AePW-4 High-Angle Working Group Kickoff Meeting

May 9, 2024

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AePW Goals and Motivation

- An open and impartial forum to assess and evaluate the current state-of-the-art and state-of-the-practice in computational aeroelastic modeling
  - How effective are current solvers at predicting aeroelastic physics critical to aircraft analysis and design?
  - How can we understand the reasons for why our solvers may fail?
  - Can we establish best-practices for using aeroelastic solvers?
  - Can we establish uncertainty bounds for computational results?
  - Can we specify requirements on future validation experiments?
- What computational and experimental areas of research need further development?

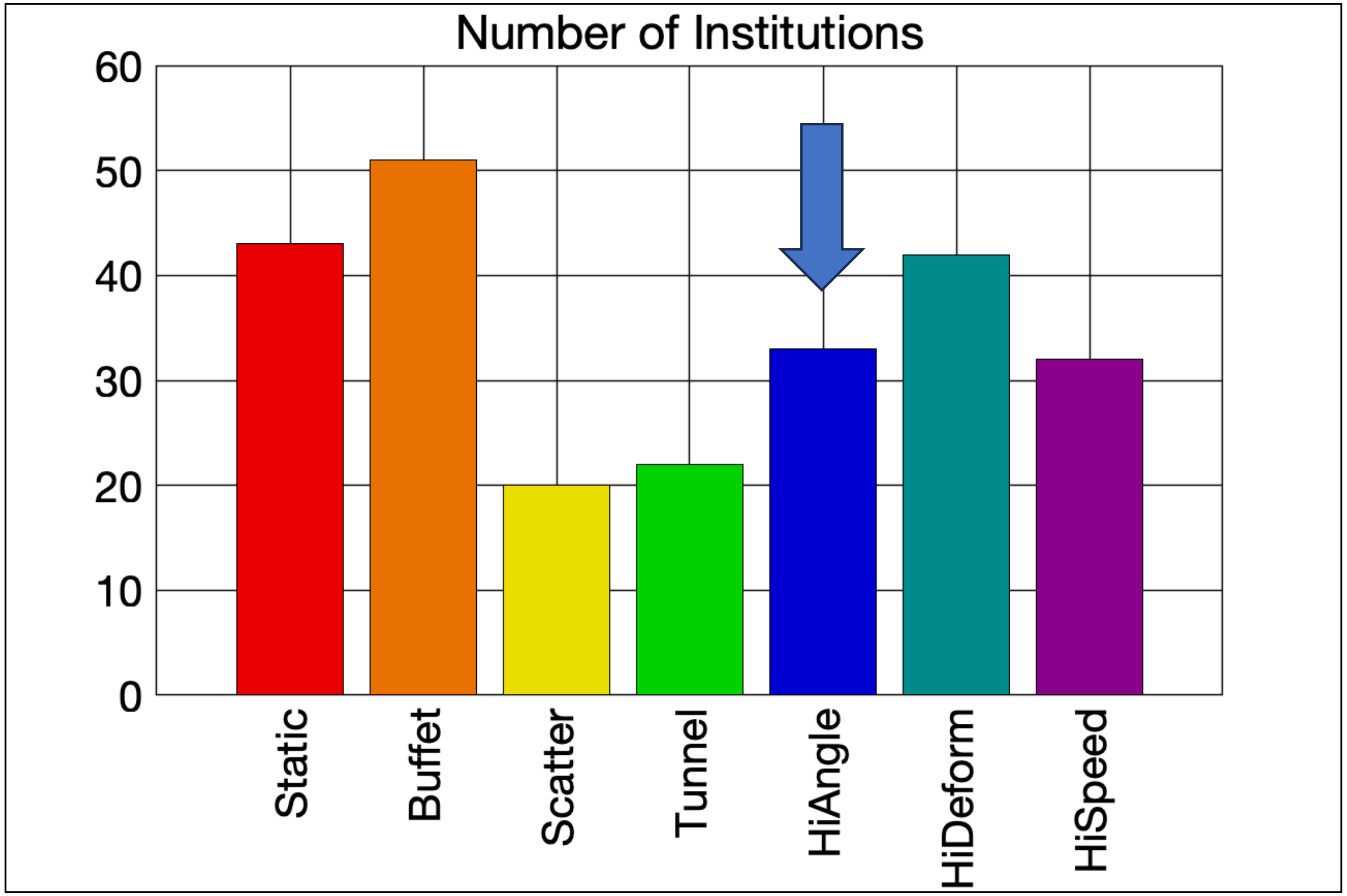
Organizing Committee

- Kirk Brouwer, AFRL (High-Speed WG)
- Carlos Cesnik, University of Michigan
- Pawel Chwalowski, NASA LaRC (High-Angle WG)
- Adam Jirasek, USAFA
- Jeff Ouellette, NASA LaRC
- Rafael Palacios, Imperial College London (High-Deformation WG)
- Daniella Raveh, Technion
- Markus Ritter, DLR
- Walt Silva, NASA LaRC
- Bret Stanford, NASA LaRC (AePW-4)

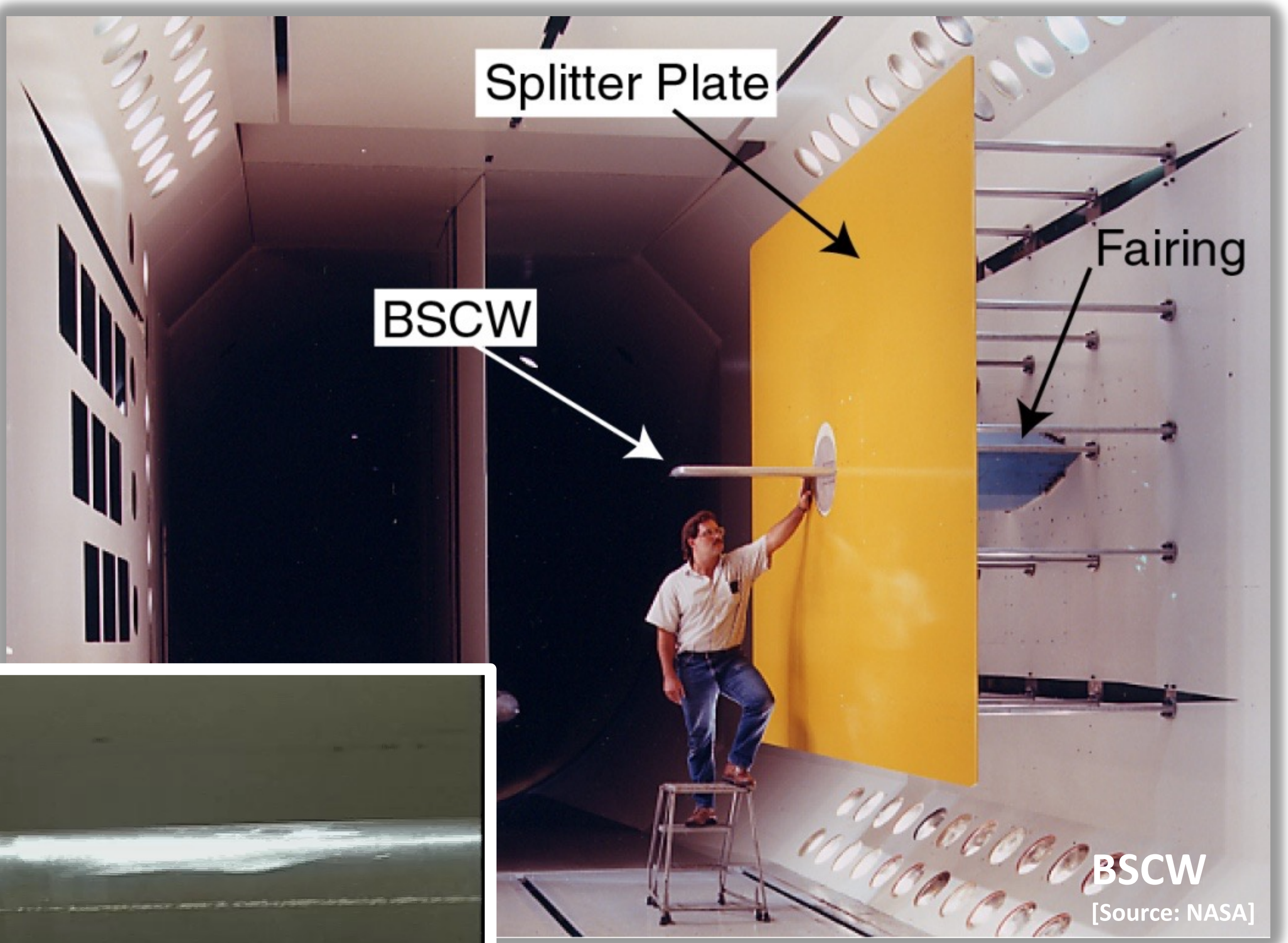
Transition to AePW-4….Joint Working Groups with DPW-8

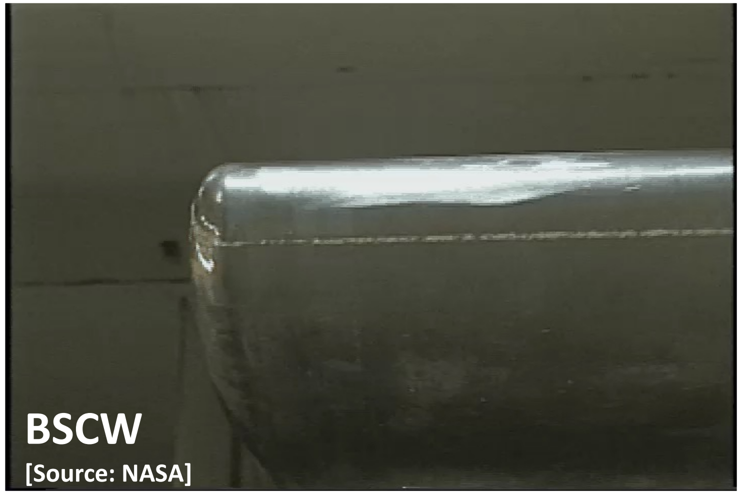
https://aiaa-dpw.larc.nasa.gov

Joint workshop will take place at AIAA Aviation 2026

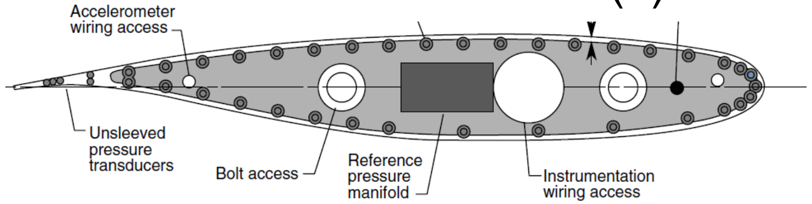


High-Angle WG: BSCW Wing Configuration

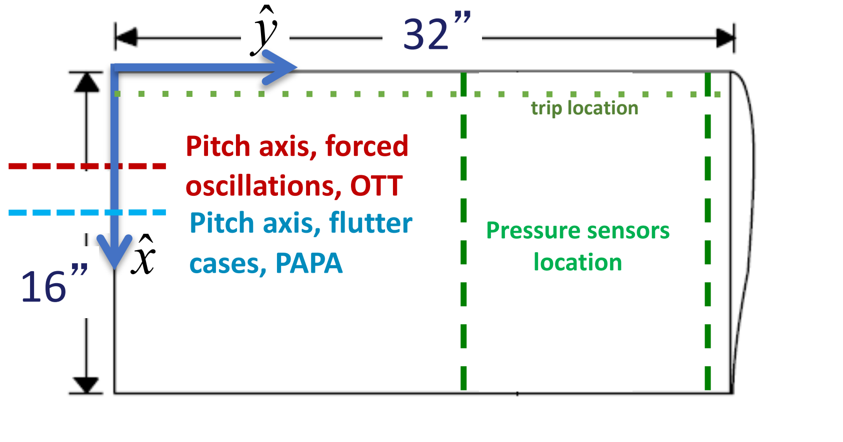




Airfoil section is SC(2)-0414



Cross-section at 60% span, showing the layout of the unsteady pressures.

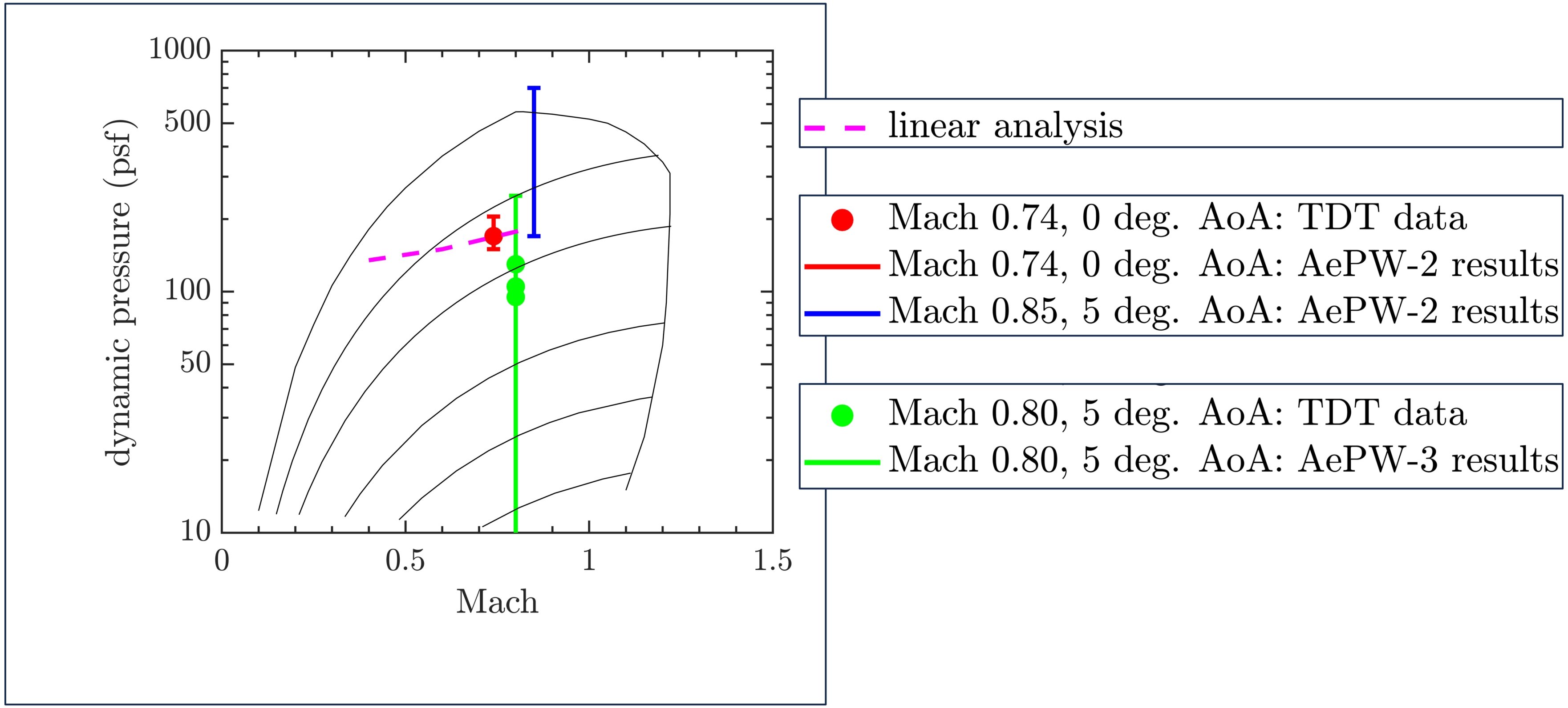


Model planform. Dimensions are in inches.

BSCW Wing Configuration Past Workshop Conditions

- AePW-1:
  - Steady-rigid and forced-oscillation cases at Mach 0.85, AoA = 5° ✓
- AePW-2:
  - Forced-oscillation case at Mach 0.70, AoA = 3° ✓
  - Flutter prediction at Mach 0.74, AoA = 0° ✓
  - Unsteady-rigid, forced-oscillation, and flutter cases at Mach 0.85, 5° ✓ ✓ ✓
- AePW-3:
  - Flutter prediction at Mach 0.80, AoA = 5° ✓
  - Shock-buffet case at Mach 0.80, AoA = 5° ✓

AePW-3: What have we learned?



- Large spread in BSCW flutter predictions from AePW-3 (though not as bad as AePW-2)
- We need more experimental data: more flutter data points, and more on-and off-body flow data at each flutter point

Past Experimental Data

EXPERIMENTAL UNSTEADY PRESSURES AT FLUTTER ON THE SUPERCRITICAL WING BENCHMARK MODEL

AIAA-93-1592-CP

Bryan E. Dansberry, Michael H. Durham*, Robert M. Bennett**, José A. Rivera*, Walter A. Silva*, and Carol D. Wieseman*; Structural Dynamics Division, NASA Langley Research Center, Hampton, VA 23681-0001
and David L. Turnock*
Lockheed Engineering and Sciences Corporation

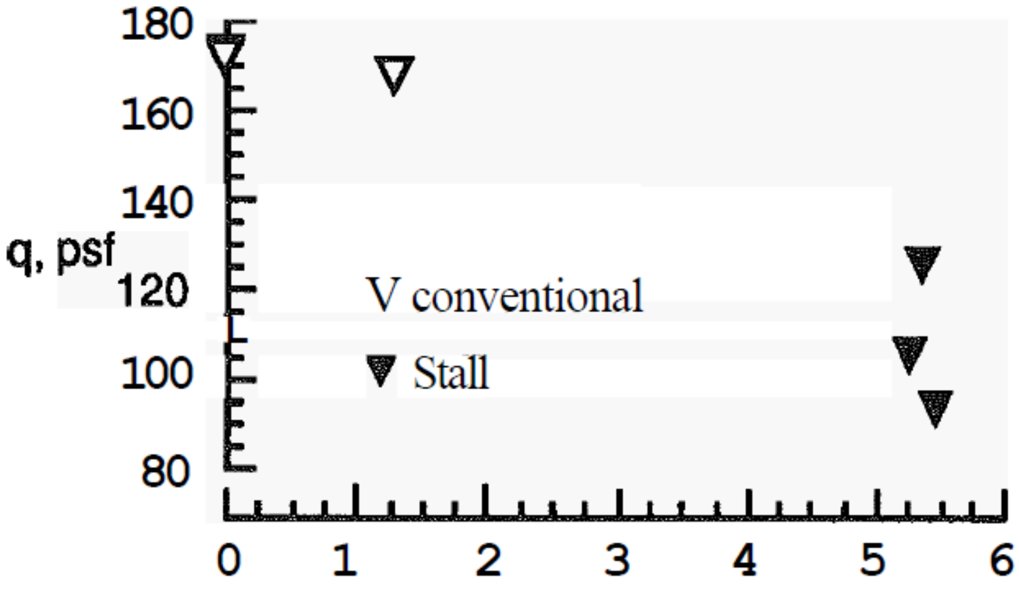


Figure 9. Stall flutter boundary in R-12 at M = 0.80.

Past Experimental Data

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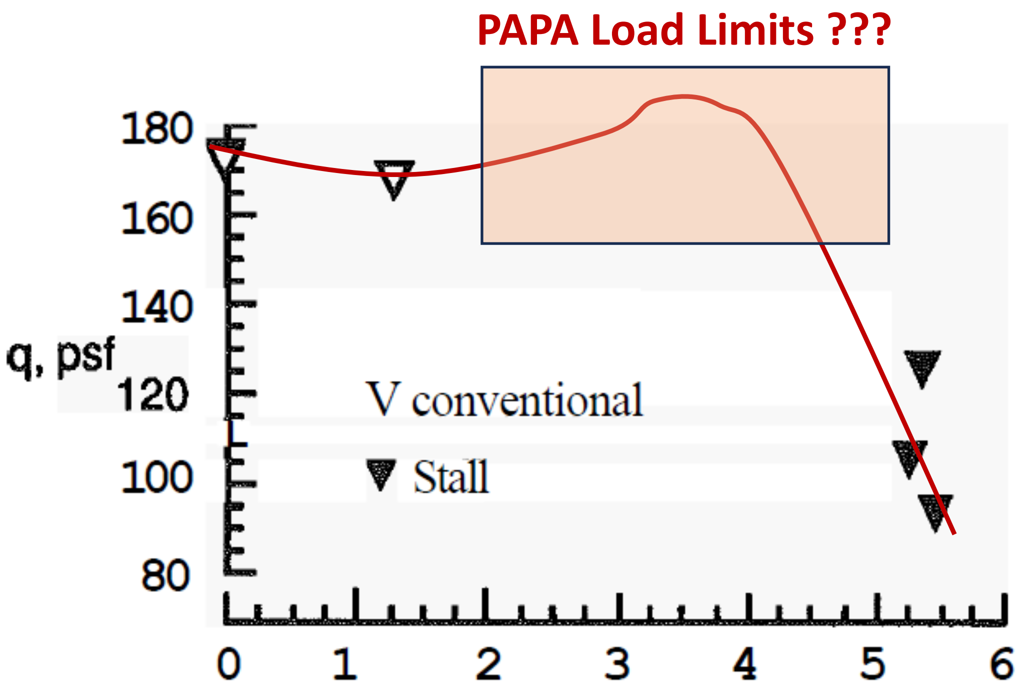


Figure 9. Stall flutter boundary in R-12 at M = 0.80.

Future Experiment: Spring 2025

- Re-examine factor of safety for PAPA load limits
- Unsteady Pressure Sensitive Paint
- Flutter Stopper
- Two rows of pressure sensors + several on splitter plate
- PIV
- Flutter and buffet data at Mach, Q, AoA range

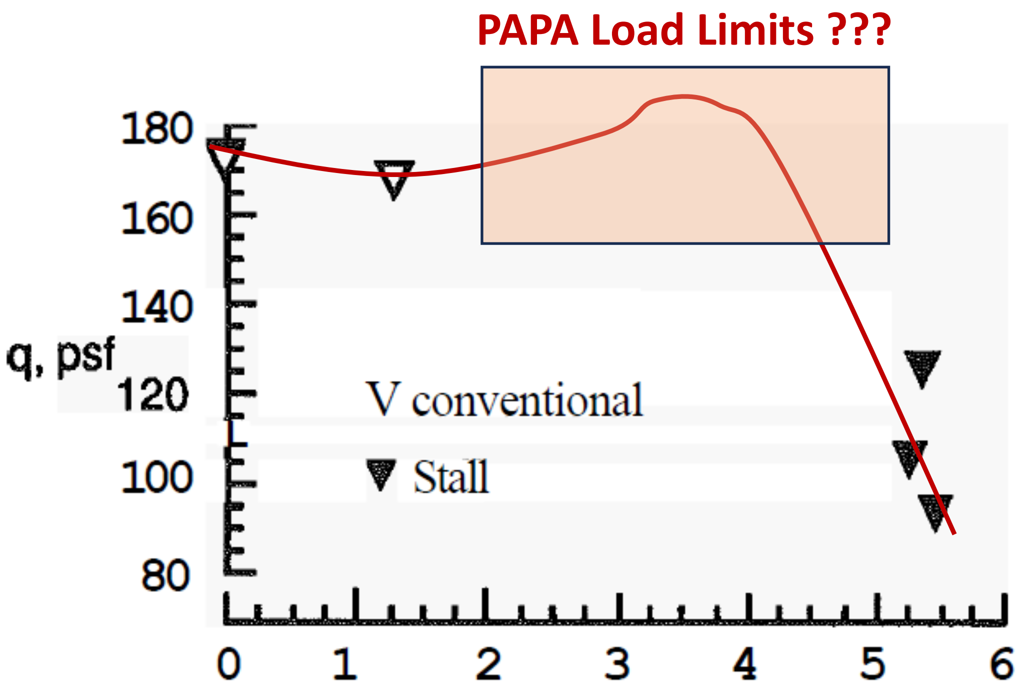


Figure 9. Stall flutter boundary in R-12 at M = 0.80.

Current Computational Effort w/FUN3D

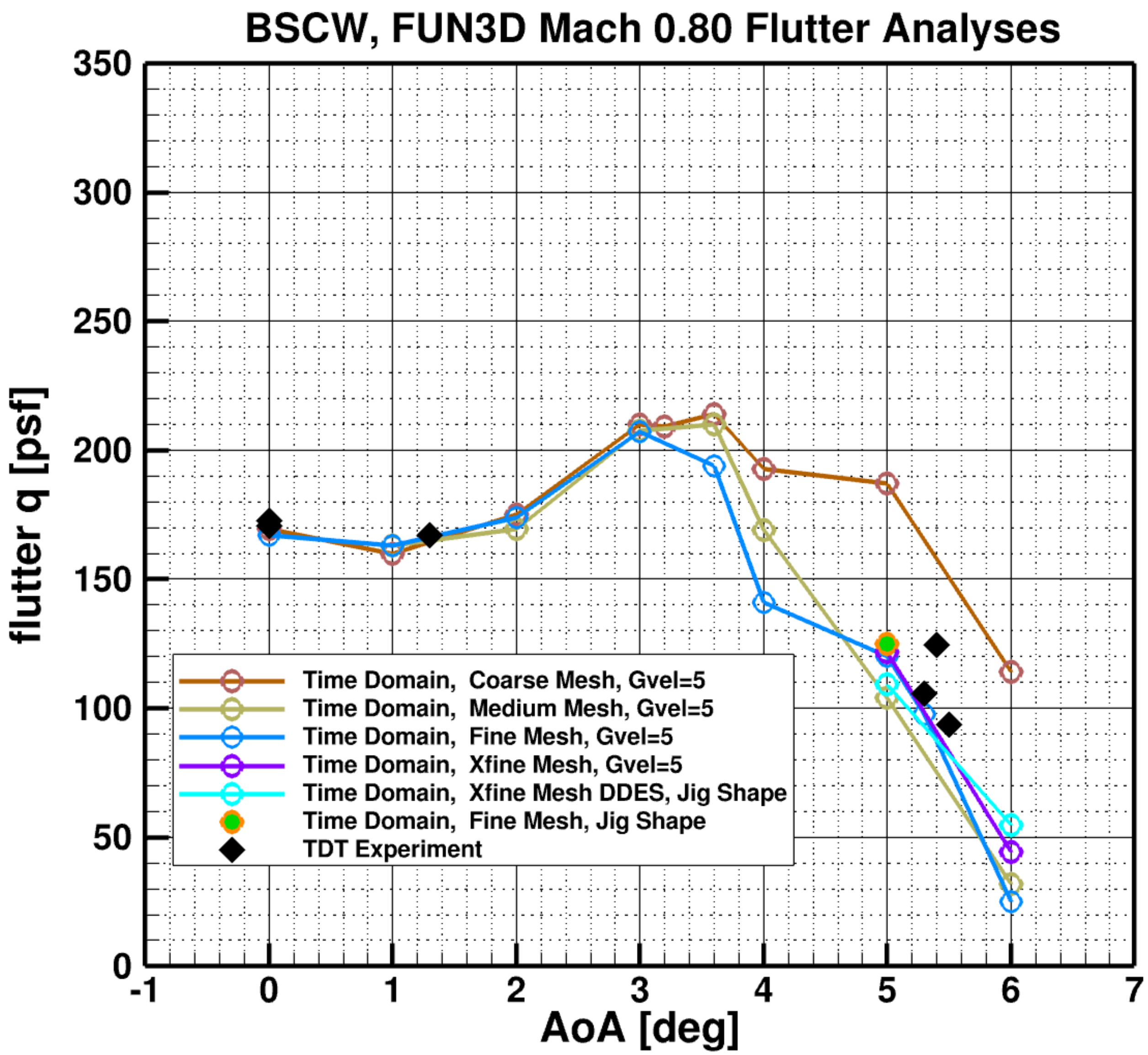
…trying to cover different methods…

- **FUN3D URANS time domain analysis:**
  Rigid steady → Static aeroelastic →
  Dynamic aeroelastic (with initial excitation using Gvel=5)

- **Working on:**
  Rigid steady → Dynamic aeroelastic (Jig shape)

- **Working on:**
  Scale-resolving DDES FUN3D time domain analysis:
  Rigid steady → Static aeroelastic →
  Dynamic aeroelastic (with initial excitation using Gvel)

- **Working on:**
  Adding URANS solutions for Xfine Mesh



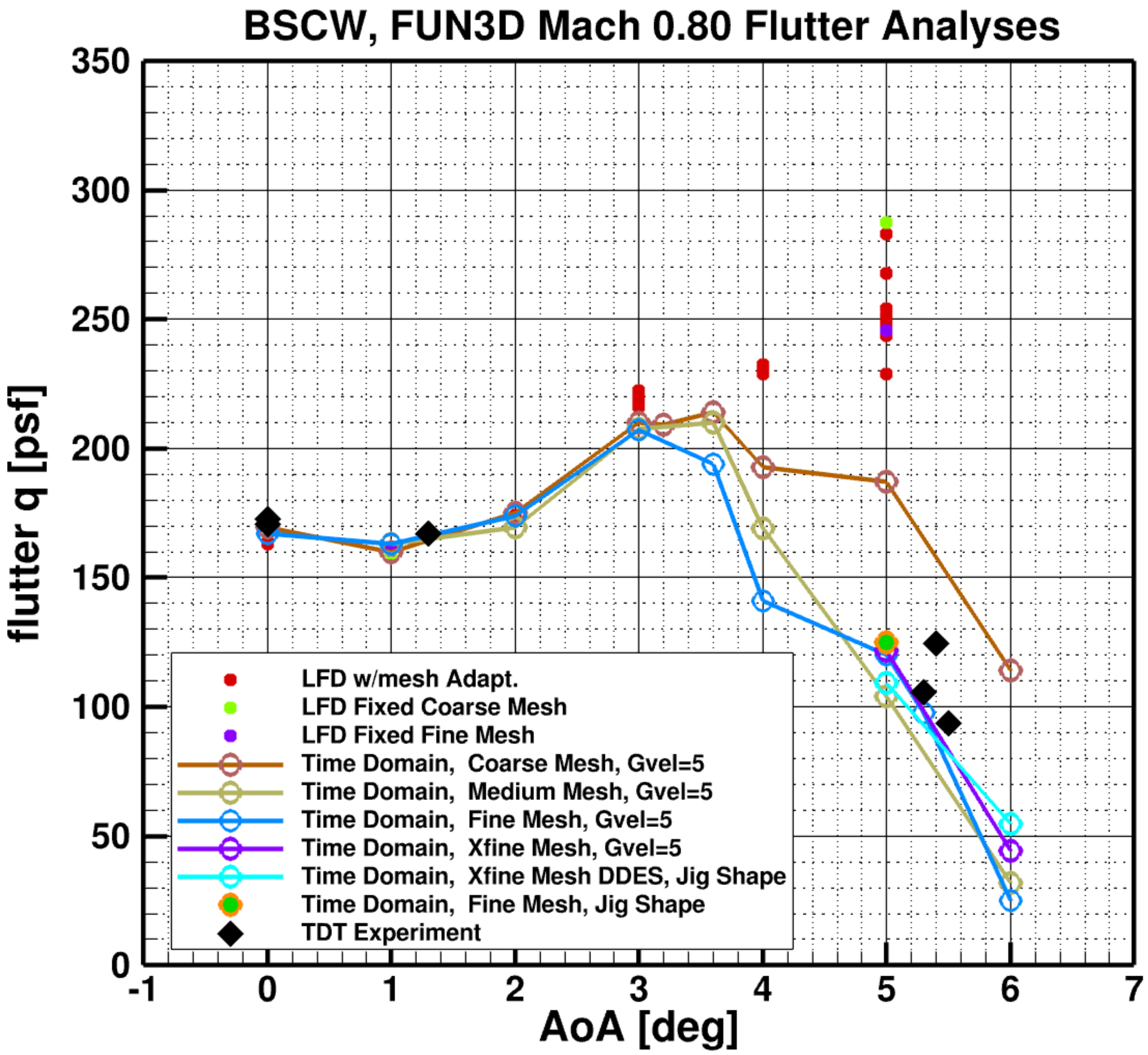
Current Computational Effort w/FUN3D

…trying to cover different methods…

- **FUN3D <u>Linearized Frequency Domain (LFD)</u>:**
  Rigid steady → Static aeroelastic → LFD

  LFD + Mesh Adaptation

- **Working on:**
  Adding angle-of-attack sweeps



AePW-4 High-Angle WG Cases

- Mandatory
  - Flutter prediction at Mach 0.80 and angle-of-attack sweep: 0° – 6°
- Optional
  - Flutter prediction at Mach 0.78, 0.76, 0.74 and angle-of-attack 3°

Schedule/Timeline/Logistics

- Monthly meetings on second Thursday of each month at 10am EDT
- Next meeting is on June 13th:
  - Agenda: CAD, Wing configuration, Grids, Computational domain, Flow conditions, etc.

- IFASD 2024: 17 – 21 June 2024, The Hague - Bret Stanford
- AIAA Aviation 2024: Las Vegas, NV - Bret Stanford
- AIAA SciTech 2025: Orlando, FL
- Spring 2025: BSCW Experiment (Data release ?)

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- AIAA Aviation 2026: AePW-4 Workshop

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AePW

Aeroelastic
Prediction
Workshop

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