Section 12:

PIMS International Space Station Operations

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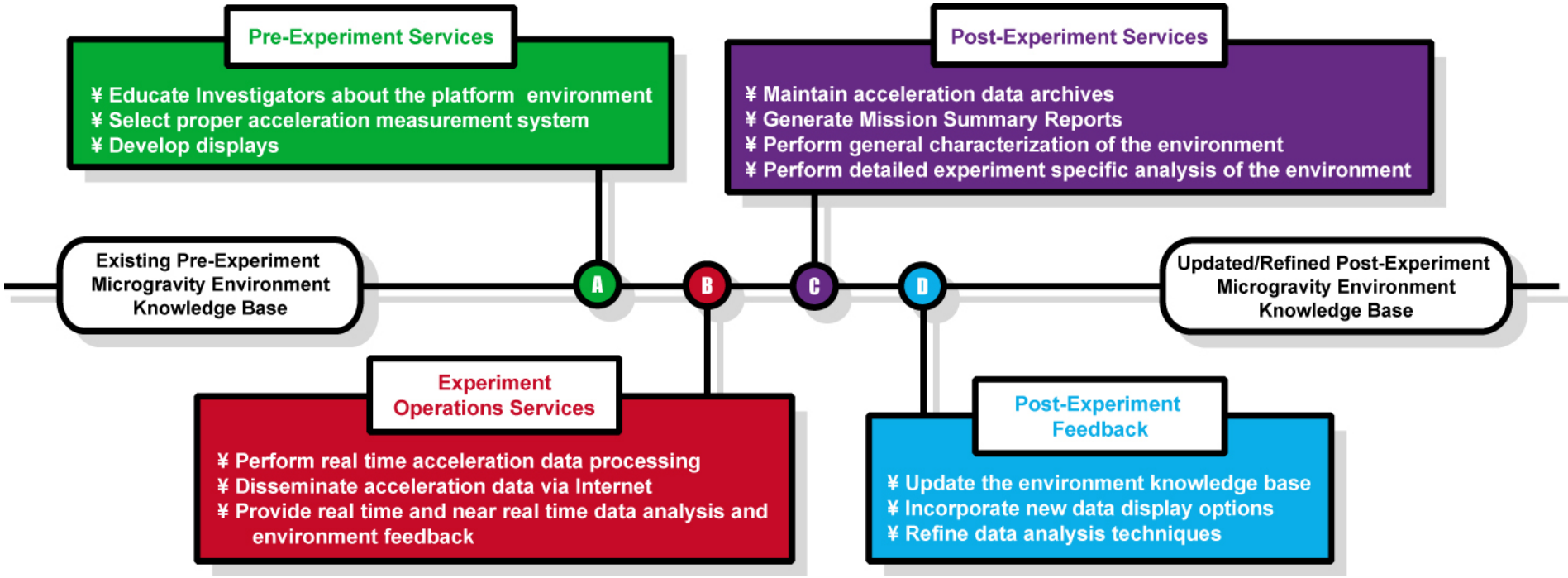
PIMS Functions During Experiment Life Cycle



Space Acceleration Measurement System-II

- **Provide distributed measurement of the vibratory and transient acceleration environment ($0.01 \leq f \leq 400$ Hz) on the ISS in support of various microgravity payloads**
- **Components**
  - **Control Unit**
    - Responsible for data and command routing
  - **Remote Triaxial Sensor (RTS) System**
    - Up to Ten RTS Electronics Enclosures (EE's)
    - Up to Two RTS Sensor Enclosures (SE's) per EE
- **Current SAMS configuration and operations**
  - **Four EE's and 5 SE's**
    - Two EE's located in ER#1, 1 EE in ARIS equipped ER#2, and 1 EE supplied to the MSG facility
    - SE in RTS drawer #1 in ER#1, SE's on Z-panel under ER#1 and ER#2, 1 SE on ER#2 light tray, 1 SE with the MSG facility
  - **Real-time data downlinked from the ISS**

Microgravity Acceleration Measurement System

- **Measure the ISS quasi-steady acceleration (f ≤ 0.01 Hz) and the ISS vibratory acceleration environment (f ≤ 100 Hz)**
- **Components**
  - **Miniature Electro-Static Accelerometer (MESA)**
    - sensor is a flight spare from the OARE program
    - measure the quasi-steady acceleration environment
    - actively downlinking acceleration data
  - **High-Resolution Accelerometer Package (HiRAP)**
    - measure the vibratory environment at the MAMS location only
    - Activated as needed via ground command to measure the vibratory environment
- **Additional features**
  - **Quasi-steady acceleration data can be mapped to various locations within the ISS using ISS body rates and body angles**
  - **Provides on orbit bias calibration capabilities**

Current Instrument Locations - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites History

Address http://pims.grc.nasa.gov/html/CURRENT_LOCATIONS.htm Go Links

PIMS INTERNATIONAL SPACE STATION

Home | PIMS Home | Acceleration Home | MSD Home

Home | Current Real-Time Plots | Current Locations | Request Data Plots | Status Data Plots | Interesting Plots | ISS Data Archives

Current Instrument Locations

NASA PAYLOAD RACK

ACCELEROMETER LOCATIONS

SYSTEM RACK

INTERNATIONAL RACK

RESUPPLY STOWAGE RACK

ZERO-G STOWAGE RACK

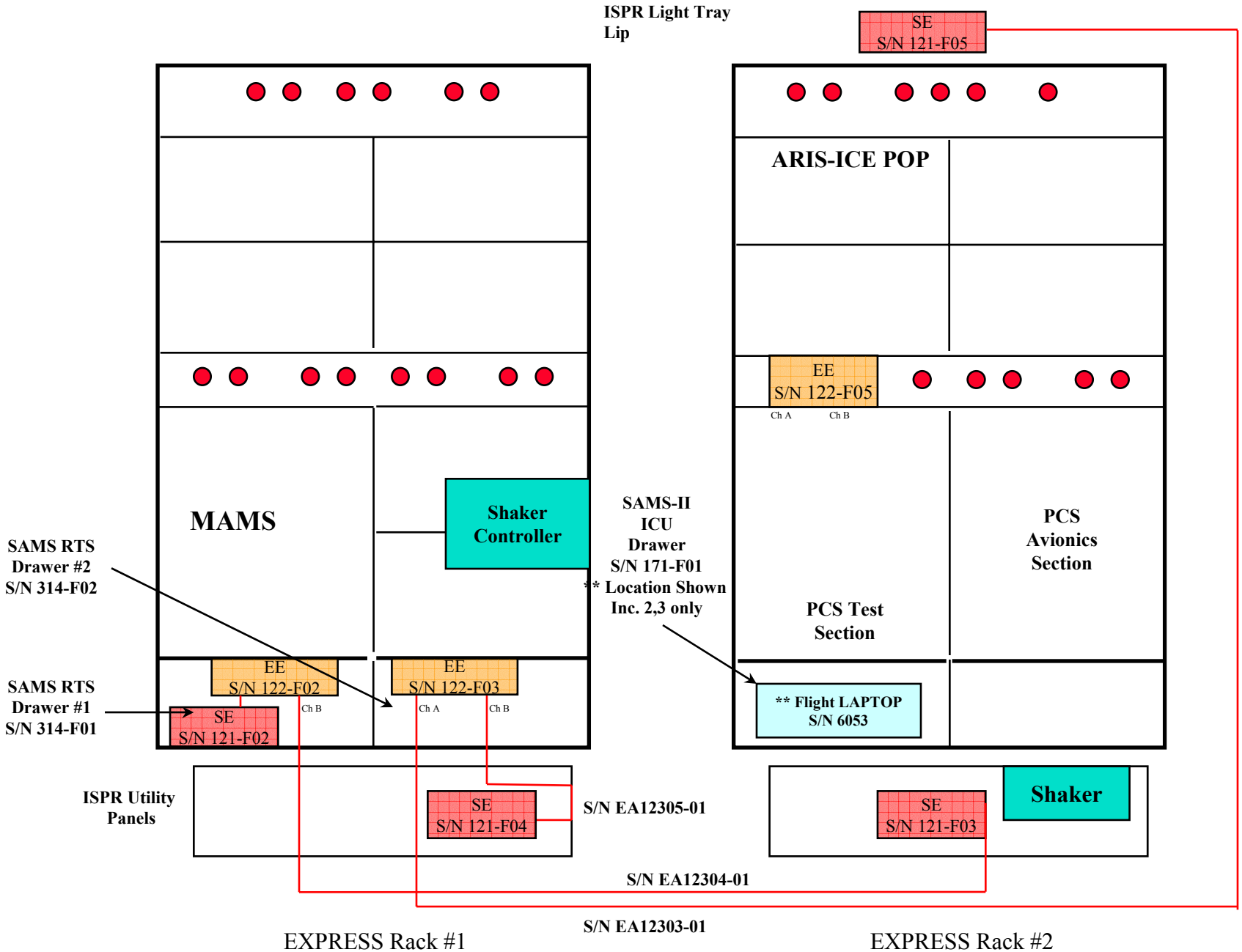
11A – Assembly Sequence

Status Data Plots | ISS Acceleration Archives | Current Real-Time Plots

Interesting Plots | Acceleration Homepage | Request Data Plots

3 Hierarchical Menu Trees Created

Local intranet



SAMS-II ON ORBIT

SENSOR CONFIGURATION FOR ER#1 and ER#2

PIMS Operational Philosophy

- **Operations are divided into three sections:**
  - **1) Real-time operations**
  - **2) Near real-time operations**
  - **3) Offline operations**
    - general characterization and specialized analyses
- **Acceleration measurement using SAMS-II and MAMS began with ISS Flight 6A (April 19, 2001) and is planned for the duration of ISS operations**
  - **MAMS activated May, 2001**
  - **SAMS activated June, 2001**
- **Potential for nearly continuous operations to characterize the environment**
  - **includes measurement of the environment, where possible, outside of "microgravity mode"**

Operational Philosophy

- **Operational configuration calls for multiple SAMS-II Sensor Enclosures (SE), MAMS MESA, and MAMS HiRAP**
  - **not all sensors will be active all the time resulting in a variety of acceleration measurement profiles**
  - **SAMS sensors are operated at PIMS default characterization configuration**
    - Sensors 121f02 (in RTS drawer in ER#1) and 121f05 (ER#2 light tray) operate at 100 Hz and are “continuously on”
    - Sensors 121f03 (ER#2 Z-panel) and 121f04 (ER#1 Z-panel) operate at 200 Hz and are “continuously on”
    - Sensor 121f08 (MSG sensor) operates at 25 Hz in support of SUBSA and PFMI investigations
  - **MAMS operations**
    - MAMS OSS sensor is located in ER#1 and is “continuously on”
    - MAMS HiRAP sensor is activated for “significant” microgravity events (docking, undockings, reboosts, etc.)

Operational Philosophy

- **AOS/LOS profiles call for 30 - 60 percent AOS coverage**
  - **requires the ability to deal with AOS and LOS data streams**
  - **ISS attitude (XPOP vs. TEA greatly affects the AOS/LOS profiles)**
    - XPOP characterized by longer, but more infrequent AOS intervals
    - TEA characterized by shorter, but more frequent AOS intervals
  - **AOS/LOS affects the availability of processed acceleration data as PIMS ground software must wait for HCOR dumps to send LOS data**
    - SAMS and MAMS HiRAP data are available in the PIMS Acceleration Data (PAD) archives with a 24 hour delay
    - MAMS OSS data are available in the PIMS Acceleration Data (PAD) archives with a 30 hour delay

Operational Philosophy

- **PIMS has developed a core set of techniques for processing and displaying the acceleration data (see Section 8 for quasi-steady data and Section 9 for vibratory data)**
  - **Based on real-time and offline experience gained from SAMS and OARE data during Space Shuttle and Mir operations**
  - **PIMS utilizes its core set of analysis techniques for processing and analyzing the acceleration data offline**
    - Real-time data provides clues, but offline analysis provides details ISS microgravity environment characterization function
    - Customized processing or displays as required by the microgravity user community
- **Microgravity acceleration data is available to Principal Investigators in near real time and offline through the WWW**
  - **http://pims.grc.nasa.gov**

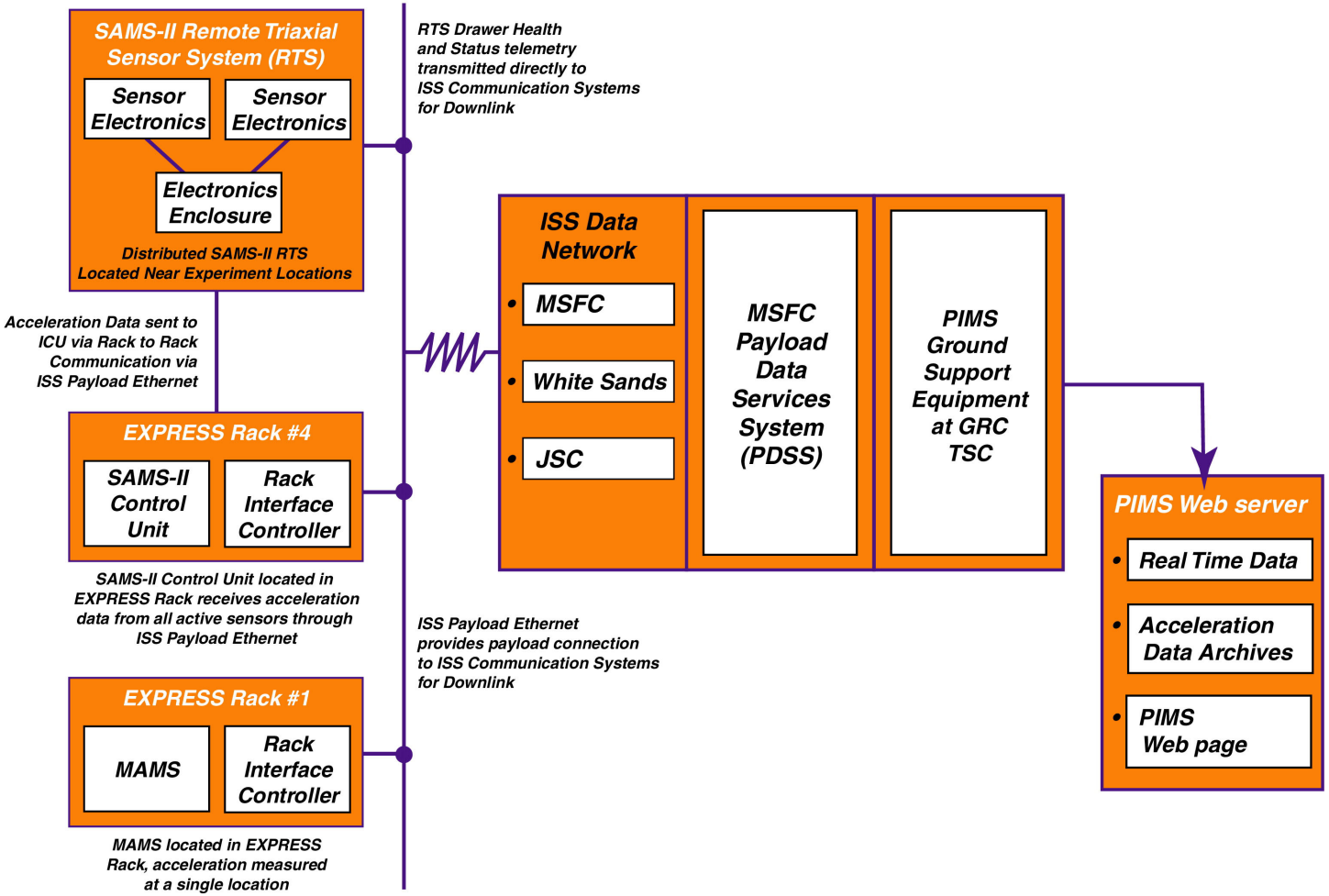
Real-Time Operations

- **Crux of PIMS Real-time Operations is the Distribution of Acceleration Data Displays via the WWW**
  - **PIMS displays are updated in real-time while electronic snapshots are routed to the PIMS WWW page**
  - **SAMS sensor 121f02-121f05 typically have only color spectrogram active**
    - Color spectrogram provides best plot for aiding PIMS general characterization activities
  - **SAMS sensor 121f08 utilizes color spectrogram and interval minimum/maximum plot type per specific SUBSA and PFMI requirements**
  - **MAMS OSS sensor shows time domain plot, typically shown at sensor location, ISS CG, and MSG (SUBSA or PFMI) location**
  - **MAMS HiRAP sensor typically has only color spectrogram active**
    - Color spectrogram provides best plot for aiding PIMS general characterization activities Acceleration data displays via the WWW

Real-Time Operations

- **Example real-time plots (HYPERLINK TO PDF HERE)**
  - **Figure 12-1 ADVASC Deactivation Inc2 Report Fig 9.3.6-2**
  - **Figure 12-2 De-Pressurization for ISS EVA Figure 9.2.5-1**
  - **Figure 12-3 LMS (STS-78) Nominal Microgravity Environment**

ISS Acceleration Data Flow for ISS Operations



Near Real-Time Operations

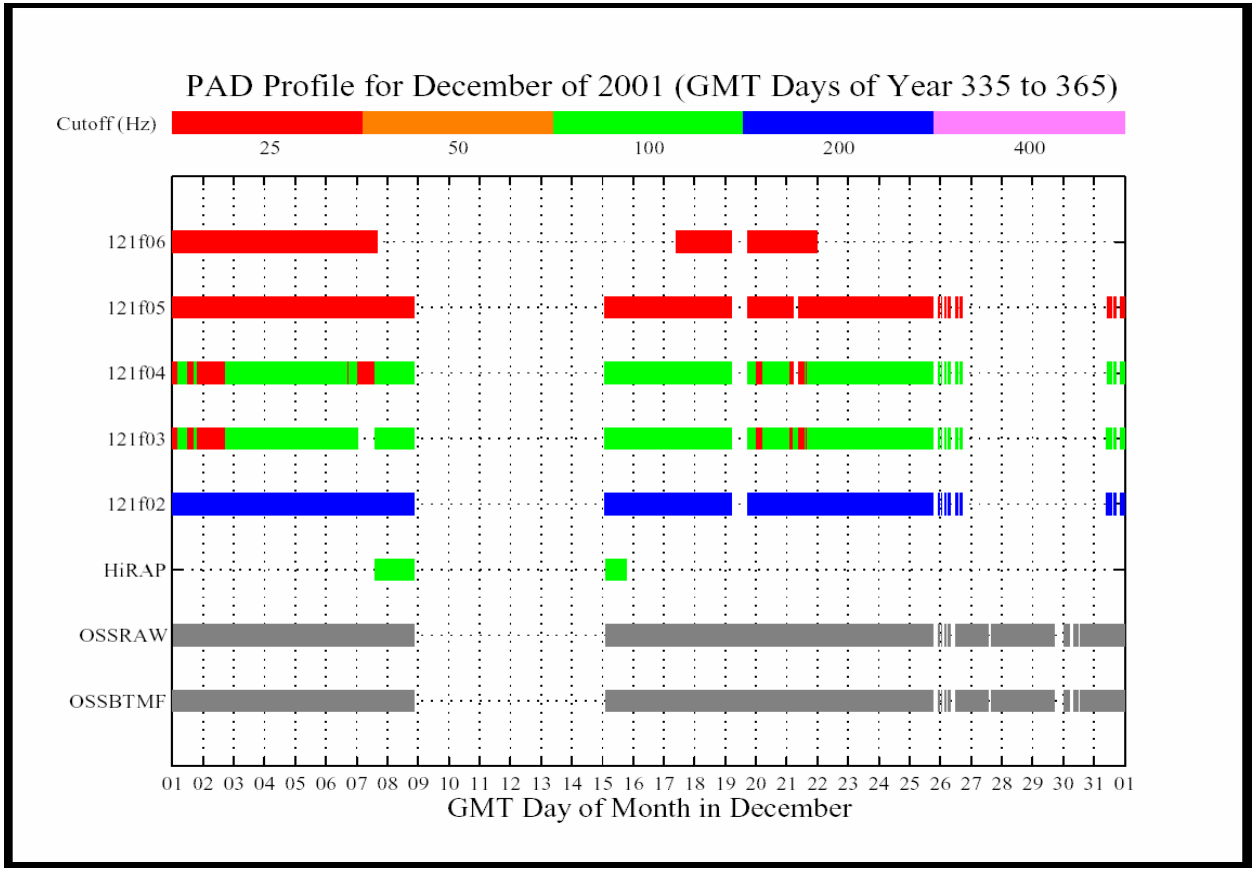
- **Two primary functions performed**
  - **Merge AOS and LOS data streams**
  - **Generate processed (t,x,y,z) data files stored in common format**
- **Standard storage format details**
  - **Represents a standard file format for ISS acceleration data from any ISS acceleration measurement system, including ancillary data associated with each accelerometer**
    - Ancillary data describes the conditions and circumstances under which the acceleration data were obtained
      - current ancillary data parameters include: t-zero, sampling rate, cutoff frequency, head ID, gain, station configuration, location, orientation, coordinate system, bias coefficients, scale factor, and Data Quality Measure (DQM)
    - SIMPLIFY ACCESS TO ACCELERATION DATA FOR PRINCIPAL INVESTIGATORS
  - **PIMS-ISS-101 ISS PIMS Acceleration Data (PAD) File Description Document details the PAD storage format**
    - http://pims.grc.nasa.gov/reports/PIMS-ISS-101_revBaseline.pdf

Offline Operations

- **Primary function is to allow access to acceleration data for non-time-critical processing**
  - **In general, allows a more detailed analysis of the measured microgravity environment**
  - **Capable of processing and analyzing a long period of data**
  - **Overall access to acceleration data greatly simplified by a universal storage format**
- **PIMS WWW page offline functions**
  - **Provide the capability to request plotted data or data files through an electronic request**
  - **Provide means for access to the processed acceleration data files**
  - **Provide access to PIMS disturbance database information**

PIMS Acceleration Data (PAD) File

- **Direct access to the PAD files through PIMS ISS web site**
  - **http://pims.grc.nasa.gov/html/ISSAccelerationArchive.html**
    - Link provides instructions for downloading acceleration data files via FTP
    - PAD profile exist for every month to quickly show data availability



PIMS Acceleration Data (PAD) File

- **Sensor and time based data hierarchy**
  - **Typical directory path:**
    - /year2002/month05/day25/sams2_accel_121f02
    - Sensor type/name at the lowest level of the directory structure
- **Filenames contain start and stop time of the acceleration data within the file**
  - **2002_09_13_01_10_29.287+2002_09_13_01_20_29.292.121f03**
    - First data point at 09/13/2002, 01:10:29.287 and last data point at 09/13/2002, 01:20:29.292
    - + sign indicates data in this file are contiguous in time and no change in the ancillary data with the previous data file
    - - sign indicates data are not contiguous in time or a change in ancillary data has occurred

PIMS Acceleration Data (PAD) File

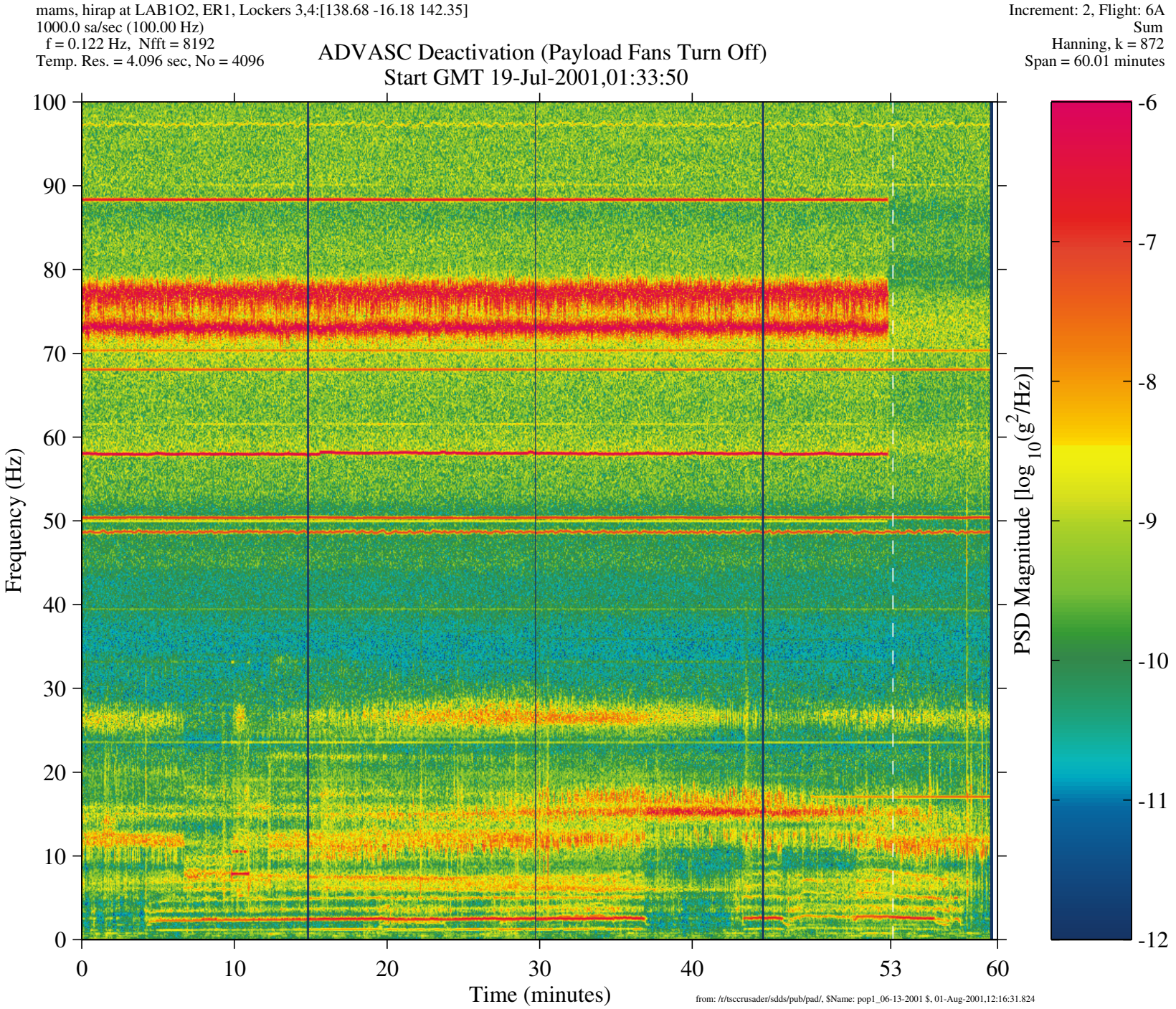
- **Typical file break examples for PAD file data**
  - **Time gap**
    - Typically results from dropped packet in the data network. At cutoff frequency of 200 Hz, SAMS transmits 8 packets per second. Loss of a single packet will generate a time gap.
    - Data packets between MSFC and GRC are transmitted via UDP, an asynchronous protocol that will have packet loss.
  - **Sample rate change**
    - Operationally, SAMS sensor could support multiple experiments with different acceleration data cutoff frequency requirements
    - Changes in sampling rate/cutoff frequency close the current data file at one sampling rate and open a new file at the new sampling rate
  - **ISS configuration change**
    - The station configuration parameter provides a gross measure of time to indicate when acceleration data were obtained
    - As Shuttle leaves the ISS, the station configuration parameter is updated to reflect the new ISS stage/increment

Offline Operations

- **Example Near Real-time Plots (HYPERLINK TO PDF HERE)**
  - **Figure 12-4 MSL-1 (STS-94) SOFBALL Radiometry Data**
- **Example Offline Plots**
  - **Figure 12-5 LMS (STS-78) Principal Component Spectral Analysis**
  - **Figure 12-6 ISS Increment 2 Principal Component Spectral Analysis Figure 10-1**

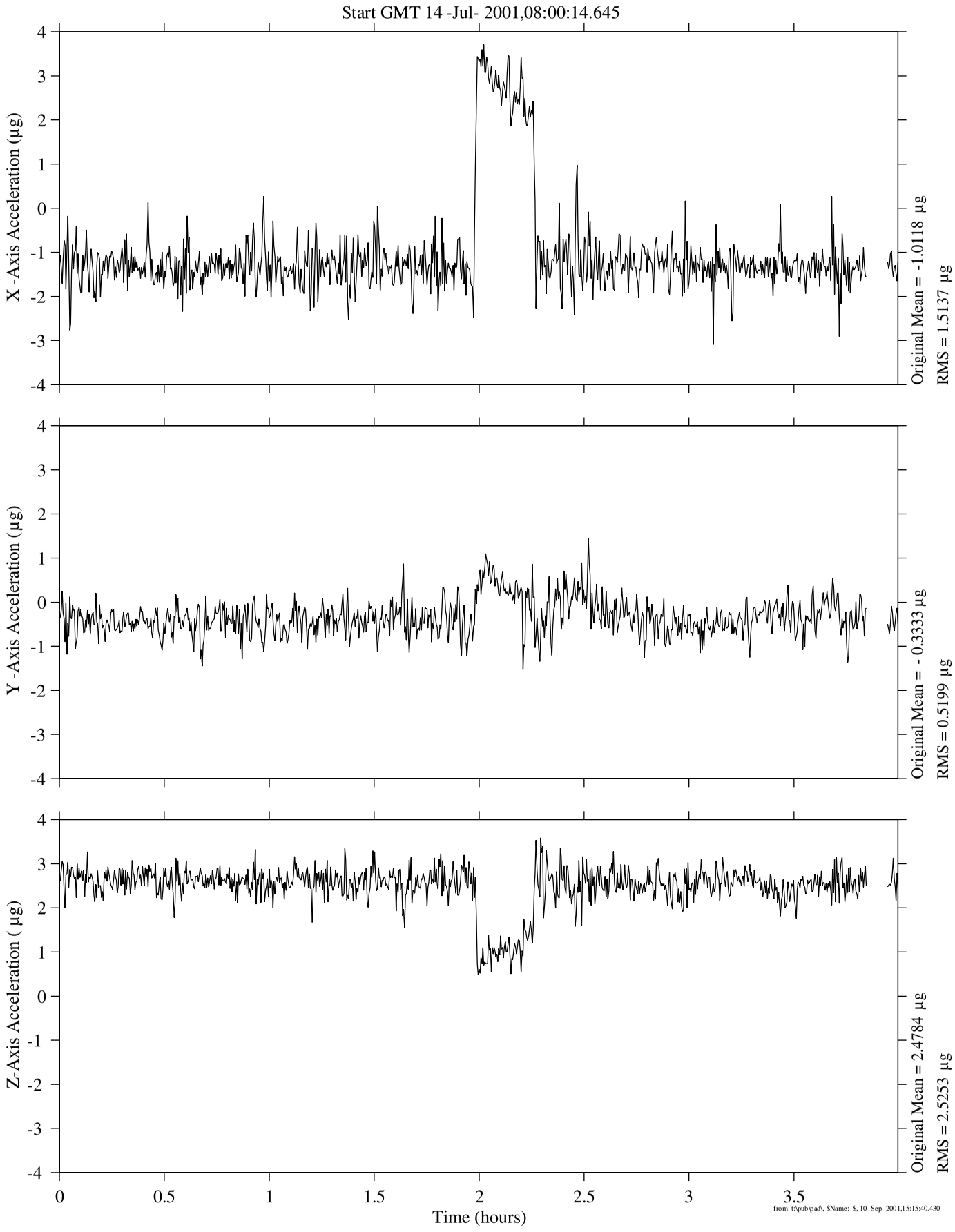
Summary

- **PIMS has been receiving, processing, and storing acceleration data for SAMS-II and MAMS data starting with flight 6A operations**
- **A universal storage format is currently employed for data storage**
  - **simplify access to acceleration data**
  - **standardize formats for data storage to maximize access to all existing acceleration data by international partners**
  - **Described in PIMS-ISS-101 document**
- **Real-time data plots of the various available accelerometers are available via the PIMS WWW page**
- **Offline access to plotted data and analysis capabilities are available through PIMS and the PIMS WWW page**
- **General and specialized characterization of the ISS microgravity environment are provided**

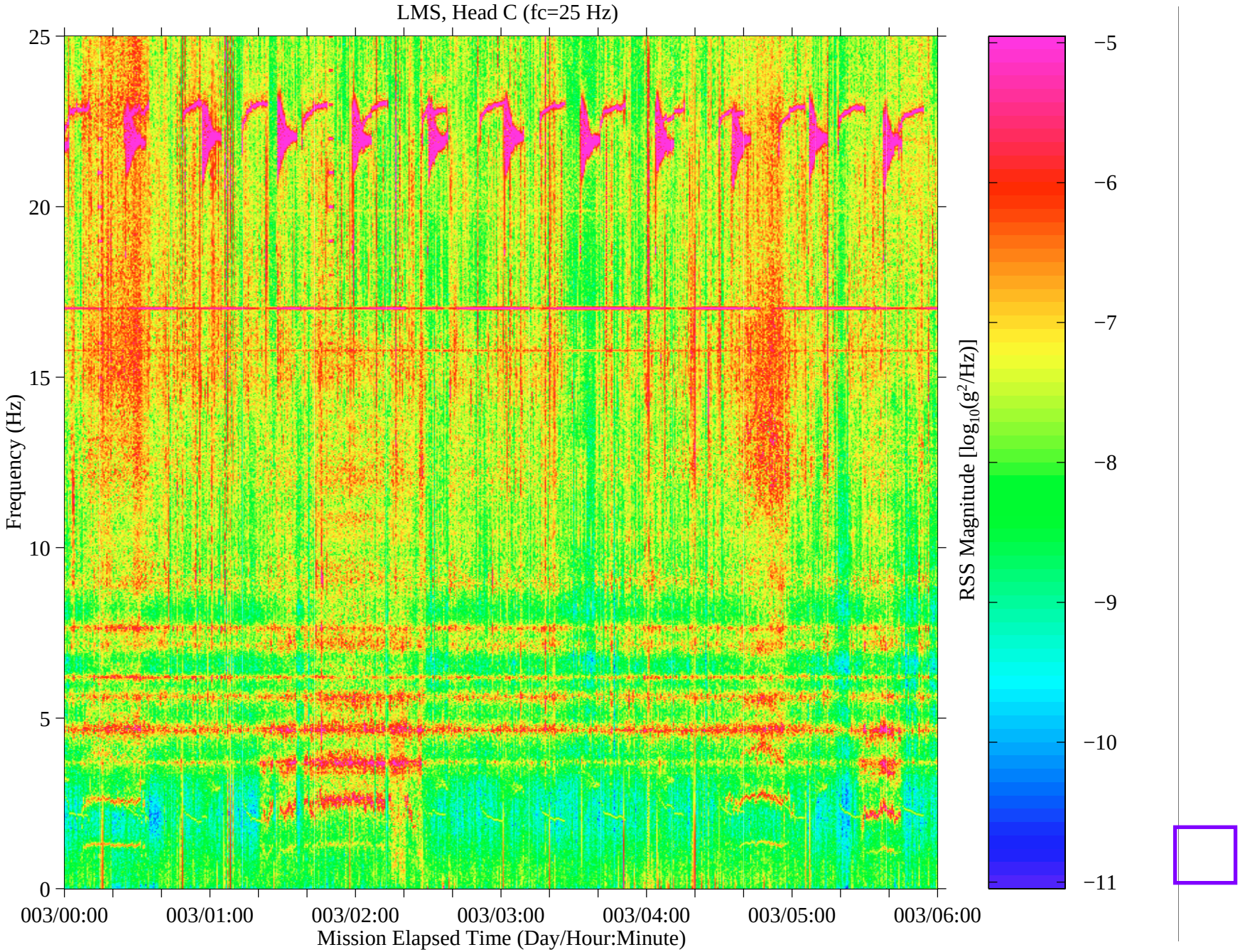


MEIT 2003 Figure 12-1: HiRAP Spectrogram of ADVASC Deactivation

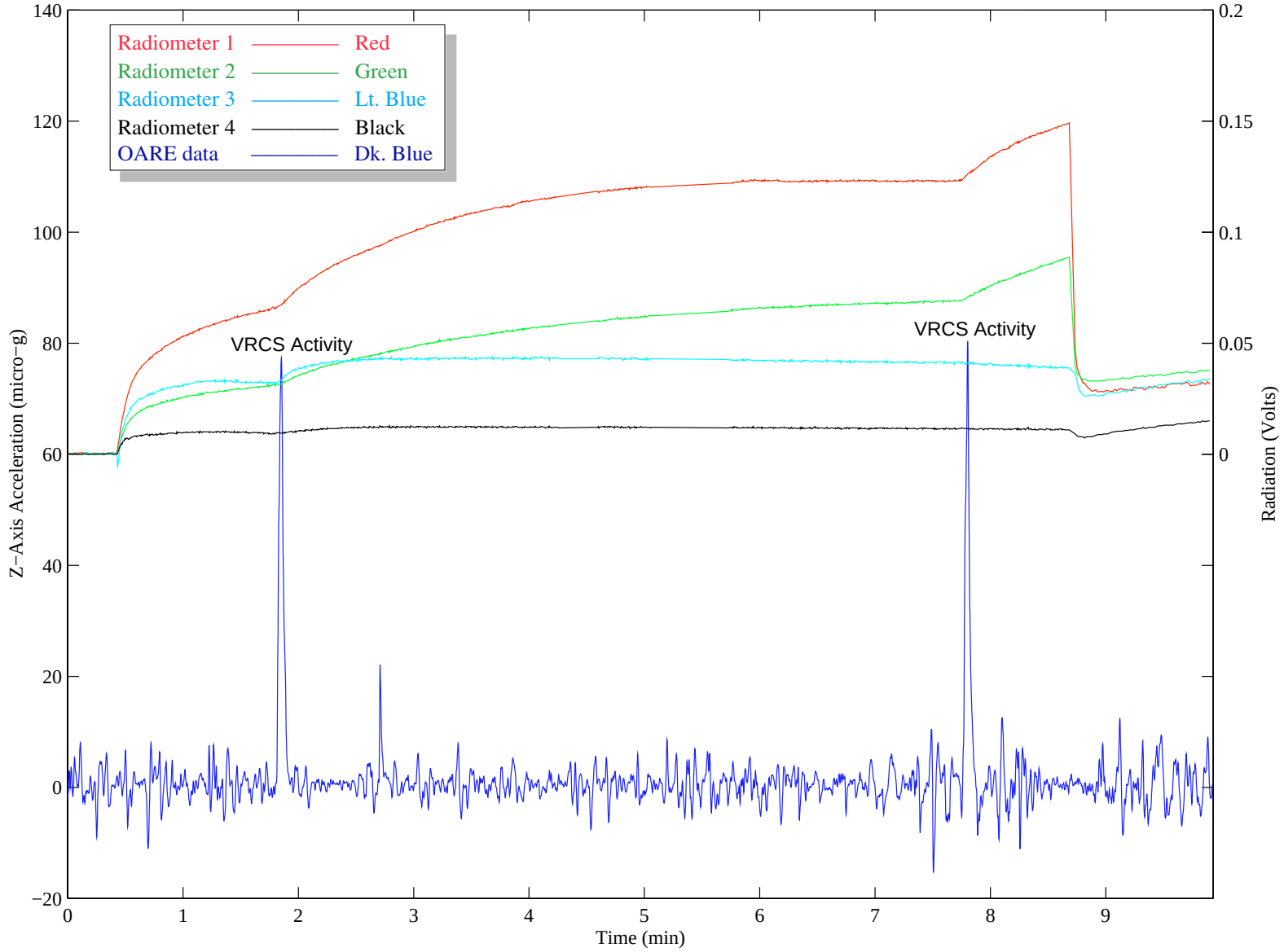
10.2 Orbiter Cabin Depressurization During STS –104



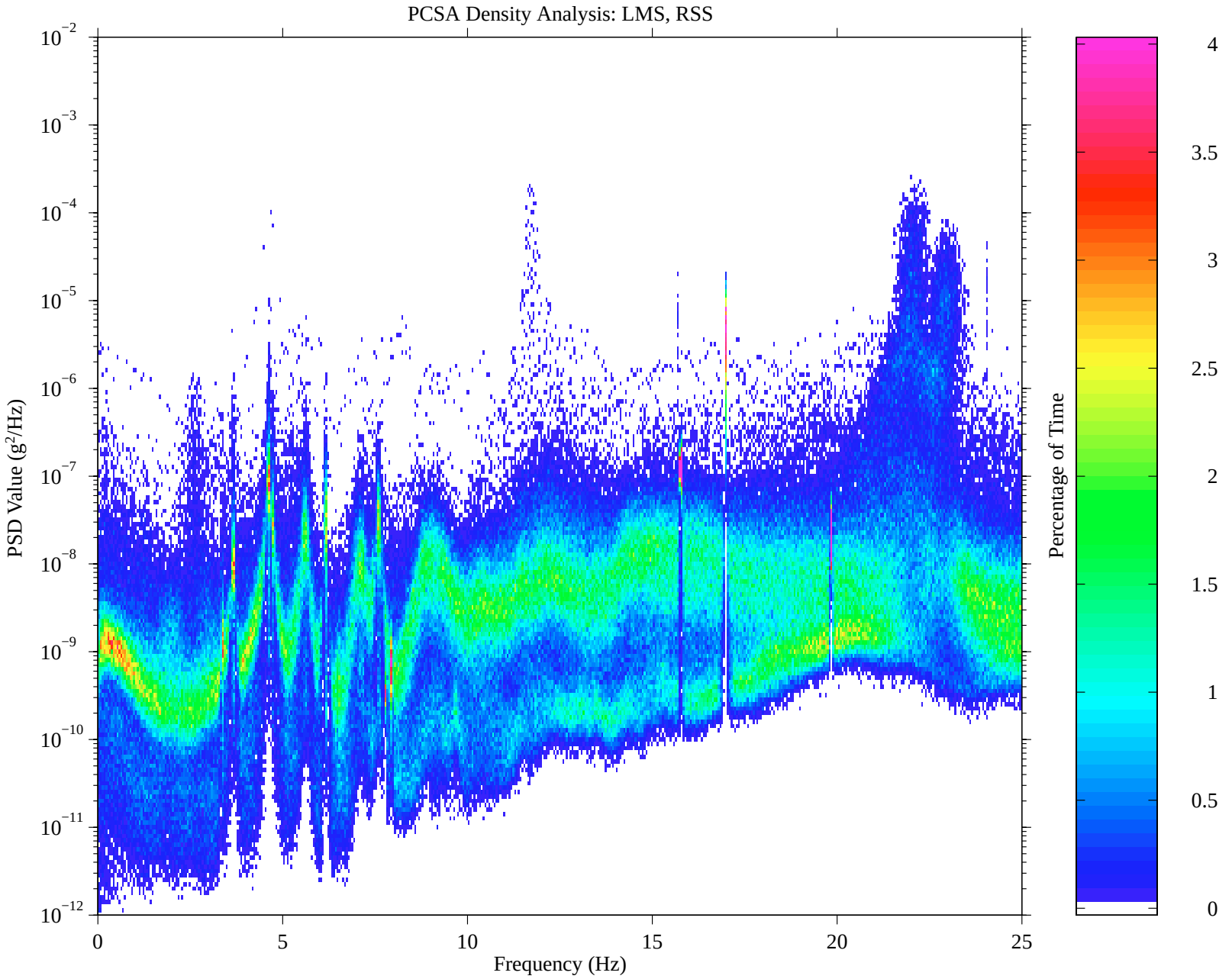
MEIT 2003 Figure 12-2: MAMS Raw OSS Data Showing Cabin De-Pressurization



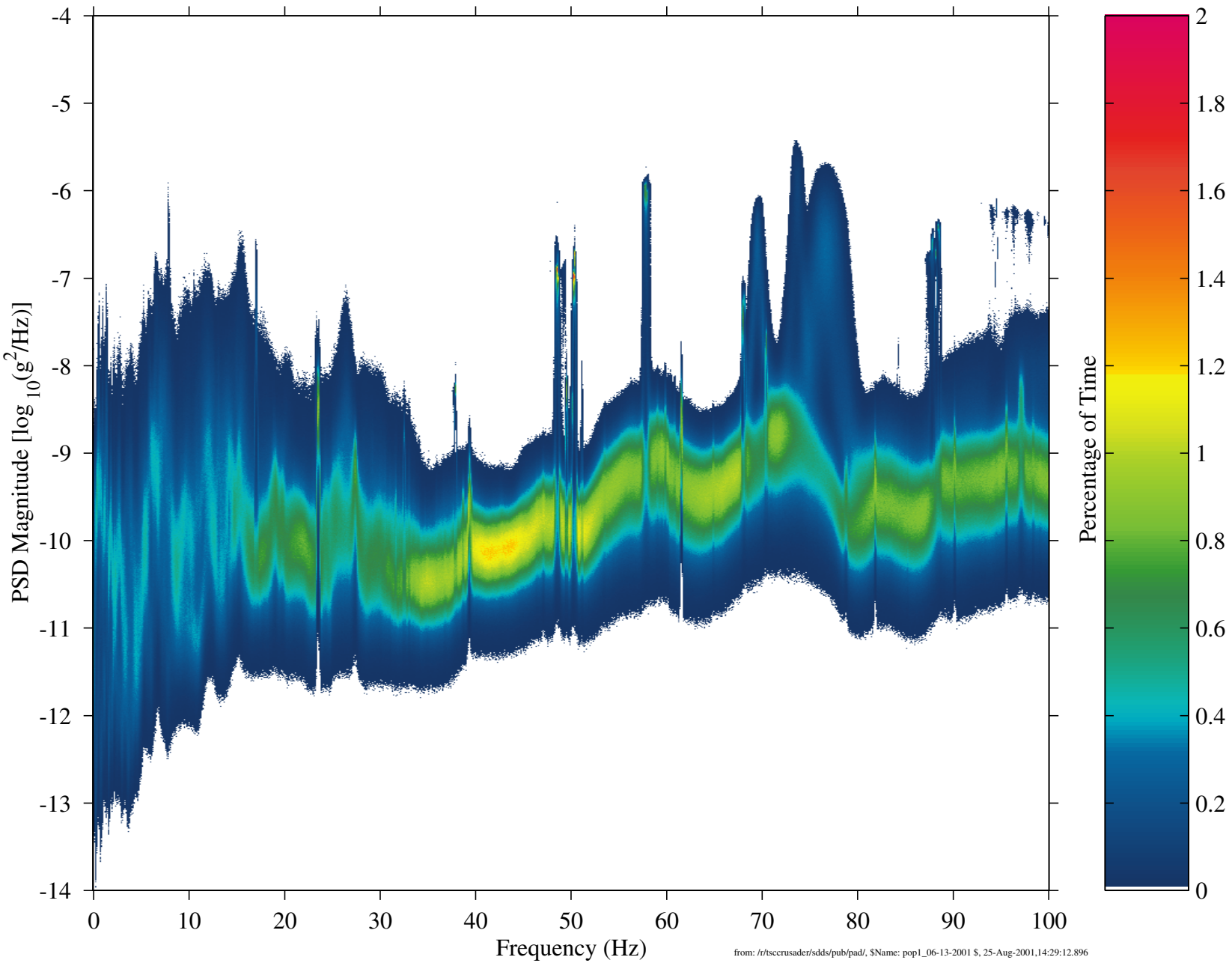
MEIT 2003 Figure 12-3: Nominal Microgravity Environment from STS-78 (LMS)



MEIT 2003 Figure 12-4: Raw OARE Data and SOFBALL Radiometry Data from STS-94 (MSL-1R)



MEIT 2003 Figure 12-5: Principal Component Spectral Analysis for the Entire STS-78 Mission (LMS)



MEIT 2003 Figure 12-6: HiRAP Principal Component Spectral Analysis Plot from Increment 2