

Ares I-X 30 Day Report



*Bob Ess, Mission Manager
Marshall Smith, SE&I Chief*

December 3, 2009





Post Flight Data Schedule

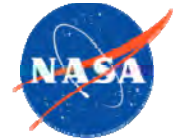


- ◆ **This is the 30day report based on initial assessment of preliminary data**

- ◆ **Future reports**
 - 60 day report Late January
 - 90 day report Late February



Outline



- ◆ **Ground Systems**
- ◆ **Guidance, Navigation and Control**
- ◆ **Roll Response**
- ◆ **Vehicle Response**
- ◆ **Control System Performance**
- ◆ **Structural Damping**
- ◆ **Thrust Oscillation**
- ◆ **Stage Separation**
- ◆ **Connector Assessment**
- ◆ **USS Splashdown**
- ◆ **Data Recorder**
- ◆ **FS Hardware Assessment**



Ground Systems (GS)



- ◆ **Completely successful Fly Away Maneuver**
 - Designed to protect higher level structures
- ◆ **Minor damage was expected at lower levels**
 - Considered acceptable
 - Shuttle has routinely causes some damage
 - Plume impingement locations were different than Shuttle that had not been hardened yet



◆ **Also experienced some damage in the flame trench to the fondue fire.**

- West side wall had some damage on the flame fence wall. No obvious brick damage was observed.
- East wall damage was near a suspect location identified in the pre-launch inspection.





GS

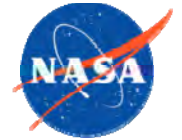


- ◆ PAD designers were very satisfied with results
- ◆ This flight will help Ares I structures designers as they design for an Ares I FAM





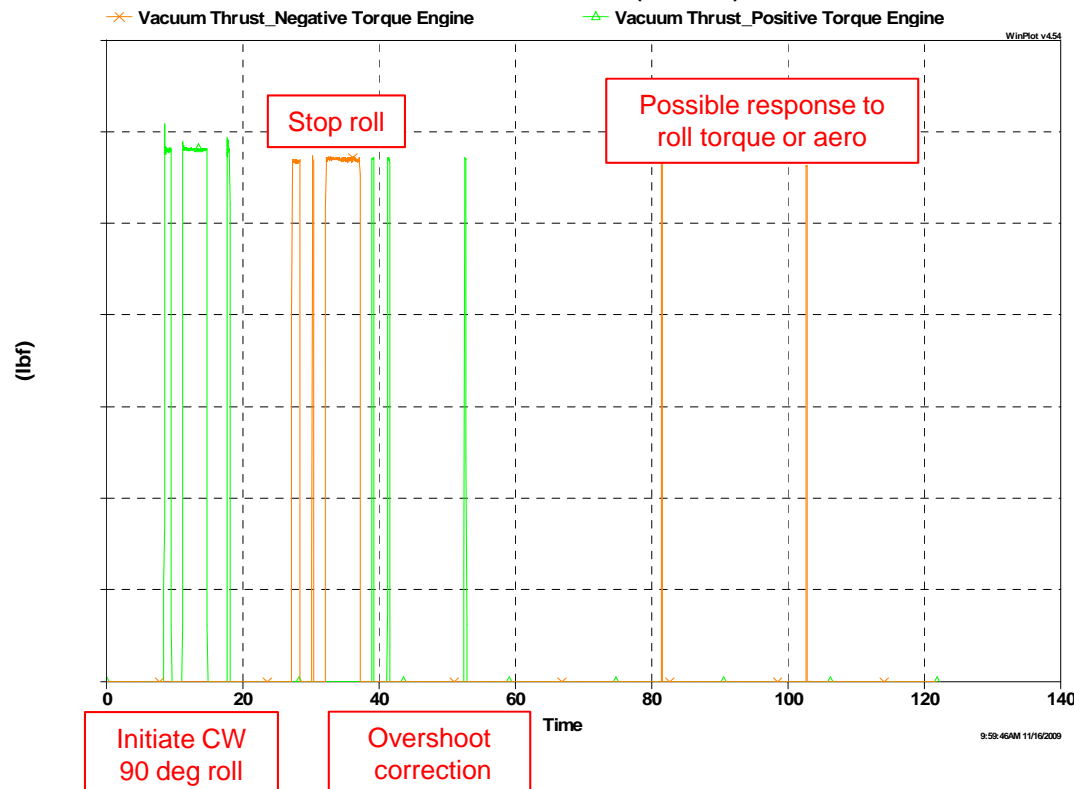
Guidance, Navigation and Control



- ◆ **Preliminary lift off drift analysis shows the vehicle performed as expected.**
 - Aft Skirt location initially translates toward the FSS due to the Fly-Away Maneuver
 - Aft Skirt travels a very minimal amount toward the FSS
- ◆ **Vehicle bending response was as expected**

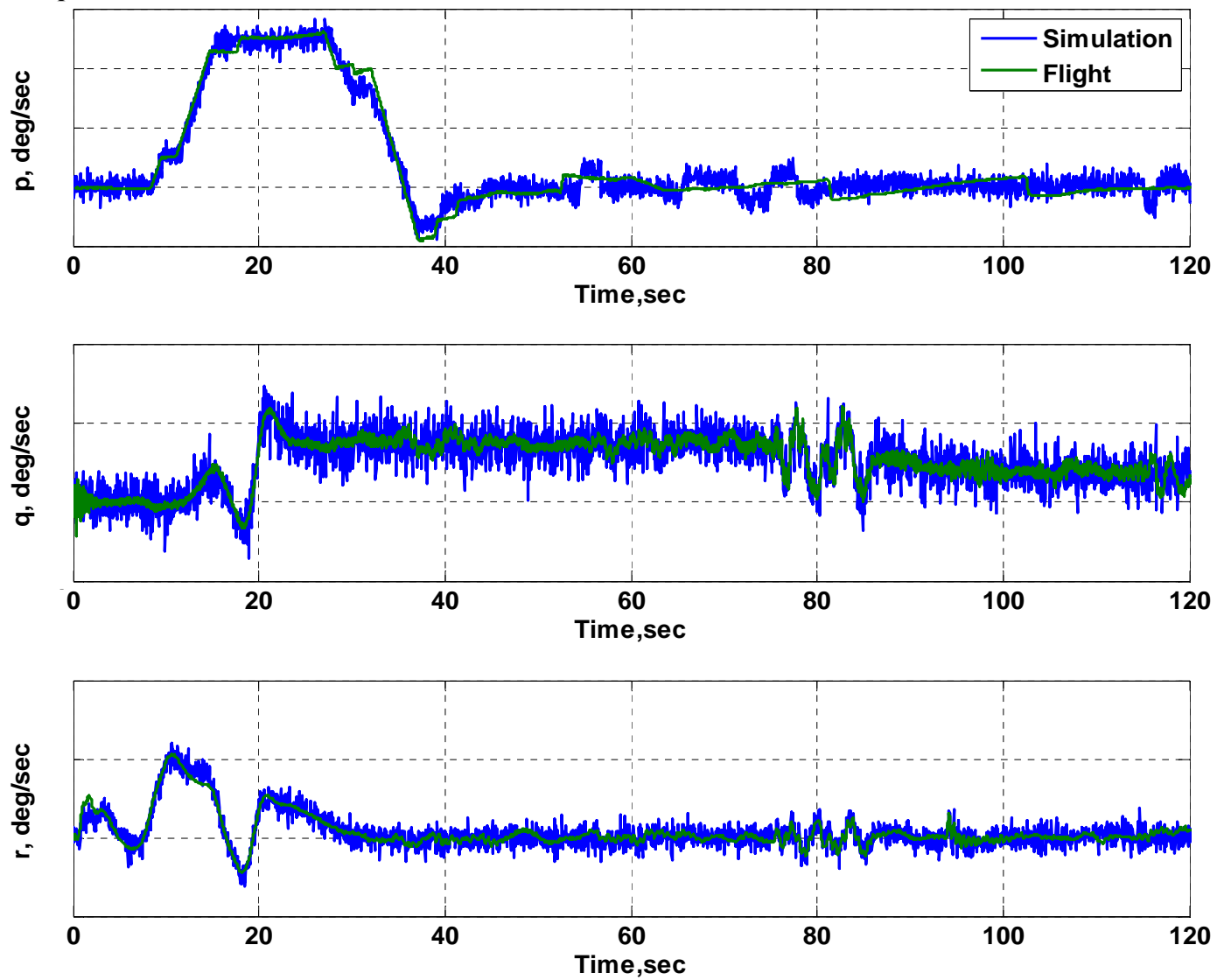
Roll Torque Estimate

- ◆ **Primary Objective 5 intended to estimate roll torque**
 - Low roll torques observed
 - Estimate of roll torque assessed by the Roll Control System firings
 - Very few firings required. Only a couple that may be related to roll torque
 - Simulations show that roll torque may be primarily due to aero data as opposed to the motor



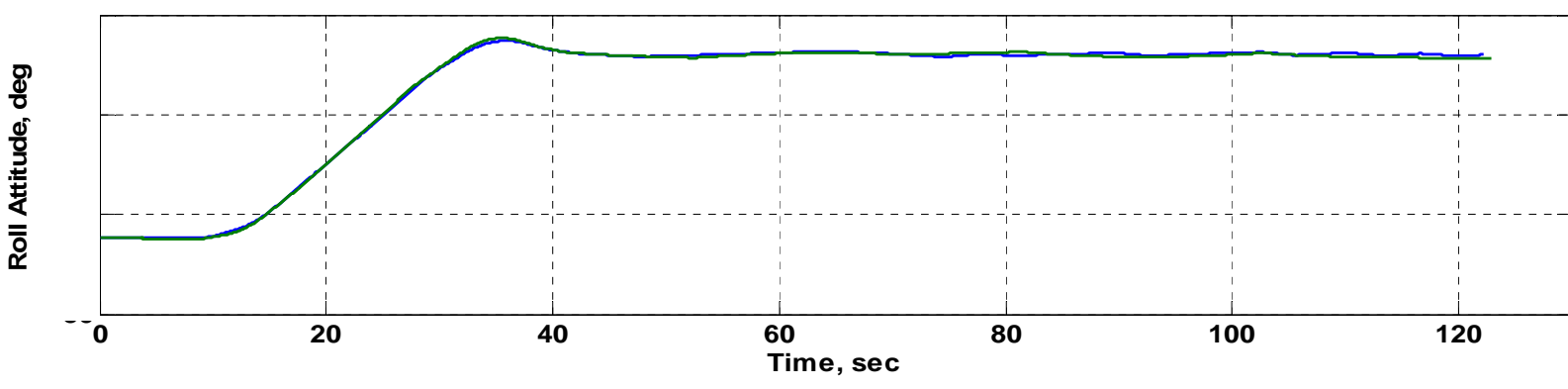
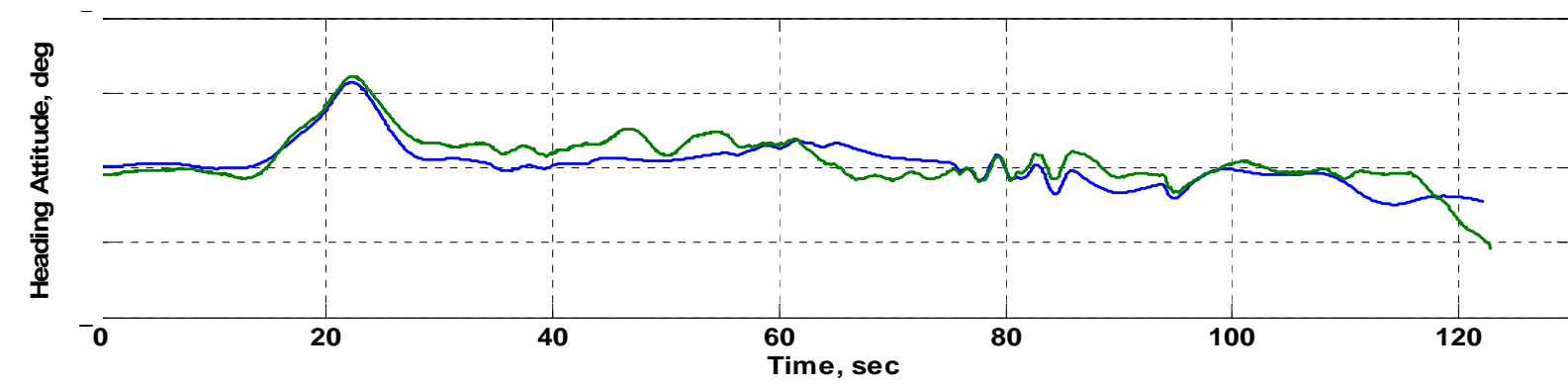
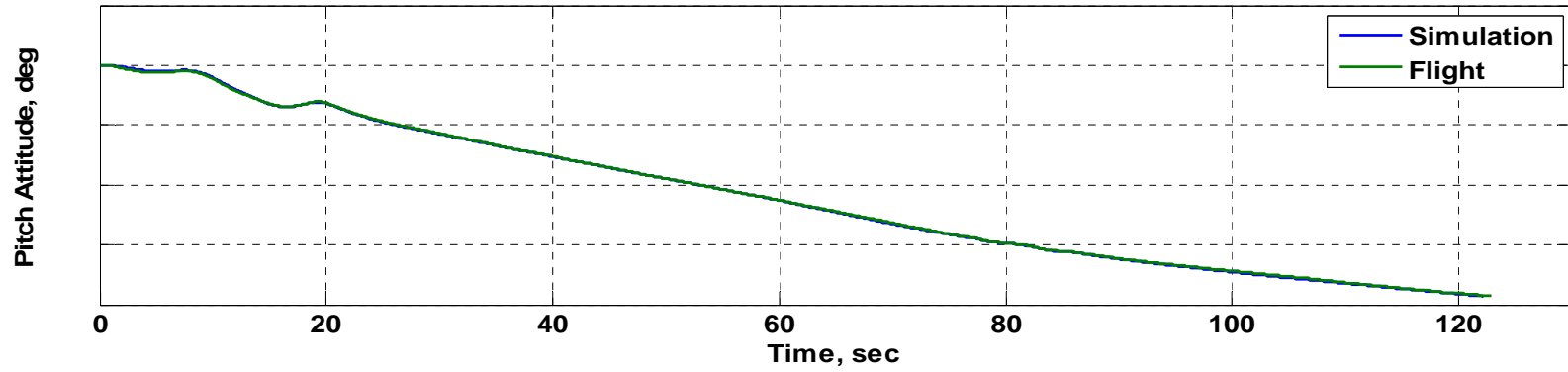


Vehicle Response vs Simulation



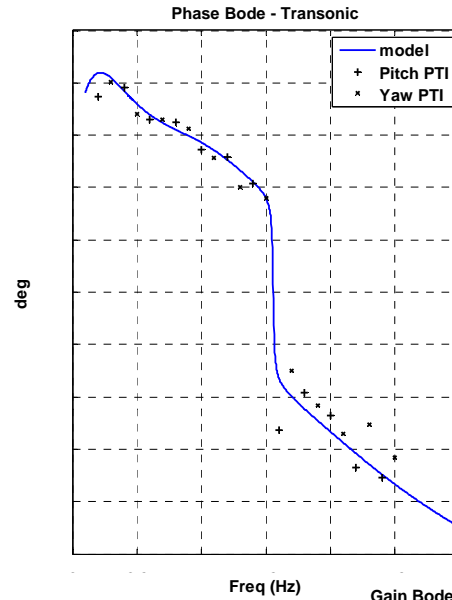
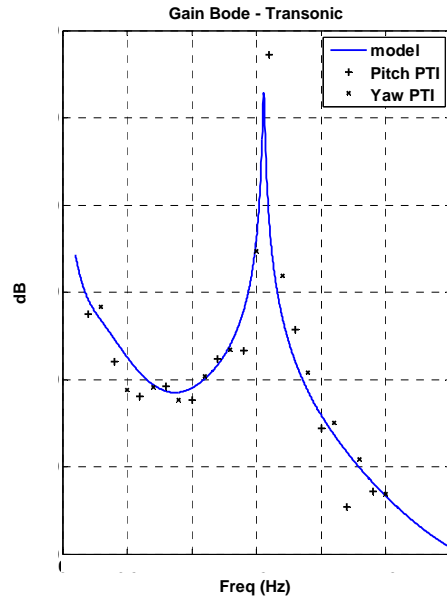
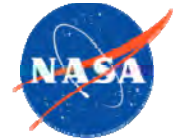


Attitudes vs Simulation



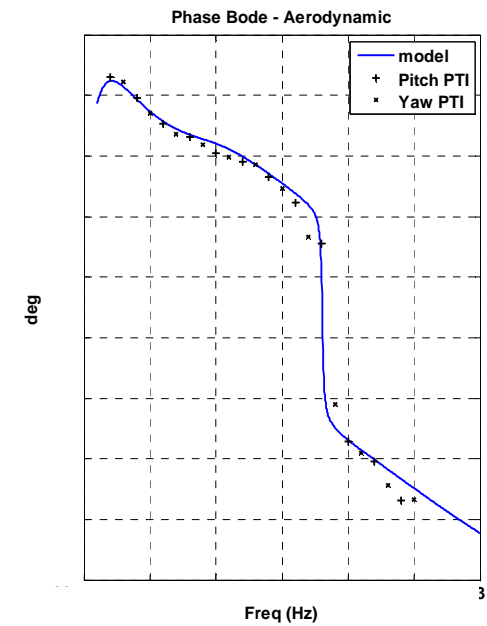
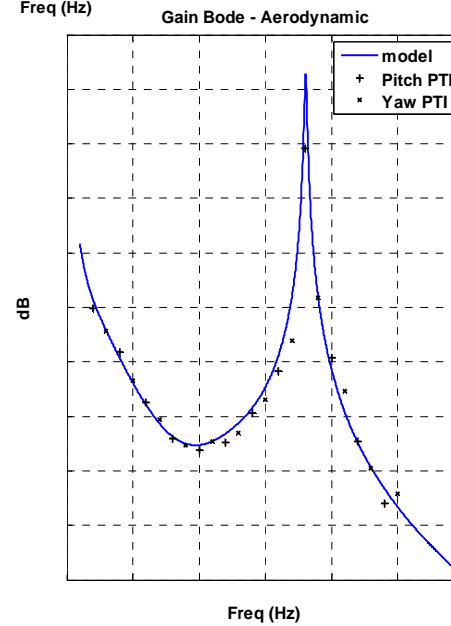


Control System Performance

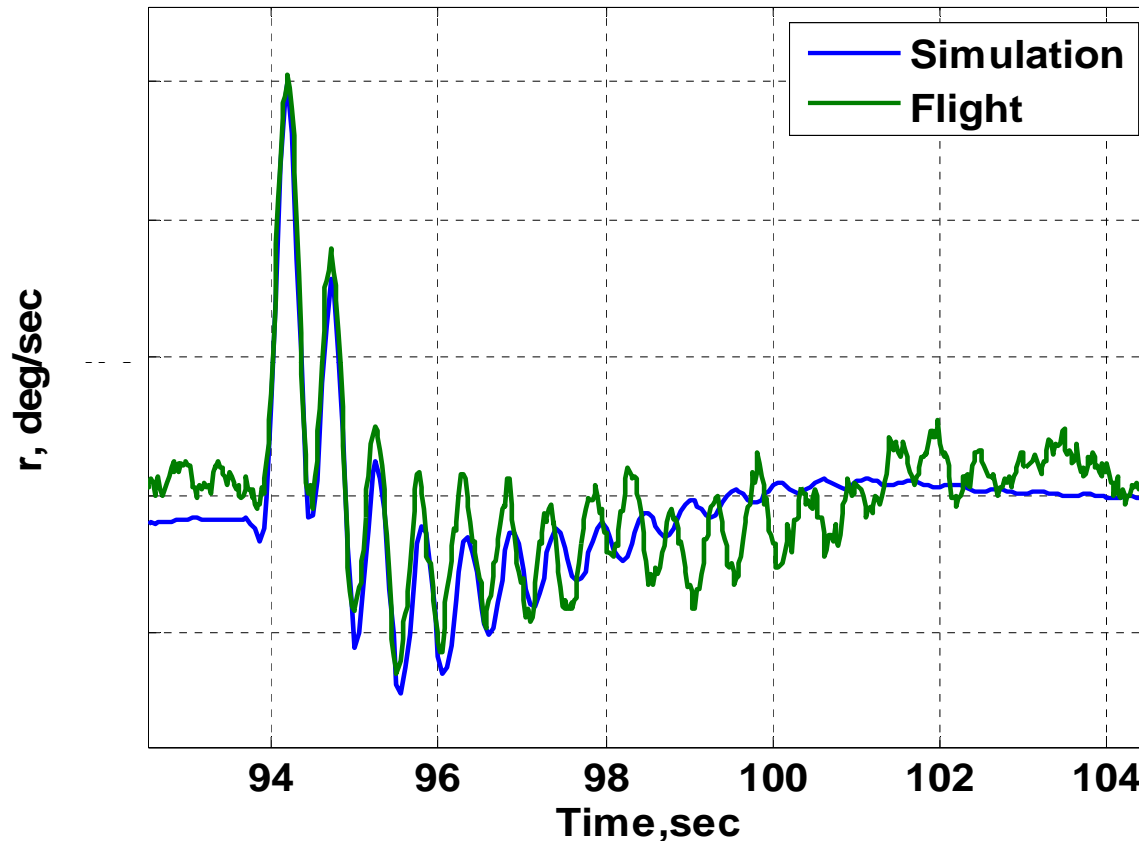


Transonic

Supersonic



Structural Damping vs. Simulation



- ◆ Quick look shows closed-loop 1st mode flight damping about 20% lower than simulation.



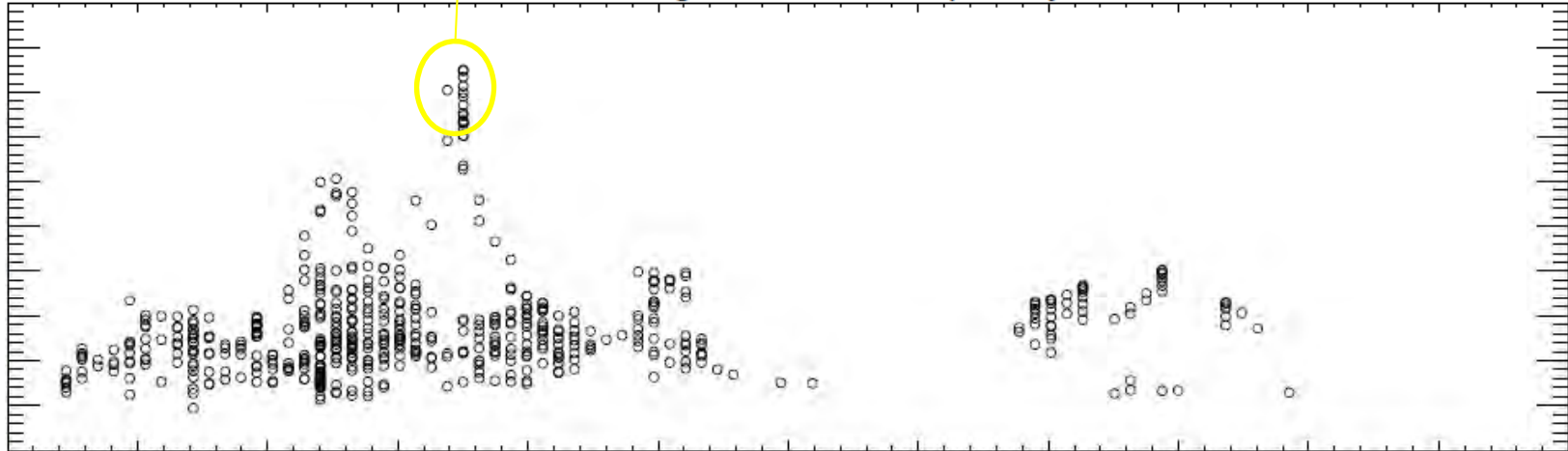
First Thrust Oscillation Mode



- ◆ 1L thrust oscillation peaked between T+77 and T+79 seconds
- ◆ Substantial margin between recommended load and actual load
 - Peak pressure was about 1/3 of the predicted value
 - Frequency was ~15 Hz

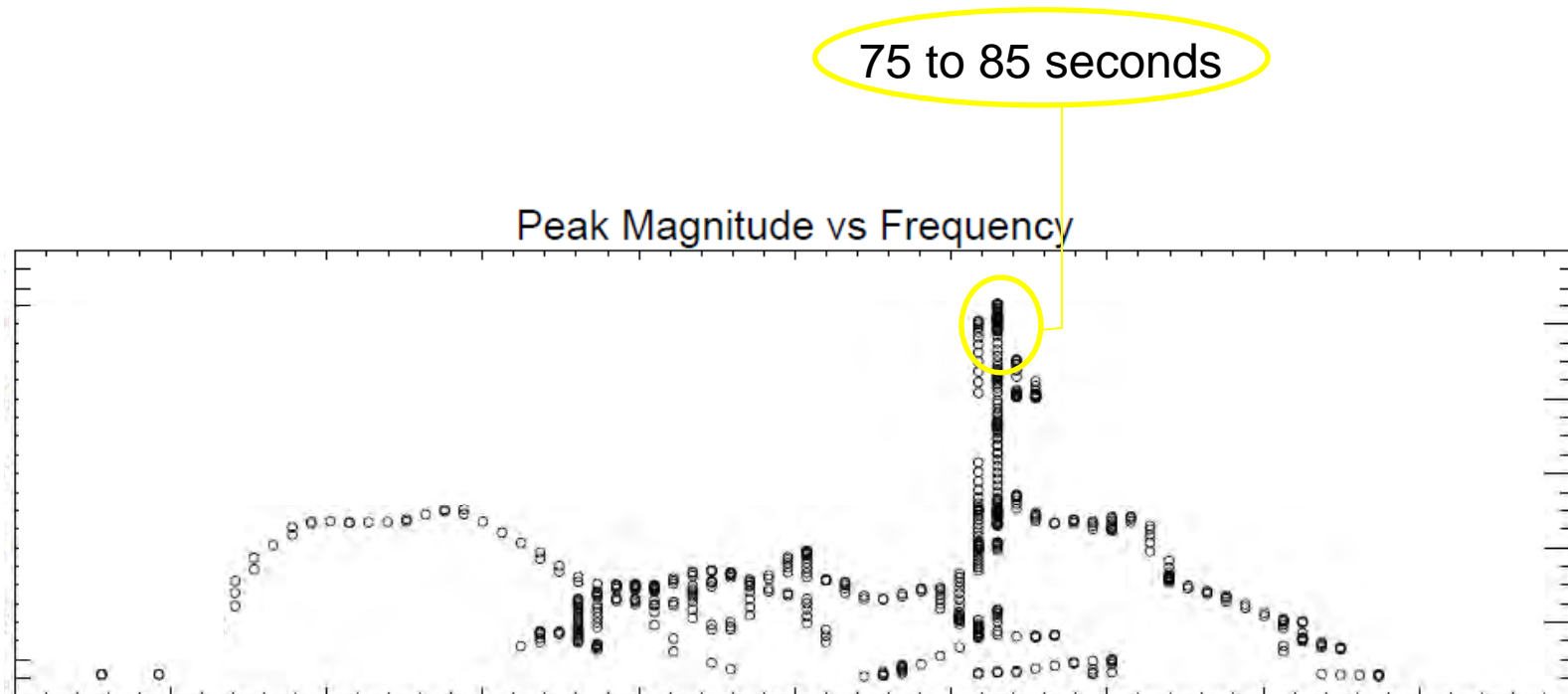
77 to 79 seconds

Peak Magnitude vs Frequency



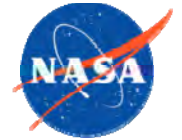
Second Thrust Oscillation Mode

- ◆ 2L thrust oscillation peaked between T+75 and T+85 seconds
- ◆ Substantial margin between recommended load and actual load
 - Peak pressure was about 1/2 of the predicted value
 - Frequency was ~ 29 Hz





Nominal Stage Separation

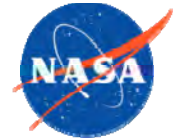


- ◆ **First Stage separation from the Upper Stage Separation was nominal**
 - Altitude at separation ~128 kft (nominal ~ 129 kft)
 - Mach ~4.6 (nominal 4.6)

- ◆ **No recontact**
 - Review of all the onboard and chase plane video show no indications of recontact
 - Initial review of debris radar does not indicate a recontact



Forward Looking Video



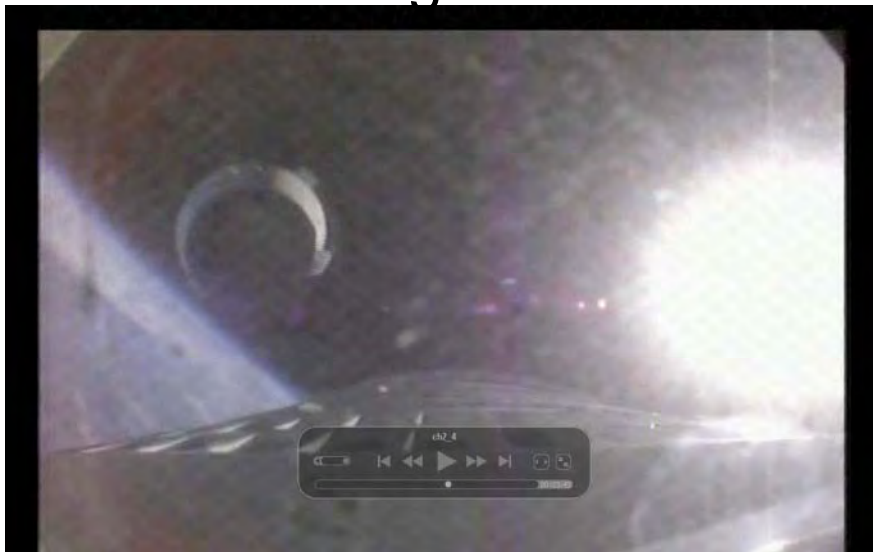
Prior to Separation

Prior to Tumble



During Tumble

Partial First Turn



Separation + 3 Sec



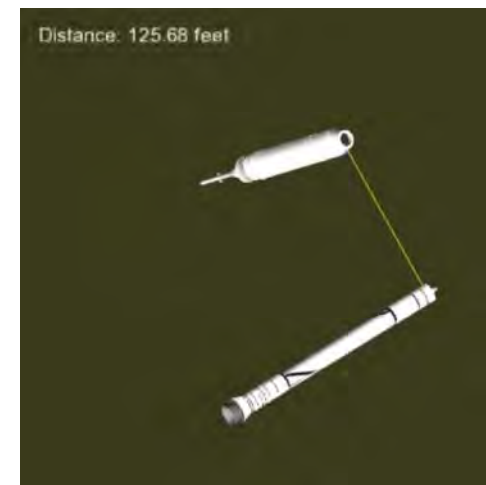
Separation + 5 Sec



Separation + 7 Sec



Separation + 9 Sec



- ◆ **Post-separation tumble of the Upper Stage Simulator was expected due to mass properties and aerodynamic forces**

- ◆ **Three separation connectors on the Forward Skirt dome did not separate**
 - Pendulum effect under the drogue chute may have caused an off center pull
 - A improper disconnect failure scenario was identified prior to launch and determined not to have any significant effects to the system
 - No loss of functionality of the connectors



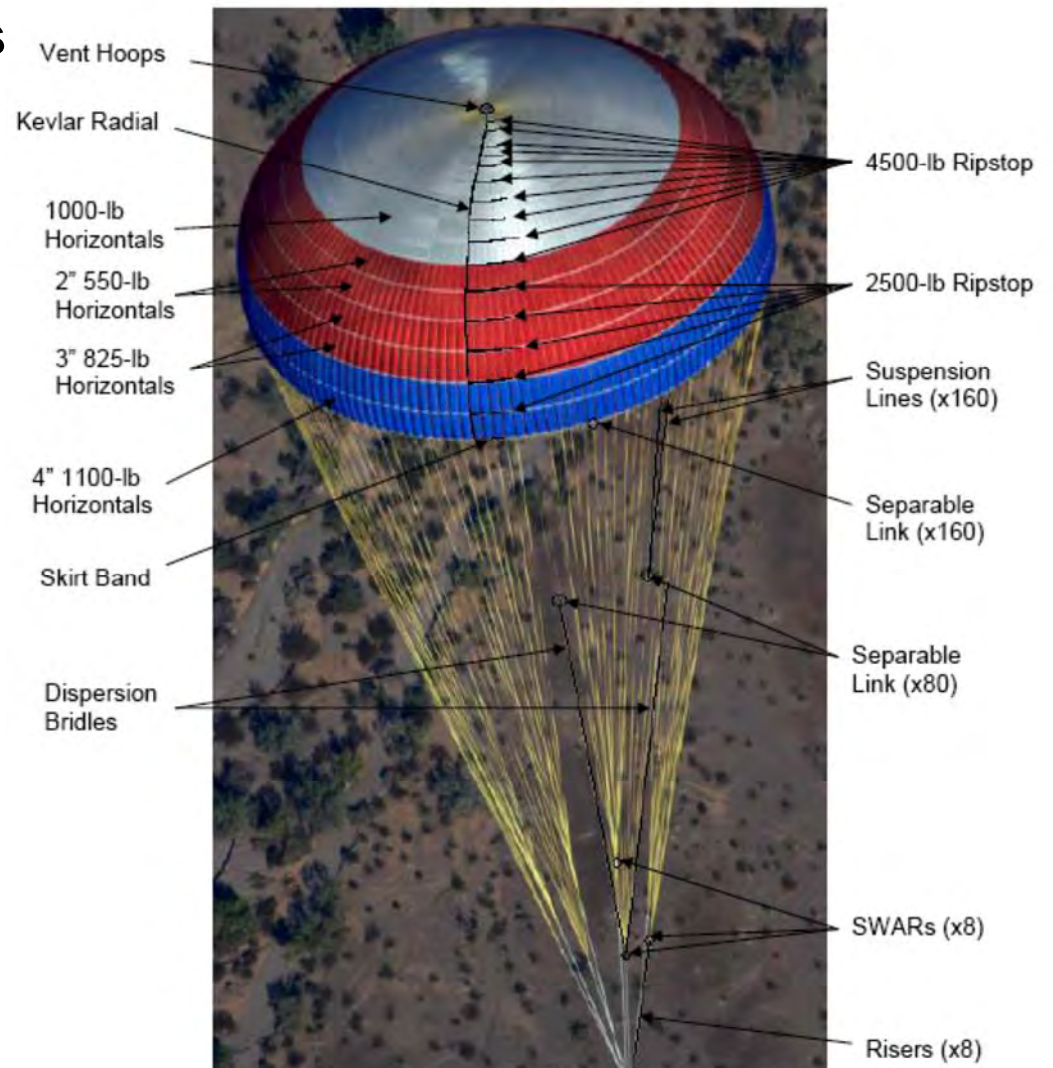
Failed Separation Connectors



Parachute Assessment

- ◆ **One of the main parachutes failed at initial inflation**
- ◆ **1st parachute may have “dis-reefed” prematurely allowing parachute to inflate too quickly**
 - Increased initial load on parachute and riser line system
 - Salt Water Activation Release (SWAR) hardware exhibits damage representative of an overload
- ◆ **A second parachute then partially failed**
 - Assessment underway

Major Components in a Main Parachute





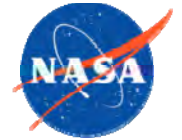
Main Parachute Failure



T+4039.982 ms



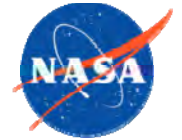
Main Parachute Failure



T+4066.641 ms

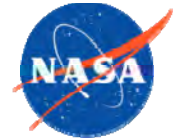


Intact USS + CM/LAS prior to Splashdown





Intact USS + CMLAS Splashdown





Data Delivery Status



- ◆ **Recovery of data from Data Recorder in process**
 - Completely recovered first 270 seconds of data and will be released internally by 12/8/09
 - Includes all 4 data streams and 3 video streams
 - Remaining 80 seconds of data is still in work