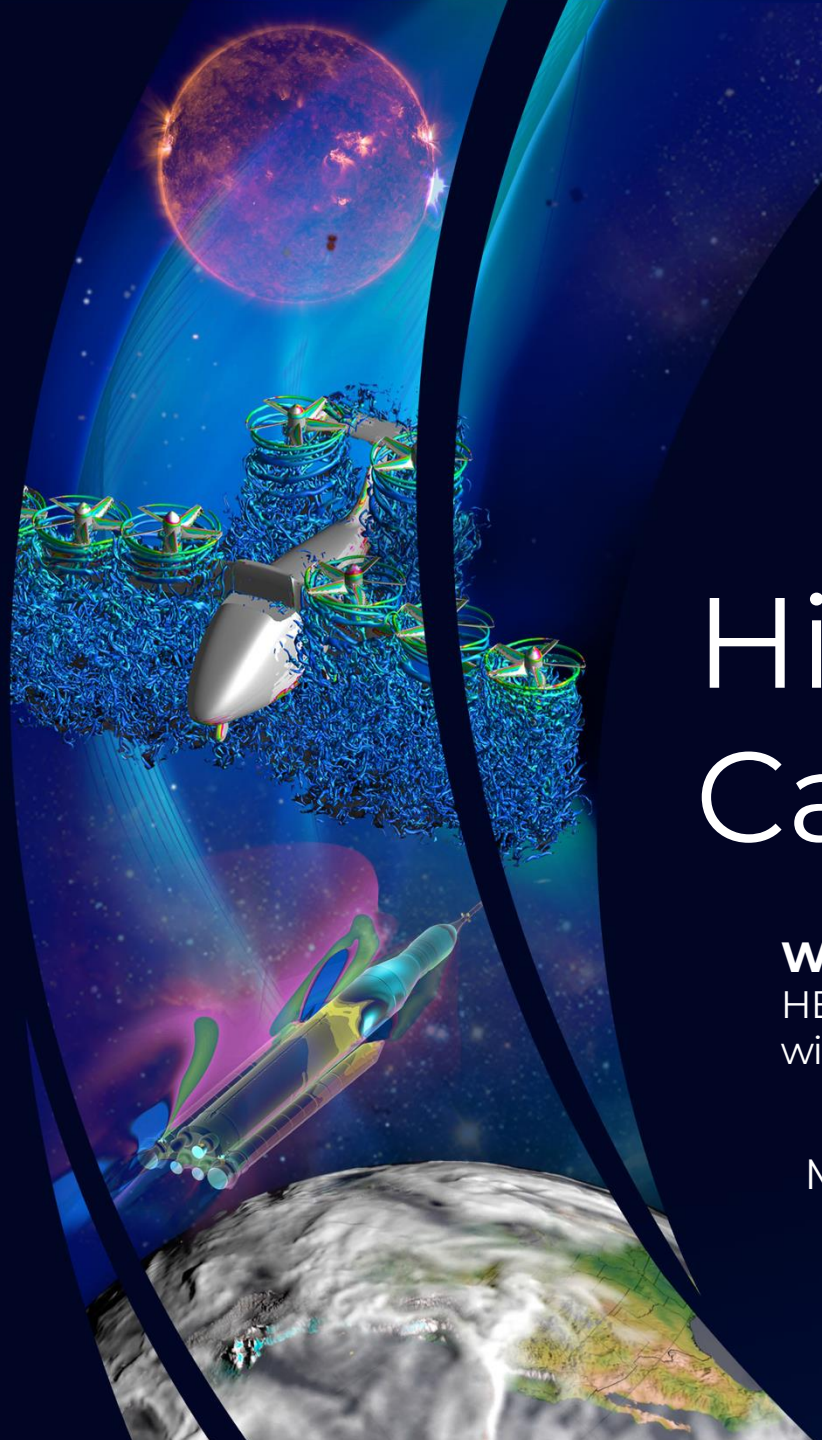


National Aeronautics and Space Administration

High-End Computing Capability

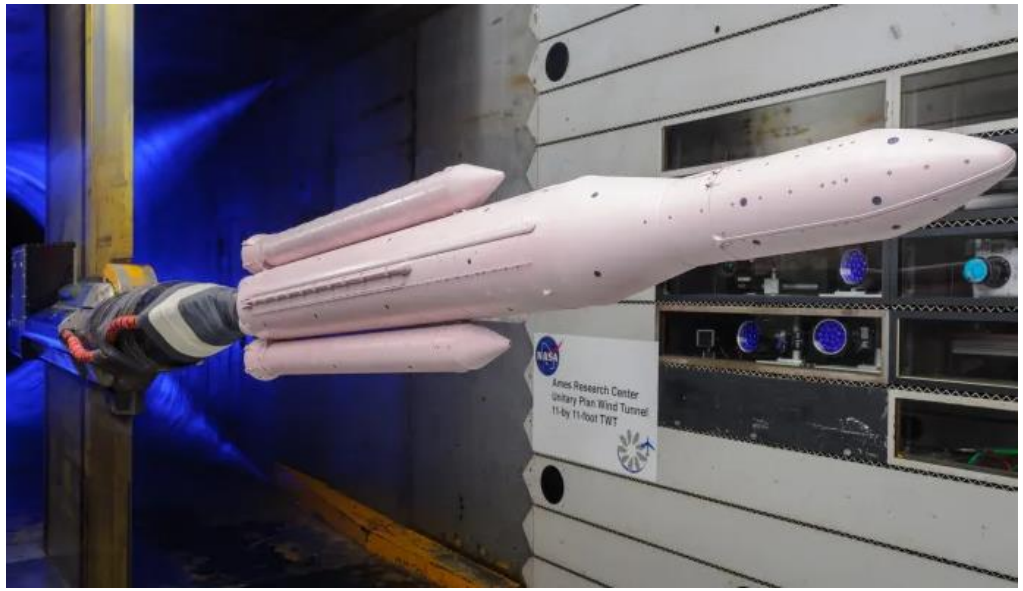
William Thigpen
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May 10, 2025

HECC Supports Latest SLS uPSP UPWT Test

- HECC's Visualization and Data Analysis (Vis) team joined efforts with the NAS Division's Launch Accent and Vehicle Aerodynamics (LAVA) team to support the latest Space Launch System (SLS) test using unsteady Pressure-Sensitive Paint (uPSP) in the NASA Ames Unitary Plan Wind Tunnel (UPWT).
- In the months leading up to the test, the Vis team collaborated closely with the uPSP UPWT team to develop comprehensive hyperwall utilities supporting interactive, near-real-time, high-visual-bandwidth analysis of uPSP wind tunnel datasets, as well as comparisons between new and previous datasets.
  - Within a day of data collection, the uPSP team was able to use the hyperwall environment to explore and analyze a subset of their data, and to evaluate their data processing pipeline. In the two weeks following the wind tunnel test, the Vis team hosted seven analysis sessions—four with the uPSP team and three including SLS customers—with more analysis sessions and further development planned in the coming months.
- Prior to the test, the LAVA team assisted by using an SLS CAD file to generate high-resolution surface triangulations to be used for the uPSP data projections. Both fine and coarse surface triangle representations were generated.
- The LAVA team used the Cabeus supercomputer's graphic processing units (GPUs) to perform a series of wall-modeled large-eddy simulations (WMLES) of a wind tunnel-scale SLS test article—each within just hours—which predicted the highly complex shock formations, shock/boundary layer interactions, and unsteady surface pressures. The Vis team concurrently rendered results on the hyperwall.

IMPACT: By leveraging HECC and NAS resources and services, the uPSP and SLS teams were able to explore and understand the results of the UPWT test more quickly and extensively than before.

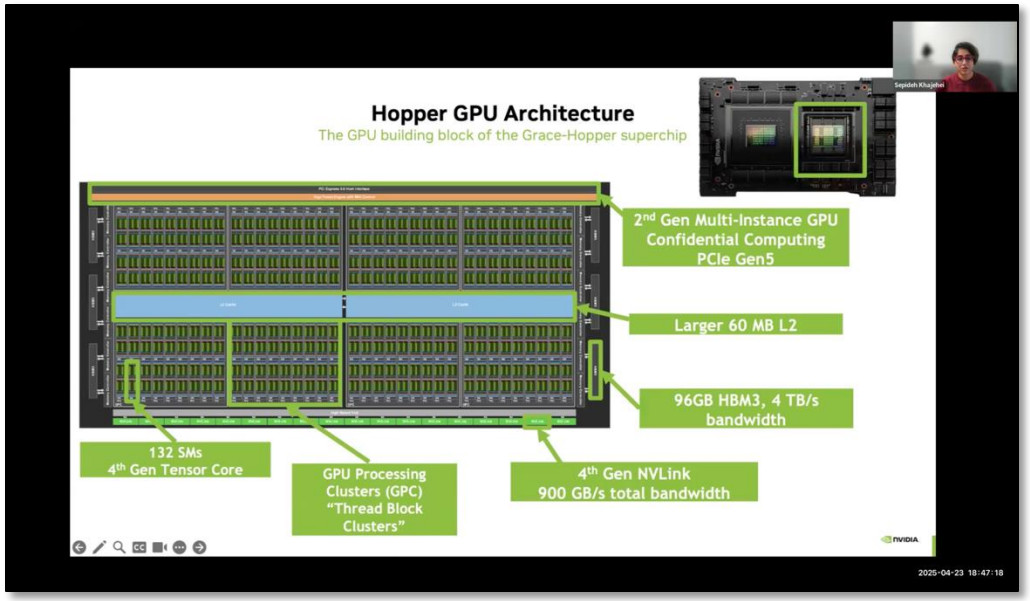


The Space Launch System 2.5% model in the 11 x 11-foot Unitary Plan Wind Tunnel, from a previous 2019 test. Images from the latest test and analysis sessions on the hyperwall will be available when cleared for public release. *Dominic Hart, NASA*

HECC Hosts GPU Onboarding Bootcamp

- HECC's Application Performance Productivity (APP) and Data Science (DS) teams hosted the successful NASA Next-Gen GPU Onboarding Bootcamp on April 23, 2025.
  - This joint training event with Open Hackathons/NVIDIA introduced NAS users to the Cabeus supercomputer's Grace Hopper nodes and provided training on GPU profiling tools and techniques.
  - APP and DS team members provided: an overview presentation of the Grace Hopper nodes, their use, software stack for HPC and AI/ML applications; installed the tools and materials used to deliver the bootcamp, and assisted users in setting up Jupyter Lab, which was the primary tool for instruction.
  - Open Hackathons/NVIDIA gave an overview of the Grace Hopper Superchip as well as profiling tools and techniques for both HPC and AI/ML applications.
  - The event was a combination of instructor-led lectures and demos, and user hands-on labs performed via Jupyter notebook on Cabeus.
- The event was well attended and received.
  - Of 72 applicants who were accepted, 53 attended the event and about 30 attendees engaged during the hands-on lab component.
  - Six instructors/mentors from both NAS and NVIDIA led the event.
  - Attendee feedback was positive, with a score of 4.5 out of 5, for the lectures, demos, and overall event.
  - Some user feedback noted that a substantial volume of material was covered in a relatively short time. Reducing the overall content or organizing a multi-day event could help with pacing next time.

IMPACT: The bootcamp introduced the Cabeus Grace Hopper system and provided training on profiling and code optimization. This will increase the performance utilization of the system.



Screenshot from the recording of a training session during the NASA Next Gen GPU Onboarding Bootcamp. *Image courtesy Open Hackathons/NVIDIA*

System Logfile Analysis Tool in Beta Test

- The Applications Performance and Productivity (APP) team released the Sawmill system log analysis tool for beta testing. When put into production, the new tool will improve upon and replace most of the functionality of Lumber, a tool that APP has used for more than 10 years.
  - Lumber analyzed data in the Portable Batch System (PBS) accounting logs and the system logs of the nodes used by a specific job, merging the job's messages into a single file. It can also generate reports of job failures, job energy usage, and application usage. The code was developed over many years. The myNAS portal uses Lumber to enhance the job information presented to users but is written.
  - The APP team examined the feasibility of replacing the legacy C-code of Lumber with a more modern language to provide a better, more extensible tool to examine the logs and determined they should prototype it
- In February, Sawmill was quickly prototyped in Python 3, demonstrating that it would be an efficient replacement for Lumber.
  - Efficiency is critical, because there are over 15,000 log files produced each day. The total volume of one day's files is typically more than 25 gigabytes of data.
  - For user convenience and to reduce the volume of information saved, Sawmill filters out "uninteresting" log messages. It also tags the most interesting messages, which saves time later in report generation.
- Occurring in April, the beta testing release enabled staff to analyze problematic jobs, including on the Grace Hopper nodes, with Sawmill. The new tool demonstrated an improvement in processing speed compared with Lumber. Work is ongoing in Sawmill's reporting and myNAS data collection capabilities; completion is expected in May.

IMPACT: Efficient processing of system logs is critical for identifying system issues that cause job failures and for quantifying how HECC resources are used.

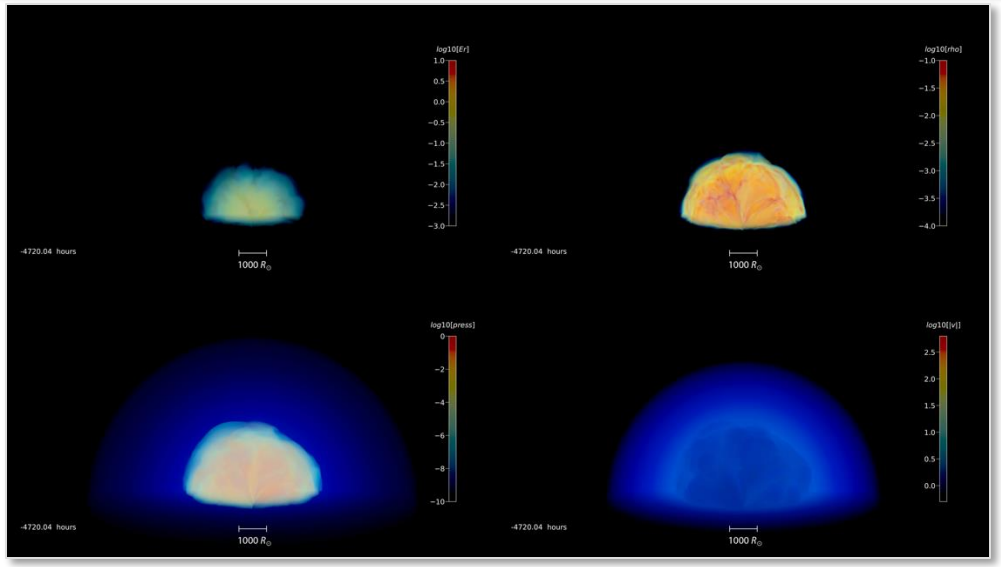


Like a real-world sawmill, the new job analysis tool makes useful products out of a huge volume of logs. *Image courtesy of iStock by Getty Images.*

Watching Supernova Shock Breakouts in 3D*

- To help interpret observations of a “shock breakout”—a bright flash that occurs when the shock wave of a supernova exploding in a dying massive red supergiant star reaches the star’s surface—researchers from the Flatiron Institute’s Center for Computational Astrophysics used HECC resources to run 3D radiation hydrodynamic simulations of these stars’ convective envelopes and to simulate the propagation of shocks from the collapse of the star through the convective envelope to obtain signatures that can be compared with observations.
- Results showed that convection in red supergiant stars can cause large-scale fluctuations of the stellar photosphere, which can significantly broaden the shock breakout signatures when compared with predictions based on one-dimensional stellar evolution models.
- Each 3D simulation ran across 150 Skylake nodes of the Electra supercomputer for one month to obtain the 3D structures of the stellar envelopes. Then, the simulations were run again with supernova shocks incorporated to obtain shock breakout signatures.
- Next steps include determining the spectrum evolution of the light curves and exploring shock breakout signatures from different types of progenitor stars, including additional types of red supergiants with varying masses and yellow supergiants, which are hotter and smaller than red supergiants.

IMPACT: The 3D simulation results will help provide more shock breakout signatures compared with predictions based on 1D stellar evolution models, helping astrophysicists interpret future observations of supernovae by instruments such as NASA’s James Webb Space Telescope.



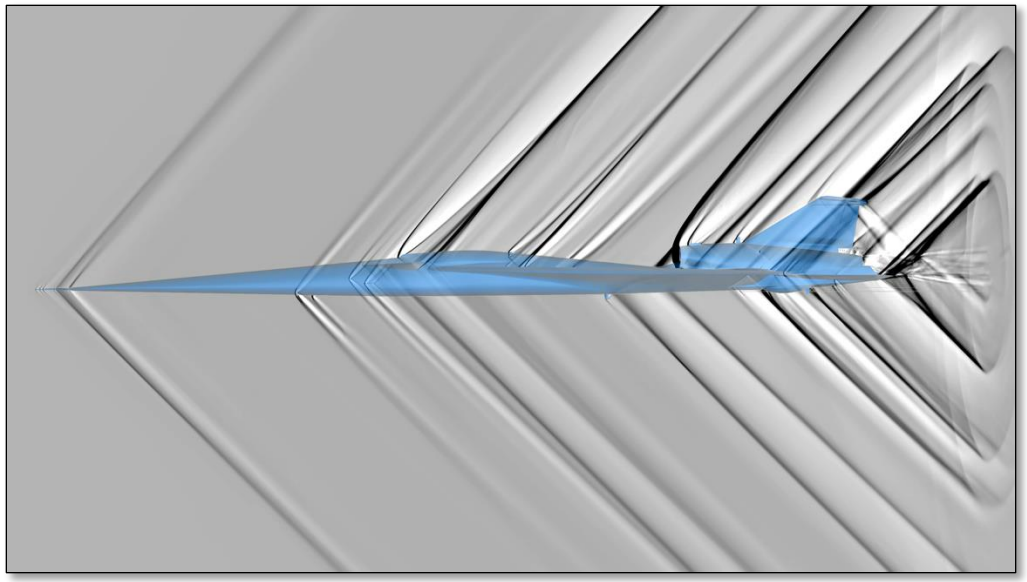
Simulated supernova shock breakout showing radiation energy density (top left); gas density (top right); gas pressure (bottom left); and magnitude of the velocity field (bottom right).
Yan-Fei Jiang, Flatiron Institute; Nina McCurdy, NASA/Ames

** HECC provided supercomputing resources and services in support of this work*

Supercomputing in Supersonics*

- Researchers in the NASA Advanced Supercomputing Division at Ames Research Center perform high-fidelity simulations to facilitate the design of quiet supersonic aircraft like the Quesst Mission's X-59 flight demonstrator and to analyze the vehicle's potential performance prior to its first flight.
- In one such analysis for the X-59, the research team uses HECC systems to conduct simulations to quantify uncertainty in the level of noise reaching the ground due to fluctuations in temperature, humidity and wind profiles of the atmosphere, and aircraft operating conditions.
- Their simulations ran primarily on the AMD Rome nodes on the Aitken supercomputer, running 8–12 wall-clock hours, with many jobs running simultaneously, and each job taking full advantage of the 128 cores per node. Each database contains between 1,000 to 50,000 simulations, which are being used to generate loudness statistics for each aircraft design.
- The team's results show that the probability of satisfying the X-59 acoustic design goal of 75 decibels during supersonic test flights at Edwards Air Force Base in the summer months is 92%, based on a 20-year window of atmospheric observations.
- This work is an important step toward enabling noise certification-by-analysis for future supersonic aircraft.

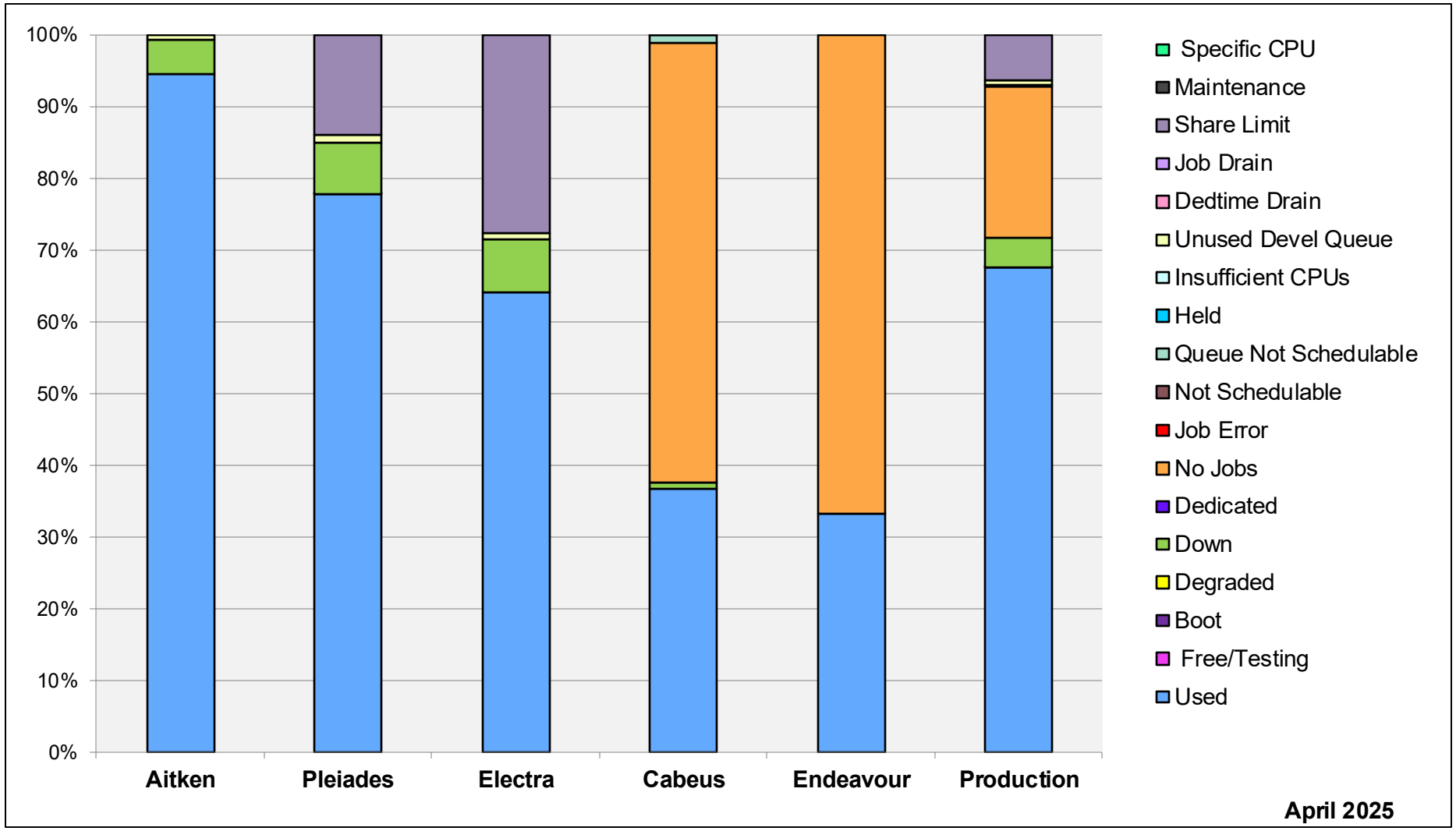
IMPACT: This work advances NASA's strategic goal for innovation in commercial high-speed aircraft, which promotes the vision of supersonic over-land air travel becoming possible for everyone.



Shadowgraph simulation, similar to a schlieren photograph, of a detailed computational model of the X-59 aircraft, showing shockwaves (dark lines correspond to discontinuous pressure jumps) and expansions (white regions). *Marian Nemec, Patrick Moran, NASA/Ames*

** HECC provided supercomputing resources and services in support of this work*

HECC Utilization



HECC Utilization Normalized to 30-Day Month

