Section 8:

Microgravity Environment of Non-Orbital Platforms

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Topics for Discussion

- **Non-orbital platforms**
  - **Terrier-Black Brant sounding rocket**
  - **KC-135 aircraft for bolted and free-float conditions**
- **Accelerometer systems used to measure the environments**
  - **SAMS (Space Acceleration Measurement System)**
  - **SAMS-FF (SAMS-Free Flyer)**

Non-Orbital Platforms

- **Terrier-Black Brant sounding rocket**
  - **Launched from White Sands, NM in support of the DARTFire experiment (September, 1997)**
  - **Achieves approximately 500 seconds of reduced gravity environment**
- **KC-135 Aircraft**
  - **Operated by Johnson Space Center**
  - **Achieves reduced gravity environment by flying parabolic trajectories**
  - **Parabolas provide 15-20 seconds of reduced gravity environment**
  - **Approximately 40-50 parabolas per campaign**

Accelerometer Systems

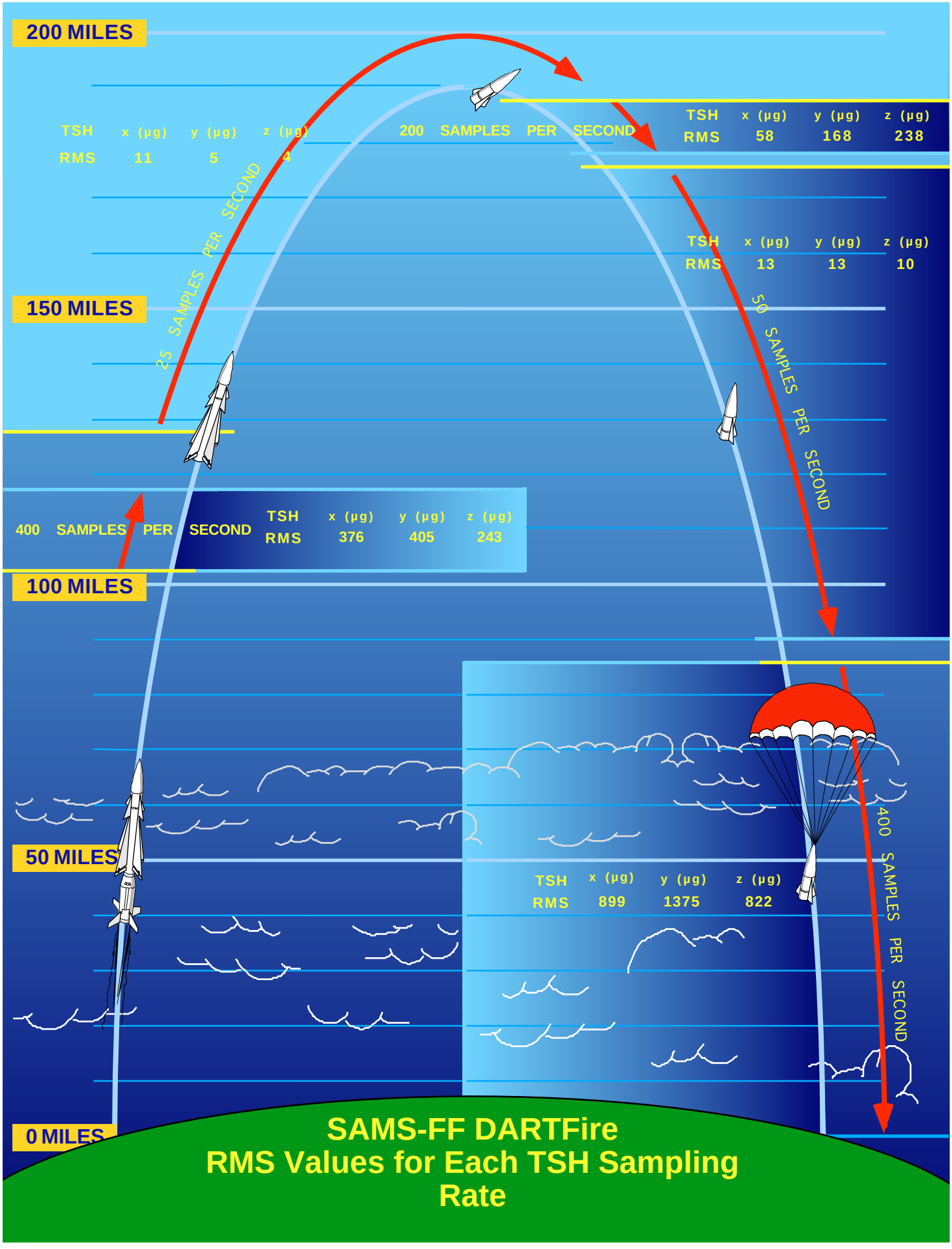
- **SAMS characteristics**
  - **Sampling rate and cut-off frequency are selected and fixed pre-mission**
  - **For support of KC-135 flights, three SAMS heads are flown**
    - head A, f_s=250 and cut-off frequency of f_c=100
    - head B, f_s=500 and cut-off frequency of f_c=100
    - head C, f_s=25 and cut-off frequency of f_c=5
- **SAMS-FF characteristics**
  - **Sampling rate and cut-off frequency are selectable during the mission**
  - **DARTFire mission utilized this variable sampling rate capability**
  - **uSEG experiment utilized two sampling rates during KC-135 testing (f_s=800 and f_s = 100)**

Sounding Rocket Environment Characterization

- **Terrier-Black sounding rocket DARTFire flight timeline is shown in the graphic in Figure 8-1**
- **Figure 8-2 illustrates the acceleration vector magnitude for the time period when the sampling rate was 25 samples per second**
  - **environment measured at less than 30 ug root sum square for the time interval analyzed**
- **Figure 8-3 is the RSS power spectral density for the time period when the sampling rate was 25 samples per second**
  - **frequency domain characteristics track known disturbance sources originating internal to the DARTFire equipment**
    - Intensified Multispectral Imager filter wheel operates at 5 Hz
    - Infrared Imager filter wheel operates at 1 Hz

KC-135 Environment Characterization

- **Figure 8-4 illustrates the KC-135 overall environment over multiple parabolas during a typical campaign as recorded by SAMS**
- **Figure 8-5 is a detailed plot of the KC-135 environment during the reduced gravity portion of the parabola as recorded by SAMS-FF**
- **Figure 8-6 is a plot of KC-135 parabola recorded in support of SAL experiment. Shows free-float of SAL test equipment and timelines the activity within the parabola**
- **Figure 8-7 is a detailed plot of the free-float period of the parabola**



SAMS-FF DARTFire
RMS Values for Each TSH Sampling Rate

Head SAMS−FF DATA, 6.55 Hz

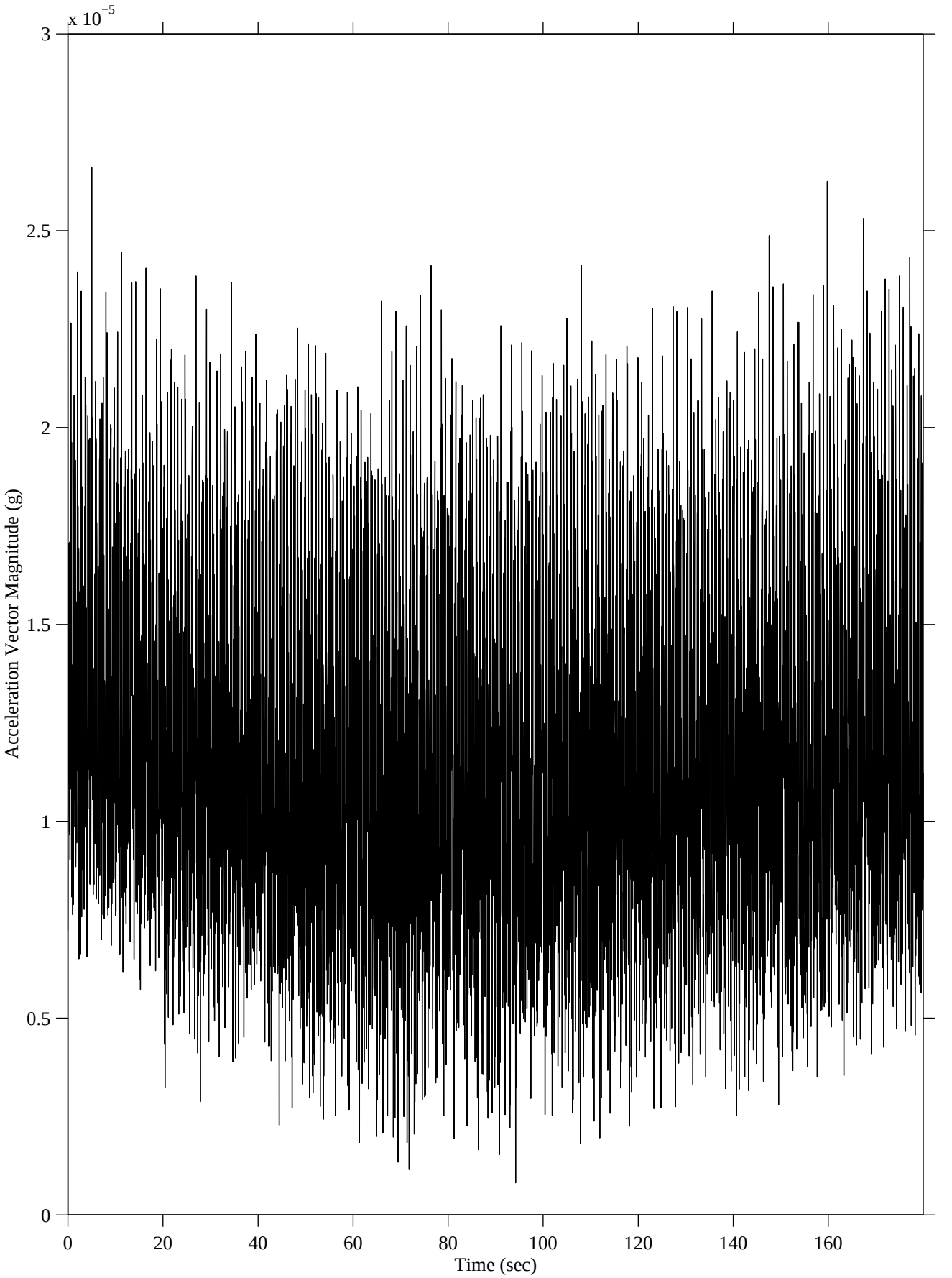
MET Start at 000/00:02:05.027

DARTFire Mission

fs= 25 samples per second

Acceleration Vector Magnitude for Fs=25

SAMS−FF Coordinates



MATLAB: 11−Aug−1998, 06:02 pm

Head SAMS−FF DATA, 6.55 Hz

DARTFire Mission

MET Start at 000/00:02:05.027, Hanning k=8

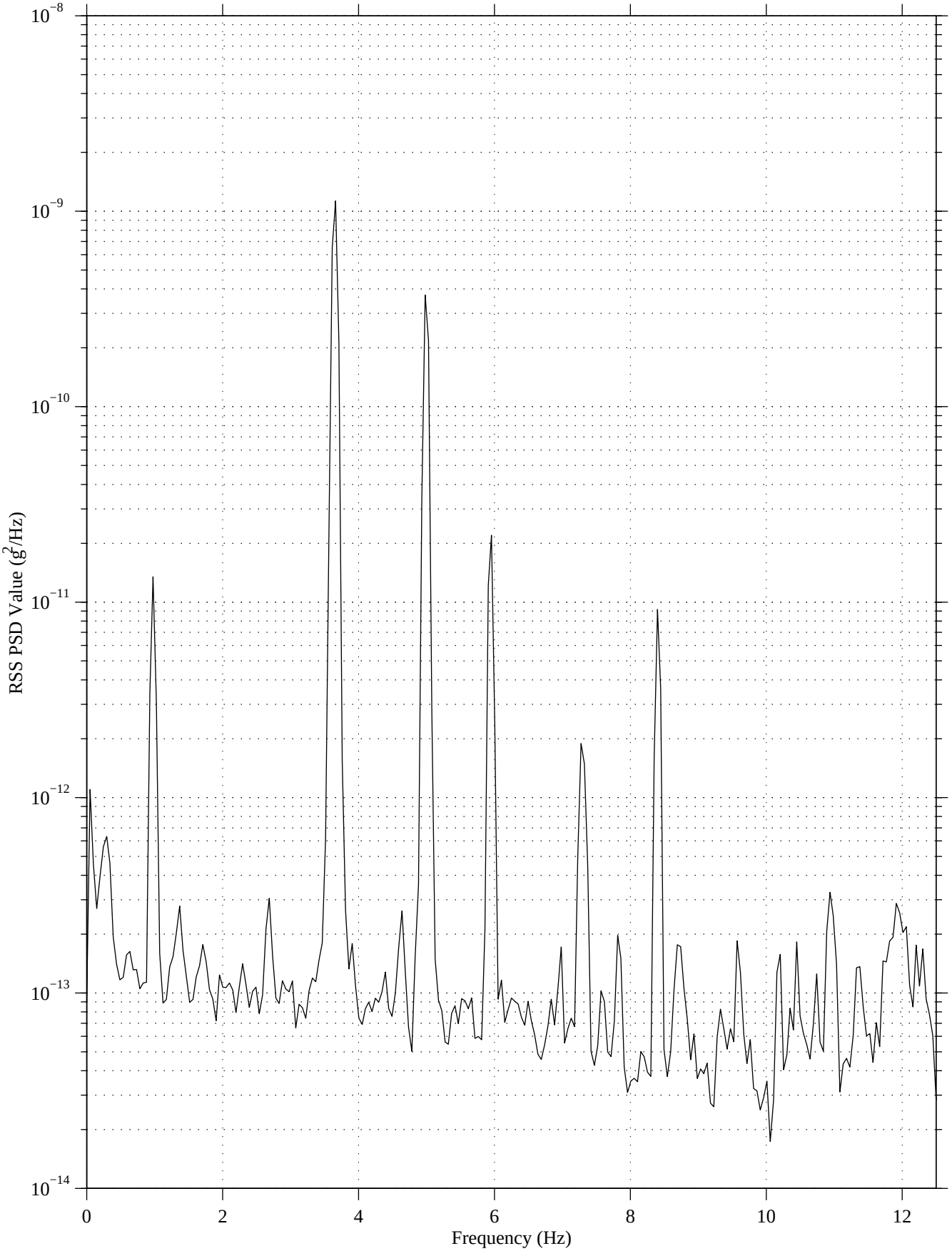
RSS Power Spectral Density for Fs=25

fs= 25 samples per second

SAMS−FF Coordinates

dF= 0.048828 Hz

T= 179.988 sec

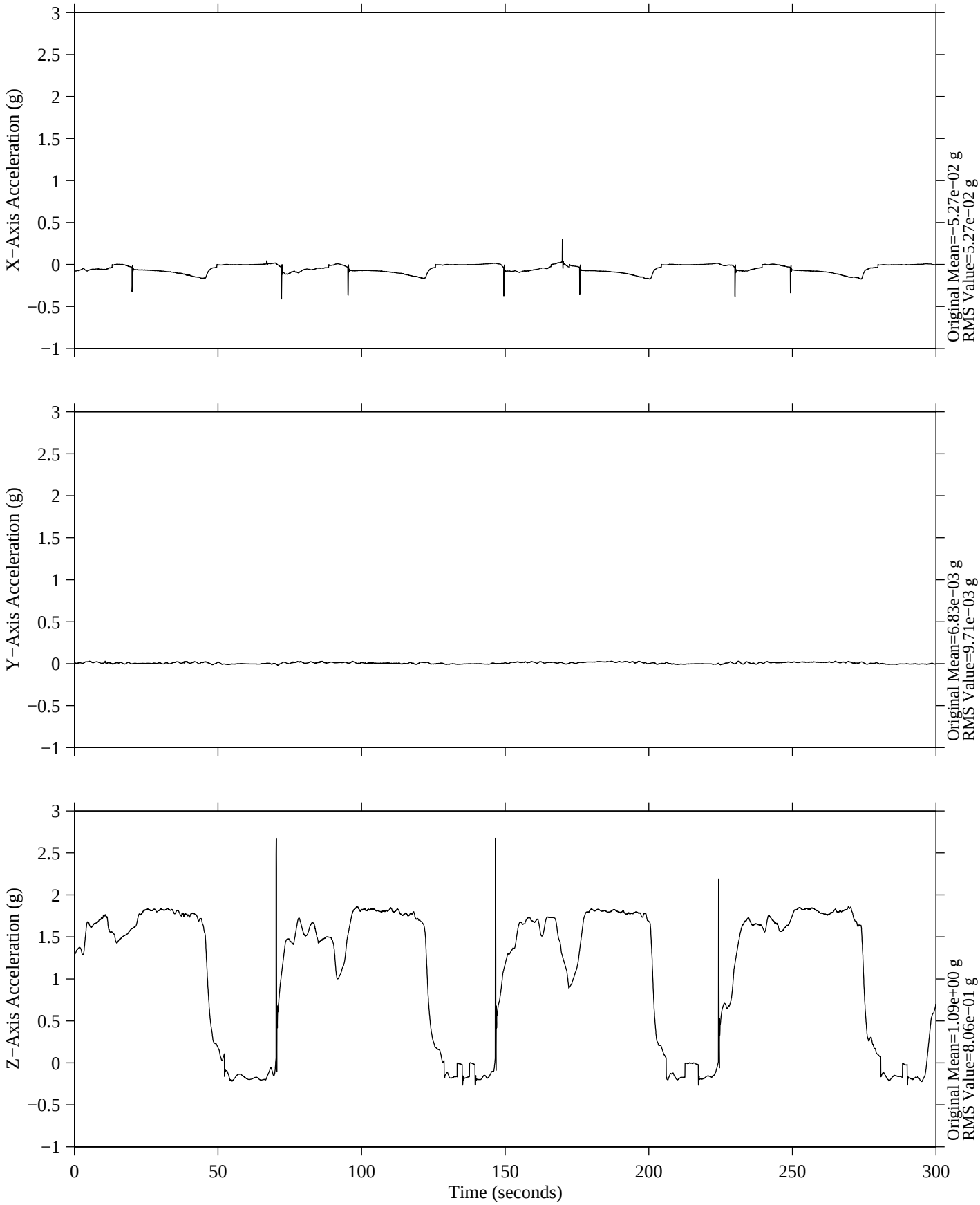


MATLAB: 11−Aug−1998, 06:05 pm

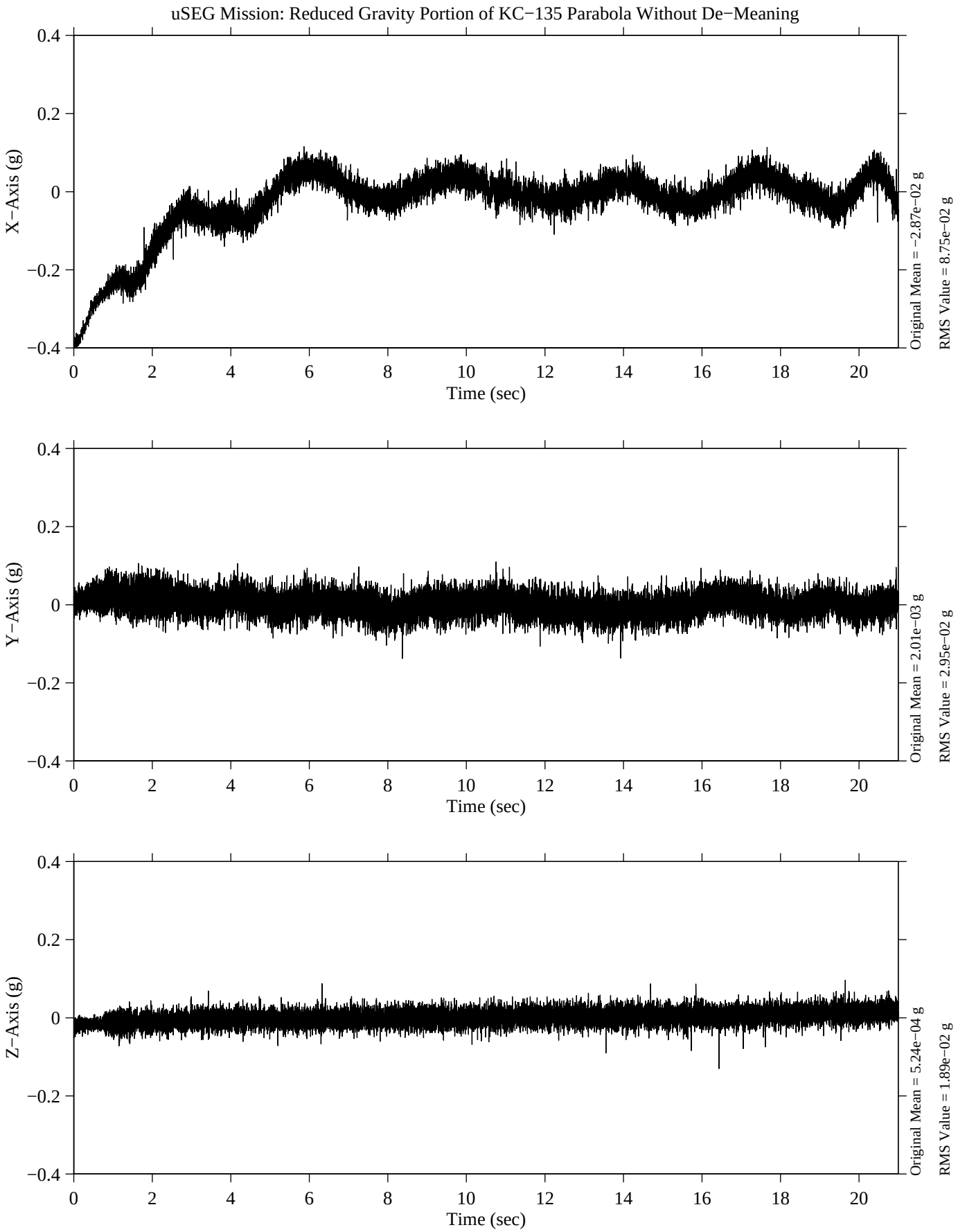
Head C, 5.0 Hz
fs=25.0 samples per second

KC−135
KC−135 Coordinates
T=300.0 seconds

Multiple KC−135 Parabolas Without De−Meaning
MET Start at 055/15:09:59.992



MATLAB: 13−Aug−1998, 10:35 am


uSEG Mission: Reduced Gravity Portion of KC−135 Parabola Without De−Meaning
X−Axis (g)
Y−Axis (g)
Z−Axis (g)
Time (sec)
Original Mean = −2.87e−02 g
RMS Value = 8.75e−02 g
Original Mean = 2.01e−03 g
RMS Value = 2.95e−02 g
Original Mean = 5.24e−04 g
RMS Value = 1.89e−02 g

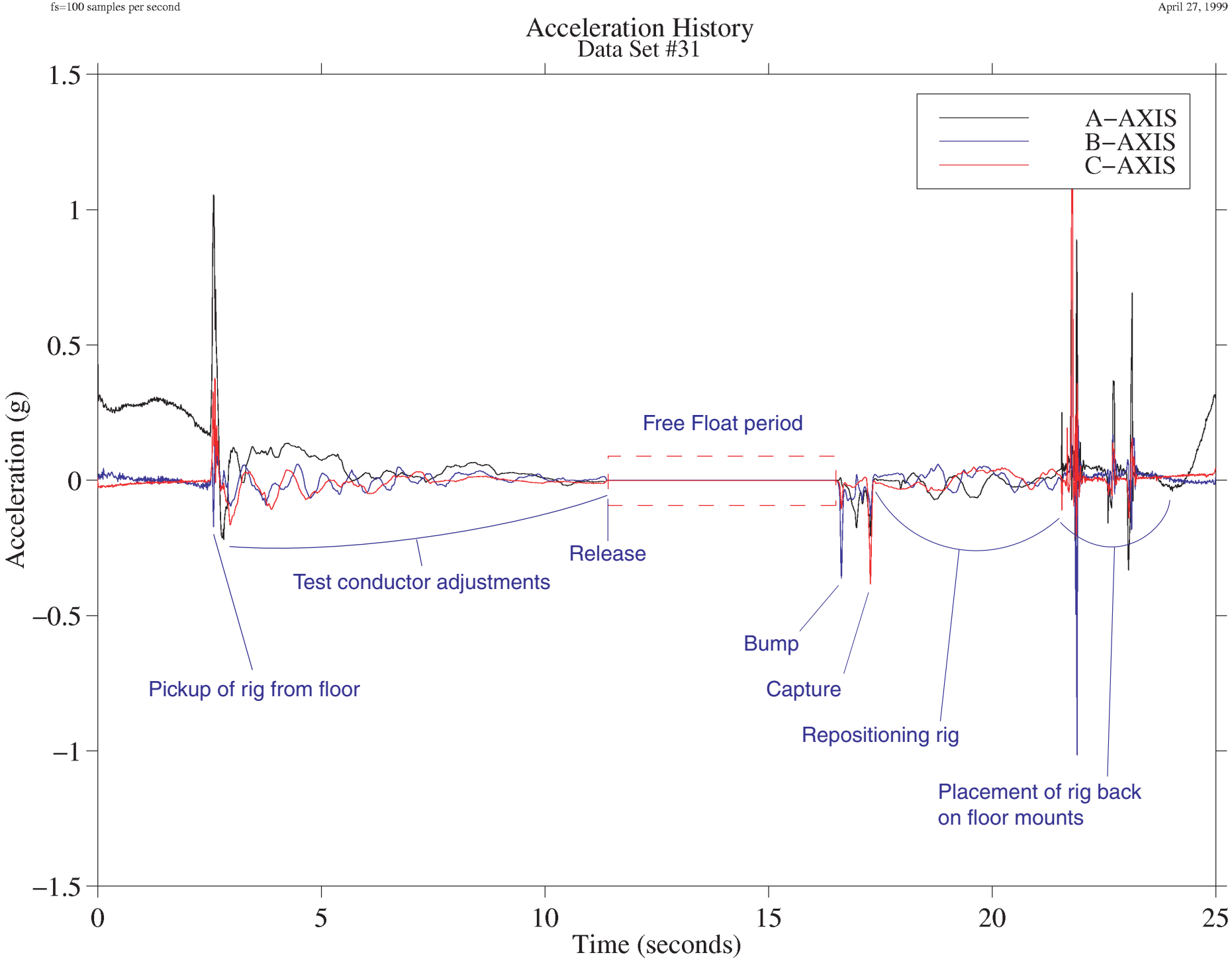


Figure 8-6: SAMS-FF Data Recorded in Support of SAL Experiment Showing Free-Float Interval

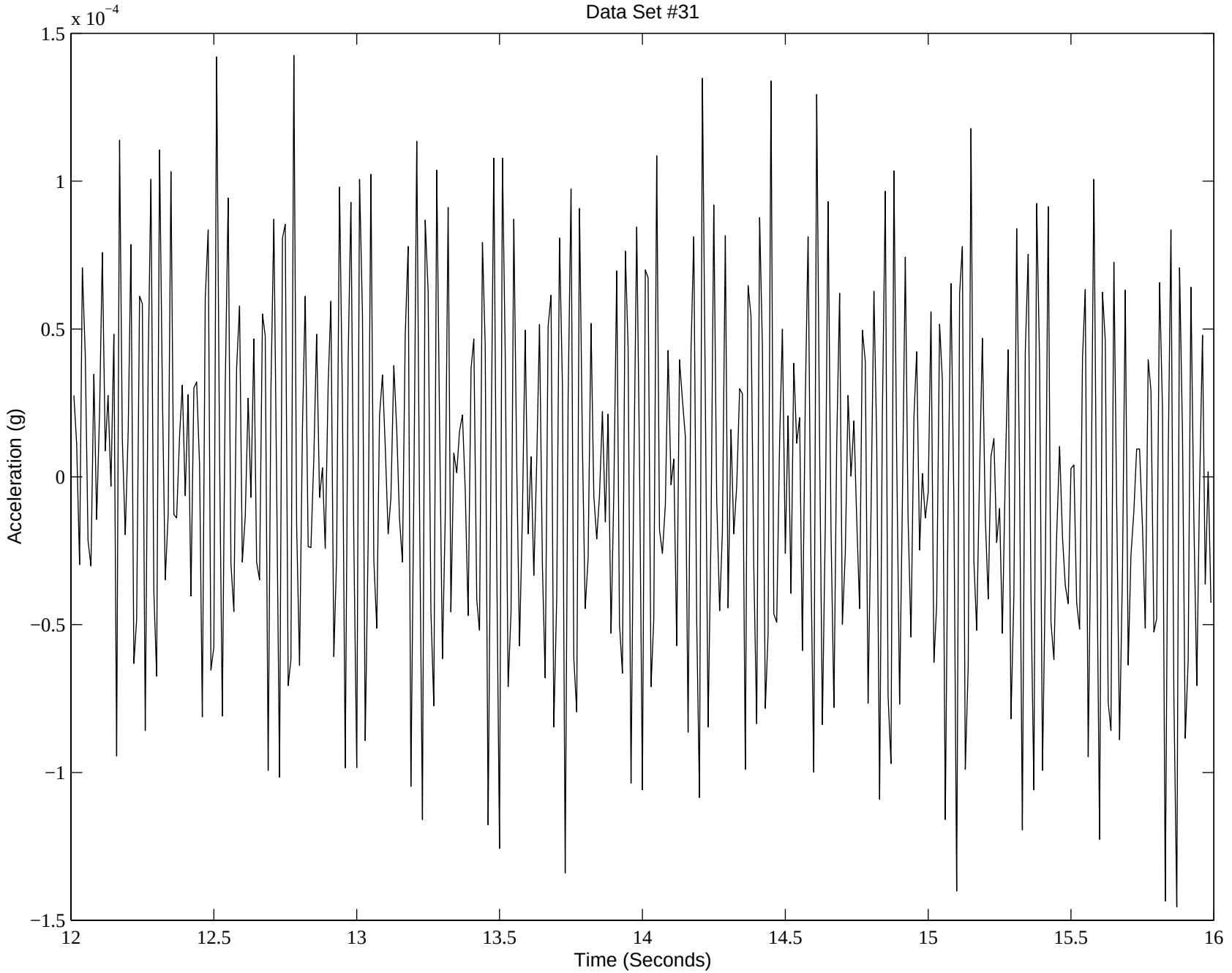


Figure 8−7: Enhancement of the Free Float Period for the Z−Axis