Section 22

International Space Station (ISS) Measured Vibratory Environment

Kenneth Hrovat

Principal Investigator Microgravity Services (PIMS)

NASA Glenn Research Center (GRC)

Acronyms & Abbreviations

µg	micro-g, 10^{-6}g (sometimes ug – "you gee")
ADVASC	Advanced Astroculture
AOS	Acquisition Of Signal
ARIS	Active Rack Isolation System
ATL	Attitude Time Line
CCAA	Common Cabin Air Assembly
CCAA	Common Cabin Air Assembly
CDT	Central Daylight Time
CDT	Central Daylight Time
CETA	Crew and Equipment Translation Assembly
CEVIS	Cycle Ergometer with Vibration Isolation System
CMG	Control Moment Gyro
DC	Direct Current (mean value)
EDT	Eastern Daylight Time
ER	EXPRESS Rack
EVA	Extravehicular Activity
EXPRESS	Expedite the Processing of Experiments to the Space Station
FE	Flight Engineer
FGB	Functionalui Germatischeskii Block
g	acceleration due to free-fall (9.81 m/s2)
GASMAP	Gas Analysis System for Metabolic Analysis of Physiology
GMT	Greenwich Mean Time
GRC	Glenn Research Center
HiRAP	High Resolution Accelerometer Package
HRF	Human Research Facility
Hz	Hertz
ISS	International Space Station
ITSC	Internal Thermal Control System
JSC	Johnson Space Center
LAB	Laboratory
LAB1O1	US LAB Overhead 1
LAB1O2	US LAB Overhead 2
LAB1P3	US LAB Port 3
LAB1S1, 2, 3	US LAB Starboard 1, 2, 3, respectively
LOS	Loss Of Signal
LTL	Low Temperature Loop
LVLH	Local Vertical Local Horizontal
MAMS	Microgravity Acceleration Measurement System
MEC	Medical Equipment Computer
MEPS	Microencapsulation Electrostatic Processing System
mg	milli-g, 10^{-3}g
MSG	Microgravity Science Glovebox
MTL	Medium Temperature Loop
NASA	National Aeronautics and Space Administration
OARE	Orbital Acceleration Research Experiment
ORU	Orbital Replacement Unit
OSS	OARE Sensor Subsystem
OTO	One-Third Octave
PAD	PIMS Acceleration Data
PAO	Public Affairs Office
PCM	Process Chamber Module
PCMCIA	Personal Computer Memory Card International Association
PCSA	Principal Component Spectral Analysis
PFE	Periodic Fitness Evaluation
PFMI	Pore Formation and Mobility Investigation
PIMS	Principal Investigator Microgravity Services
PSD	Power Spectral Density
PuFF	Pulmonary Function in Flight
RMS	Root-Mean-Square
RPM	Revolutions Per Minute
RTS	Remote Triaxial Sensor
SAMS	Space Acceleration Measurement System
SKV	Russian acronym for Air Conditioner
SM	Service Module
SSA	Space Station Analysis
STS	Space Transportation System
TEA	Torque Equilibrium Attitude
TeSS	Temporary Sleep Station
TVIS	Treadmill Vibration Isolation System
UF	Utilization Flight
UFO	Unidentified Flying Object
US	United States
VELO	Velosiped
XPH	X-axis Parallel to angular momentum vector, represented by "h"
XPOP	X Principal Axis Perpendicular to the Orbit Plane
XVV	X body axis toward the Velocity Vector
YVV	Y-axis toward Velocity Vector
Z1	Zenith position of Unity (Node 1) module
ZLV	Z-axis in Local Vertical
ZNN	Z-axis toward Nadir when station at orbital Noon in J2000 frame

Outline

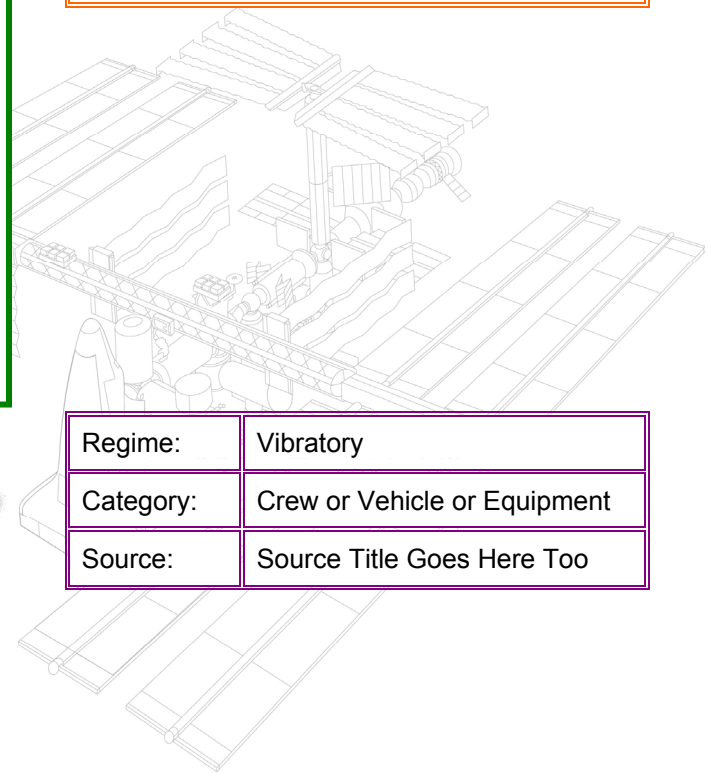
Source Title Goes Here
Qualify

Representative figure or plot usually goes in this box.

- To qualify, we typically use a spectrogram.
- Not intended to completely characterize a particular disturbance, but rather to show typical or nominal operation.

Data Description	
Sensor	identifier sample rate (cutoff frequency)
Location	of sensor
Inc/Flight	Increment #, Flight #
Plot Type	spectrogram or …

Notes:
The text in this box serves to qualify the disturbance source under consideration. It might, for instance, describe some of the structures and boundaries observed in both time and frequency.



Regime:	Vibratory
Category:	Crew or Vehicle or Equipment
Source:	Source Title Goes Here Too

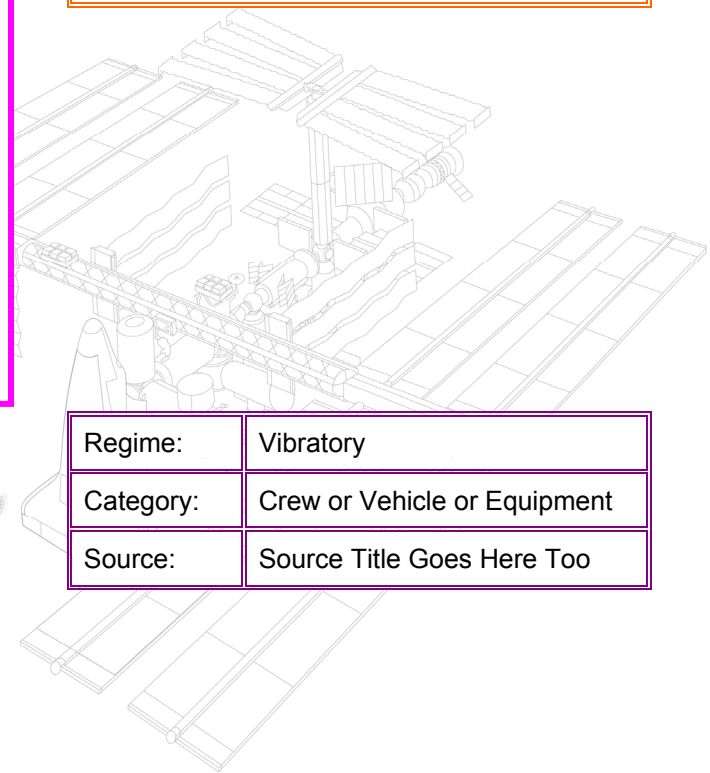
Source Title Goes Here
Quantify

Representative figure or plot usually goes in this box.

- To quantify, we typically use RMS values & may use peak values for transient events.
- Sometimes, handbook pages show no discernible effect.

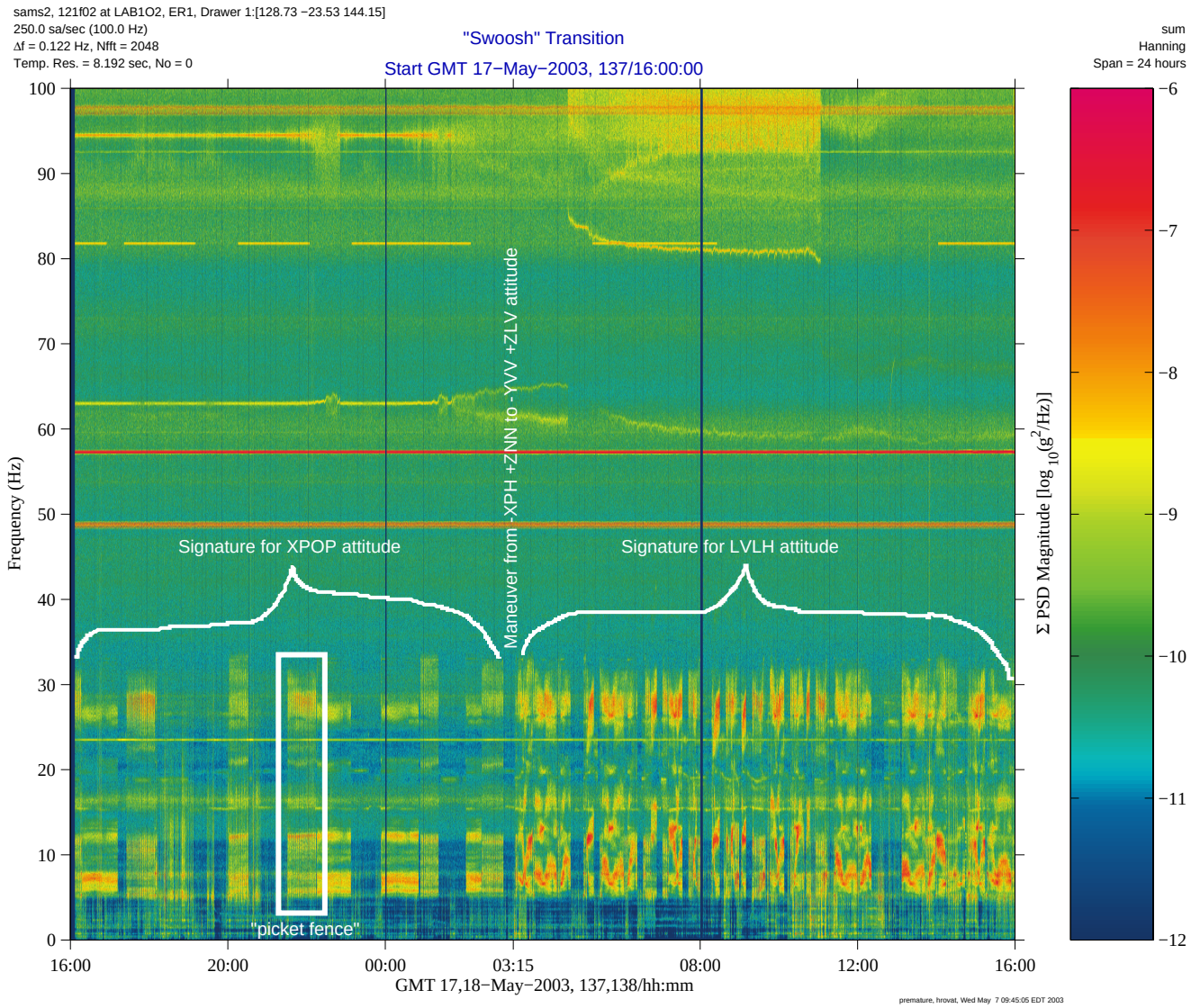
Data Description	
Sensor	identifier sample rate (cutoff frequency)
Location	of sensor
Inc/Flight	Increment #, Flight #
Plot Type	interval RMS or …

Notes:
The text in this box serves to quantify the disturbance source under consideration. It might, for instance, show how the RMS value over a narrow band of frequencies varies with time as a disturbance source turns on/off.



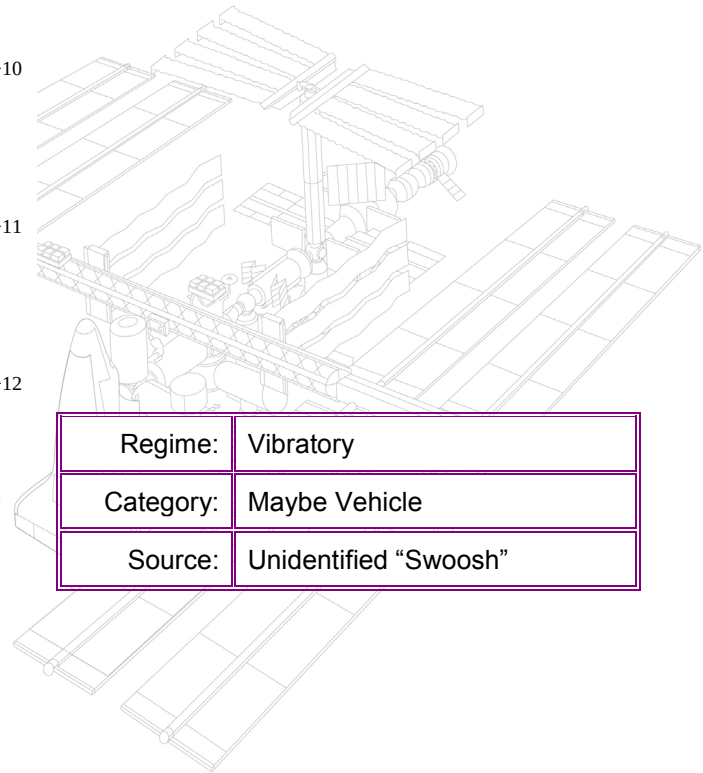
Regime:	Vibratory
Category:	Crew or Vehicle or Equipment
Source:	Source Title Goes Here Too

Unidentified “Swoosh”
Qualify



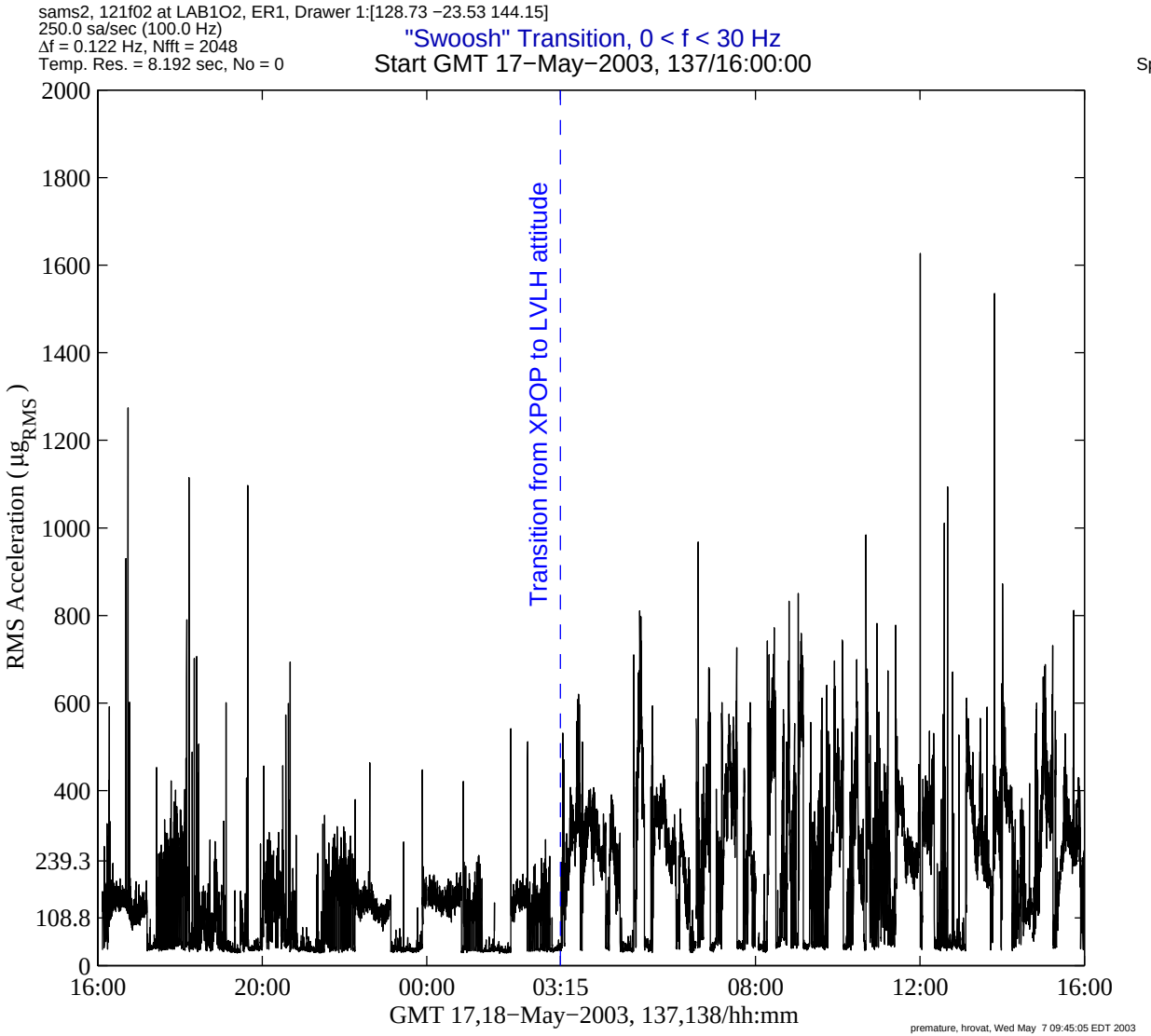
Data Description	
Sensor	SAMS 121f02 250.0 sa/sec (100.00 Hz)
Location	LAB1O2, ER1, Drawer 1
Inc/Flight	Increment: 7 Flight: 6S
Plot Type	spectrogram

Notes:
This unidentified disturbance plays a major role in shaping the vibratory environment below about 30 Hz. A distinct shift in its vibratory signature occurs with transitions between XPOP and LVLH attitudes of the space station. The figure here shows a transition from XPOP to LVLH attitude. The “swoosh” nickname comes from the frequency variations observed primarily around 10 Hz during LVLH attitudes. Another somewhat subtle variation is shown in the rectangle and dubbed the “picket fence”.



Regime:	Vibratory
Category:	Maybe Vehicle
Source:	Unidentified “Swoosh”

Unidentified “Swoosh”
Quantify



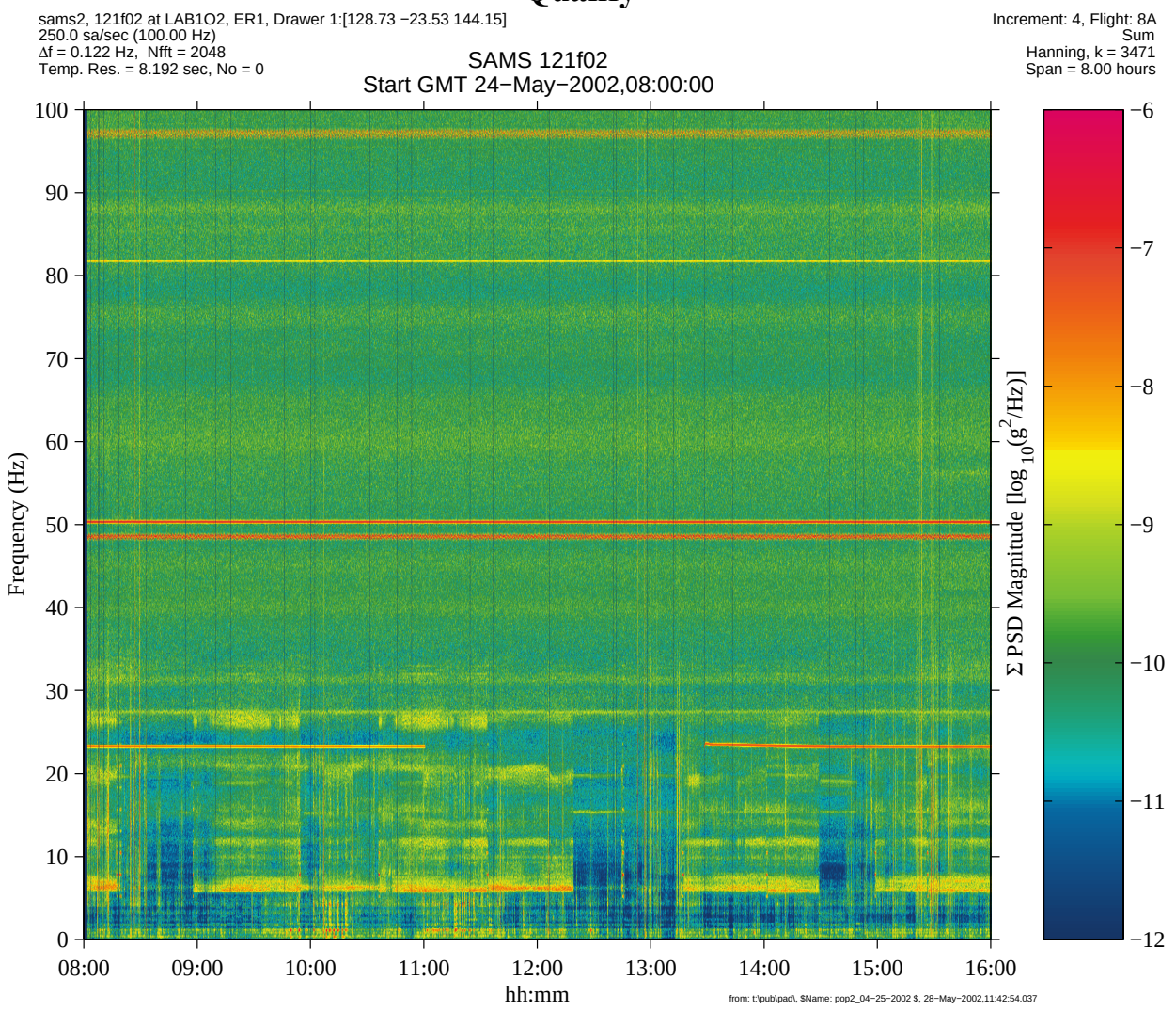
Data Description	
Sensor	SAMS 121f02 250.0 sa/sec (100.00 Hz)
Location	LAB1O2, ER1, Drawer 1
Inc/Flight	Increment: 7 Flight: 6S
Plot Type	interval RMS

Notes:
As indicated by the vertical line at about GMT 18-May-2003,138/03:15, the space station maneuvered from XPOP to LVLH attitude. This interval RMS plot for the frequency band below 30 Hz shows that the LVLH manifestation of the unidentified “swoosh” (before 03:15 in the figure) has substantially greater impact on the vibratory environment than that for XPOP (after 03:15 in the figure). The XPOP value below is for the 11 hours 15 minutes before the transition, while the LVLH value is for the 12 hours 45 minutes after the transition.

Attitude	Median μgRMS
-XPH +ZNN (XPOP)	108.8
-YVV +ZLV (LVLH)	239.3

Regime:	Vibratory
Category:	Maybe Vehicle
Source:	Unidentified “Swoosh”

SKV Air Conditioner Qualify



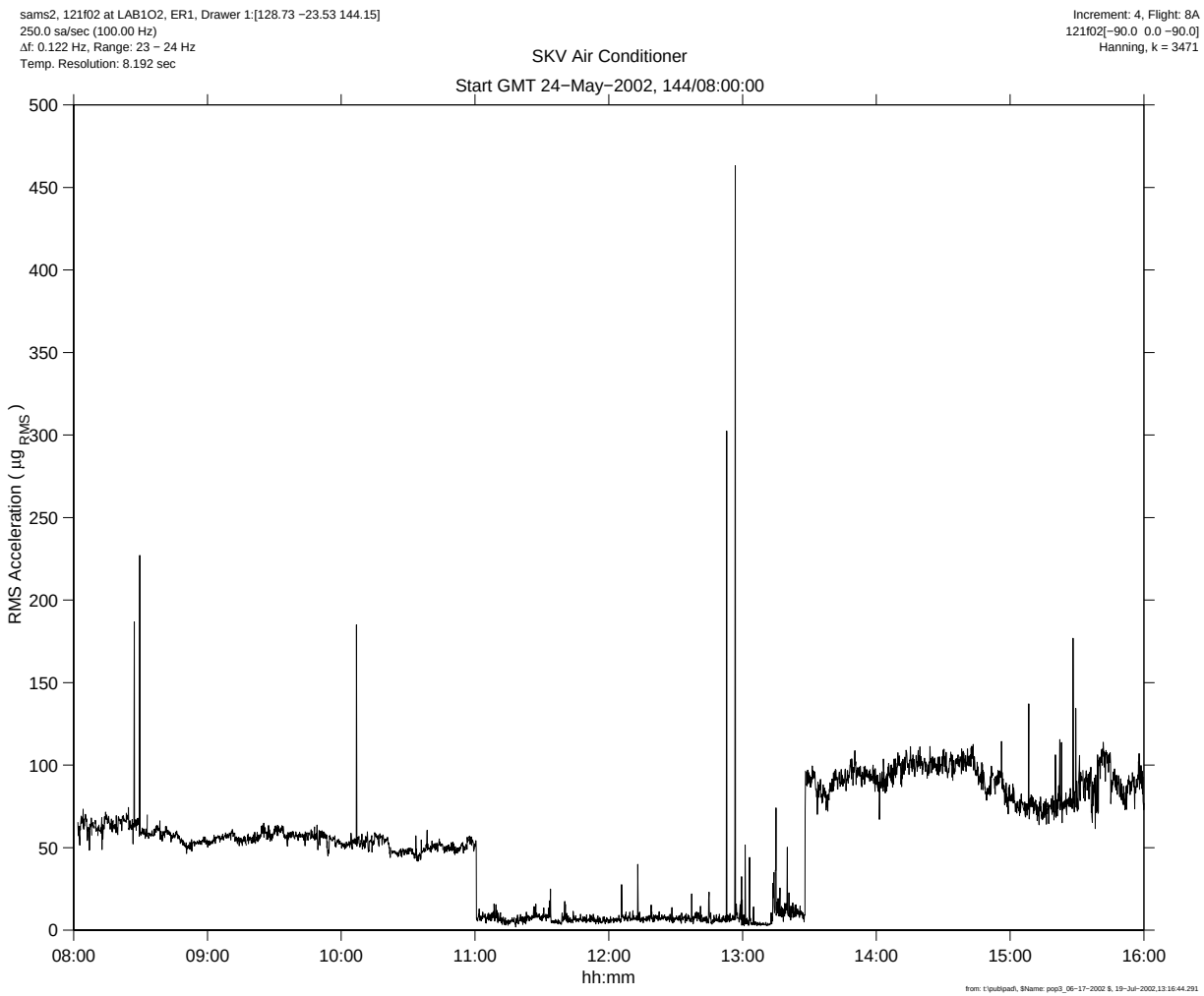
Data Description	
Sensor	121f02 250.0 sa/sec (100.00 Hz)
Location	LAB1O2, ER1, Drawer 1
Inc/Flight	Increment: 4, Flight: 8A
Plot Type	spectrogram

Notes:

- This Russian air conditioner is part of the Environmental Control and Life Support System (ECLSS).
- As part of preparation for an ExtraVehicular Activity (EVA), the crew will move ducting in order to work with hatches. It has been noted that this is accompanied by a temporary deactivation of the air conditioner.
- Nominally one SKV is operating, but there are times when both SKV-1 and SKV-2 are on.
- The nearly continuous operation of this equipment produces a narrowband disturbance near 23.5 Hz. This spectral peak serves as vibratory beacon signal.

Regime:	Vibratory
Category:	Vehicle
Source:	SKV Air Conditioner

SKV Air Conditioner Quantify



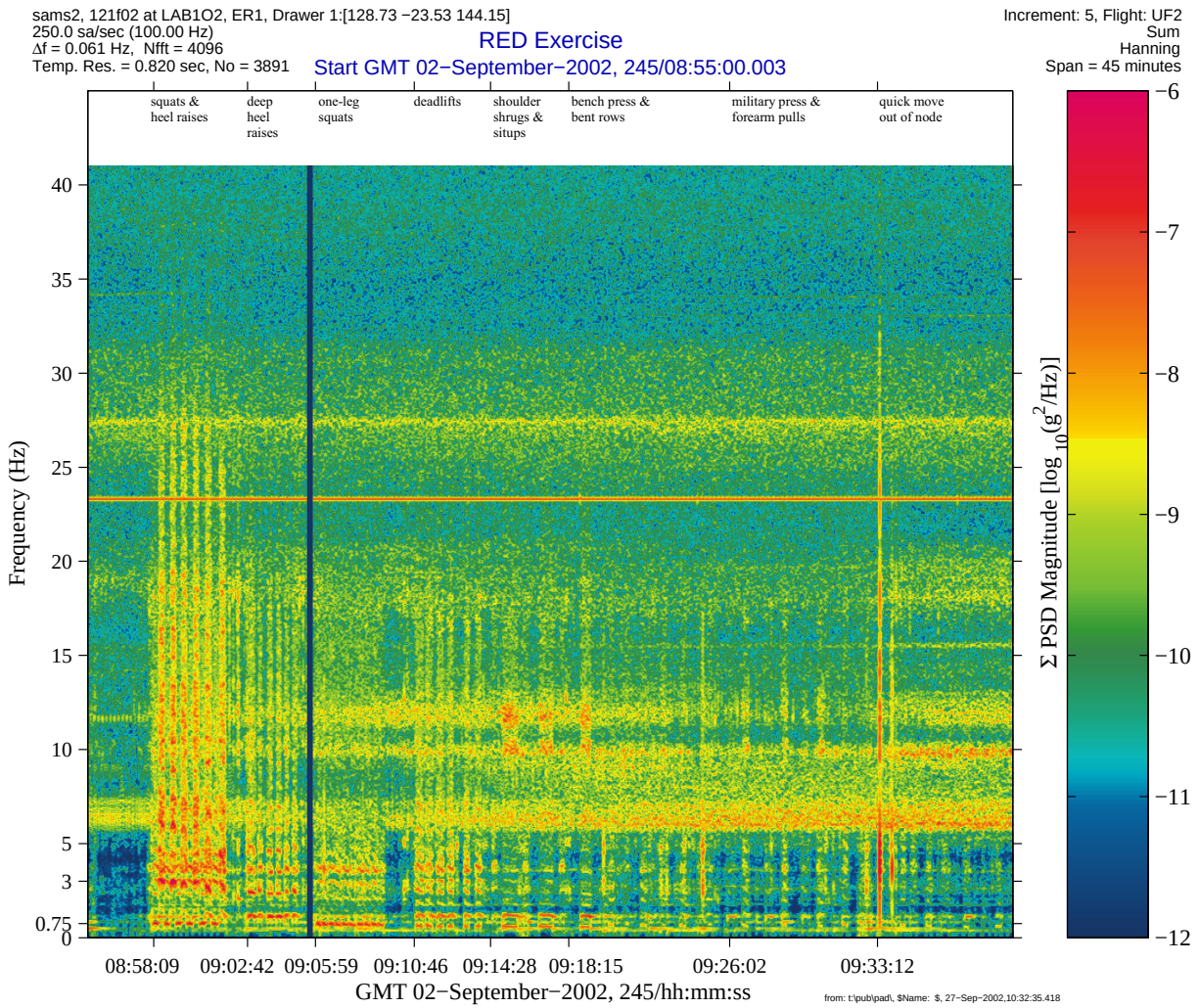
Data Description	
Sensor	121f02 250.0 sa/sec (100.00 Hz)
Location	LAB1O2, ER1, Drawer 1
Inc/Flight	Increment: 4, Flight: 8A
Plot Type	interval RMS

Notes:
For the 8-hour period shown in the figure, Parseval's theorem was used to derive the RMS acceleration level for a narrow band around the SKV air conditioner's operating frequency. The results for the frequency band from 23 to 24 Hz is tabulated below:

SKV	GMT	Median (μg_{RMS})
ON	08:00 – 11:00	55.4
OFF	11:00 – 13:28	6.8
ON	13:28 – 16:00	91.2

Regime:	Vibratory
Category:	Vehicle
Source:	SKV Air Conditioner

Resistive Exercise Device (RED)
Qualify



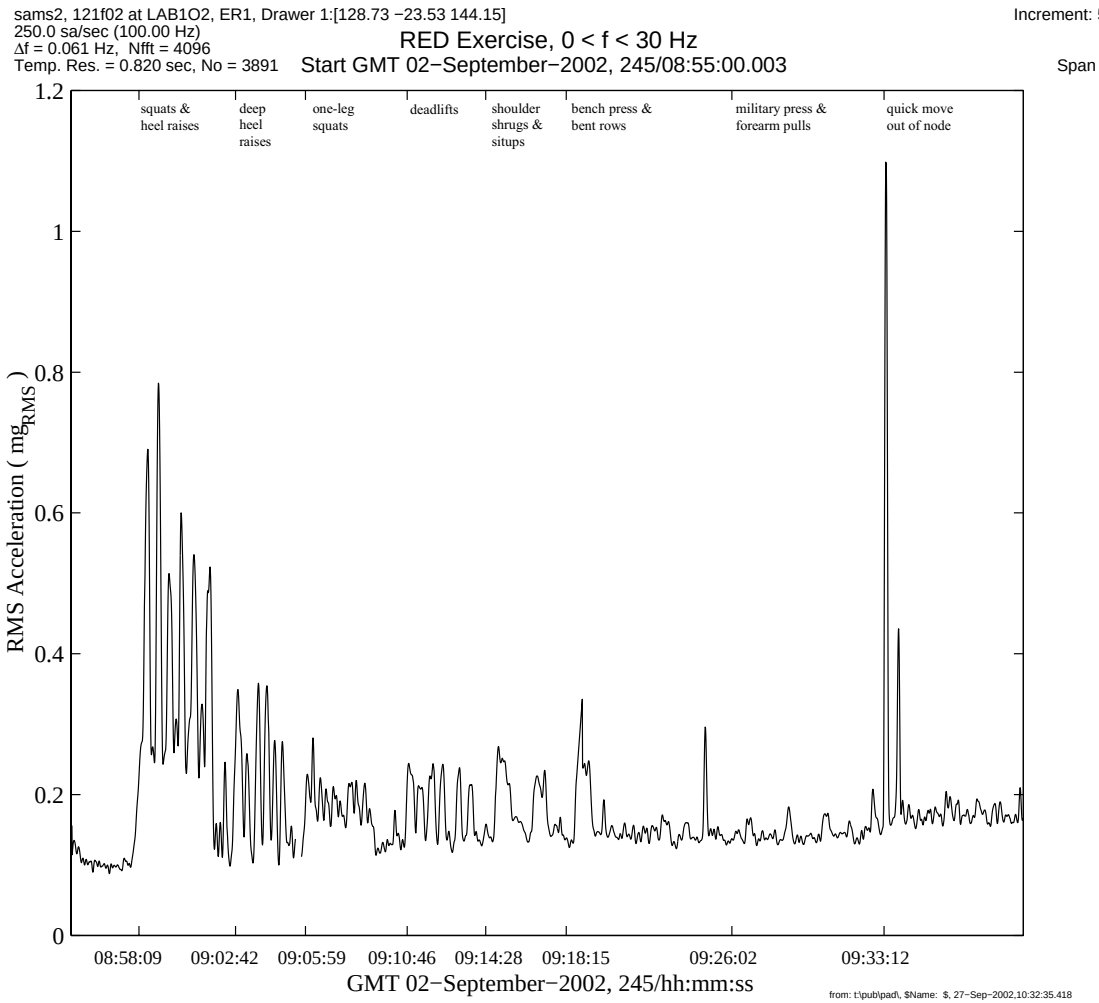
Data Description	
Sensor	121f02 250.0 sa/sec (100.00 Hz)
Location	LAB1O2, ER1, Drawer 1
Inc/Flight	Increment: 5, Flight: UF2
Plot Type	spectrogram

Notes:

- multi-purpose exercise device
- crank canisters to adjust resistance
- in the interim, it is hardmounted
- used routinely and located in the Z1 alcove of Node 1
- base plate parallel with Z1 hatch
- help crew preserve strength and bone mineral
- exercise types: squats, heel raises, deadlifts, bench press, upright rows, bent rows

Regime:	Vibratory
Category:	Crew Activity
Source:	Resistive Exercise Device (RED)

Resistive Exercise Device (RED)
Quantify



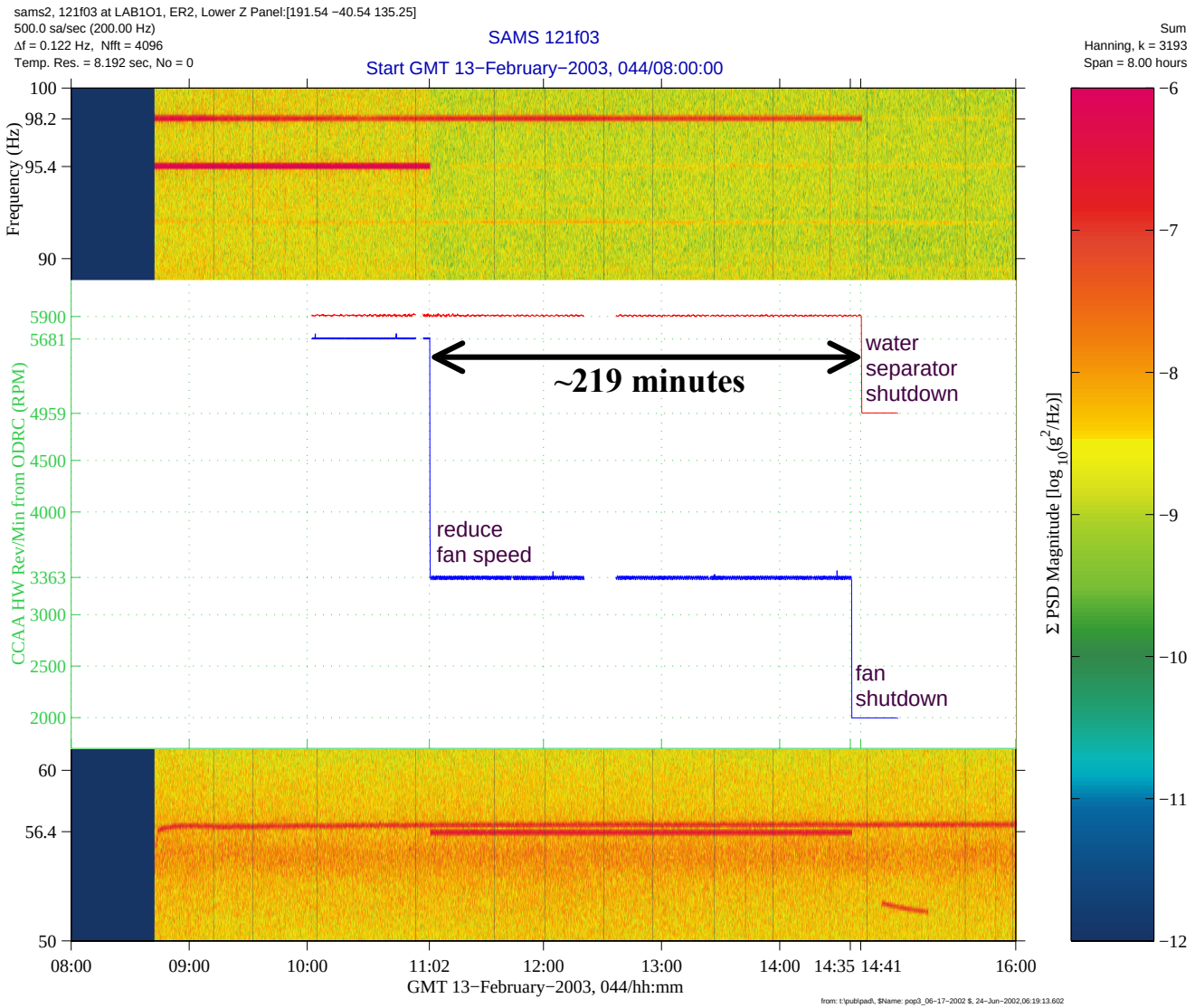
Data Description	
Sensor	121f02 250.0 sa/sec (100.00 Hz)
Location	LAB1O2, ER1, Drawer 1
Inc/Flight	Increment: 5, Flight: UF2
Plot Type	interval RMS

Notes:
The interval RMS figure shown spans the entire RED exercise period and covers the frequency range below 30 Hz. This period consisted of several exercise types as annotated in the figure. Several of these types were analyzed for the frequency range below 10 Hz as tabulated below:

Type	Maximum (μg_{RMS})	GMT Start 02-Sep-2002, 245/
baseline (no RED)	60	08:55:00
squats	301	08:58:09
heel raises	691	08:58:26
deep heel raises	336	09:02:42
deadlifts	206	09:10:46
bench/bent rows	222	09:20:21
one-leg squats	255	09:05:59

Regime:	Vibratory
Category:	Crew Activity
Source:	Resistive Exercise Device (RED)

Common Cabin Air Assembly (CCAA)
Qualify

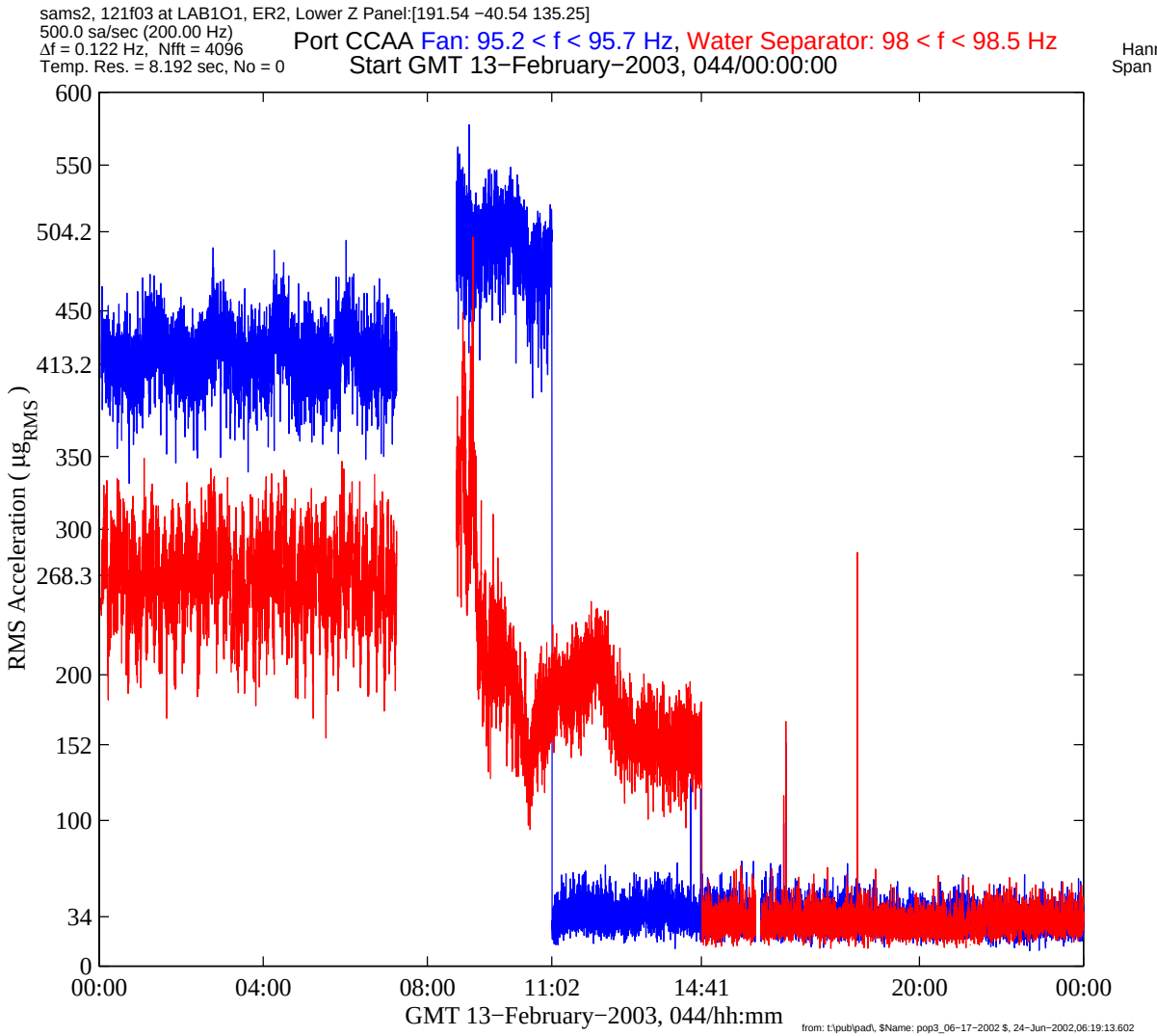


Data Description	
Sensor	SAMS 121f03 500.0 sa/sec (200.00 Hz)
Location	LAB1O1, ER2, Lower Z Panel
Inc/Flight	Increment: 6, Flight: 11A
Plot Type	spectrogram

Notes:
The Common Cabin Air Assembly (CCAA) in the U.S. On-Orbit Segment modules (port CCAA in LAB1P6, and starboard CCAA in LAB1S6) of the ISS provides the capability to control the cabin air temperature, maintain the cabin air humidity level within desired limits, and generate ventilation air flow. During a normal shutdown operation of the CCAA, the inlet orbital replacement unit (ORU) fan speed is reduced from about 5700 RPM (~95 Hz) to about 3400 RPM (~57 Hz). At that point, the water separator ORU continues to operate at about 5900 RPM (~98 Hz) for approximately 200 minutes to accomplish dry-out prior to final shutdown. Both fans are then shutdown during the transition from port to starboard CCAA duty. It should be noted that the water separator operates at a fixed fan speed of 5900 ± 118 RPM (98 ± 2 Hz) and the inlet is a variable speed fan that operates between 3208 to 7668 RPM (53.5 to 127.8 Hz).

Regime:	Vibratory
Category:	Vehicle
Source:	Common Cabin Air Assembly (CCAA)

Common Cabin Air Assembly (CCAA)
Quantify

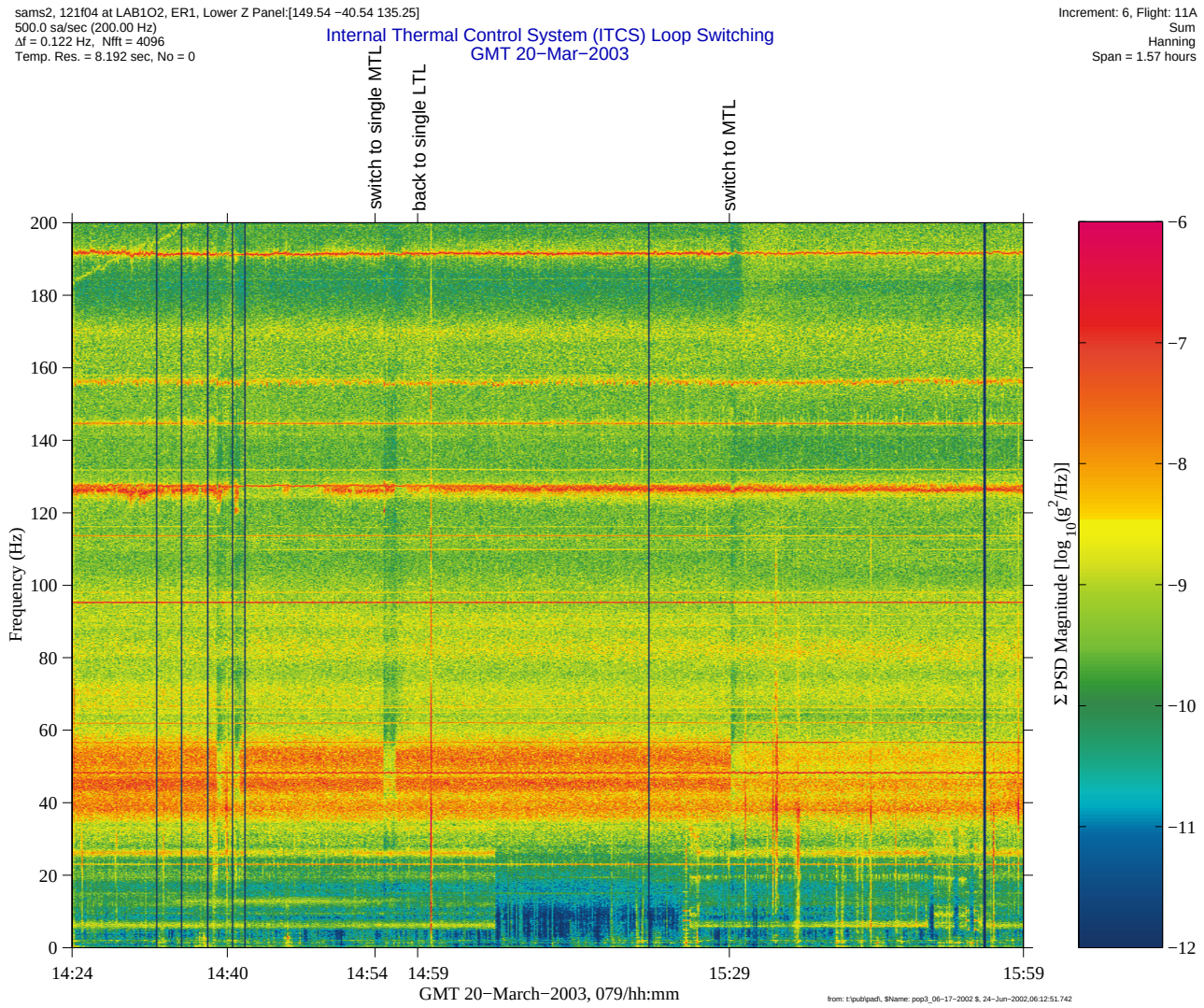


Data Description	
Sensor	121f03 500.0 sa/sec (200.00 Hz)
Location	LAB1O1, ER2, Lower Z Panel
Inc/Flight	Increment: 6, Flight: 11A
Plot Type	interval RMS

Notes:
In order to quantify the port CCAA (LAB1P6) shutdown event, the interval RMS curves for the 24-hours shown in this figure were computed. These curves show that the higher frequency (red trace) water separator transitioned from nominal RMS values of about 268.3 μg_{RMS} to about 152 μg_{RMS} during dry-out before returning this narrow portion of the spectrum to a baseline of about 34 μg_{RMS}. The inlet fan operated between about 413 μg_{RMS} during nominal operation up to 550 μg_{RMS} before its step down to a lower frequency for dry-out. Note that the lower frequency operation of the inlet fan was not quantified due to its proximity to another strong, narrowband signal just above its operational rate.

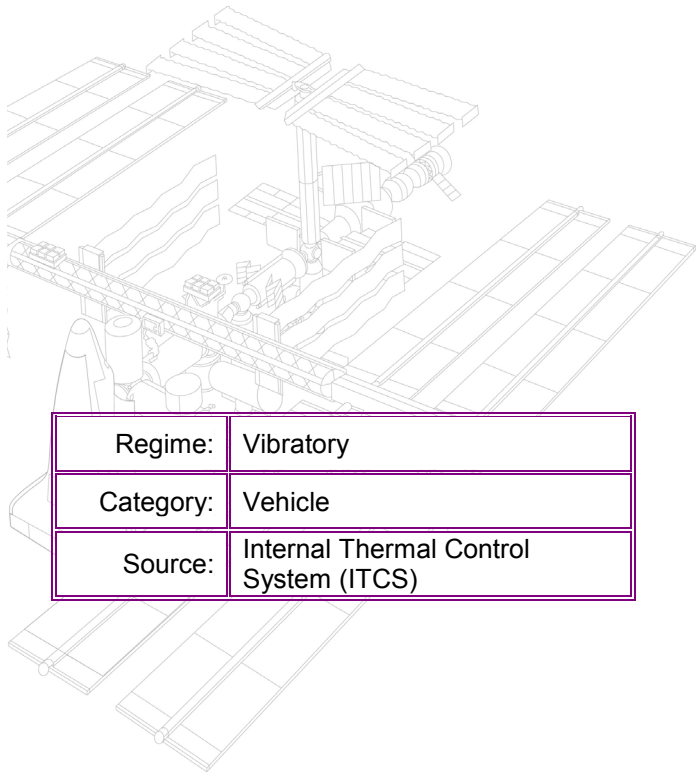
Regime:	Vibratory
Category:	Vehicle
Source:	Common Cabin Air Assembly (CCAA)

Internal Thermal Control System (ITCS)
Qualify



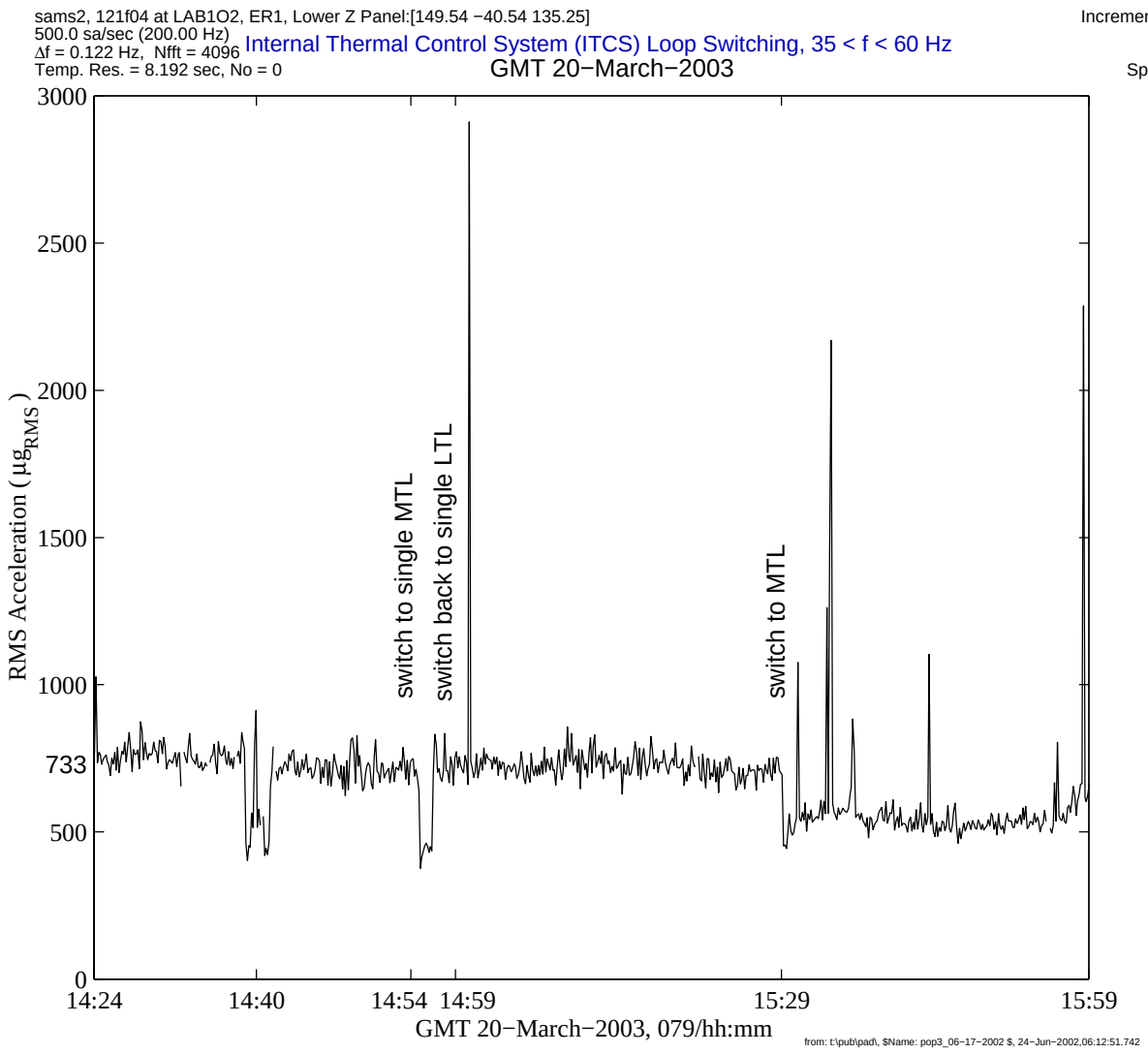
Data Description	
Sensor	SAMS 121f04 500.0 sa/sec (200.00 Hz)
Location	LAB1O2, ER1, Lower Z Panel
Inc/Flight	Increment: 6 Flight: 11A
Plot Type	spectrogram

Notes:
The Internal Thermal Control System (ITCS) seems to contribute broadband energy into the acceleration spectrum, particularly between about 35 and 60 Hz when it's in the single Low Temperature Loop (LTL) mode. When switched to the Medium Temperature Loop (MTL) mode, there is a noticeable broadband decrease in the acceleration spectrum below 200 Hz.



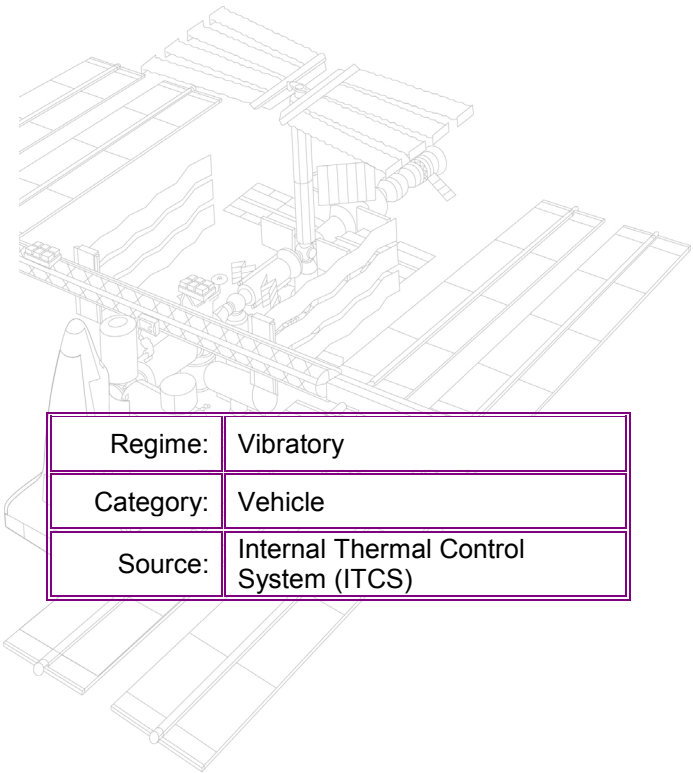
Regime:	Vibratory
Category:	Vehicle
Source:	Internal Thermal Control System (ITCS)

Internal Thermal Control System (ITCS)
Quantify



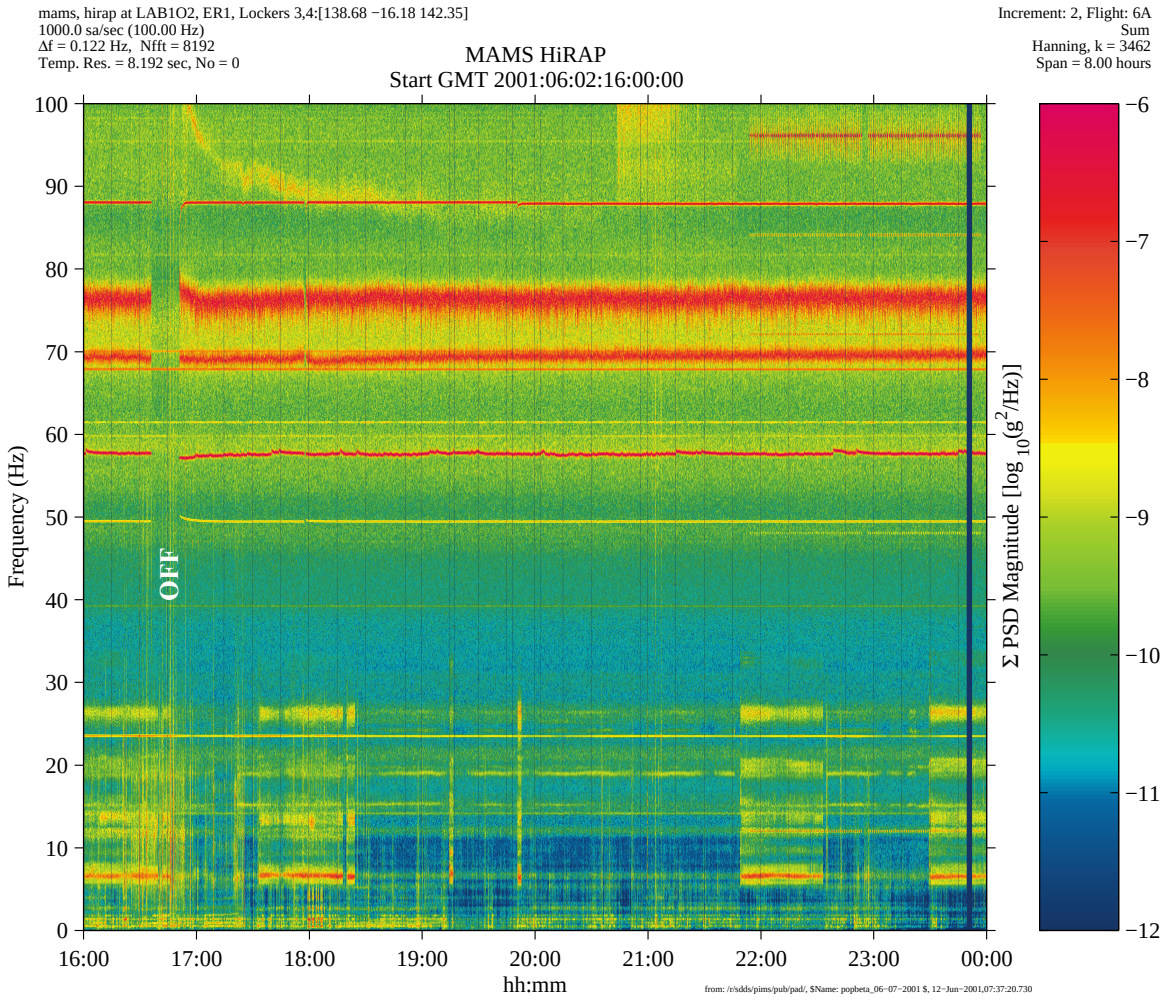
Data Description	
Sensor	SAMS 121f04 500.0 sa/sec (200.00 Hz)
Location	LAB1O2, ER1, Lower Z Panel
Inc/Flight	Increment: 6 Flight: 11A
Plot Type	interval RMS

Notes:
The Internal Thermal Control System (ITCS) seems to contribute broadband energy into the acceleration spectrum, particularly between about 35 and 60 Hz when it's in the single Low Temperature Loop (LTL) mode. When switched to the Medium Temperature Loop (MTL) mode, there is a noticeable broadband decrease in the acceleration spectrum below 200 Hz.



Regime:	Vibratory
Category:	Vehicle
Source:	Internal Thermal Control System (ITCS)

ADVanced AStroCulture (ADVASC) Experiment Equipment Qualify



Data Description	
Sensor	HiRAP 1000.0 sa/sec (100.00 Hz)
Location	LAB1O2, ER1, Lockers 3,4
Inc/Flight	Increment: 2, Flight: 6A
Plot Type	spectrogram

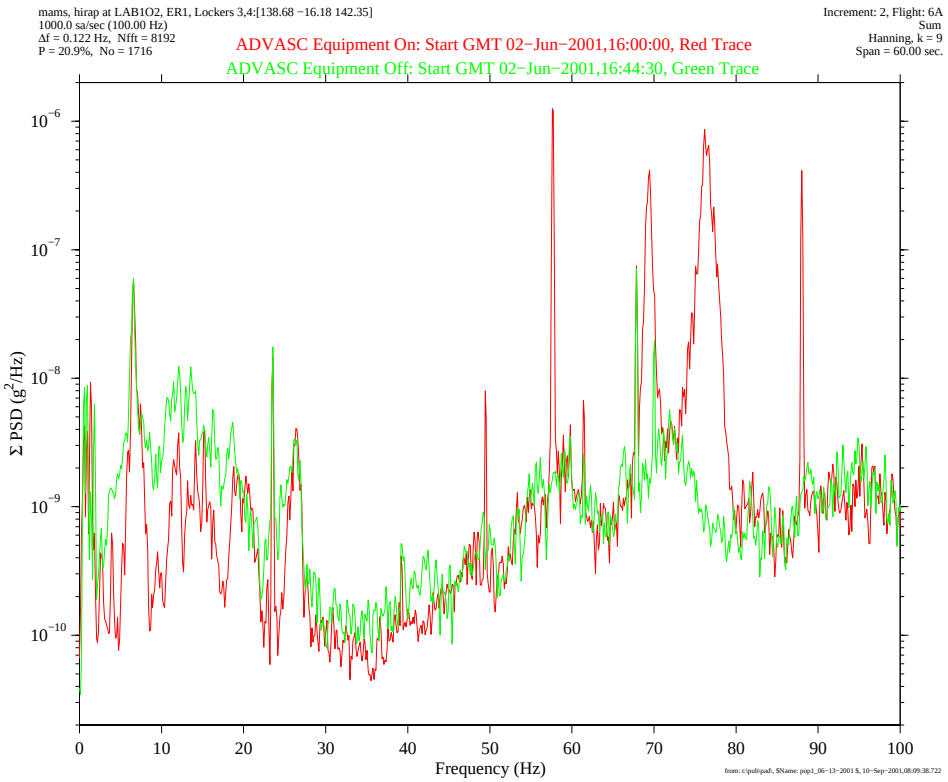
Notes:

- ADVASC experiment equipment*:
  - **pump** – narrowband signal centered at about 53.5 Hz
  - **2 fans** – narrowband signals centered at about 48 and 88 Hz.
  - **2 blowers** – broadband signals centered at about 72 and 78 Hz

* as confirmed by ADVASC team at University of Wisconsin

Regime:	Vibratory
Category:	Experiment Equipment
Source:	ADVanced AStroCulture (ADVASC)

ADVanced AStroCulture (ADVASC) Experiment Equipment Quantify



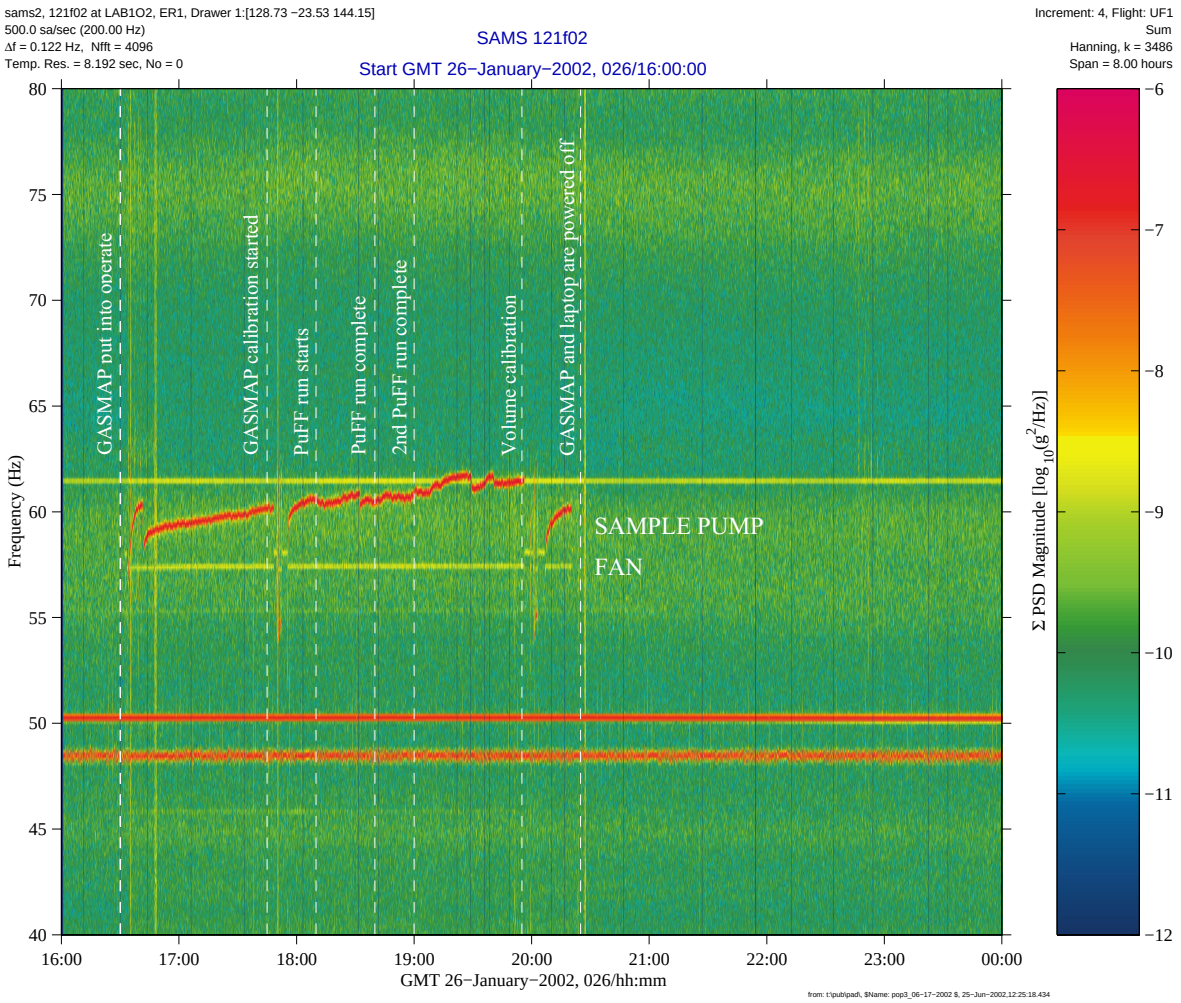
Data Description	
Sensor	HiRAP 1000.0 sa/sec (100.00 Hz)
Location	LAB1O2, ER1, Lockers 3,4
Inc/Flight	Increment: 2, Flight: 6A
Plot Type	spectrogram

Notes:

Frequency (Hz)			ADVASC Disturbance	RMS Acceleration (μgRMS)	
HiRAP Measured		Expected		ADVASC ON	ADVASC OFF
Center	Range				
49.4	49.1 - 49.7	48.3	2,900 RPM fan	41.6	19.0
57.6	57.3 - 57.9	52 - 55	air pump	568.9	31.4
69.5	68.1 - 70.9	71.7	4,300 RPM blower	512.9	97.4
76.5	73.0 - 79.7	78.3	4,700 RPM blower	940.9	86.9
88.0	87.6 - 88.4	88.3	5,300 RPM CPU fan	284.3	32.8

Regime:	Vibratory
Category:	Experiment Equipment
Source:	ADVanced AStroCulture (ADVASC)

Gas Analysis System for Metabolic Analysis of Physiology (GASMAP) Qualify



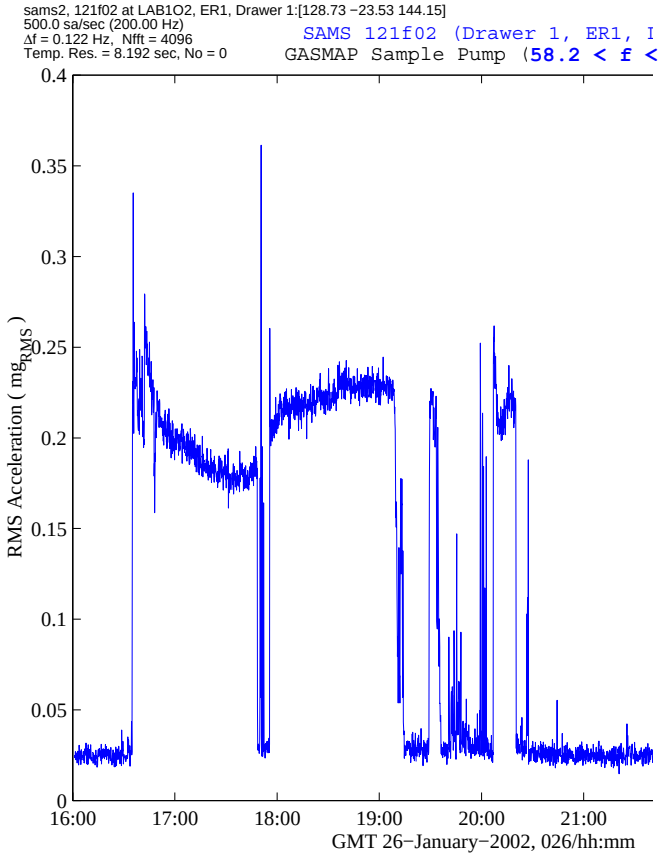
Data Description	
Sensor	121f02 500.0 sa/sec (200.00 Hz)
Location	LAB1O2, ER1, Drawer 1
Inc/Flight	Increment: 4, Flight: UF1
Plot Type	spectrogram

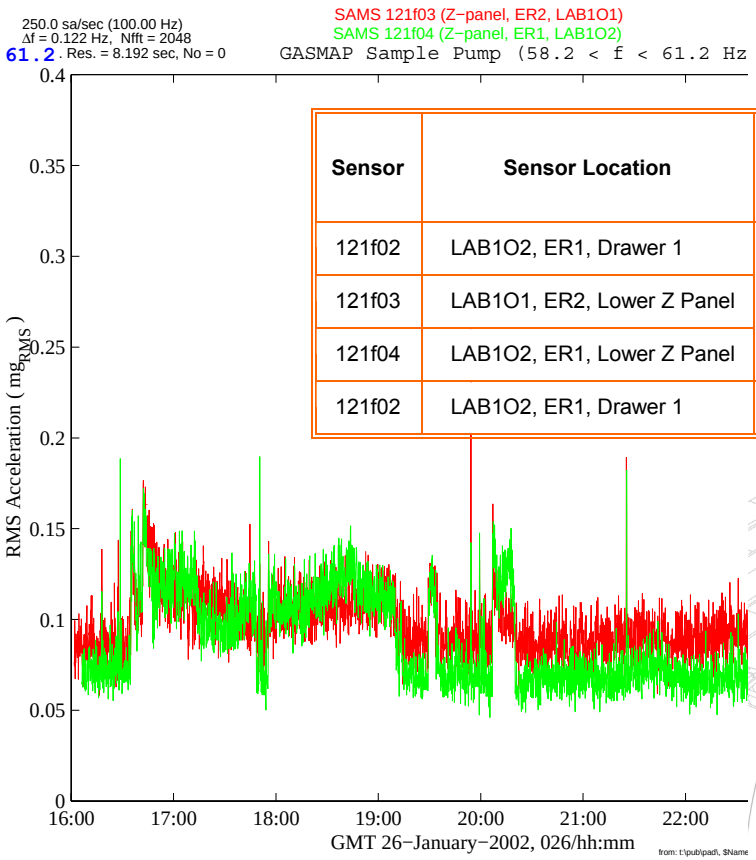
Notes:
The GASMAP device is used to monitor and analyze both inhaled and exhaled breath streams to determine their gas concentrations. Two GASMAP signatures are noted in the figure near 60 Hz: **a sample pump and a fan**. This equipment is located in the HRF rack #1 (LAB1S2) and used for the Pulmonary Function in Flight (PuFF) experiment, which studies effects of extravehicular activity (EVA) and long-term exposure to microgravity on the pulmonary function. As discussed with payload developers, the frequency changes away from nominal operation are likely a function of varying loads on the sample pump. The pump frequency ranged from 54 Hz (for brief calibrations) up to 62 Hz after the second PuFF run. The fan is tightly controlled in frequency but also transitions from baseline of about 57.4 Hz up to 58.1 Hz noted during calibrations.

Regime:	Vibratory
Category:	Experiment Equipment
Source:	GASMAP

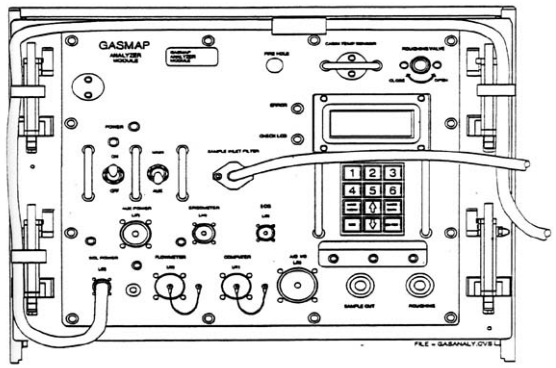
Gas Analysis System for Metabolic Analysis of Physiology (GASMAP) Quantify

Data Description	
Sensor	121f02 500.0 sa/sec (200.00 Hz)
Location	LAB1O2, ER1, Drawer 1
Inc/Flight	Increment: 4, Flight: UF1
Plot Type	interval RMS



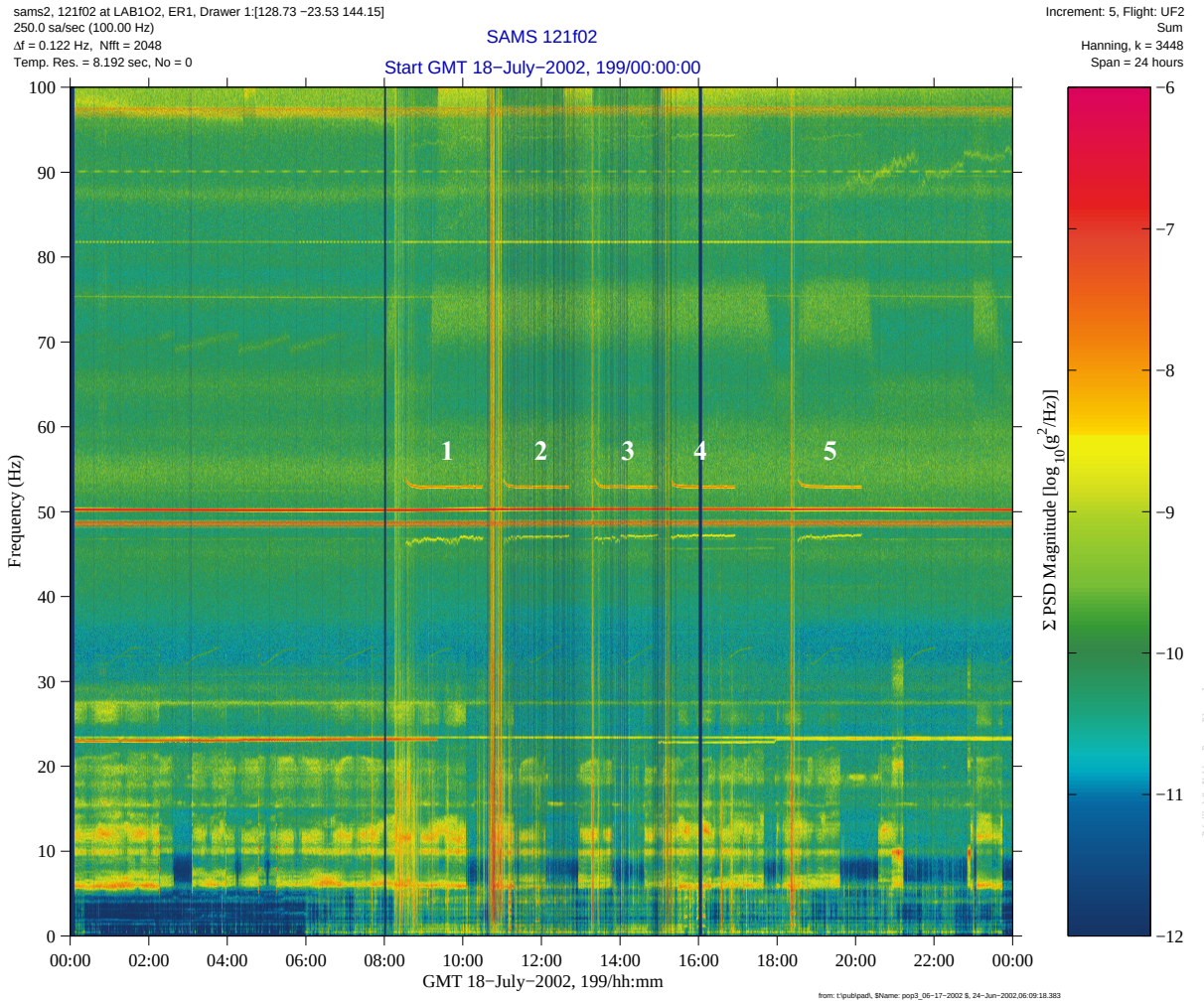


Sensor	Sensor Location	GASMAP Equipment	Frequency Range (Hz)	State	RMS Acceleration (ug_{RMS})
121f02	LAB1O2, ER1, Drawer 1	SAMPLE PUMP	58.2 – 61.2	OFF	24
				ON	>200
121f03	LAB1O1, ER2, Lower Z Panel			OFF	91
				ON	>115
121f04	LAB1O2, ER1, Lower Z Panel			OFF	70
				ON	>115
121f02	LAB1O2, ER1, Drawer 1	FAN	57.2 – 57.6	OFF	8
				ON	19



Regime:	Vibratory
Category:	Experiment Equipment
Source:	GASMAP

Microencapsulation Electrostatic Processing System (MEPS) Qualify

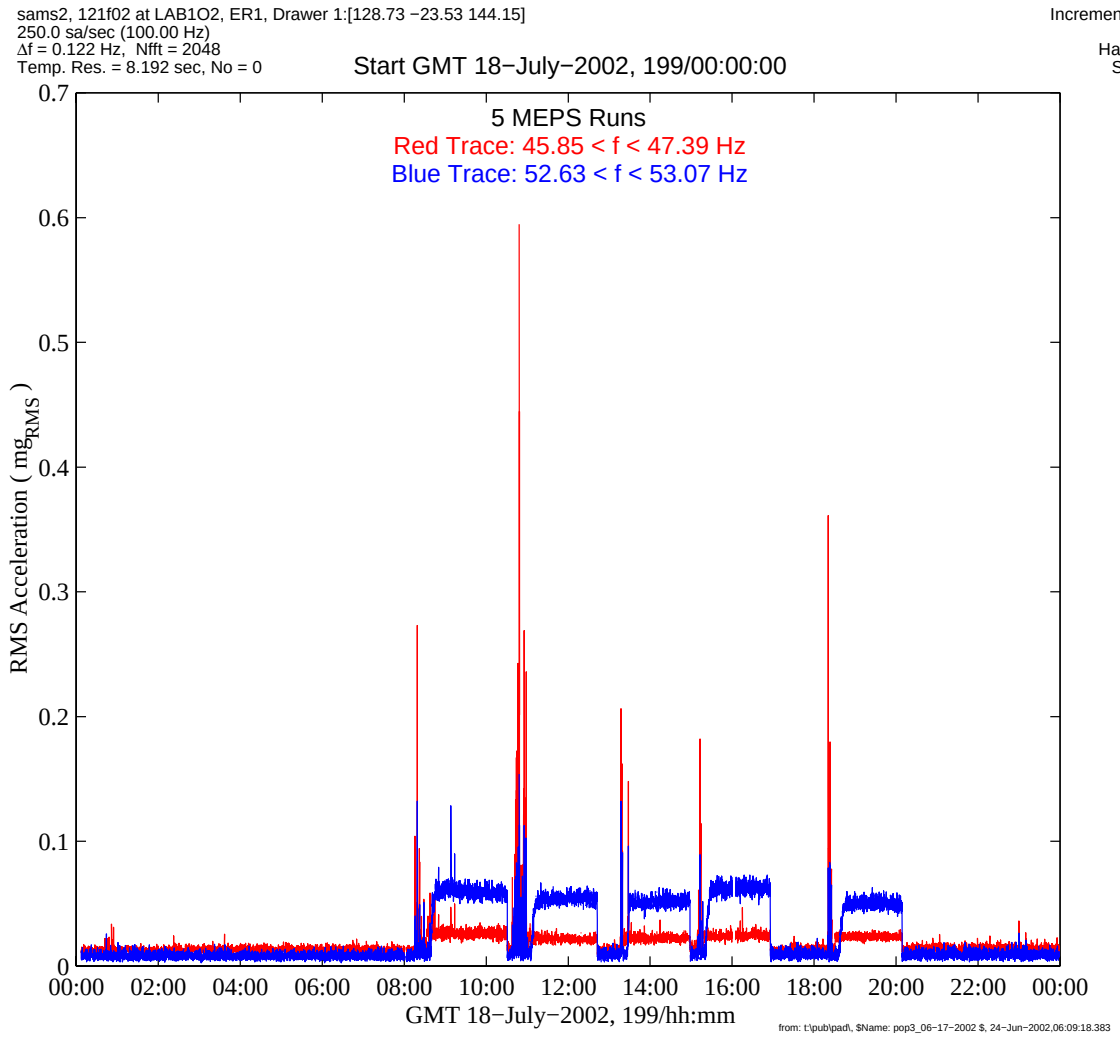


Data Description	
Sensor	121f02 250.0 sa/sec (100.00 Hz)
Location	LAB1O2, ER1, Drawer 1
Inc/Flight	Increment: 5, Flight: UF2
Plot Type	spectrogram

Notes:
The MEPS is located in locker #8 of ER1 (LAB1O2) near the 121f02 sensor in RTS drawer 1. This 24-hour spectrogram readily shows 5 MEPS sample runs with the start/stop delimited by 2 narrowband signals. The weaker of these was centered at 47.1 Hz and the stronger at 52.8 Hz. Note that each of the 5 runs is preceded by the impulsive events of Process Chamber Module (PCM) insertion.

Regime:	Vibratory
Category:	Experiment Equipment
Source:	MEPS

Microencapsulation Electrostatic Processing System (MEPS) Quantify

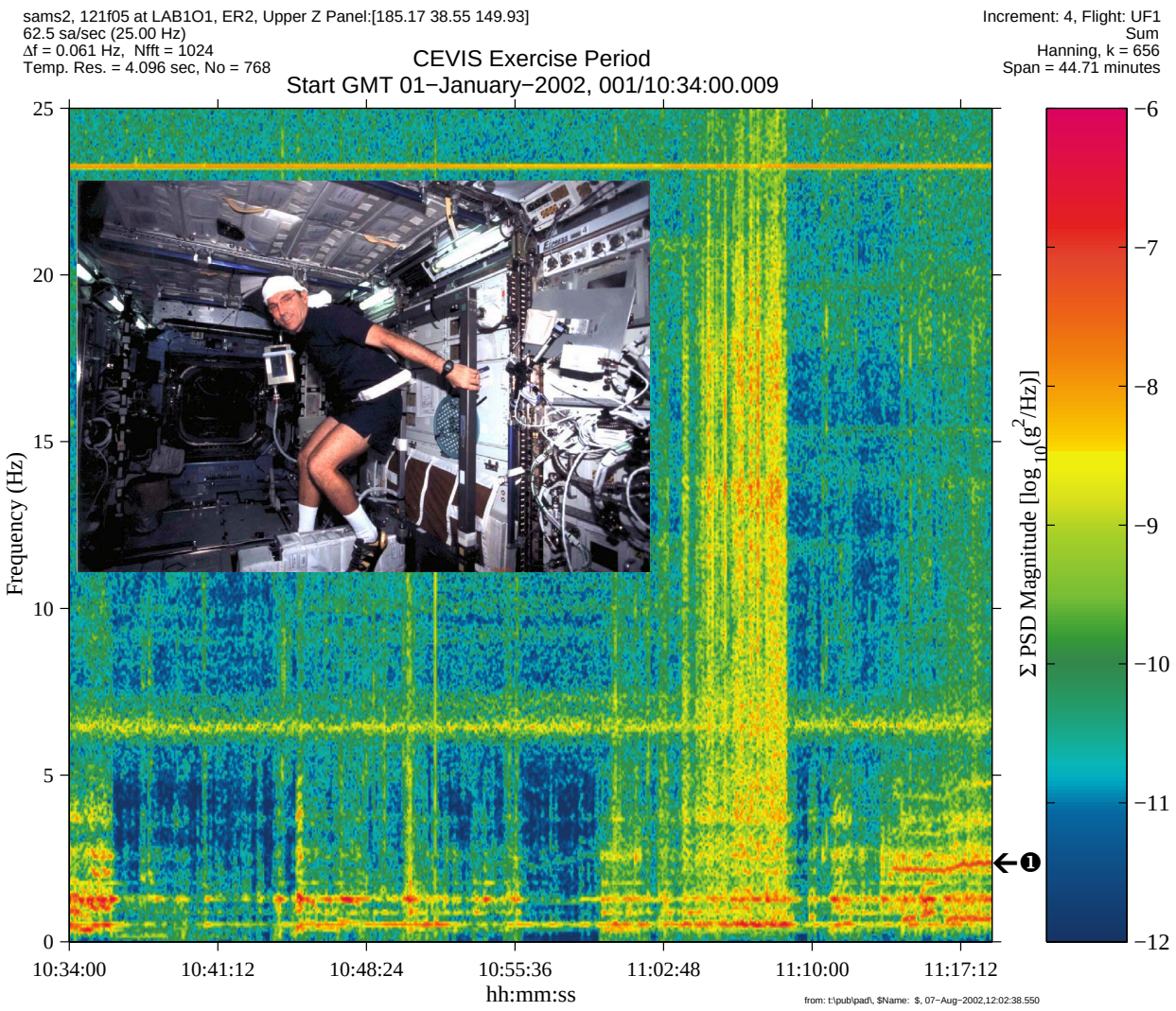


Data Description	
Sensor	121f02 250.0 sa/sec (100.00 Hz)
Location	LAB1O2, ER1, Drawer 1
Inc/Flight	Increment: 5, Flight: UF2
Plot Type	interval RMS

Notes:
This interval RMS versus time plot corresponds to the same time frame as that of the 24-hour spectrogram shown on the "qualify" page. This figure shows the contribution of the 2 narrowband signals that accompany the MEPS runs. The red trace gives the RMS acceleration for the fainter, low-frequency signal centered at 47.1 Hz. This signal steps from about 14 to 24 ug_{RMS} in the frequency range from 45.85 to 47.39 Hz. Likewise, the blue trace for the stronger signal centered at 52.8 Hz steps from about 9 to 54 ug_{RMS} in the frequency range from 52.63 to 53.07 Hz. The largest transient in this time frame was 103 mg and is attributed to insertion of the Process Chamber Module (PCM) for the 2nd sample run.

Regime:	Vibratory
Category:	Experiment Equipment
Source:	MEPS

Cycle Ergometer with Vibration Isolation System (CEVIS)
QUALIFY

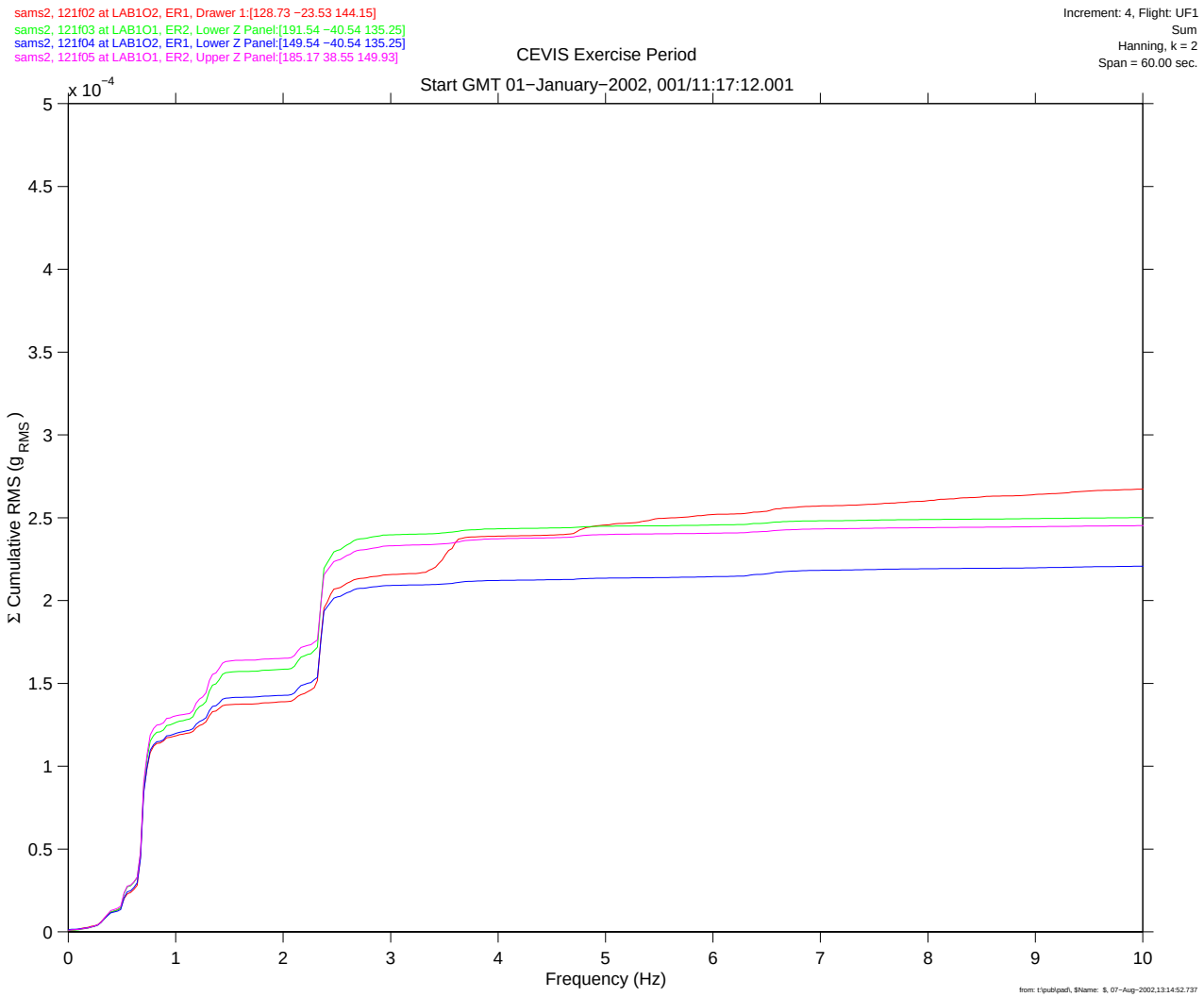


Data Description	
Sensor	121f05 62.5 sa/sec (25.00 Hz)
Location	LAB1O1, ER2, Light Tray
Inc/Flight	Increment: 4, Flight: UF1
Plot Type	spectrogram

Notes:
The CEVIS exercise device is located in the US Lab at LAB1P3. The narrowband peak at about 2.5 Hz marked on the lower right of the spectrogram is the pedaling frequency for this CEVIS exercise period. For Shuttle ergometer exercise, the pedaling signature was accompanied by that of shoulder sway with frequency around half the pedal rate. On the ISS for this CEVIS exercise period, the shoulder sway signature is obscured by structural modes that fall in the same frequency range.

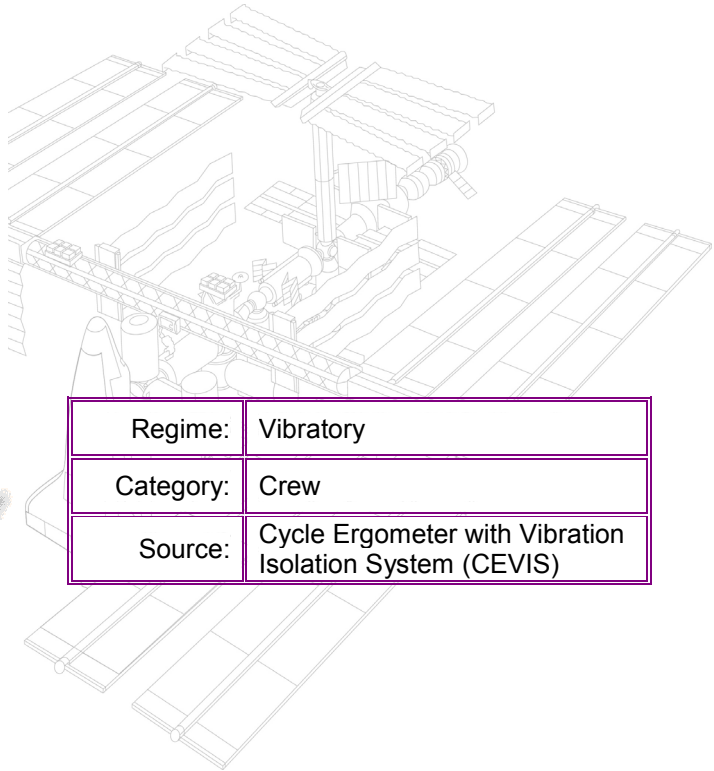
Regime:	Vibratory
Category:	Crew
Source:	Cycle Ergometer with Vibration Isolation System (CEVIS)

Cycle Ergometer with Vibration Isolation System (CEVIS)
QUANTIFY



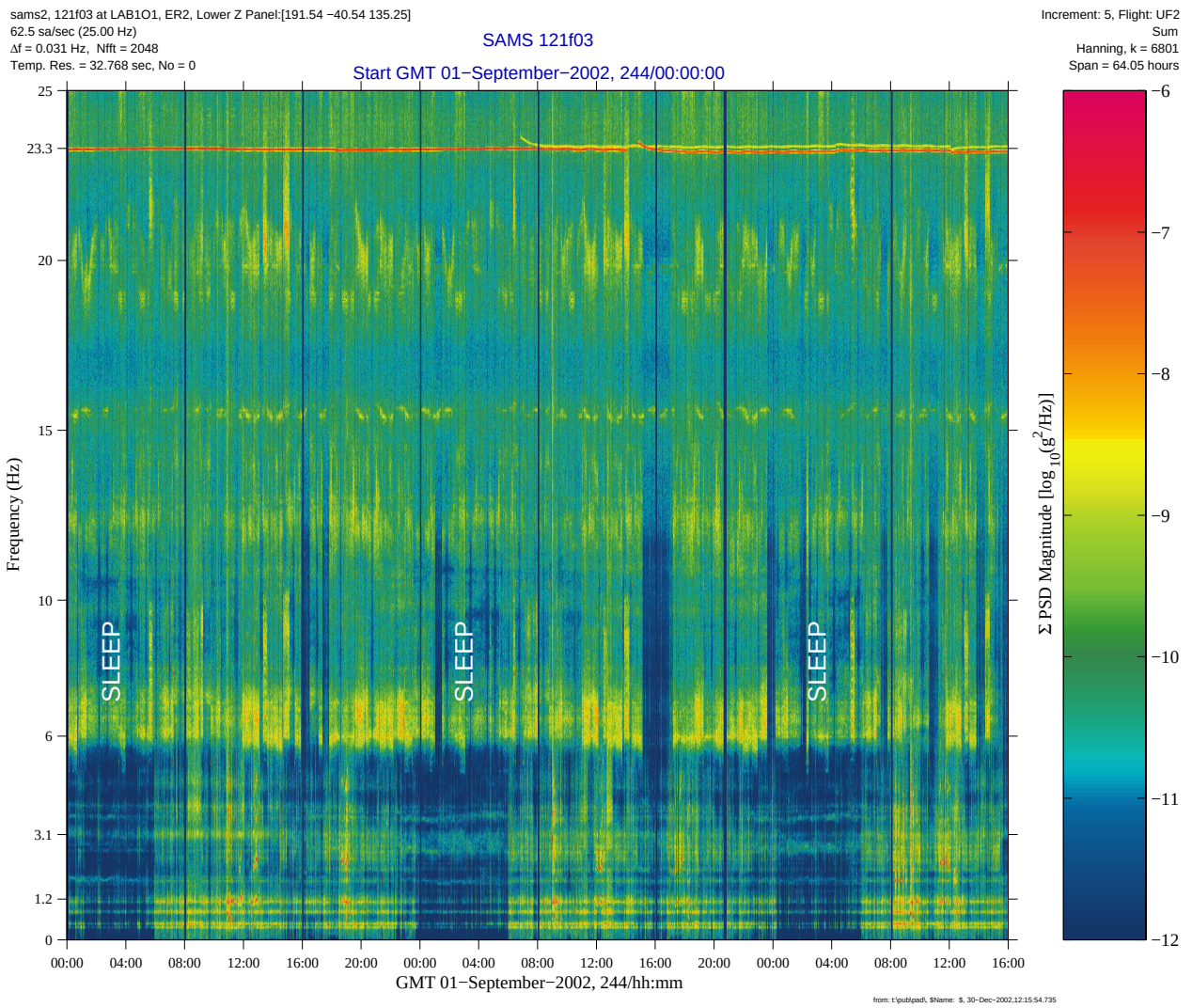
Data Description	
Sensor	see upper left of figure
Location	see upper left of figure
Inc/Flight	Increment: 4, Flight: UF1
Plot Type	cumulative RMS

Notes:
To quantify the impact of a CEVIS exercise period from four sensor locations, the cumulative RMS acceleration versus frequency curves shown in the figure were computed. The legend at the upper left shows which trace was computed for each of the different sensors. The curves in this figure all step up about 70 ug_{RMS} at the pedaling frequency, but vary to some degree across the rest of the acceleration spectrum below 10 Hz. The variability is expected as the SAMS sensors used for the analysis were distributed throughout ER1 and ER2 as indicated by the legend.



Regime:	Vibratory
Category:	Crew
Source:	Cycle Ergometer with Vibration Isolation System (CEVIS)

Sleep/Wake
QUALIFY

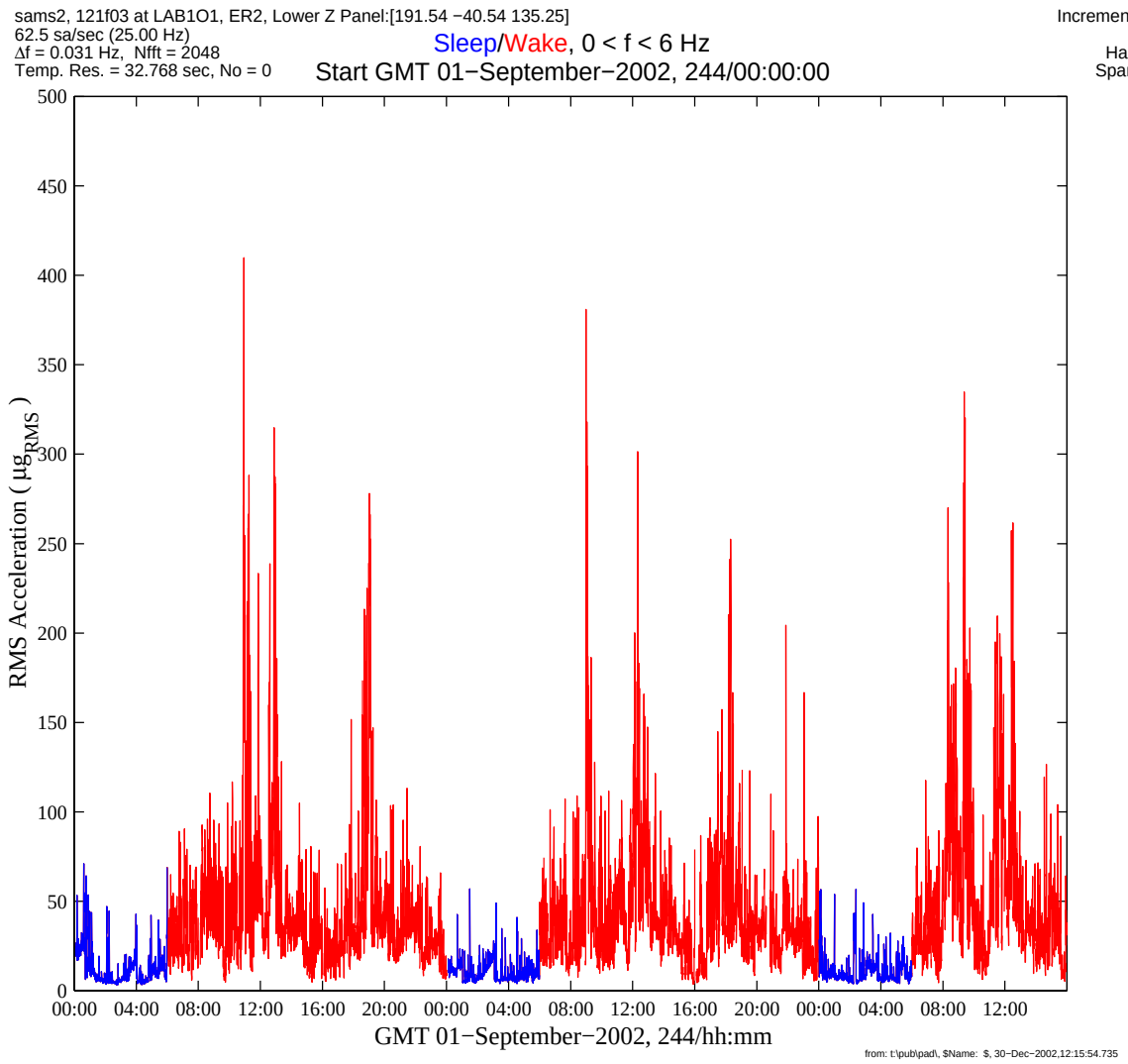


Data Description	
Sensor	121f03 62.5 sa/sec (25.00 Hz)
Location	LAB1O1, ER2, Lower Z Panel
Inc/Flight	Increment: 5, Flight: UF2
Plot Type	spectrogram

Notes:
This figure shows 3 sleep periods over a 64-hour span. The impact of crew wake periods relative to sleep is primarily below about 6 Hz. This is seen as a shift toward the blue end of the PSD magnitude color scale below about 6 Hz during the 3 sleep periods. The transition from sleep to wake is typically a sudden event owing to a wake alarm, while the transition from wake to sleep is gradual as might be expected. Signatures for both Russian air conditioners (SKV-1 and SKV-2) are also seen here toward the top of this figure at about 23.3 Hz. The slightly lower frequency and more intense SKV is on for this entire 64-hour duration, while the other one starts just after the end of the 2nd sleep period.

Regime:	Vibratory
Category:	Crew
Source:	Sleep/Wake

Sleep/Wake
QUANTIFY



Data Description	
Sensor	121f03 62.5 sa/sec (25.00 Hz)
Location	LAB1O1, ER2, Lower Z Panel
Inc/Flight	Increment: 5, Flight: UF2
Plot Type	interval RMS

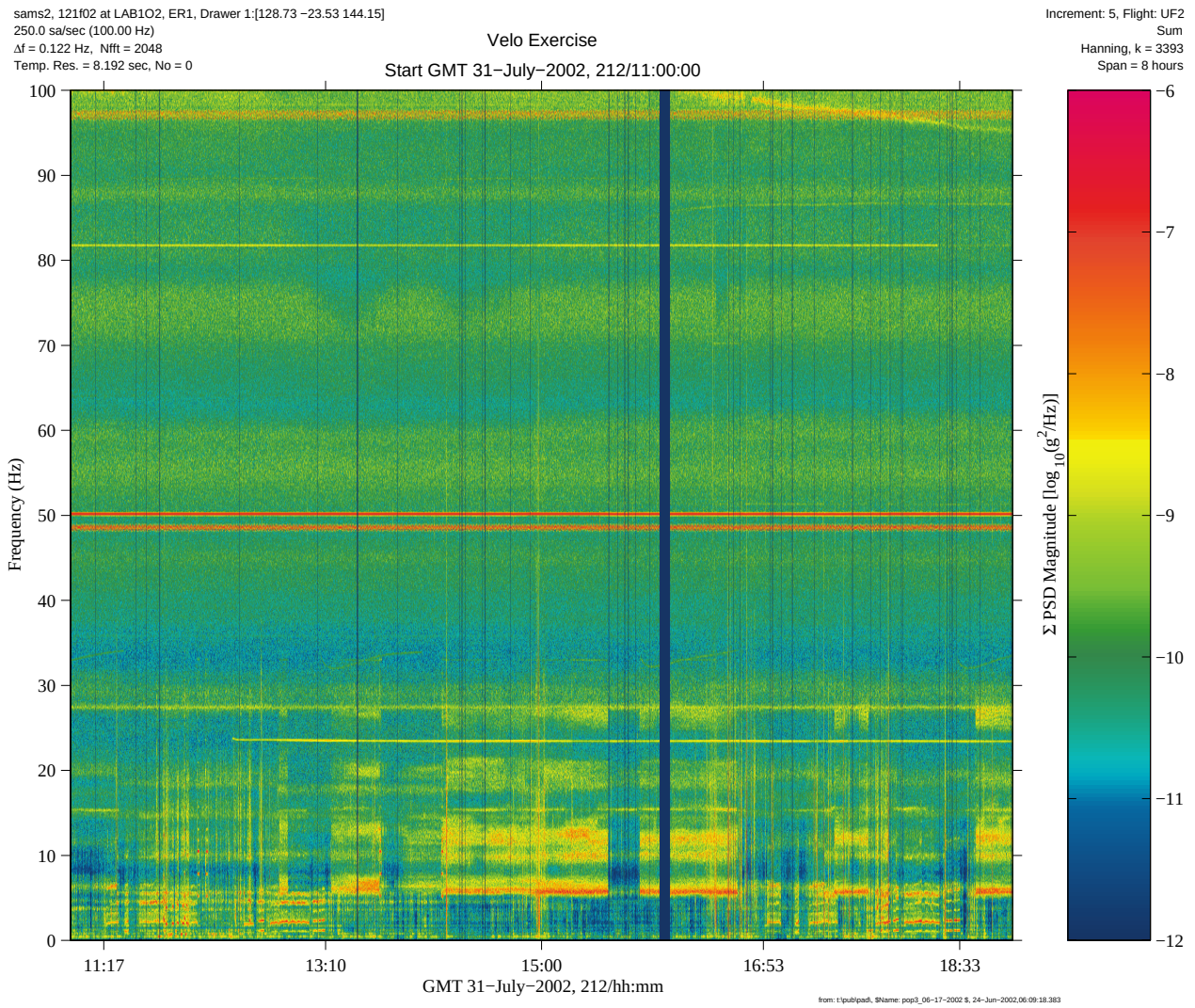
Notes:
The plot shows interval RMS values during a 64-hour period for the frequency band below 6 Hz. This is the portion of the acceleration spectrum that shows contrast between crew sleep and wake periods. Statistics gathered for this time frame show:

SLEEP
- 95th percentile: 25.8 μg_{RMS}
- **median: 8.4 μg_{RMS}**
- mean: 11.2 μg_{RMS}

WAKE
- 95th percentile: 123.6 μg_{RMS}
- **median: 34.9 μg_{RMS}**
- mean: 46.0 μg_{RMS}

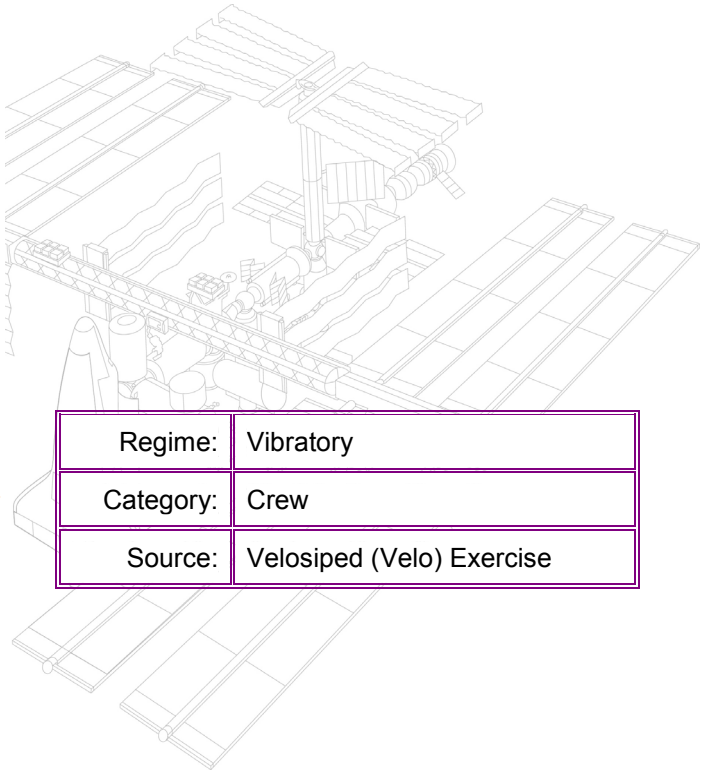
Regime:	Vibratory
Category:	Crew
Source:	Sleep/Wake

Velosiped (Velo) Exercise
QUALIFY



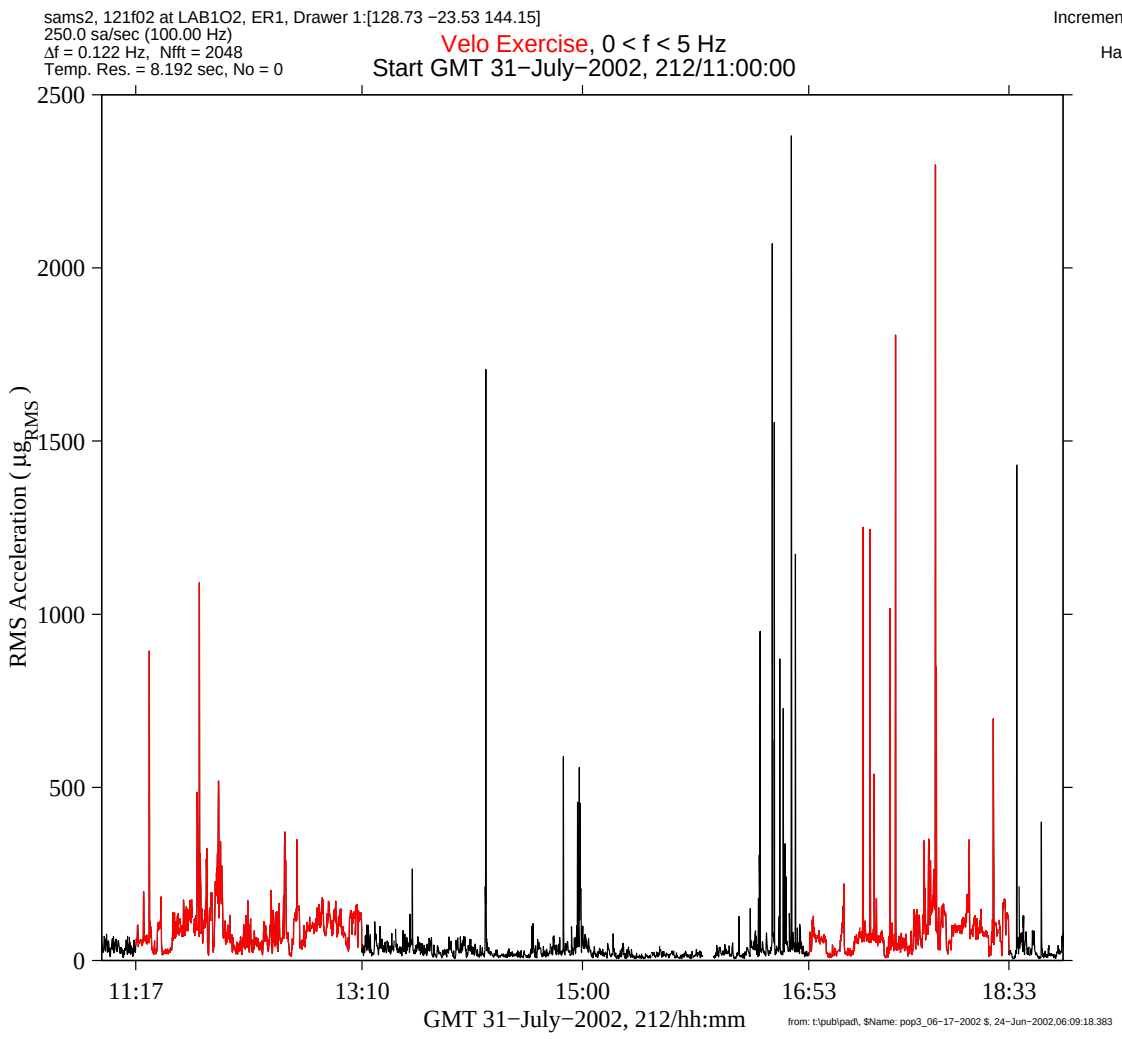
Data Description	
Sensor	121f02 250.0 sa/sec (100.00 Hz)
Location	LAB1O2, ER1, Drawer 1
Inc/Flight	Increment: 5, Flight: UF2
Plot Type	spectrogram

Notes:
The abbreviation velo is short for velosiped, a Russian bicycle exercise device – the abbreviation velo is to velosiped like bike is to bicycle. Two distinct periods that show velo exercise are seen in the figure below about 5 Hz from 11:17 to 13:10 and from 16:53 to 18:33. For these periods, both the pedal rate signature at about 2.2 Hz and the shoulder sway at half that rate are evident.



Regime:	Vibratory
Category:	Crew
Source:	Velosiped (Velo) Exercise

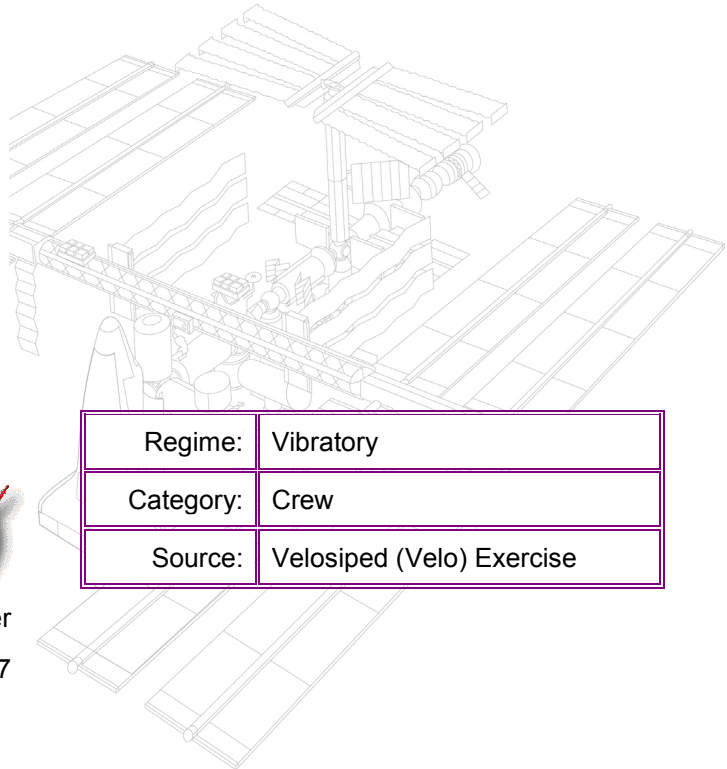
Velosiped (Velo) Exercise
QUANTIFY



Data Description	
Sensor	121f02 250.0 sa/sec (100.00 Hz)
Location	LAB1O2, ER1, Drawer 1
Inc/Flight	Increment: 5, Flight: UF2
Plot Type	interval RMS

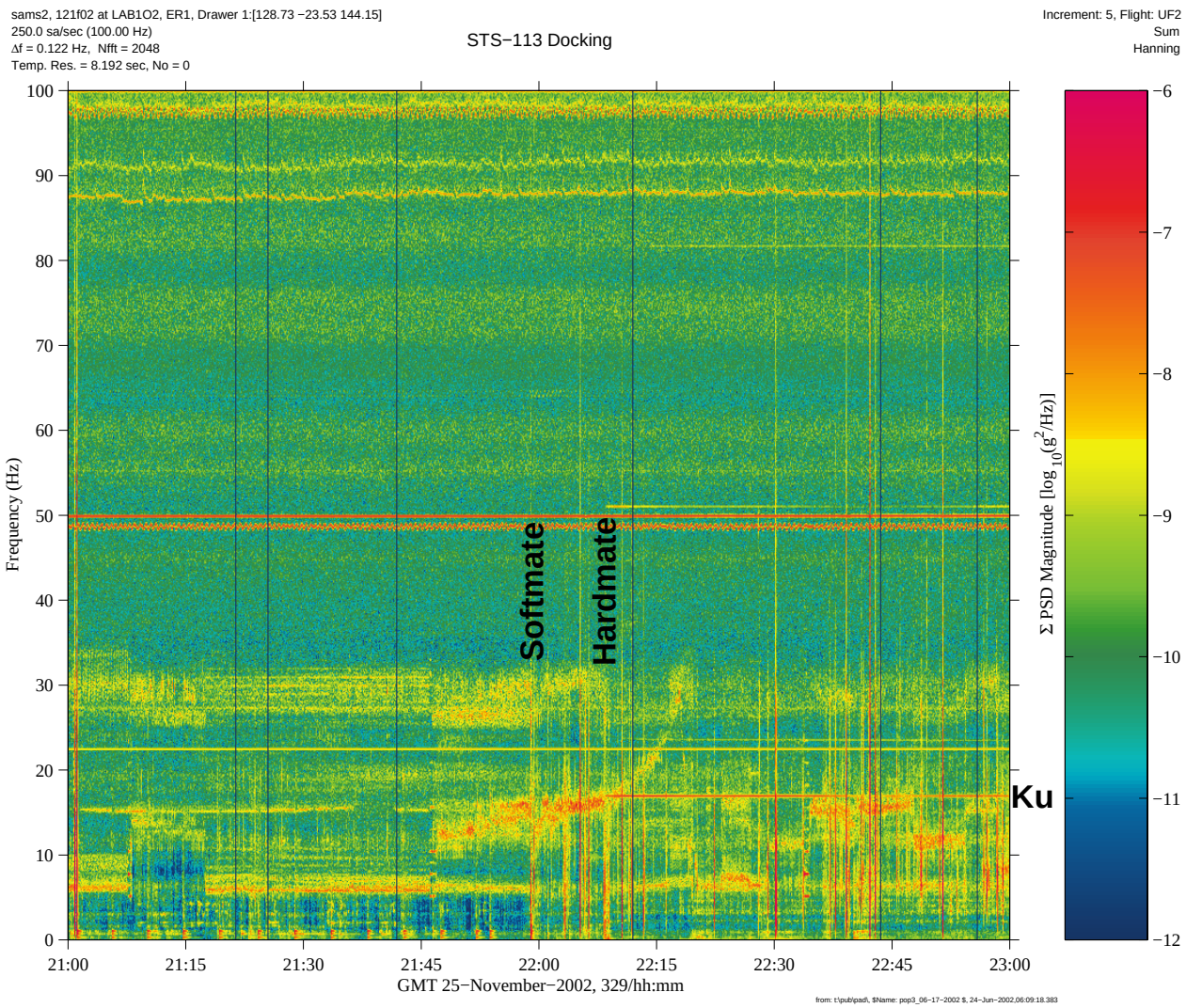
Notes:
This figure shows that the RMS acceleration values below 5 Hz during the velo exercise periods (shown in red) are noticeably above baseline for this 8-hour period. Statistics computed from these data show:

Velo exercise periods' median: 74.1 μg_{RMS}
Non-velo median: 23.8 μg_{RMS}



Regime:	Vibratory
Category:	Crew
Source:	Velosiped (Velo) Exercise

Shuttle Docking
QUALIFY



Data Description	
Sensor	121f02 250.0 sa/sec (100.00 Hz)
Location	LAB1O2, ER1, Drawer 1
Inc/Flight	Increment: 5, Flight: UF2
Plot Type	spectrogram

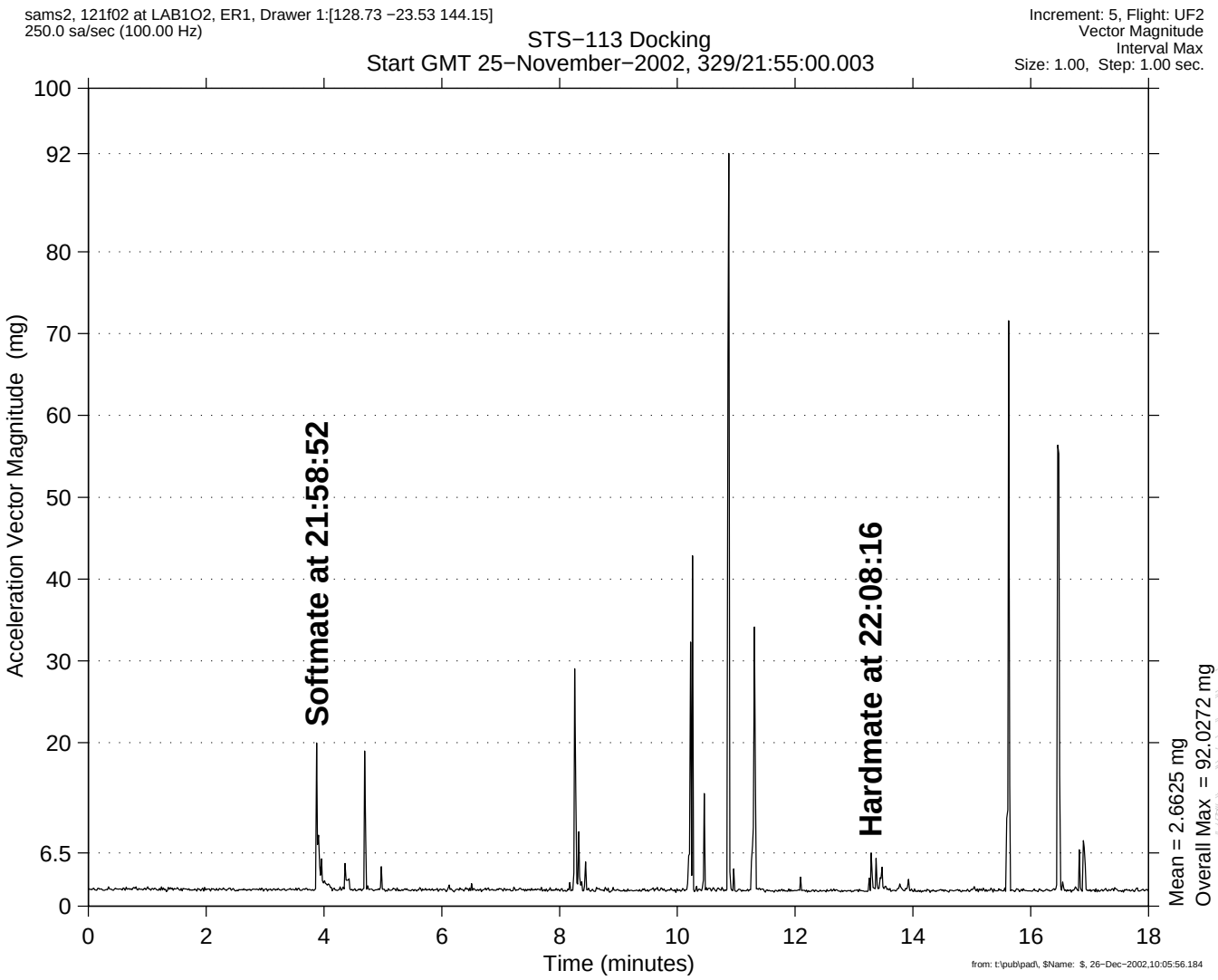
Notes:
The Shuttle docks at the forward end of the US Lab to a Pressurized Mating Adapter (PMA-2). Initial contact is referred to as "softmate" even though its impact is typically greater in magnitude than the "hardmate" event. A typical Shuttle docking is as follows:

(1) initial contact and capture (softmate)
(2) pause several minutes to let relative motion between the two spacecraft damp out
(3) drive latches to make solid mechanical connection (hardmate)

Upon completion of the hardmate, the two spacecraft effectively become one structure from a vibratory acceleration transmission perspective. This is usually evidenced by measurements made on the space station, which show the signature of the Shuttle's Ku-band antenna. This antenna is nearly continuously dithered at 17 Hz to prevent mechanical stiction and usually is accompanied by higher harmonics (most notably 34 and 51 Hz).

Regime:	Vibratory
Category:	Vehicle
Source:	Shuttle Docking

Shuttle Docking
QUANTIFY



Data Description	
Sensor	121f02 250.0 sa/sec (100.00 Hz)
Location	LAB1O2, ER1, Drawer 1
Inc/Flight	Increment: 5, Flight: UF2
Plot Type	interval max

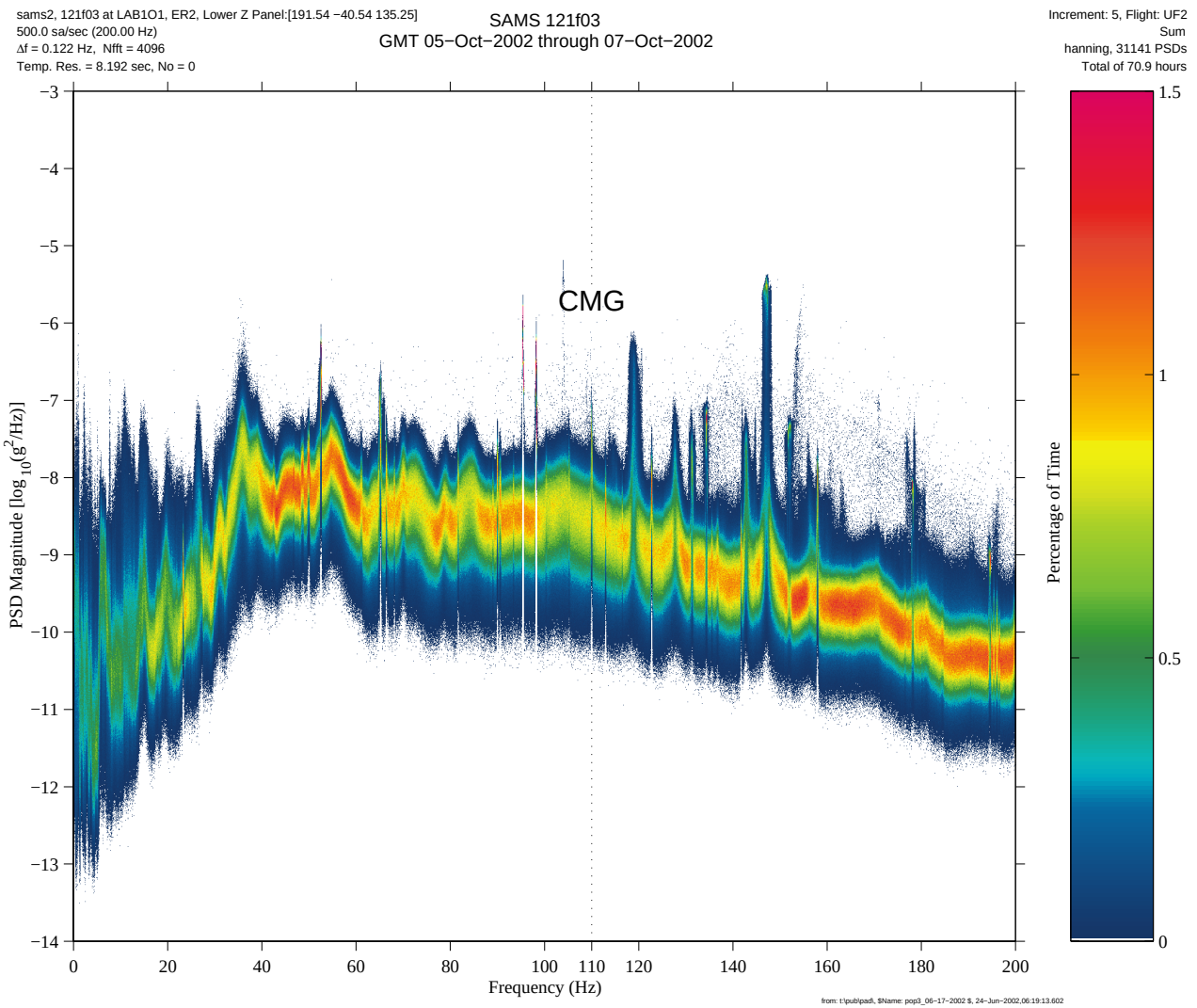
Notes:
The 1-second interval max plot is annotated to show the STS-113 Shuttle docking sequence:

(1) initial contact and capture at about the 4-minute mark; **softmate: 20 mg**
(2) pause about 10 minutes to allow the relative motion between the two spacecraft dampen out
(3) drive latches to make solid mechanical connection; **hardmate: 6.5 mg**

This interval max plot also shows that other impulsive events can dwarf the primary docking impact events. In this case, a peak acceleration of about 92 mg took place between the softmate and hardmate events.

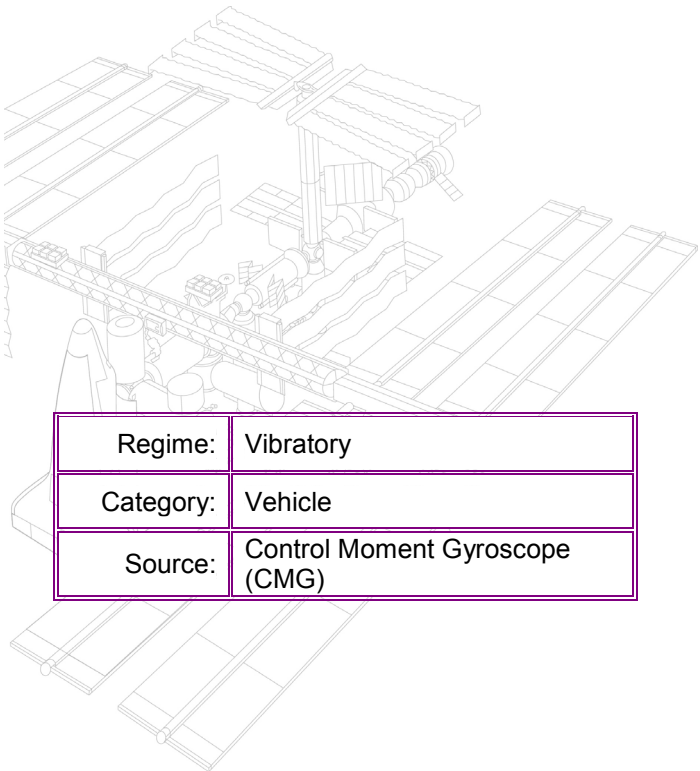
Regime:	Vibratory
Category:	Vehicle
Source:	Shuttle Docking

Control Moment Gyroscope (CMG)
QUALIFY



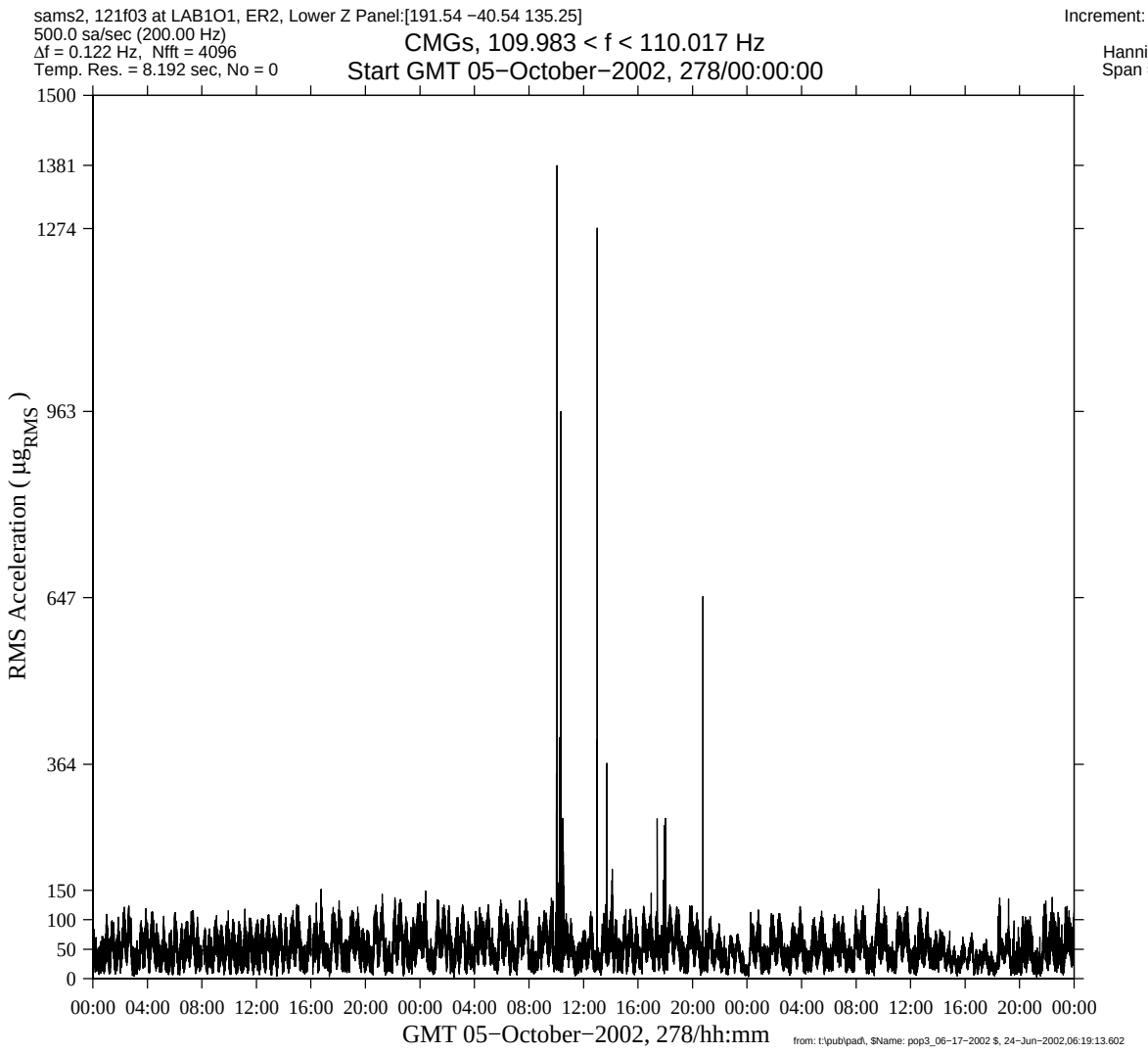
Data Description	
Sensor	121f03 500.0 sa/sec (200.00 Hz)
Location	LAB1O1, ER2, Lower Z Panel
Inc/Flight	Increment: 5, Flight: UF2
Plot Type	PCSA

Notes:
There are 4 control moment gyroscopes (CMGs) located on the Z1 truss structure (currently, only 3 are operational). These rotate at 6,600 revolutions per minute (RPM) within 1 RPM (1/60 Hz) to provide non-propulsive attitude control for the space station. The principal component spectral analysis (PCSA) plot at the left summarizes the acceleration spectrum for a 3-day span. As seen by the narrow spectral peak at 110 Hz, these gyros are tightly controlled in frequency.



Regime:	Vibratory
Category:	Vehicle
Source:	Control Moment Gyroscope (CMG)

Control Moment Gyroscope (CMG)
QUANTIFY



Data Description	
Sensor	121f03 500.0 sa/sec (200.00 Hz)
Location	LAB1O1, ER2, Lower Z Panel
Inc/Flight	Increment: 5, Flight: UF2
Plot Type	interval RMS

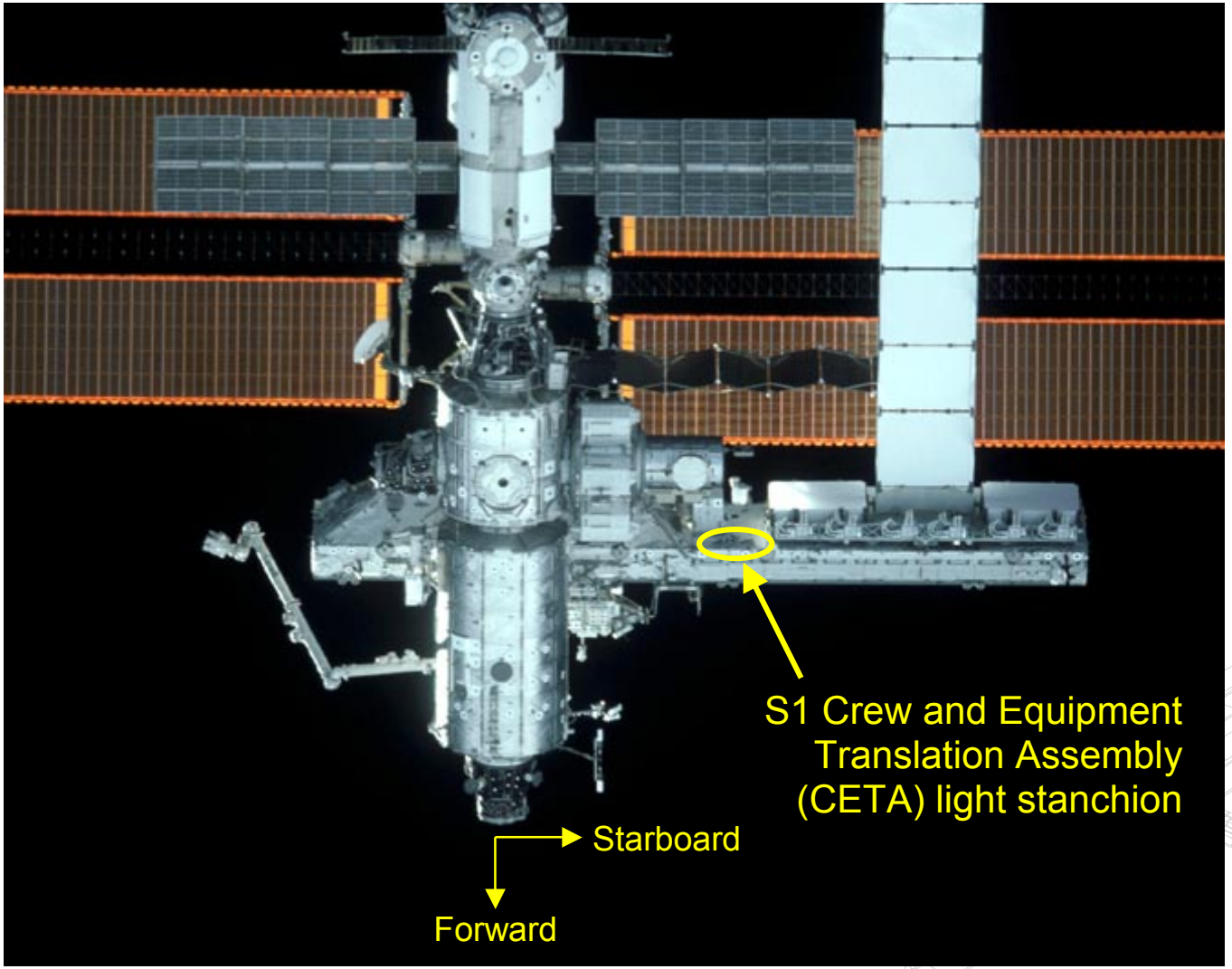
Notes:
The plot shows interval RMS values during a 3-day period for a narrow frequency band (109.983 to 110.071 Hz) around the CMG operating frequency (110 Hz). Statistics gathered for this time frame show:

95th percentile:	94.9 μg_{RMS}
median:	47.7 μg_{RMS}
mean:	50.9 μg_{RMS}

This plot also shows that this small frequency band will also register much higher RMS levels not necessarily attributable to nominal operation of the CMGs.

Regime:	Vibratory
Category:	Vehicle
Source:	Control Moment Gyroscope (CMG)

Hammer Taps To Remove S1 CETA Light Stanchion Qualify

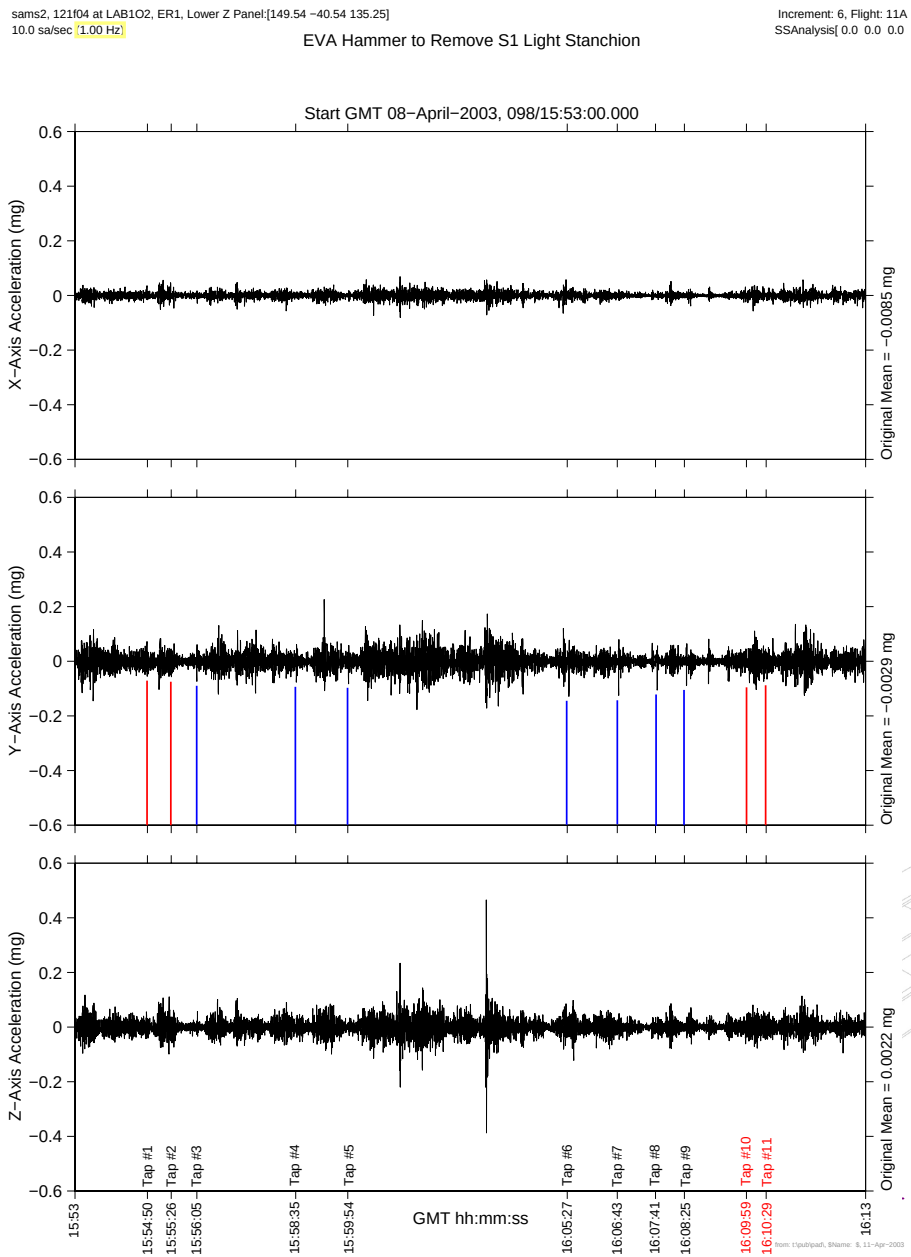


Data Description	
Sensor	SAMS 121f04 10.0 sa/sec (1.00 Hz)
Location	LAB1O2, ER1, Lower Z Panel
Inc/Flight	Increment: 6, Flight: 11A
Plot Type	

Notes:
During the extravehicular activity (EVA) on GMT 08-April-2003, the Expedition 6 crew successfully freed the light stanchion of the S1 crew and equipment translation assembly (CETA) railcart. This stanchion had remained stuck after an aborted light installation during the first stage EVA and had to be removed by tapping it 11 times with a Russian hammer. Predictions indicated that these hammer blows might impart significant transient accelerations.

Regime:	Vibratory
Category:	Crew
Source:	Hammer Taps During EVA

Hammer Taps To Remove S1 CETA Light Stanchion Quantify

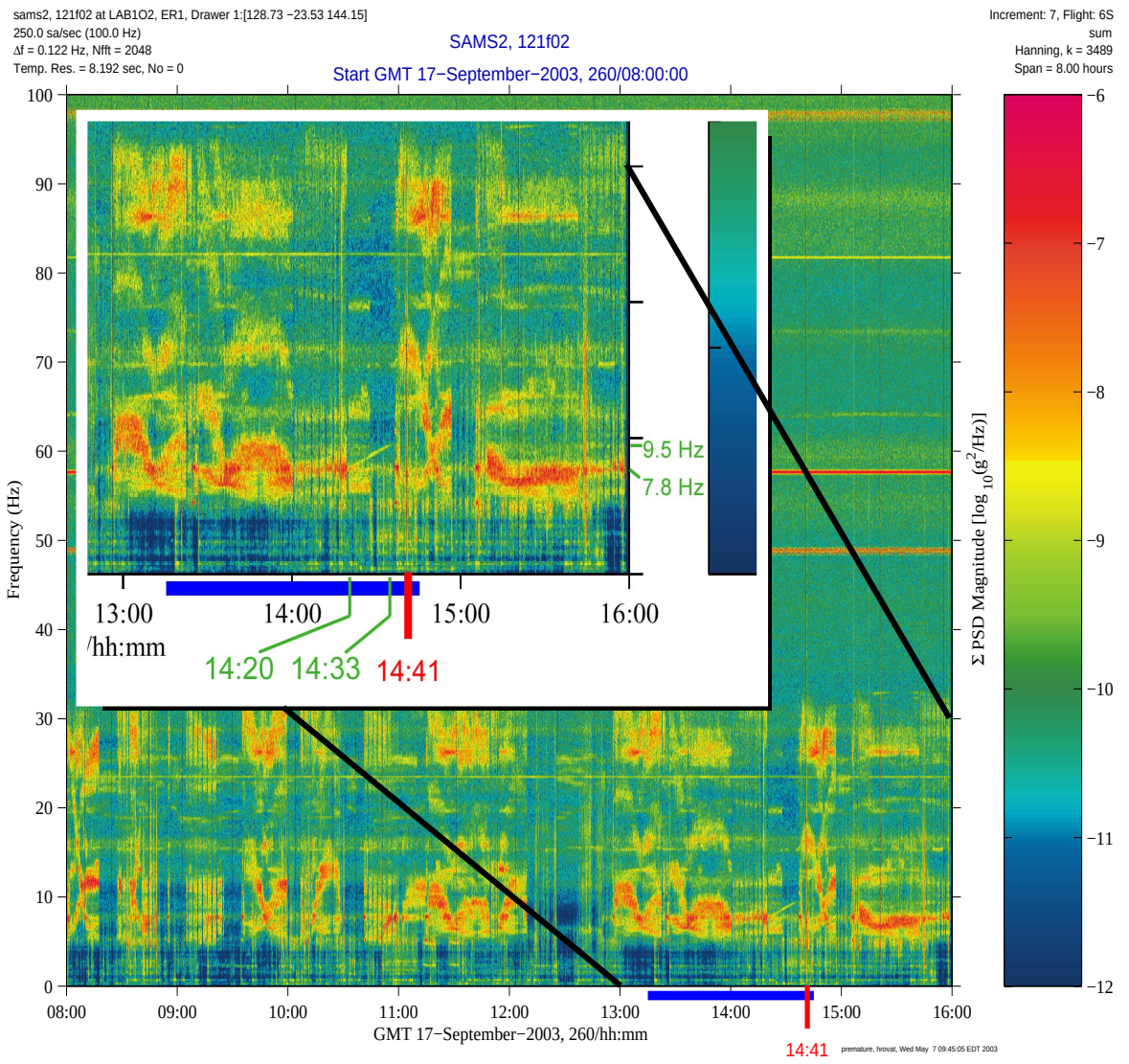


Data Description	
Sensor	SAMS 121f04 10.0 sa/sec (1.00 Hz)
Location	LAB1O2, ER1, Lower Z Panel
Inc/Flight	Increment: 6, Flight: 11A
Plot Type	time series

Notes:
This figure shows SAMS data that has been lowpass filtered at 1 Hz, which is well below the nominal cutoff frequency. This filtering was done in order to more clearly show the impact of the hammer taps on the vibratory environment at the Z-panel of the EXPRESS rack 1 location. The long blue ticks on the Y_A-axis plot show positive correlation between times of hits from taps #3 through #9 with small, transient accelerations aligned with the Y_A-axis. Polarity of the SAMS data is such that these small, negative accelerations are in the station starboard direction. For these 1 Hz lowpass filtered data, the largest acceleration attributable to these hammer taps was #6, the one that occurred at GMT 16:05:27 with a magnitude of about 0.13 mg. The last 2 time ticks are shown on the bottom axis in red due to ambivalent timeline information.

Regime:	Vibratory
Category:	Crew
Source:	Hammer Taps During EVA

Hand Posture Analyzer (HPA)
Qualify

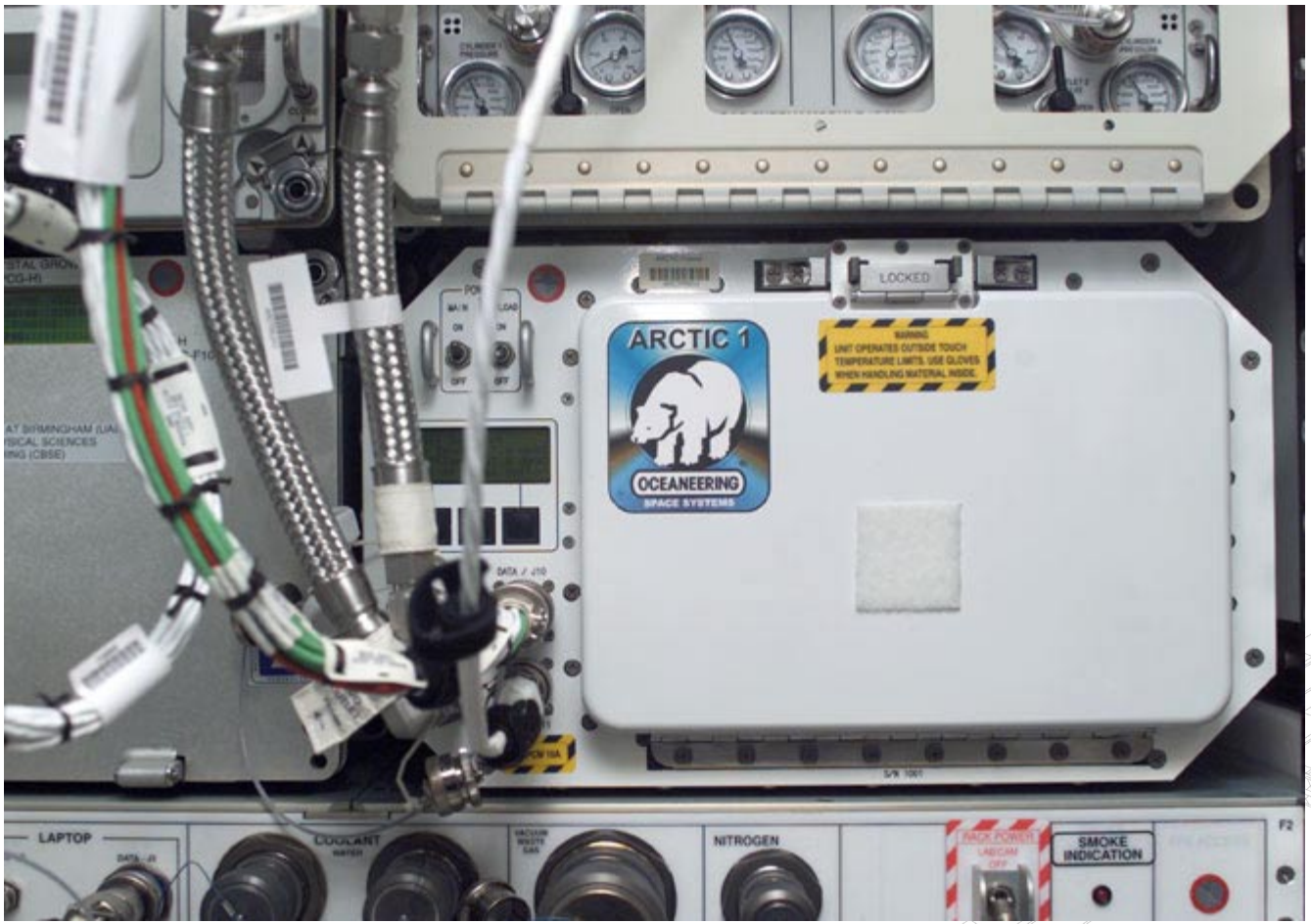


Data Description	
Sensor	SAMS 121f02 250.0 sa/sec (10.0 Hz)
Location	LAB1O2, ER1, ER1 Drawer 1
Inc/Flight	Increment: 7 Flight: 6S
Plot Type	spectrogram

Notes:
According to the on-orbit satus report for GMT 17-Sep-2003, “Ed Lu performed the Hand Posture Analyzer (HPA) experiment for the first time, using the posture acquisition glove (PGA). Since it has delicate sensors attached to the tops of the fingers, pressure should only be applied to the "palm side" while donning and doffing. The research objective of the ASI/Italy (Kayser Co.) designed HPA is to investigate the performance degradation of the human upper limb muscle-skeletal apparatus and its morphological-functional modifications during long term exposition to zero-G and to study the role of gravity in the planning and execution hierarchy of reaching, grasping, manipulating and transporting objects. The HPA facility consists of a Hand Grip Dynamometer (HGD), a Pinch Force Dynamometer (PFD), the instrumented PAG with 15 degrees of freedom, allowing the measurement of the bending angles on individual phalanxes, coupled to a Wrist Electronic Box (WEB) housing an inertial tracking system in order to acquire tri-axial acceleration and rotation of the forearm.” No positive identification of these equipment manifest in the vibratory acceleration data collected in the US Lab has been made yet. This figure (particularly the inset), however, shows a distinct signal near the end of the scheduled time for these operations. The signal ramped from 7.8 to 9.5 Hz between 14:20 and 14:33 as annotated in this figure. The vertical red hash at 14:41 marks a relatively strong transient near the end of scheduled operations.

Regime:	Vibratory
Category:	Crew
Source:	Hand Posture Analyzer (HPA)

Advanced Thermoelectric Refrigerator/Freezer/Incubator (ARCTIC) Qualify



ARCTIC freezer installed in EXPRESS Rack 4 following arrival on STS-110 (photographed April 17, 2002).

Data Description	
Sensor	
Location	
Inc/Flight	
Plot Type	

Notes:
The Advanced Thermoelectric Refrigerator/Freezer/Incubator (ARCTIC) is used for storing biological samples in a thermally-controlled environment on the International Space Station before they are returned to Earth for scientific analyses. The ARCTIC can also be used for storing perishable items and reagents. The ARCTIC freezer is a thermoelectric device that requires continuous and auxiliary power. It receives water and air cooling from the EXPRESS rack. ARCTIC 1 and 2 are scheduled to remain on Station and will only be powered up when needed. The crew will activate the freezers, insert and remove samples as needed, and perform weekly system health checks. Correspondence with hardware developers indicate that this thermoelectric device has no moving parts, so that nominal operation does not introduce any acceleration disturbance. Examination of SAMS data during activation and deactivation times for the ARCTIC support this assertion.

Regime:	Vibratory
Category:	Experiment Equipment
Source:	Advanced Thermoelectric Refrigerator/Freezer/Incubator (ARCTIC)

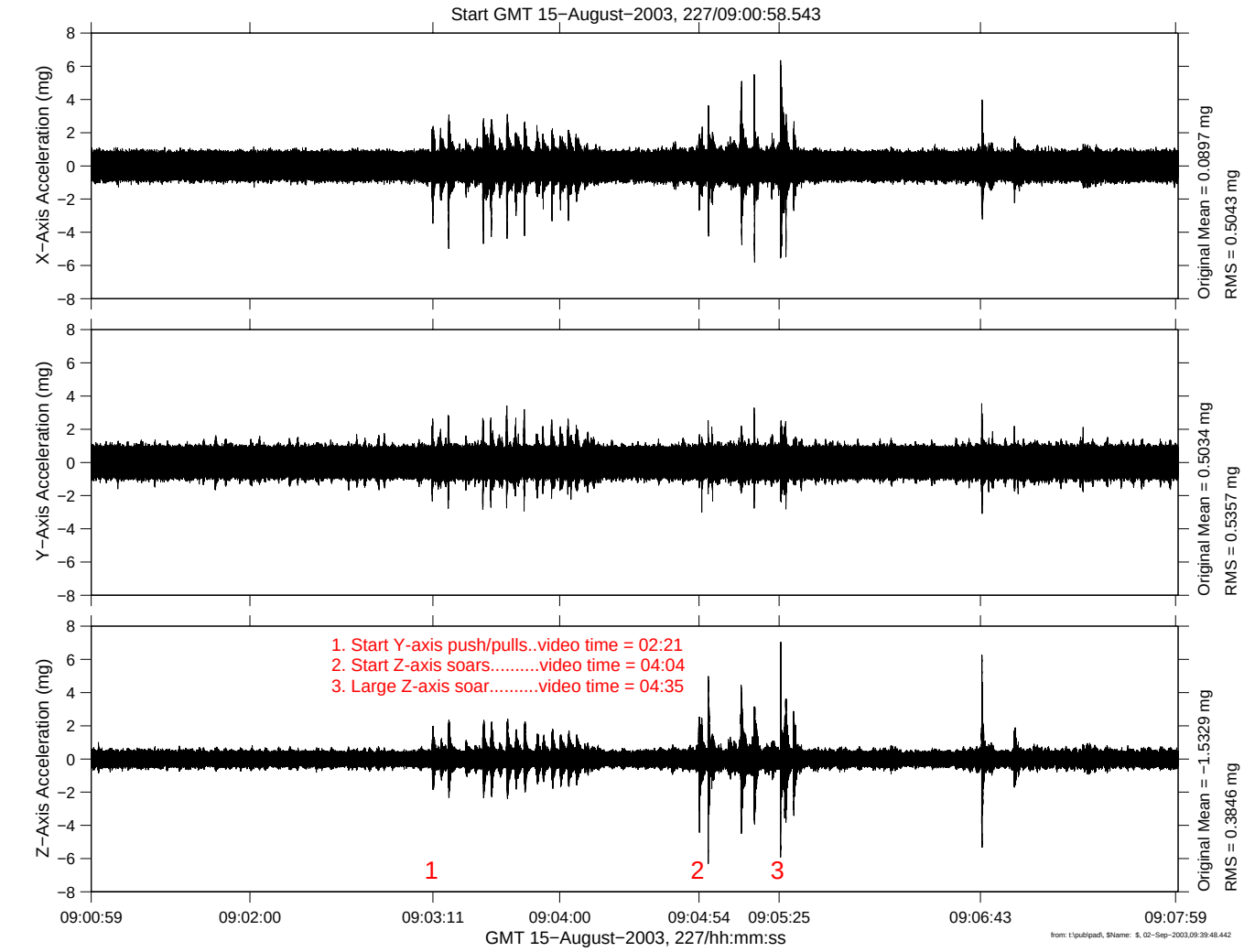
Crew Pushoff/Landing Qualify

Data Description	
Sensor	MAMS HiRAP 100.0 sa/sec (1000.00 Hz)
Location	LAB1O2, ER1, Lockers 3,4
Inc/Flight	Increment: 7 Flight: 6S
Plot Type	

Notes:
In support of an experiment called Pore Formation and Mobility Investigation (PFMI), Ed Lu took about 7 minutes to perform several push/pulls at the MSG handrail along with pushoffs and landings near the Microgravity Science Glovebox (MSG). The objective was to ascertain the ability of the MAMS HiRAP sensor in ER1 (LAB1O2) to detect accelerations that might affect the PFMI and other experiments in the MSG. The handrail used for the push/pull test is just forward of the MSG location in LAB1S3, while the pushoffs and landings were primarily between deck and overhead racks near the MSG (between LAB1D2 and LAB1O2). The figure shown here is a screenshot of video obtained from the JSC that shows the complete test by Expedition 7 crew member, Ed Lu.

Regime:	Vibratory
Category:	Crew
Source:	Pushoff/Landing

Crew Pushoff/Landing Quantify

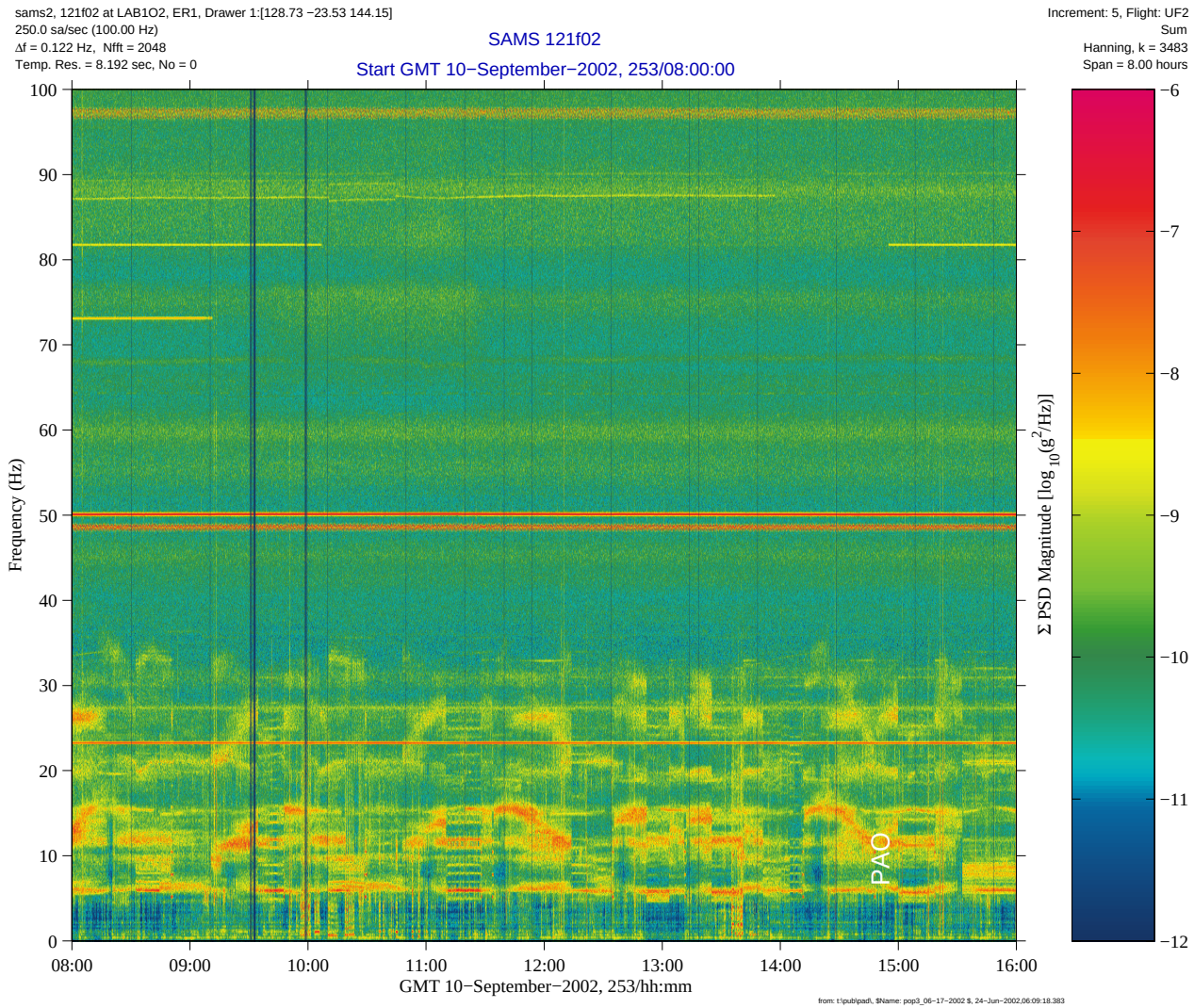


Data Description	
Sensor	MAMS HiRAP 100.0 sa/sec (1000.00 Hz)
Location	LAB1O2, ER1, Lockers 3,4
Inc/Flight	Increment: 7 Flight: 6S
Plot Type	time series

Notes:
These tests performed by Ed Lu consisted of 20 push/pulls at the MSG handrail starting at about GMT 15-Aug-03, 227/09:03:11 (this time was MAMS recorded GMT, which was ahead of expected GMT by about 50 seconds). The peak acceleration vector magnitude was about 5 mg for the handrail push/pulls, while the set of 3 pushoff/landings that started at about GMT 15-Aug-03, 227/09:04:54 had a peak magnitude of just over 8 mg. This large transient came at GMT 15-Aug-03, 227/09:05:25. Close examination of the Z_A-axis data shows that pushoff/landing type of impacts tends to excite a structural mode at about 7.5 Hz. This resonance continues noticeably for a couple of seconds or so before subsiding. The PIMS team at the NASA GRC has archived a copy of the video that was shot for this test.

Regime:	Vibratory
Category:	Crew
Source:	Pushoff/Landing

Public Affairs Office (PAO) Event
QUALIFY

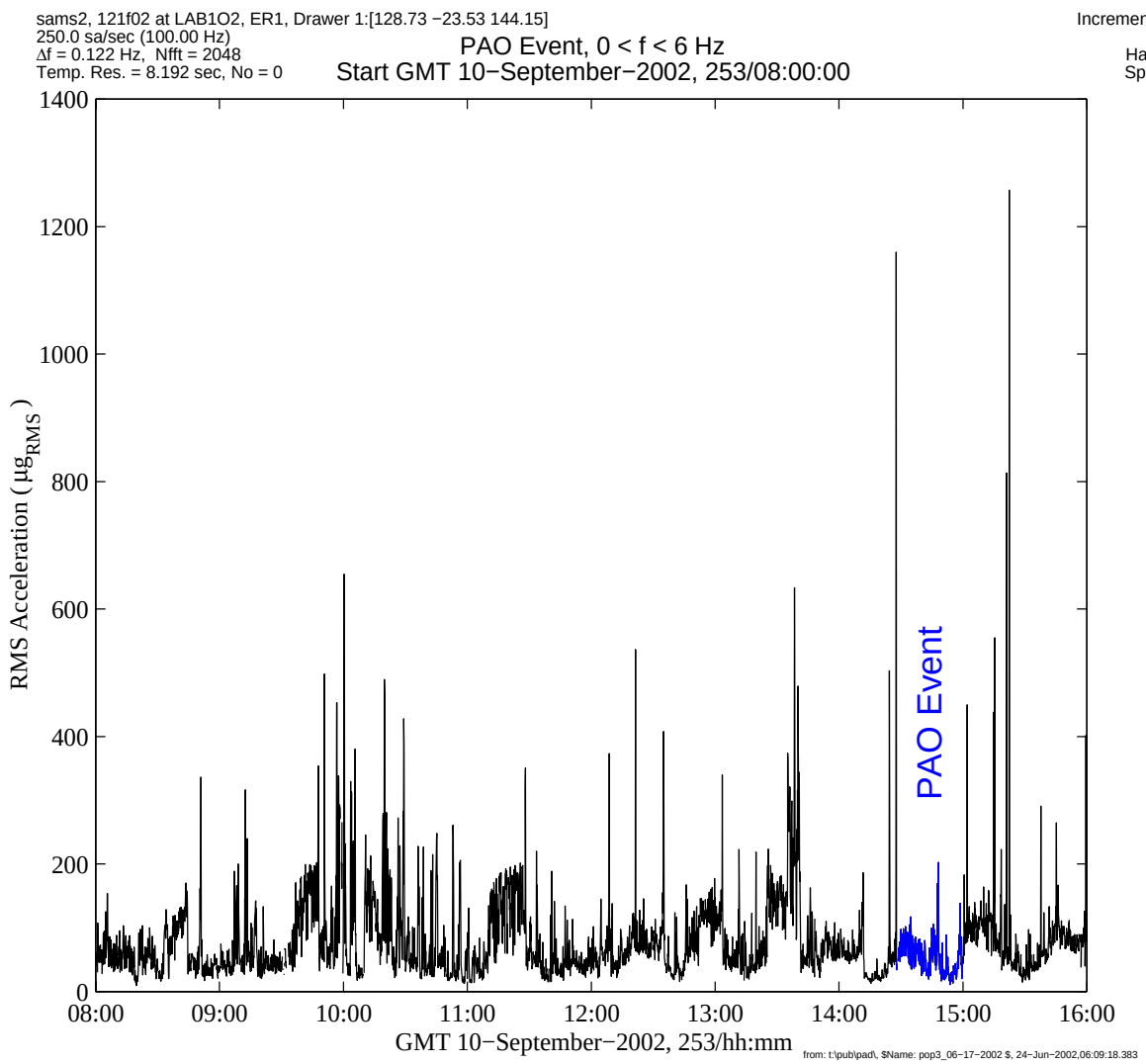


Data Description	
Sensor	121f02 250.0 sa/sec (100.00 Hz)
Location	LAB1O2, ER1, Drawer 1
Inc/Flight	Increment: 5, Flight: UF2
Plot Type	spectrogram

Notes:
For a microgravity environment that mimics crew sleep, one can consider PAO events that occupy the entire crew (note that some PAO events occupy only part of the crew). These events typically last at least 10 minutes or so with the crew gathered in front of a video camera participating in an interview. During this time the crew is usually quite still, but there are times when they demonstrate various things that require them to push-off or otherwise apply a force to vehicle structure. The figure here shows the subtle contrast between nominal activity and all 3 crew participating in a PAO event from about 14:45 to about 15:00. Like crew sleep the difference lies primarily below about 6 Hz.

Regime:	Vibratory
Category:	Crew
Source:	Public Affairs Office (PAO) Event

Public Affairs Office (PAO) Event
QUANTIFY



Data Description	
Sensor	121f02 250.0 sa/sec (100.00 Hz)
Location	LAB1O2, ER1, Drawer 1
Inc/Flight	Increment: 5, Flight: UF2
Plot Type	interval RMS

Notes:
This figure shows that the RMS acceleration values below 6 Hz during the PAO event are noticeably smaller than the rest of this 8-hour period. The RMS levels are typically about midway between the crew sleep and crew wake levels. Statistics gathered for this time frame show:

PAO Event median: 49.9 μg_{RMS}
Non-PAO median: 61.9 μg_{RMS}

Note that PAO durations (10 minutes or more) may be enough time for investigators to be opportunistic about scheduling certain autonomous or ground-commanded aspects of their experiment to be performed during this time, particularly for those sensitive below 6 Hz.

Regime:	Vibratory
Category:	Crew
Source:	Public Affairs Office (PAO) Event

Crew Pushoff/Landing During Public Affairs Office (PAO) Event Qualify

Data Description	
Sensor	
Location	
Inc/Flight	Increment: 7 Flight: 6S
Plot Type	

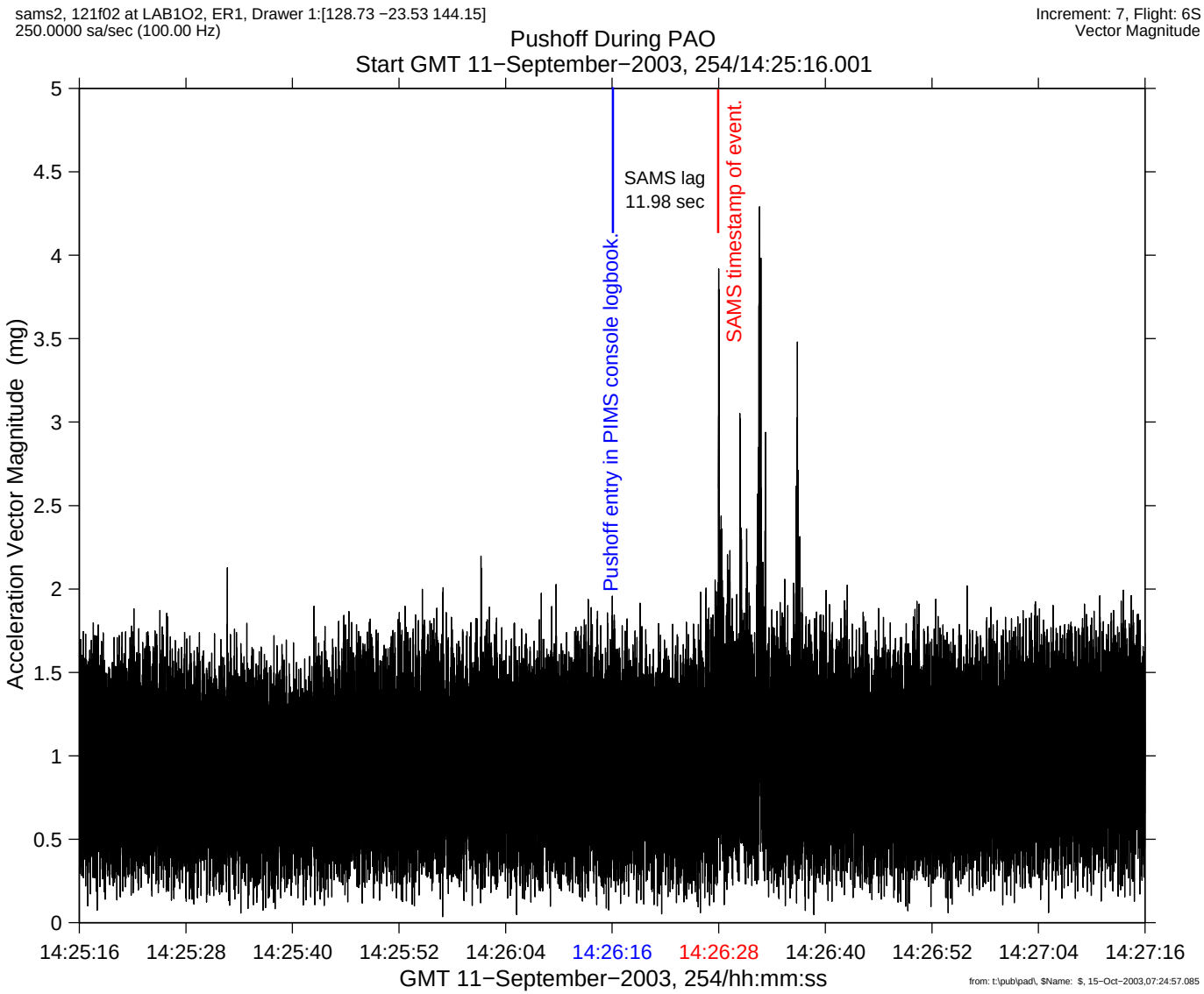



Leftmost frame shows that at GMT 11-Sep-03, 254/14:26:16, Yuri pushed off deck to start demonstration for students.

Notes:
In support of public outreach, Ed Lu and Yuri Malenchenko performed a Public Affairs Office (PAO) interview with KCAU-TV in Sioux City, Iowa. Upon request as part of the interview, Malenchenko performed a reduced-gravity demonstration for students in the audience. The snapshots at the left were taken from video recorded during this demonstration. The PAO event took place from GMT 11-Sep-03, 254/14:11:23 to 14:29:06. The field of view for the video was looking aft in the US Lab. SAMS sensors located in overhead racks toward the front of the US Lab recorded the accelerations experienced at those locations during this crew pushoff event. The PIMS console log maintained during this event showed this entry for the event: "In response to request from school student, at GMT 11-Sep-03, 254/14:26:16, Yuri pushed off deck with both legs and landed on ceiling (just aft of MSG), then pushed off ceiling back to deck all within a second or so."

Regime:	Vibratory
Category:	Crew
Source:	Pushoff/Landing

Crew Pushoff/Landing During Public Affairs Office (PAO) Event Quantify



Data Description	
Sensor	SAMS 121f02 250.0 sa/sec (100.00 Hz)
Location	LAB1O2, ER1, Drawer 1
Inc/Flight	Increment: 7 Flight: 6S
Plot Type	time series of vector magnitude

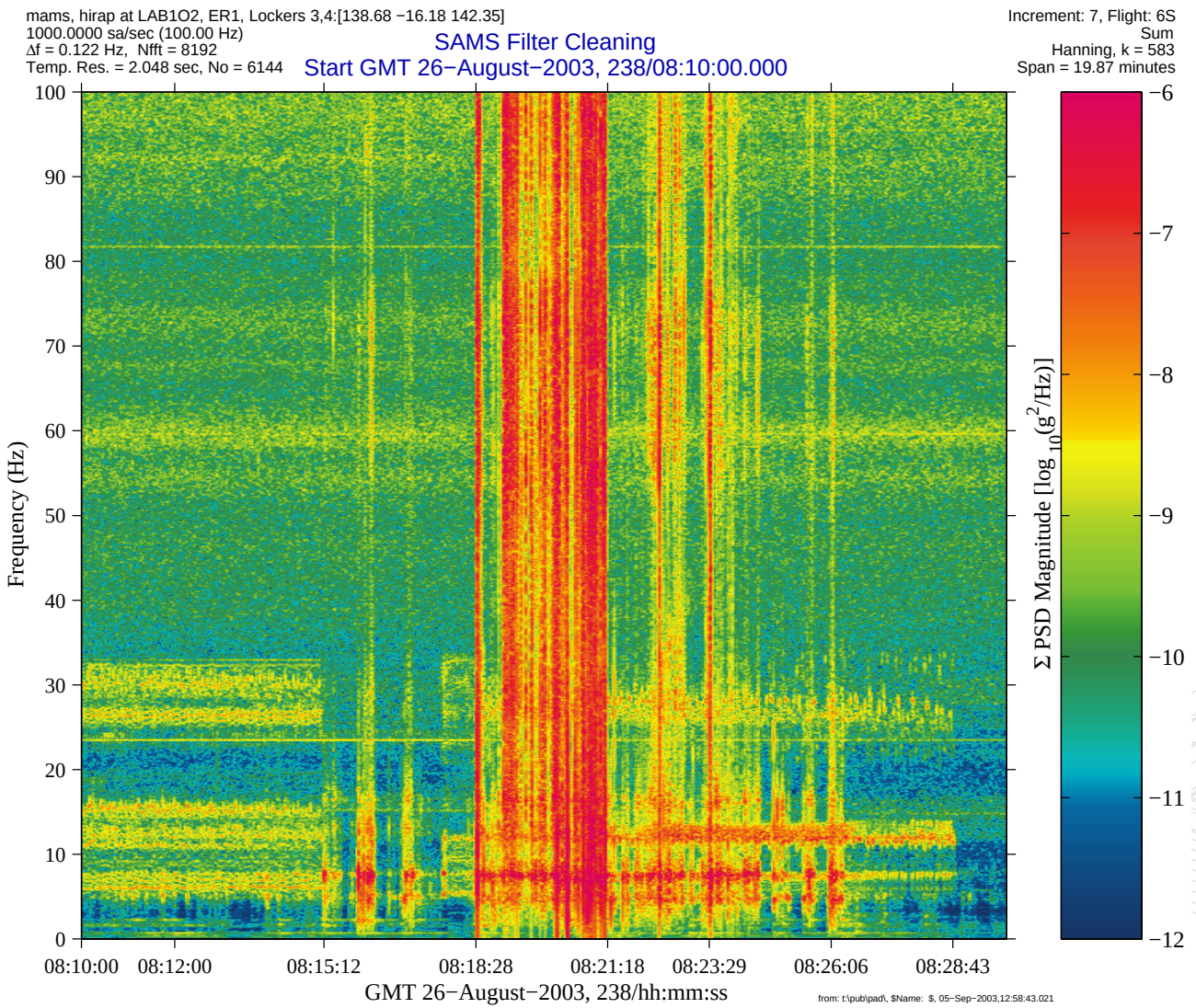
Notes:
The table below shows the maximum acceleration magnitude around the time of this event for all 4 active SAMS sensors. All sensors exhibit the lag cited in the figure shown for 121f02.

SENSOR	LOCATION	MAX (mg)
121f02 (100 Hz)	LAB1O2, ER1, Drawer 1	4.29
121f03 (200 Hz)	LAB1O1, ER2, Lower Z Panel	11.90
121f04 (200 Hz)	LAB1O2, ER1, Lower Z Panel	12.87
121f05* (100 Hz)	LAB1O1, ER2, Upper Z Panel	5.57

* The 121f05 sensor had a transient at same time as other sensors as shown in table, but this was not it's max for the event. It registered 10.39 mg at about GMT 11-Sep-2003, 14:26:31.

Regime:	Vibratory
Category:	Crew
Source:	Pushoff/Landing

SAMS Filter Cleaning
Qualify



Data Description	
Sensor	MAMS HiRAP 100.0 sa/sec (1000.00 Hz)
Location	LAB1O2, ER1, Lockers 3,4
Inc/Flight	Increment: 7 Flight: 6S
Plot Type	

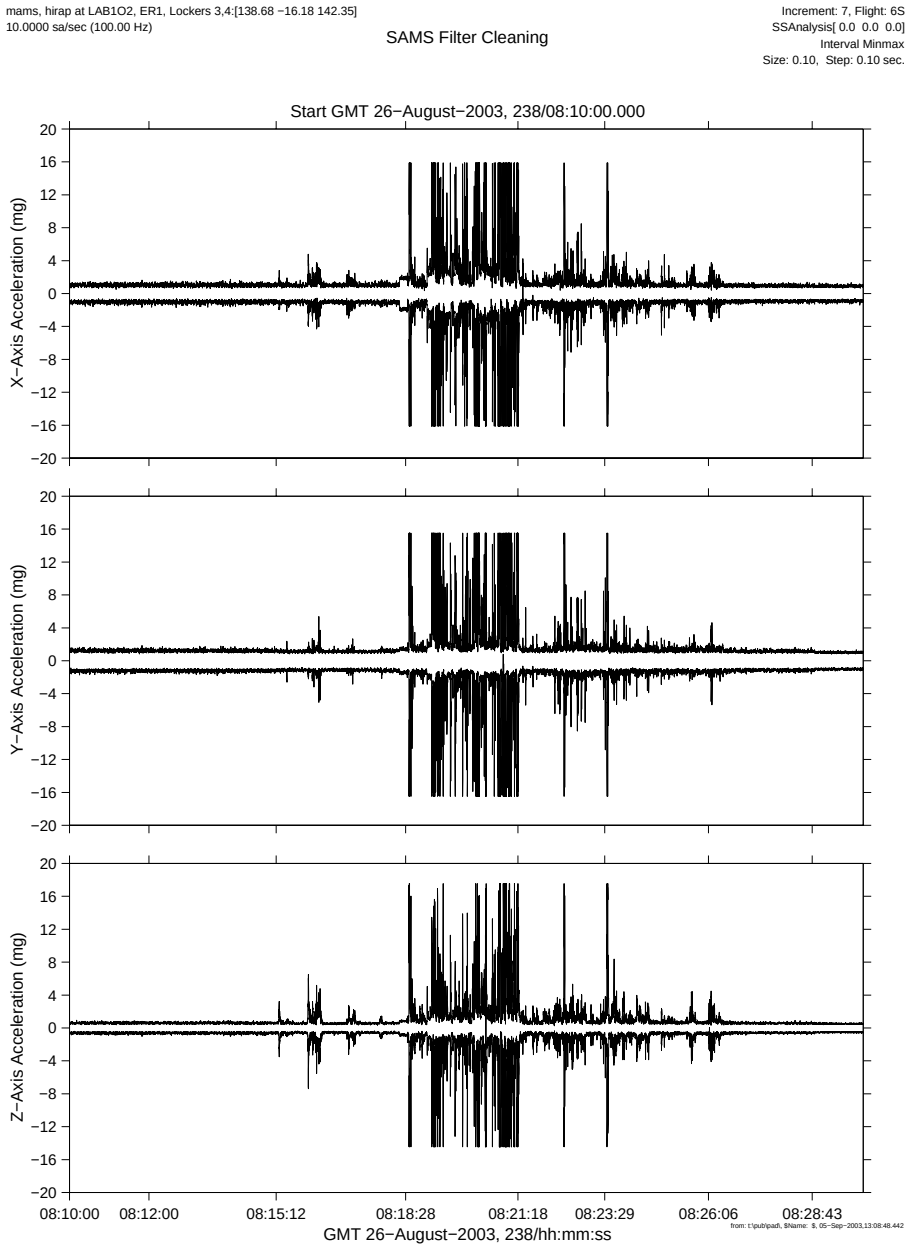
Notes:
Periodic SAMS drawer filter cleanings are required for maintenance and to help ensure ongoing vibratory acceleration measurement and data collection. During this activity, the normal course of events is as follows:

- ground command powers off all 3 drawers
- crew cleans filters on all 3 drawers during the same session by pulling each drawer out 5 or 8 inches and removing any debris with gray tape or the vacuum
- crew reinserts drawers and mates any cables that may have needed to be moved
- crew powers up interim control unit and laptop
- ground powers on RTS drawers

Since SAMS was powered off for this cleaning, the event had to be characterized by another accelerometer system. In this case, MAMS HiRAP was used.

Regime:	Transient
Category:	Crew
Source:	SAMS Filter Cleaning

SAMS Filter Cleaning
Quantify

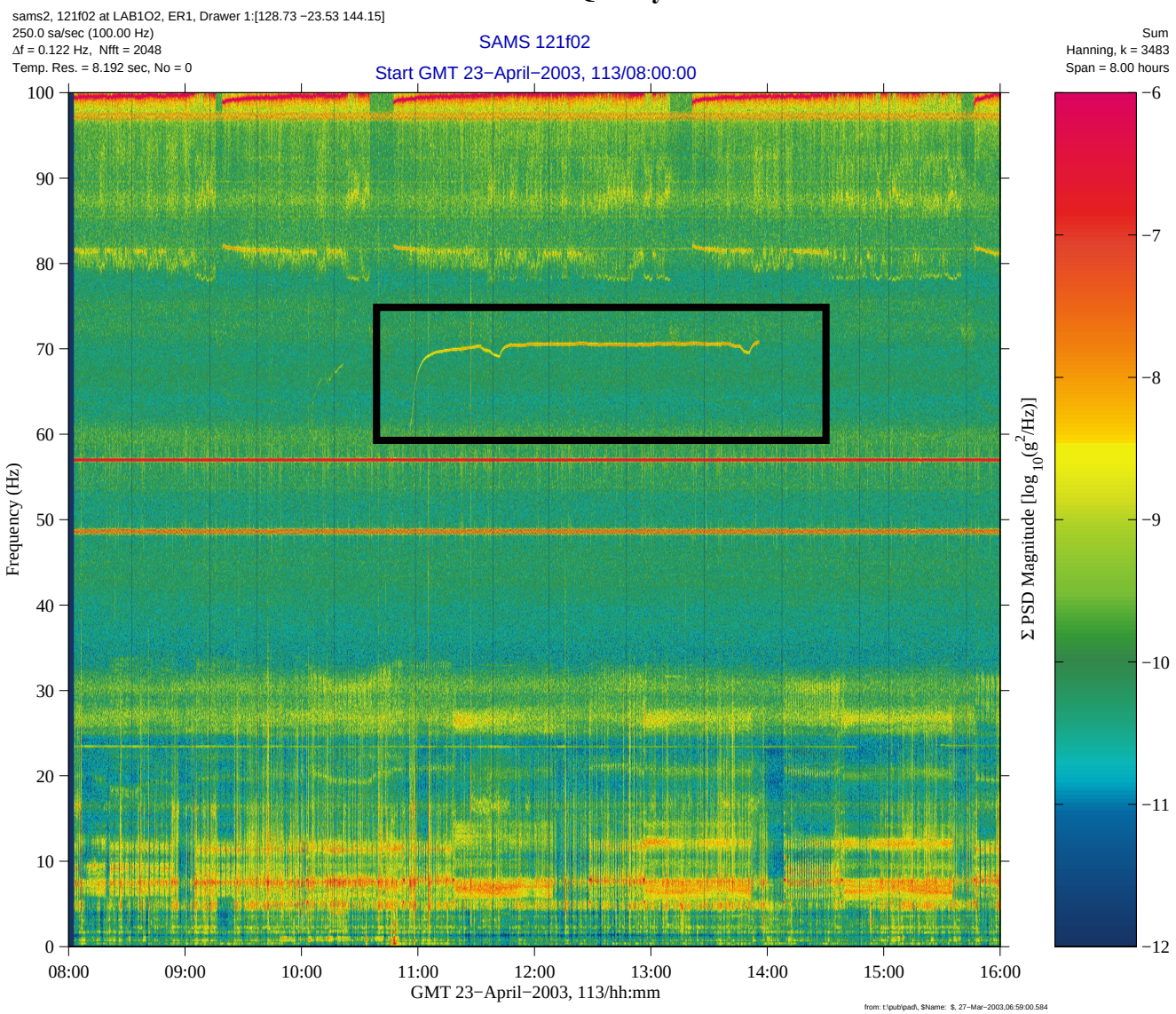


Data Description	
Sensor	MAMS HiRAP 100.0 sa/sec (1000.00 Hz)
Location	LAB1O2, ER1, Lockers 3,4
Inc/Flight	Increment: 7 Flight: 6S
Plot Type	interval min/max

Notes:
In order to perform SAMS filter cleanings, the crew can potentially introduce large transients into the acceleration environment. These impulsive accelerations take place over about 10 minutes, which is the nominal span of time required to do this maintenance. The 0.1-second interval min/max figure shown here was computed from MAMS HiRAP measurements made in the same rack (ER1) as the drawers that contain the SAMS filters. As a result, the accelerations recorded there were expectedly high. In fact, the MAMS HiRAP sensor was saturated at 16 mg (per-axis) and therefore acceleration vector magnitude excursions were greater than 27 mg. The dynamic range of the HiRAP sensors prohibited detection of how much above 27 mg those impulses actually were. Maintenance such as this SAMS filter cleaning can be coordinated with payload planners in an effort to mitigate the impact on nearby investigations.

Regime:	Transient
Category:	Crew
Source:	SAMS Filter Cleaning

Periodic Fitness Evaluation (PFE)
Qualify



Data Description	
Sensor	121f02 250.0 sa/sec (100.00 Hz)
Location	LAB1O2, ER1, Drawer 1
Inc/Flight	Increment: 6, Flight: 11A
Plot Type	spectrogram

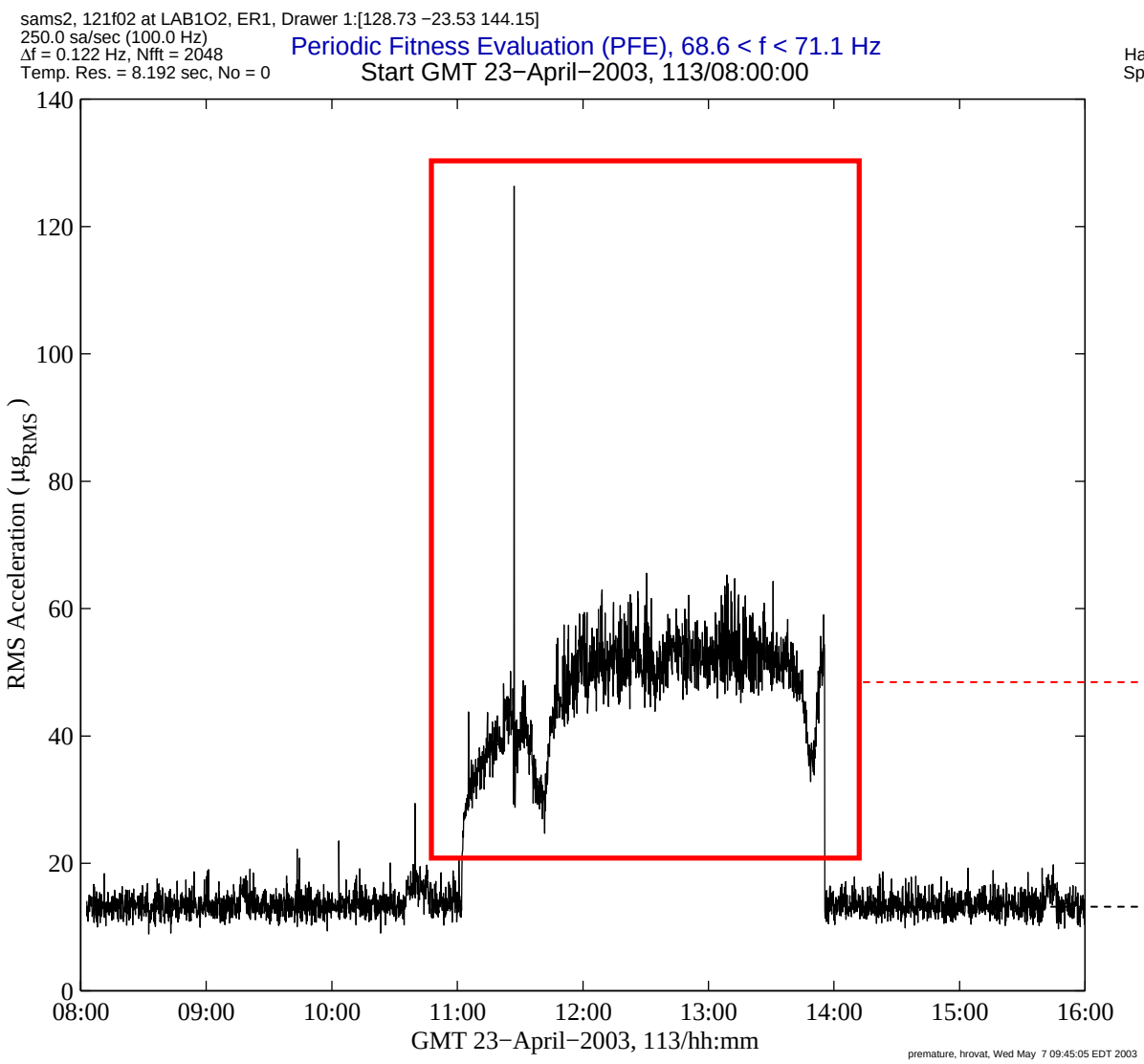
Notes:

There appears to be at least some tangential correlation between narrowband spectral peaks in the acceleration data and some equipment associated with PFE medical ops. For PFE sessions, the signature is prominent in SAMS 121f02 and MAMS HiRAP data, and to a lesser extent on the SAMS 121f05 sensor. The following observations are based on SAMS 121f02 data:

- GMT 037/06-Feb-03: Relatively strong narrowband signal at ~67 Hz from about 09:17-09:47 and from about 09:58-10:55; CDR 09:13-09:33, FE2 09:56-10:17 [maybe left equipment running after evaluation and remembered to turn it off at 10:55?].
- GMT 082/23-Mar-03: A strong narrowband signal at ~71 Hz (variable in frequency) from about 12:59 to 16:13.
- GMT 113/23-Apr-03: A strong narrowband signal at ~71 Hz (variable in frequency) appears from 10:56-13:55. This signature is shown in the black box of the spectrogram to the left.
- GMT 339/05-Dec-03: Relatively weak narrowband signal at ~56 Hz from about 12:32 to 16:31; CDR 12:50-13:10, FE2 13:34-13:54.

Regime:	Vibratory
Category:	Equipment
Source:	Periodic Fitness Evaluation (PFE)

Periodic Fitness Evaluation (PFE)
Quantify



49.6 μg_{RMS} during PFE

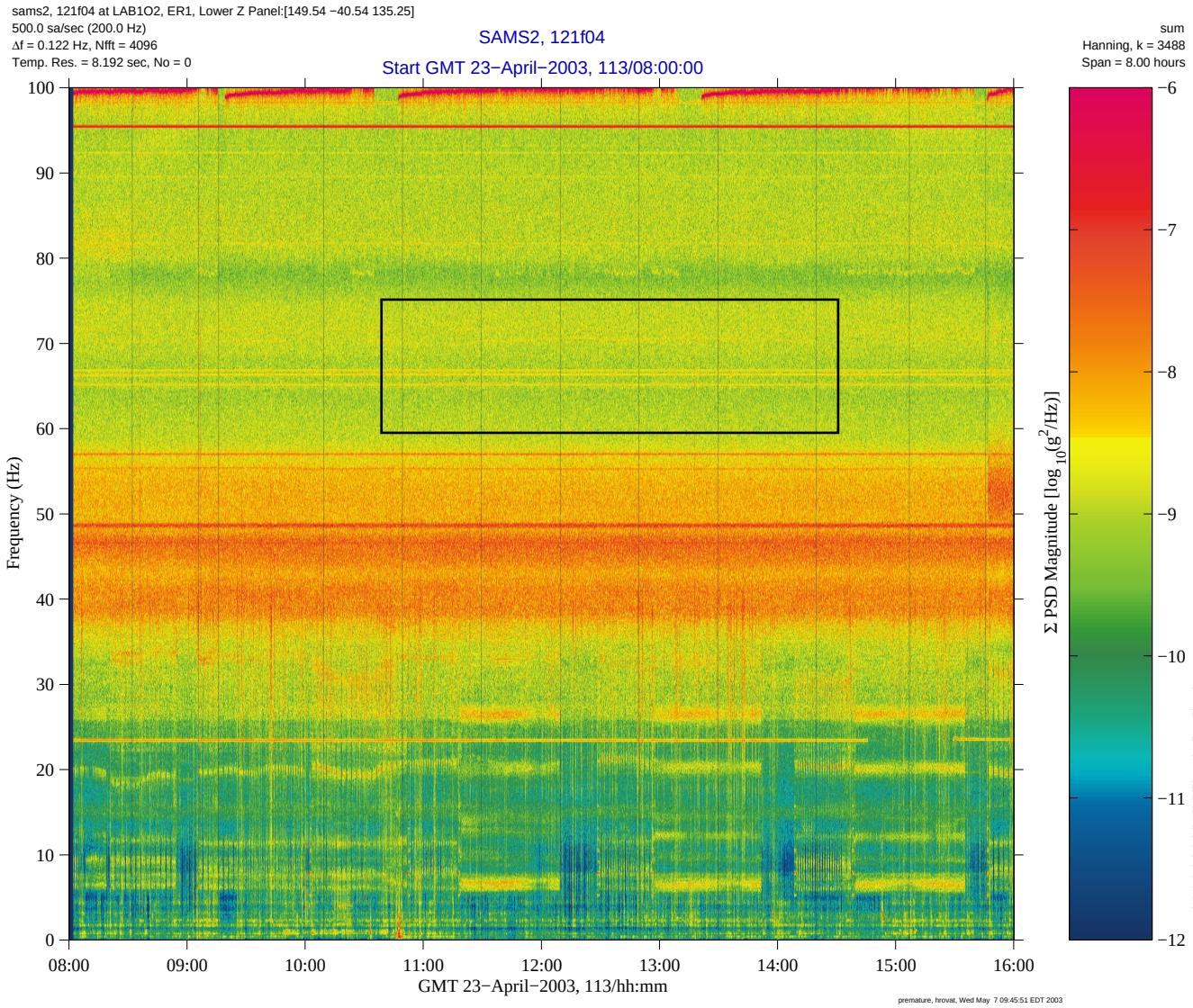
13.5 μg_{RMS} without PFE

Data Description	
Sensor	121f02 250.0 sa/sec (100.00 Hz)
Location	LAB1O2, ER1, Drawer 1
Inc/Flight	Increment: 6, Flight: 11A
Plot Type	Interval RMS

Notes:
For the PFE activity on GMT 113/23-Apr-03, the strong narrowband signal at ~71 Hz that appeared from 10:56-13:55 was analyzed and quantified in terms of the RMS level for the frequency band from 68.6 to 71.1 Hz The median RMS level calculated for the period shown in the interval RMS plot at the left was 13.5 μg_{RMS} when the PFE equipment was off, and 49.6 μg_{RMS} when the equipment was on (as marked by the red box).

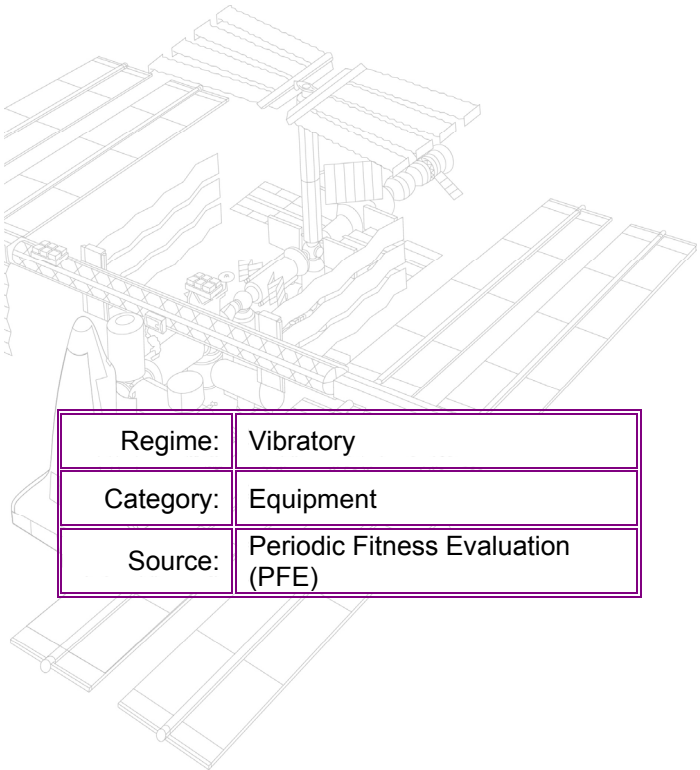
Regime:	Vibratory
Category:	Crew
Source:	Periodic Fitness Evaluation (PFE)

Periodic Fitness Evaluation (PFE)
Qualify



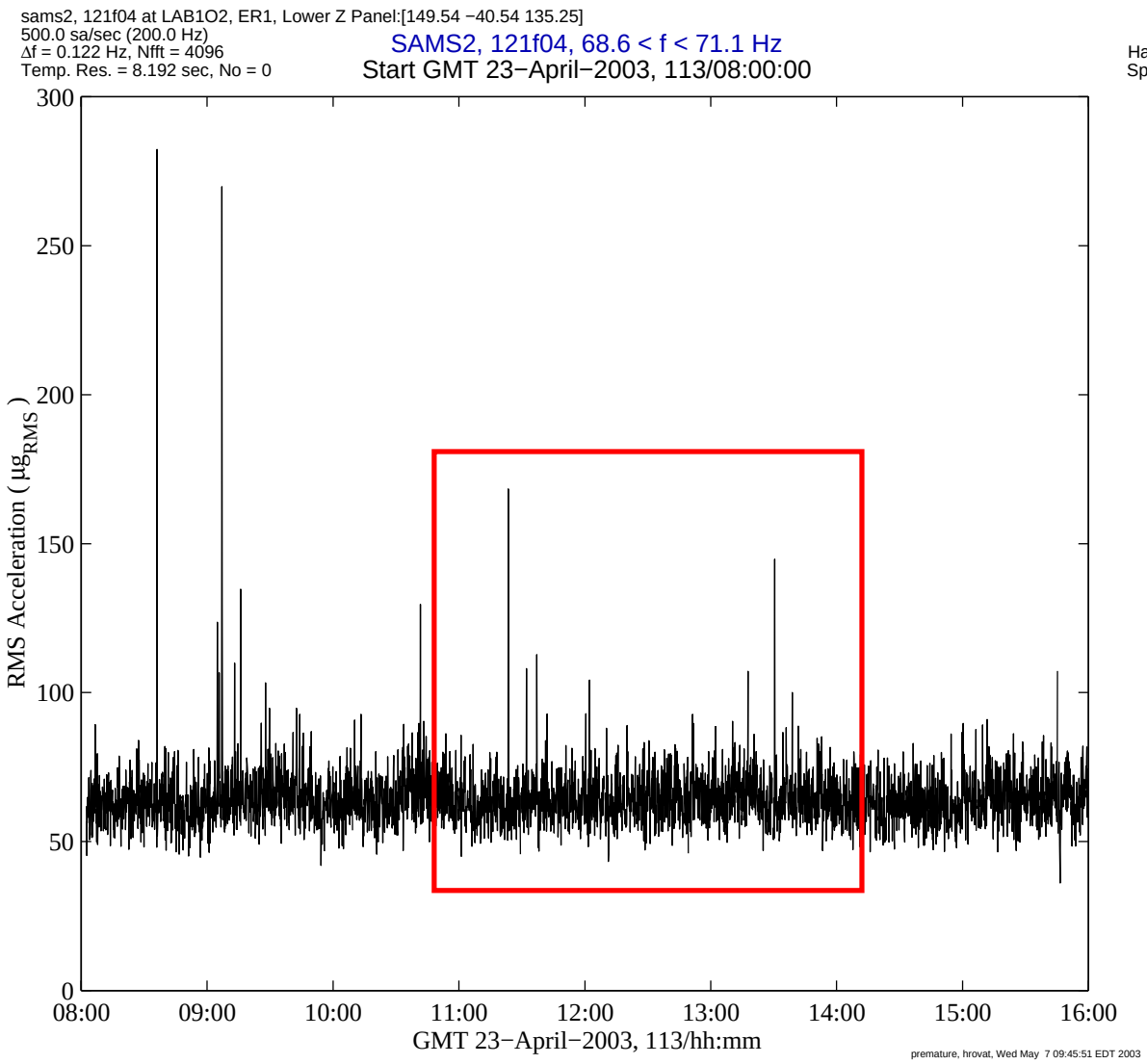
Data Description	
Sensor	121f04 500.0 sa/sec (200.00 Hz)
Location	LAB1O2, ER1, Lower Z Panel
Inc/Flight	Increment: 6, Flight: 11A
Plot Type	spectrogram

Notes:
While the spectrogram for the 121f02 sensor (located inside drawer 1 of ER1) showed a prominent signature for PFE activity, this spectrogram for the 121f04 sensor (located on the Z panel of the same rack, ER1) does not show any discernible signature for the same time and frequency range of interest. We do note, however, that the ambient vibratory environment at the Z panel location of the 121f04 sensor is subject to a broadband disturbance that was not seen for the same period and frequency range in the 121f02 data.



Regime:	Vibratory
Category:	Equipment
Source:	Periodic Fitness Evaluation (PFE)

Periodic Fitness Evaluation (PFE)
Quantify

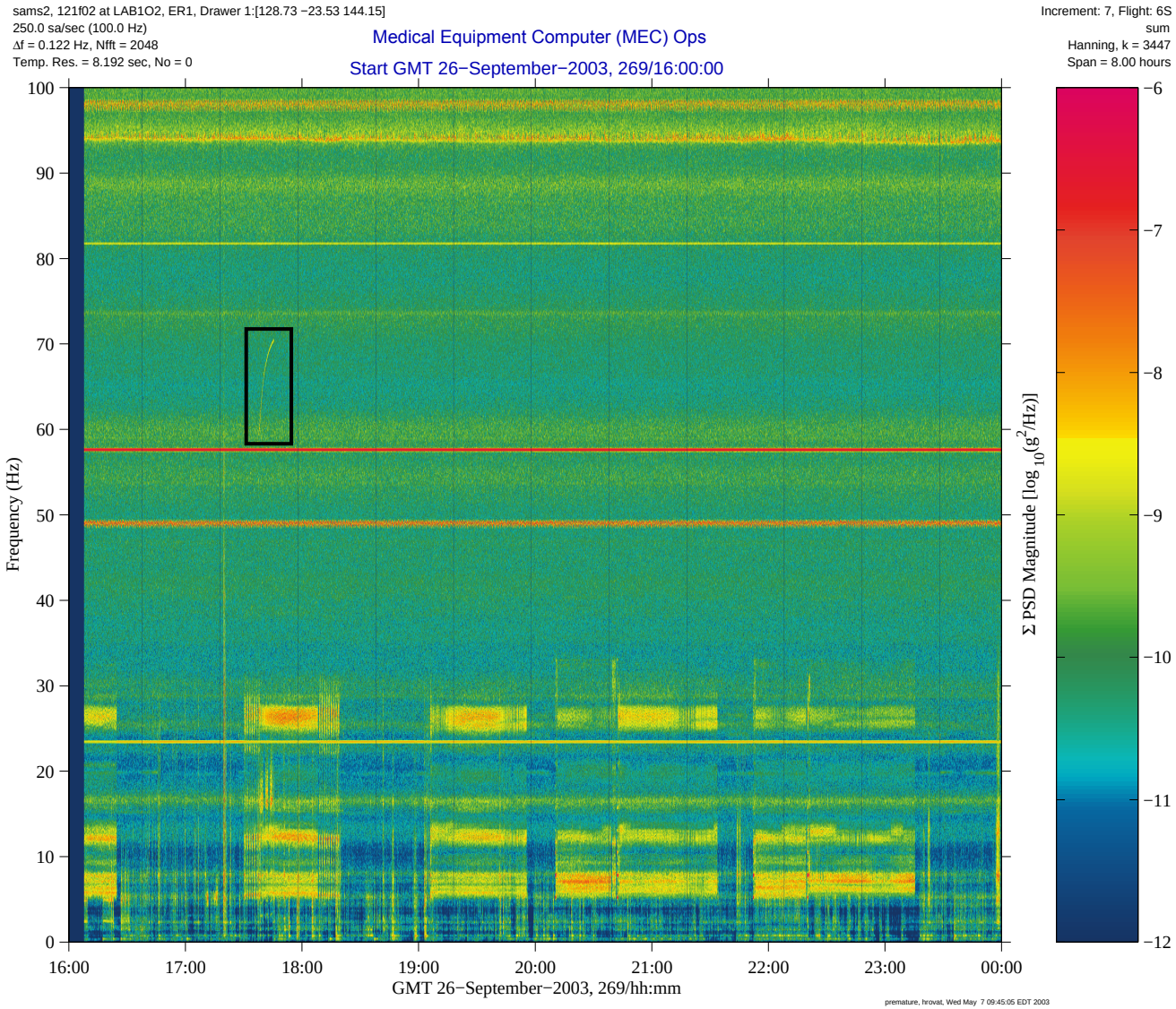


Data Description	
Sensor	121f04 500.0 sa/sec (200.00 Hz)
Location	LAB1O2, ER1, Lower Z Panel
Inc/Flight	Increment: 6, Flight: 11A
Plot Type	Interval RMS

Notes:
While the interval RMS plot for the 121f02 sensor (located inside drawer 1 of ER1) showed a prominent signature for PFE activity, this same analysis performed for the 121f04 sensor (located on the Z panel of the same rack, ER1) does not show any discernible shift up from the baseline RMS level. The same period that showed this upward shift in the 121f02 data is again marked by a red box here. The median RMS level calculated for the entire 8-hour period period shown in the interval RMS plot at the left was 63.6 μg_{RMS}. Recall for the 121f02 sensor data, that the baseline was 13.5 μg_{RMS} when the PFE equipment was off, and 49.6 μg_{RMS} when the equipment was on. This disturbance is effectively overwhelmed by the ambient environment and not readily detected at this Z panel location. We cannot say that it is not transmitted to this location, it's just that we cannot detect it against the background vibrations here.

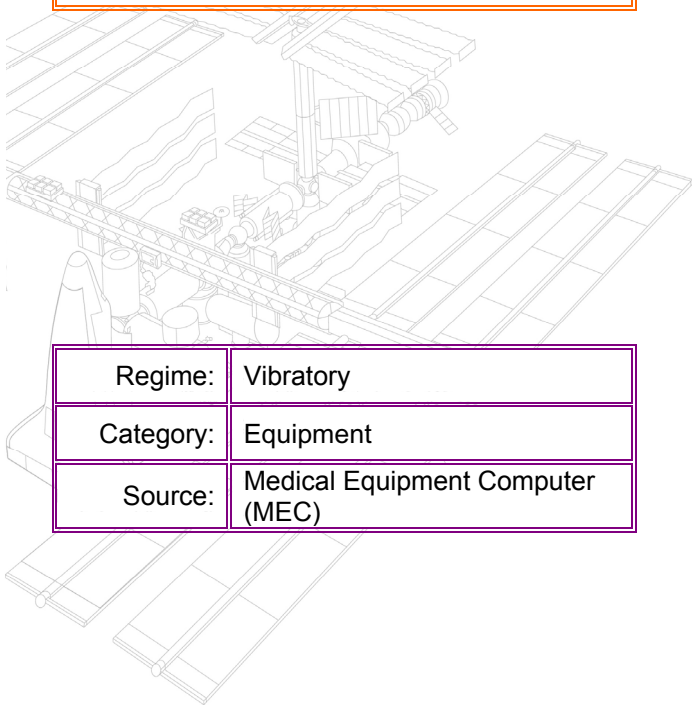
Regime:	Vibratory
Category:	Crew
Source:	Periodic Fitness Evaluation (PFE)

Medical Equipment Computer (MEC) Qualify



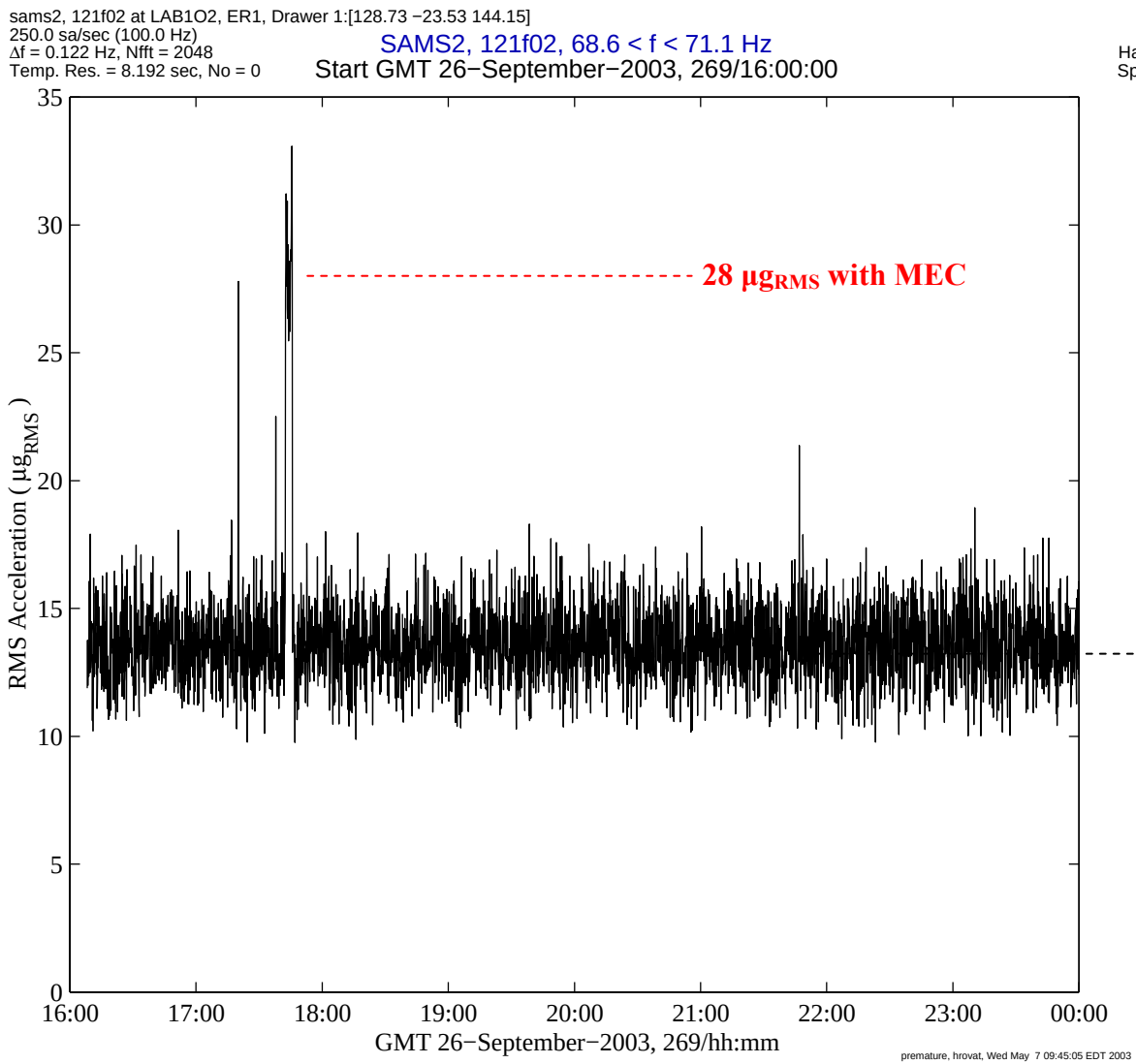
Data Description	
Sensor	121f02 250.0 sa/sec (100.0 Hz)
Location	LAB1O2, ER1, Drawer 1
Inc/Flight	Increment: 7, Flight: 6S
Plot Type	spectrogram

Notes:
For crew activity that involves the medical equipment computer (MEC), a narrowband signature similar to the start-up of signature observed for the Periodic Fitness Evaluation (PFE) activity is observable in vibratory data collected by SAMS 121f02 and MAMS HiRAP sensors. The 121f02 spectrogram at the left has this brief signature surrounded by a black box. The specific example of this signature shown in this box lasts slightly less than 8 minutes and climbs from 59.5 to 70.4 Hz. This is brief example is representative of the MEC operations, although sometimes this narrowband disturbance persists for a long span, while presumably the crew is tending to other tasks.



Regime:	Vibratory
Category:	Equipment
Source:	Medical Equipment Computer (MEC)

Medical Equipment Computer (MEC)
Quantify

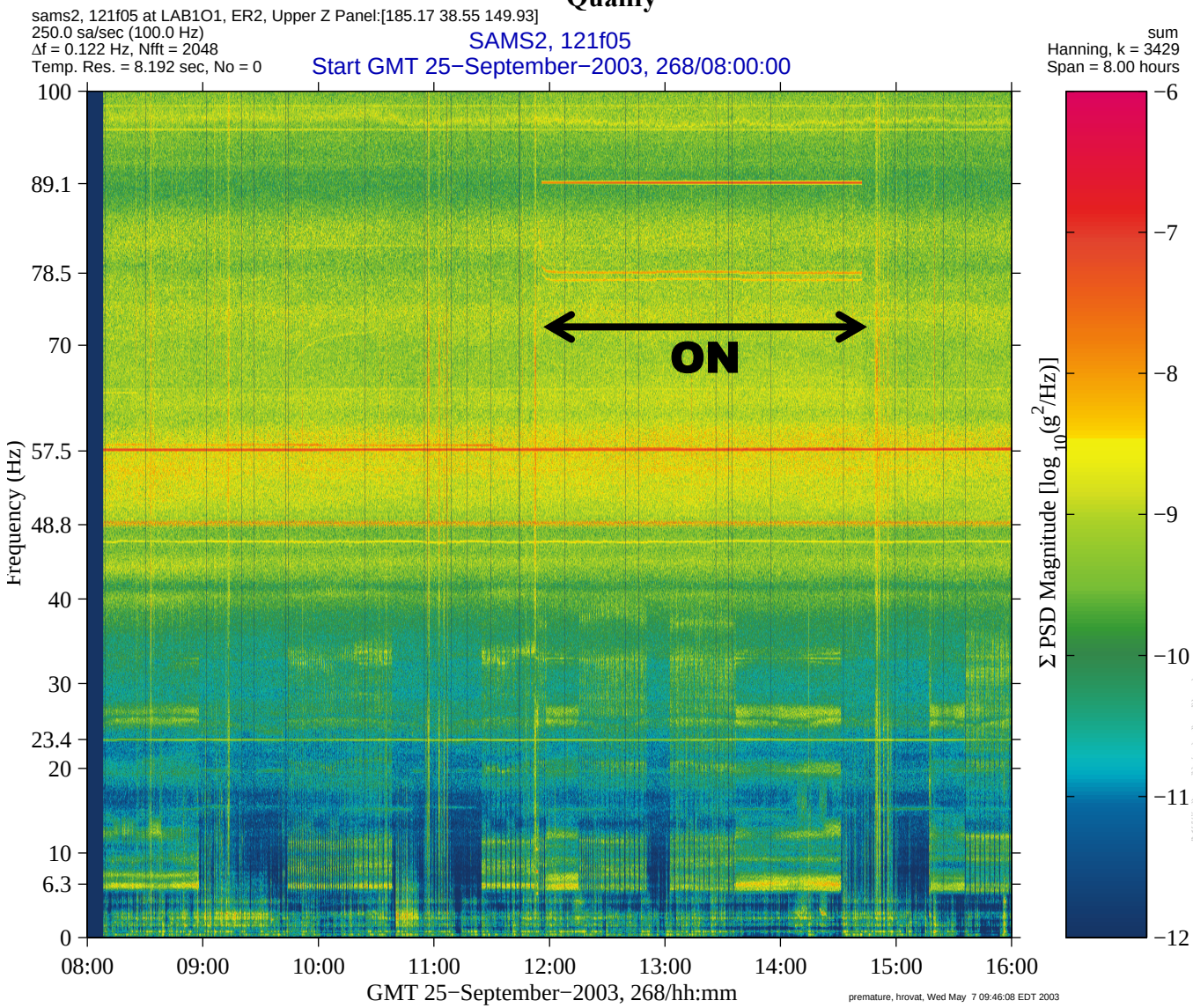


Data Description	
Sensor	121f02 250.0 sa/sec (100.0 Hz)
Location	LAB1O2, ER1, Drawer 1
Inc/Flight	Increment: 7, Flight: 6S
Plot Type	Interval RMS

Notes:
This interval RMS plot serves to show the effect of the MEC equipment on the narrow vibratory range around 70 Hz. The RMS level shifts from a baseline of just under 14 μg_{RMS} to up over 28 μg_{RMS} while the equipment is being operated. To put this in some context for comparison, the median RMS level for the entire passband (up to 100 Hz) for the entire period shown at the left is over 350 µgRMS.

Regime:	Vibratory
Category:	Equipment
Source:	Medical Equipment Computer (MEC)

Ultrasound Operations
Qualify



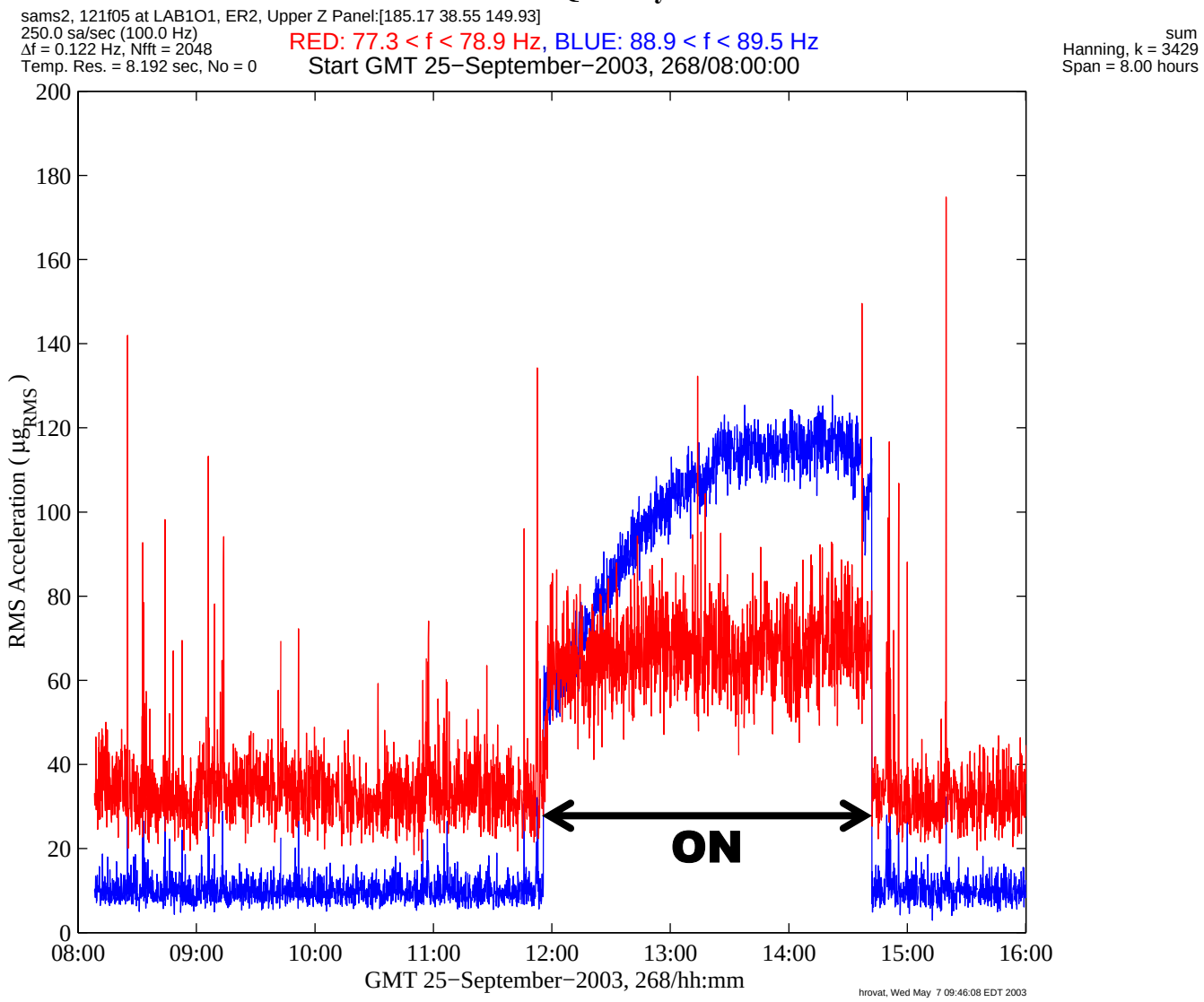
Data Description	
Sensor	121f05 250.0 sa/sec (100.0 Hz)
Location	LAB1O1, ER2, Upper Z Panel
Inc/Flight	Increment: 7, Flight: 6S
Plot Type	spectrogram

Notes:
This spectrogram shows three narrowband disturbances that appear related to ultrasound operations. The highest frequency component is centered at about 89.1 Hz (~5346 RPM), while there are twin lower frequency signals at about 77.7 and 78.6 Hz. All three signals turn on/off simultaneously, and analysis of the data set used to generate this figure indicates that the equipment was turned on at approximately GMT 11:55 and off at about GMT 14:42 for the duration of 2 hours and 47 minutes. Canvassing of the vibratory acceleration archive collected on the ISS shows the appearance of similar signatures for the following GMTs:

07-Feb-2002, 038/14:00-15:00
08-Feb-2002, 039/07:32-09:30
06-Mar-2003, 065/10:40-12:25
24-Jun-2003, 175/13:09-15:48
25-Sep-2003, 268/12:00-14:45

Regime:	Vibratory
Category:	Equipment
Source:	Ultrasound Operations

Ultrasound Operations
Quantify



Data Description	
Sensor	121f05 250.0 sa/sec (100.0 Hz)
Location	LAB1O1, ER2, Upper Z Panel
Inc/Flight	Increment: 7, Flight: 6S
Plot Type	Interval RMS

Notes:
It's interesting to note from the interval RMS plot shown that the higher frequency (blue trace) narrowband (~89.1 Hz) disturbance gradually climbs to a steady state RMS value over the first hour or two, while the higher frequency (red trace) disturbance, more or less, steps to its steady state RMS value. Referring back to the spectrogram used to qualify the ultrasound operations, note that the lower frequency disturbance consists of twin traces at about 77.7 and 78.6 Hz. Both of these contribute to the RMS level shown in the table below, which shows a comparison of these ultrasound-related disturbances.

	RMS Acceleration (μgRMS)	
Band (Hz)	**OFF**	**ON**
77.3-78.9	32.8	66.5
88.9-89.5	9.7	107.4

For some context, the RMS level for the entire passband (up to 100 Hz) was 296.6 μg_{RMS} for the entire day.

Regime:	Vibratory
Category:	Equipment
Source:	Ultrasound Operations