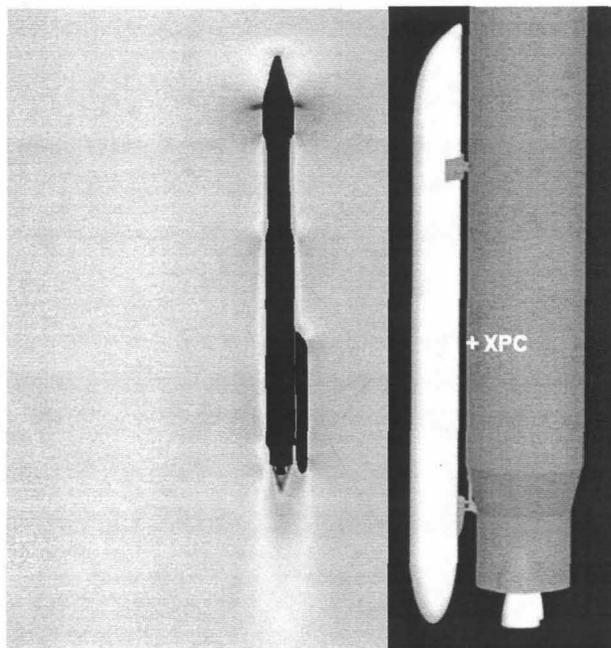




John F. Kennedy Space Center

LAUNCH SERVICES PROGRAM

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



Next Generation Suborbital Researchers Conference

18-20 February 2010

Boulder, CO

Paul Schallhorn, Ph.D.

Curtis Groves

Charles Tatro

NASA Launch Services Program

Kennedy Space Center, Florida

Bernard Kutter

Gerald Sztakowski

United Launch Alliance

Denver, CO

Tim Bulk

Brian Pitchford

Special Aerospace Services

Boulder, CO



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Overview

LAUNCH SERVICES PROGRAM

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

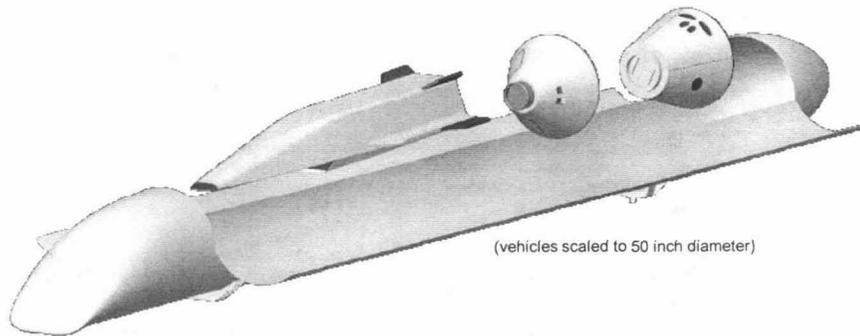


Overview of XPC Concept

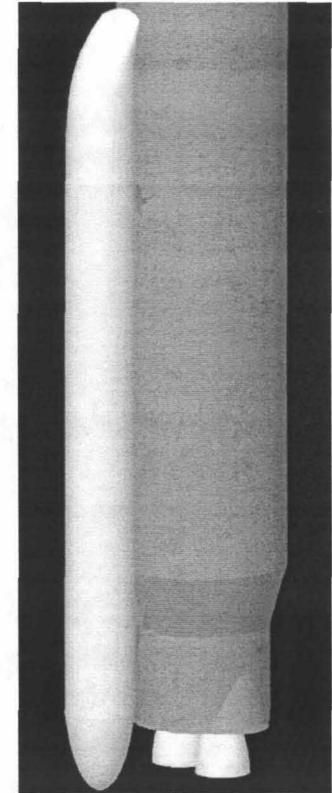
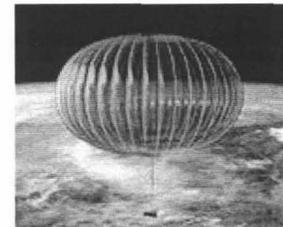
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- Potential Identified for “Suborbital Heavy Lift”
- Flies in SRB Location
- Anytime Excess Performance is Available
- Remains Attached or can be Jettisoned
- Unpressurized
- Disposable or Reusable
- Mimics Non-Propulsive SRB



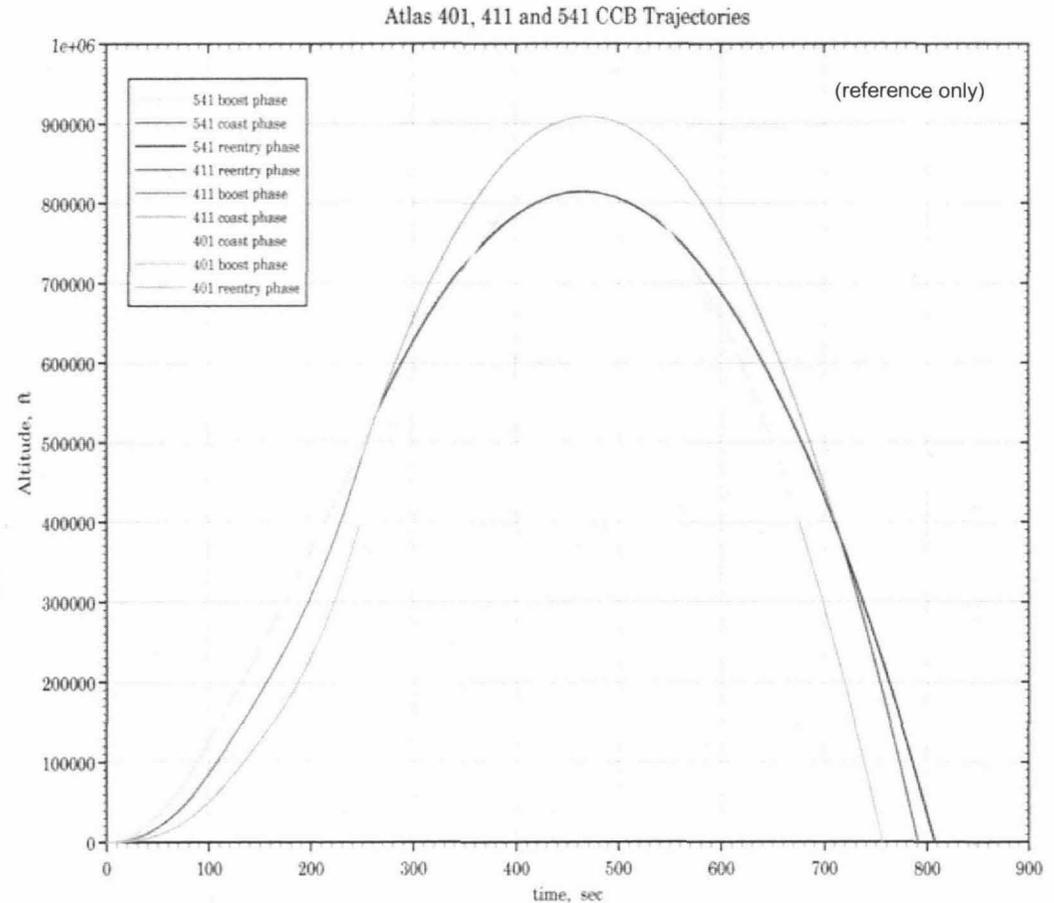
(vehicles scaled to 50 inch diameter)





XPC Concept (cont.)

- **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

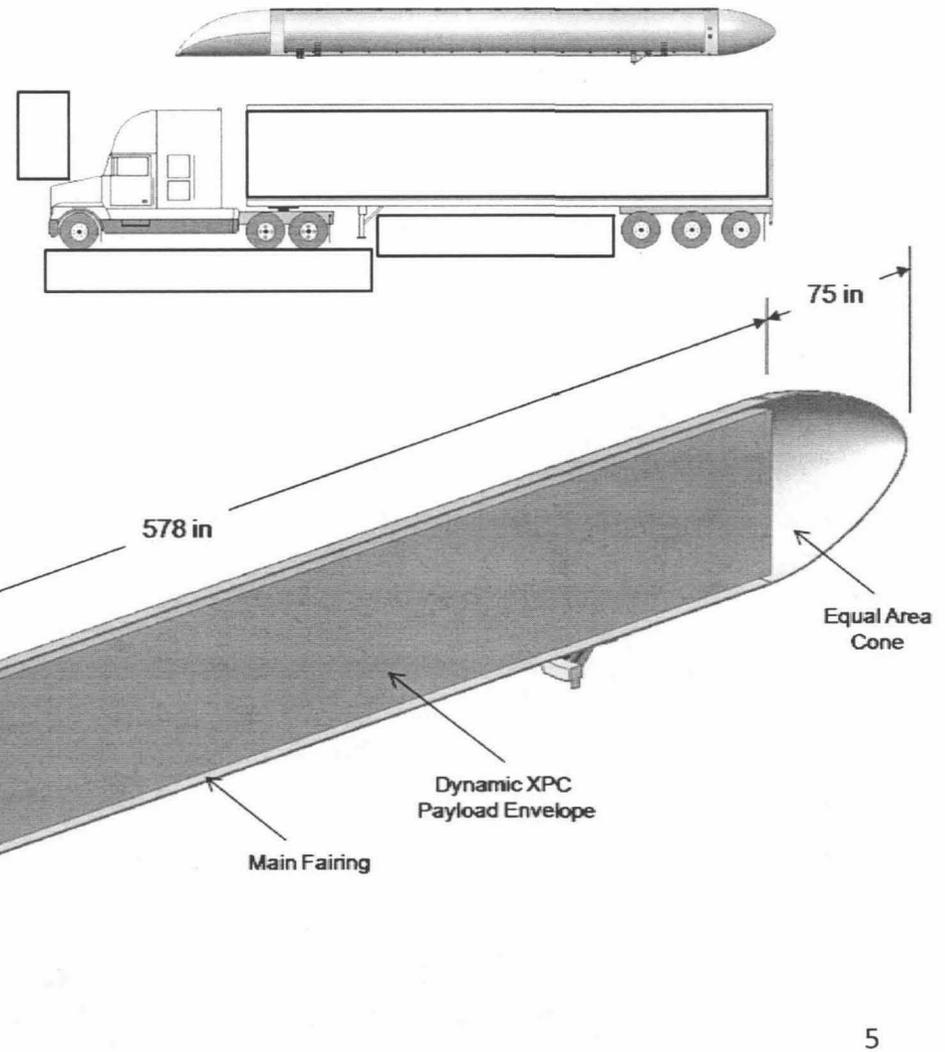




XPC Concept (cont.)

- **Large Payload Volume and Mass**

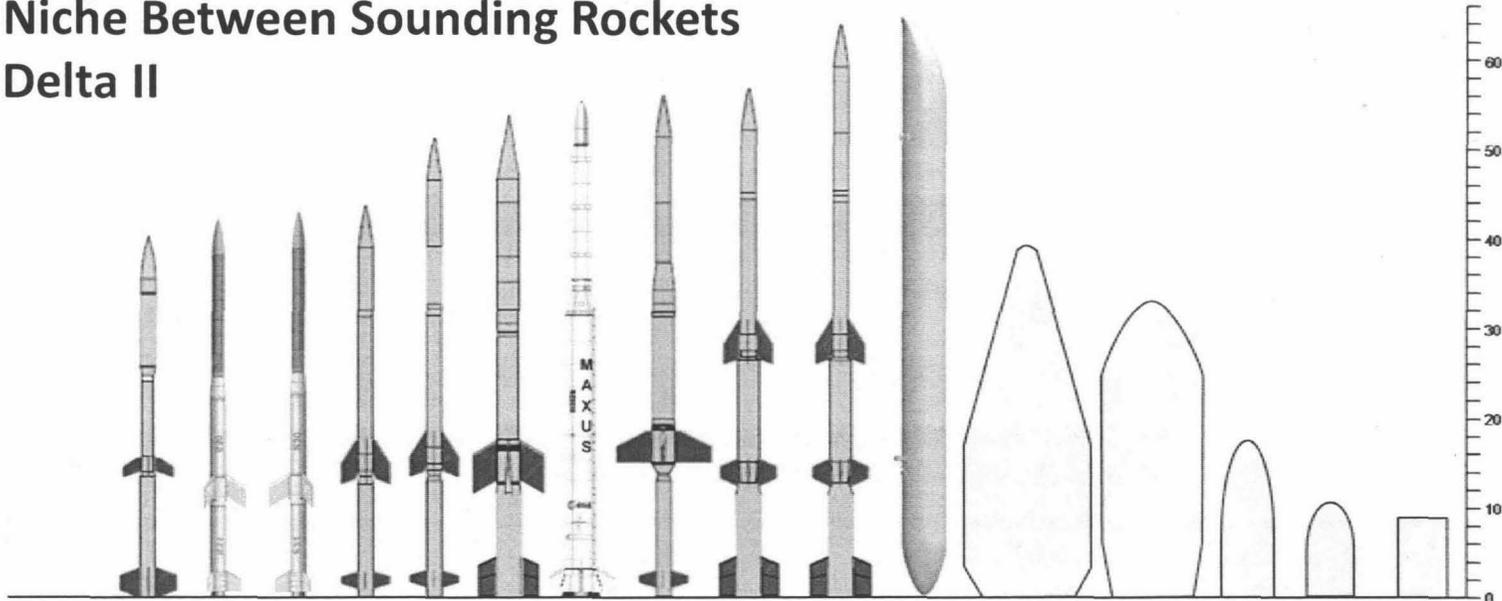
- 60 in. diameter
- 50 ft. length
- 1200 ft³ volume
- 5000 pounds
- Exceeds NASA's Sounding Rockets
- Exceeds Suborbital Commercial Providers





XPC Concept (cont.)

- Fills Niche Between Sounding Rockets and Delta II

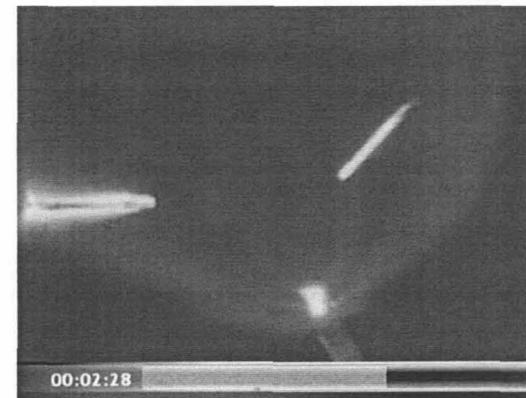
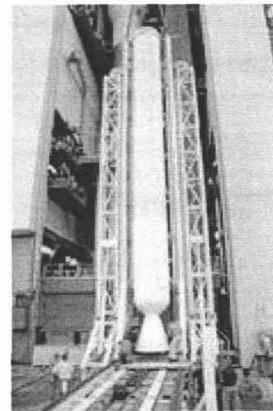
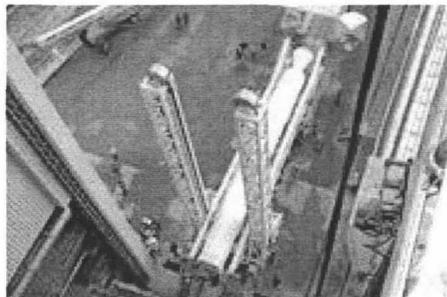
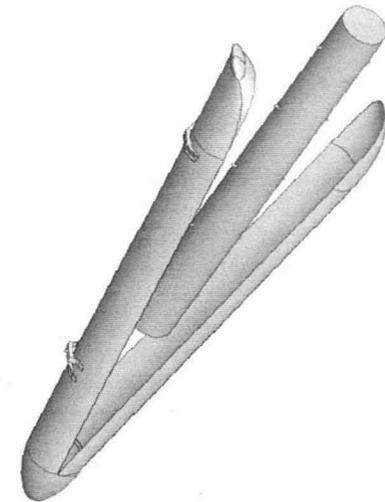


VEHICLE	Temer Orion	Maser	Texas	Black Brant IX	Black Brant X	Talos Oriole	Maxus	Temer Oriole	Black Brant IX	Black Brant XII	External Payload Carrier (XPC)	Atlas V 4-m PLF	Delta II (-10L)	Falcon 1e	Pegasus	SpaceShip2
Payload Diameter (m)	17	17	17	17	17	30	25	22	17	17	50	148	108	54	45	66
Payload Length (m)	TBD	134	134	TBD	76	TBD	150	TBD	TBD	TBD	578	366	284	110	84	108
Payload Volume (m 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 (km)	162	140	140	324	567	270	TBD	189	432	783	120	GTO	GTO	1600	756	60



XPC Concept (cont.)

- **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



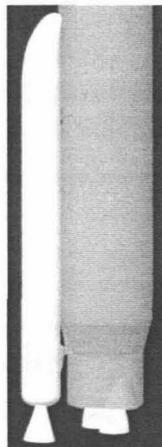


XPC Concept – NASA LSP

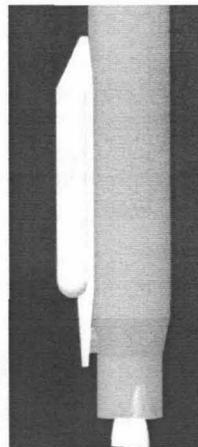
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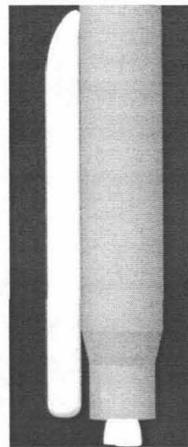
- **NASA LSP Internal Studies**
 - Aerodynamic Design Studies
 - Multiple considerations
 - Equal Surface Area Cone chosen
 - Negligible affect on launch vehicle



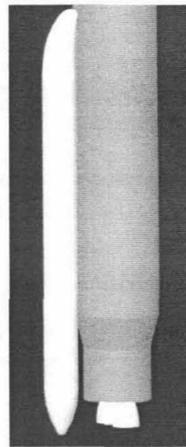
Atlas 411



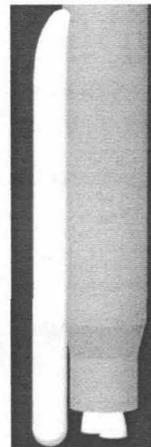
POD



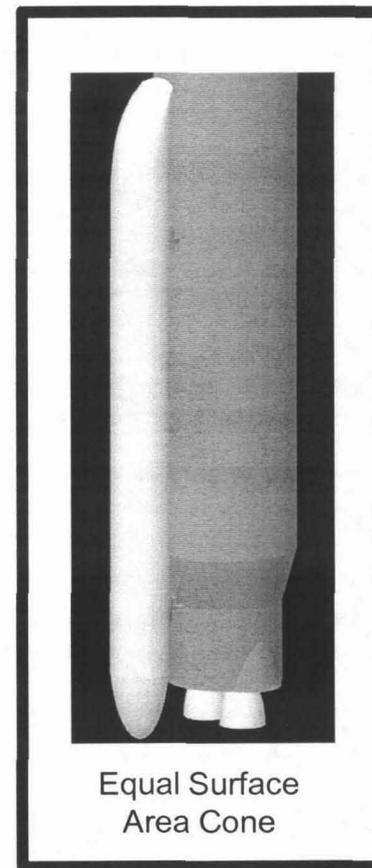
Blunt Base



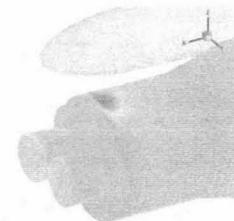
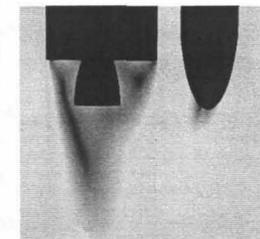
Cone



Spherical
Cap



Equal Surface
Area Cone





XPC Concept – SAS

- **SAS IRAD and Strategic Assessment**

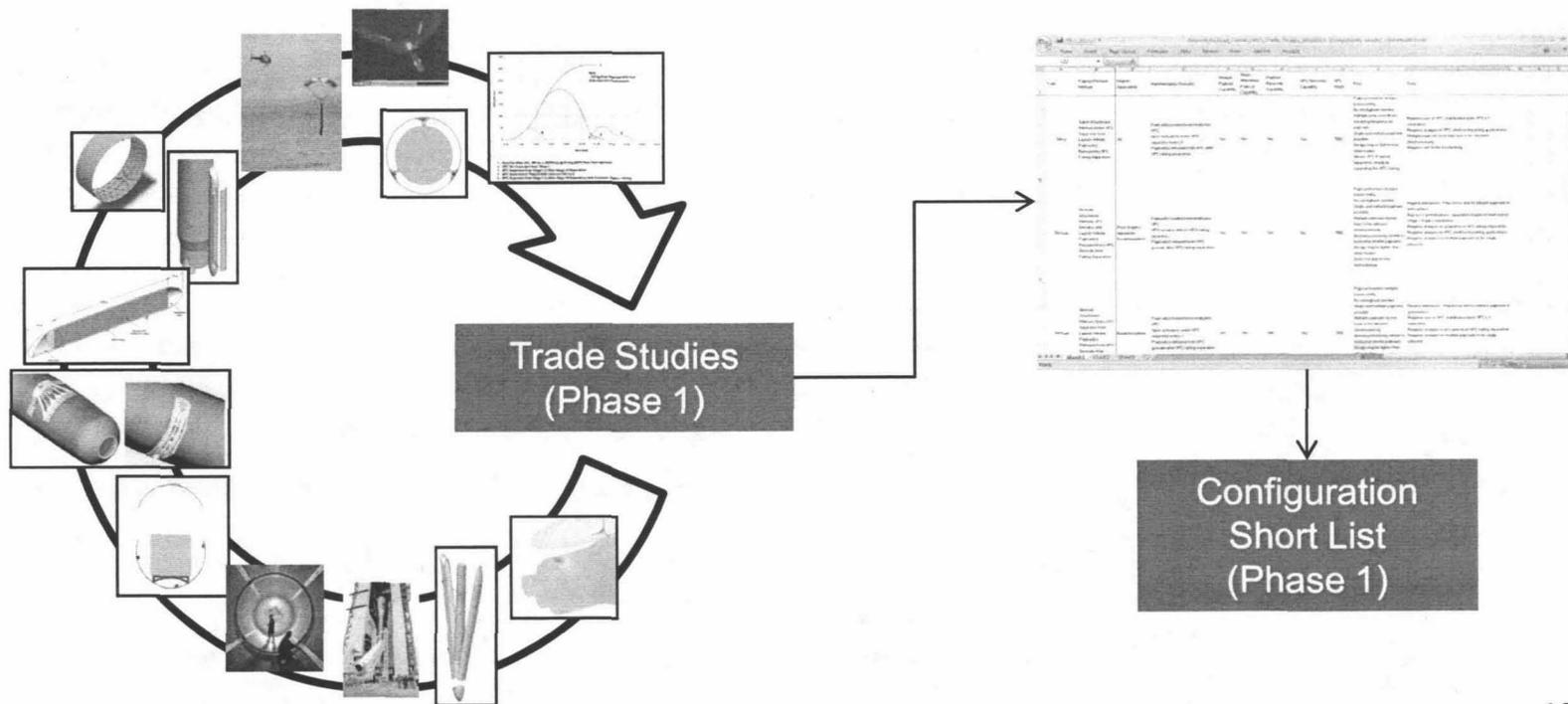
- Investigating XPC Concepts
 - Worked with ULA and NASA LSP over past year on areas of interest
- Identified Multiple User Potential
- Growing Interest from NASA-Langley and AFRL
- Internally Funded Design Concepts for AFRL
 - Reusable Booster Technology
- Extremely Promising Test Bed
 - Military
 -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





Phase I Study

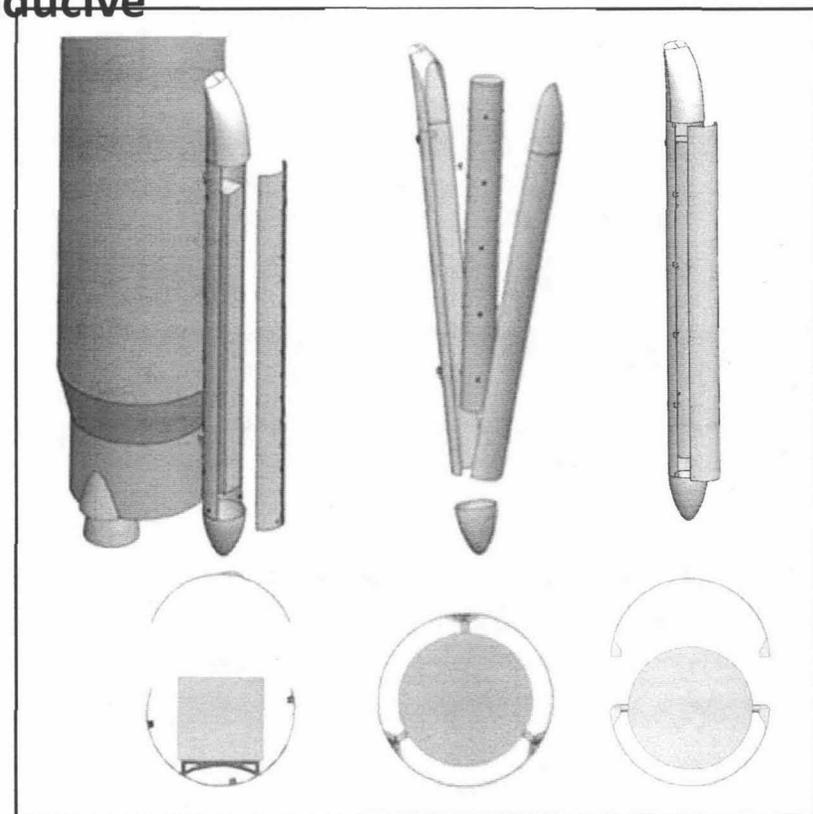
- ULA and SAS Tasked to Evaluate Feasibility
- Research and Trade Studies Conducted
- 57 Variations Considered
 - Configuration, Trajectory, Payload Attachment, Recoverability, etc





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**



Strongback

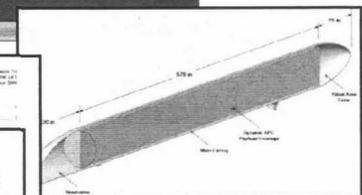
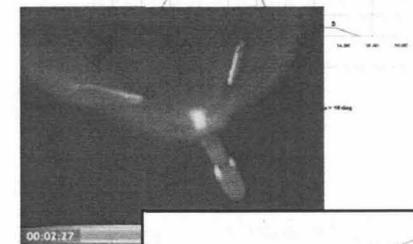
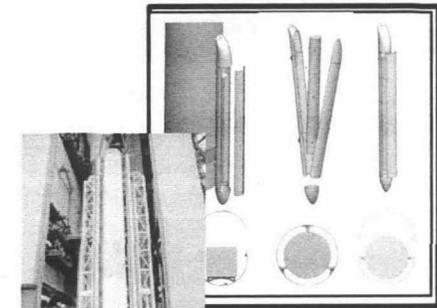
Sabot

Gunwale



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**



SYSTEMS RELEASE PRELIMINARY DESIGN STUDY

Table of Contents

1.0 Introduction

The purpose of this study is to provide an overview of the design and development of the SRM. The SRM is a key component of the launch vehicle and is responsible for providing the majority of the thrust during the ascent phase of the mission.

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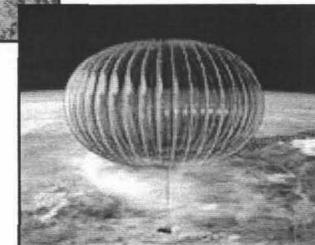
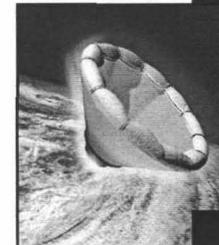
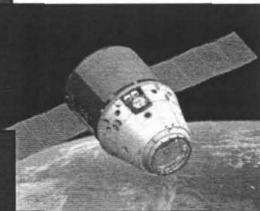
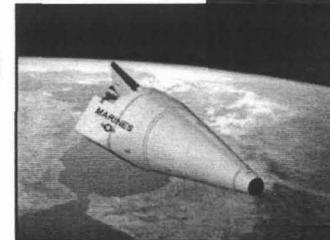
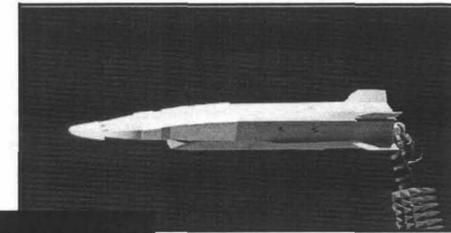
1.0 Introduction

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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**