



# **KENNEDY SPACE CENTER LAUNCH AND LANDING SUPPORT**

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# Agenda

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- **KSC Payload Processing**
- **KSC Facilities and Capabilities**
- **Research Development and Life Science Experience**



# KSC Payload Processing



# Launch Site Processing



- Research arrives at KSC
- Logistics provides receiving and transportation to desired site



- Laboratories prepared for processing (commodities, equipment, glassware, etc.)
- Science Processing in SSPF/SLSL

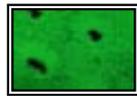


- Integrate science into hardware
- Integrate hardware for checkout/ interface testing (power, data, etc.) as required
- Physical configuration for flight
- Late stow and integration at the launch site



Launch

Mission Ops



- Laboratories prepared for processing
- Science Processing in SSPF/SLSL



Ship to KSC or to Customer Site



Landing and Recovery Hawthorne, CA\*

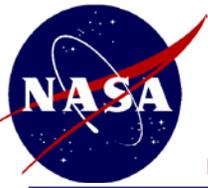
\*Some post-flight processing capabilities may exist at Hawthorne



# Payload Processing

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- **Pre-arrival coordination**
  - A Launch Site Support Manager will be assigned to be the customer's advocate throughout processing
  - Identify Ground Support Requirements (detailed operational and administrative products and services needed for processing)
  - Identify Technical Requirements for on-line processing
  - Provide customer procedures for review of safety controls and operations compatibility
  - Identify personnel for badging; complete required training for KSC processing
  - Identify needed Logistics support
    - Transportation/receiving, warehousing, imagery, tool loan
  - Obtain Ground Safety Review Panel approval
- **Customers may utilize KSC labs and resources to complete off-line post-shipment activities prior to turnover for packing or launch**
- **KSC personnel may perform on-line tasks as needed or required**
  - Testing
  - Fluids servicing
  - Integration to carrier



# Key Launch Site Processing Roles

- **Time Critical Ground Handling**

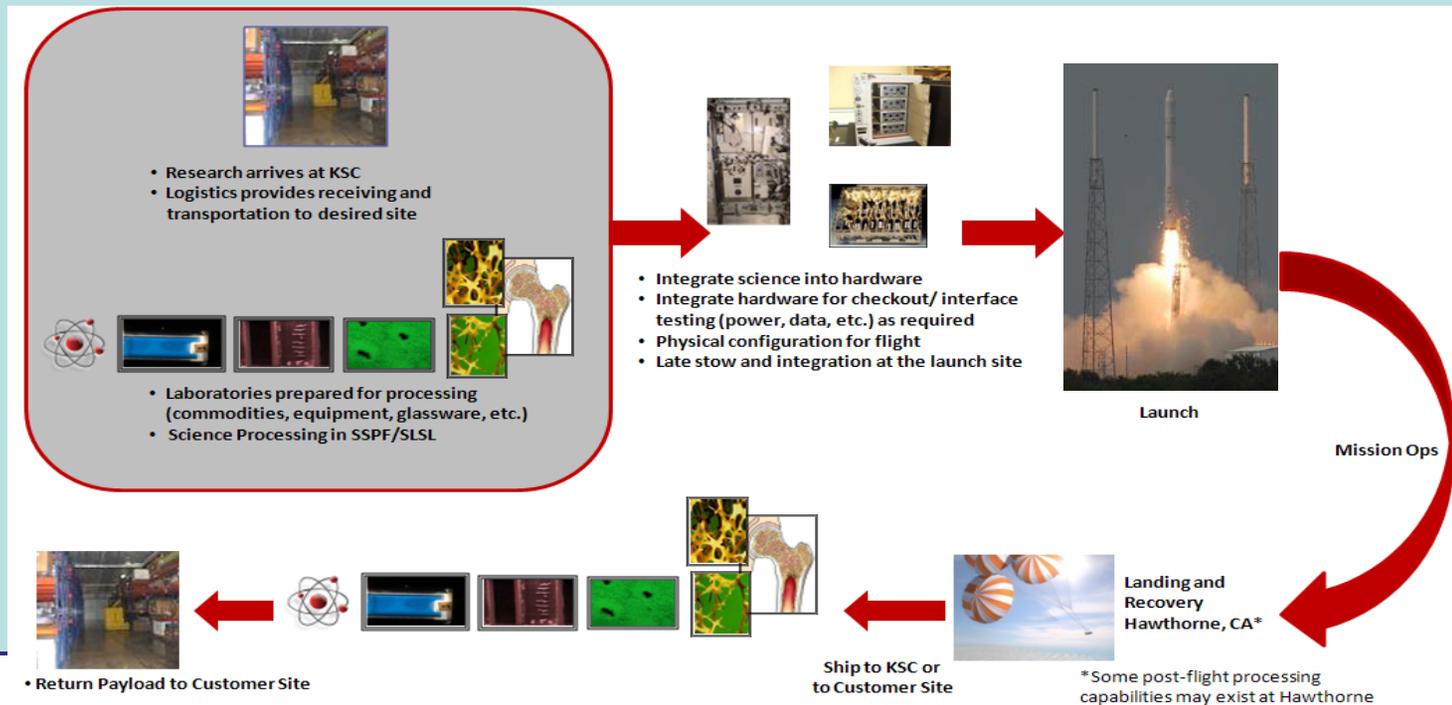
- Final prep & install into launch vehicles, scrub refurbishment to minimize science loss
- Physical retrieval of payload h/w, post mission operations, h/w return to PDs

- **Technical Integration**

- Engineering requirement/criteria development, definition, and implementation for technical requirements datasets
- Verification of payload physical and functional interfaces with applicable interface agreements through certified tests, inspections, and/or analyses

- **Customer Advocacy**

- Advanced planning and documentation of support requirements and unique agreements
- Arrangement of badging, development of schedules, provision of necessary documentation and general customer assistance with ground processing flow, deadlines, shipping, and offline





# Key Launch Site Processing Roles

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- **Customer Advocacy**

- Advanced planning and documentation of support requirements and unique agreements
- Support for **real-time** off-line processing changes
- Input to research ground processing policy and philosophy
- Operations & Maintenance (O&M) and unique outfitting of science processing laboratories
- Prioritization of on-dock arrivals
- Communication of launch site safety and base requirements
- Review of ground safety packages
- Provision of active operational support to Payload Developers during early design phases
- Arrangement of badging, development of schedules, provision of necessary documentation and general customer assistance with ground processing flow, Ground Safety Review Panel deadlines, shipping, and offline lab outfitting
- Launch site support oversight for customer's payload processing, launch, and landing activities
- Ensure applicable payload requirement documents are met
- Review payload customer procedures ensuring Agency/Center support requirement policies are accurately reflected



# Key Launch Site Processing Roles

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- **Technical Integration**

- Engineering requirement/criteria development, definition, and implementation for technical requirements datasets, including Time-Critical Ground Handling Requirements
- Payload turnover activities (Integration Data Package review, issue resolution)
- Procedure development and review of customer ground and flight procedures
- Experiment off-line operations (e.g. sharp edge inspections) & on-line processing ops
- O&M of ISS Payload Ground Support Equipment, simulators, rack testers, etc.
- Verification of payload physical and functional interfaces with applicable interface agreements through certified tests, inspections, and/or analyses
- Turnover and installation into launch vehicle
- Scrub refurbishment to minimize science loss
- Landing early destow coordination/execution
- Developing/Coordinating implementation of experiment upload schedules
- Remote launch/landing operational responsibilities (TBD post-Shuttle)

- **Time Critical Ground Handling**

- Final prep & install into launch vehicles, scrub refurbishment
- Interface with flight crew for technical issues
- Coordination of real-time destow tasks and schedules with Flight Crew Systems
- Physical retrieval of payload hardware, post mission operations, hardware return to PDs
- Coordination with researchers



# Leveraging KSC Experience

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- **Extending existing roles using current expertise**
  - Commercial Vehicle Late Stow/Early Destow
  - Sub-Rack/Pallet Payload Interface Tests
  - Sub-Rack/Pallet Payload Verification
  - Sub-Rack/Pallet On-Orbit Troubleshooting
  - Ops & Science Processing Consultation during Payload Design
  - National Lab & IP Facility-Class Payload Physical Integration and Test
  - National Lab & IP Science Processing Support
  - Assistance with Animal Care processing



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# KSC Facilities and Capabilities



# Space Station Processing Facility

- **High Bay**
  - 38,000 ft<sup>2</sup> Class 100K clean area
  - 8 footprints, completely reconfigurable
  - Available commodities include 208V/480V power, chilled water, GN<sub>2</sub>, GHe, LN<sub>2</sub>
  - Two 30-ton electrical bridge cranes with 50-ft hook height
- **Intermediate Bay**
  - 17,000 ft<sup>2</sup> Class 100K clean area
  - Two 5-ton electrical bridge cranes with 25-ft hook height
- **Airlock**
  - 5000 ft<sup>2</sup> Class 300K clean area
  - 15-ton electrical bridge crane with 50-ft hook height
- **Administrative Space**
  - Office Space for approximately 1000 employees
  - 25 Conference Rooms
- **Specialty Areas**
  - Off-Line Processing Rooms  
(7 Science Labs, 2 Central Services Labs, 8 Hardware Labs)
  - 9 control rooms located on raised floor areas
  - Multi-Layer Insulation (MLI) Sewing Room
  - Vapor Containment Facility to house liquid anhydrous ammonia
  - Flight Crew Room: final checkpoint for all flight crew equipment





# SSPF Floor Plan





# SSPF Testing Capabilities

- **Payload Rack Checkout Unit (PRCU)**
  - Provides ISS interface verifications which include Power, Command & Data Handling, Video, Fluids, Vacuum, Fire Detection System, Impedance Analysis and GN<sub>2</sub>
  - Includes a connection to MSFC HOSC for commanding and data monitoring
- **Testing Capabilities**
  - International Standard Payload Rack (ISPR)
  - Sub-rack payloads
  - Sub-pallet payloads (unpressurized) which will be mounted on a truss location or Express Logistics Carrier (ELC)
    - Includes final flight configuration testing with an ELC Simulator and verification testing
- **Fluids Servicing**
  - Spacecraft Fueling (Mono and Bipropellant)
  - Gases up to 6000 PSI (GN<sub>2</sub>, GH<sub>2</sub>, etc)
  - O<sub>2</sub> and NH<sub>3</sub> Servicing
  - Noble Gas servicing at lower pressures
  - Cryo Servicing





# SSPF Lab Capabilities

- **Lab Capabilities Summary**
  - Class 300,000 clean rooms
  - 7 Science Labs
  - 8 Hardware Labs
  - 2 Central Services
  - Specialized Science Equipment (e.g. laminar flow benches, incubators, microscopes, biological safety cabinets, portable fume hoods, water baths, etc.)
- **Payloads Processing Support**
  - Skills, equipment and labs unique to pre/post mission support requirements at launch site for hardware integration, hardware/science integration, offline checkout, including life science & biological payloads





# Baseline Data Collection Facility

- **BDCF Mission**

- Optimize the completion of Human Life Sciences Research
- Series of laboratories designed to study astronaut response to spaceflight immediately upon return to Earth

- **Experiment equipment**

- Magnetic Resonance Imaging (MRI)
- Densitometers
- Cardiovascular devices
- Vestibular testing equipment
  - Rotating chairs
  - Treadmills
  - Obstacle courses





# Space Life Sciences Laboratory

- **Building Information**

- 73,000 ft<sup>2</sup> available area
- Population: 140 residents, 38 visitors
- 25 Science Labs
- 8 Hardware Labs
- 6 Animal Holding Rooms

- **Partnerships**

- NASA/KSC: Manages Research & Utilization
- Space Florida: Owner of SLS Lab
- Life Science Services Contract: Tenant of SLS Lab, responsible for O&M
- University of Florida and Florida Tech: Resident university partners

- **Unique Agency Capabilities**

- Provides infrastructure to enable ISS Research including non-exploration research and maturation of critical Exploration technologies
- Skills, equipment and labs unique to pre/post mission support requirements at launch site of life science and biological payloads

- **Specialty Areas**

- Animal Care Facility (ACF) provides animal husbandry & support for space flight missions and meets all necessary Agency & Federal cert/license requirements
- Controlled Environment Lab (CEL)
  - Skills and infrastructure uniquely developed originally for biological sustainable systems (i.e. bio-regenerative life support systems), now serving multi-discipline investigations
  - Orbit Environment Simulators for science 'control' of STS/ISS pressurized environment payloads (temp, humidity, CO<sub>2</sub>, lighting)





# SLS Lab Capabilities

## Controlled Environment Lab

15 Controlled Environment Chambers (CEC)  
Low Pressure Test Bed  
Lunar/Mars Vacuum Chamber

## Animal Care

Rodent/Aquatic/Avian/Insect

## Experiment Processing Support

Shuttle/Station/Unmanned

## Flight Experiment Development

Design/Testing/Integration

## Flight Mission Support

Orbit Environment Simulators (OES)  
Experiment Monitoring Area (EMA)





# SLS Lab Capabilities

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<b>Bimolecular/Microbial Ecology</b>	Genetic Identification, Quantification & Qualification
<b>Analytical Chemistry</b>	Organic/Inorganic/Volatile Gases
<b>Astrobiology</b>	UF & FIT Resident Science Programs
<b>Microscopy/Imaging</b>	Atomic Force (AFM), X-Ray Photoelectron Spectroscopy (XPS), Scanning Electron (SEM), Confocal Fluorescence
<b>Applied Chemistry</b>	In-Situ Resource Utilization (ISRU), Environmental Remediation, Corrosion Detection & Coatings, Polymer & Advanced Materials
<b>Applied Physics</b>	Granular & Surface Systems
<b>Electrostatics</b>	Dust Characterization & Remediation, Surface Physics

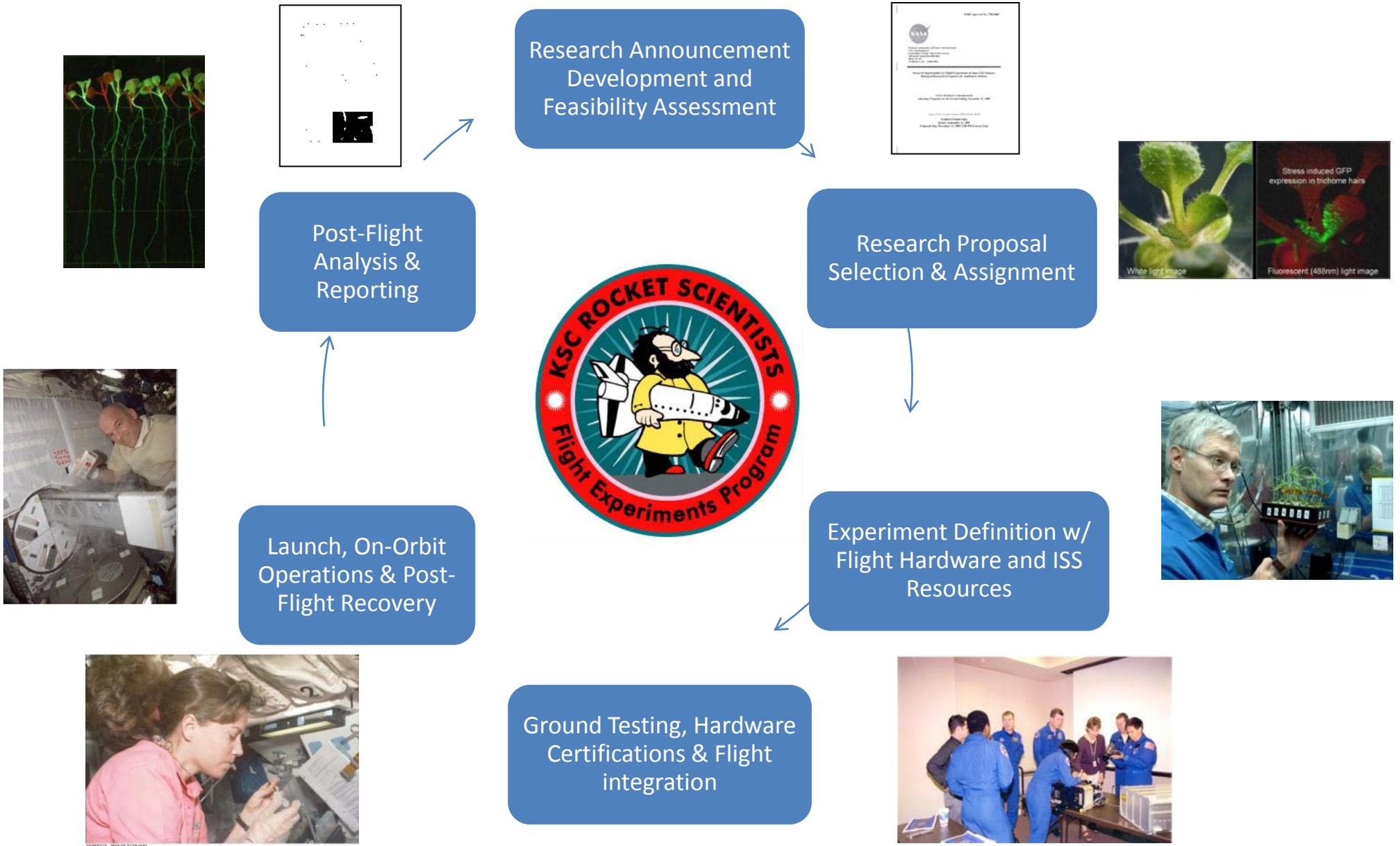




# Research Development and Life Science Experience

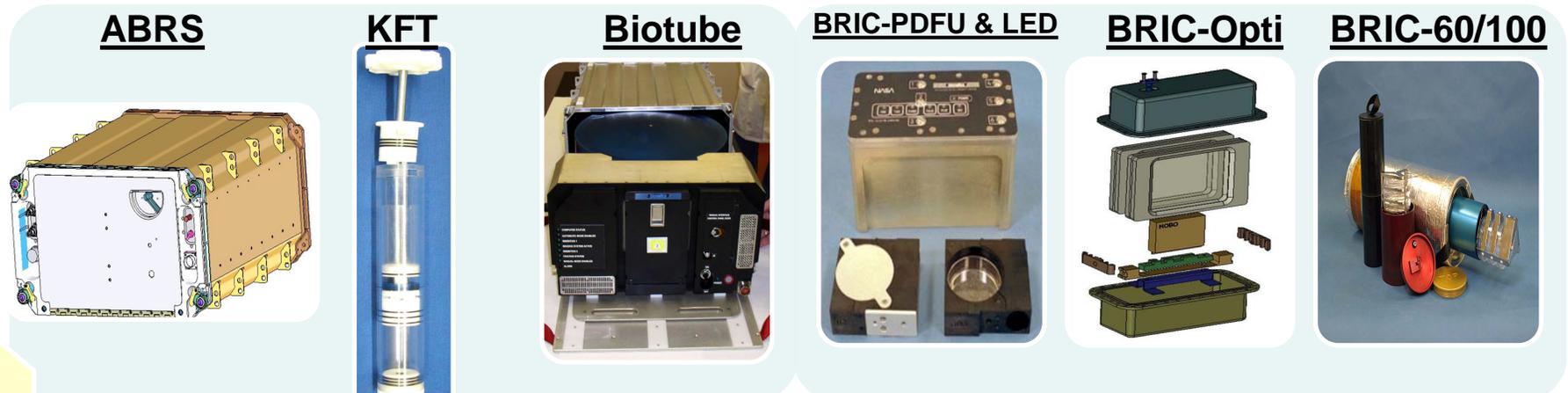


# Research Payload Development





# KSC ISS-Research Flight Hardware



## Inventory

- On ISS
- At KSC
- Certification
- Planned Upgrades

	<b>ABRS</b>	<b>KFT</b>	<b>Biotube</b>	<b>BRIC-PDFU &amp; LED</b>	<b>BRIC-Opti</b>	<b>BRIC-60/100</b>
•On ISS	1	4	0	0	0	0
•At KSC	1	70	1	10	30	16 (60mm) 15 (100mm)
•Certification	STS & ISS	STS & ISS	STS	STS	STS & ISS	STS & Progress
•Planned Upgrades	BFP & YFP imaging	none	ISS Cert	Lid mods & ISS Cert	none	none





# KSC Life Science Expertise

- **Areas of Expertise**

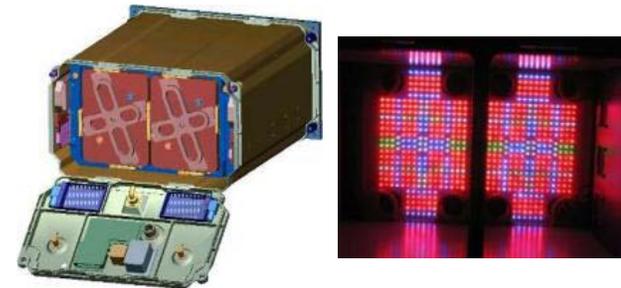
- Processing biological payloads
- Biological payload development and Flight execution
- Developing life support systems & flight hardware
- BRICs and ABRS flight facilities
- Maintaining commitments to Investigators
- Managing Labs to support space related research
- Managing Grants (e.g. ILSRA)

- **Critical Skills**

- Mission Integration
- Project Integration
- Payload Scientist
- Science Disciplines: Exploration Life Support, Molecular Biology, Plant Physiology, Analytical Chemistry, Microbial Ecology, Wet Solid Waste, Air Purification
- OES manager, engineer, and technician
- CMDS Software Manager
- Certified Animal Care Manager
- Engineering Disciplines: Optics, Communications, Electrical, Mechanical, Spacecraft Thermal, Fluids, Power Systems, Lighting, Structural

- **Customers**

- NASA HQ / ESMD & SOMD
- International Space Station
- International Science Community
- Florida State Partnership
- ISS National Lab Community
- Commercial



ABRS



BRIC Opti