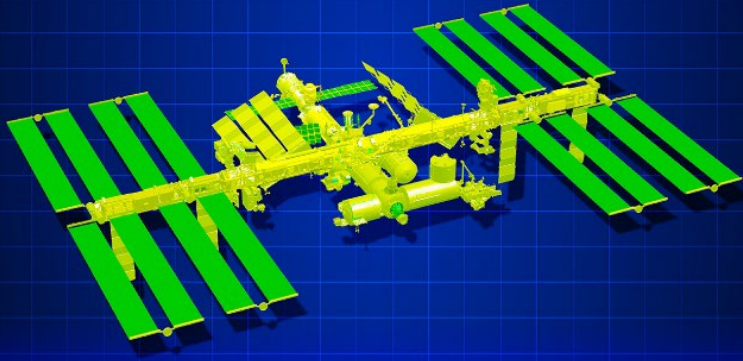


POIWG #54



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DATE: APRIL 16-18, 2024
HUNTSVILLE, AL

Title: POIWG 54 Splinter Session Space Acceleration Measurement System (SAMS)

Author: Ken Hrovat

Affiliation: Voyager
Space

April 17, 2024





Space Acceleration Measurement System (SAMS)

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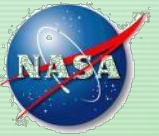
Outline:

1. SAMS Customer Support
2. Topics to Discuss with POIC
3. Overview of SAMS and MAMS
4. SAMS Topology
5. More Overview
6. Recent Anecdote: SAMS Data Correlation

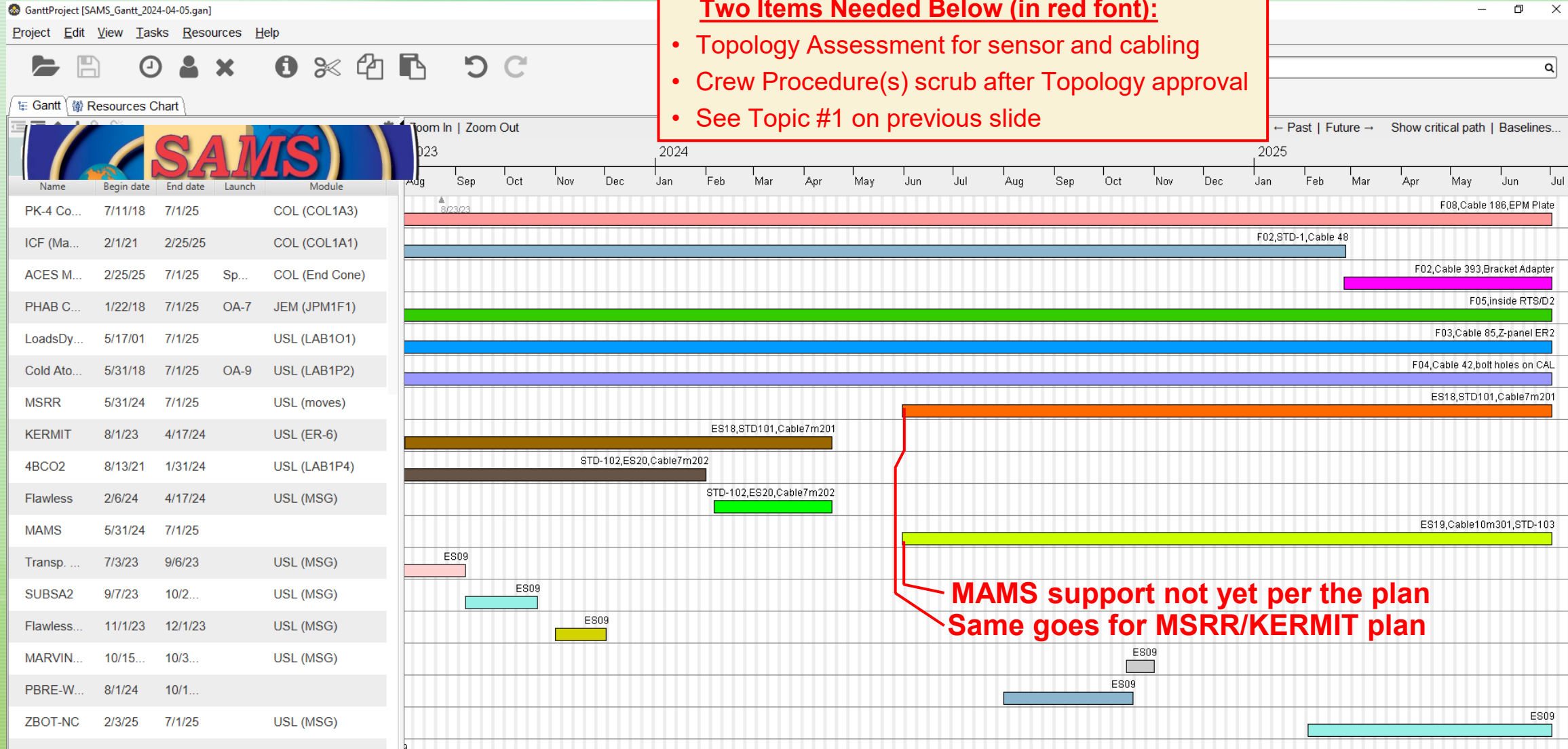
Goal, Capabilities, and Services:

- measure the local vibratory regime in **all 3 ISS labs**
- goal is continuous, **24x7** operations (*CIR, FIR, and MSG turn on/off as needed*)
- measurement frequency range: **$0.01 < f < 200$ Hz (SAMS), $f < 0.01$ Hz (MAMS)**





Customer Support: View by Payload



NOT SHOWN: dedicated TSH sensors es05 in CIR & es06 in FIR



Topics to Discuss with POIC

- 1. SAMS Sensor Moves or Temp Stow by Crew:** Crew temp stow of SAMS sensor in Columbus, I think related to Cold Atom Lab activities. For acceleration archive data integrity, we need to know when a sensor move occurs, particularly if extended duration move. We can salvage meaningful data at the new/temp location provided we know that location and orientation of the sensor head. At NASA GRC our ground processing can account for this so we can put these data in acceleration archive too. We distribute data in Space Station Analysis (SSA) coordinates. It's a minor change here, and if done "soon enough", then we are good to go; otherwise, we can still correct but it takes less reliable, off-nominal, manual intervention.
- 2. SAMS Outage Impact on GMT 2024-03-25 / 085:** OC routinely asks us for science/customer impacts when SAMS outage starts or may start. We give lab-by-lab breakdown for SAMS sensors and usually [always?] end with **"and Struc&Mech too, especially noting if a dynamic event is known to be coming up"**. During one recent such outage (could not get crew time over 2 days after inadvertent Emerald Brick switched off), we heard back after-the-fact from Boeing Loads & Dynamics, that **"IWIS missed the 71S docking (it came early) and she was going to use SAMS for the modules trending"**. There is a disconnect on who to check with for generic term "Struc&Mech", so we need to include Loads & Dynamics contacts as well.
- 3. GMT 088 28V SIS Power Cable: Stowage:** "After GMT 087, we are currently down to one functional 28V SISO Power Cable S/N 1001, P/N SEG46119434-301, currently installed at Express Rack 6 supporting the SAMS Control Unit (CU) ZBook. It is plugged into a PEEK 28VDC, 20A, Exp Rack Adapt Cable, S/N 1001, and a PS-28 Junction Box. After we use this cable for DNAN2 ops on GMT 088, it was noted that **a conversation is in order about impacting SAMS customers and Struc&Mech objectives** -- a possible back up cable to take the place of this one, if at all possible.
We were asked: "Could we potentially use some other kind of cable to keep the SAMS ZBook in a good config?"
SAMS team: "Can we arrange to manifest the cable in need for sparing?"



Overview of SAMS and MAMS

As of 03/29/2024, **SAMS** had collected over **764,000 sensor hours (about 20 terabytes)** of data on ISS.

Component	 Quasi-Steady	 Vibratory	 Transient
Frequency	$0 \leq f < 0.01 \text{ Hz}$	$0.01 \leq f \leq 200 \text{ Hz}$	broadband
Magnitude	μg 's (or less) peak	tens to thousands μg_{RMS}	tens of mg's peak
Primary Sources	gravity gradient & rotational effects: not at center of mass drag: function of altitude, attitude, day/night, etc. vehicle: venting water or air	equipment: pumps, fans, centrifuges, compressors, etc. crew: ergometer or treadmill exercise vehicle: structural modes	vehicle: thrusters, dockings crew: pushoffs & landings, drawer/door closings, experiment setup equipment: machinery startup





Topology

Version # Increment 71
Generated On 2023-10-18

Increment: 71

SAMS Sensor Locations

as of 2024-03-28

SAMS Sensor Head Locations

- 2 SE F02, COL1A1, ER3, Seat Track
- 3 SE F03, LAB101, ER2, Lower Z Panel
- 4 SE F04, LAB1P2, ER7, Cold Atom Lab Front
- 5 SE F05, JPM1F1, ER5, Inside RTS/D2
- 8 SE F08, COL1A3, EPM, near PK-4
- 9 TSH-ES09, LAB1S2, MSG
- 5 TSH-ES05, LAB1S3, CIR
- 6 TSH-ES06, LAB1S4, FIR
- 18 TSH-ES18, LAB104, ER-6
- 20 TSH-ES20, LAB1S2, MSG, Seat Track
- TSH-ES03, -ES19, stowed spares

hard-wired
hard-wired

LEGEND:

Sensor that does not move

Sensor that has moved or may move

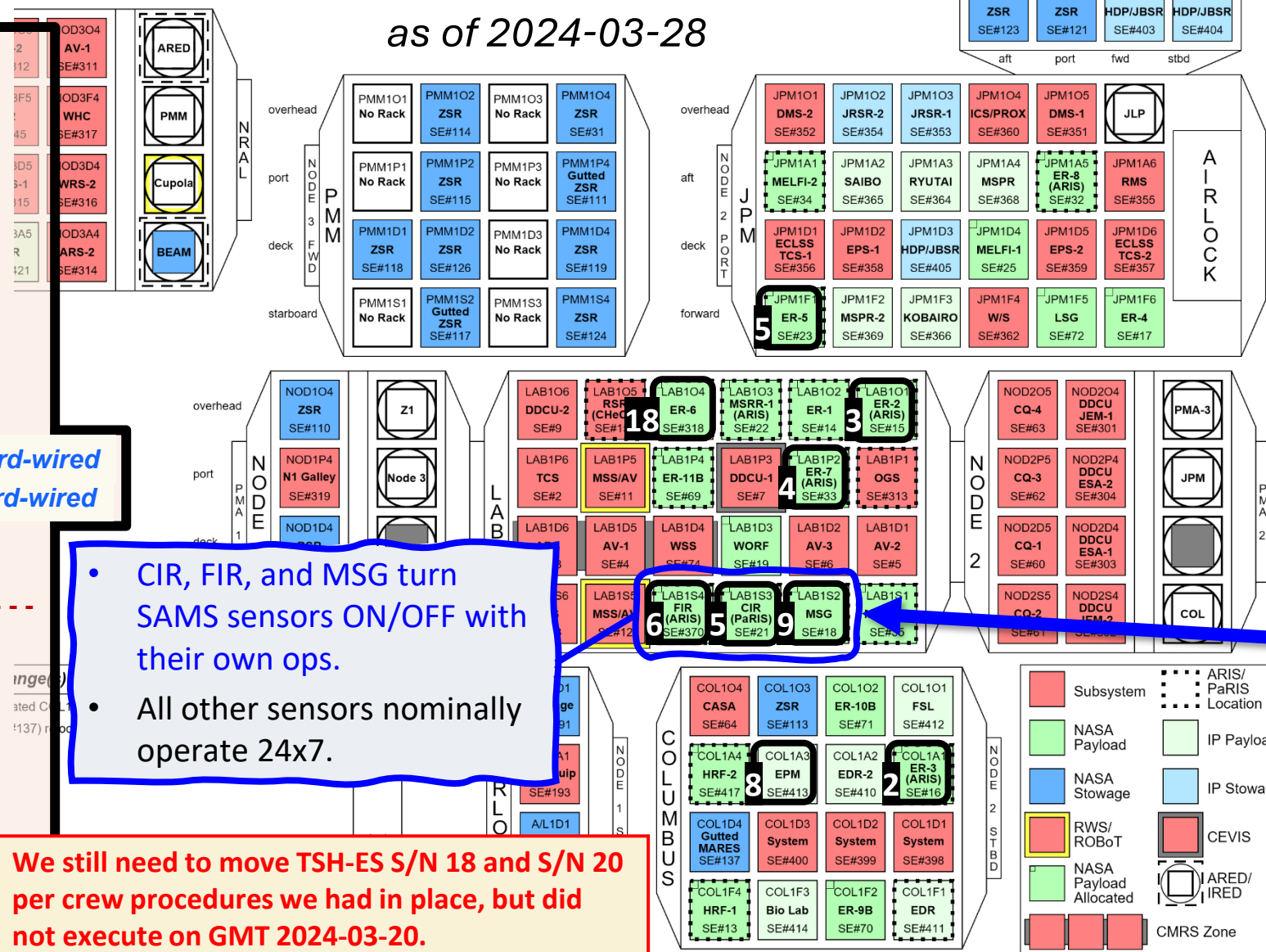
Sensor that has never moved

Stowed or not currently connected

MSG sensor gets installed for some payloads

- CIR, FIR, and MSG turn SAMS sensors ON/OFF with their own ops.
- All other sensors nominally operate 24x7.

We still need to move TSH-ES S/N 18 and S/N 20 per crew procedures we had in place, but did not execute on GMT 2024-03-20.





Topology

MMP

Version # Increment 71
Generated On 2023-10-18

Increment: 71

SAMS EE* Locations

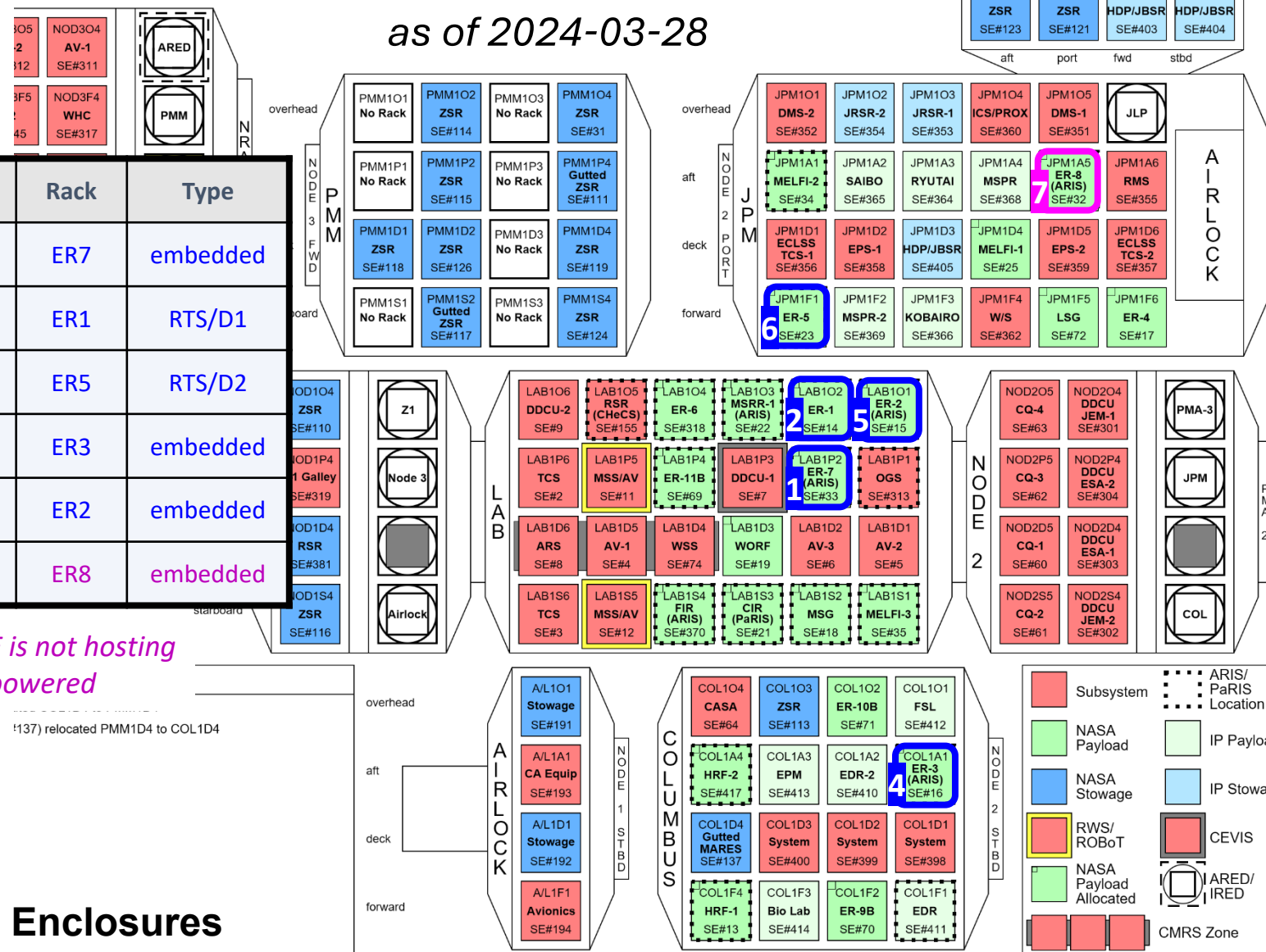
as of 2024-03-28

Code	EE	Location	Rack	Type
1	EE-F01	LAB1P2	ER7	embedded
2	EE-F02	LAB1O2	ER1	RTS/D1
6	EE-F06	JPM1F1	ER5	RTS/D2
4	EE-F04	COL1A1	ER3	embedded
5	EE-F05	LAB1O1	ER2	embedded
7	EE-F07	JPM1A5	ER8	embedded

As of GMT 2024-04-04, this EE is not hosting
any sensors and is not powered

*137) relocated PMM1D4 to COL1D4

*EE = Electronics Enclosures





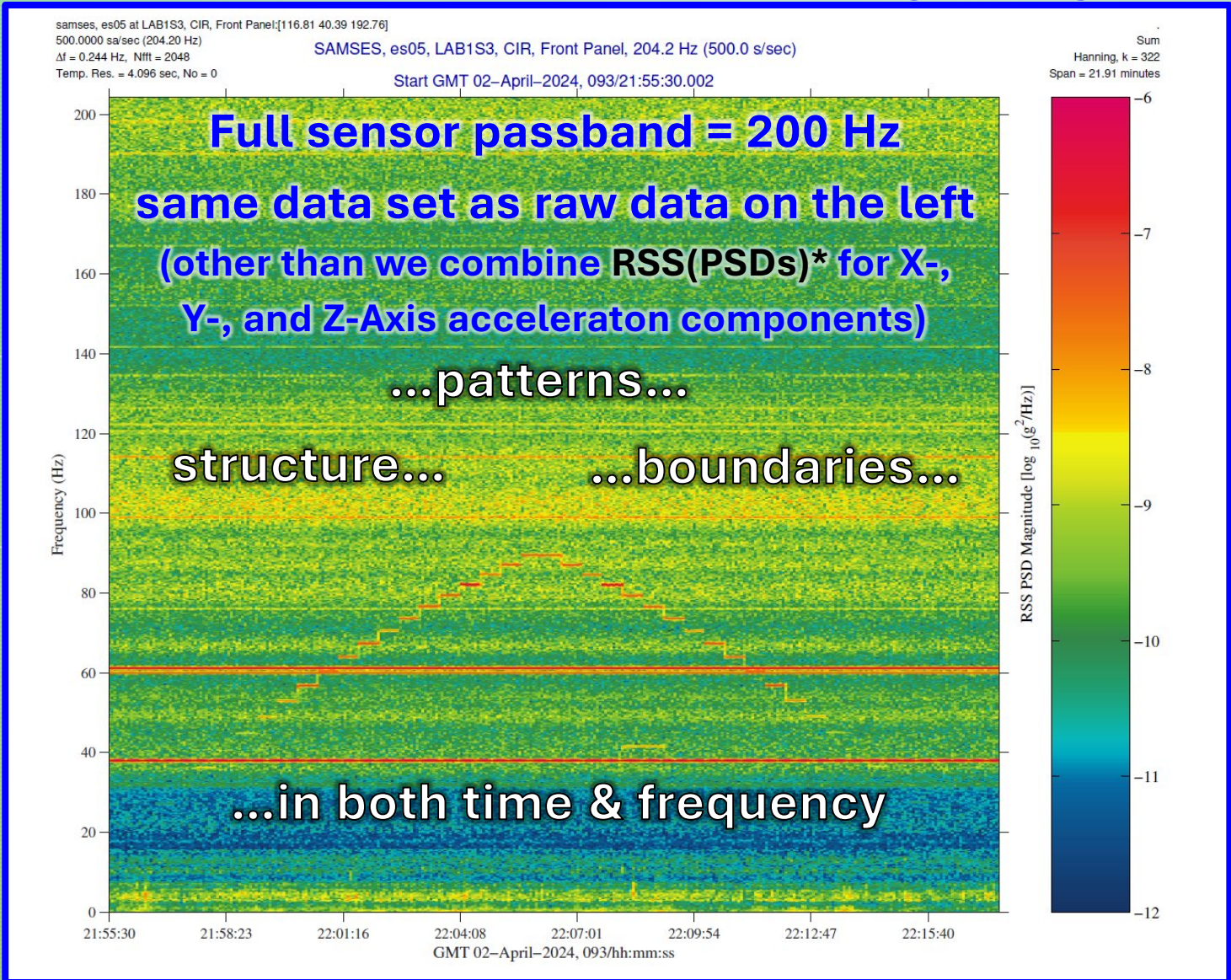
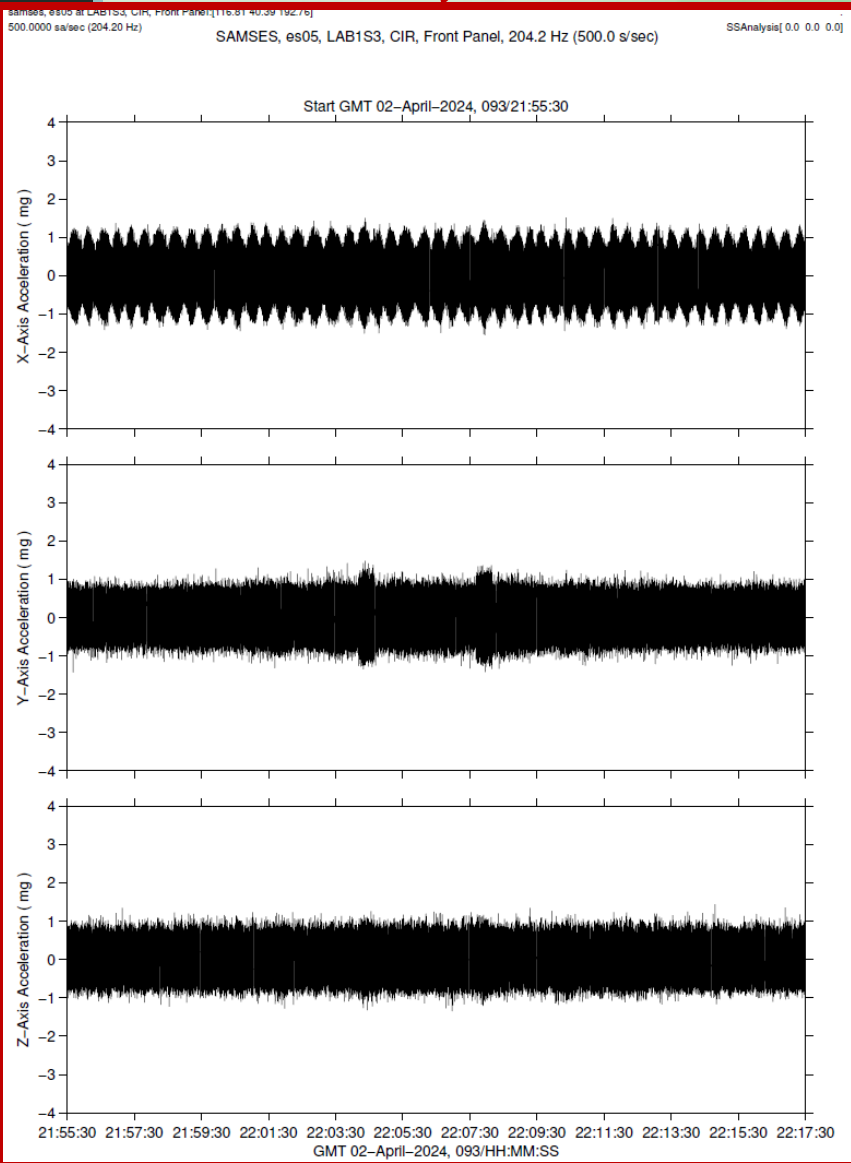
More Overview

If you want to...	then...
download SAMS data	visit https://gipoc.grc.nasa.gov/pims/pub/pad -- e.g. use the vibration measurements recorded by SAMS in your own models or correlate with your results
read the binary acceleration data files	visit the link shown just below here to see how you can start working with acceleration data https://gipoc.grc.nasa.gov/pims/plots/user/mohan/how2read_pad_binary_files.html
browse daily summary “roadmap” plots	visit https://gipoc.grc.nasa.gov/pims/roadmap -- these roadmap plots show patterns, structure and boundaries in both time and frequency; these are updated daily
browse acceleration handbook pages	visit https://gipoc.grc.nasa.gov/wp/pims/handbook -- these are a collection of PDF files that briefly quantify & qualify various events, activities and various aspects of the microgravity acceleration environment
monitor vibratory environment in near real-time	visit https://gipoc.grc.nasa.gov/wp/pims/current-real-time/



Recent Anecdote: SAMS Data Correlation

SAMS data, as-measured **USE CASE:** correlation with independent engineering data



*RSS(PSDs): Root-Sum-of-Squares of Power Spectral Densities (x-, y-, and z-axis) 9



Recent Anecdote: SAMS Data Correlation

Kept time span the same as previous plot, but zoomed-in on frequency (vertical) axis after refining the PSD parameters so we can better correlate SAMS measurements with independent engineering data.

PSD parameter tradeoffs always boil down to temporal versus frequency resolution.

