Introduction and Case Descriptions for the Sonic Boom Prediction Workshop

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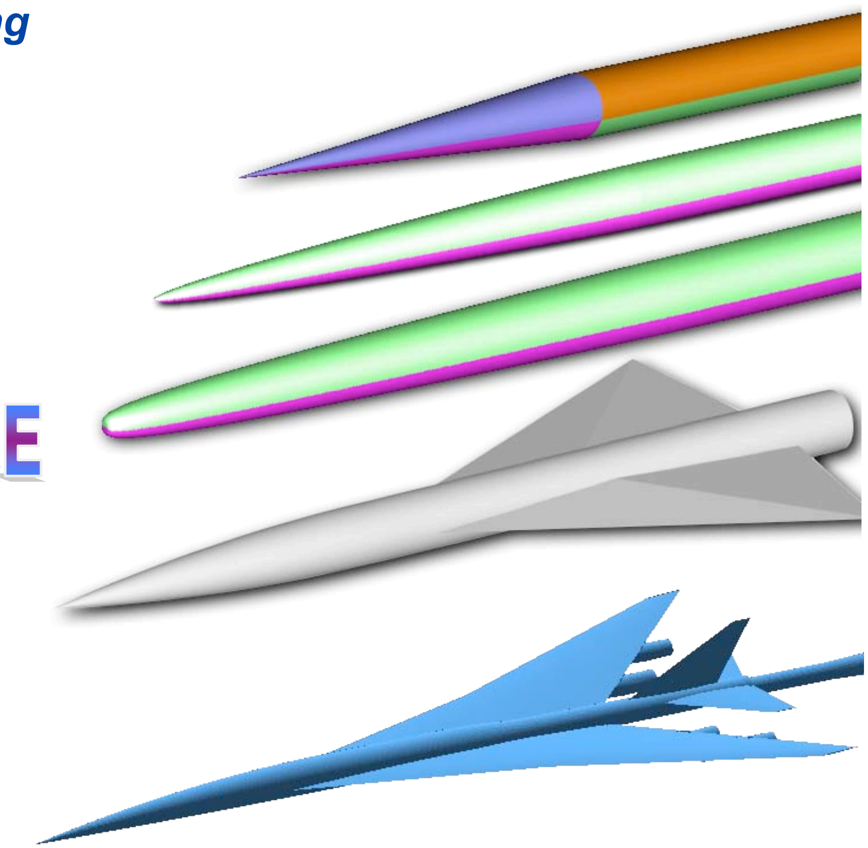


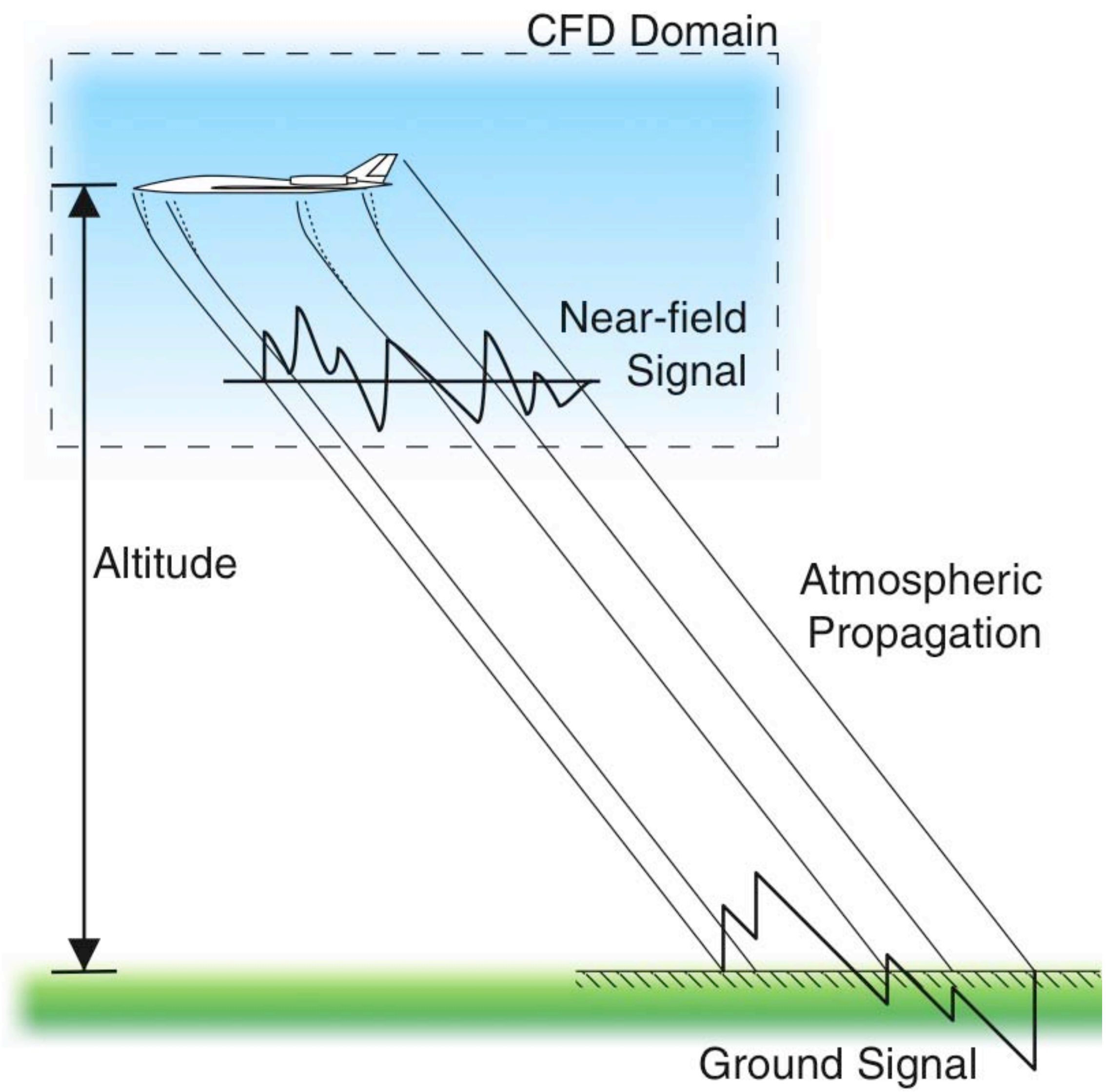
AIRPLANE

Cart3D

FUN3D
Fully Unstructured Navier-Stokes

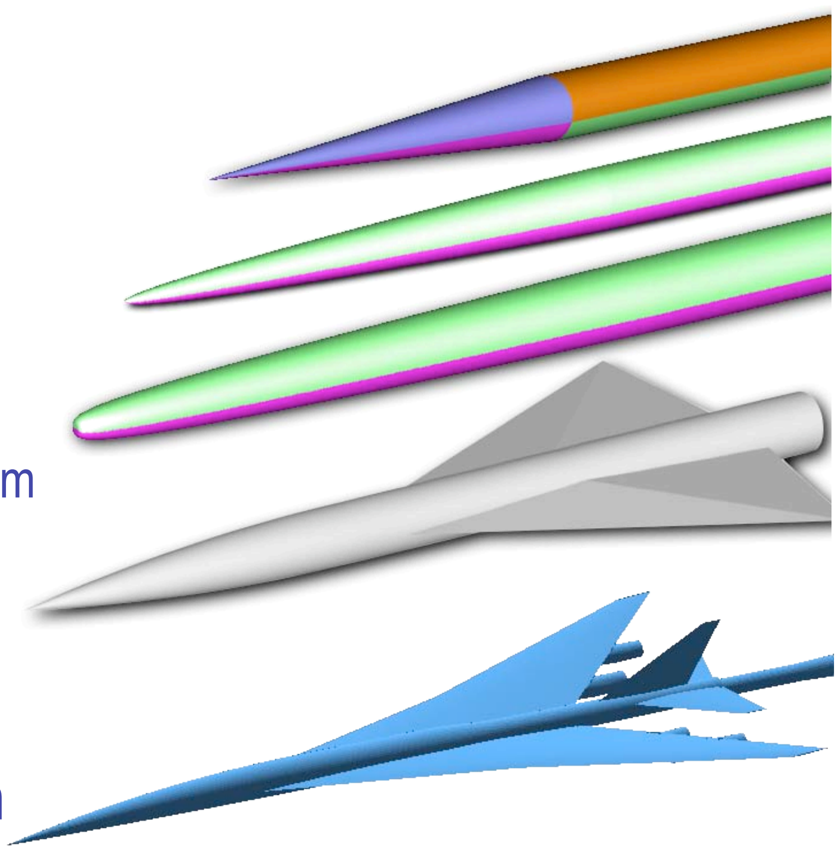
USM3D

Sonic Boom Analysis

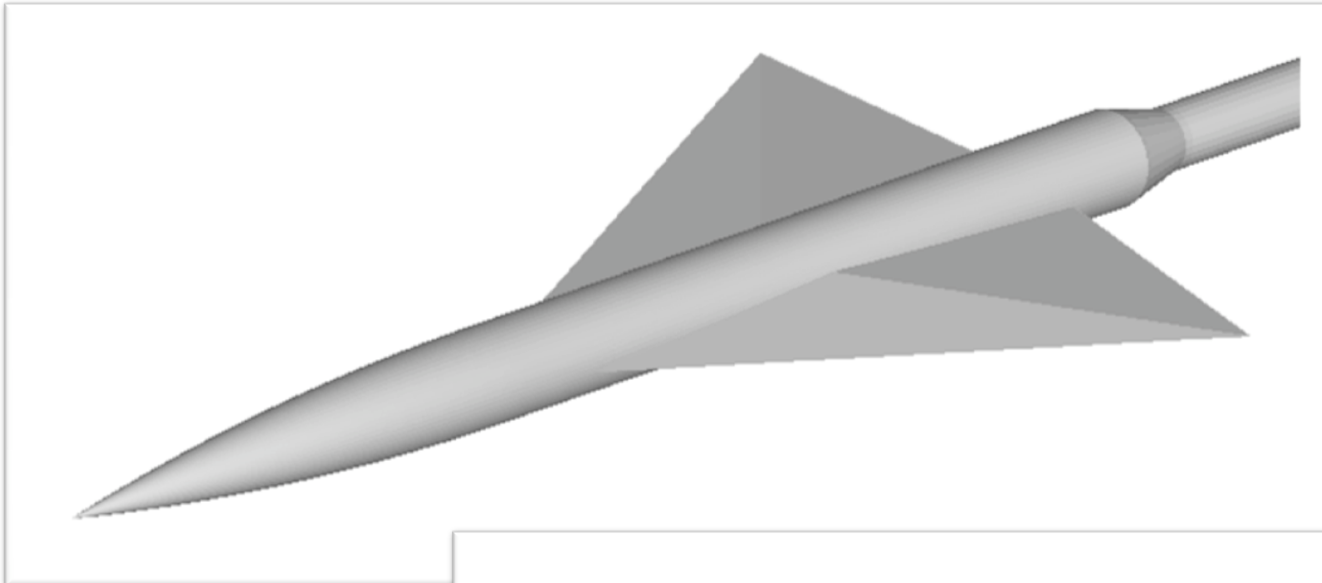


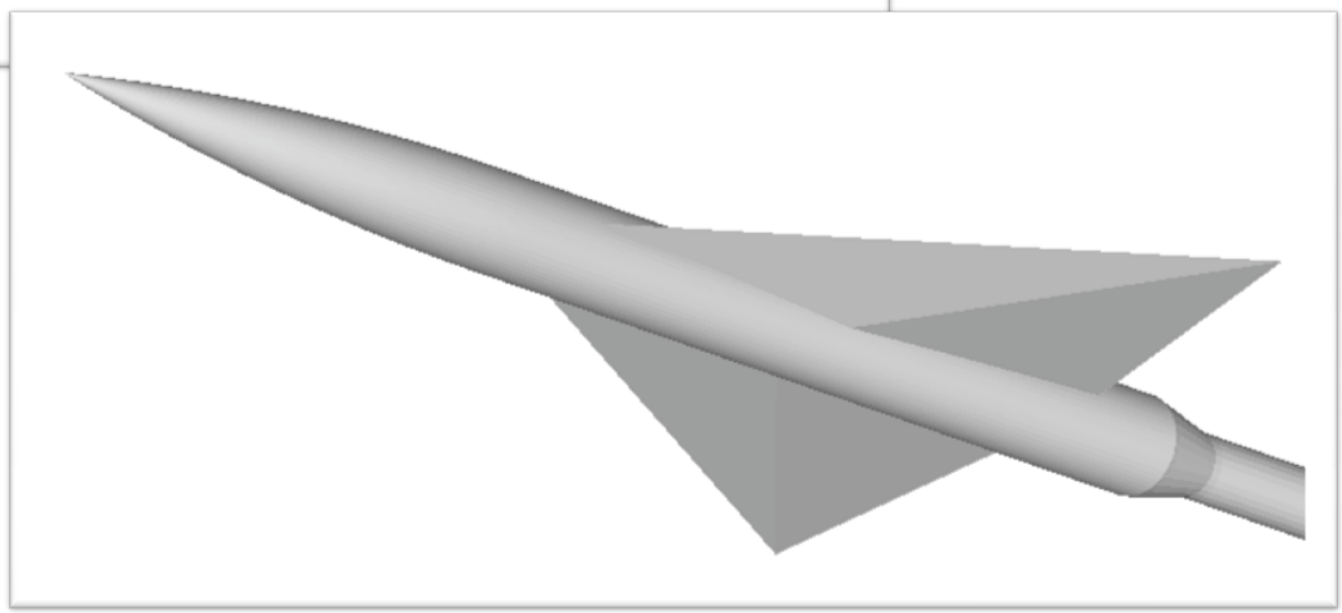
Validation Geometry Selection (experimental models)

- 6.48 degree Cone-Cylinder
  - Finite rise pressure signature
- Parabolic body of revolution
  - Representative of a typical transport vehicle fuselage
- Quartic body of revolution
  - Large bow shock simulation and low boom shape
- 69 degree swept Delta-Wing-Body
  - Simple lifting configuration
- Ames Low Boom Wing-Body-Tail with nacelles and B.L. diverters (LBWT)
  - Representative of low sonic boom complete configuration

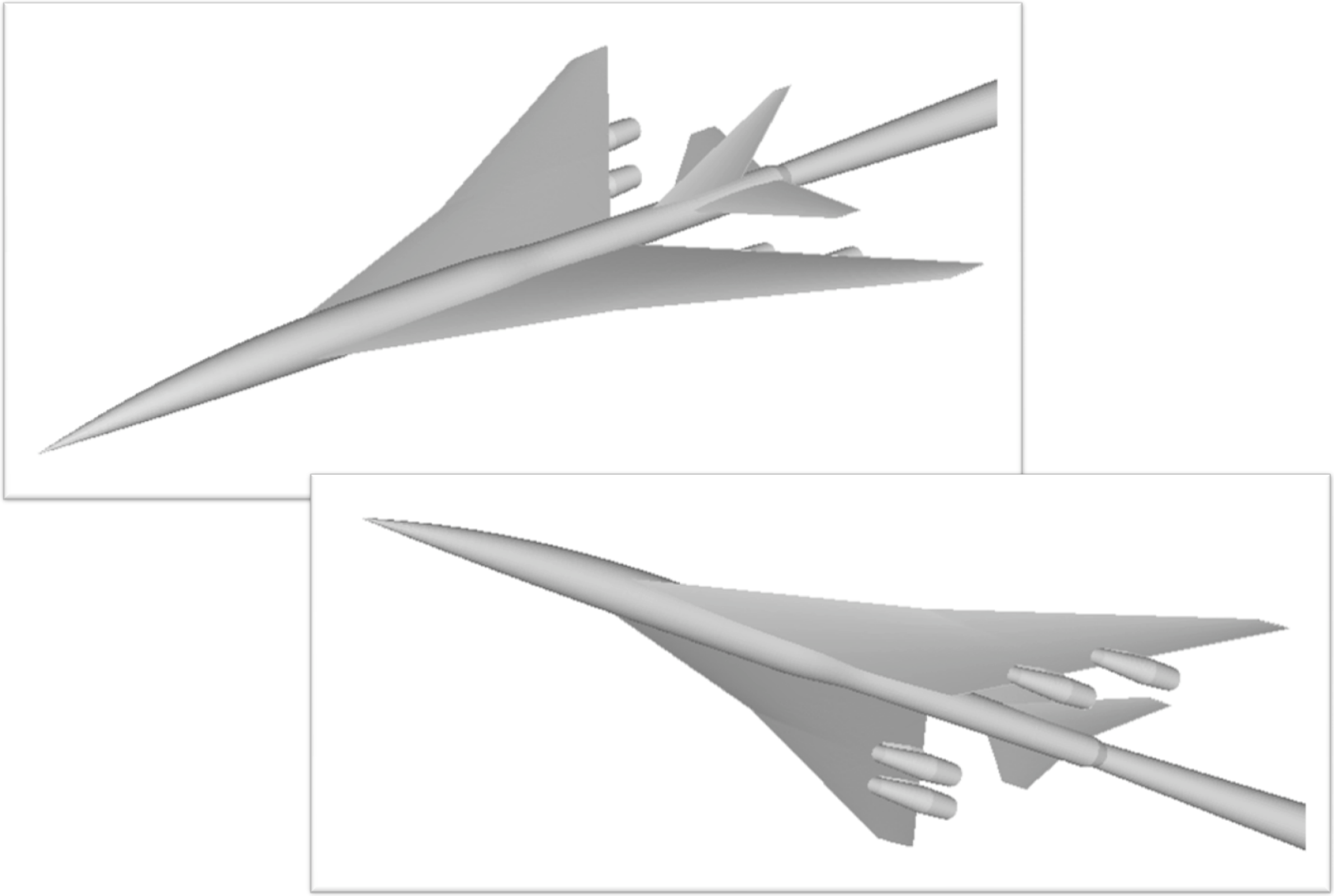


Delta Wing Fuselage





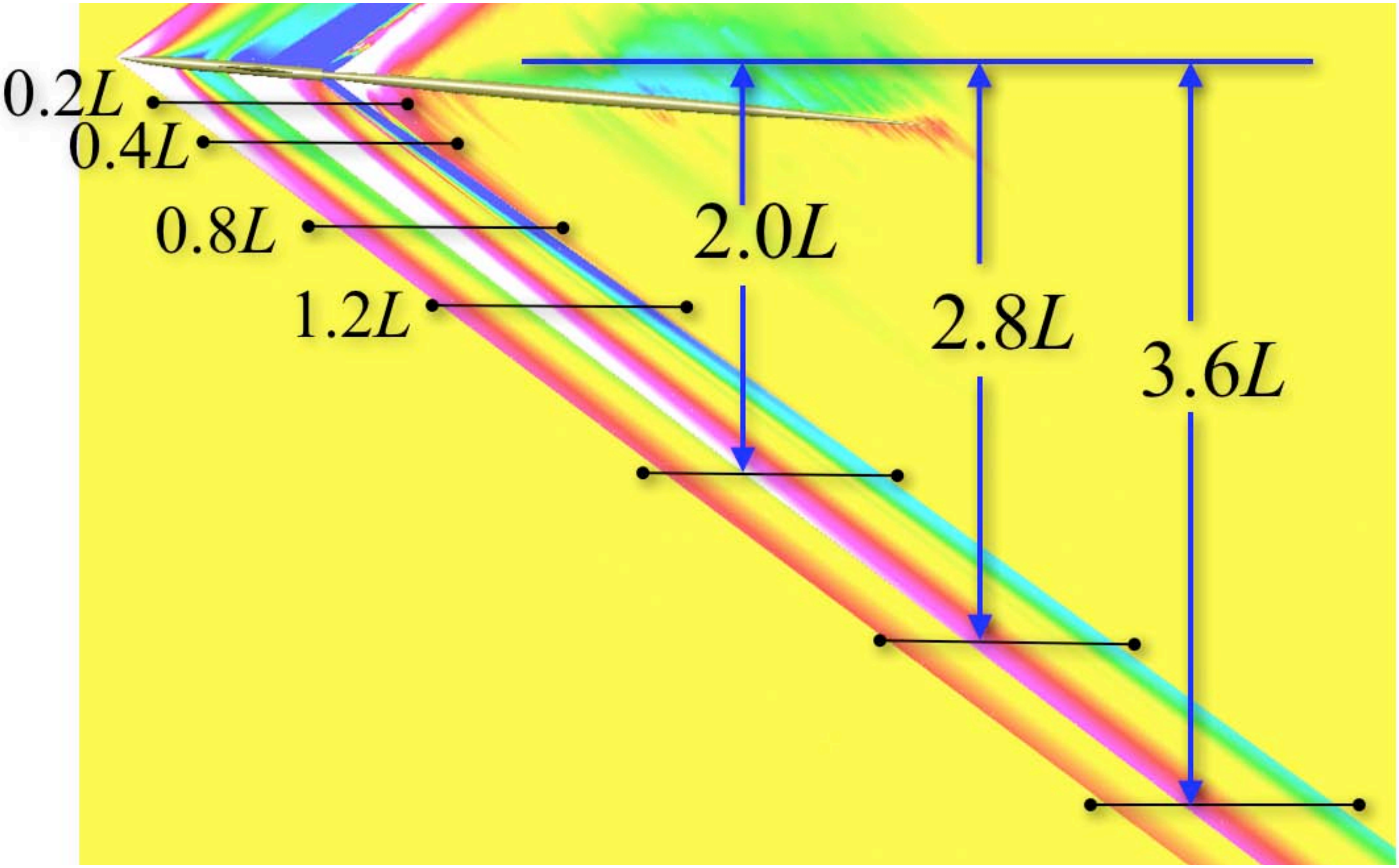
Low Boom Wing Tail



Experimental Validation Cases

Configuration	Mach	AoA	h/l	Report no.
6.48° Cone-Cylinder; L=8.6 units	1.68	0.0	10.0	NASA TM X-2219
Parabolic Body of Revolution; r=f(x**0.5); L=2.0 units	1.41	0.0	10.0	NASA TN D-3106
Quartic Body of Revolution; r=f(x**0.25); L=2.0 units	1.41	0.0	10.0	NASA TN D-3106
69° Swept Delta-Wing-Body; L=17.52 units	1.68	4.74	3.6	NASA TN D-7160
Ames Low Boom Wing-Body-Tail (LBWT) with 4 nacelles, L=12.0	2.0	2.0	1.167	NASA CP-1999-209699

Computational Study of Near Field Signatures For the 69° Swept Delta-Wing Body

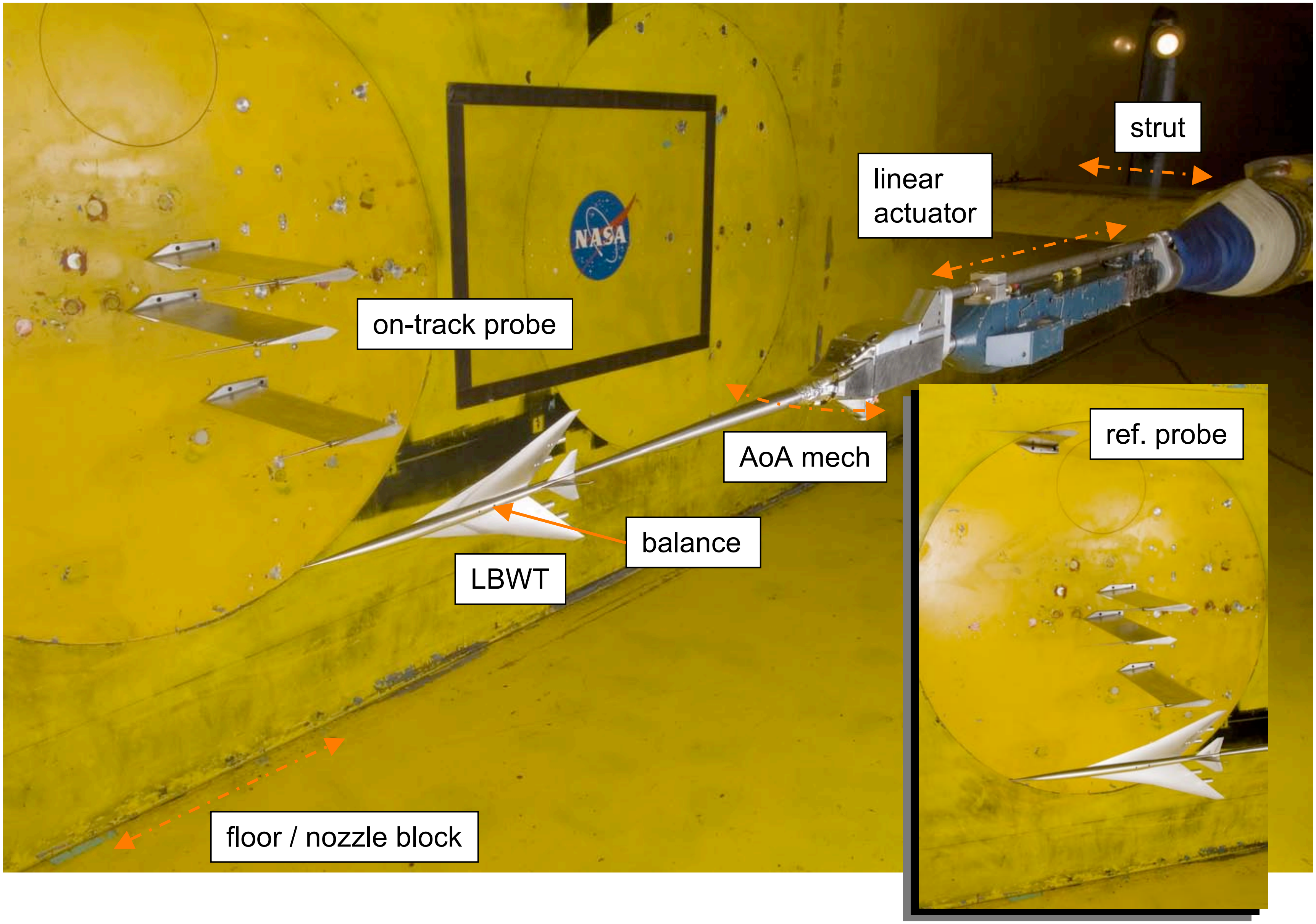


Experimental Data

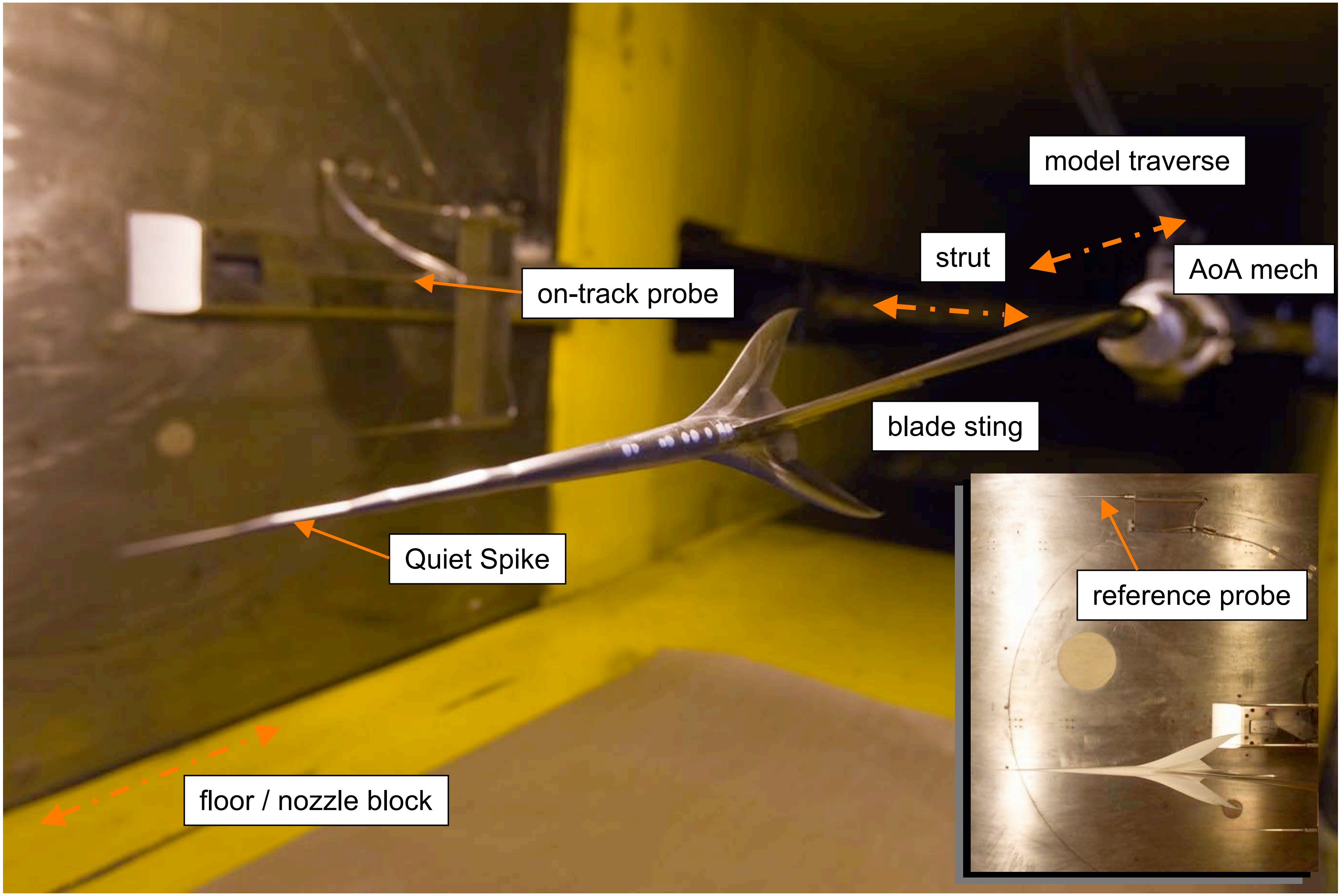
- NASA Ames 9x7 Unitary Plan Wind Tunnel (UPWT)
  - Cone-Cylinder
  - 69° Swept Delta-Wing-Body
  - Ames Low Boom Wing-Body-Tail (LBWT)

- NASA Langley 4x4 UPWT
  - Parabolic Body of Revolution
  - Quartic Body of Revolution

The Experimental Setup in 9x7 UPWT



The Experimental Setup in 4x4 UPWT



Experimental and Computational Considerations

Wind Tunnel	CFD
CN may vary by 10-20% due to sting/ram deflection (α variation on large lifting models) and stream angle	Alpha and CN are constant
Flow is unsteady in Tunnel (model vibrates with turbulence)	Flow is steady / model is steady
Tunnel conditions (temperature and humidity) change during signature taking (~30 – 60 mins)	No change in flow conditions
Reference probe in different location than overpressure probes	P_{inf} is computed
Viscosity effects captured B.L not tripped	No viscous effects for Euler computations
Model base/sting cavity on lifting models has proper physics	Model base/sting geometries as solid ramps or steps
Geometry as built	Geometry as designed

Differences in computational and experimental data are expected

Computational Methods Assessed

AIRPLANE - Euler tetrahedral cells

CART3D - Euler Cartesian cells

FUN3D - Navier-Stokes (Euler mode) tetrahedral cells

USM3D - Navier-Stokes (Euler mode) tetrahedral cells

Agenda

8:00 - 8:15 **Introduction and Case Descriptions for the Sonic Boom Prediction Workshop** - Ms. Susan Cliff, NASA-Ames

8:15 - 9:00 **Assessment of Unstructured Euler Methods for Sonic Boom Pressure Signatures Using Grid Refinement and Domain Rotation Methods** - Ms. Susan Cliff, Mr. Scott Thomas, Mr. Matt McMullen, Mr. John Melton and Mr. Don Durston, NASA-Ames

9:00 - 9:30 **Output-Adaptive Tetrahedral Cut-Cell Validation for Sonic Boom Prediction** - Dr. Michael Park and Dr. Eric Nielsen, NASA-Langley

9:30 - 10:00 **Sonic-Boom Prediction with Output-Based Adaptation and Cart3D** - Mr. Michael Aftosmis, Mr. Marian Nemec, Mr. Mathias Wintzer, NASA ARC

10:00 - 10:30 **BREAK**

10:30 - 11:00 **A Method for Shearing and Stretching Unstructured Grids for Improved Sonic Boom Prediction** - Mr. Richard Campbell and Ms. Melissa Carter, NASA LaRC

11:00 - 11:30 **Summary and Comparison of NASA's Supersonic Boom Prediction Methods** - Ms. Melissa Carter, NASA LaRC