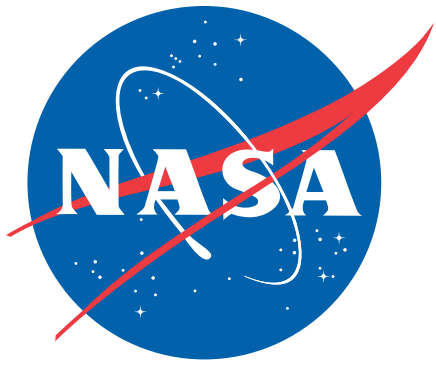




National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center



Applied Aeroscience and CFD Branch Overview

Benedicte Stewart

Applied Aeroscience and Computational Fluid Dynamics Branch

Engineering Directorate

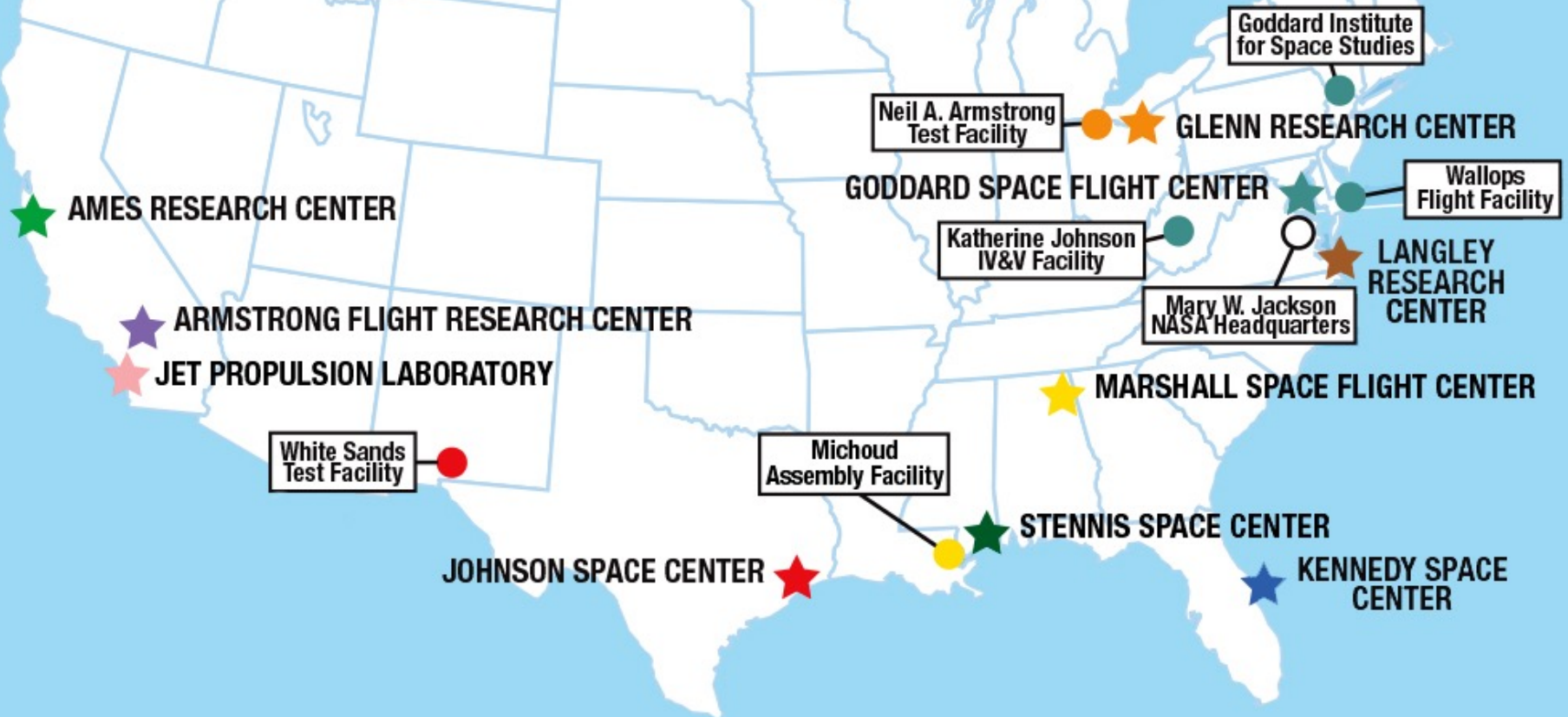
Houston, Texas USA



National Aeronautics and Space Administration



NASA Partnerships are found in every state and many other countries





Lyndon B. Johnson Space Center



Principal Mission: **Human Spaceflight**



Space Operations Mission Directorate
Exploration Systems Development Mission Directorate





NASA Lyndon B. Johnson Space Center Organizational Structure

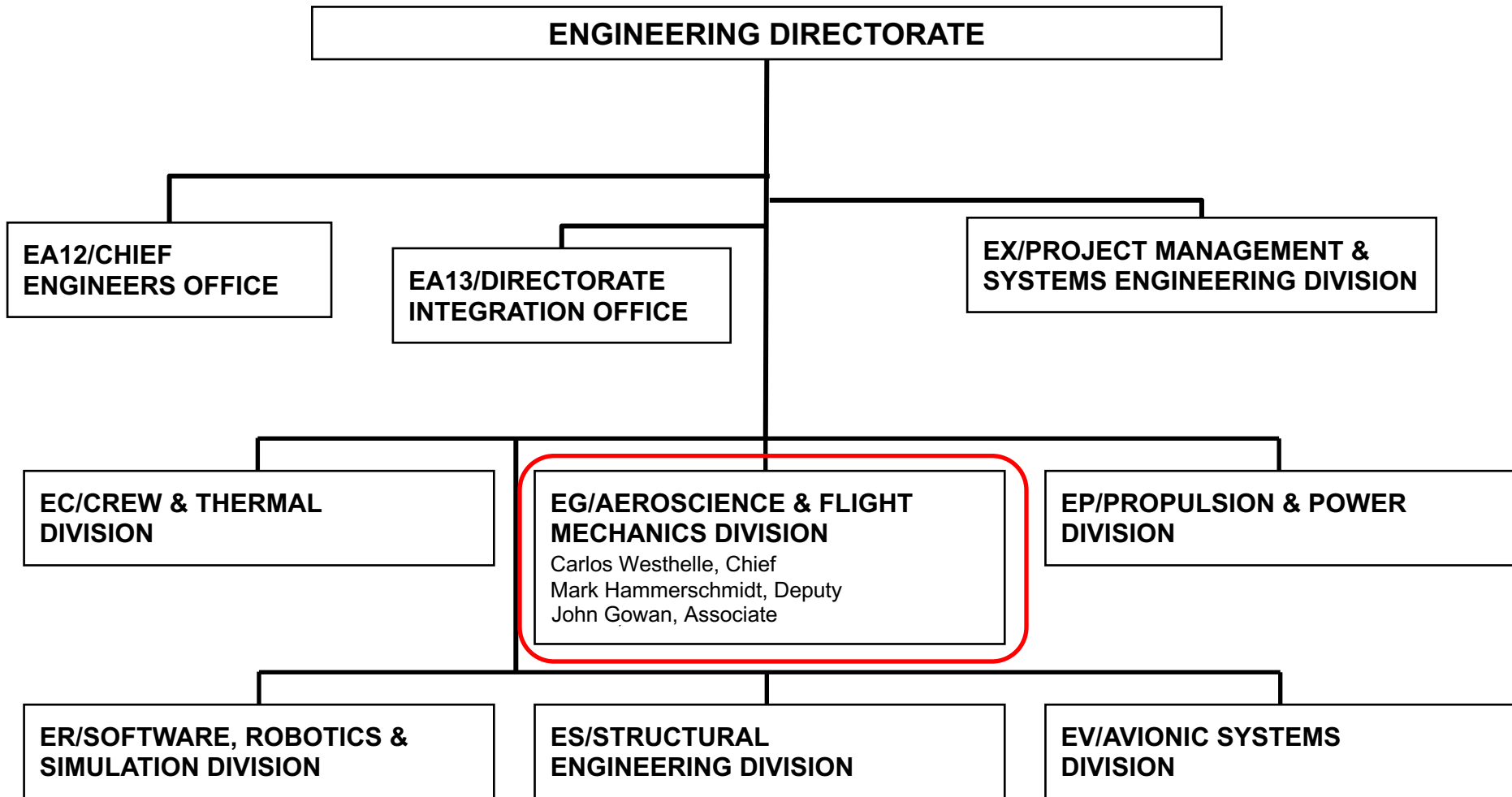


Center

- Directorates
 - Divisions
 - Branches
 - Disciplines



NASA Lyndon B. Johnson Space Center Organizational Structure



Branch Overview

- Technical Competencies:

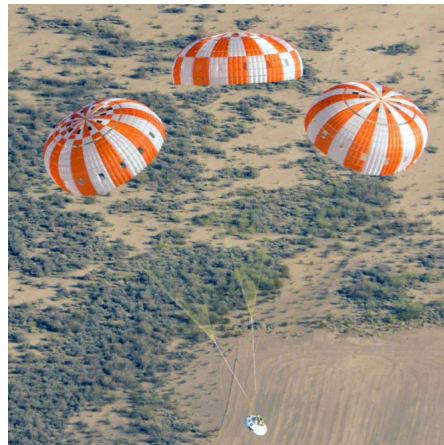
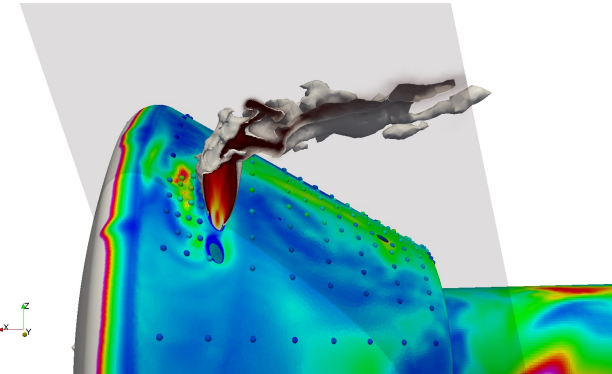
- Aerodynamics
- Aerothermodynamics
- Rarefied Gas Dynamics
- Decelerator Systems

- Program Support:

- Orion
- International Space Station
- Commercial Crew Program
- Gateway
- Human Landing System
- Space Launch System
- Other projects through SAA
- SME consulting to SMD and STMD

- Data sources:

- Modeling and simulation
- Flight testing
- Ground testing



AHF999iRun003 Config-X, Angle of Attack



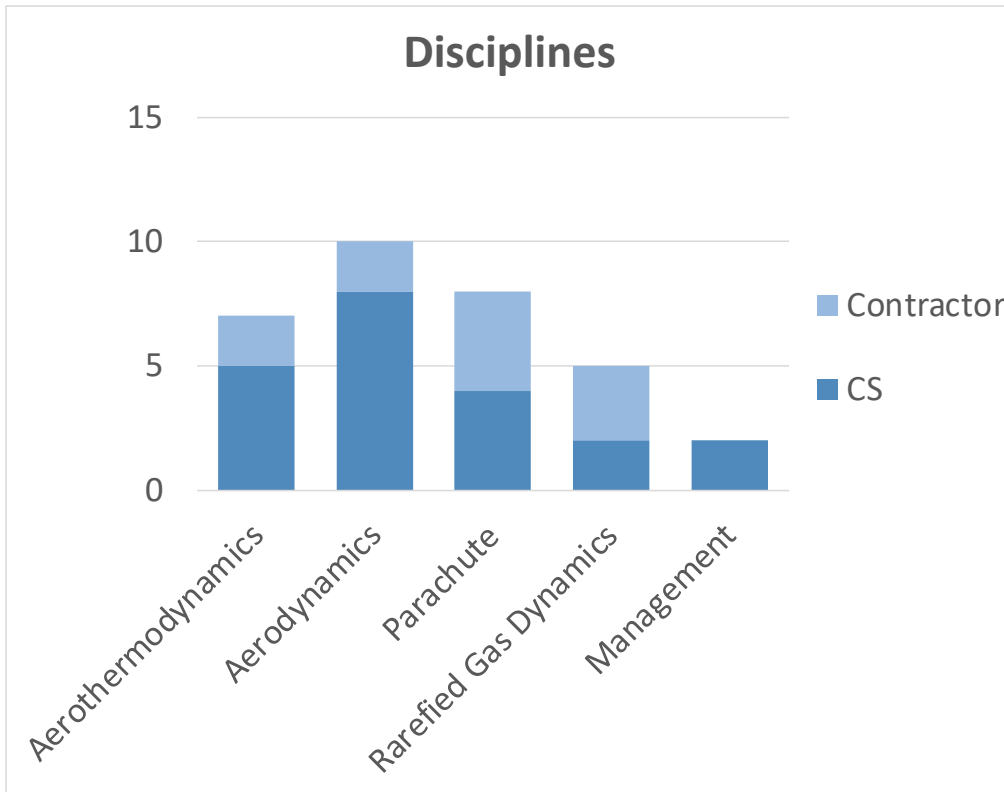
Our People



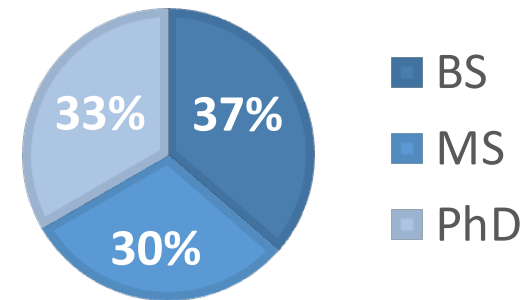
20 Full-time Civil Servants (CS)

11 Full-time Contractors

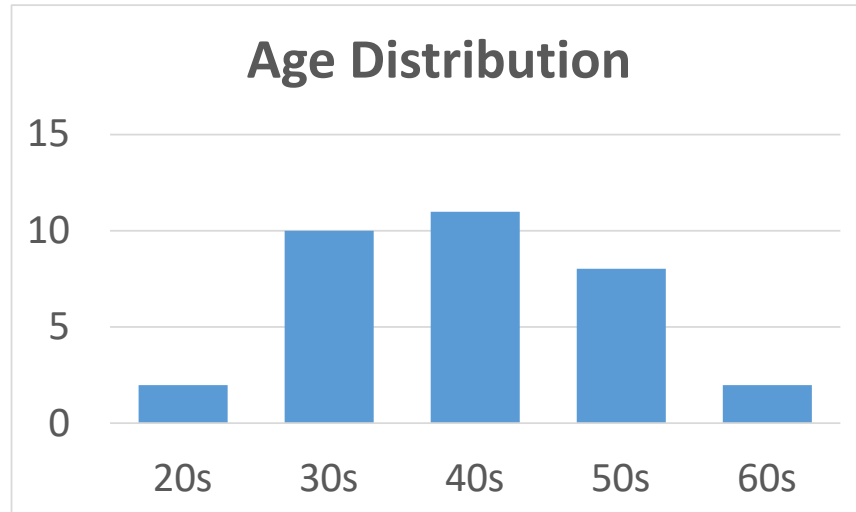
Disciplines



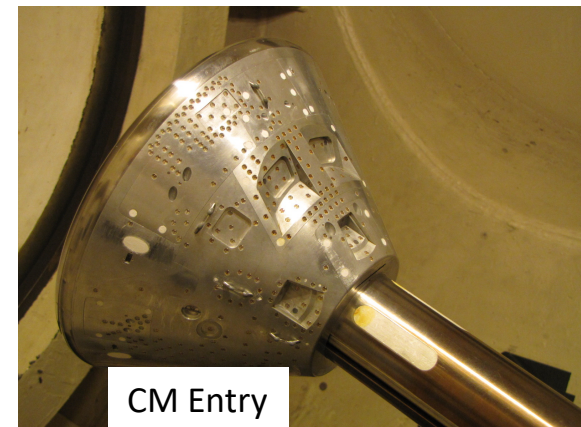
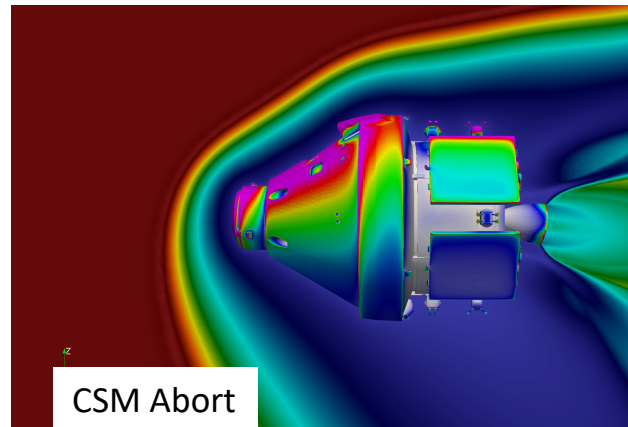
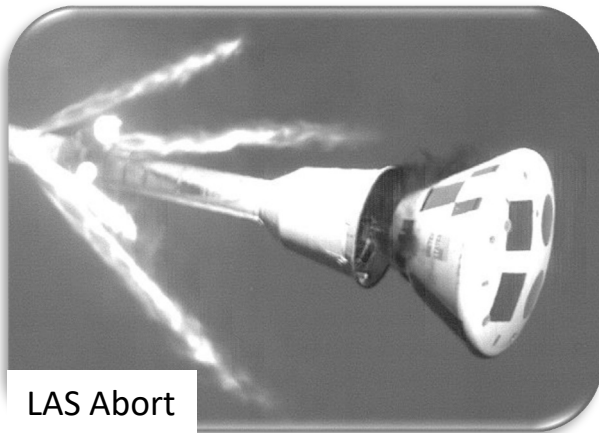
Full Time Employees Degrees



Age Distribution



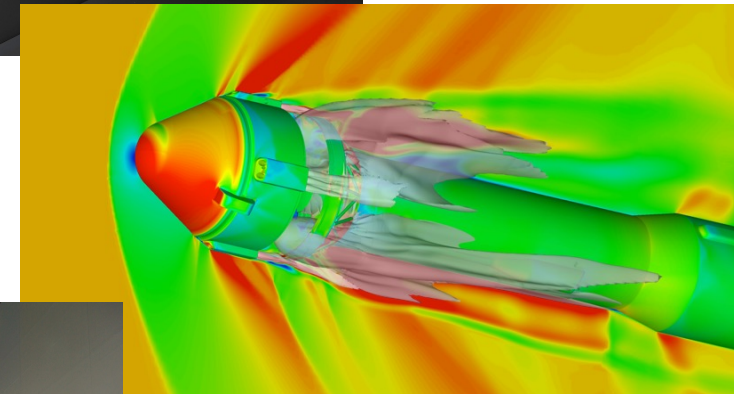
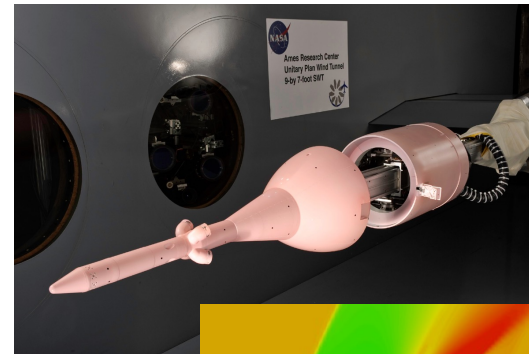
- Ground testing: Utilize a broad range of world-class testing facilities to bring cost-effective validation data in support of design
- Flight testing: Develop and verify flight test objectives and plan/support flight instrumentation suite
 - Orion PA-1, EFT-1, AA-2, Artemis-1
 - Orbiter DTOs for boundary layer transition, catalysis, protuberance heating and plume impingement
 - CCP DTOs and sensor calibration
- Computational methods:
 - CFD (DPLR, Loci-CHEM, OVERFLOW, US3D, DAC, FUN3D, Cart3D)
 - Ablator Response Model (CHAR)
 - EG3 maintains a high-performance computing facility (25,000+ cores, 600+ users)
- Historical data, and engineering-level analysis:
 - Plume engineering analysis tool (EMPIRE)





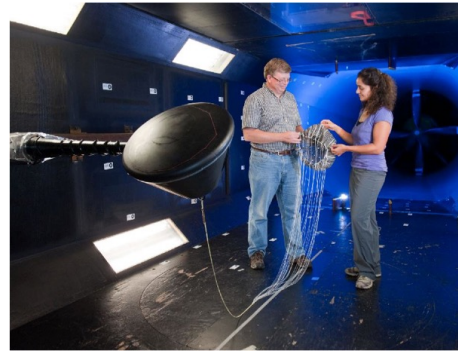
Technical Competencies

- Goal is to provide **comprehensive aerodynamic induced environments from ascent through abort, entry and landing**
- Product highlights:
 - Lead agency-wide team in the development of aerodynamics environment database for Orion
 - Technical authority role
 - Launch debris analyses
 - CFD SME support of Space Act Agreements
- Technical challenges:
 - Unsteady aerodynamics
 - Jet interaction environments

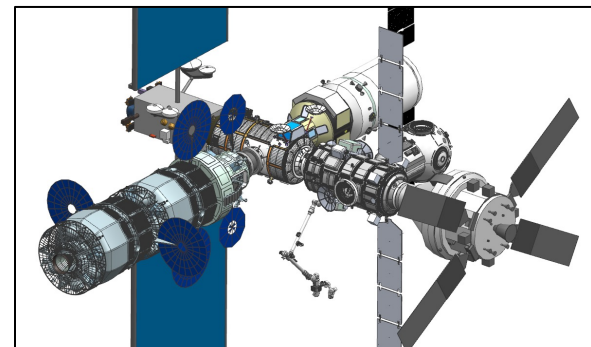
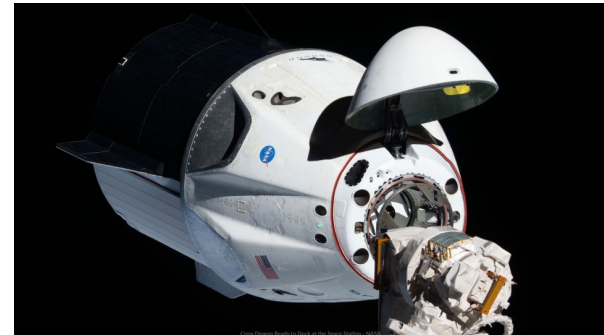


Parachute Discipline

- Goal is to **design, develop, evaluate model, test, and certify** guided and ballistic parachute systems
- Product highlight:
 - Development of complex models of parachute behavior
 - Technical authority role
- Technical challenges:
 - Current modeling is heavily dependent on testing data
 - Maturation of Fluid Structure Interaction capabilities

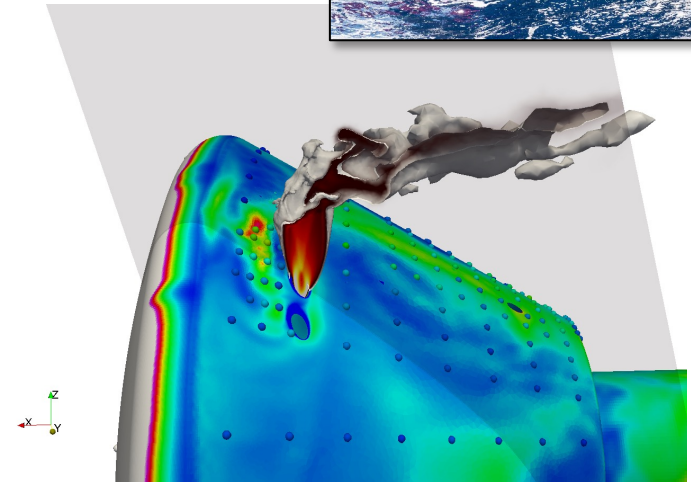
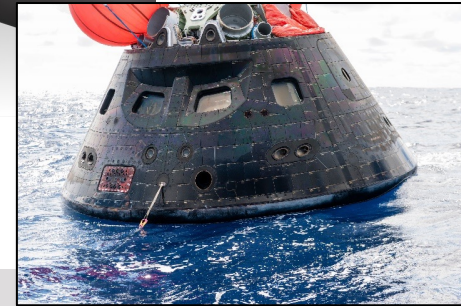
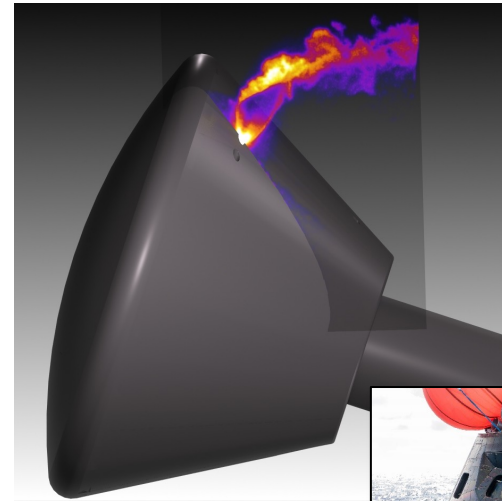


- Goal is to provide state-of-the-art **capabilities and tools for analysis of a variety of low density, non-continuum flows** (from transitional to free molecular)
- Product highlights:
 - Develop high altitude aerodynamics and aerothermodynamics environment database for Orion
 - Develop thruster plume models and produce plume impingement analyses for Orion, ISS and Gateway
 - SME for commercial LEO partners
 - Technology development of analysis tools
- Technical challenges:
 - Bridging the gap between CFD and DSMC
 - High-fidelity simulations of complex plume impingement problems



Aerothermal Discipline

- Goal is to provide **heating environments to all external spacecraft components for all flight regimes** so thermal protection system (TPS) materials can be adequately selected and sized
- Product highlights:
 - Lead agency-wide team in the development of aerothermodynamics environment database for Orion
 - Technical authority role
 - Technology development of analysis tools
- Technical challenges:
 - Jet interaction environments
 - Boundary layer transition
 - Fluid-surface interactions (ablation)





Examples of Current Projects



On-Orbit Plume Reflections





Artemis 1 Post-Flight Analyses Parachute

