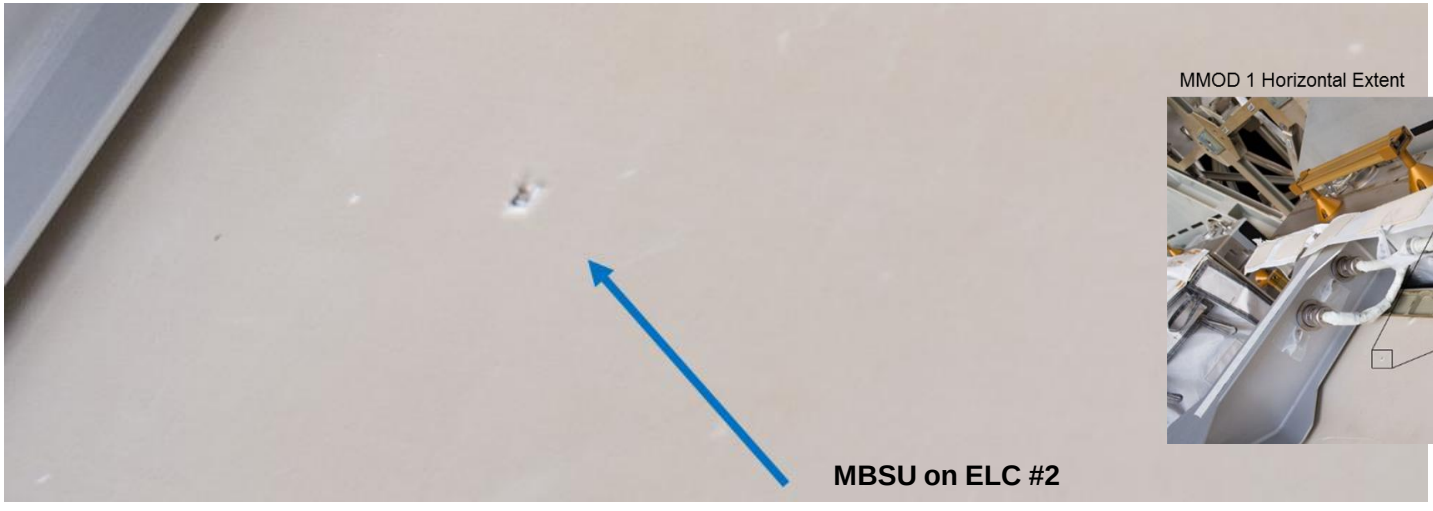
Possible MMOD Strikes



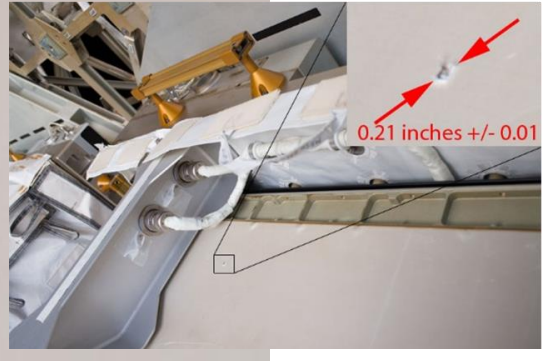
S1 CETA Light Stanchion



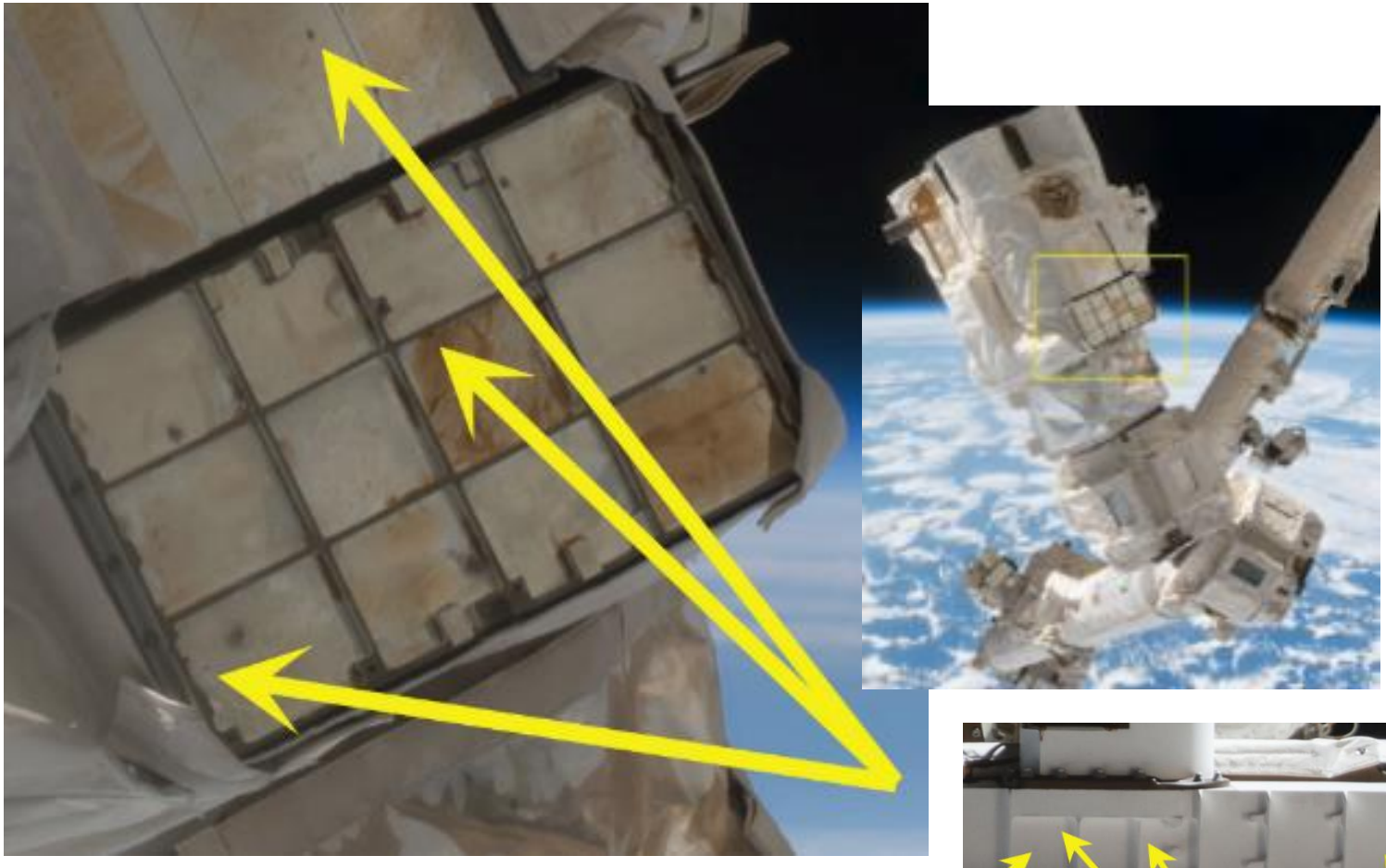
SGANT on ESP 3



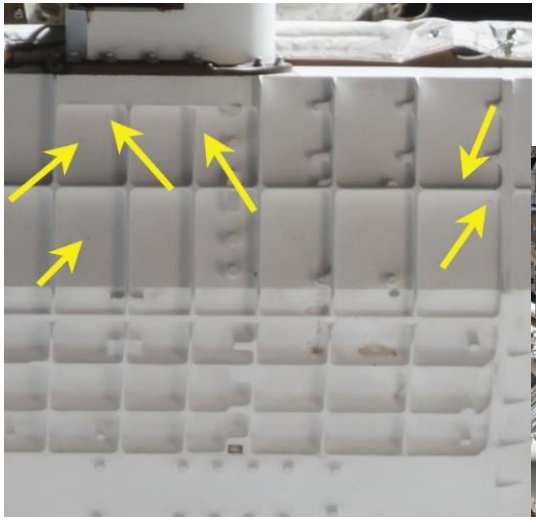
MBSU on ELC #2

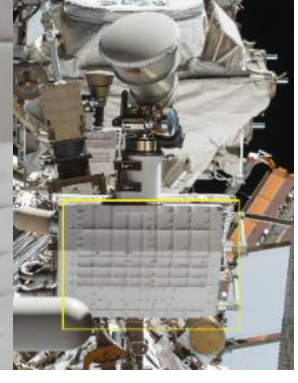


Possible MMOD Strikes



SSRMS LEE B

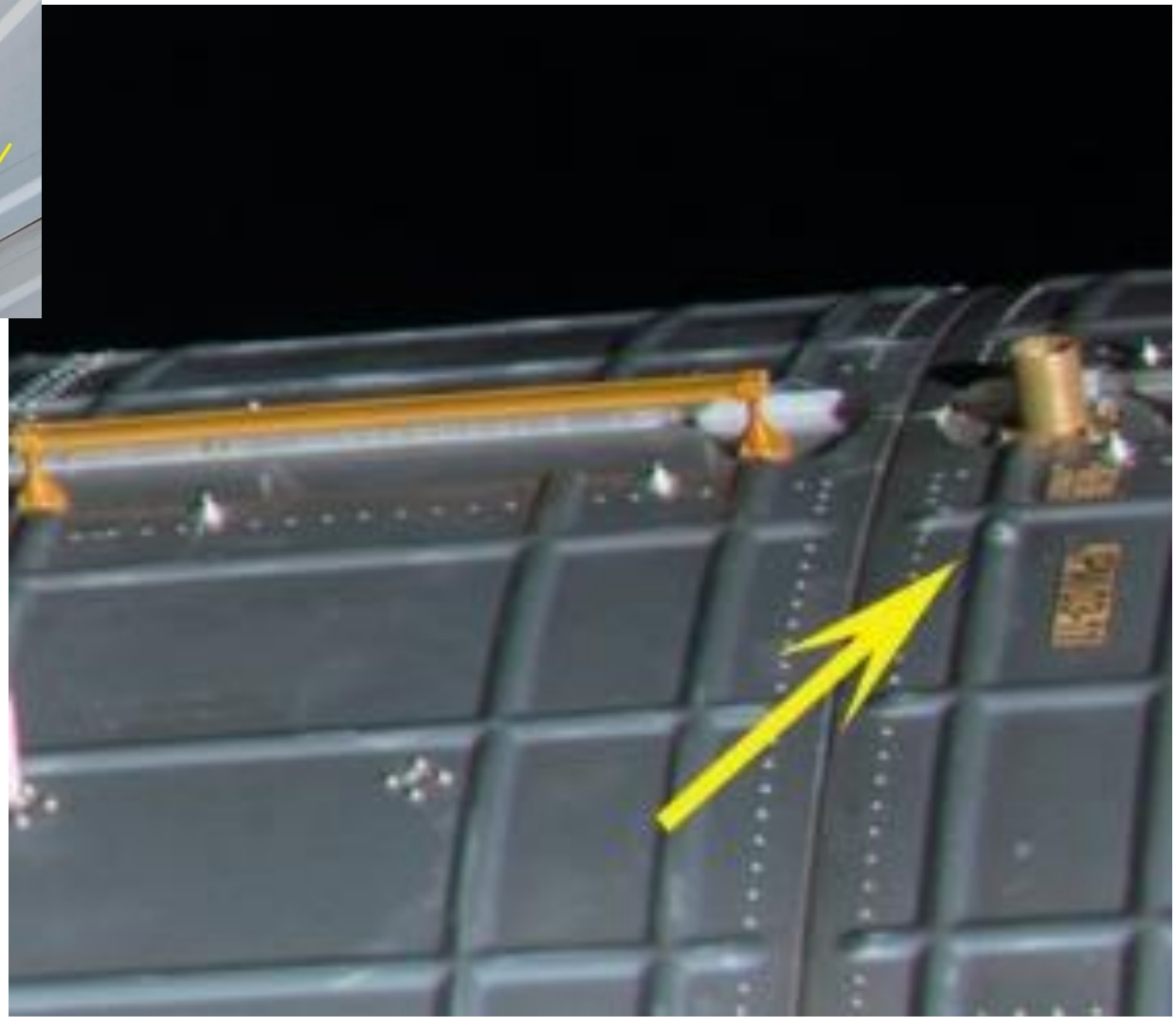




S1 Nadir S-Band Antenna

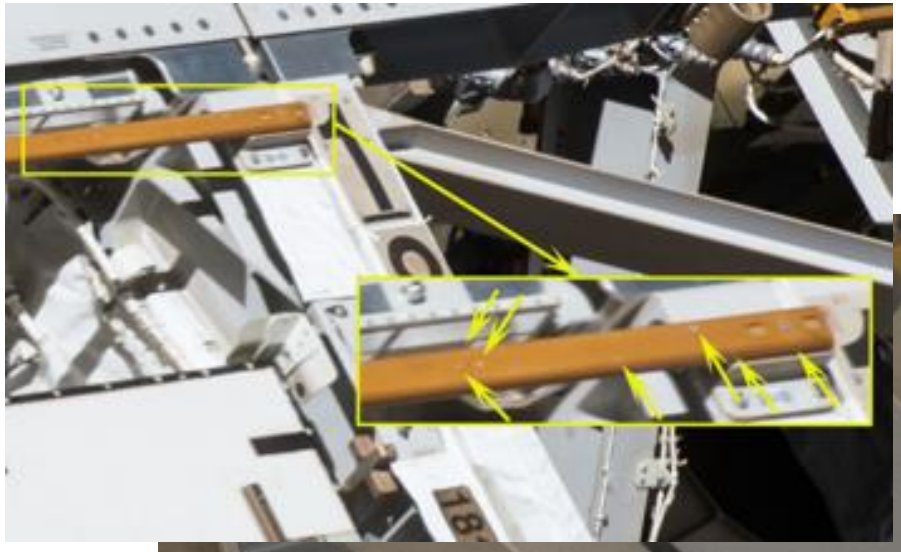
Possible MMOD Strikes

US Lab Module Nadir Side



JPM Nadir MMOD Shield

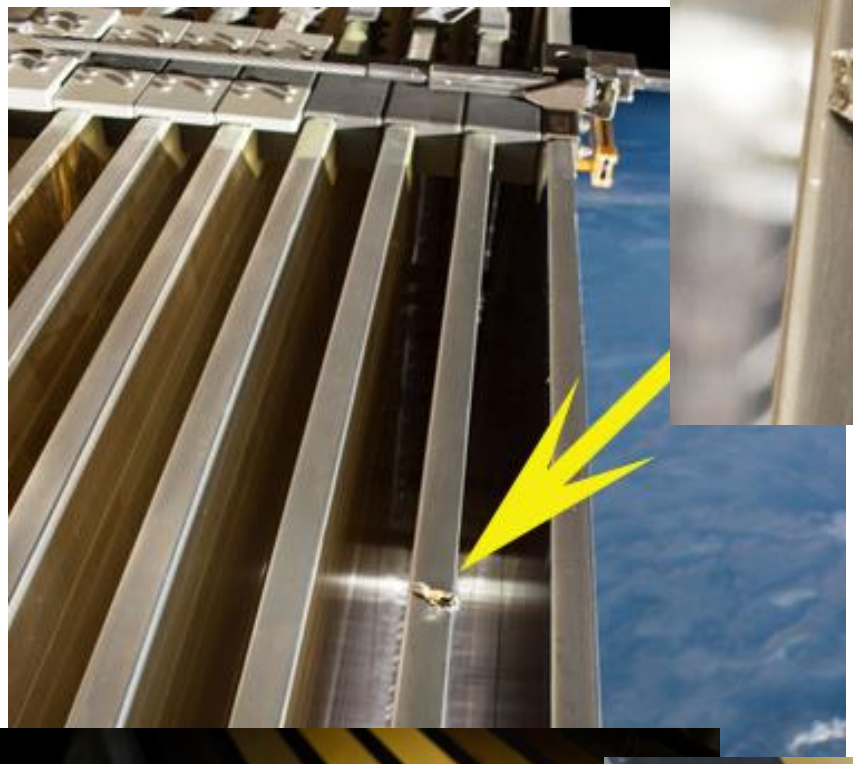
Possible MMOD Strikes

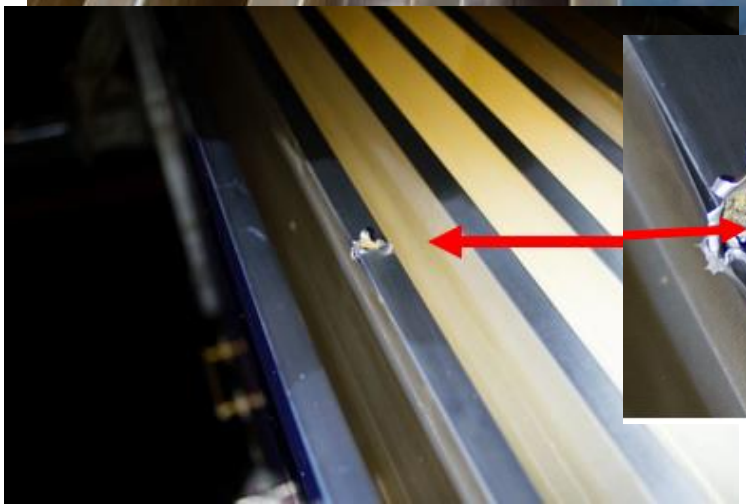


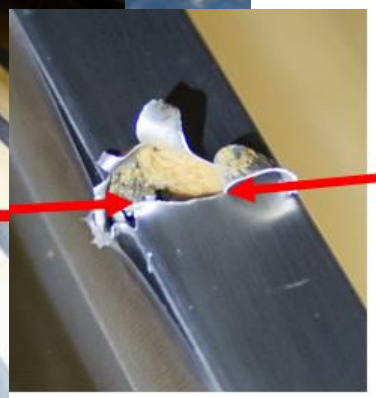
EVA Handrail Sharp Edge Risk

MMOD Strike

Trailing Thermal Control Radiator (TTCR)



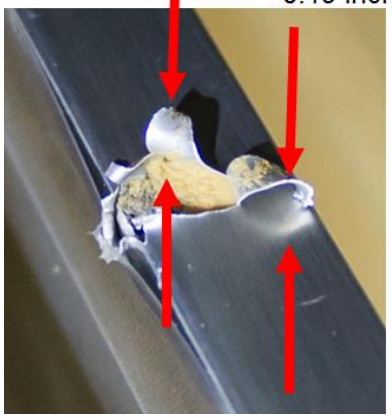




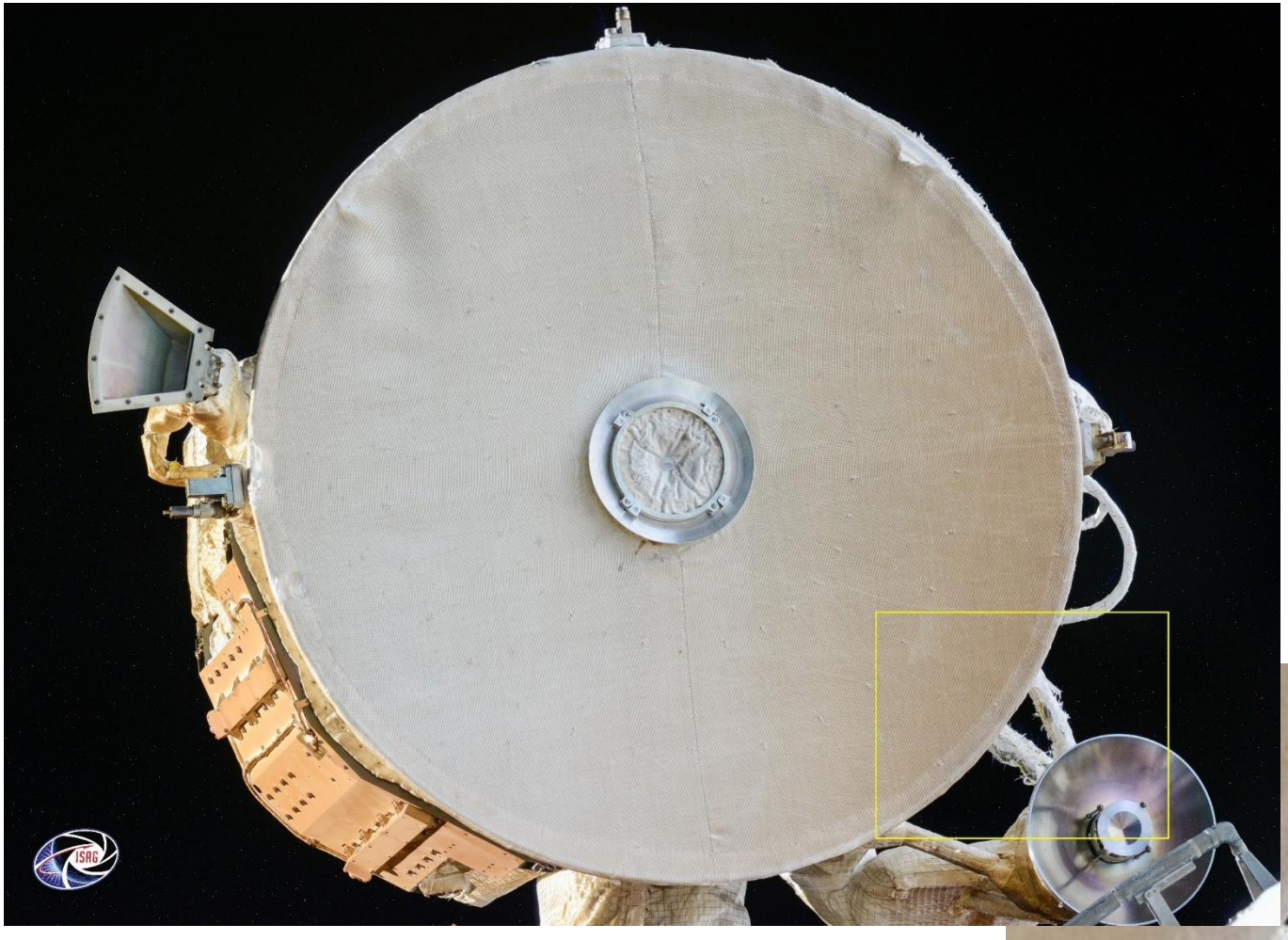
0.50 inch

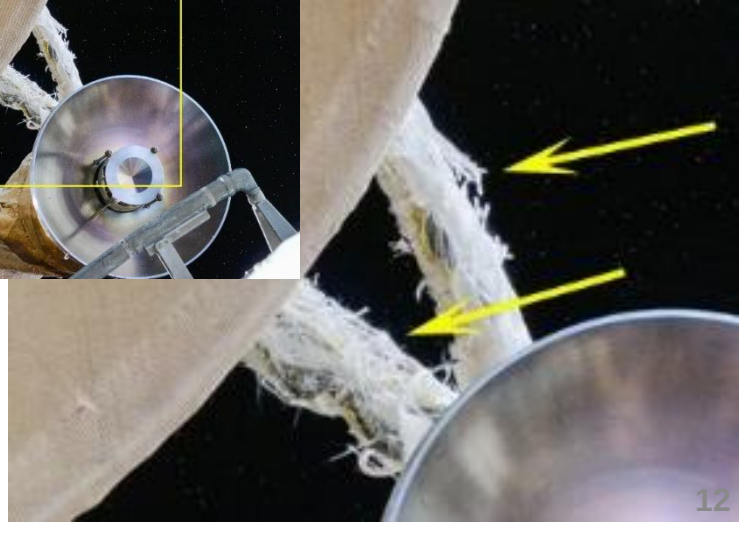
0.19 inch height above plane

0.19 inch height above plane



Deterioration Observed on SM LIRA Antenna

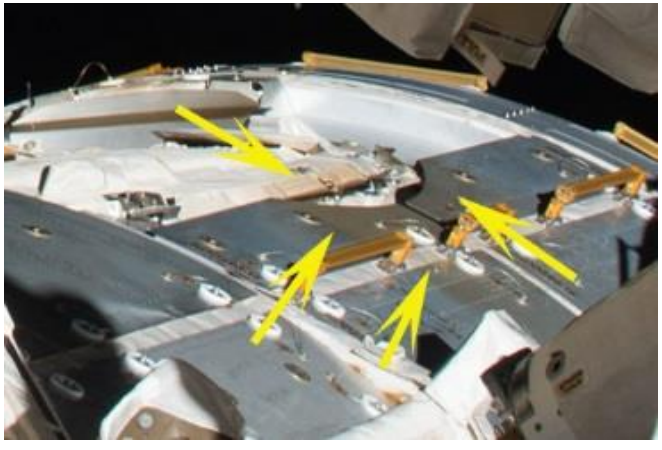




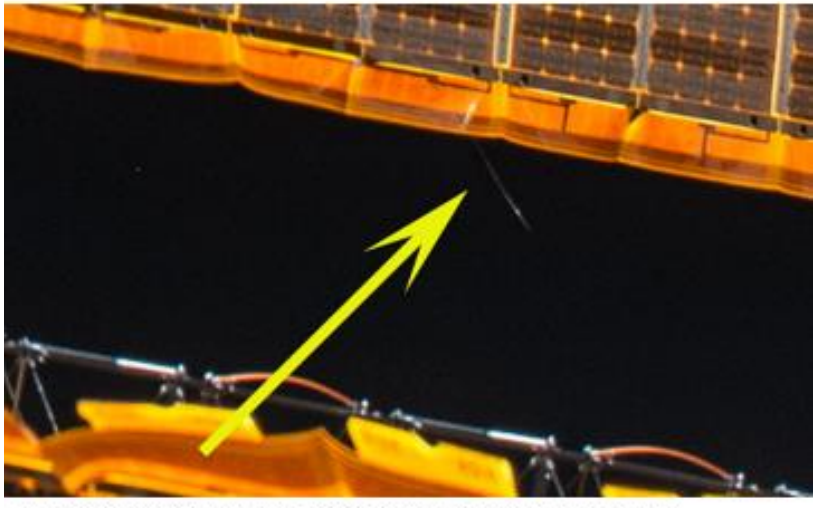
External Degradation

MLI Lifted on SSRMS LEE

Possible Torn MLI Near Energia Label on MRM2 Forward/Port

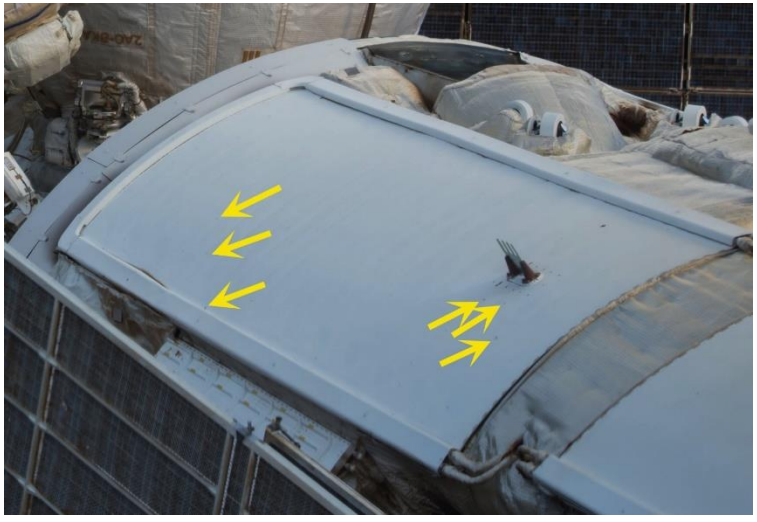


Discoloration on Node 2 Nadir CBM

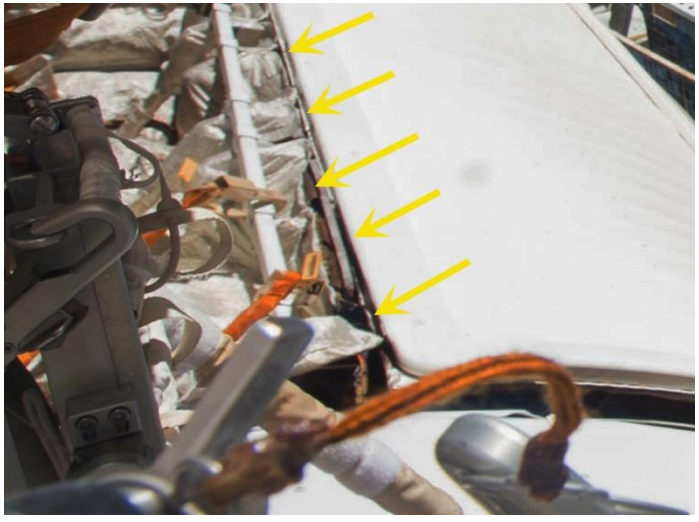


Part of P6 SAW Blanket Material or Wire Hanging From Blanket

External Degradation

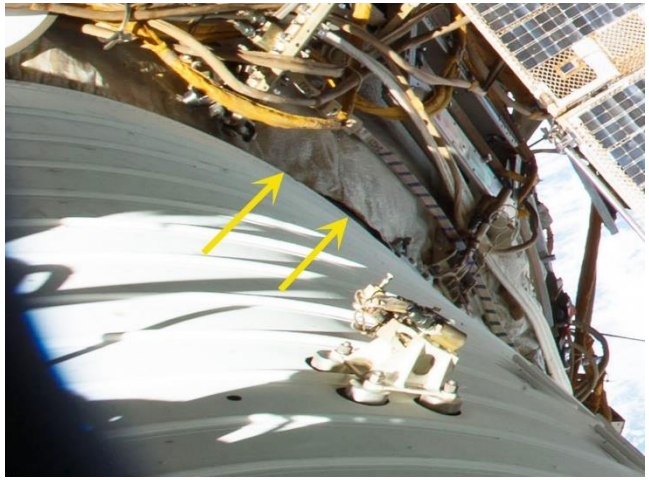


Possible MMOD Strikes or Paint Chips on FGB; Nadir



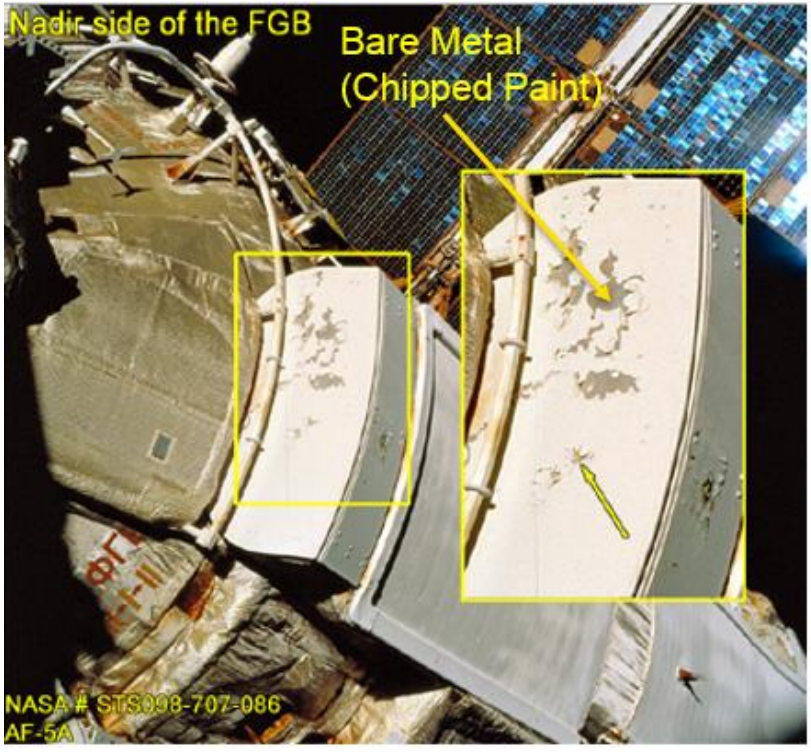
Possible MLI Lifted on FGB; Plane 3 /Zenith

Discoloration Observed on FGB MLI Next to Radiator; Plane 1 /Nadir

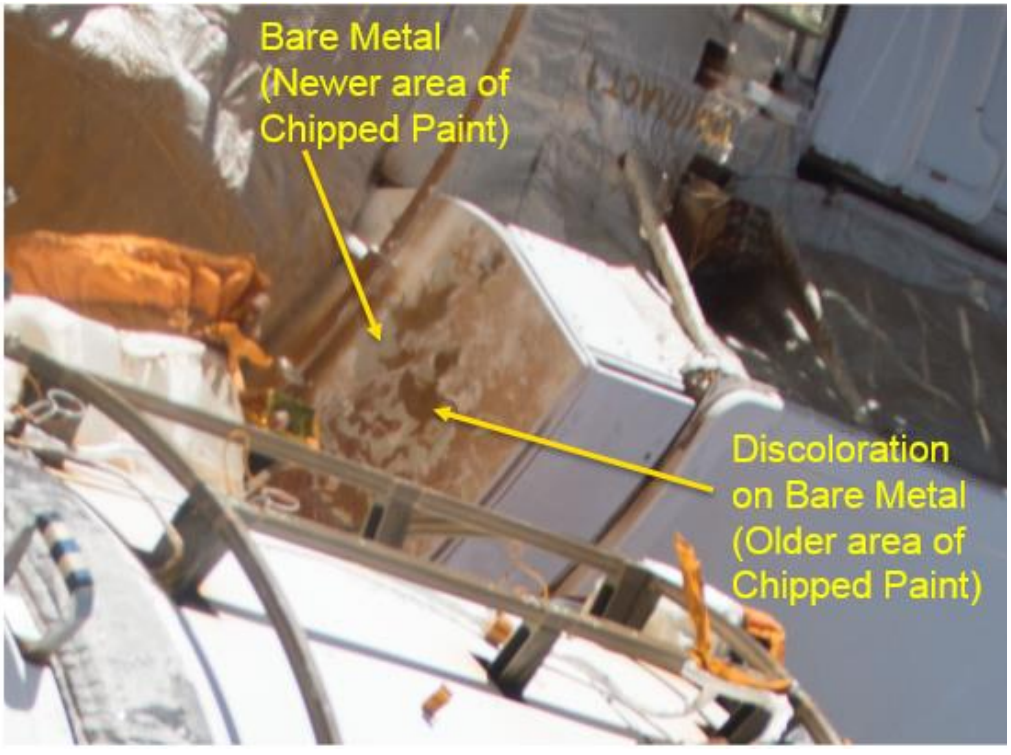


Lifted MLI on Service Module; Plane 3 /Zenith

External Degradation



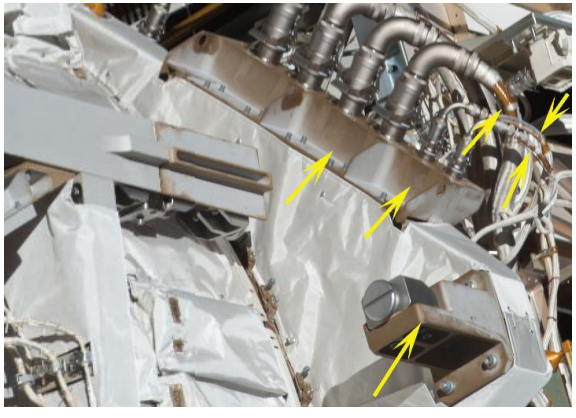
STS-098/AF-5A Chipped Paint on FGB MMOD Shielding Panel



Increment 47 Chipped Paint and Discoloration on same FGB MMOD Shielding Panel

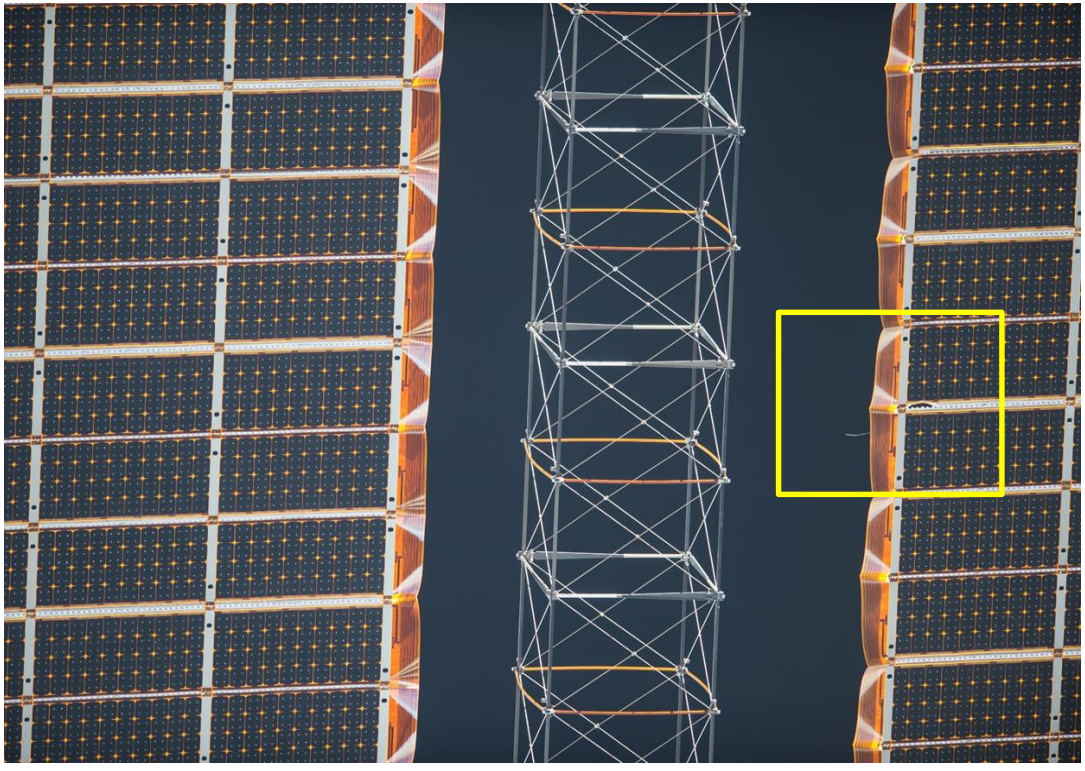
External Degradation

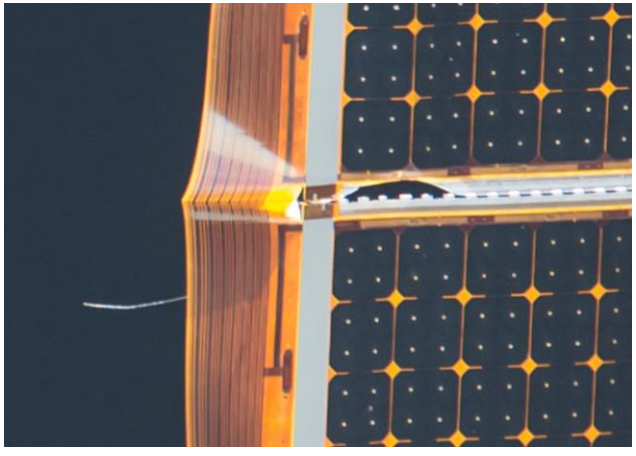
MLI Damage and Discoloration on S6 Mast Canister



Discolorations & Marks P4 Truss IEA

External Degradation





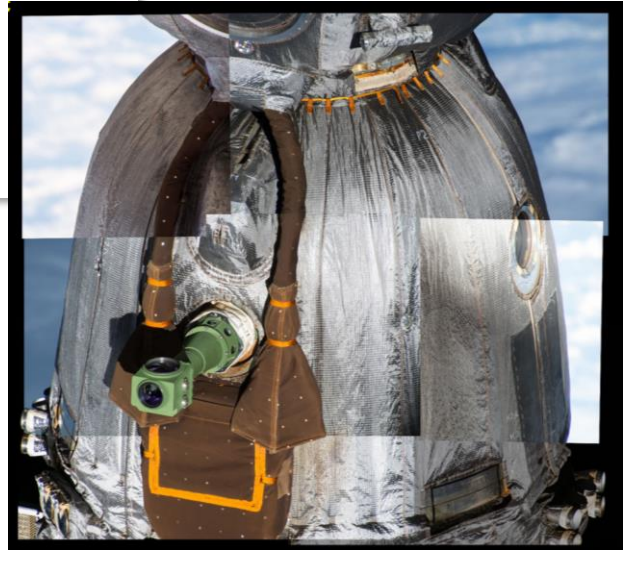
“New” 7 inch tear is visible on Solar Array 3B.

Soyuz Inspection

MRM1 docked Soyuz descent module is surveyed with crew and EHDC photos

Cupola Window 5

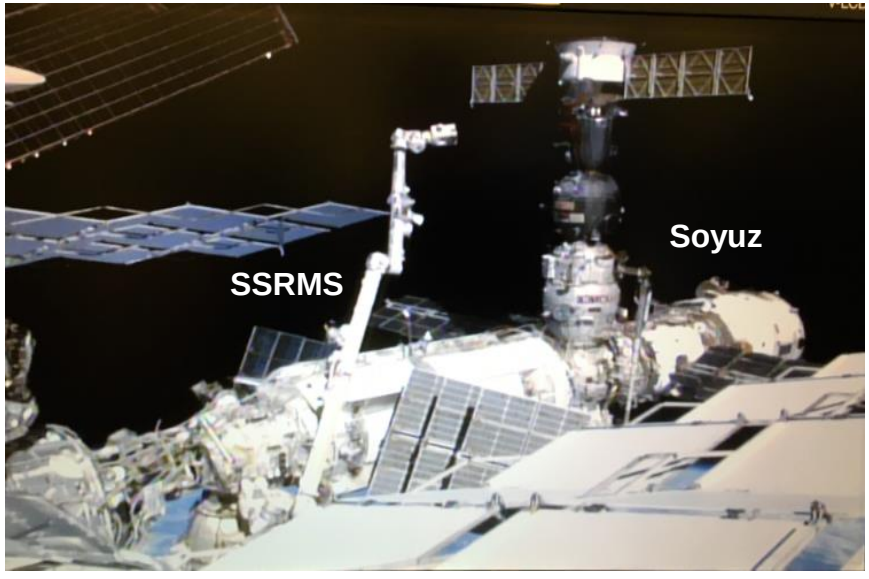
Docking Compartment Window #1



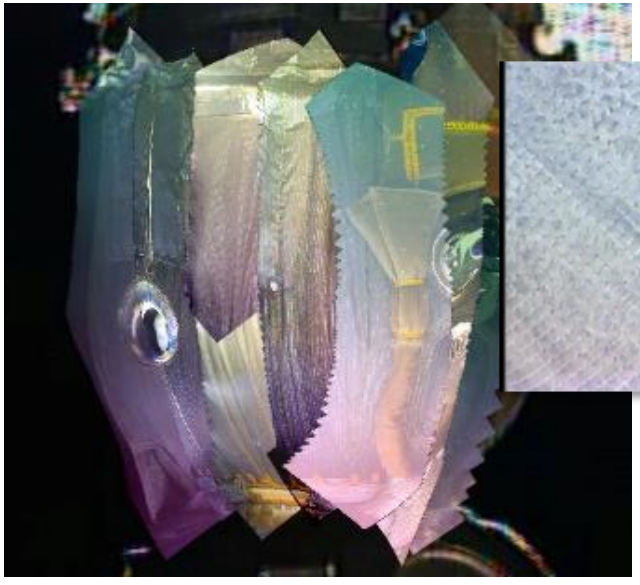
Mosaic of CP9 EHDC Survey Photos

Soyuz Inspection

MRM2 docked Soyuz are surveyed with SSRMS video (stbd VV) and EHDC photos (port VV)



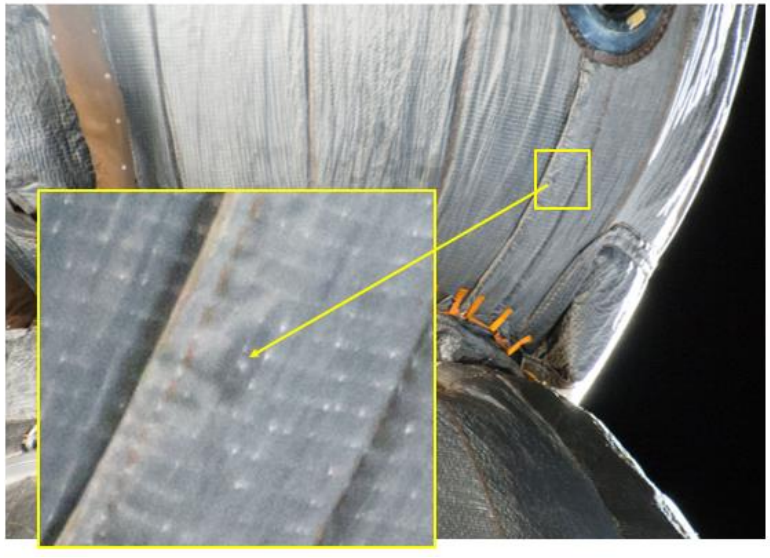
SSRMS Survey Inspection of 48S



Mosaic of SSRMS scans

SSRMS Video Frame

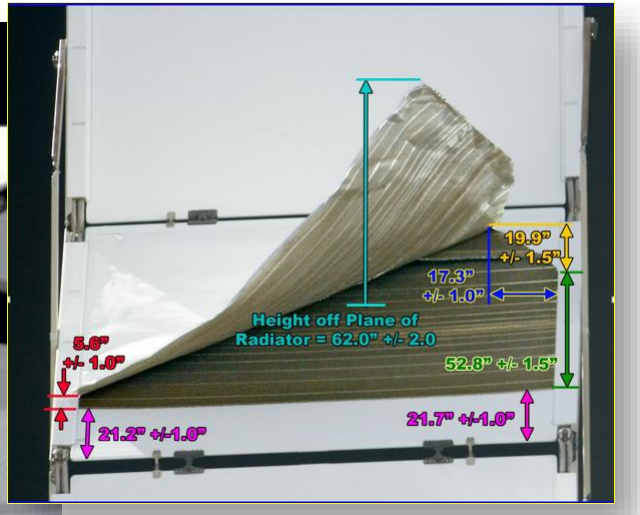
Mosaic of CP9 EHDC photos



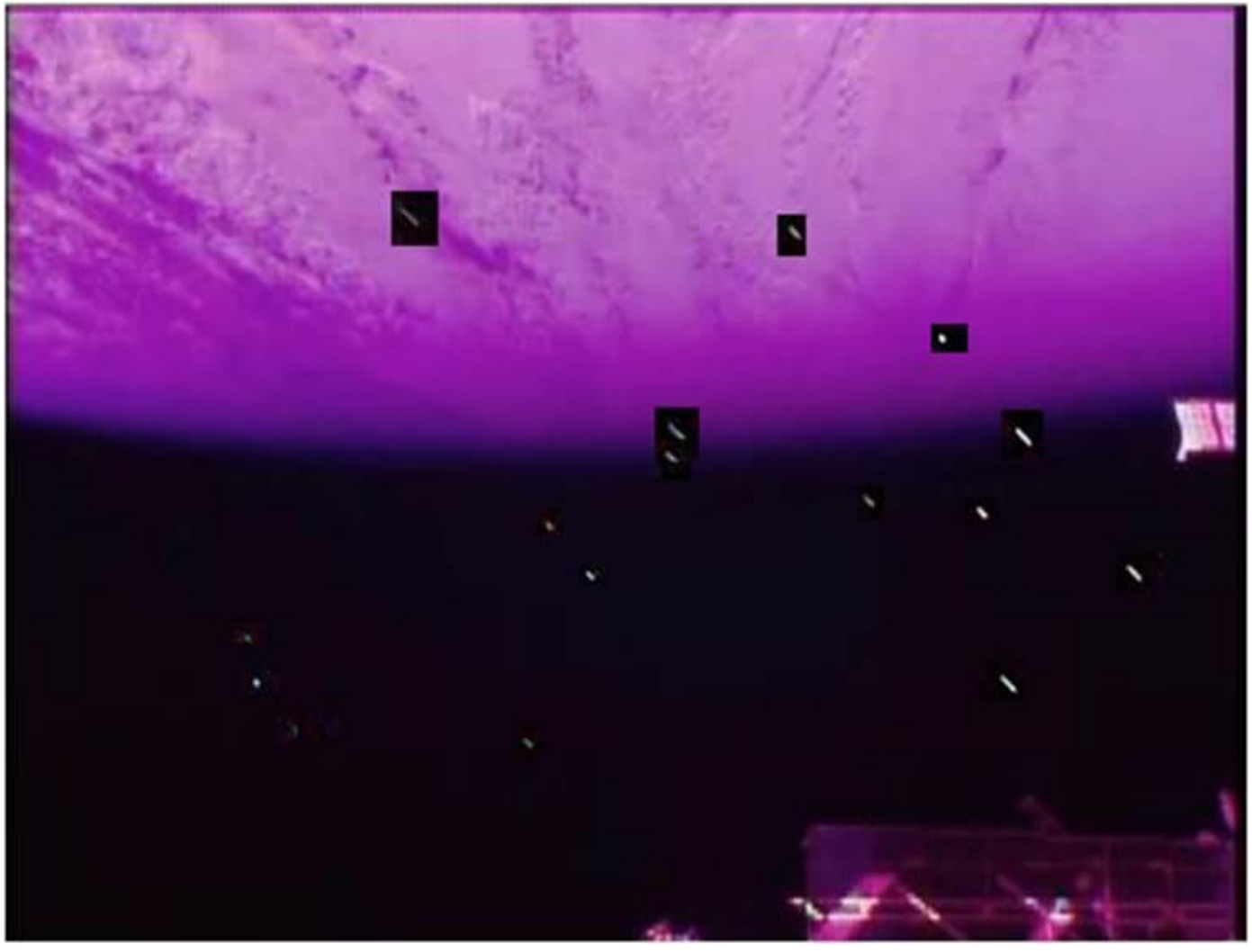
EHDC Photo

Bi-monthly Inspection of S1-3 Radiator Panel 7

http://isal-web1.jsc.nasa.gov/content/folder341/Inboard_radiator_damage.htm

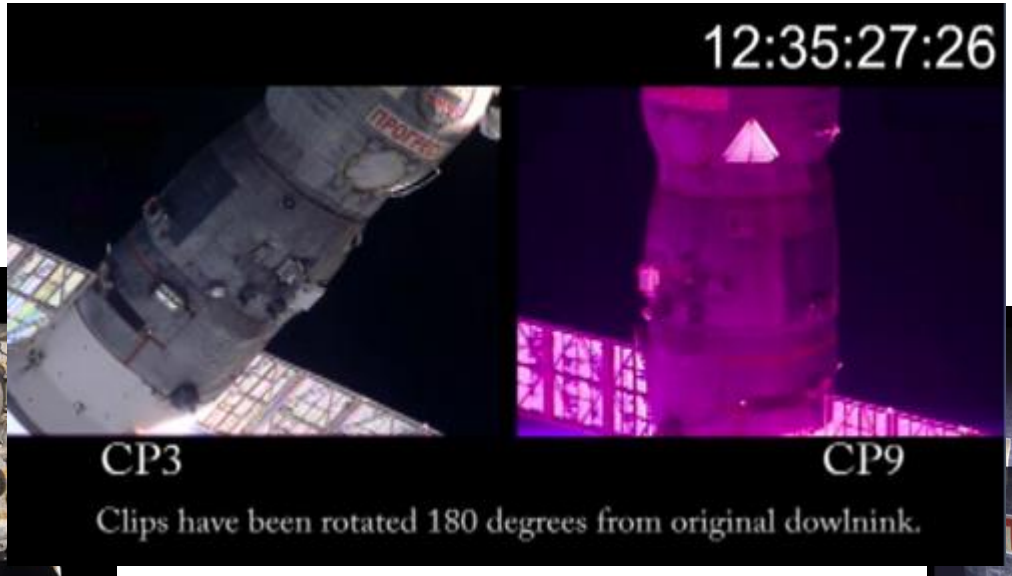


Leak Source Investigation



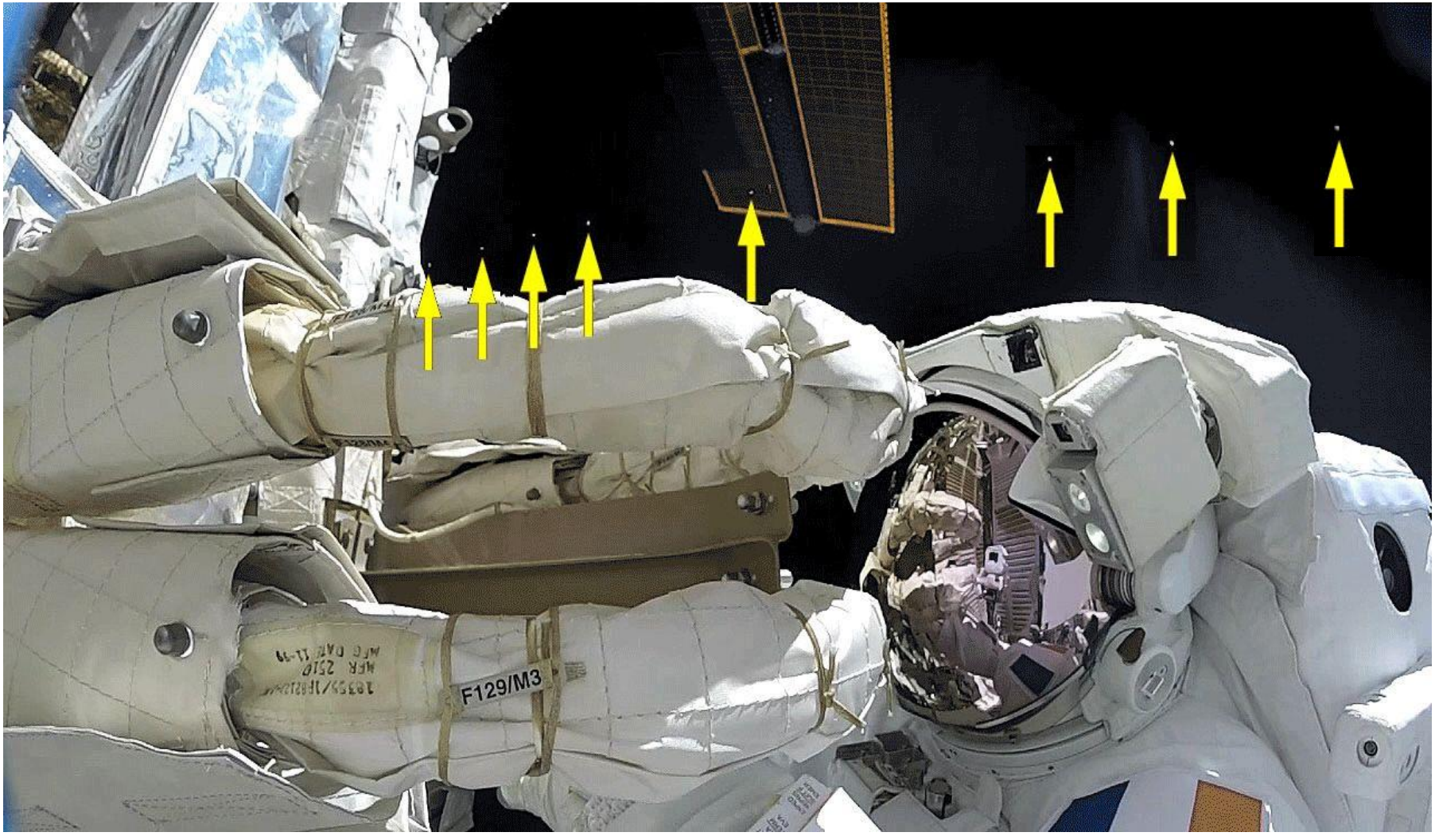
Composite Image of Ammonia Flakes With ISS Hardware

Leak Source Investigation



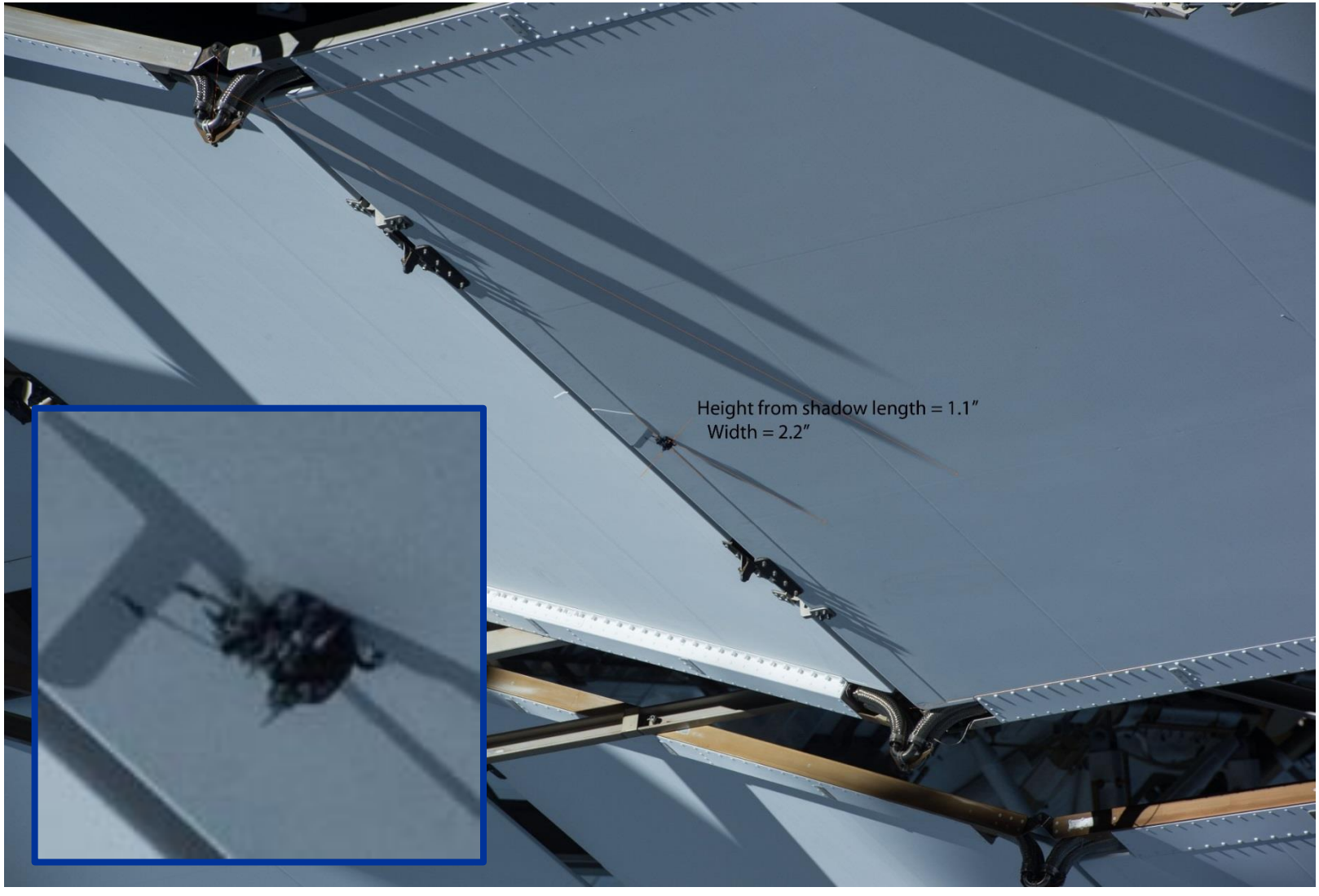
Progress 62P Rodnik Video Analysis

EVA 40 - RBVM Leak



Ammonia Flakes Observed in EVA 40 GoPro Video

Possible EVA Grease Ball on Thermal Radiator



Imagery Analysis Highlights

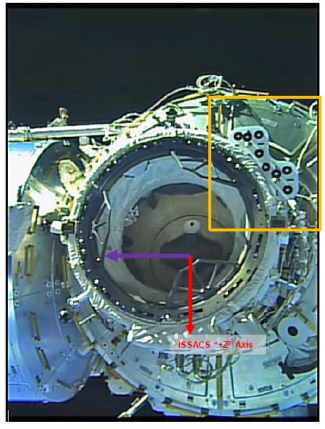
May 2015 – May 2018

Static Analysis Examples

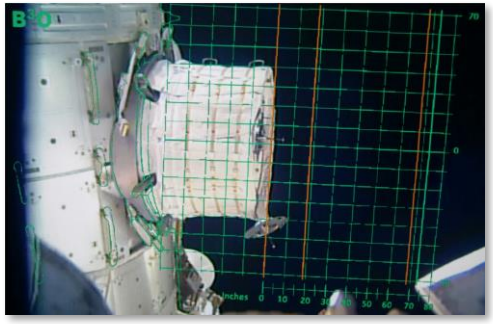
IDA2 Docking Targets

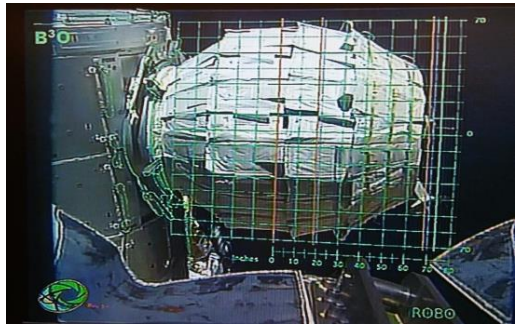
Point	X	Y	Z	Sig X	Sig Y	Sig Z	# of Images
IDA2_T10	620.524	-18.751	186.727	0.190	0.078	0.082	16
IDA2_T11 Standoff	626.524	-22.008	189.918	0.114	0.078	0.076	20
IDA2_T12	620.486	-25.324	186.62	0.192	0.086	0.086	14
IDA2_T13	620.479	-25.33	193.188	0.206	0.094	0.092	11
IDA2_T14	620.448	-27.51	197.875	0.198	0.094	0.092	11
IDA2_T15 Standoff	626.513	-30.727	202.561	0.110	0.090	0.088	18
IDA2_T16	620.395	-34.051	205.718	0.166	0.102	0.098	12
IDA2_T17	620.424	-34.072	199.243	0.168	0.100	0.098	13

All units in Inches



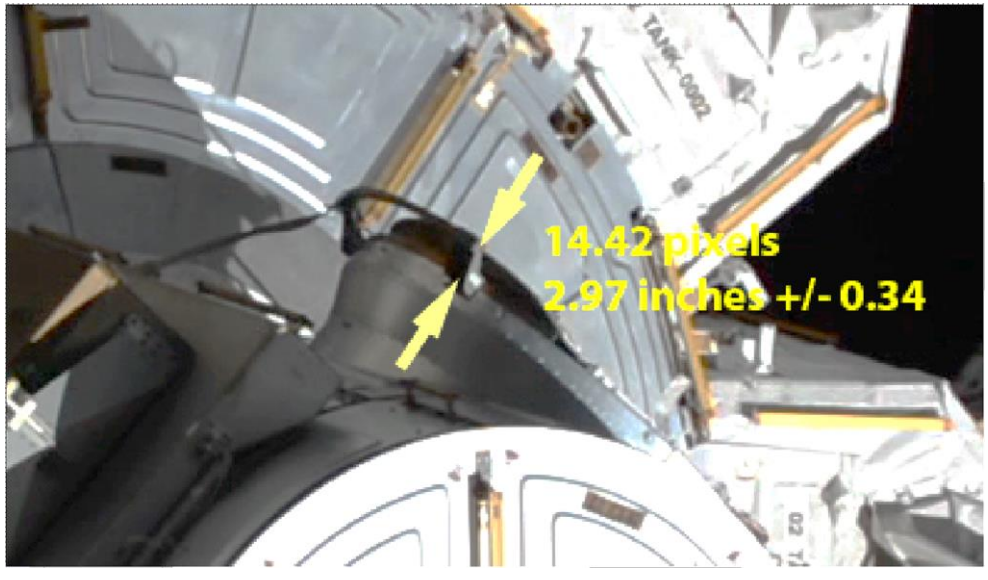
As installed orientation of IDA2 on PMA2





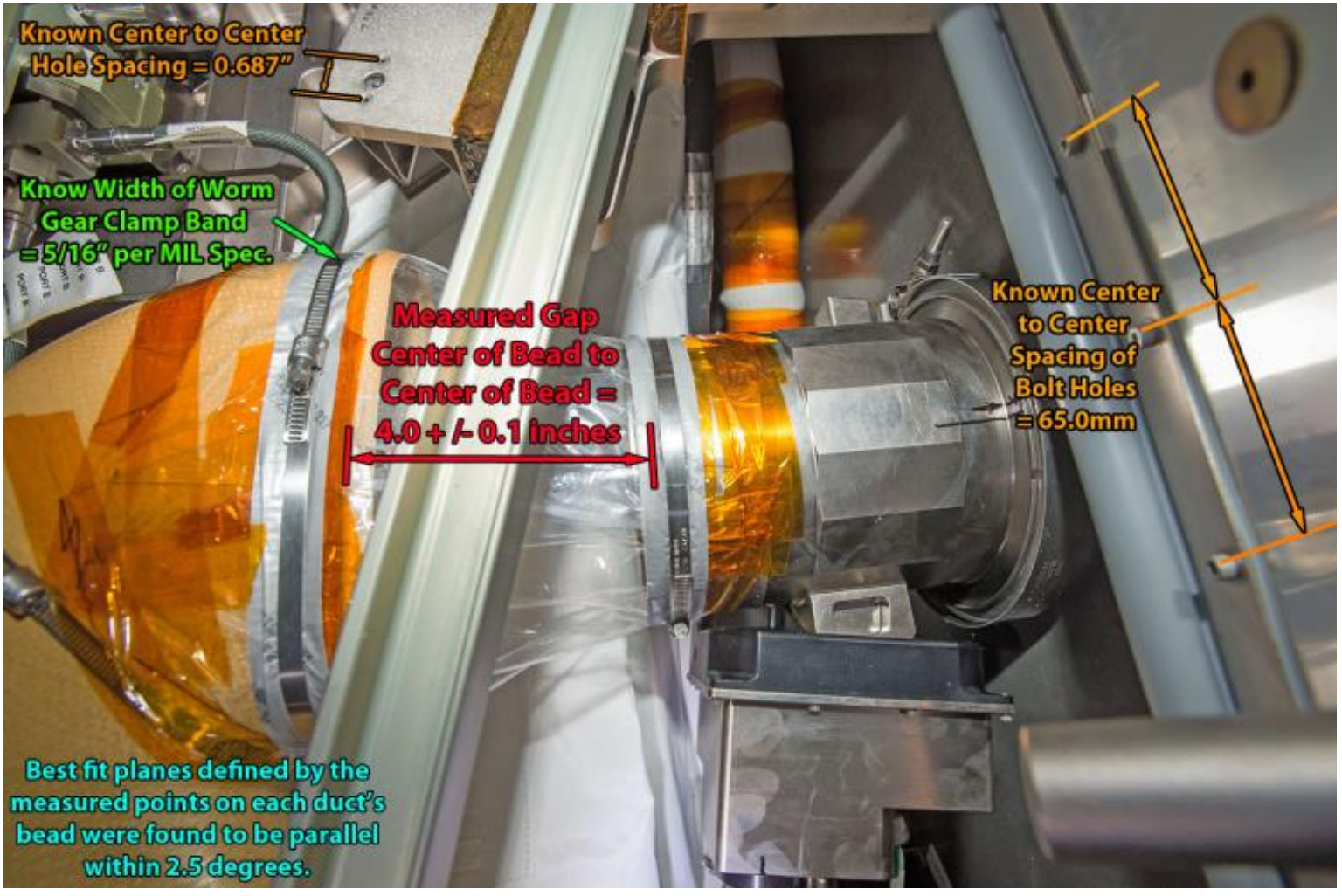
BEAM Inflation Progress

Crew Body Measurements

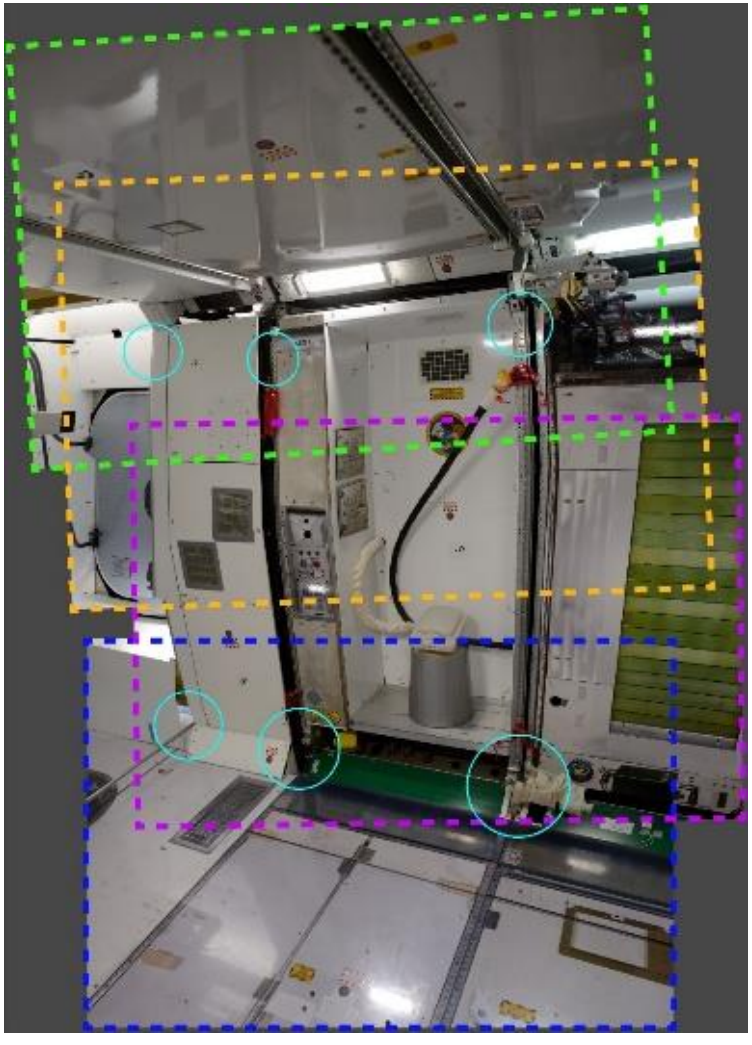


Airlock Cover Gap

Measurement of IMV Coupler Gap at Node 2 Aft Starboard



Node 3 Measurements for Waste & Hygiene Compartment (WHC) Remodel



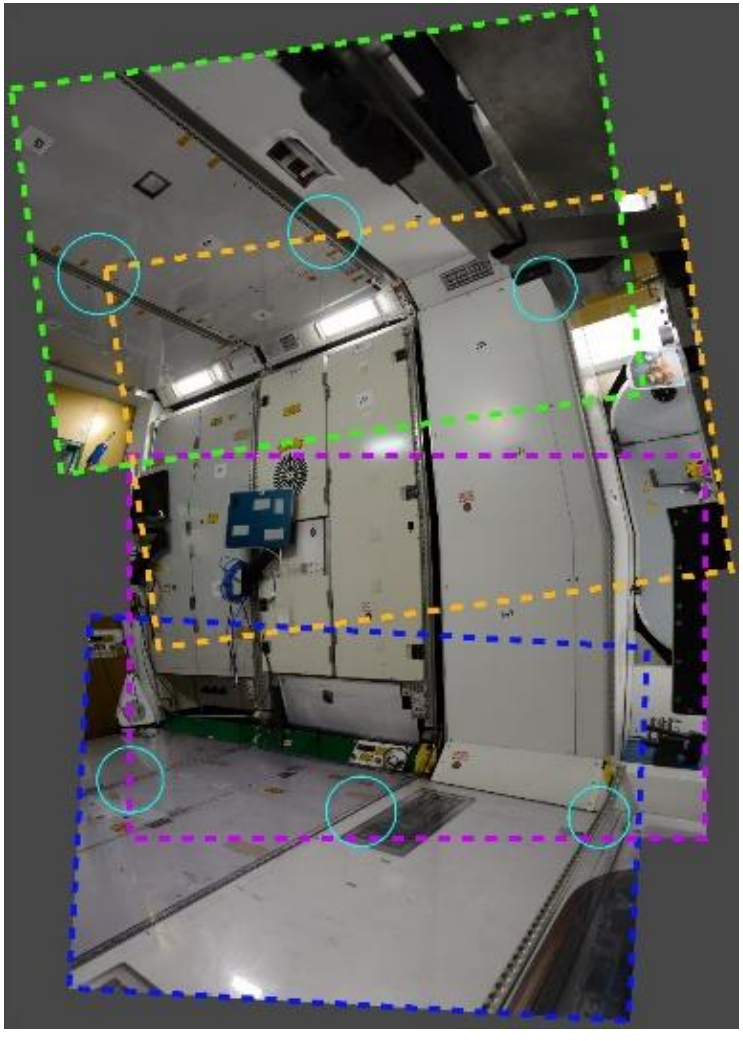
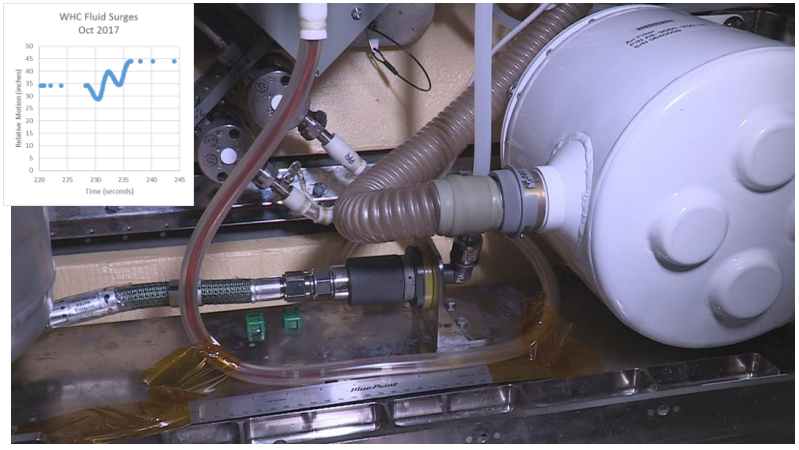
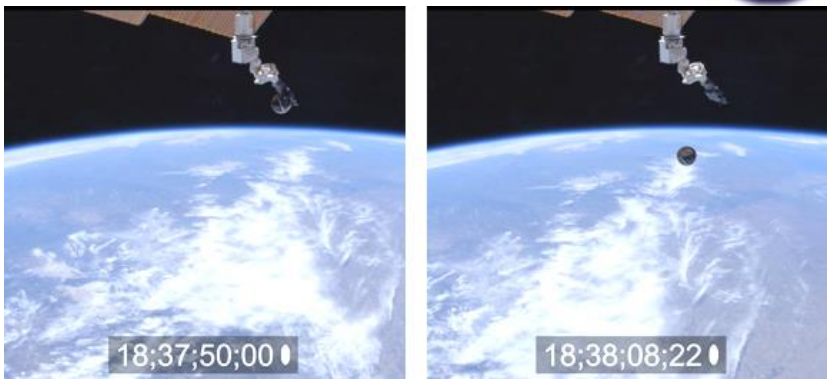


Image composites for the crew procedure provide a reference for required focus areas and overlap.

Dynamic Analysis Examples

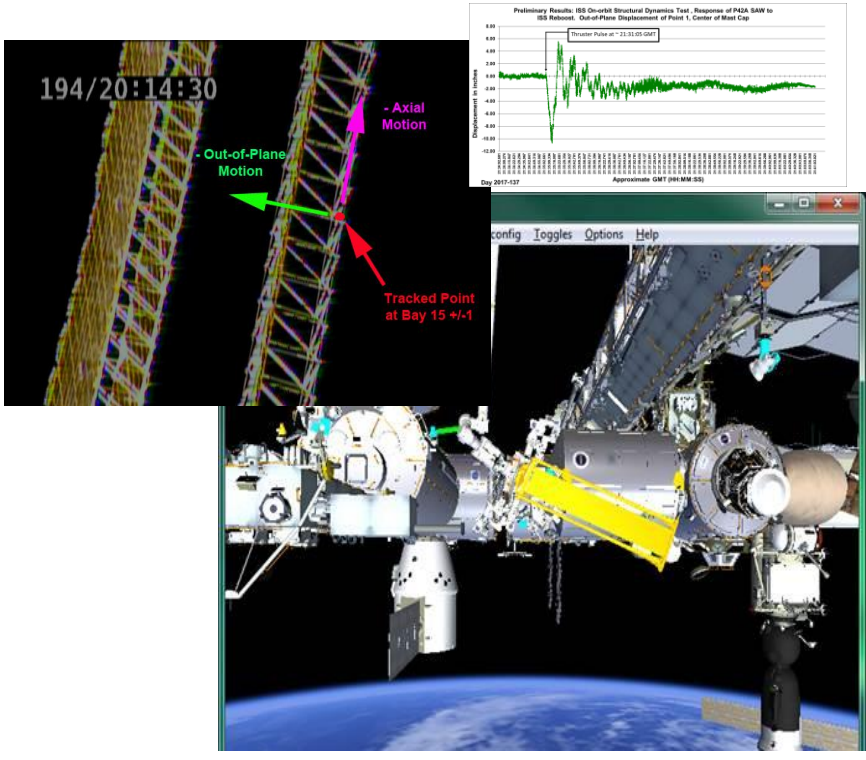


WHC Fluid Flow Rates



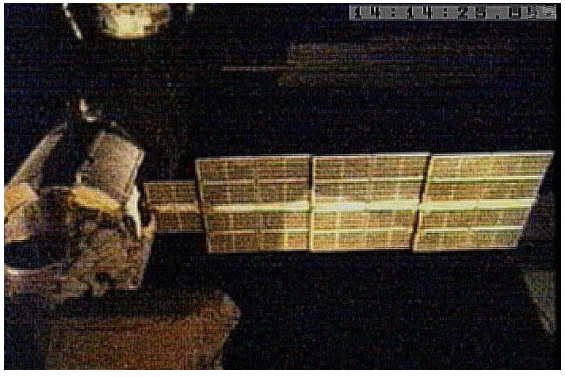
Spinsat Deployment Rates and
JEM RMS Deflection

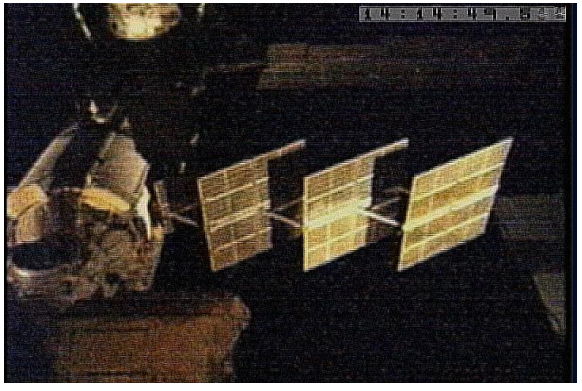
RPCM Pull Force

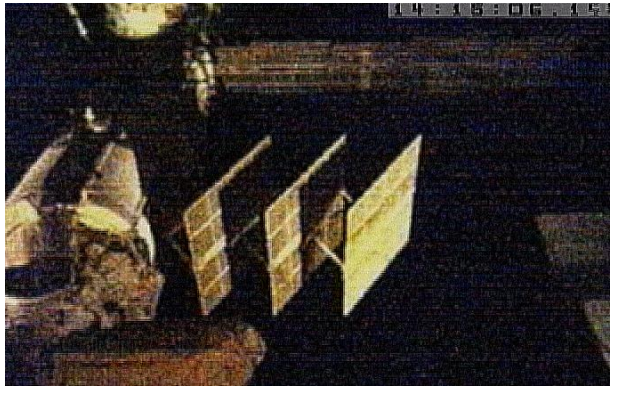


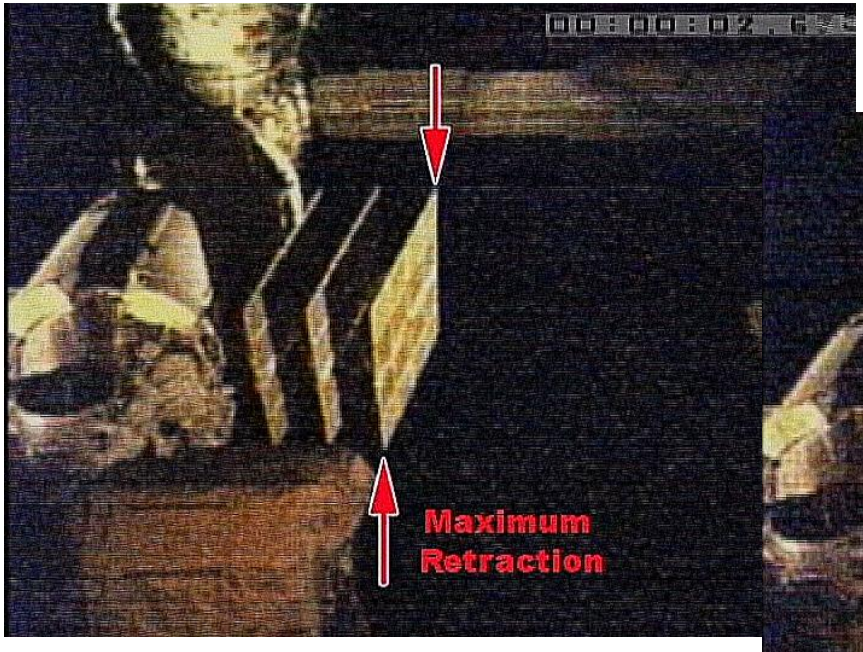
Solar Array Dynamics

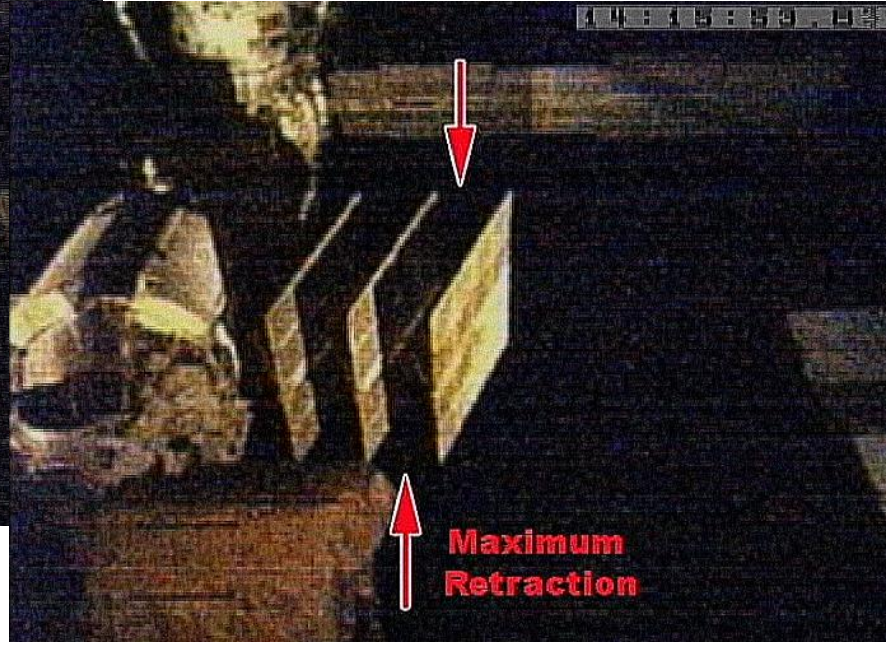
FGB Solar Array Retracted Position Monitoring







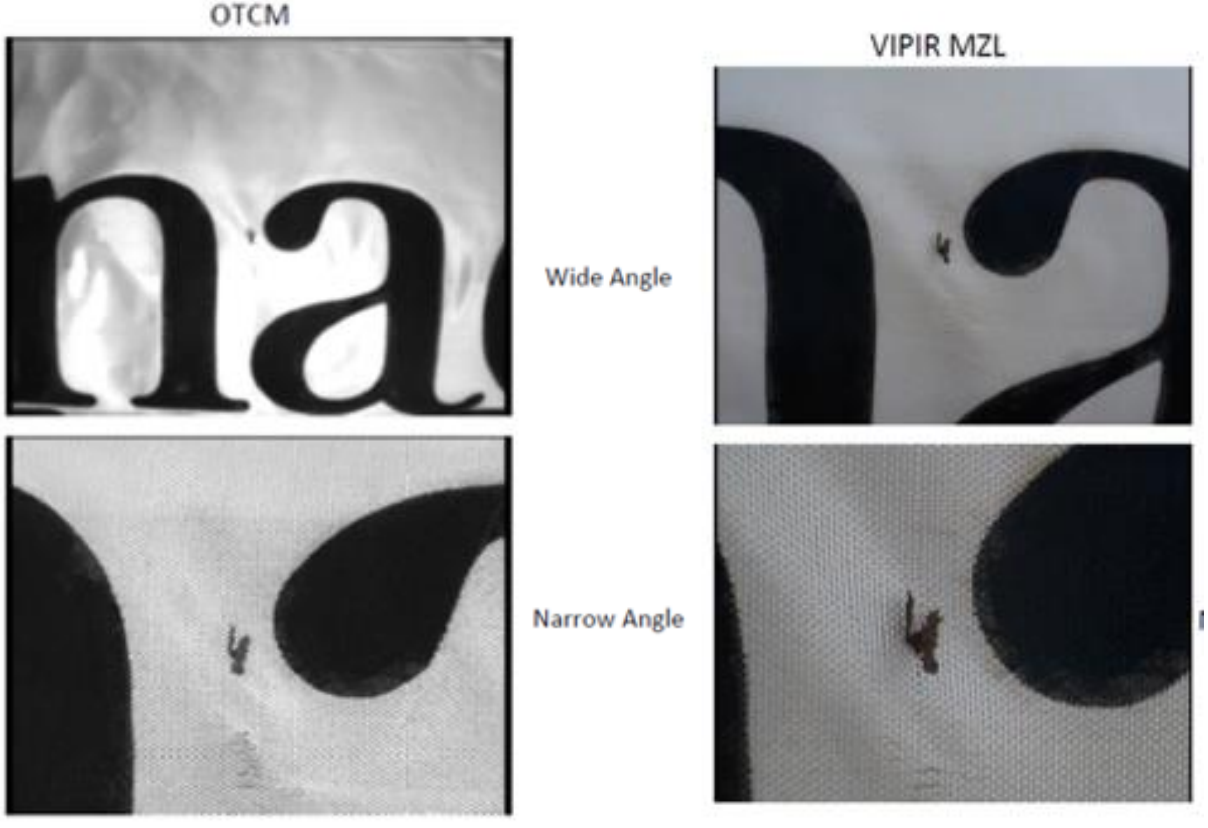


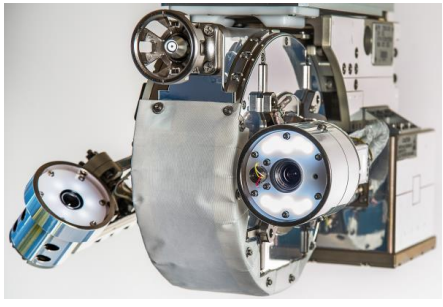


Final Stowed Position

Inspection Tool Assessment

- CSA had a desire to image an old potential MMOD strike on the SSRMS
- ISAG developed a plan to use the SPDM arm OTCM camera and DTO VIPIR camera.
- Video of the area of interest was acquired from several different arm positions and wrist rotations to allow creation of stereo imagery for analysis.
- Provided a valuable test of focused inspection capability using existing and planned ISS cameras (VIPIR2 and “Dextre Deployable Vision System” a.k.a. “Dextre Operated Camera”).

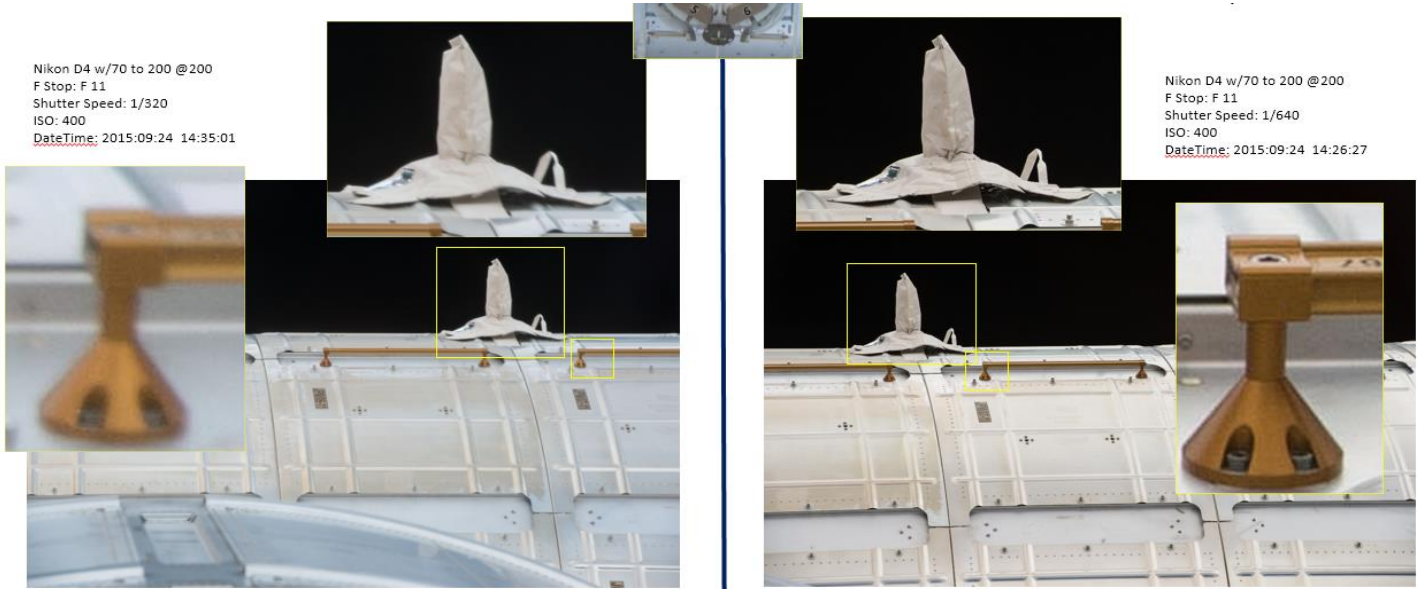




VIPIR

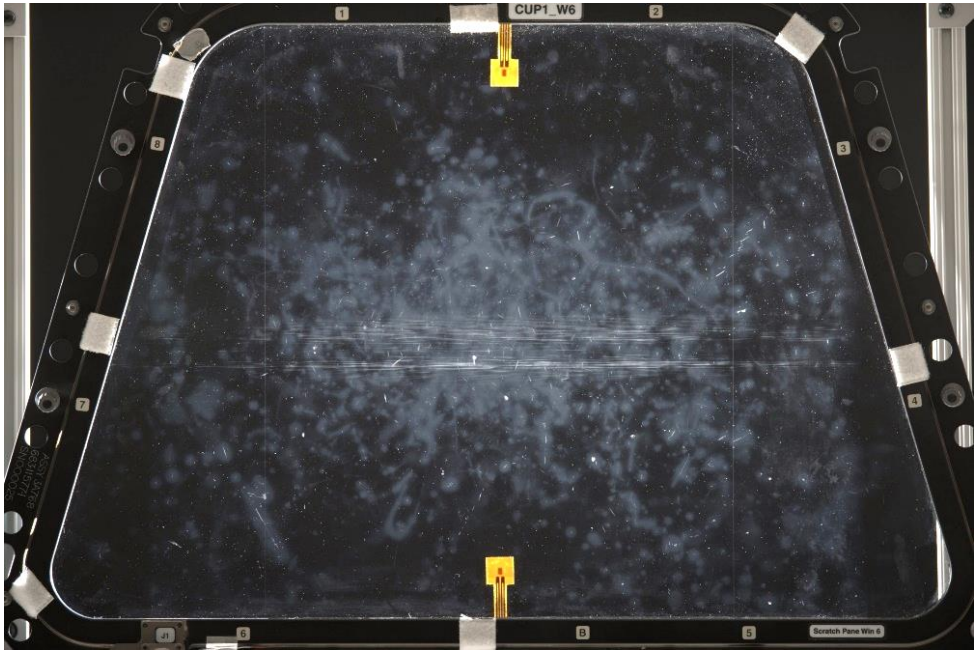
VIPIR MZL Image

Cupola Scratch Pane Replacement



Captured through cupola scratch pane.

Captured without scratch pane.



Haze and Nicks on Returned Pane

Optical Quality Testing