

# Kennedy Space Center

National Aeronautics and  
Space Administration



POC Name: : Laurie Walls  
POC Email: : Laurie.K.Walls@nasa.gov

## Center Overview

- Center director: Robert Cabana
- History
  - NASA established its Launch Operations Center on Florida's east coast in July, 1962. It was subsequently named NASA's John F. Kennedy Space Center and has helped set the stage for America's adventure in space for more than four decades.
  - The spaceport has served as the departure gate for every American manned mission and hundreds of advanced scientific spacecraft. From the early days of Project Mercury to the space shuttle and International Space Station, from the Hubble Space Telescope to the Mars Exploration Rovers, the center enjoys a rich heritage in its vital role as NASA's processing and launch center.
- Center staffing
  - Approximately 13,100 employees (2100 civil servants)



## Thermal/Fluids Analysis

- Software
  - Thermal Desktop (RadCad, FloCad)
  - Thermal Synthesizer System
  - TRASYS
  - SINDA/G
  - SINDA/Fluint
  - MINIVER
  - Flow 3D
  - FLUENT
  - CHCHVENT
  - GridGen
  - GFSSP
  - TARP
  - OVERFLOW
  - COMET
  - MATLAB
- Capabilities
  - Analysis of Expendable Launch Vehicle thermal control designs
  - Post Flight aerodynamic reconstruction, analysis and evaluation
  - Combustion analysis capability within SINDA/FLUINT
  - Integrated Solid Propellant Program SRM performance modeling within SINDA/FLUINT
  - Correlated 6-DOF CFD modeling of propellant slosh behavior in micro-gravity with dynamic boundary motion and fluid feedback
  - Droplet vaporization models for propellant state & helium usage predictions
  - Dynamically coupled 2-phase fluid behavior with vehicle control feedback modeling
  - Fully coupled propellant thermodynamic/structural thermal modeling including stratification and slosh events in micro-gravity
  - CFD models for flow impingement characterizations with test data correlations
  - Propellant slosh database for validation of CFD predictions
  - Cryogenic Fluid Management design analysis and testing



## Thermal/Fluids Testing

- Facilities
  - Cryogenics Test Laboratory
  - Materials Failures Analysis Laboratory
- Capabilities
  - Thermal insulation systems
  - Cryogenics components
  - Propellant process systems
  - Low temperature applications
  - Failure analysis of metallic and nonmetallic materials
  - Thermal analysis (TMA; DSC; DMA)
- Current Challenges/Issues
  - Hydrogen Test Area (in development)



## Thermal/Fluids Staffing

- Launch Services Program
  - 8 Civil Servants
  - 4 on-site contractors, two remote, via the Expendable Launch Vehicle Integration Services (ELVIS) contract
- KSC Fluids Technology Branch
  - 6 Civil Servants
  - 10 on-site contractors
- Engineering Design Analysis Branch
  - 3 Civil Servants

## Current Projects/Programs Supported

- Analysis
  - Thermal Insulation System Analysis Tool
  - CryoSIM
  - Propellant Scavenging
  - Densified Methane for Ground Operations
- Launch Services Program
  - CRYogenic Orbital Testbed (CRYOTE)
  - Long Duration, Low Gravity Slosh Experiment
  - Reduced Gravity Cryogenic Propellant Stratification
  - Mars and Lunar lander plume environment modeling
  - External Payload Carrier development and analysis
- Research and Development



## Major Accomplishments/Awards/Recognition

- Hosted Secondary Cryogenic Payload Testbed Workshop
  - Attended by ~ 55 people
  - 18 companies from industry represented
- Design/Installation of multi-layer insulation and instrumentation in support of ground testing of future payloads
- Design and analysis of an external payload carrier for a launch vehicle
- CFD modeling of internal payload fairing flowfields, impingement velocities, and heat transfer coefficients with supporting validation testing

## Outlook

- Generating opportunities to advance current development projects
  - Opportunities to improve test facilities and capabilities at KSC
- Perform upgrades to existing vacuum chambers and bring on-line
- Provides capability to support spacecraft and launch vehicle customers
  - Develop Launch Complex equipment qualification area
- Provide capability to qualify new hardware for launch pad servicing
  - Develop advanced ground operations concepts and hardware
  - Opportunities to utilize ISS for propellant slosh experiments to characterize microgravity effects
  - Development of a launch vehicle payload carrier for scaled aerodynamic test flights of new vehicle concepts



## Information for TFAWS Center Status Poster

- KSC
- Laurie Walls
- Laurie.K.Walls@nasa.gov
- Center Overview
  - Robert Cabana
  - Aerial view of center
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  - Approximately 13,100 employees, 2100 are civil servants
- Capabilities
  - Analysis Capabilities
    - Thermal Desktop (RadCad, FloCad)
    - Thermal Synthesizer System
    - TRASYS
    - SINDA/G
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    - OVERFLOW
    - COMET
    - MATLAB
  - Unique capabilities
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    - Post Flight aerodynamic reconstruction, analysis and evaluation
    - Combustion analysis capability within SINDA/FLUINT

- Integrated Solid Propellant Program SRM performance modeling within SINDA/FLUINT
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- Staffing
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  - Engineering Design Analysis Branch
    - Three Civil Servants
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- Current Challenges
  - Capabilities Issues
    - No software issues at the moment
    - Hydrogen Test Area (in development)
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- Status
  - Current Projects/Programs Supported

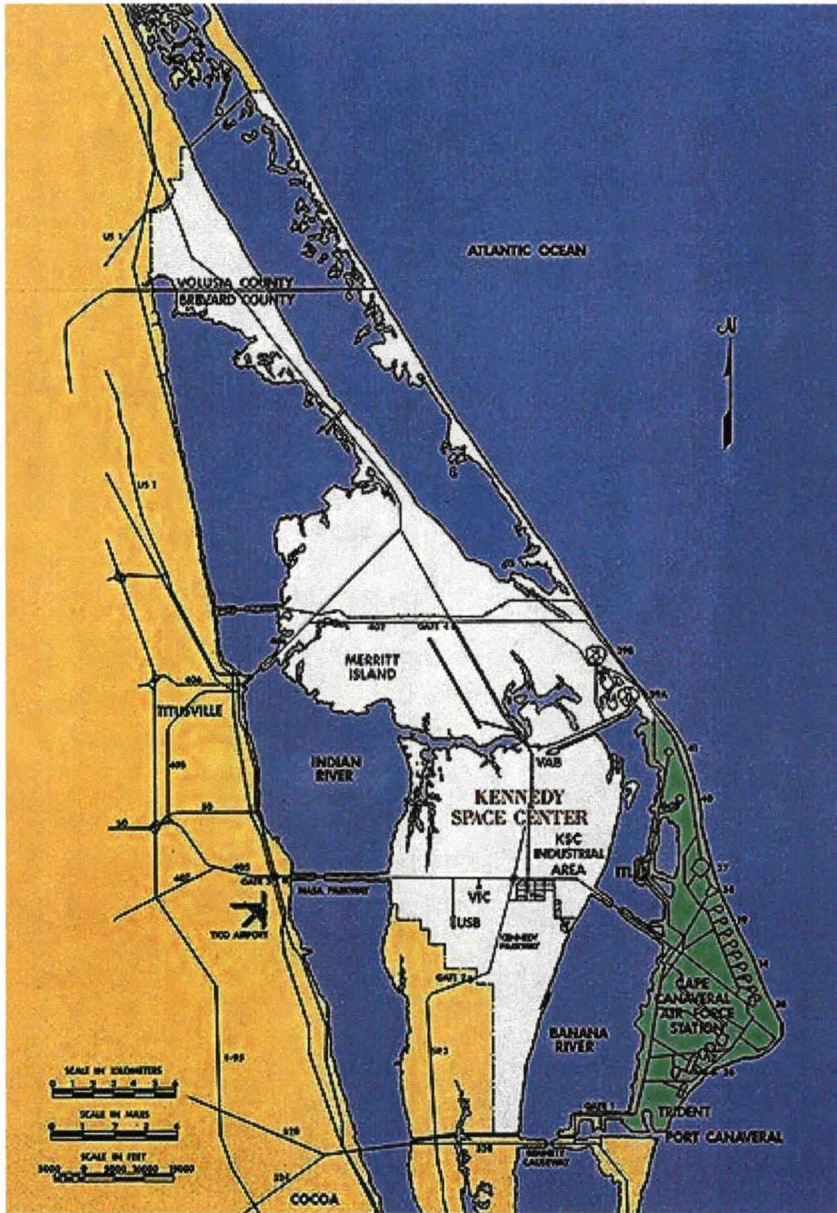
- Exploration Technology
  - Analysis
    - Thermal Insulation System Analysis Tool
    - CryoSIM
    - Propellant Scavenging
    - Densified Methane for Ground Operations
  - Research and Development
    - Development of low maintenance ground systems
    - Propellant conditioning
    - Cold helium production & servicing
    - Integrated Refrigeration and Storage (IRAS) systems
    - High efficiency transfer lines
  - Launch Services Program
    - Analysis and Integration for all NASA missions
    - Research and Development Projects
    - CRYogenic Orbital Testbed (CRYOTE)
    - Long Duration, Low Gravity Slosh Experiment
    - Reduced Gravity Cryogenic Propellant Stratification
    - Mars and Lunar lander plume environment modeling
    - External Payload Carrier development and analysis
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- Major Tasks
  - Exploration Technology Development
    - Developing and testing cold helium heat exchanger
    - Ground Operations Densified Methane Study
    - Methane Lunar System Thermal Control Test
    - Launch and Ascent
    - Multilayer Insulation Uncertainty Mitigation
    - Liquid Oxygen conditioning for Replenish
    - Propellant condensation using cold heads immersed in liquid
    - Propellant scavenging on the Lunar/Martian surface
  - Launch Services Program
    - Integrated Spacecraft/Launch Vehicle Thermal Analyses
    - Venting/Aeroheating/Aerodynamic Analyses
    - Thermodynamic Analyses
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- Major Accomplishments/Awards/recognition
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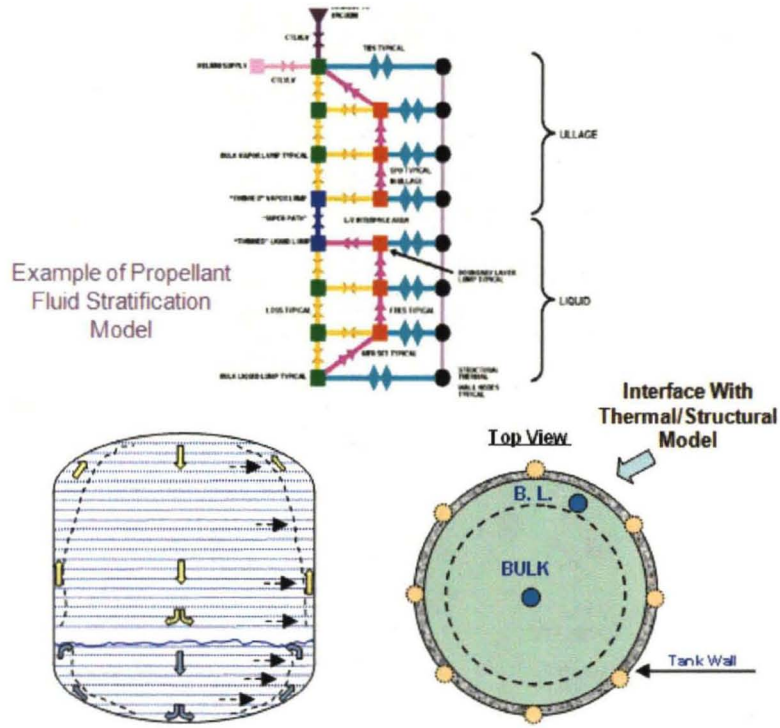
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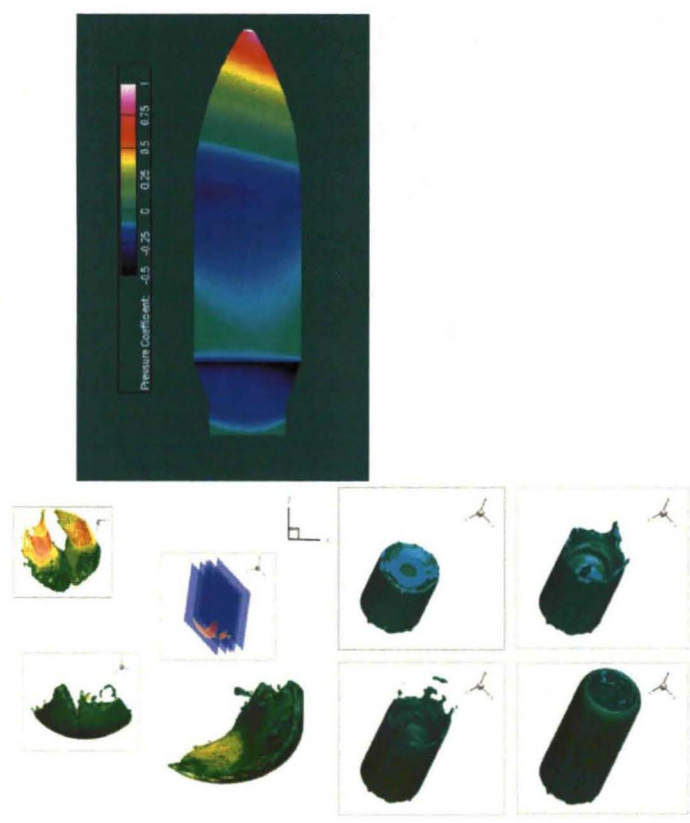
- Outlook

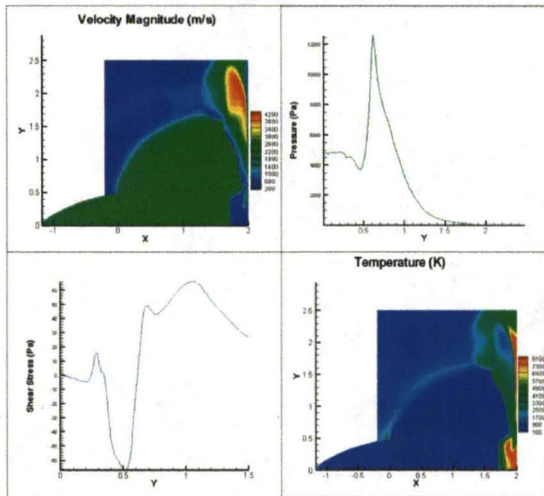
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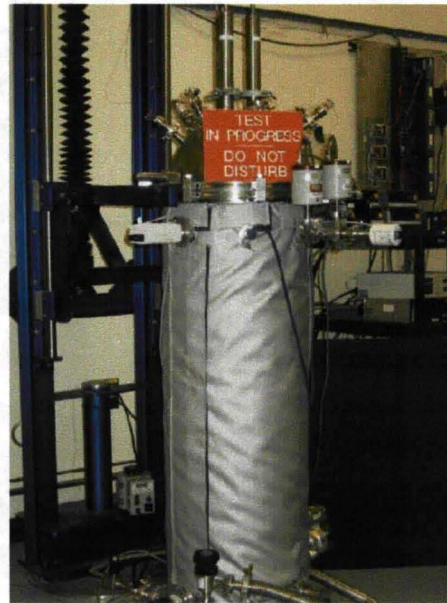
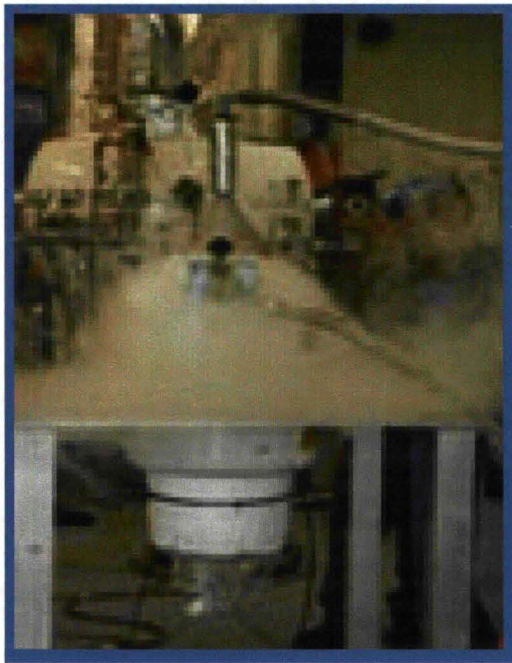


Above - Example of Analysis Capabilities



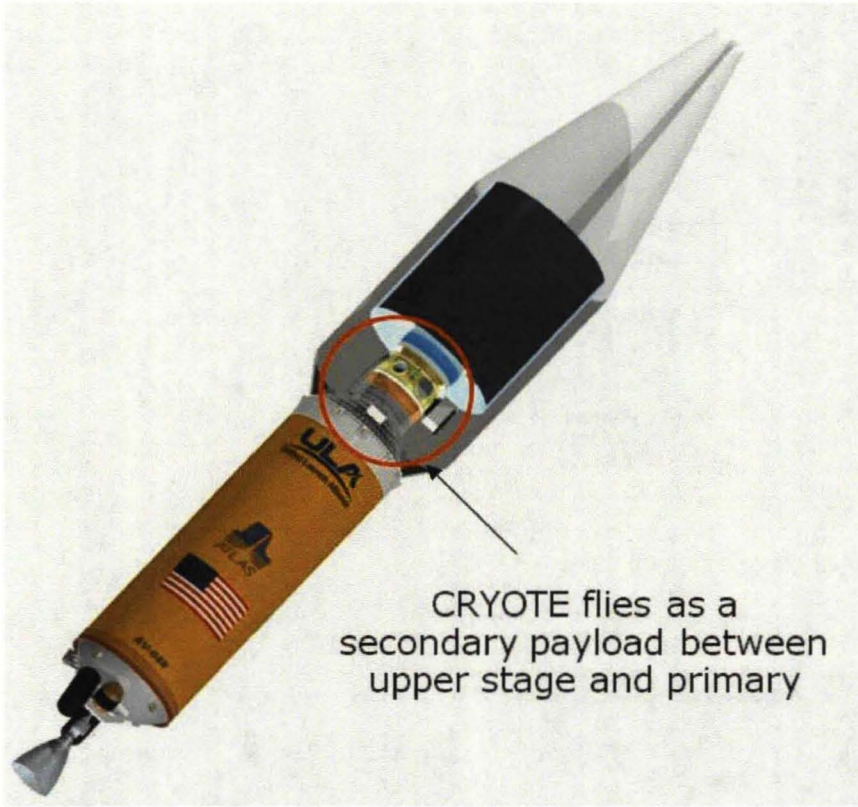


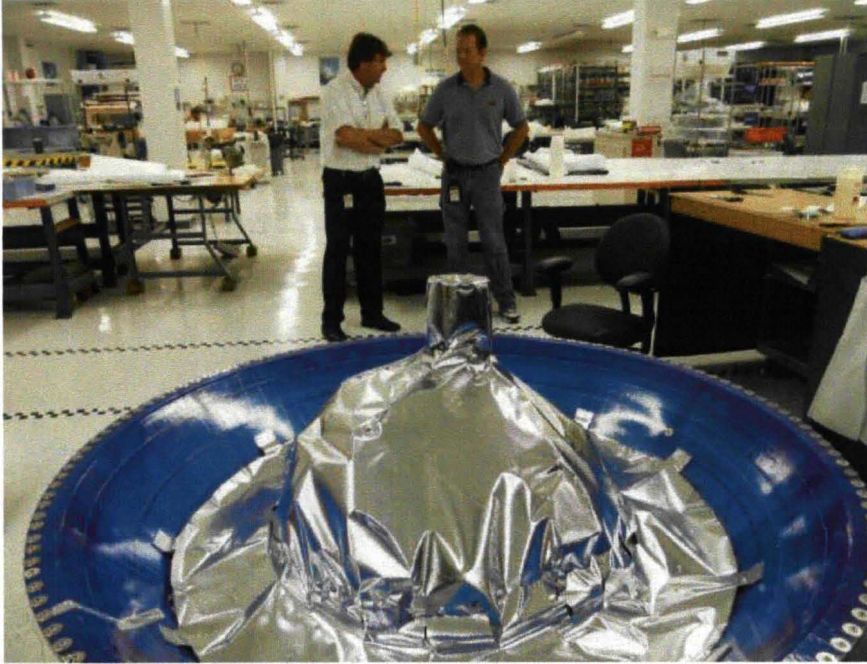
Above - Examples of Unique capabilities



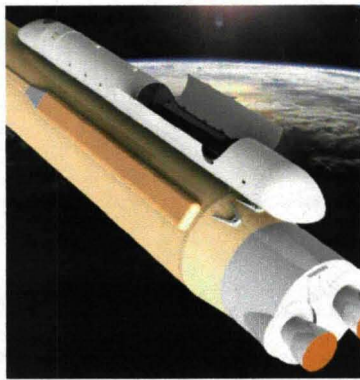
Testing at the Cryogenics Test Lab



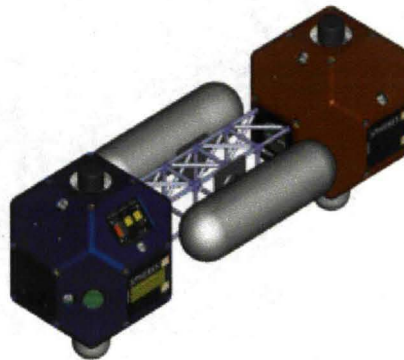




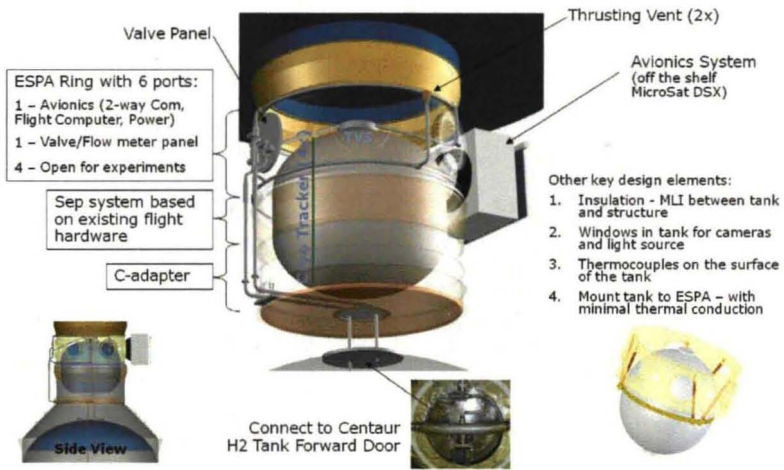
○ Examples Major Accomplishments/Awards/recognition



External payload Carrier work



ISS SLOSH Experiment - Examples of Outlook – projects in



Examples of Outlook – projects in work