



ADEPT Sounding Rocket One Flight Test Overview

Alan Cassell¹, Paul Wercinski¹, Bryan Yount¹, Owen Nishioka¹,
Joseph Williams¹, Soumyo Dutta², Ashley Korzun²

¹*NASA Silicon Valley Ames Research Center*

²*NASA Langley Research Center*

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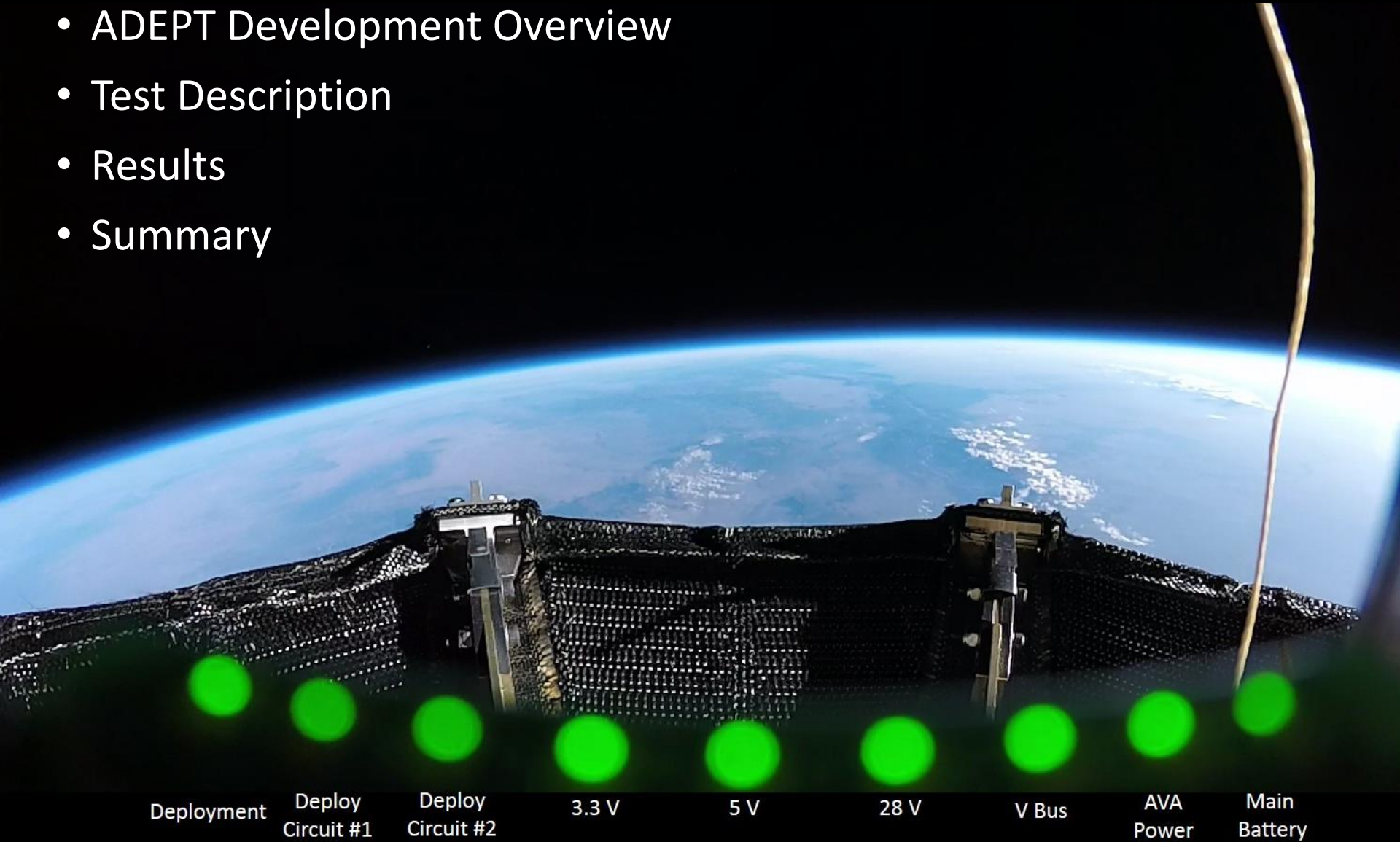




Outline



- ADEPT Development Overview
- Test Description
- Results
- Summary



Deployment

Deploy
Circuit #1

Deploy
Circuit #2

3.3 V

5 V

28 V

V Bus

AVA
Power

Main
Battery



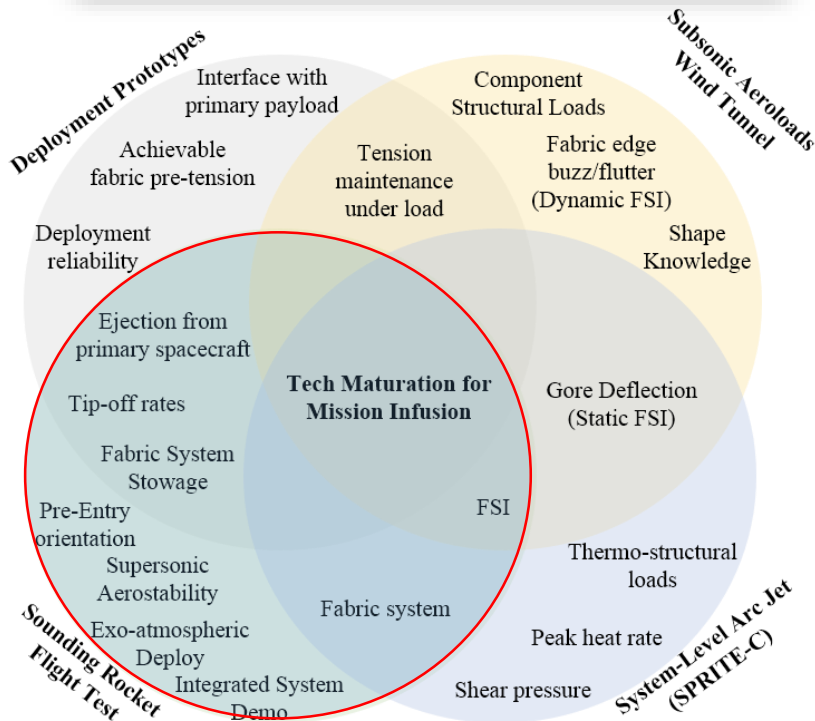
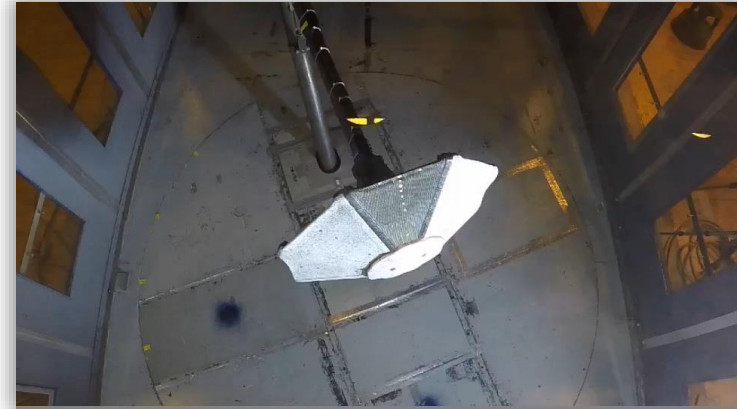
Adaptive Deployable Entry and Placement Technology 1 m Class Development Overview



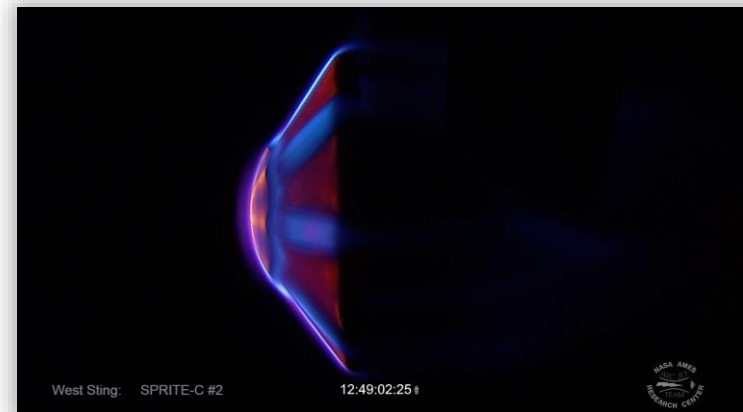
Deployment



Aeroloads Testing



Aerothermal Testing





Flight Test Objectives

SR-1 Key Performance Parameters		
Performance Parameter	Threshold Value	Project Goal
#1- Exo-atmospheric deployment to an entry configuration of the 1m-class ADEPT.	Less than fully locked condition resulting in shape with less than 70-degree fore body cone angle.	Full, locked deployment before reaching 80 km altitude on descent, to 70-degree fore body cone angle achieving 6x greater drag area.
#2- Aerodynamic stability without active control of the 1m- class ADEPT in a flight configuration.	Does not tumble prior to M=0.8 while decelerating from peak Mach # (when Mach number is decreasing after passing through peak Mach number).	ADEPT does not tumble* before ground impact; Sign of pitch damping coefficient (Cmq) is determined; FF-CFD simulation tool is validated

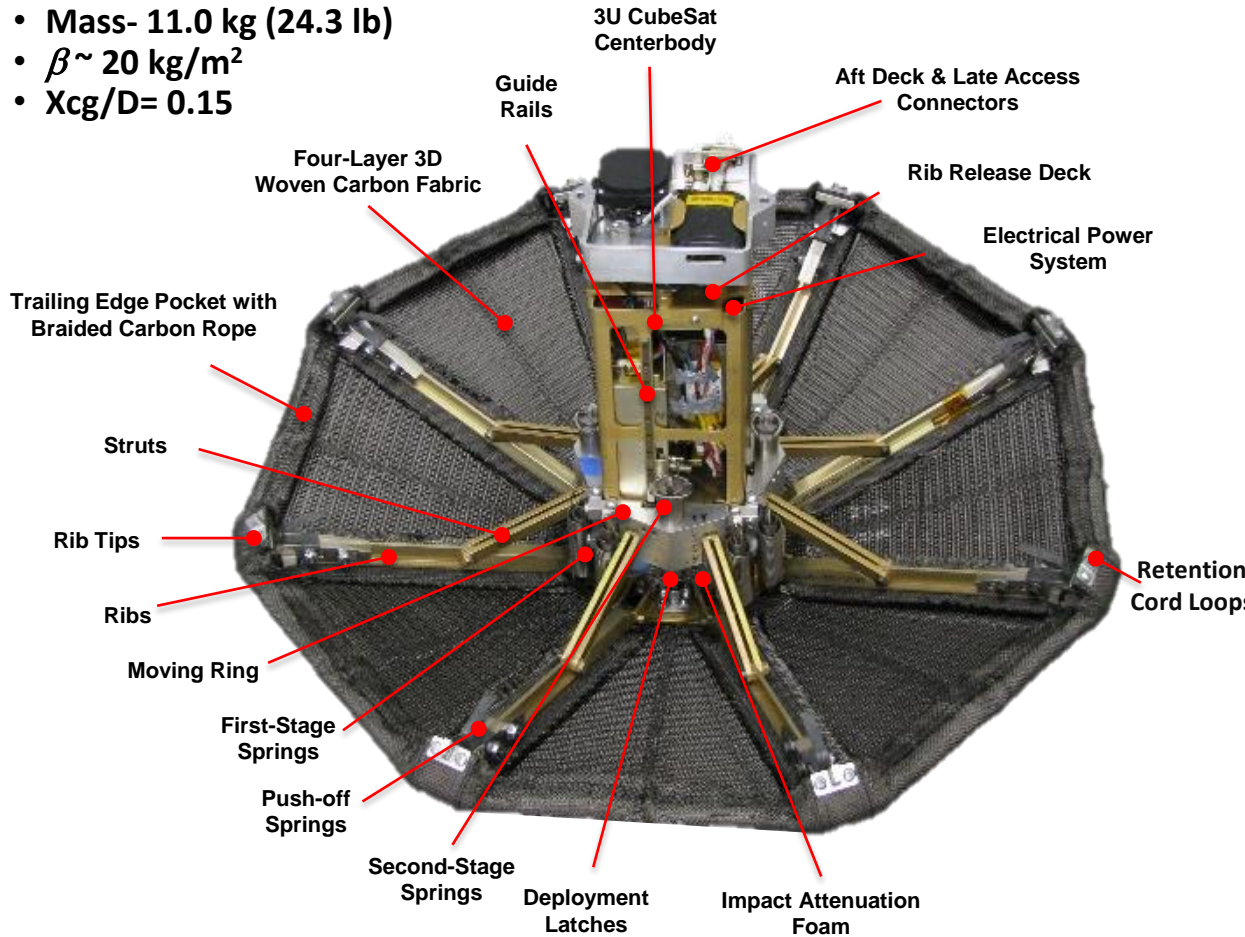
Mission Success Criteria

- A. ADEPT separates from the sounding rocket prior to apogee- **SUCCESSFUL**
- B. ADEPT does not re-contact any part of the launch vehicle after separation- **SUCCESSFUL**
- C. ADEPT reaches an apogee greater than 100 km- **SUCCESSFUL**
- D. ADEPT achieves fully deployed configuration prior to reaching 80 km altitude on descent- **SUCCESSFUL**
- E. Obtain on-board video of deployed ADEPT to observe fabric response during entry- **SUCCESSFUL**
- F. Obtain data necessary to reconstruct ADEPT 6-DOF descent trajectory- **SUCCESSFUL**

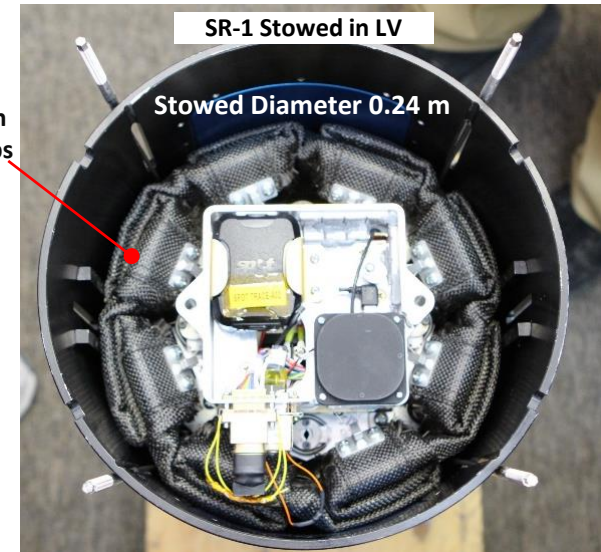


SR-1 Flight Article Description

- Rib tip to Rib tip diameter- 0.70 m
- Half cone angle (ribs)- 70 deg
- Mass- 11.0 kg (24.3 lb)
- $\beta \sim 20 \text{ kg/m}^2$
- $X_{cg}/D = 0.15$

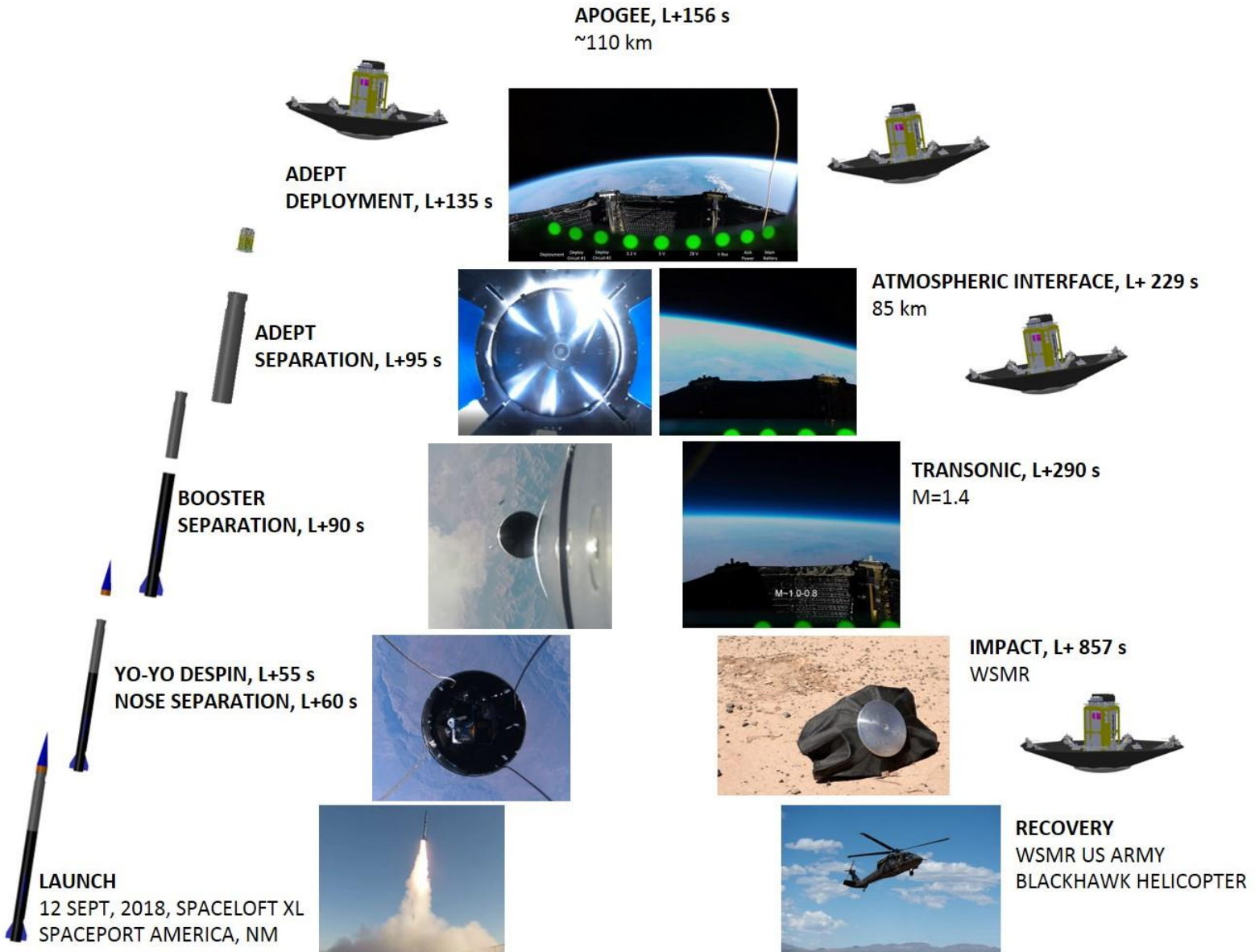


Instrumentation	Data/Function
AVA	Accelerometers, Rate Gyros, Magnetometer, GPS Tracking
NGIMU	Accelerometers, Rate Gyros, IMU Board Temp Sensors
LED Indicator Board	System Health Indicator Status
GoPro Video	1080p, 60 fps video
C-Band Transponder	WSMR Radar Tracking
SPOT Trace	GPS Recovery Tracker
Separation Sensors	Power-on signal for deployment timer, C-Band & GoPro
Deployment Switch	Indicates full deployment





Operations Timeline





Flight Test Video

UP Aerospace

September 12th, 2018

SL-12 Mission: Successfully deploy
NASA Adept SR-1 Payload approx
100km. Testing new heat shield
technology.

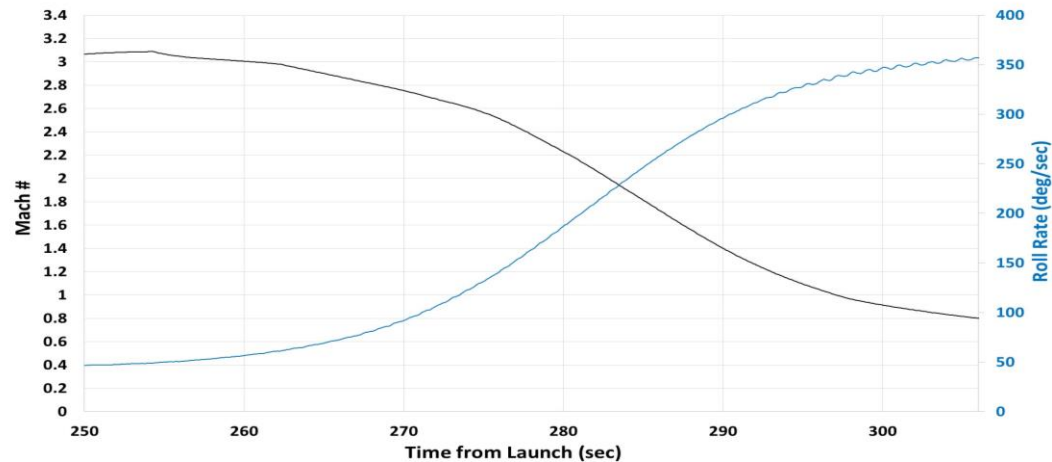
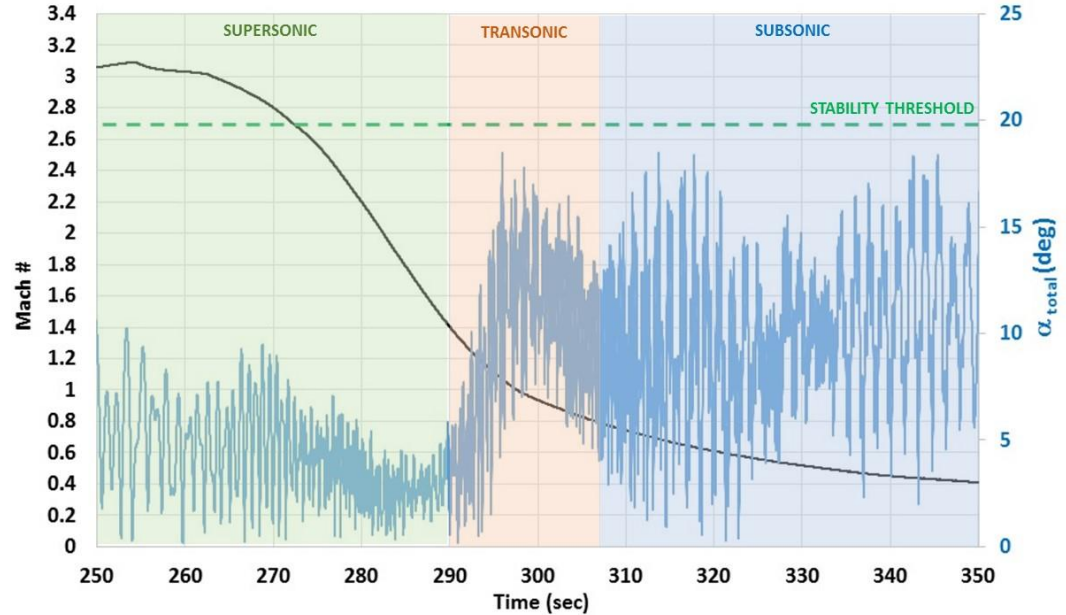
Required Re-Entry Speed: Mach 2.5





Summary

- Exoatmospheric deployment to entry configuration was confirmed through sensor and video data. **Meets KPP#1 Project Value.**
- Total angle of attack remains below stability threshold of 20 degrees through M=0.4. **Meets Threshold Value for KPP#2-** vehicle tumbled at $\sim M=0.2$.
- The spin rate increase through supersonic deceleration was unexpected. Post flight analysis is ongoing to determine cause.
- For details on the flight mechanics modeling, see: Soumyo Dutta's presentation Friday.
- For further details on the ADEPT SR-1 Flight Test, see series of papers in a special session at AIAA Aviation, 2019. See list of publications on the last chart for details.





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Space Technology Mission Directorate:

- Game Changing Development Program
- Flight Opportunities Program

Spaceport America

White Sands Missile Range

Bally Ribbon Mills

Thin Red Line Aerospace





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