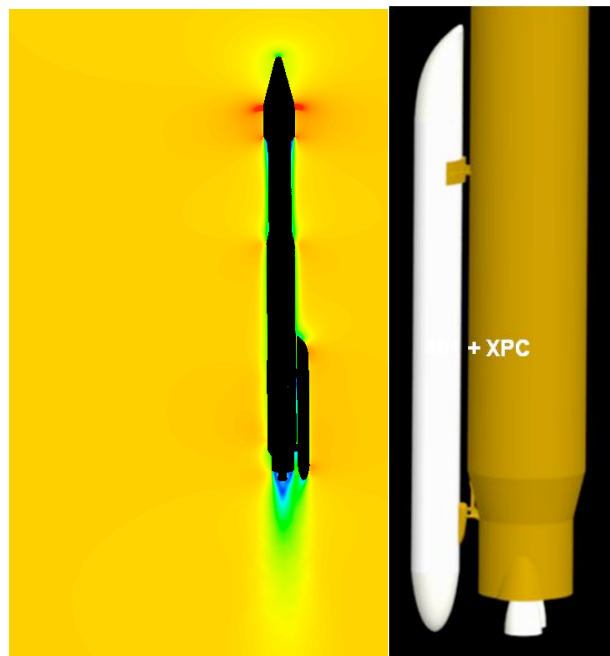




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LAUNCH SERVICES PROGRAM

External Payload Carrier (XPC) – A Novel Platform for Suborbital Research



Next Generation Suborbital Researchers Conference

18-20 February 2010

Boulder, CO

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Overview

LAUNCH SERVICES PROGRAM

- **External Payload Carrier (XPC) Concept**
- **Phase I Study**
- **Current Status**
- **Summary**

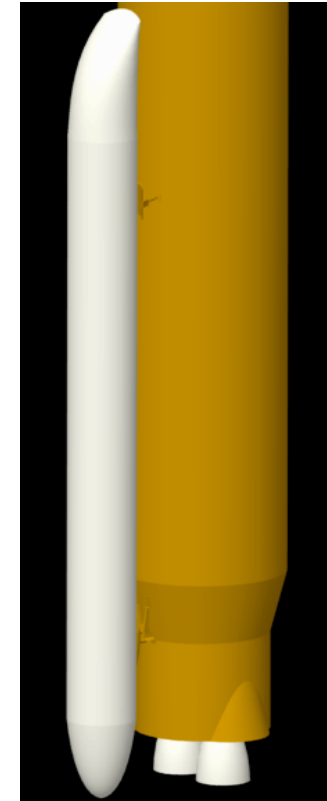
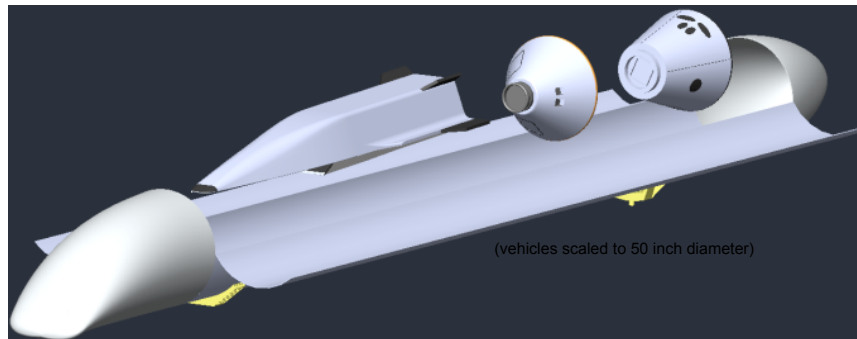


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Overview of XPC Concept

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- **Potential Identified for “Suborbital Heavy Lift”**
- **Flies in SRB Location**
- **Anytime Excess Performance is Available**
- **Remains Attached or can be Jettisoned**
- **Unpressurized**
- **Disposable or Reusable**
- **Mimics Non-Propulsive SRB**



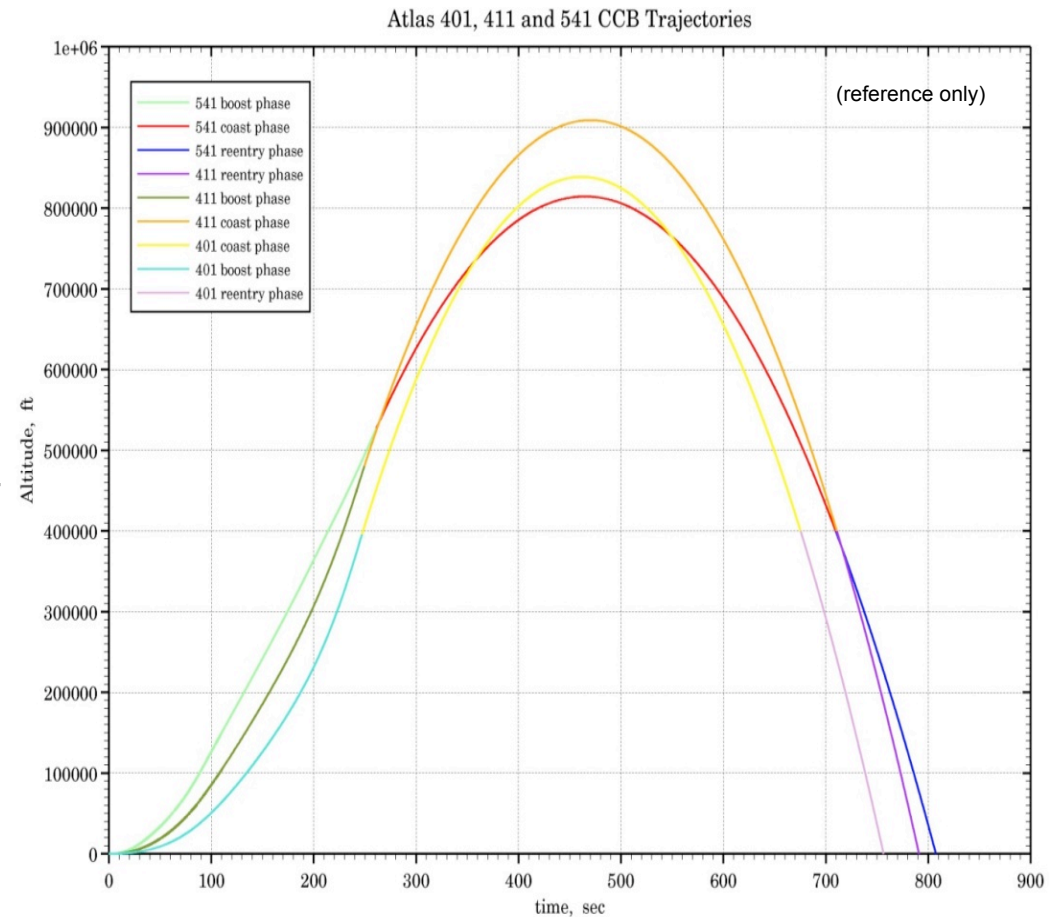


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XPC Concept (cont.)

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- **Large Payloads to High Altitudes**
 - Suborbital
 - Possible from Excess Performance
 - Result of Delta II payloads on EELVs
- **Jettisonable Along Entire Stage 1 Trajectory**
 - First Flight Remains Attached
 - Early Flights Jettisonable
 - During SRB separation
 - After Stage 1-Stage 2 separation

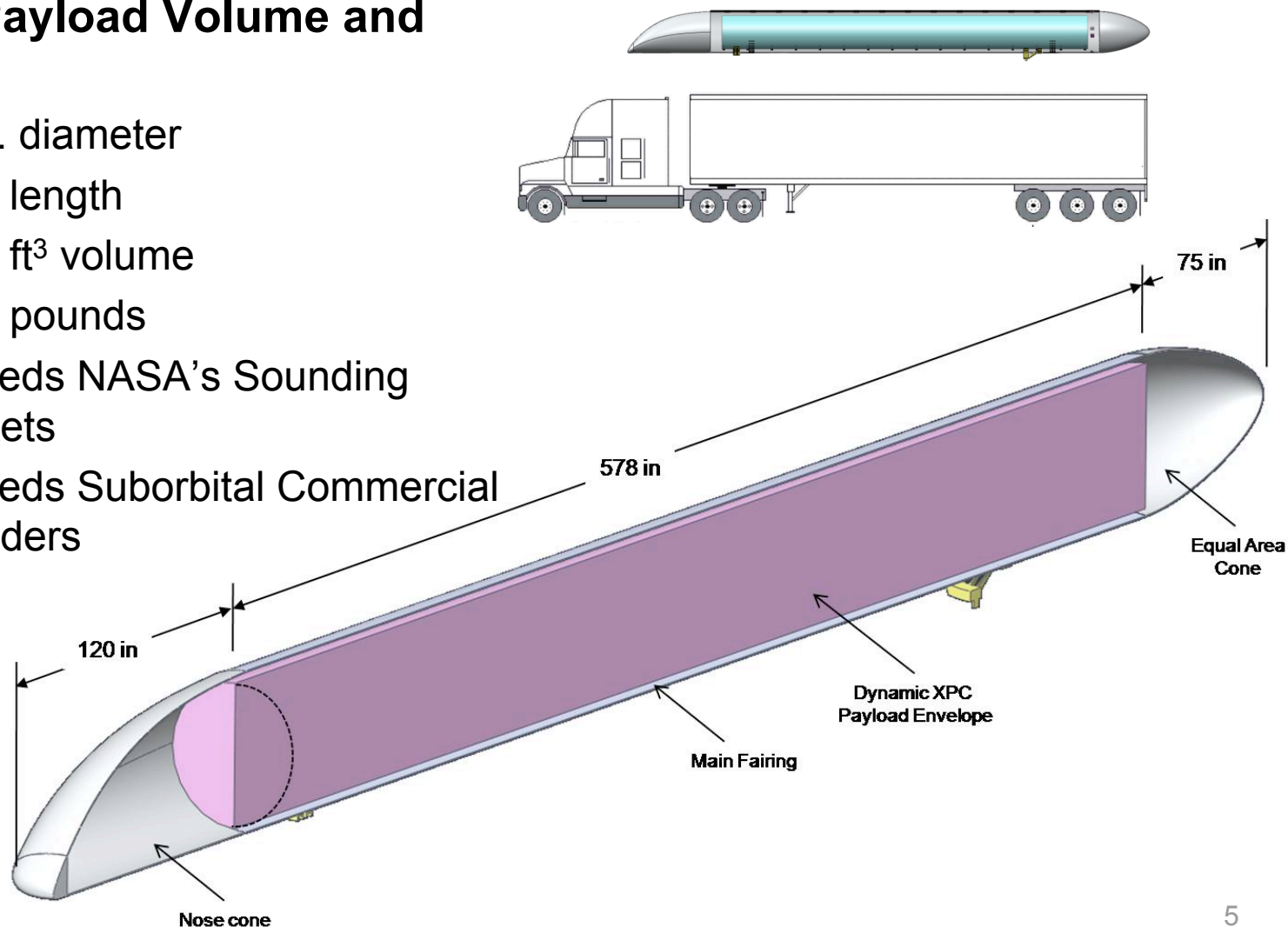




XPC Concept (cont.)

- **Large Payload Volume and Mass**

- 60 in. diameter
- 50 ft. length
- 1200 ft³ volume
- 5000 pounds
- Exceeds NASA's Sounding Rockets
- Exceeds Suborbital Commercial Providers



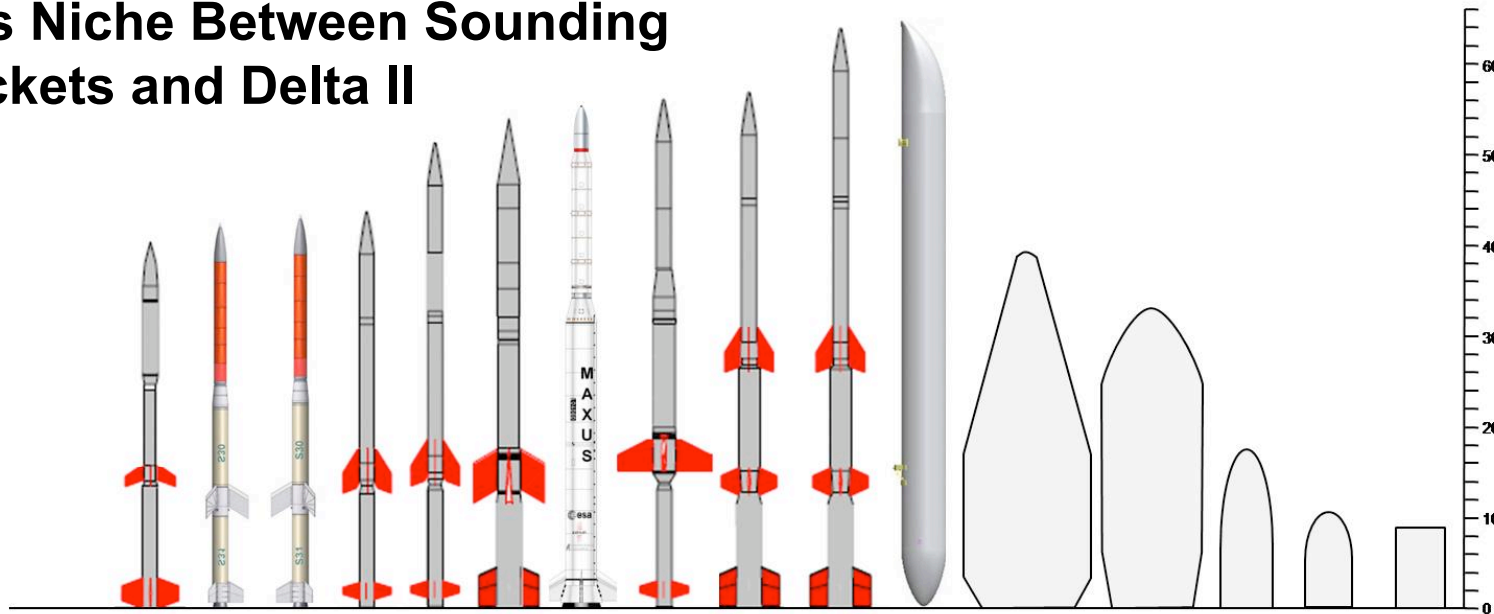


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XPC Concept (cont.)

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- Fills Niche Between Sounding Rockets and Delta II



VEHICLE	Terrier Orion	Maser	Texus	Black Brant IX	Black Brant X	Talos Orion	Maxus	Terrier-Orion	Black Brant IX	Black Brant XII	External Payload Carrier (XPC)	Atlas V 4-m PLF	Delta II (-10L)	Falcon 1e	Pegasus	SpaceShip2
Payload Diameter (m)	17	17	17	17	17	30	25	22	17	17	50	148	108	54	45	66
Payload Length (m)	TBD	134	134	TBD	76	TBD	150	TBD	TBD	TBD	578	366	284	110	84	108
Payload Volume (ft ³)	TBD	18	18	TBD	10	TBD	43	TBD	TBD	TBD	1200	4200	2800	TBD	TBD	214
Payload Mass (lbs)	200	573	573	400	300	500	1058	800	400	250	5000	11000	4700	2300	460	2000
Maximum Apogee (nm)	162	140	140	324	567	270	TBD	189	432	783	120	GTO	GTO	1600	756	60

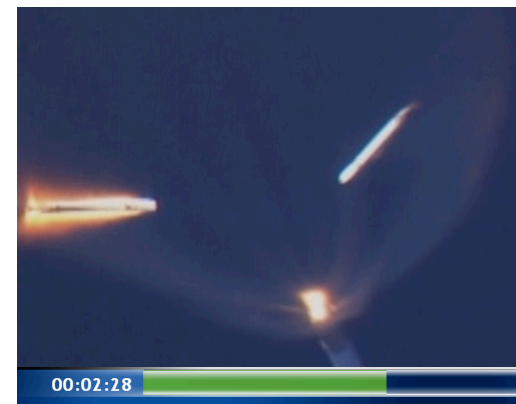
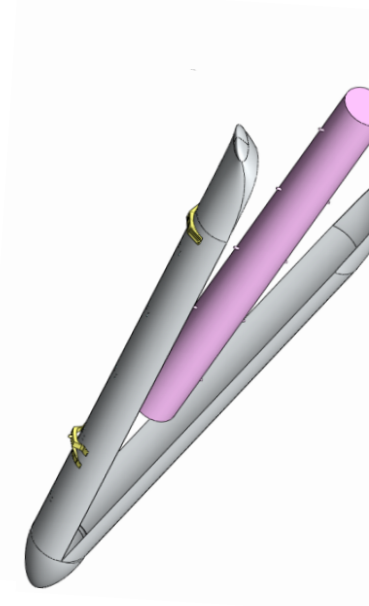


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XPC Concept (cont.)

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- **Mimics Atlas V SRB**
 - Ground Operations
 - Processing
 - Attachment (uses identical SRB hardware)
 - Flight Operations
 - Aerodynamically equivalent to SRB
 - Negligible impact to launch vehicle or primary payload
 - Jettisonable along *entire* Stage 1 trajectory
 - Atlas V designed to carry expended SRB





XPC Concept – NASA LSP

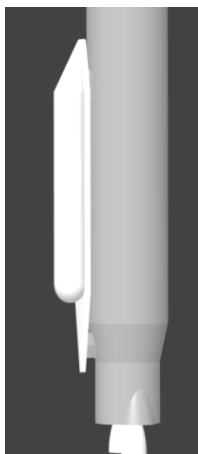
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LAUNCH SERVICES PROGRAM

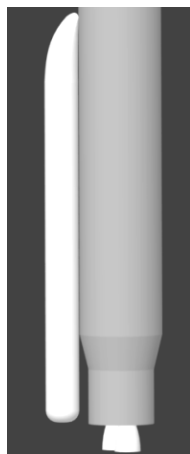
- **NASA LSP Internal Studies**
 - Aerodynamic Design Studies
 - Multiple considerations
 - Equal Surface Area Cone chosen
 - Negligible affect on launch vehicle



Atlas 411



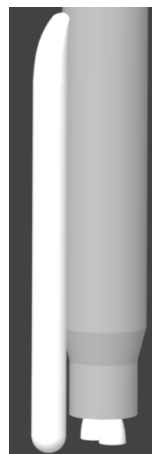
POD



Blunt Base



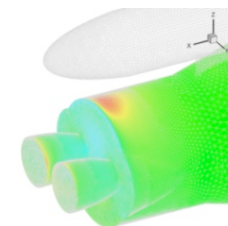
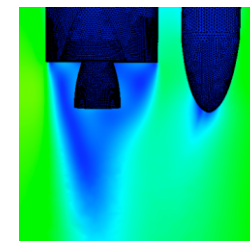
Cone



Spherical
Cap



Equal Surface
Area Cone

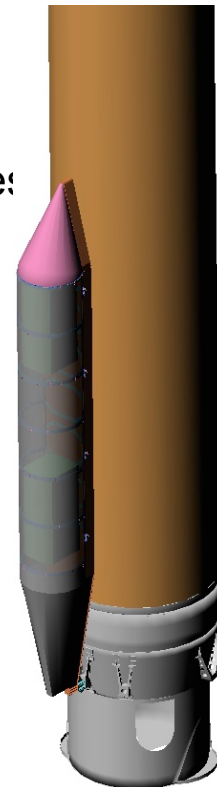




XPC Concept – SAS

- **SAS IRAD and Strategic Assessment**

- Investigating XPC Concepts
 - Worked with ULA and NASA LSP over past year on areas of interest
- Identified Multiple User Potential
- Growing Interest from NASA-Langley and AFRL
- Internally Funded Design Concepts for AFRL
 - Reusable Booster Technology
- Extremely Promising Test Bed
 - Military
 - Commercial
 - High Altitude, Hypersonic Aeronautics
 - Microgravity
 - Tropospheric → Upper Atmospheric (Ionosphere) → Exoatmospheric Research
 - Reentry Vehicle Research
 - Reusable technology (EELV Next Generation)
 - Point to Point Applications



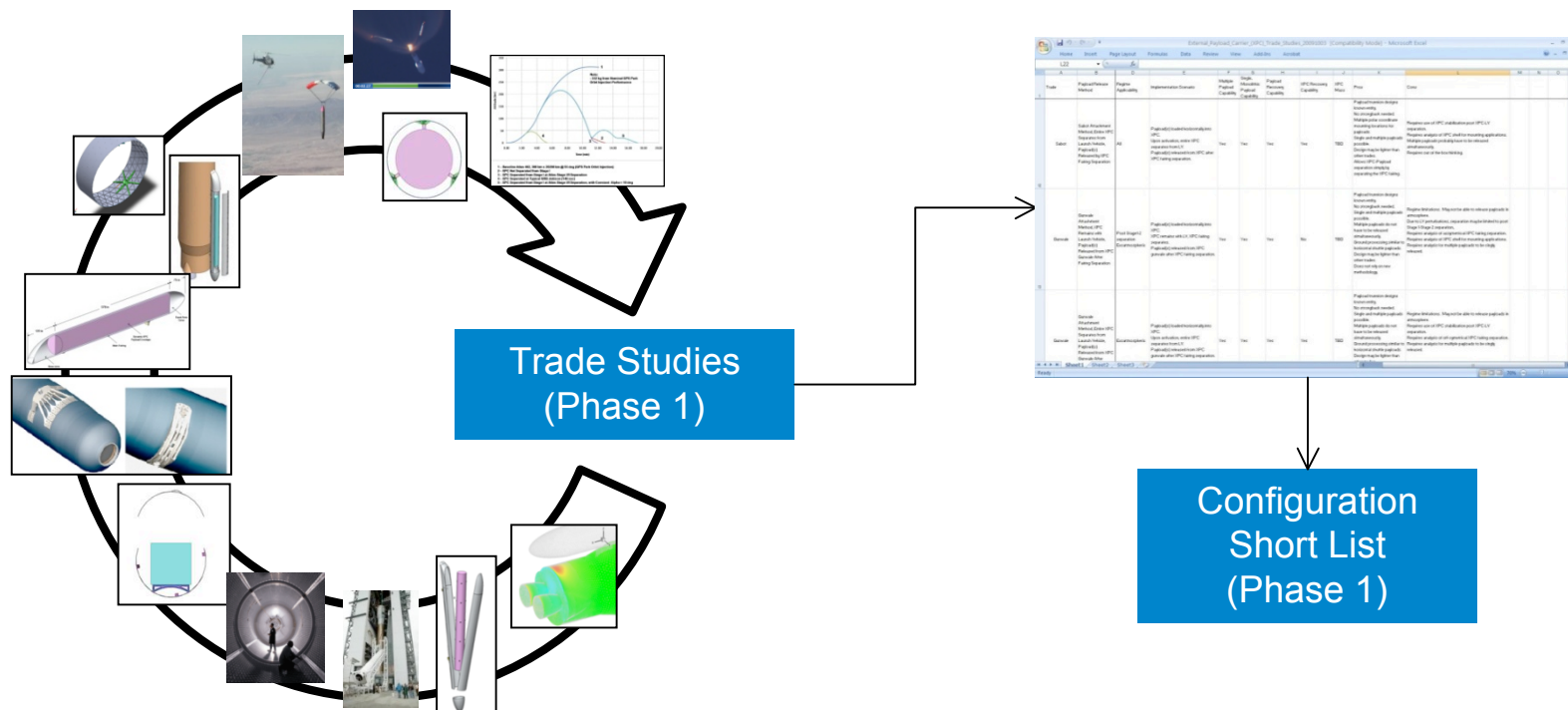


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Phase I Study

LAUNCH SERVICES PROGRAM

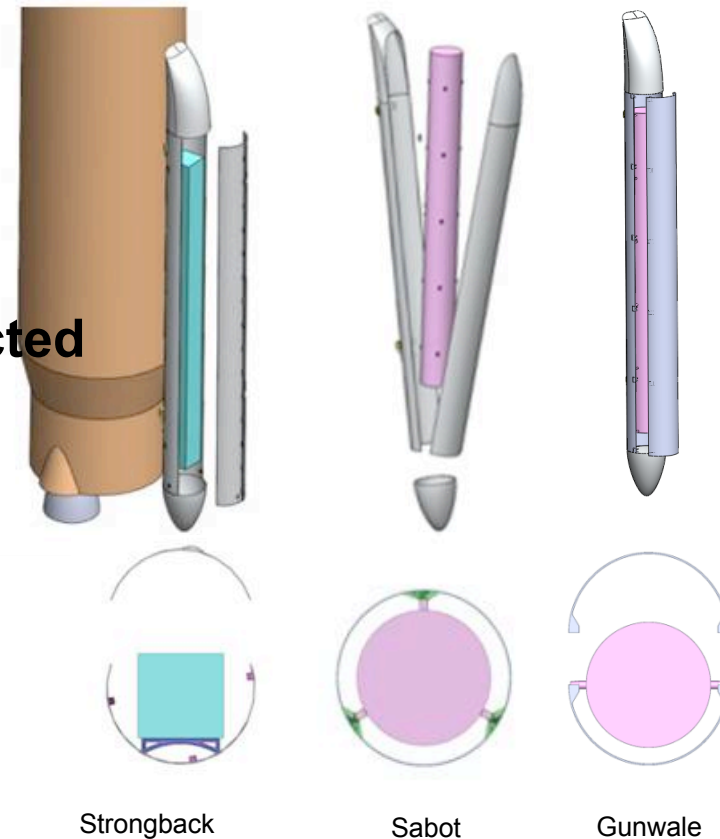
- ULA and SAS Tasked to Evaluate Feasibility
- Research and Trade Studies Conducted
- 57 Variations Considered
 - Configuration, Trajectory, Payload Attachment, Recoverability, etc





Overview of Findings

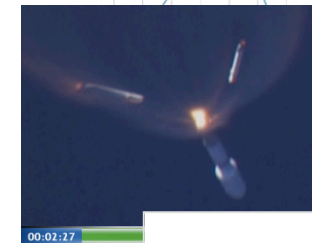
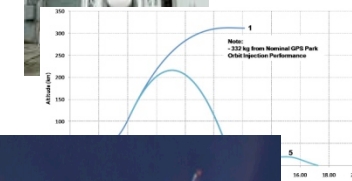
- **Pros and Cons Identified**
- **Most Ground Operations Appear Conducive**
 - Minimal Additional Hardware
- **All Atmospheric/Exoatmospheric Regimes Attainable**
 - Configuration Dependant
- **Three Viable Configurations Selected**
 - Strongback
 - Sabot
 - Gunwale
- **Final Configuration in Phase II**





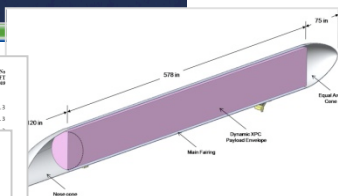
Findings (cont.)

- **Design Baselines Identified**
 - Aluminum isogrid (heritage Atlas V)
 - SRB attachment hardware
 - SRB outer mold line
 - Incremental flight capabilities
- **Needed Subsystems Identified**
- **Preliminary Testing Requirements Identified**
- **Preliminary Modeling Complete**
- **Draft System Requirements Document (SRD) Complete**
- **Phase I Preliminary Feasibility Study Complete**



UNITED LAUNCH ALLIANCE PROPRIETARY INFORMATION EXPORT CONTROLLED DATA	
Document No. 000.000.000 Rev. 00.00.00 000.000.000	
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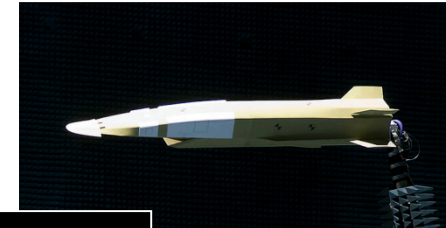
1.0 Introduction	
The External Payload Center (XPC) is a system to convey suborbital payloads on the exterior surface of a launch vehicle. Currently, the vehicle is planned to be an Atlas V. The XPC mimics the non-propulsive aerodynamic characteristics of a solid rocket booster (SRB).	
[SYS1]	The design of the XPC shall not preclude evolving the design for additional capabilities. <i>Rationale 1</i> The XPC is a spiral design. As such, the initial design must not preclude future designs.
[SYS2]	The design of the XPC shall not preclude evolving the design for use on additional launch vehicles. <i>Rationale 1</i> The XPC is currently destined for flight on the Atlas V. While the design may not be applicable to other launch vehicles, it should not preclude the use of other launch vehicles.
[SYS3]	The XPC shall interface with the launch vehicle in such a way as to mimic an SRB. <i>Rationale 3</i> To build upon the experience of the ground crews and to minimize the cost of XPC, the processing must mimic the processing and integration of an SRB to the greatest extent possible.





Current Status

- **NASA LSP has recently (1/10) agreed to fund XPC development through the Preliminary Design (Phase II)**
- **Expected outcome of the Preliminary Design includes:**
 - XPC Final Configuration
 - Post-jettison Stabilization
 - Payload Separation
 - Subsystem Design
- **Currently Seeking Input From User Community**
 - NASA Mission Directorates
 - DoD
 - Commercial Sector





Summary

- **ULA, SAS, and NASA LSP are examining a new platform for suborbital research utilizing the Atlas V Launch Vehicle**
- **The new platform, XPC, fill a new niche within the suborbital realm – Large Heavy Lift (~1200 ft³, 5000 lb payload)**
 - Will not compete with the commercial suborbital launch sector
- **The XPC will utilize excess performance on Atlas V missions**
- **The Preliminary Design phase recently underway**
- **The XPC team is soliciting input from potential users**