Results of Spacecraft Loads and Acoustic Measurement (SLAM) System Flight on Advanced Composition Explorer (ACE) Spacecraft

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Credits

- NASA Code Q
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Outline

- Background
- Description of System/Transducers
- Transducer locations
- Flight Events
- Sample Data
- Conclusions

Background - ACE

- Parked at L1 - 1/100 of Sun-Earth distance
- Samples low-energy particles of solar origin
- Samples high-energy galactic particles
- “Space Weather” warning of 1-hour

Background - SLAM

- Lack of recent measurements of payload flight environment
- 2nd design - first flew on Lewis
- Used spare parts from other projects

Description of System

- Overall Weight: < 11.4 kg (< 25 lbs)
- SLAM System Power output: 67 Watts
- Operation Time: ~ 7 minutes
- Data channels: 9 high frequency, 9 low frequency
- Spacecraft Interfaces:
  - Minimum of 4 pins in the umbilical cable
  - RF lanyard disconnect for antenna connection to vehicle
- Launch Vehicle Interface:
  - Fairing-mounted omni antenna (S band)
  - Blockhouse switch box (connected through umbilical)
- Special features:
  - Automatic timer to turn off after 7 minutes.
  - Contains low voltage cut-off to insure safety.
  - Samples and transmits data real time (no data storage available).

Transducer Types

- Endevco 2221F High Frequency Accelerometers
  - Frequency Response: 5 to 2000 Hz
  - Range set to: +/-20g's
  - Sampling rate: 10k samples/second

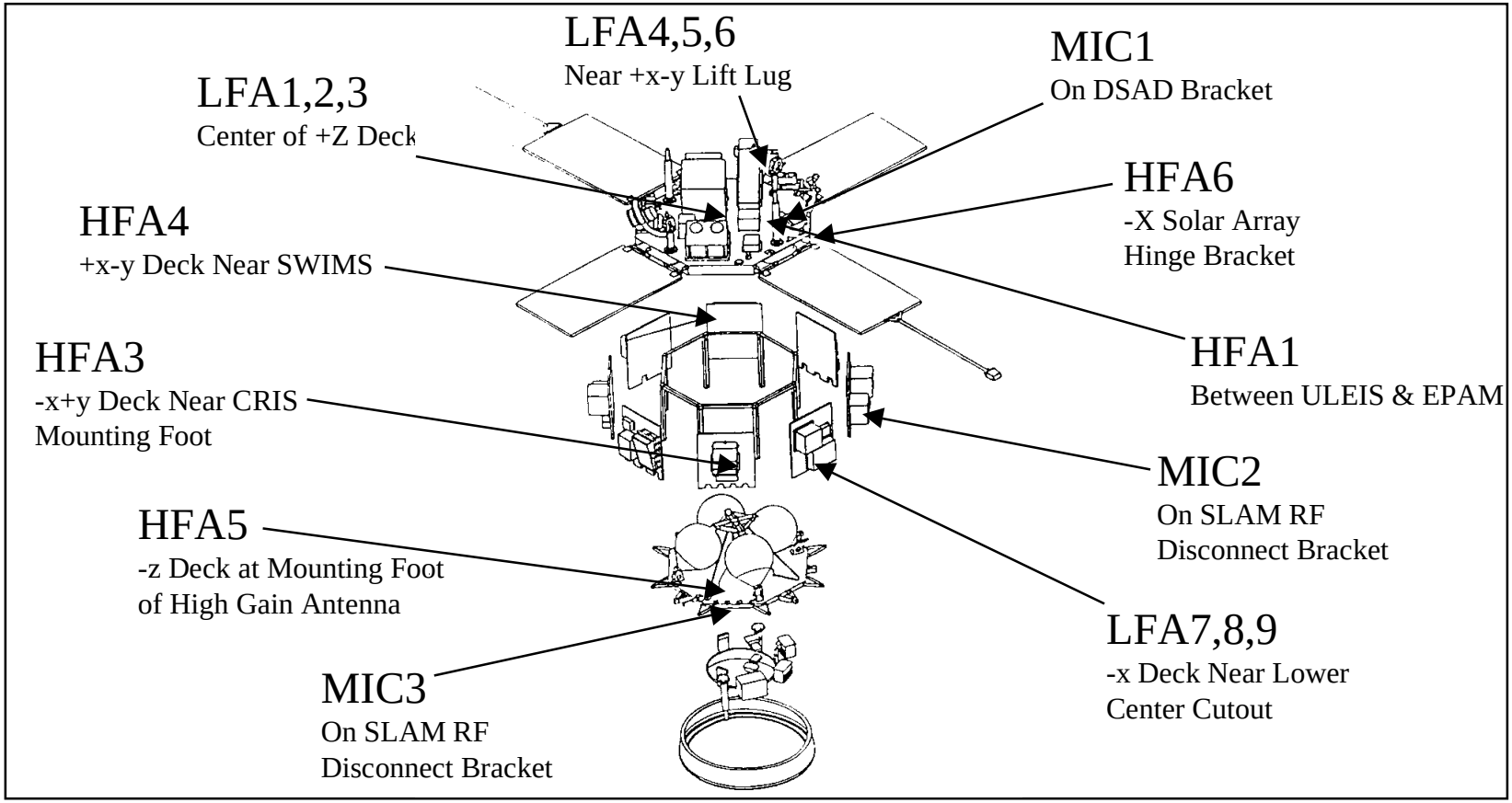
- Kistler 8304A(X) Low Frequency Accelerometers
  - Frequency Response: 0 to 100 Hz
  - Range set to: +/-25g's
  - Sampling rate: 1k samples/second

- Endevco 2510 Microphones
  - Frequency Response: 5 to 2000Hz
  - Range set to: +/- .1305 psi
  - Sampling rate: 10k samples/second

Transducer Locations - Table

DESCRIPTION	DESIGNATOR
Mic on DSAD Bkt (+Z Dk) Outside Ther Blkt	MIC1
Mic on SLAM RF Discnt Bkt Outside Ther Blkt (-X-Y Dk)	MIC2
Mic on High Gain Antenna Mtg Foot (-Z Dk)	MIC3
High Freq Accel on +Z Dk, Btwn EPAM & ULEIS	HFA1
High Freq Accel Channel to be used for CRIS Load Cells	HFA2
High Freq Accel on -X+Y Dk, @ Base of CRIS	HFA3
High Freq Accel on +X-Y Dk, Near SWIMS	HFA4
High Freq Accel on -Z Dk, @ Mtg Foot of High Gain Ant	HFA5
High Freq Accel on -X Solar Array Hinge Bracket	HFA6
Low Freq Accel on +Z Dk, Ctr	LFA1(+x)
Low Freq Accel on +Z Dk, Ctr	LFA2(+y)
Low Freq Accel on +Z Dk, Ctr	LFA3(+z)
Low Freq Accel on +Z Dk, -Y Side	LFA4(+x)
Low Freq Accel on +Z Dk, -Y Side	LFA5(+y)
Low Freq Accel on +Z Dk, -Y Side	LFA6(+z)
Low Freq Accel on +Z Dk, Lwr Ctr	LFA7(-x top)
Low Freq Accel on +Z Dk, Lwr Ctr	LFA8(-y side)
Low Freq Accel on +Z Dk, Lwr Ctr	LFA9(+z)

Transducer Locations - Sketch



Flight Event Descriptions

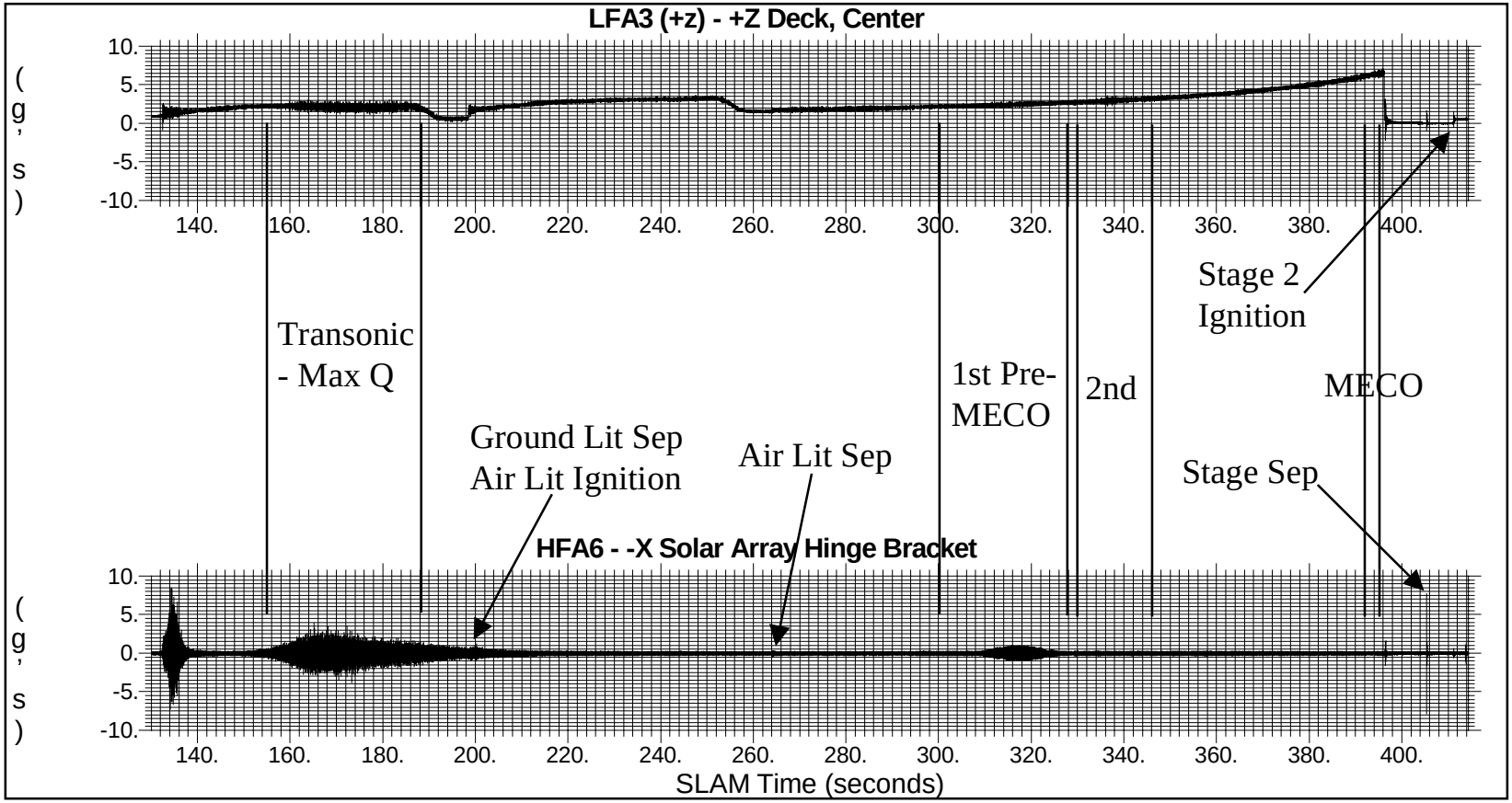
- Lift-Off
- Transonic: Buffeting near Mach 1
- Max-Q
- Pre-MECO: 26-33 Hz Oscillations
- MECO: 16-18 Hz Oscillations

Flight Event Times

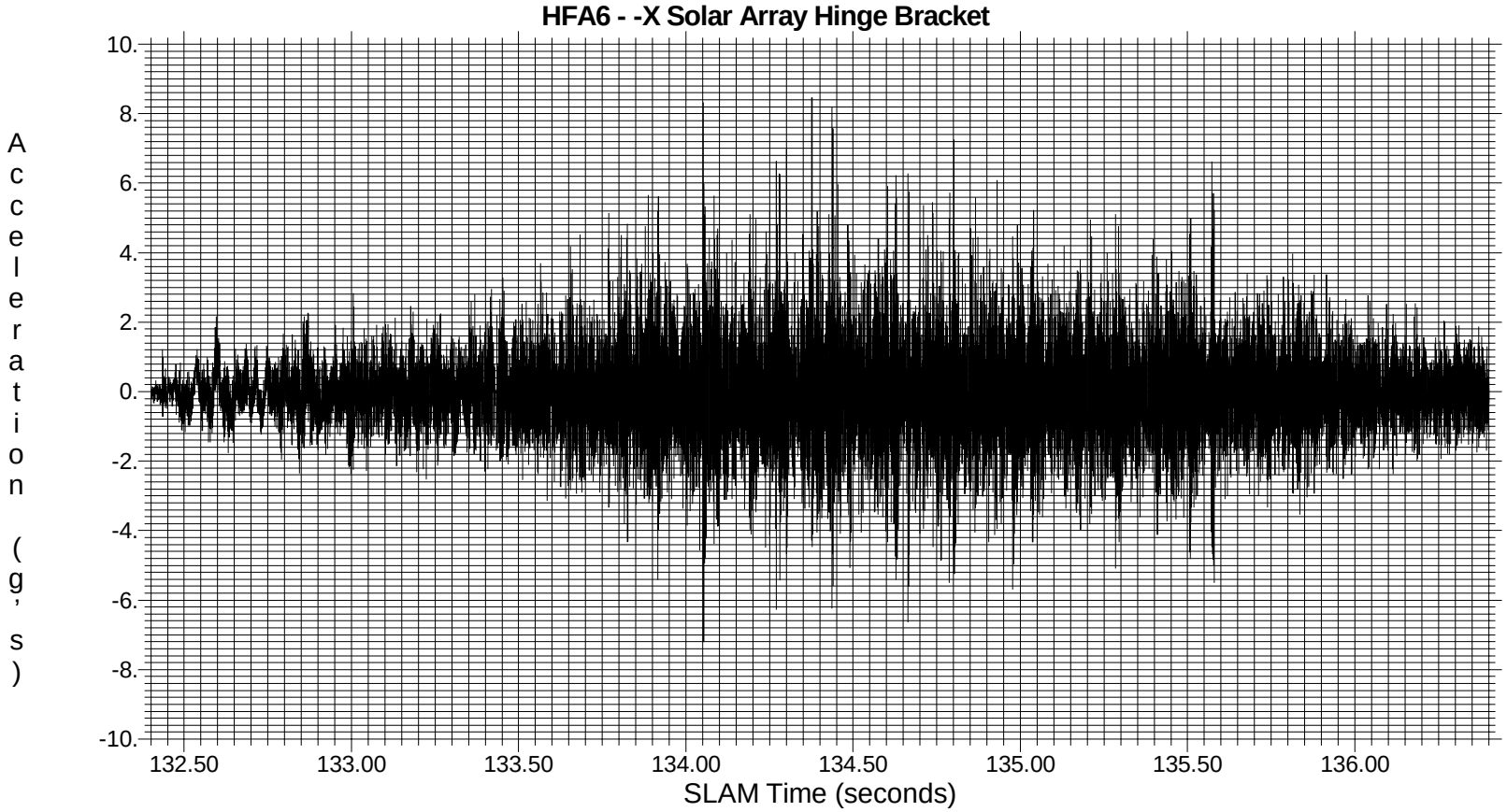
Main Engine Ignition	132.4 sec
Ground Lit Solid Motor Ignition	132.5 sec
Liftoff	132.7 - 139 sec
Transonic - Max Q	155 - 188 sec
Air Lit Solid Motor Ignition	198.2 sec
Ground Lit Solid Motor Separation	198.7 sec
Air Lit Solid Motor Separation	264.2 sec
1st Pre-MECO	300 - 328 sec
2nd Pre-MECO	330 - 346 sec
MECO	392 - 395 sec
Stage 1/2 Separation	405 sec
Stage 2 Ignition	411 sec
Fairing Separation	415 sec

- Launch Date - August 25, 1997
- Liftoff (T0) occurred at 132.67 seconds SLAM time which corresponds to 237 14 39 0.54 GMT

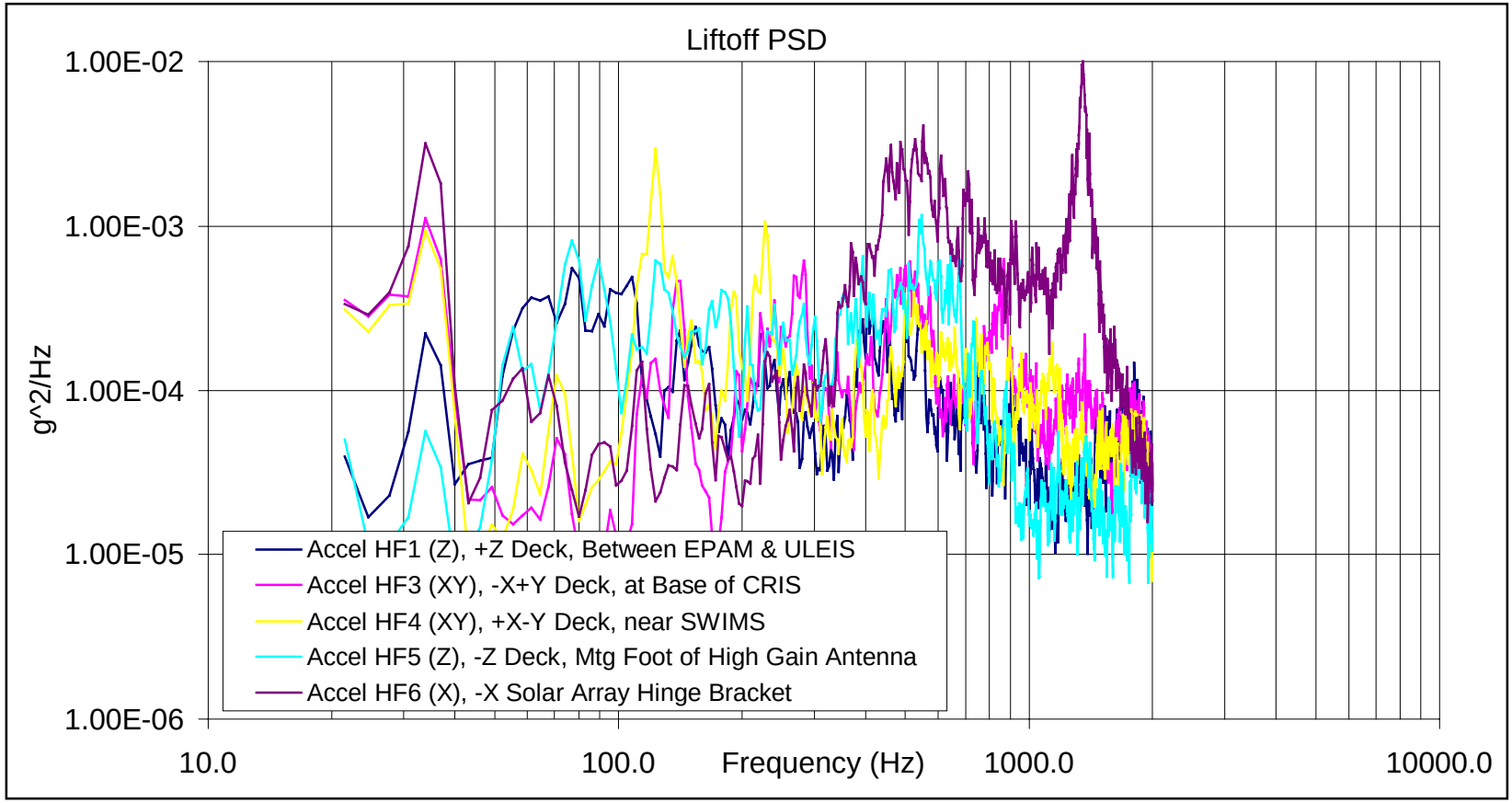
Flight Events Identified



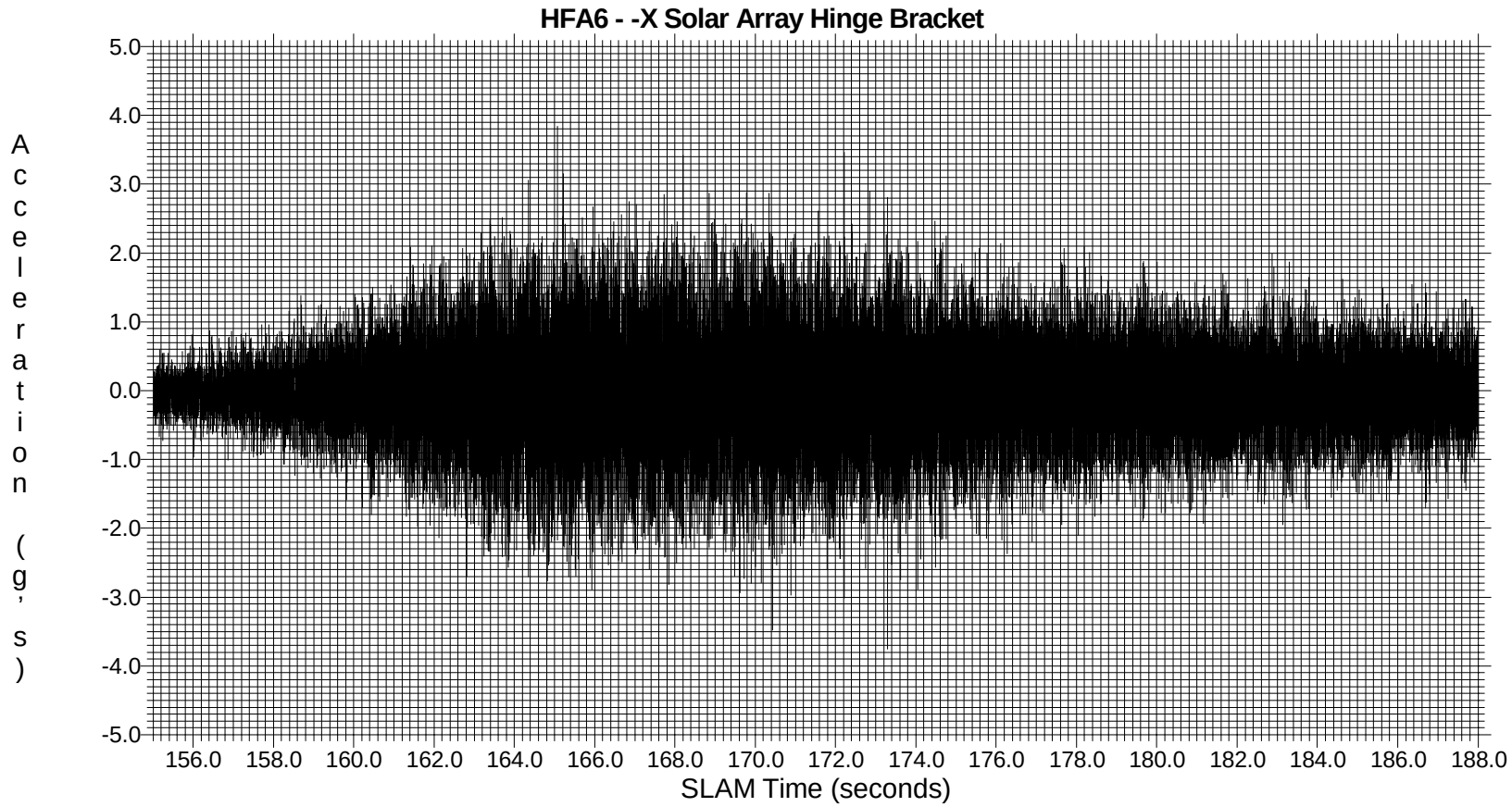
Liftoff Time-History



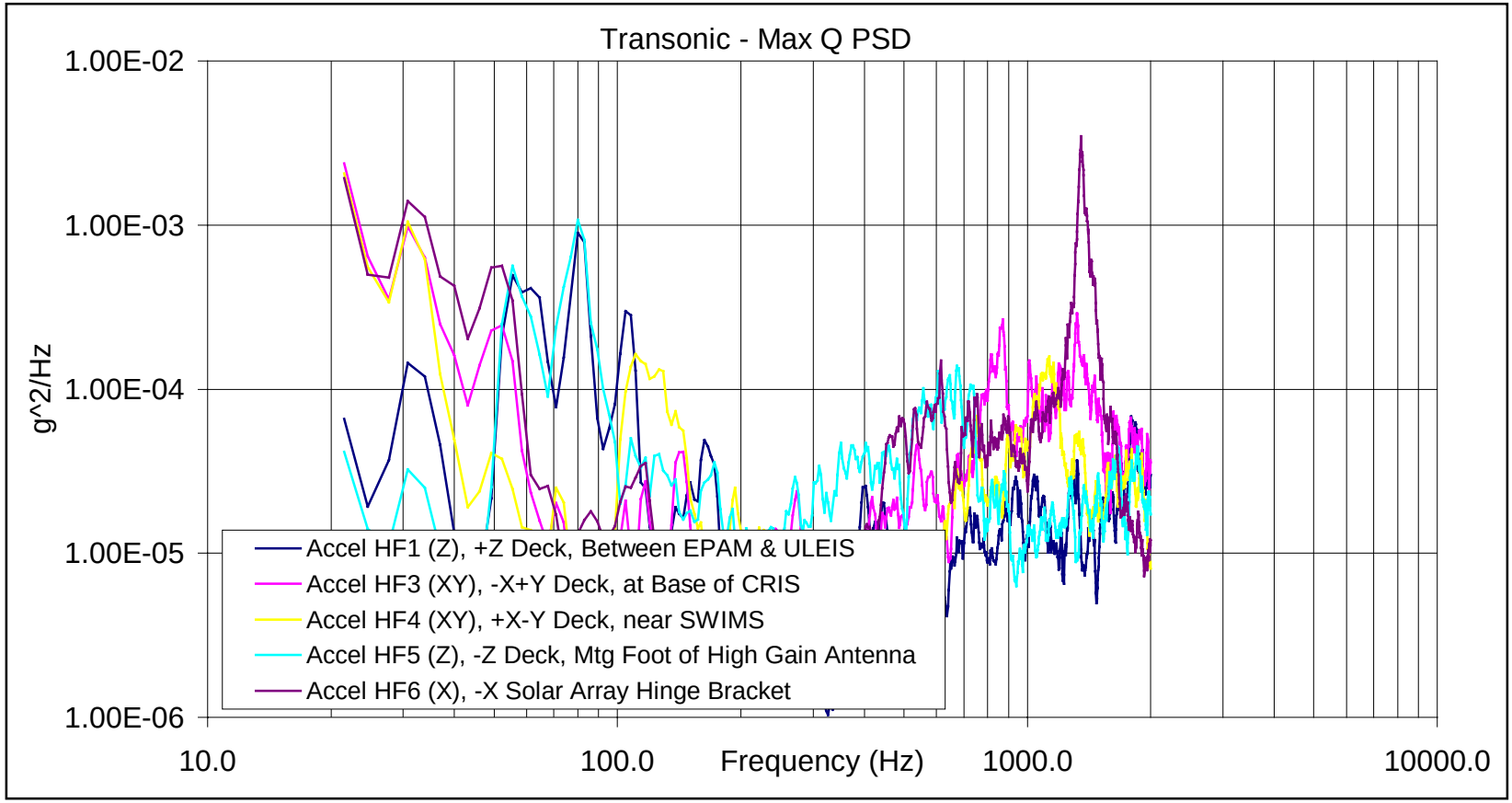
Liftoff PSDs



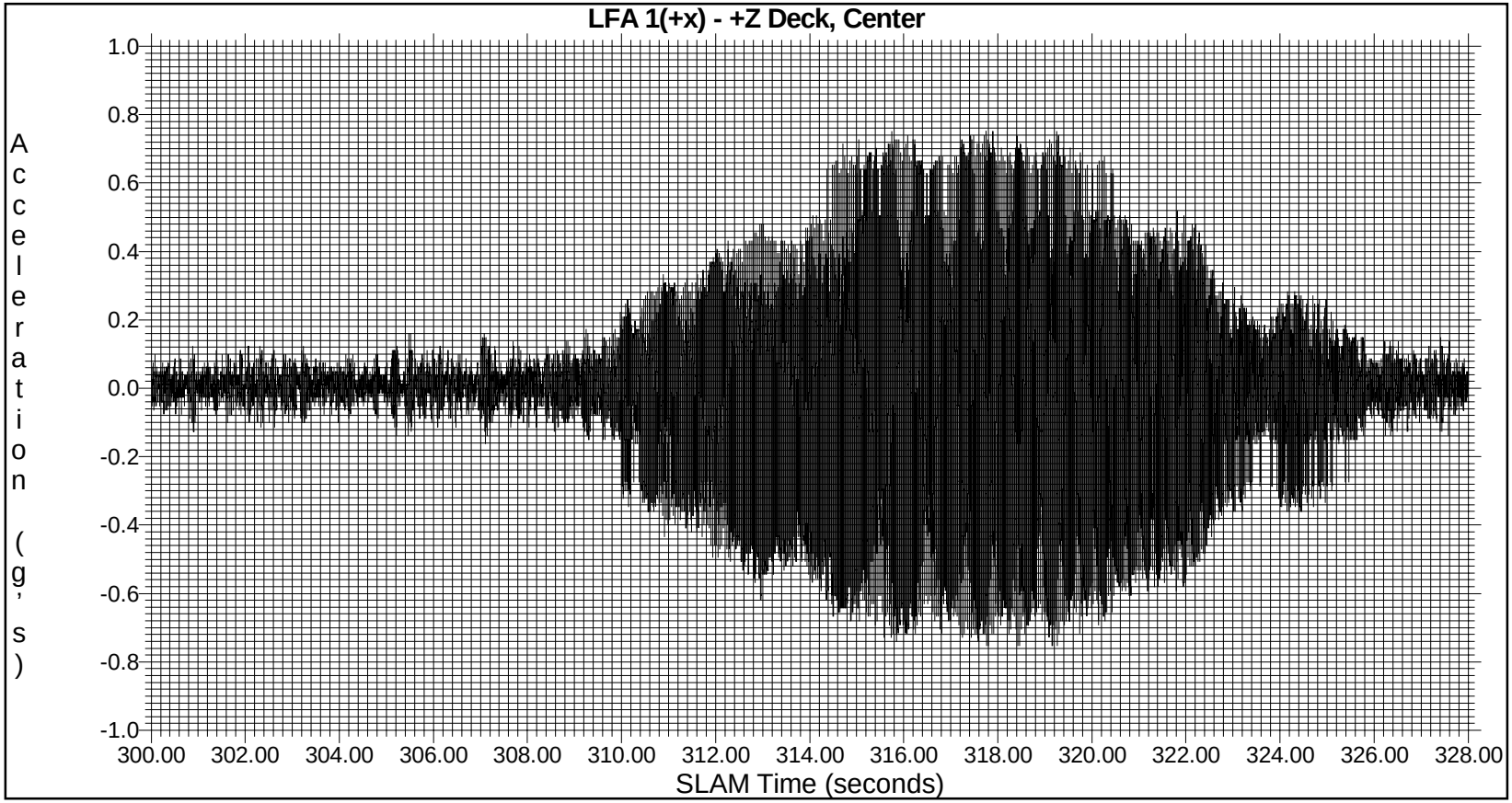
Transonic Max Q Time-History



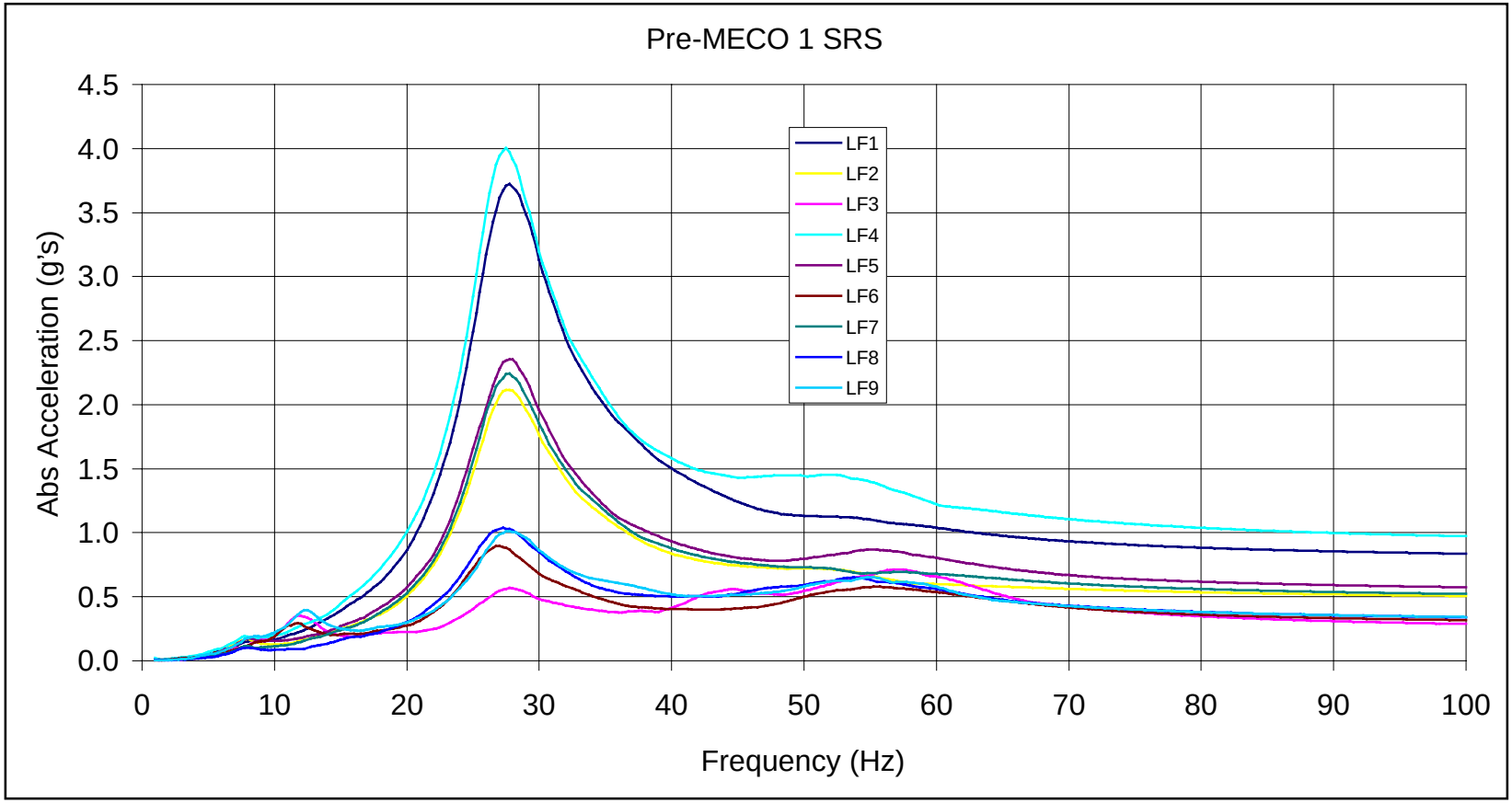
Transonic Max Q PSDs



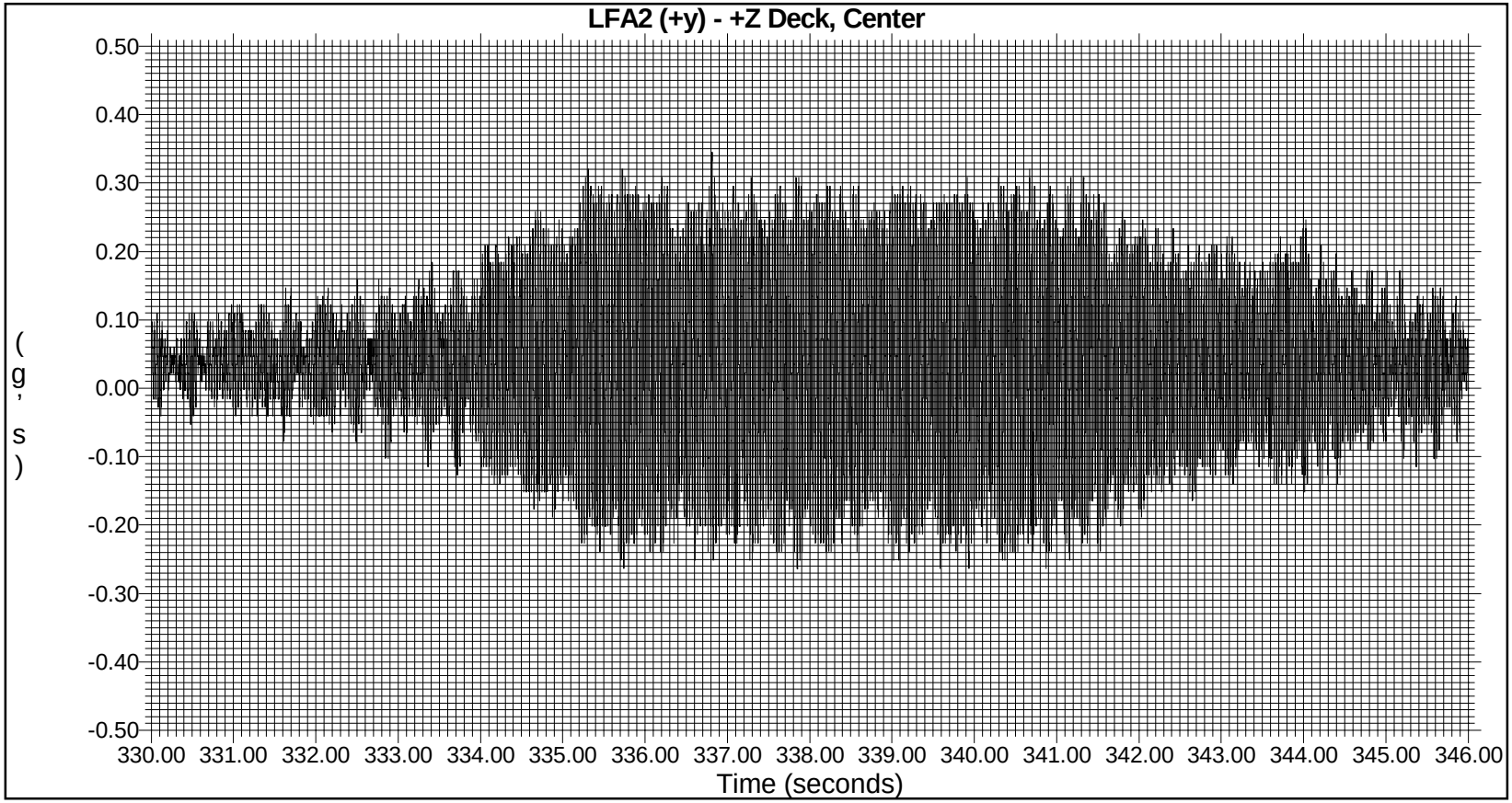
Pre-MECO1 Time-History



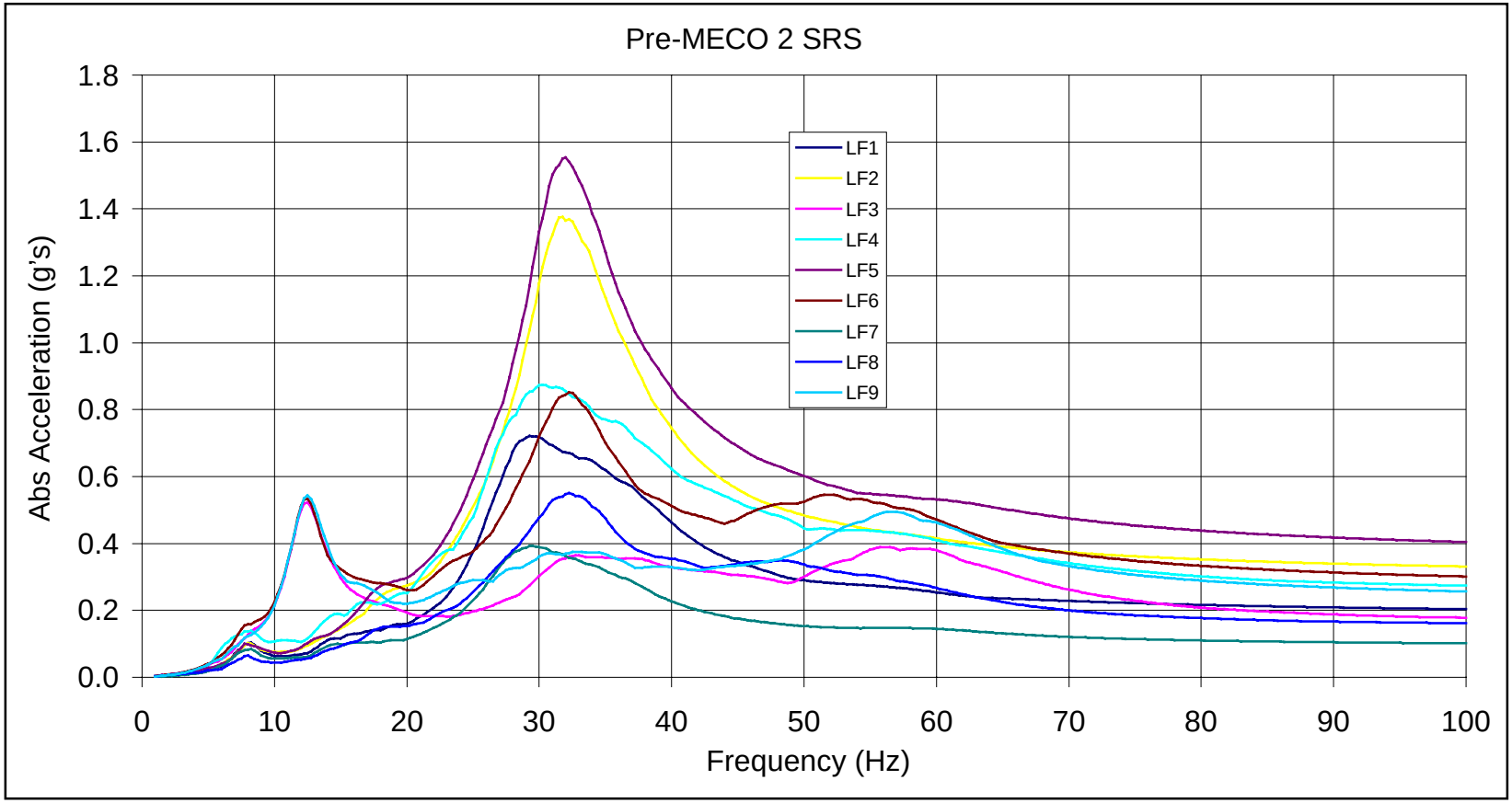
Pre-MECO1 SRS's



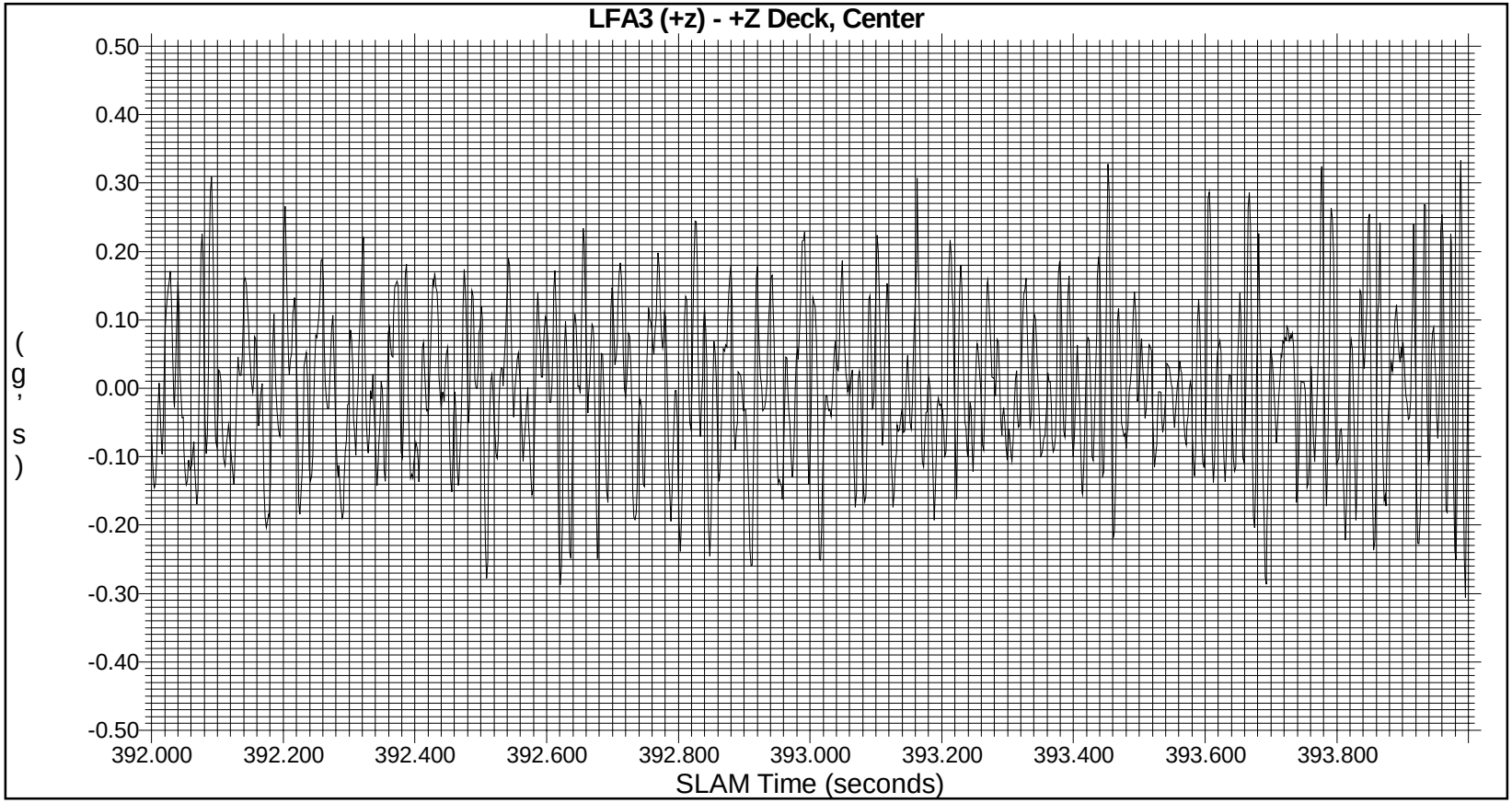
Pre-MECO2 Time-History



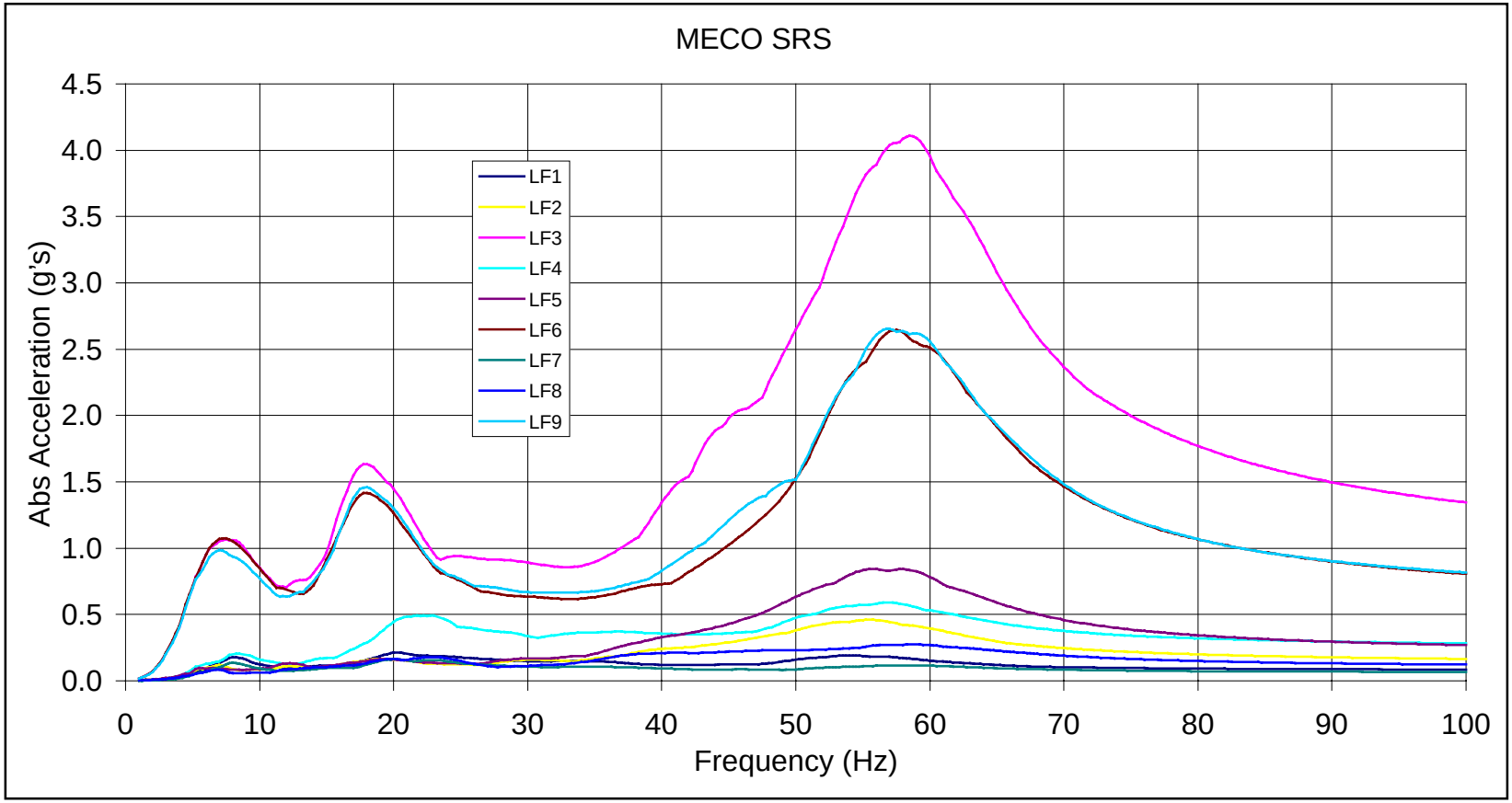
Pre-MECO2 SRS



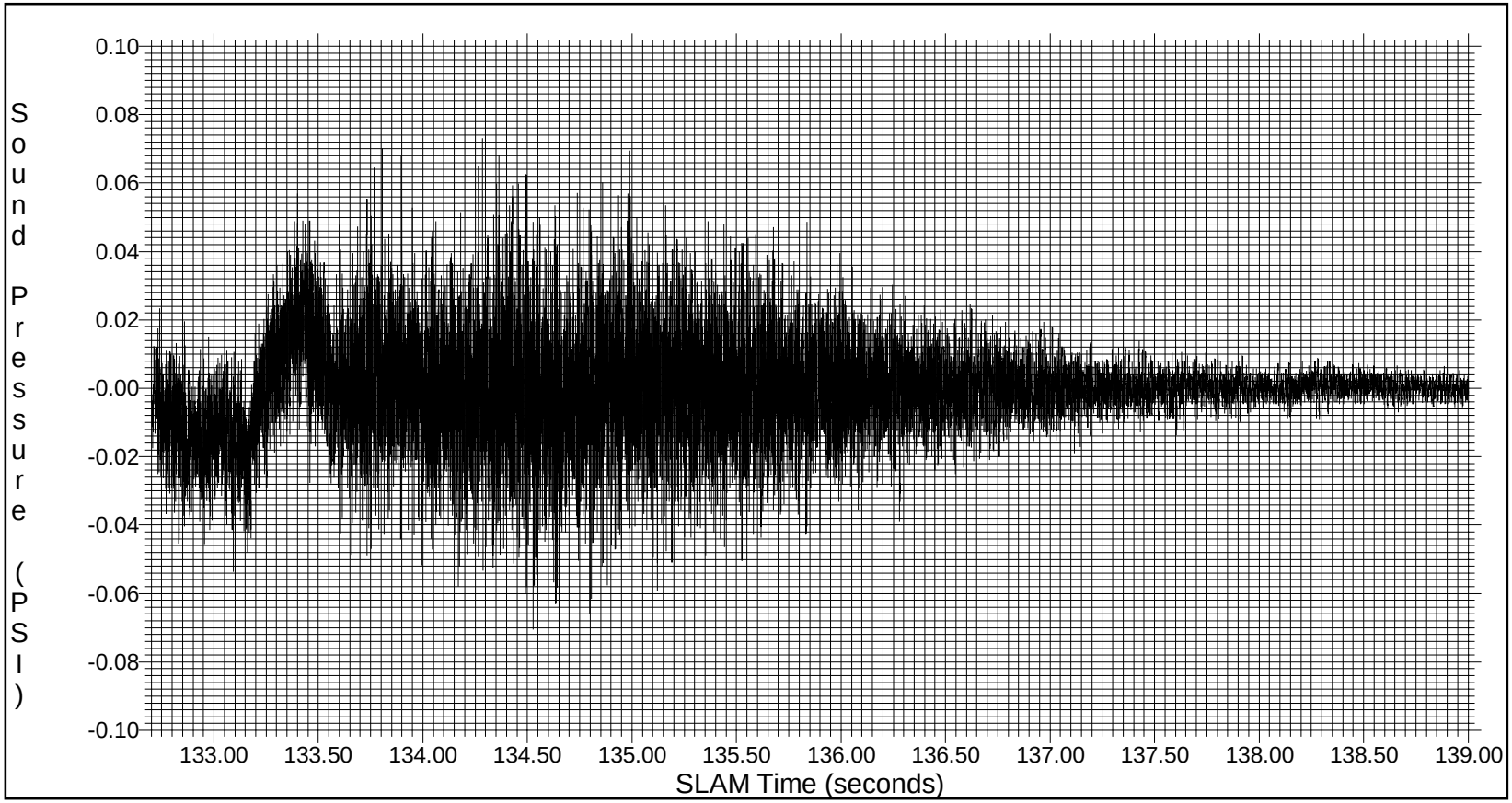
MECO Time Histories



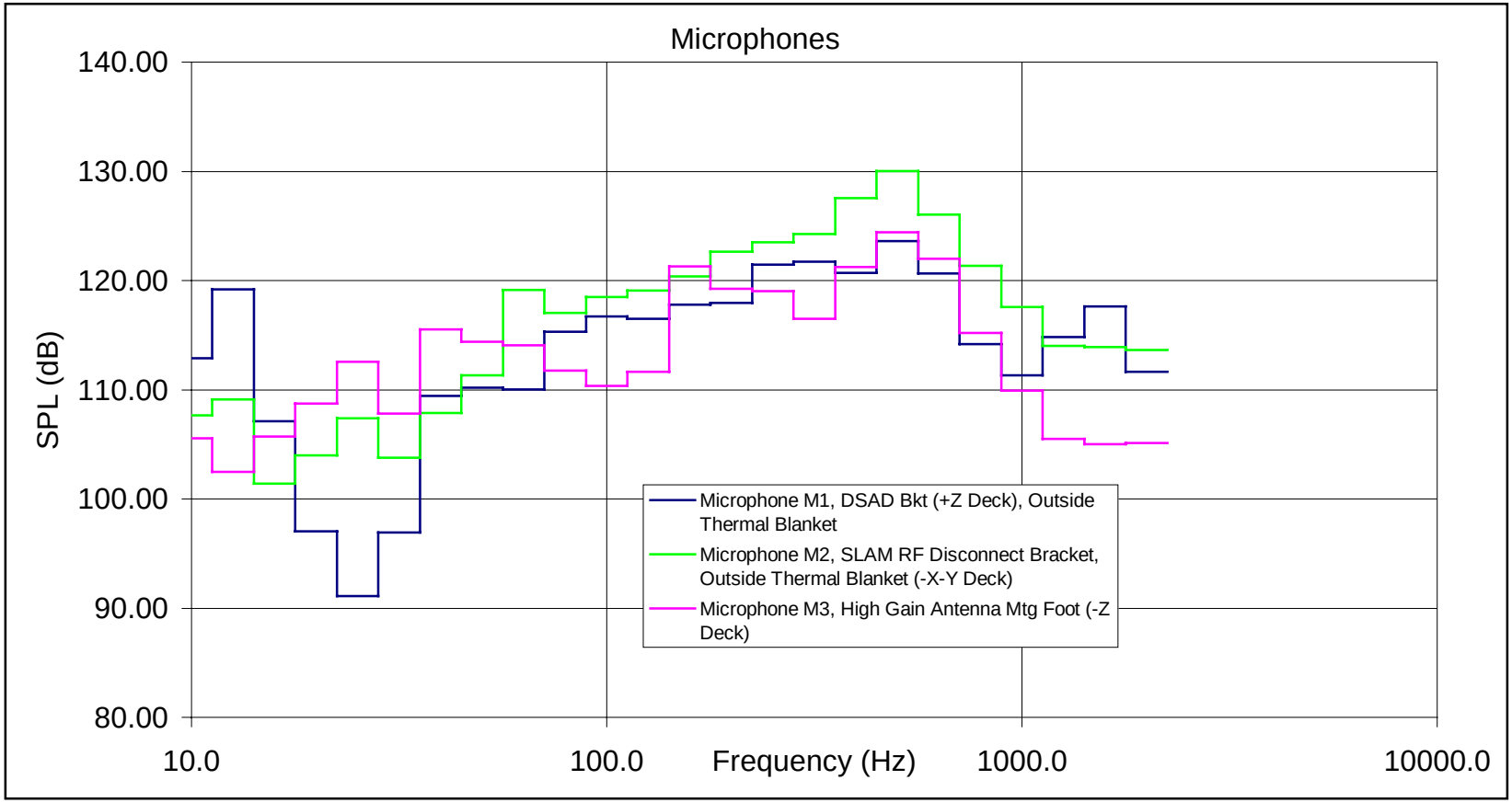
MECO SRS


MECO SRS
Abs Acceleration (g's)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
LF1
LF2
LF3
LF4
LF5
LF6
LF7
LF8
LF9

Microphone Liftoff Time History



Microphone 1/3-Octave Spectrum



Conclusions

- More work to be done:
  - compare to ground tests
  - compare to predicted flight loads

- Publication of results

Websites

- For background info and some plots:
  http://analyst.gsfc.nasa.gov/slam/

- For time history data and more plots:
  ftp://dynalpha.gsfc.nasa.gov/pub/ace_slam/