

# Recent Advances in Propulsion Airframe Aeroacoustics

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by

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# Outline

- What is Propulsion Airframe Aeroacoustics (PAA)?
  - Definition
  - PAA in Action
  - Approach
- A recent PAA Experiment
  - Setup
  - Effects investigated
- Use of PAA Results
  - Prediction of System Noise
- Conclusions

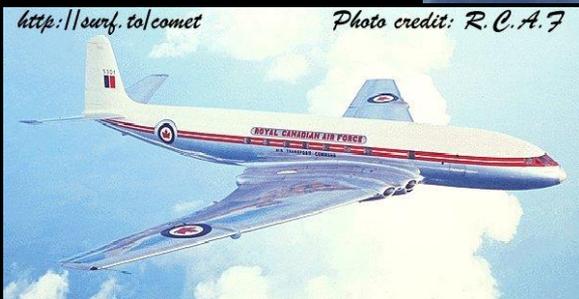
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# Propulsion Airframe Aeroacoustics (PAA)

- Definition: Aeroacoustic effects associated with the integration of the propulsion and airframe systems.
- Includes:
  - Integration effects on inlet and exhaust systems
  - Flow interaction and acoustic propagation effects
  - Configurations from conventional to revolutionary
- PAA goal is to reduce interaction effects directly or use integration to reduce net radiated noise.

# Configuration Examples



# PAA in Action



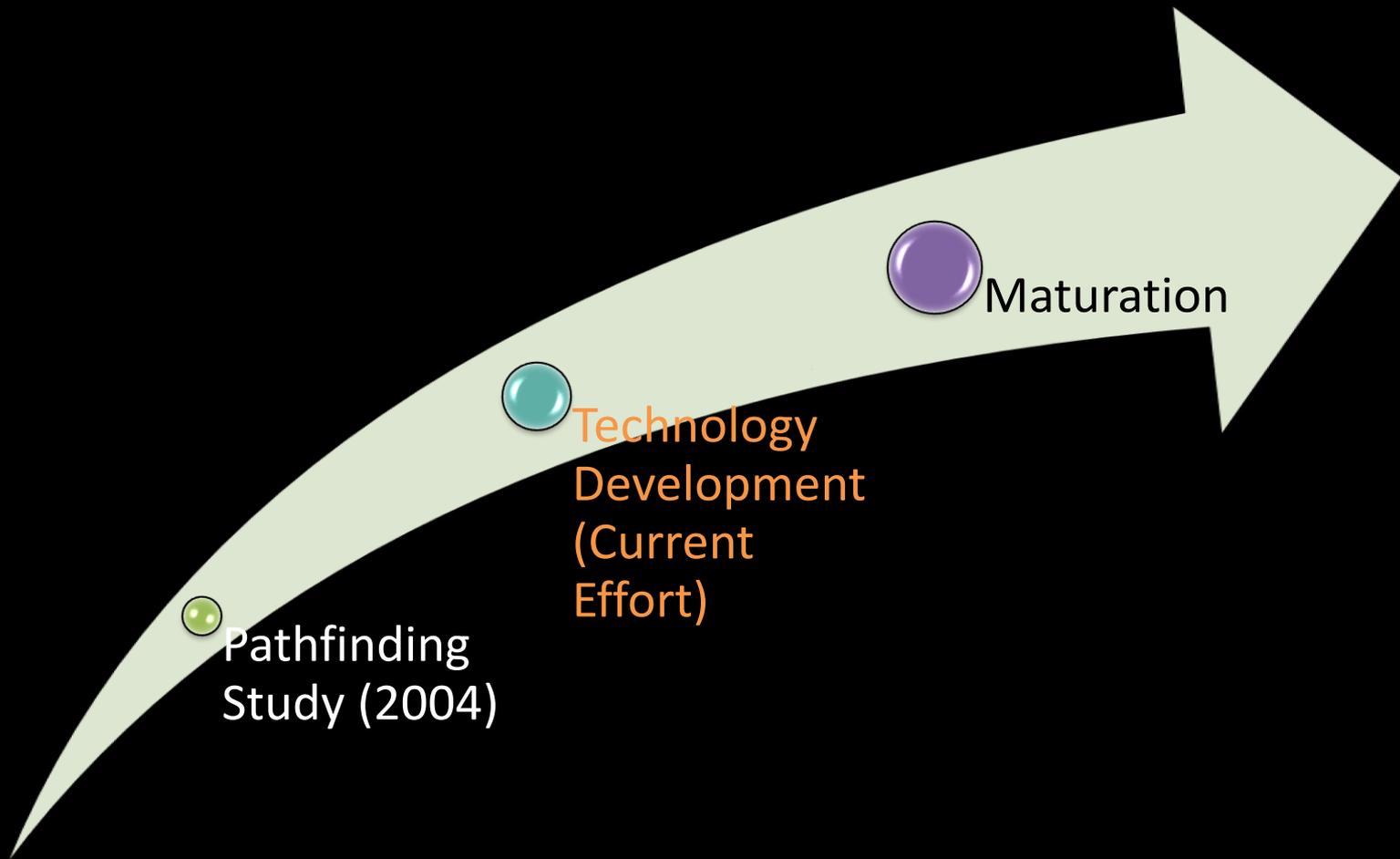
Lab experiments in 2004 led to PAA chevrons on QTD2 flight test in 2005

QTD2 success resulted in PAA chevrons on 747-8

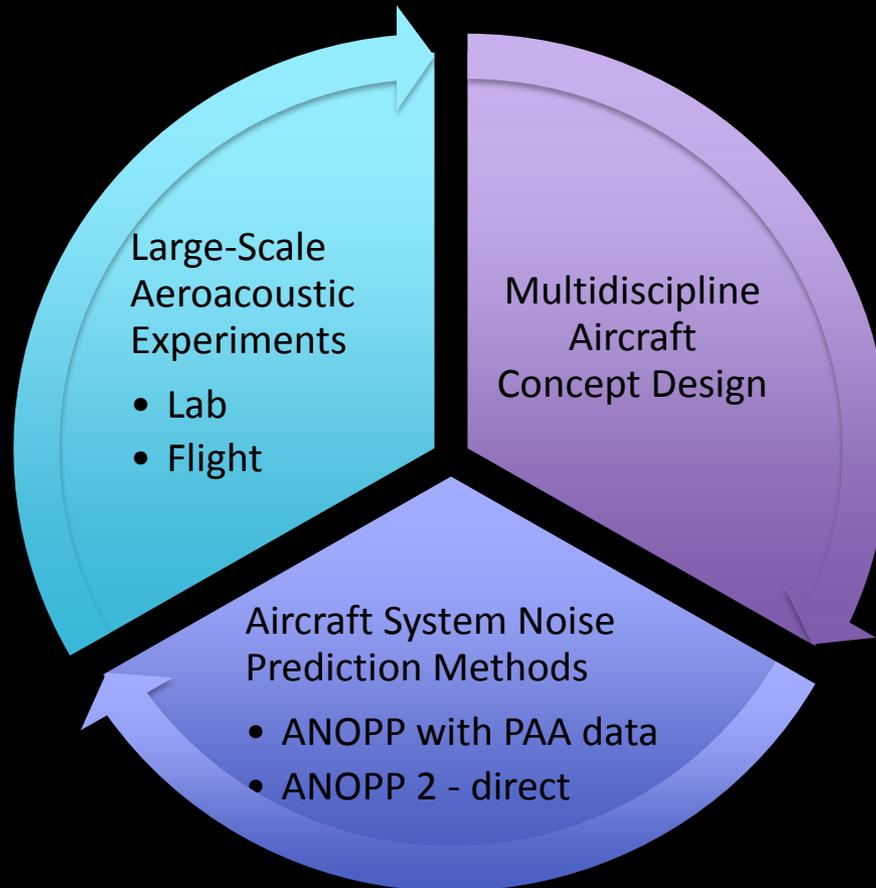


Photos courtesy of Boeing

# PAA Approach



# Technology Development



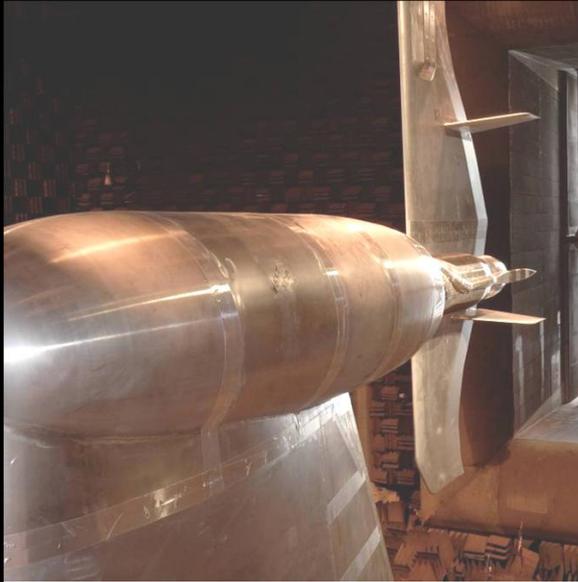
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# Overall Experimental Setup (LSAF)

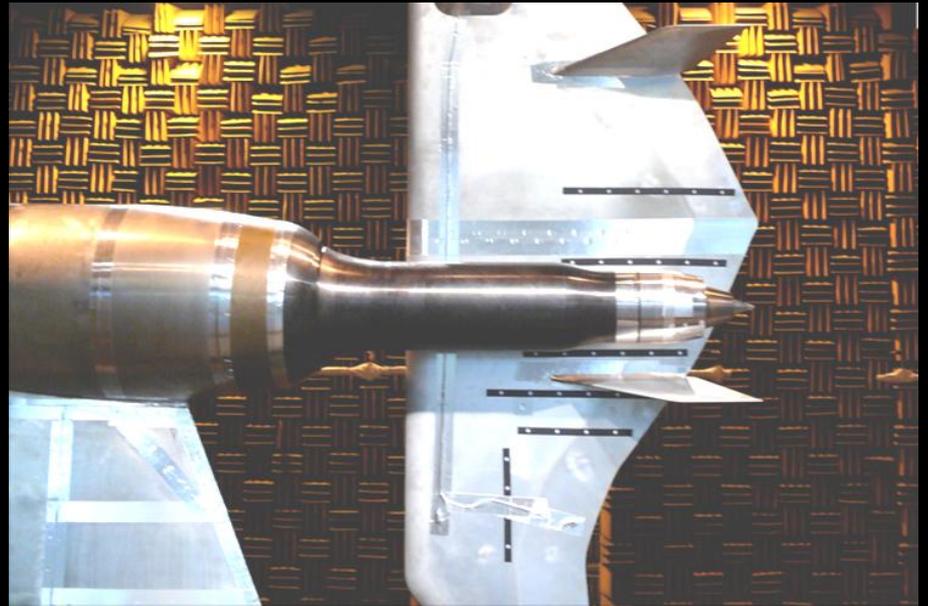


# PAA Experiment



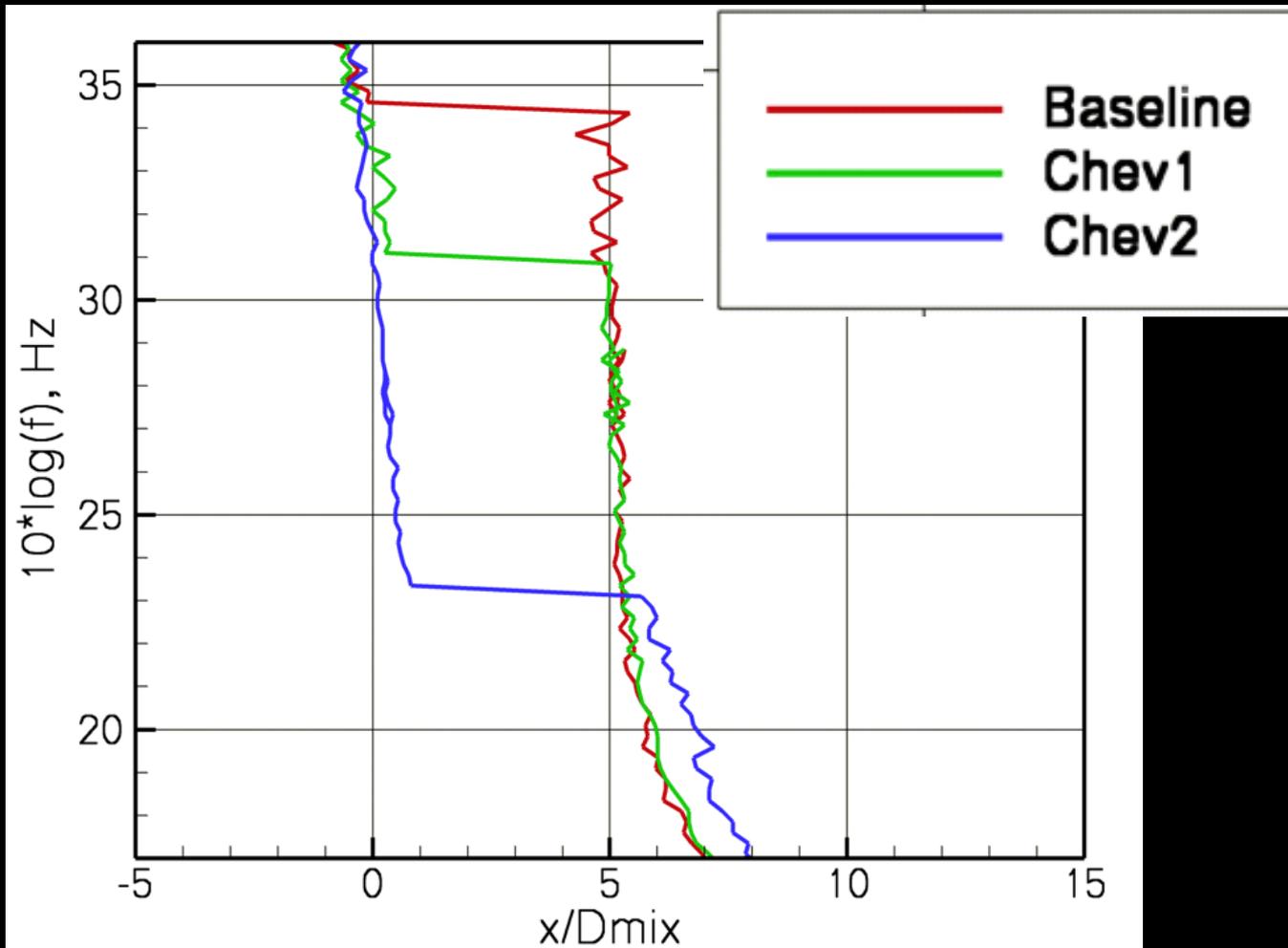
# Some PAA Effects Investigated

Basic Shielding – Nozzle moved upstream



Impact of Chevrons and specific Pylon contributions

# Chevrons move Jet Sources Upstream

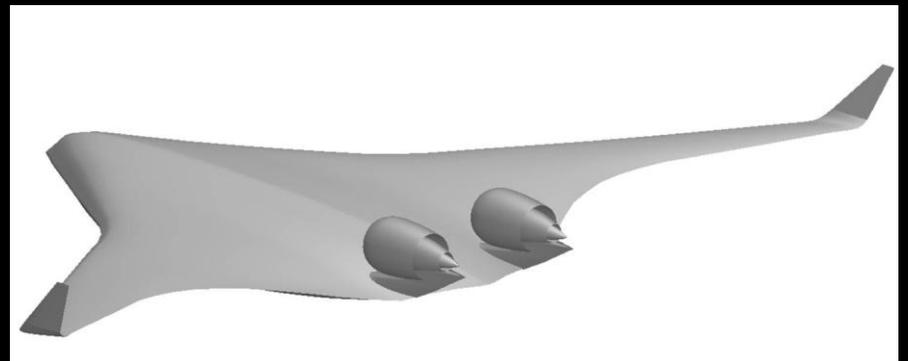
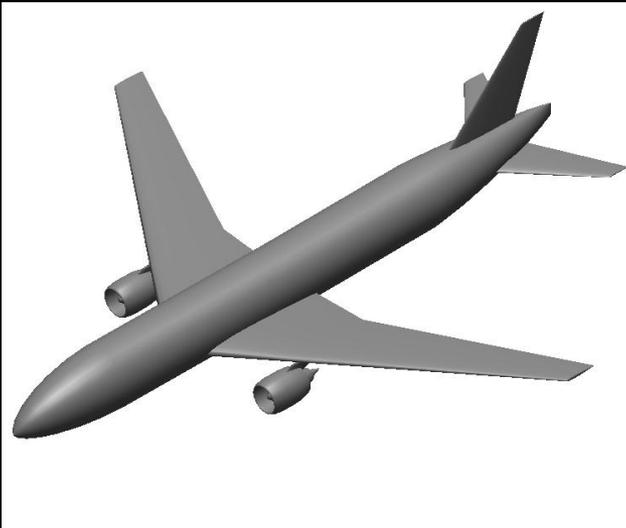


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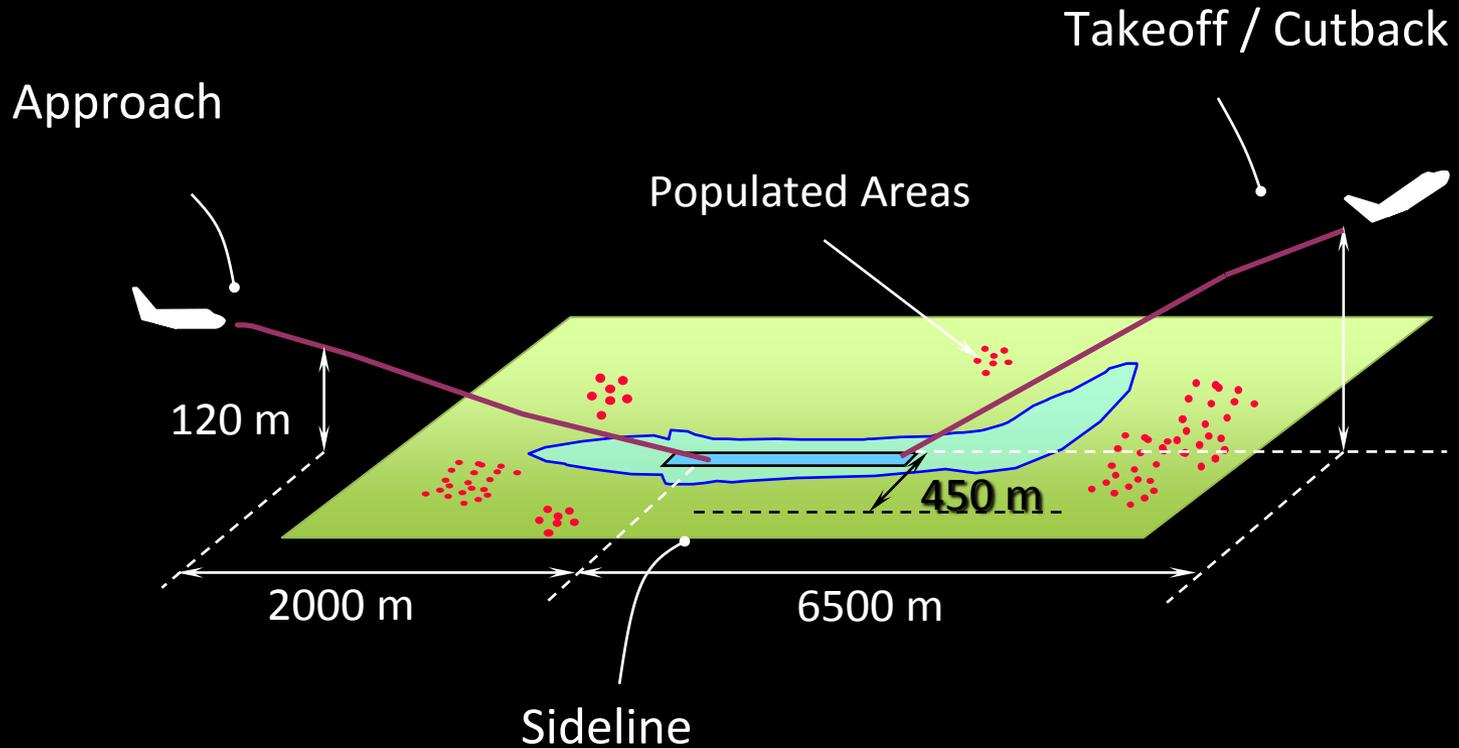
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# System Calculations

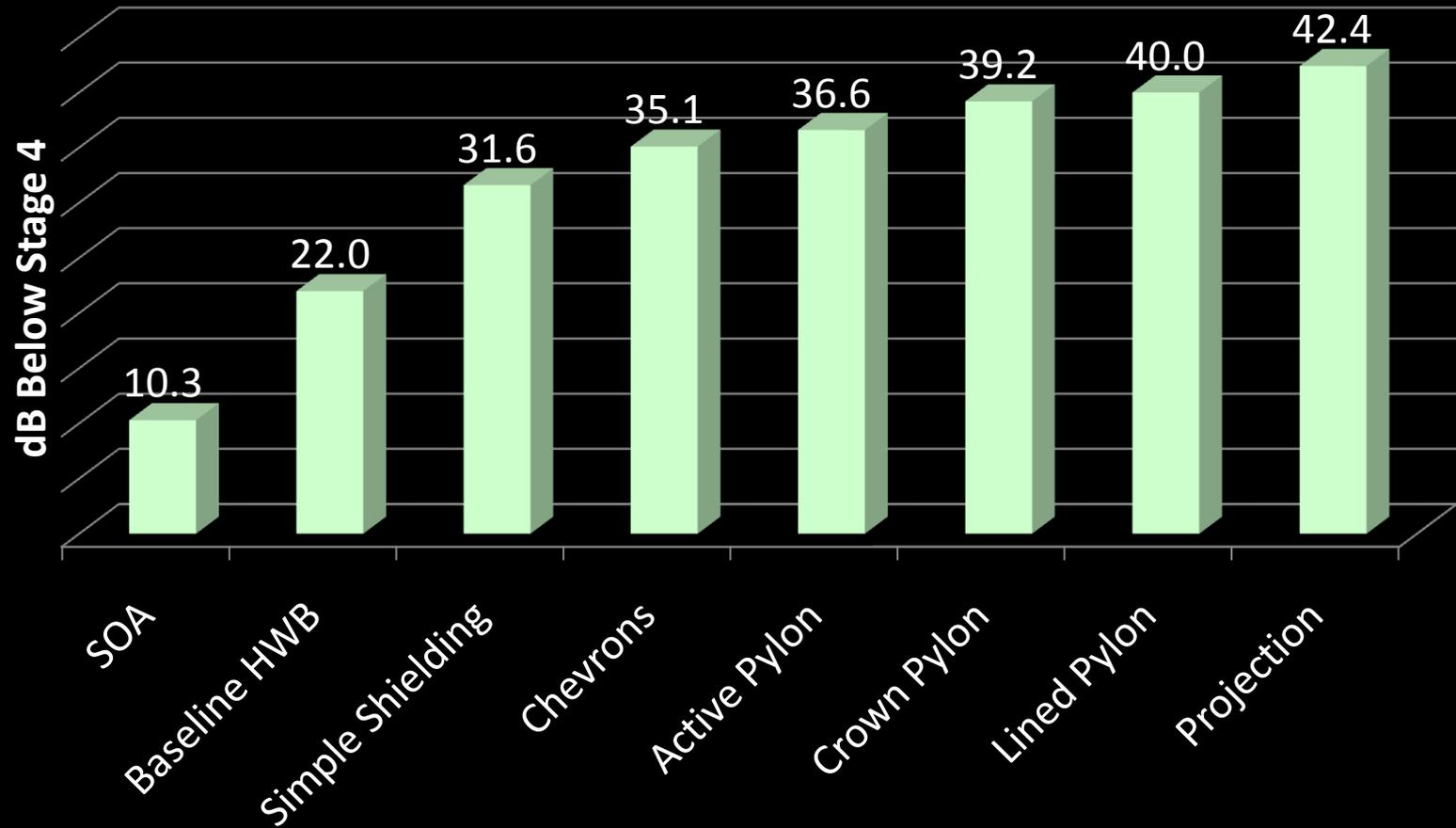
- Use NASA tools to generate 'SOA' and 'HWB' aircraft sized for same payload and 7500 NM mission
- Equivalent technology level and same engine family



# Aircraft 'flown' for FAA cert. trajectory

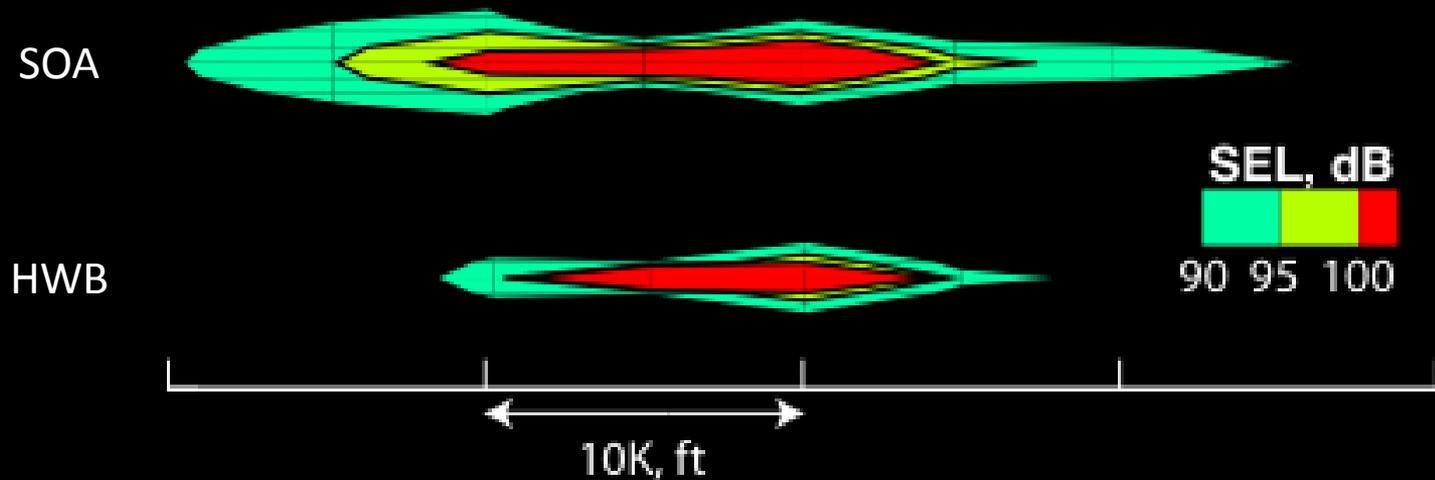


# Progress towards Goal



# Sound Exposure Level (SEL) Contour

- For simulated Arrival and Departure (aircraft flying right to left)



66% Reduction in ground contour area

# Conclusions

- PAA effects provide a powerful enabler for aircraft noise reduction
- Shielding of jet noise sources is feasible
- Aircraft noise is a system-level problem requiring system-level solutions

# References

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AIAA-2006-2438
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AIAA-2006-2439
- Hybrid Wing Body Aircraft System Noise Assessment with Propulsion Airframe Aeroacoustic Experiment  
AIAA-2010-3913
- Propulsion Airframe Aeroacoustic Integration Effects for a Hybrid Wing Body Aircraft Configuration  
AIAA-2010-3912