

Test of the PHOENIX RLV model at NEAT

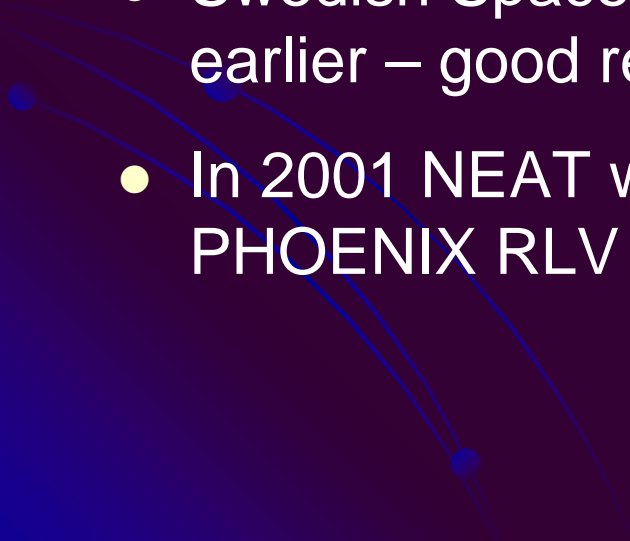
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Outline of presentation

- Introduction
 - NEAT
 - Vidssel missile test range
 - Test vehicle system
 - PHOENIX RLV model
 - T-bar
 - Carrier helicopter
 - Testing the PHOENIX
 - Trajectories
 - Safety
 - Permits
 - Captive flights
 - Free flight
 - Future
 - Other RLV tests
 - Conclusion
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Introduction

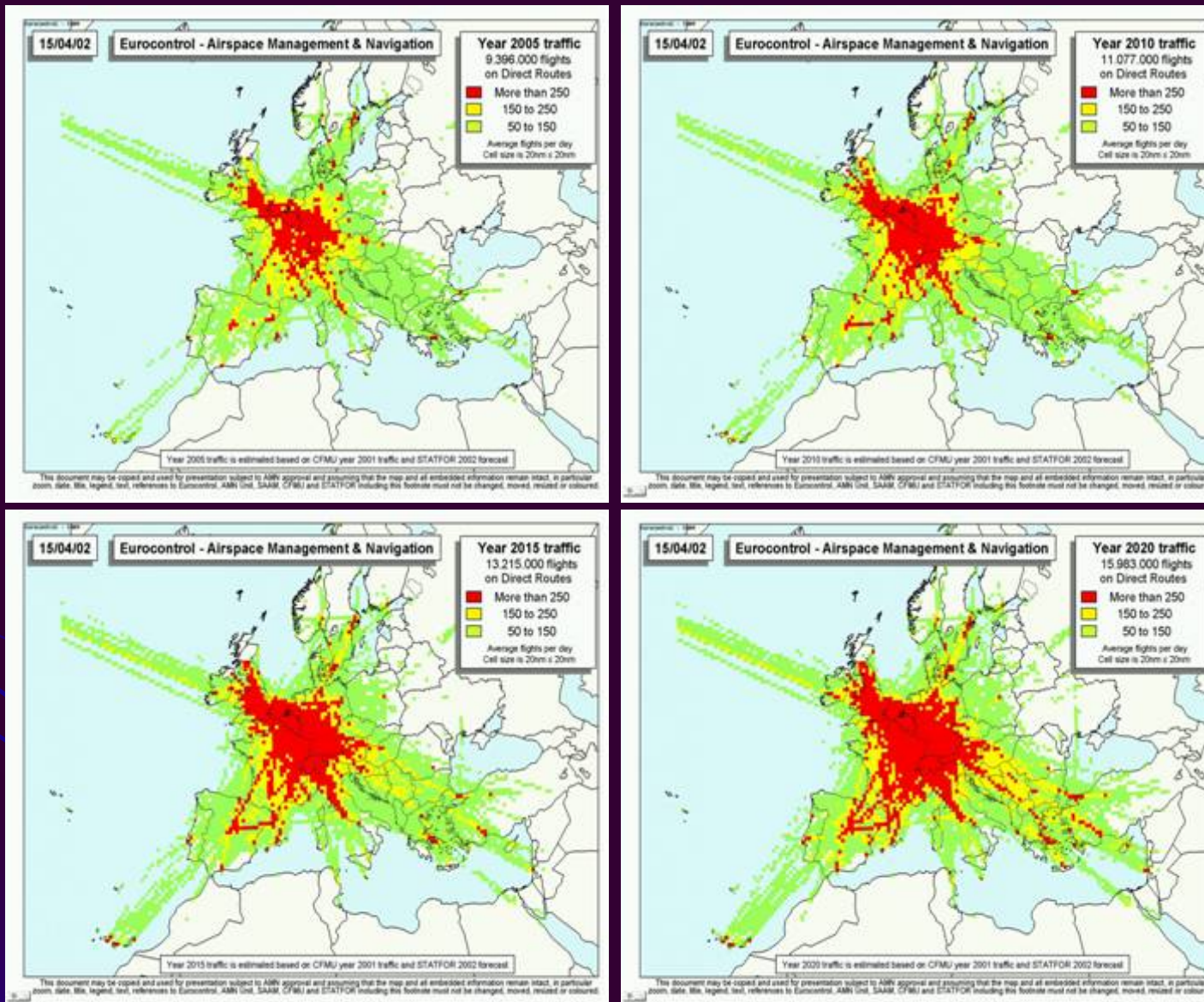
- Test to verify system for autonomous landing on conventional runways
 - Planned use of data in future Hopper RLV
 - Risks with untried vehicles made test in populated area difficult
 - Swedish Space Corporation had worked with Astrium earlier – good reputation
 - In 2001 NEAT was chosen as test range for the PHOENIX RLV models
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NEAT – A unique resource in Europe



- Overland test range
- Extremely low population density (<1 per km²)
- Enlarged area 350x100 km, (length of Denmark)
- Subarctic climate
- Low density commercial air traffic

Air traffic forecast - Europe





Field of Applications



- Test & Evaluation of aerospace vehicles (focus on RLV / UAV)
- Systems verification
- Operations training and operational concept trials
- High altitude scientific research



Vidsel missile test range

- Swedish Defence Materiel Administration facility
- Fully equipped, military GCA airfield with hangars and workshops
- 1650 km² restricted ground area
- Telemetry / Radar / Time Space-Position Instrumentation



Esrange space operation centre

- Swedish Space Corporation facility
- Sounding rocket and balloon launch site
- 6000 km² restricted airspace
- Telemetry / Radar Instrumentation
- TSPI if needed



Test vehicle system

Airborne systems
for the test:

- PHOENIX RLV model
- Carrier helicopter
- T-bar



PHOENIX RLV model

- 6.90 m long
- 3.84 m wide
- 2.56 m high
- 1200 kg weight
- Parachute flight termination system (visible as round hatch in aft part of vehicle)



Carrier helicopter

- Boeing Vertol CH-46 Sea Knight
- Normally stationed at FMV Linköping
- Dedicated test helicopter
- Parent company asset



T-bar

- Adapter between PHOENIX and carrier
- T-shaped
- Bomb release mechanism from type 37 aircraft
- 5.5 m wires
- Hook-up <2 mins



Hook up

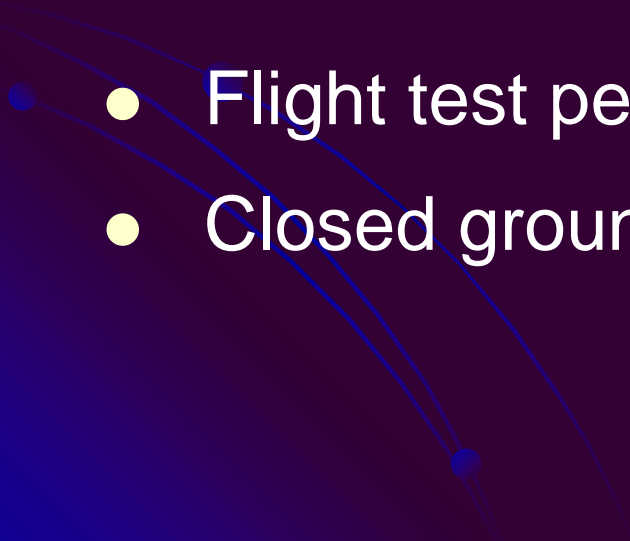
Duration 54 sec



Testing the PHOENIX (1)

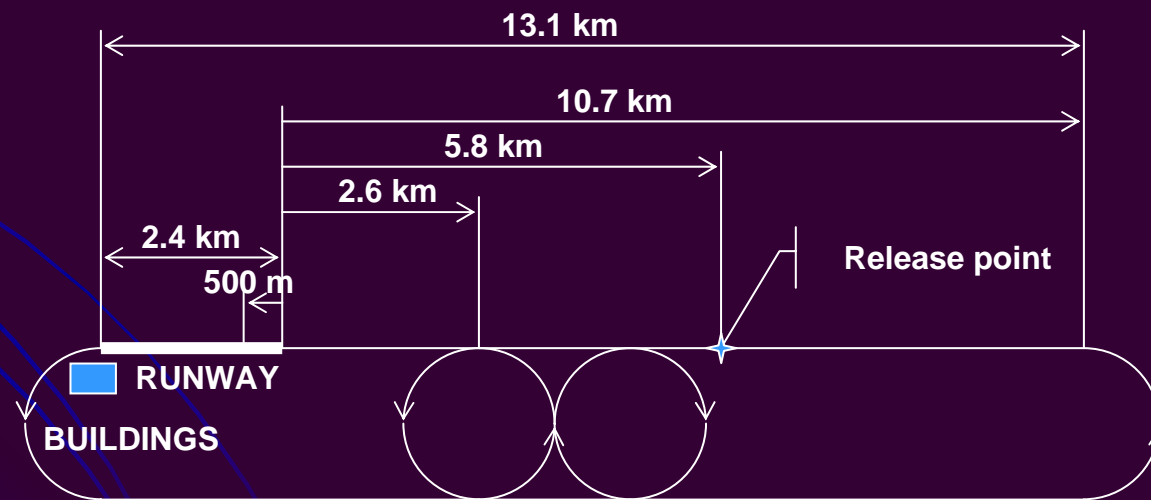
- Preparatory testing
 - T-bar acceptance – Summer 2003
 - Empty aerodynamics
 - Mechanical test with drop tank
 - Captive 1 with mock-up – September 2003
 - Gave good feed-back on behaviour, led to wires being changed to stiffer ones
 - FTS test – October 2003
 - Parachute system tested
 - Captive 2 with flight vehicle – April 2004
 - All systems ready for May free-flight

Test procedure at Vidssel

- Dedicated flight trajectories
 - TSPI placed at base
 - One on a hill 1 km from runway
 - One by runway – remotely operated
 - Radar on same hill as TSPI
 - Flight test permit from FMV
 - Closed ground area
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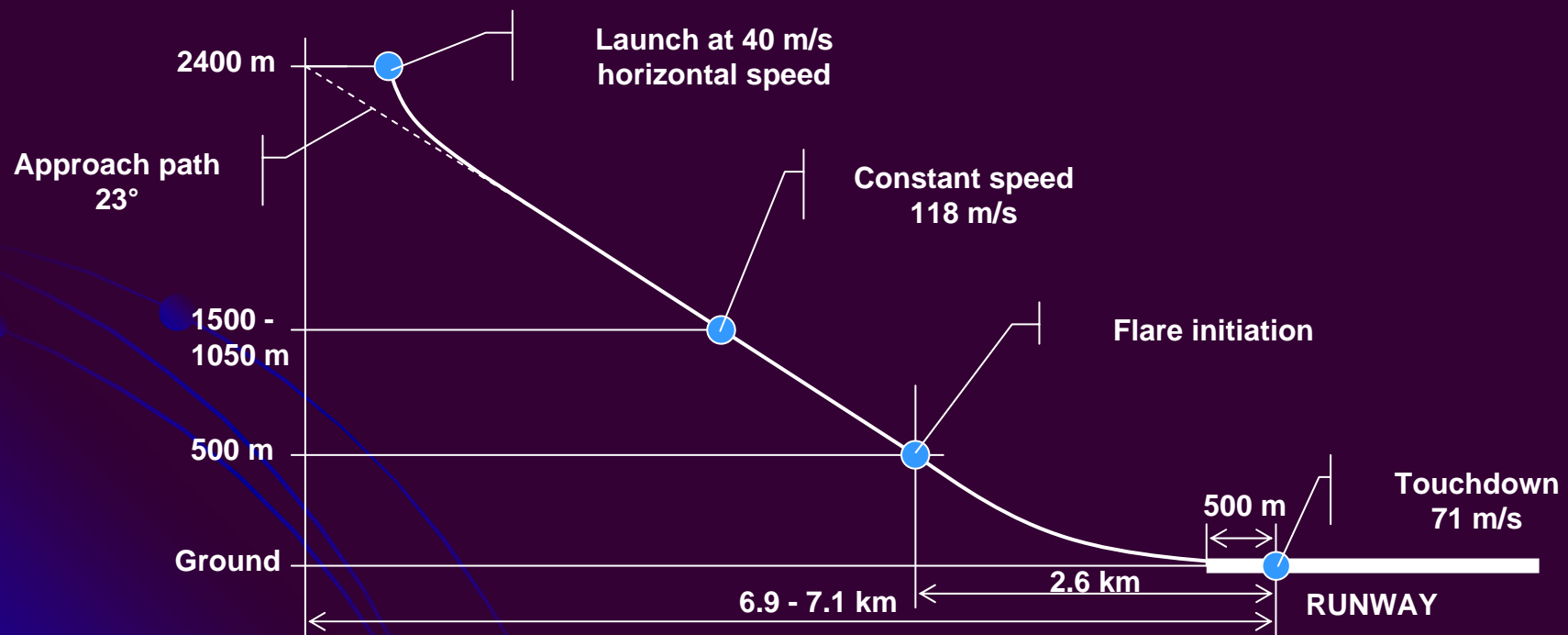
Helicopter trajectory

- Climbing to 2400 m AGL through figure 8 manouver
- Line up with runway
- Release PHOENIX at 40 m/s
- 25 min from hook-up to release



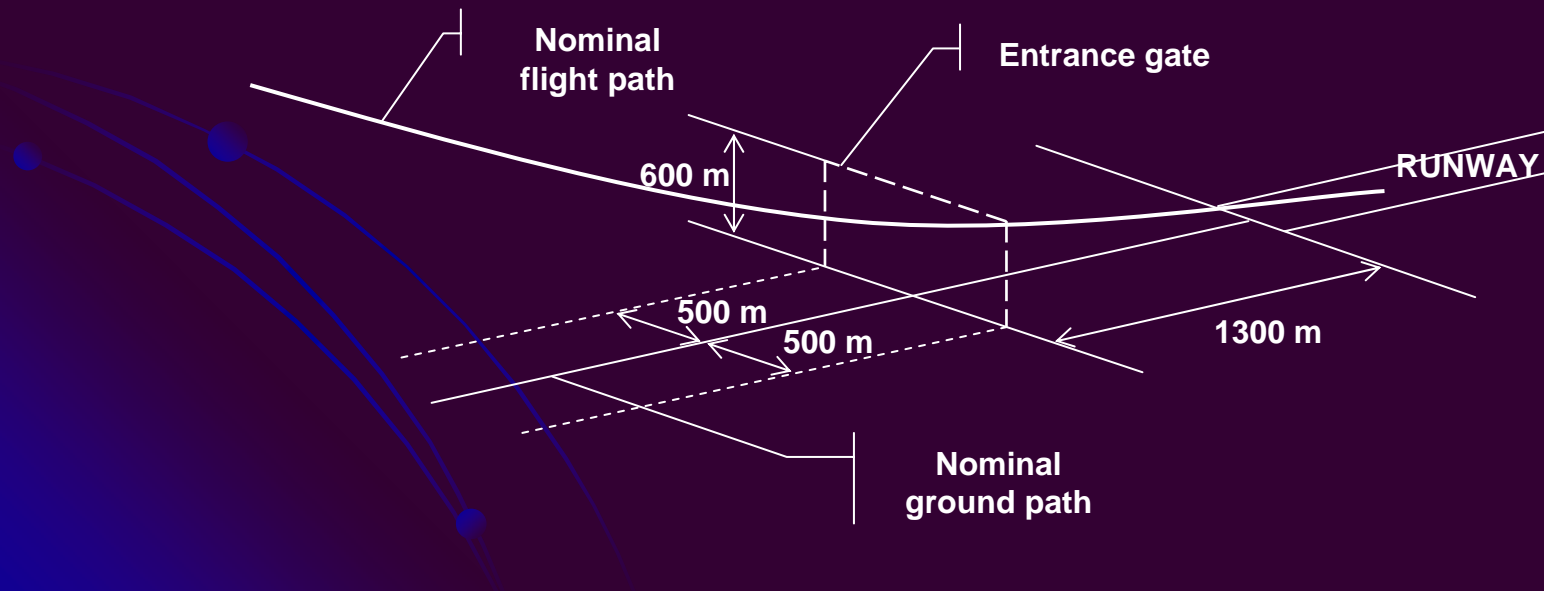
PHOENIX trajectory

- Simulate RLV return path
- Catch up with 23° slope
- 70 seconds from release to touchdown



Entrance gate

- Critical safety aspect
- Overshooting the gate – FTS activation and subsequent parachute landing
- Not enough runway if gate missed



Testing the PHOENIX (2)

- Flight campaign – May 2004
 - Captive
 - General rehearsal with all systems
 - Helicopter flew PHOENIX along path
 - Free flight
 - First release May 8th
 - Smooth separation
 - Followed simulated flight path perfectly
 - Landed 2 cm off-centre and 8 m short



1st free flight

Duration 1 min 46 sec



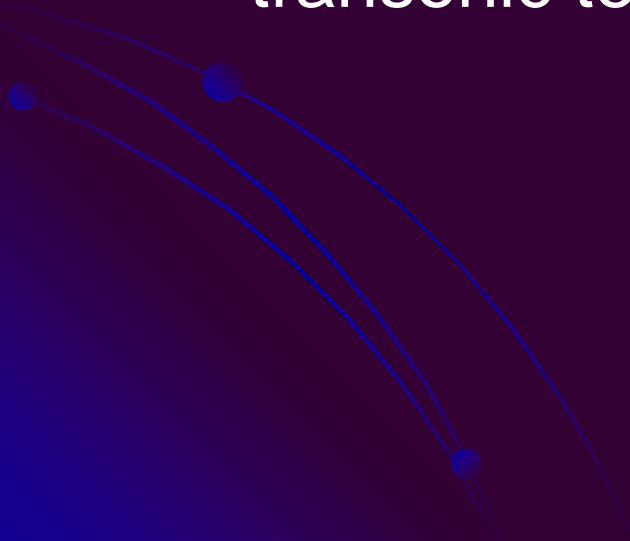
Flights 2 and 3

- 2nd test similar to first
- 3rd test with offset release point
 - Higher wind conditions
 - 100 m right offset
 - Flew back into path
- Very good flight results



Future tests

- PHOENIX as a RLV test-bed
 - Subsystem test
 - Tried configuration PHOENIX at NEAT
- To be used in ESA FLPP
- PHOENIX aircraft or balloon launched for transonic tests



Other RLV Tests

Several different RLV systems tests are envisioned to take place at NEAT:

- Aerodynamic tests *
- Autonomous landing system tests *
- Re-entry tests
- Hypersonic tests

* completed at NEAT

Aerodynamic tests

- HSFD
- Summer 2003
- JAXA (former NAL/NASDA, Japan) and CNES (France)

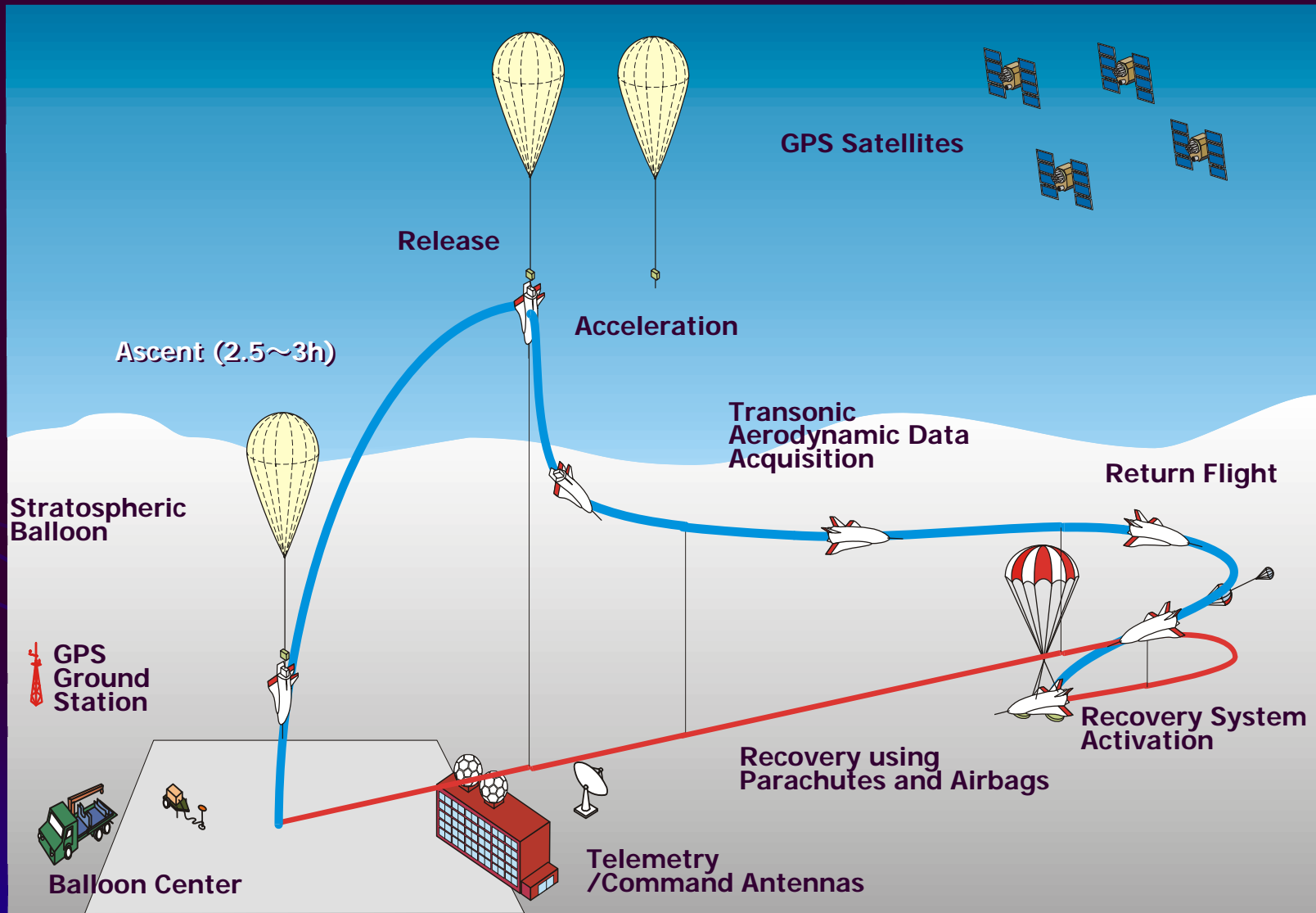


In hangar



On dolly

HSFD flight



Landing site



Huygens descent test

- ESA drop-tested a model of the Huygens probe in May 1995 from Esrange.
- Balloon ascent to 37 km before release
- Impact within Esrange impact area due to turn-around wind conditions

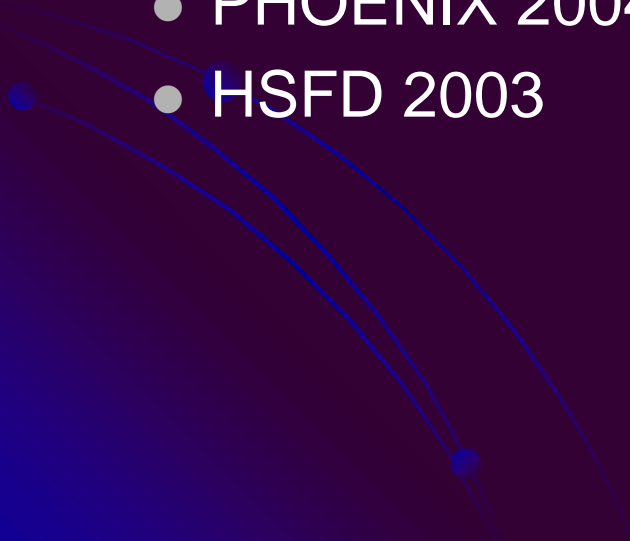


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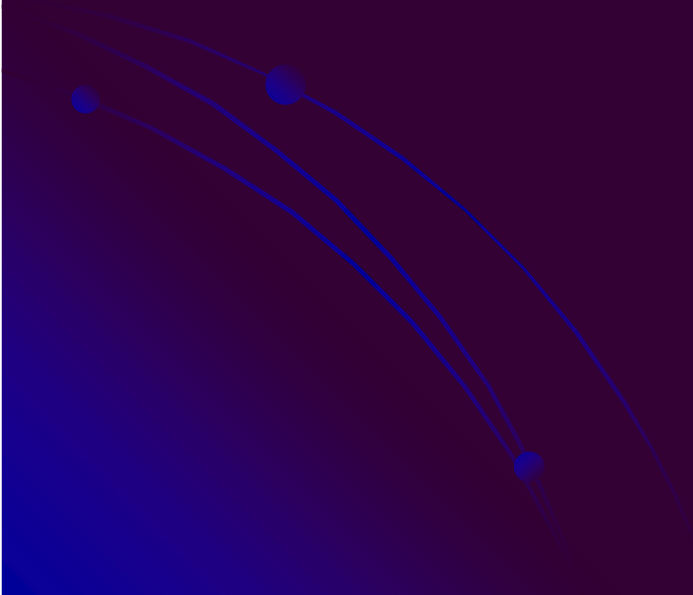
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Conclusion

- PHOENIX has flown with excellent results
 - Possible to use as sub-system test-bed
 - NEAT has shown itself as a good resource for RLV testing
 - PHOENIX 2004
 - HSFD 2003
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Questions

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EADS video

Duration 5 min 23 sec

