A satellite view of the Earth from space, showing the curvature of the planet, the blue oceans, and the white clouds of the atmosphere.

## ***CBSE NIH Implementation Partner***

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Visit Our Web Page At : **<http://www.cbse.uab.edu>**



## ***UAB Center for Biophysical Sciences and Engineering History***

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- ***Previously named the Center for Macromolecular Crystallography***
- ***Designated in 1985 by NASA as a Commercial Space Center to promote the participation and investment of industry in the commercial development of space***
- ***In 1990 the Engineering Group was formed to design, develop and integrate hardware systems for both laboratory and microgravity experiments***
- ***In 2000 the name was changed to CBSE to better reflect our expanding services, basic applied research, and technology transfer***
- ***The 115 staff members are comprised of PhDs, Scientists, Engineers, technicians, Grad Students and Administrative personnel***
- ***Since 1985 our organization has performed 61 different experiments on 47 different Shuttle Flights, on-board operations on both the ISS, and Space Station MIR***
- ***We have also supported 29 other experimenters with hardware and integration services***
- ***Hardware development and Flight Certification for Space Flight Participant hardware on Soyuz and the Russian ISS Segment***



STS 51D<sup>\*\*</sup>  
VDA



STS 51F<sup>\*\*</sup>  
VDA



STS 61B<sup>\*\*</sup>  
VDA



STS 61C<sup>\*\*</sup>  
VDA



STS 26<sup>\*\*</sup>  
VDA



STS 29<sup>\*\*</sup>  
VDA



STS 32<sup>\*\*</sup>  
VDA (2)



STS 31<sup>\*\*</sup>  
VDA



STS 37  
PCF



STS 43  
PCF



STS 48  
VDA



STS 42  
VDA (2)



STS 49  
PCF



STS 50  
VDA (2), GBX



STS 47  
VDA



STS 52  
PCF



STS 57  
PCF, VDA, COS



STS 51  
PCF



STS 60  
PCF, PCFLS



STS 62  
VDA (2)



STS 65  
VDA



STS 68  
VDA



STS 66  
VDA, COS



STS 63  
VDA (2), PCFLS/T



STS 67  
VDA



STS 70  
PCFLS/T



STS 73  
VDA, PCF, GBX



STS 72  
VDA-2, PCF, VG



STS 75  
CVDA



STS 77  
CVDA, PCF, VG



STS 79  
CVDA



STS 83  
VDA-2



STS 84  
VDA-2, CVDA



STS 94  
VDA-2



STS 86  
PCF, VG



STS 89  
XDT



STS 91  
CVDA



STS 95  
PCF, VG, CVDA, VDA-2



STS 101  
PCF, VG



STS 100  
(ISS)  
CPCG-H



INCREMENT 2  
CPCG-H



STS 105  
DCPCG



INCREMENT 3  
DCPCG



STS 110  
CPCG-H



INCREMENT 4  
CPCG-H



STS 107  
PCF, VG, CMPCG



STS 118  
MERLIN



STS 123  
MERLIN



STS 126  
MERLIN, GLACIER



INCREMENT 18  
MERLIN, GLACIER



STS 119  
GLACIER



INCREMENT 19  
MERLIN, GLACIER



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# ***CBSE AVAILABLE HARDWARE SYSTEMS***





**STATUS:** Shuttle/ISS Certified - 7 flight units available for use.

**FLIGHT HISTORY:**

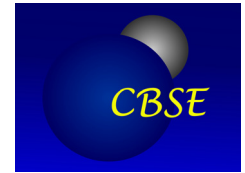
- STS-118 (Shuttle-sortie)
- STS-123 (Shuttle-sortie)
- STS-126 (Shuttle-ISS) – Currently on ISS and operational since 11/30/2008

## Microgravity Experiment Research Locker Incubator (MERLIN) Features:

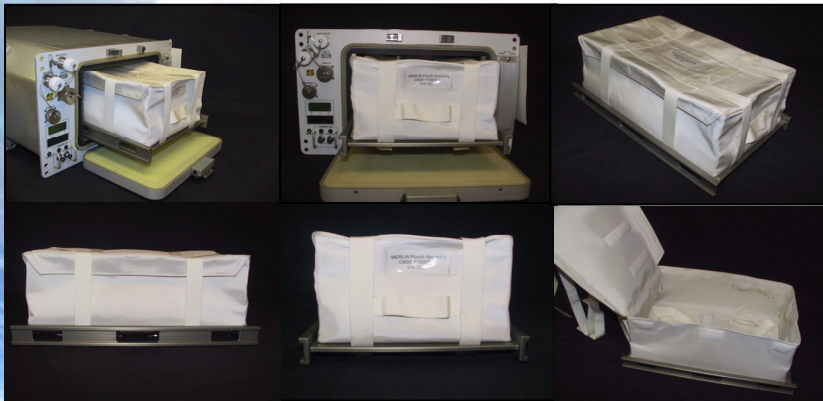
- Advanced Single Middeck Locker Incubator / Freezer (Heat exchanger designed for both rear-air (AAA) or ISS water loop (MTL) heat rejection)
- Interfaces to Shuttle middeck, and ISS EXPRESS rack
- Accommodate existing experiments designed for CRIM (some minor modifications may be required)
- 28+ pound payload with 16.5" (X) by 10.188" (Y) by 6.69" (Z) experiment volume (CG at the center of the experiment volume)
- Payload volume for both conduction or convection cooling modes
- Provides thermal control from -20 °C to 48.5 °C on ISS. +4 °C to 48.5 °C on Shuttle
- Fully programmable temperature control including ramps and recovery modes can be configured / executed via the Front Panel display, the EXPRESS Laptop, or from from UAB Operations Center.
- Downlink EXPRESS Rack interface accommodated –
  - System temperature sensors (8)
  - Experiment temperatures sensors (up to 11)
  - Control temperature sensors (derived)
  - A/D sensors (up to 10)
  - Digital I/O (8)
  - Last command status information
  - Error reporting/acknowledgement information
  - Data storage utilization status
  - Thermal control data



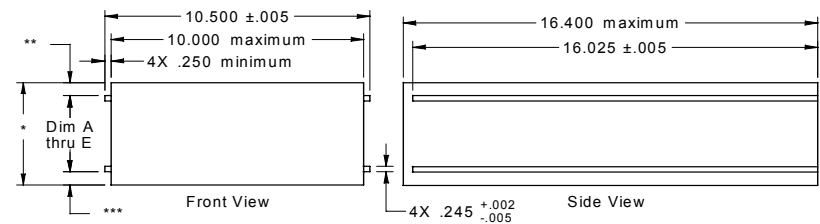
# MERLIN Accommodations Overview



**MERLIN INTERNAL VOLUME**



**MERLIN POUCH ASSEMBLY (used for small passive sample items)**



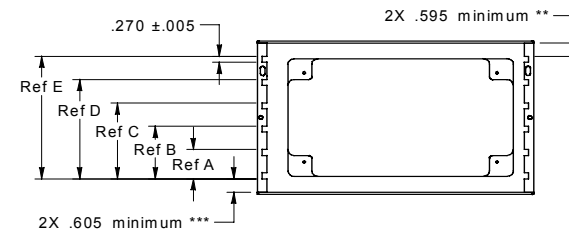
**Mandatory MERLIN Payload Design Dimensions**  
(Other design dimensions and actual design may vary)  
(dimensions in inches)

MERLIN Payload Design Height Dimension Chart		
Dim Ltr	Slot Configuration Used	Design Height Dimension (in.)
A	Single Slot Height	1.305 ± .005
B	Double Slot Height	2.365 ± .005
C	Triple Slot Height	3.425 ± .005
D	Quadruple Slot Height	4.485 ± .005
E	Quintuple Slot Height	5.545 ± .005

\* 6.600 in. maximum

\*\* Subject to \* dimension and .595 in. minimum in MERLIN Internal Volume.

\*\*\* Subject to \* dimension and .605 in. minimum in MERLIN Internal Volume.

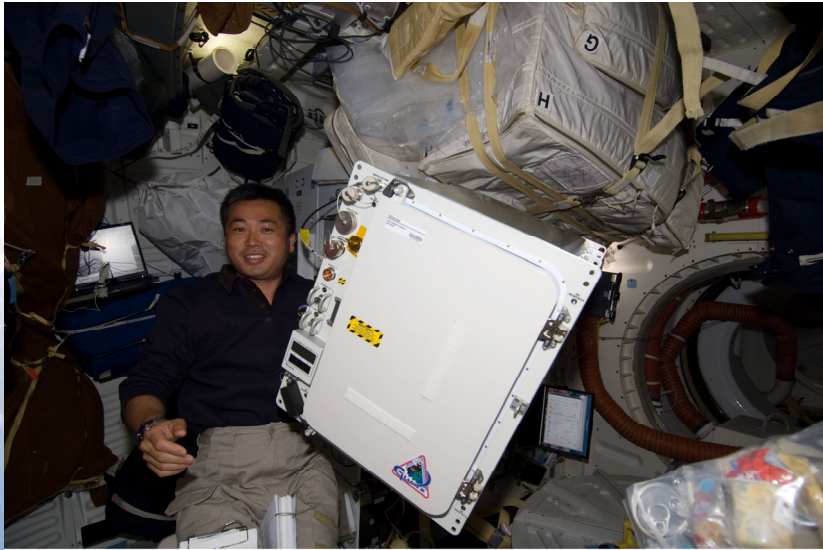


**MERLIN Internal Volume**  
(For design reference)  
(dimensions in inches)

**MERLIN INTERNAL VOLUME INTERFACE**



# GLACIER Hardware Overview



S119E006764

**STATUS: Shuttle/ISS Certified - 6 flight units available for use.**

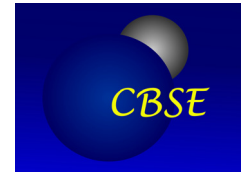
## **FLIGHT HISTORY:**

- STS-126 (Shuttle-sortie)
- STS-126 (Shuttle (MPLM) – ISS)
- STS-119 (Shuttle- ISS) Currently on ISS and operational since 3/15/2009

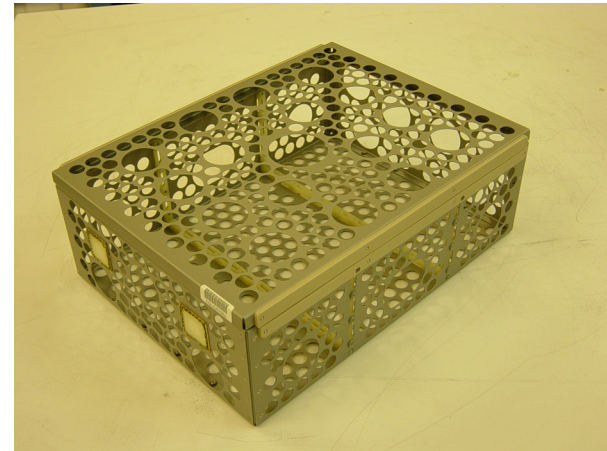
- **General Laboratory Active Cryogenic ISS Experiment Refrigerator (GLACIER) Features:**
- *The Glacier hardware was designed, built, integrated, and flown by CBSE. Glacier is NASA owned equipment. Use of this System must be coordinated through the JSC EC2 Organization*
- GLACIER complement consists of six Flight Units and one Engineering unit. Active ascent/ descent in Shuttle Middeck, COTS and Cargo CEV. Passive ascent in ATV and Shuttle MPLM
- GLACIER supports a selectable temperature range of +4°C to -160°C
  - Middeck (36 cfm) or EXPRESS (30 cfm) air cooling mode: -95°C
  - EXPRESS water cooling mode (50 lbs/hr): -160°C
- GLACIER supports 18.1 lbs of experiment samples with Middeck waiver
- GLACIER can accommodate a payload as large as 23.1 cm x 16.6 cm x 7.4 cm. (2.84 liters)
  - This is the internal dimension of a GLACIER tray
  - There are four GLACIER trays (effective total volume of all trays is 11.35 liters)
- GLACIER is a double Middeck locker equivalent in size
- GLACIER vacuum insulated Cold Volume can maintain samples below -68°C for a maximum of 20 hrs without power, if operating at -160°C and is 75% full
- Ethernet interface through EXPRESS Rack for downlink telemetry and uplink commands



# ***GLACIER Accommodations Overview***



**GLACIER COLD VOLUME**

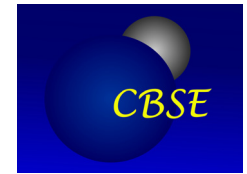


**GLACIER SAMPLE TRAY**

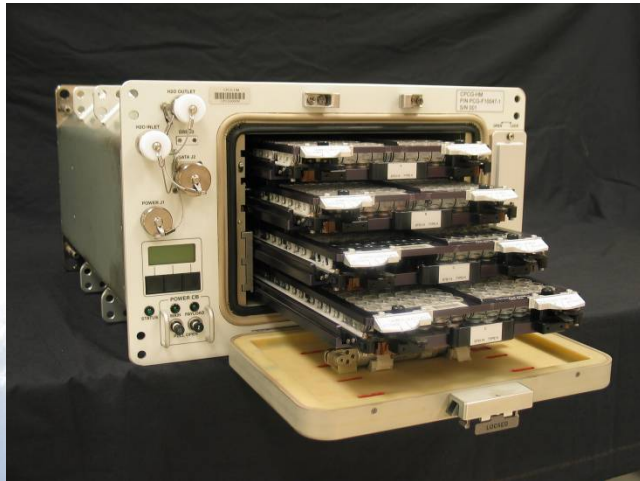




## ***HDPCG Hardware Overview***



### **High Density Protein Crystal Growth**



***STATUS: Shuttle/ISS Certified – 2 flight units available for use. (8 Trays, 2 support structures)***

***FLIGHT HISTORY: Inside CRIM-M***

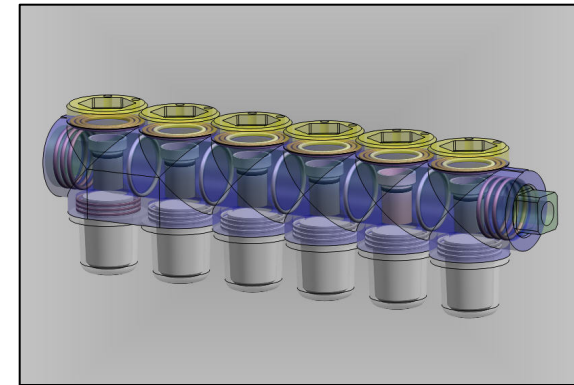
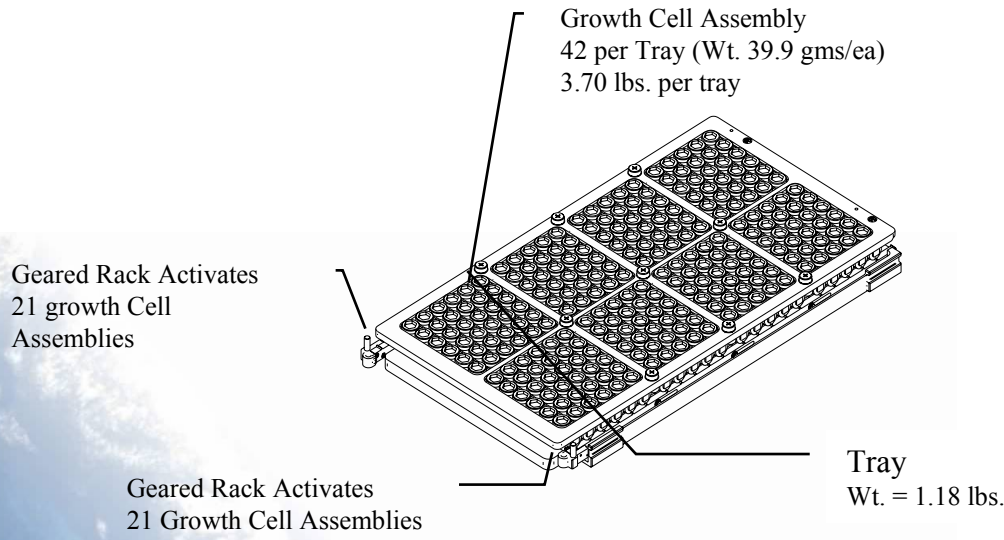
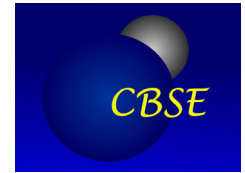
- ***STS-100 to STS-105 (Shuttle-ISS I-2)***
- ***STS-110 to STS-111 (Shuttle-ISS I-4)***
- ***STS-107 (Shuttle)***
- ***Upgrades from CRIM-M to MERLIN Interface implemented and readied for RFT. Project cancelled prior to flight.***

#### **Features:**

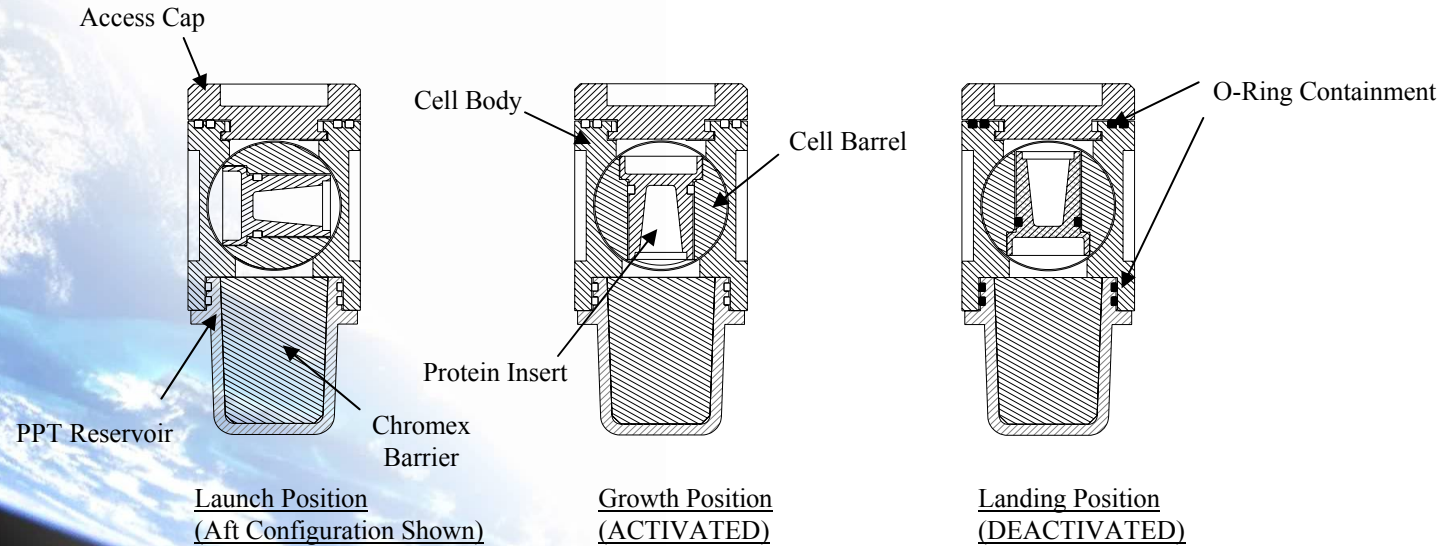
- **Design allows for multiple PI teams in 1 system**
- **Shuttle Middeck and ISS-EXPRESS Certified**
- **Individual Growth Cells available to PI teams for Ground based testing and condition refinement**
- **4 Tray configuration provides up to 1008 samples**
  - **4 Tray Assemblies per MERLIN.**
  - **42 Growth Cells per Tray**
  - **6 Sample per Growth Cells**
- **Enhanced Design of Previous Crystal Growth Experiments.**
- **Better Thermal Conduction to the Experiment Chambers**
- **Simple Activation and Deactivation**
- **Housed inside MERLIN for active Thermal Control**
- **Can also be used to support other biology, biotechnology, chemistry, etc. experiments**



# HDPCG Hardware Overview



HDPCG Growth Cell Assembly

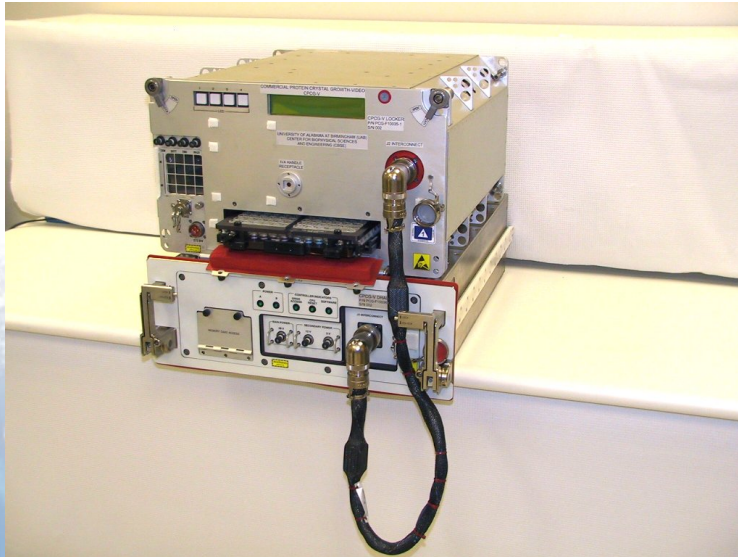




# HDPCG Hardware Overview



## Video Control and Monitoring System (VCMS)



**STATUS:** Shuttle/ISS Certified – 2 flight units available for use.

**FLIGHT HISTORY:**

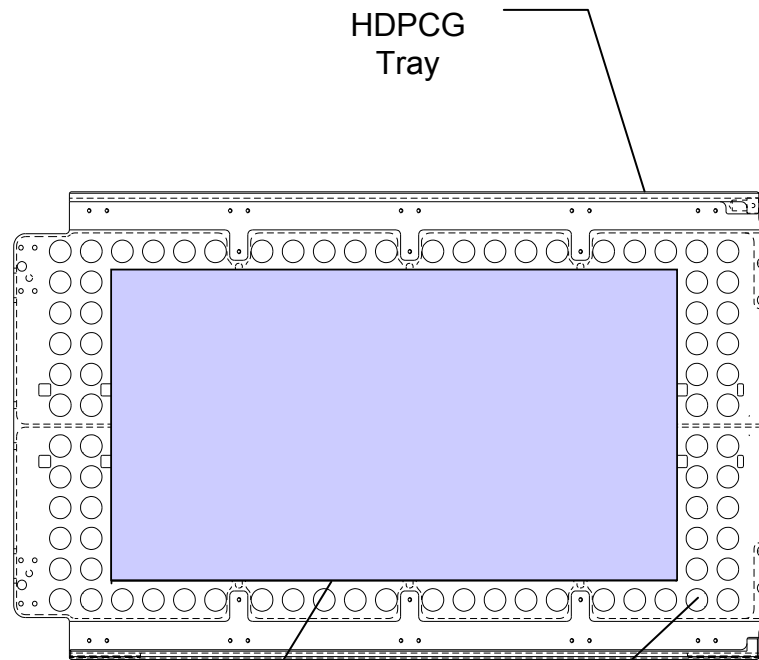
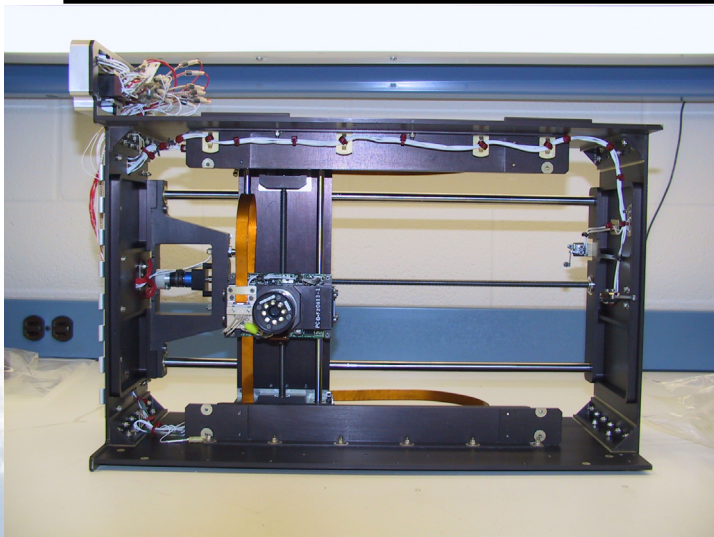
- *Certified and installed for flight on ULF1.1. Project subsequently deleted. Hardware removed from vehicle and returned to Bonded Storage*

### Features:

- Performs video capture of HDPCG cells
- Shuttle Middeck and ISS-EXPRESS Certified
- Monitors HDPCG growth cells via down-linked digitized images. Provides earth-based scientists with images detailing characteristics of protein crystal growth.
- Consists of 2 components.
  - Video Capture device flown inside thermal carrier for active cooling during image collection.
  - Controller Assembly (ISIS) drawer has camera control device, disk storage and communications control.
- HDPCG Trays are transferred to the VCMS system for automated video capture
- Each Tray is photographed over the ISS stage to monitor sample growth.

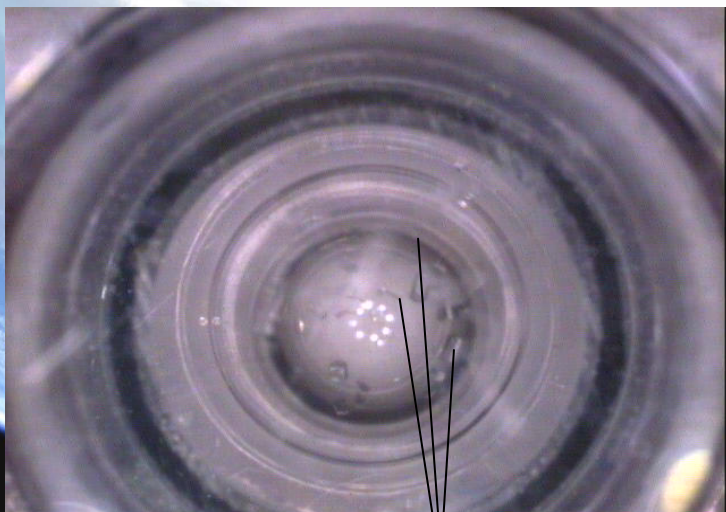


# HDPCG Hardware Overview



Video Camera Coverage Area

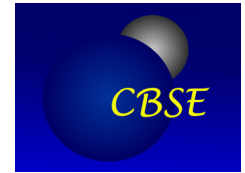
Sample Cells



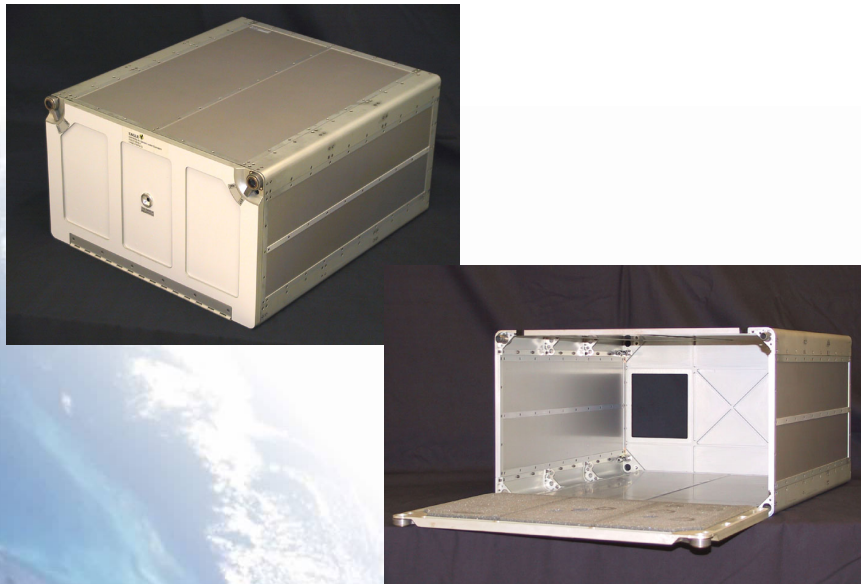
Typical Crystal



# ***EAGLE Hardware Overview***



## **EXPRESS Air Generic Locker Equivalent (EAGLE)**



***STATUS: Shuttle/ISS Certified - 2 flight units available for use.***

***FLIGHT HISTORY:***

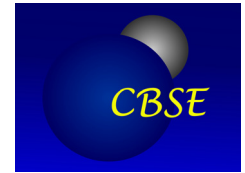
- ***STS-105 to STS-108 – MPLM ISS***

### **Features:**

- **Rear air-breathing capability designed to interface with a VPMP to allow easy transfer to EXPRESS Rack**
- **Overall external dimensions match those of a single middeck locker with the exception of the depth, which is 0.50” shorter, to allow for utilization of a VPMP**
- **Internal volume is slightly larger than a standard middeck locker (even though 0.50” shorter) through novel incorporation of the installation guides within the experiment volume**
- **Includes a user modifiable door**
- **Analyzed & qualified for Shuttle Middeck, Shuttle MPLM loads**
- **Qualified for 11 flights**
- **Locker weight in shown configuration: 13.7 lbs**
- **Max. payload weight: 53 lbs**



## Sample Transportation Container (STC) Hardware Overview



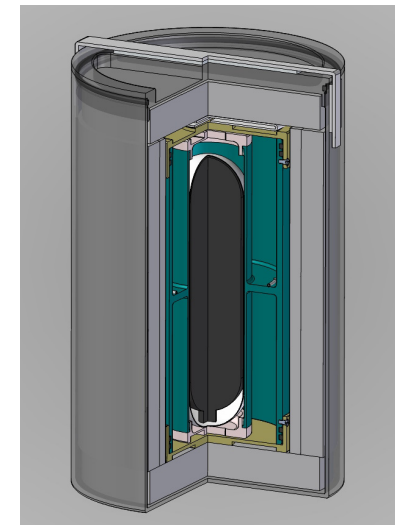
### Features:

- An Aerogel insulated container used to house Protein Crystal Growth experiments on Soyuz and the ISS Russian Module
- The insulated container maintains the PCG experiments in a frozen state until  $\mu g$  is reached
- A passive container that provides multiple levels of containment
- Size:  $\text{Ø } 5.5'' \times 9''$
- Weight: 4.8 lbs fully loaded with 1000 PCG Experiments

**STATUS:** Soyuz/ISS Certified – 2 flight units available for use.

**FLIGHT HISTORY:** Stored in Richard Garriott's Personal Storage

- Launched on TMA 13, returned on TMA 12

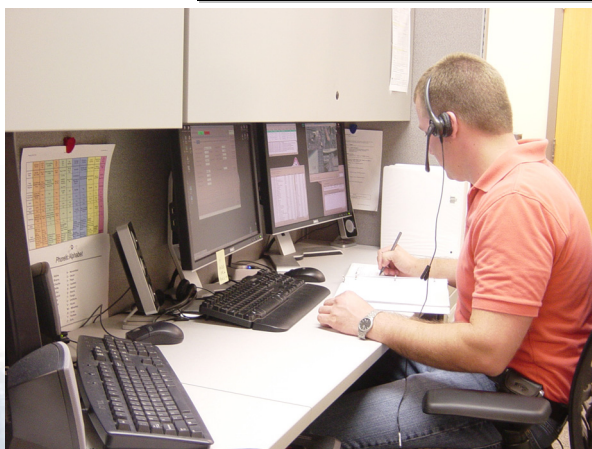




# UAB Center for Biophysical Sciences and Engineering Capabilities



## REMOTE OPERATIONS CONTROL CENTER



### Features:

- Fully Operational to support ISS operations.
- Telemetry, Commanding, Video and Voice systems
- Operations Platforms (EHS, OSTPV, OPS1, RICCO)
- Web Based Telemetry status and Data mining tools available to PI teams
  - Allows PI teams to view system telemetry from anywhere with internet access
- Automated Database Parameter monitoring tools. Notifies recipients via Text Message or Email if a boundary condition is exceeded

Windows: Overview Power Temperature System Resources Air Flow Circulation Fan Door Vacuum Memory

**OVERVIEW**

Retrive Current Data Database Timestamp

GLACIER Error	0	Error History	22 May 2009 12:41:35
GLACIER Time	22 May 2009 17:41:46		
Temperature Control Mode	Set Point		
Set Point Temperature	-95.0 deg C		
Current Temperature	-95.0 deg C		

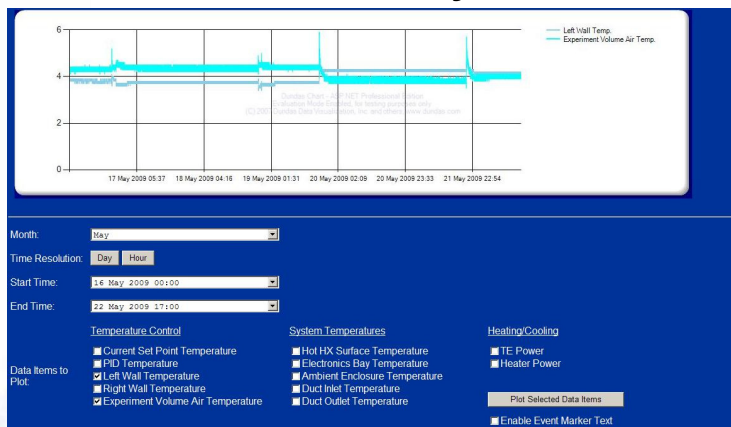
**POWER**

Average Current	4.5 A
Voltage	27.5 V
Power Draw	123.8 W
Over Current Trip	18.0 A
Over Current Status	OK
Battery Voltage	9.0 V

**TEMPERATURE**

Cooler 1 Status	On	Cooler 2 Status	On
Cooler 1 Stroke	7	Cooler 2 Stroke	7
Cold Head Temp. 1A	-106.5 deg C	Cold Head Temp. 2A	-113.8 deg C
Cold Head Temp. 1B	-106.8 deg C	Cold Head Temp. 2B	-113.4 deg C
Heater 1 Power	0 %	Heater 2 Power	0 %

AAA Fan Mode: Manual  
AAA Fan Setting: High





## ***UAB Center for Biophysical Sciences and Engineering Capabilities***

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- ***Extensive experience with Academic, Governmental and Commercial Research Organizations, both foreign and domestic***
- ***ISO Certified Engineering***
- ***We have in-house research facilities and scientific expertise available to assist a PI team with their research***
- ***We are experts in the ISS Payload Flight Integration Process. From Safety to Verification to Human Factors compliance, we can do it all for you***
- ***Our team is ready to make your research a success***

