

**Providing Low Cost Access to Space** 

### REM Capabilities of The Lynx Suborbital Vehicle

Presentation to Next-Generation Suborbital Researchers Conference February 18, 2010

# Lynx Overview ...



- Suborbital space vehicle
- Horizontal takeoff/landing
- Two seats pilot plus one
- Small vehicle
  - Wingspan ~24 feet
  - Length ~30 feet
- Multi-mission capable
  - In-cockpit experiments
  - External mount experiments
  - Test pilot/astronaut training
  - Upper atmospheric sampling
  - Microsatellite launch



### Lynx Heritage ...

- EZ Rocket taught us ...
  - Development of safe reusable propulsion
  - Integration into airframe
  - Low cost & safe operational procedures
  - Regulatory framework
- X-Racer taught us ...
  - Pump fed fuel enabled high performance for future ops
  - Improved low cost ops and safety regime processes
  - Improved airframe skill sets and avionics integration





### Lynx: Mark I



- Horizontal takeoff/landing
- 61 km (200,000 ft) peak altitude
- Mach 2.4 top speed
- First flight in 2011



# LYNX Mark II



- Follows Mark I
  by 9-18 months
- ~5000 flight life
- Mach 3.5, over 100 km
- Can launch two stage to LEO ~10kg



## **Flight Operations**





- Aircraft-like operations from any airport with a 7,000-foot (2,100 m) runway and appropriate airspace
- Fast turnaround
- Low maintenance: 2 hour engine runtime overhaul intervals
- Up to 4 sorties per day
- Weather/seasonal constraints: winds

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Zero-g time



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## **Acceleration vs Time**





## **Internal Payloads**



Payload Locations in Lynx Pressure Cabin Primary Payload - Right Seat: Standard 19" 14U rack, chassis for two Space Shuttle mid-deck lockers, or user provided custom enclosure. Mass up to 120 kg. Secondary Payload - Aft Pilot Seat: 50 cm height x 40.5 cm wide x 46 cm bottom, 16.5 cm top. Mass up to 20 kg.

### **External Payloads**





### **Payload Mass-Internal Volume**





# **Payload Specifications**



SPECIFICATIONS	LYNX MARK I	LYNX MARK II
Primary Payload Mass (w/o participant)	Internal: 120 kg External: 280 kg	Internal: 120 kg External: 650 kg
Primary External (Pod) Payload Dimensions (w/o participant)	43 cm diameter x 240 cm long	76 cm diameter x 340 cm long
Primary Internal Payload (w/o participant)	Standard 19" 14U rack: 41 cm depth; 2 Shuttle mid-deck lockers; or user provided enclosure	Standard 19" 14U rack: 41 cm depth; 2 Shuttle mid-deck lockers; or user provided enclosure
Secondary Internal Payload Mass & Dimensions (w/participant)	20 kg; 50 cm height x 46 cm bottom x 16.5 cm top	20 kg; 50 cm height x 46 cm bottom x 16.5 cm top
Aft Fairing Payload Mass & Dimensions	3 kg; 20 cm depth x 15 cm diameter	3 kg; 20 cm depth x 15 cm diameter
Power Available	28 VDC	28 VDC (can be augmented)
Pointing Accuracy	+/- 2 degrees	+/- 0.5 degrees
Minimum Turnaround Time	4 hours	2 hours
Nominal Apogee (assumes 120 kg internal payload)	>61 km (200,000 ft)	>100 km (330,000 ft)
Microgravity Time (10E-2 g)	56 seconds	3 minutes
Other Services	He, N <sub>2</sub> , O <sub>2</sub>	He, N <sub>2</sub> , O <sub>2</sub> , Optically flat window
Estimated price for various services	Ranges from \$5K to \$500K, nominal \$50 to \$100K	Ranges from \$5K to \$500K, nominal \$50 to \$100K

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### Lynx Status



- Engine testing in progress
- Fabrication begun on cockpit
- Finalizing CFD shape and wind tunnel testing
- First test flights in 2011
- Opportunities to fly experiments during test flight program



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### **The Lynx Suborbital Vehicle**

Jeff Greason, CEO XCOR Aerospace February 18, 2010

## **XCOR History** ...

- Founded in 1999
- Located at Mojave Air & Spaceport, CA
- Eleven different rocket engine designs with over 3,500 firings
- Two generations of rocket powered vehicles built & flown
- Building suborbital Lynx FAA-licensed launch vehicle
- Funded by angel investors, sales and contract revenues
- Revenue producing





# **Optics & Sampling**



- Space allocated in vehicle design for external port behind cockpit on the top of vehicle.
- Port cover is a 6" square panel that can be manufactured from a variety of ceramic and transparent materials, depending upon the customer's requirements.
- For external loads, larger transparencies could be used.
- The 6" opening can be modified to hold multiple vacuum containers for atmospheric sampling.

## Lynx Overview



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- Length: 335" [27.9 ft] 8.51 m
- Wing Span: 290" [24.2 ft] 7.37 m
- Height: 88" [7.3 ft] 2.2 m, with gear
- Wing Area
  239 ft2
  22.2 m2
- Aspect Ratio 2.2



# Lynx I Structure





## **Lynx Flight Profile**

**Suborbital Payloads & People** 

+4.6 minutes

**Coast Upwards** 

Engines Off - 58.5 km (192,000 feet)

LYNX Mk. II Flight Profile Single Stage Suborbital Spacecraft

Horizontal Takeoff - Horizontal Landing www.xcor.com

+3 minutes



Intelligence, Surveillance and Reconnaissance Missions



**Optically Pure Glass for Better Imaging** 





Apagee - 103 km (338,000 feet)

microgravity environment

**Re-Entry** 

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Max G-force at pullout: 4.5 G

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### The View ...



#### Lynx Mark I (Prototype) 200,000 Ft Above Mojave

#### Lynx Mark II (Production) 350,000 Ft Above Mojave



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- Human: Pilot + Spaceflight Participant
- Two Primary: One internal, one external
- Three Secondary: One internal, two external

# **Payload Environment**



- Power: nominal 28 VDC bus
- Cooling: internal payloads use convection cooling from the pressurized cockpit air
- Acoustic: suitable for sample melting and experiment thermal management.
- Data Processing and Recording: TBD
- Payload Control: autonomous, secured and immobile
- Deployment: Lynx Cub launched at the appropriate altitude and trajectory; 10-6 ug if active RCS installed: 20 seconds
- Pointing Accuracy: Non-precision vehicle pointing +/-2°; with cold gas RCS +/- 1° is normal.