CBSE
ISS Research Academy

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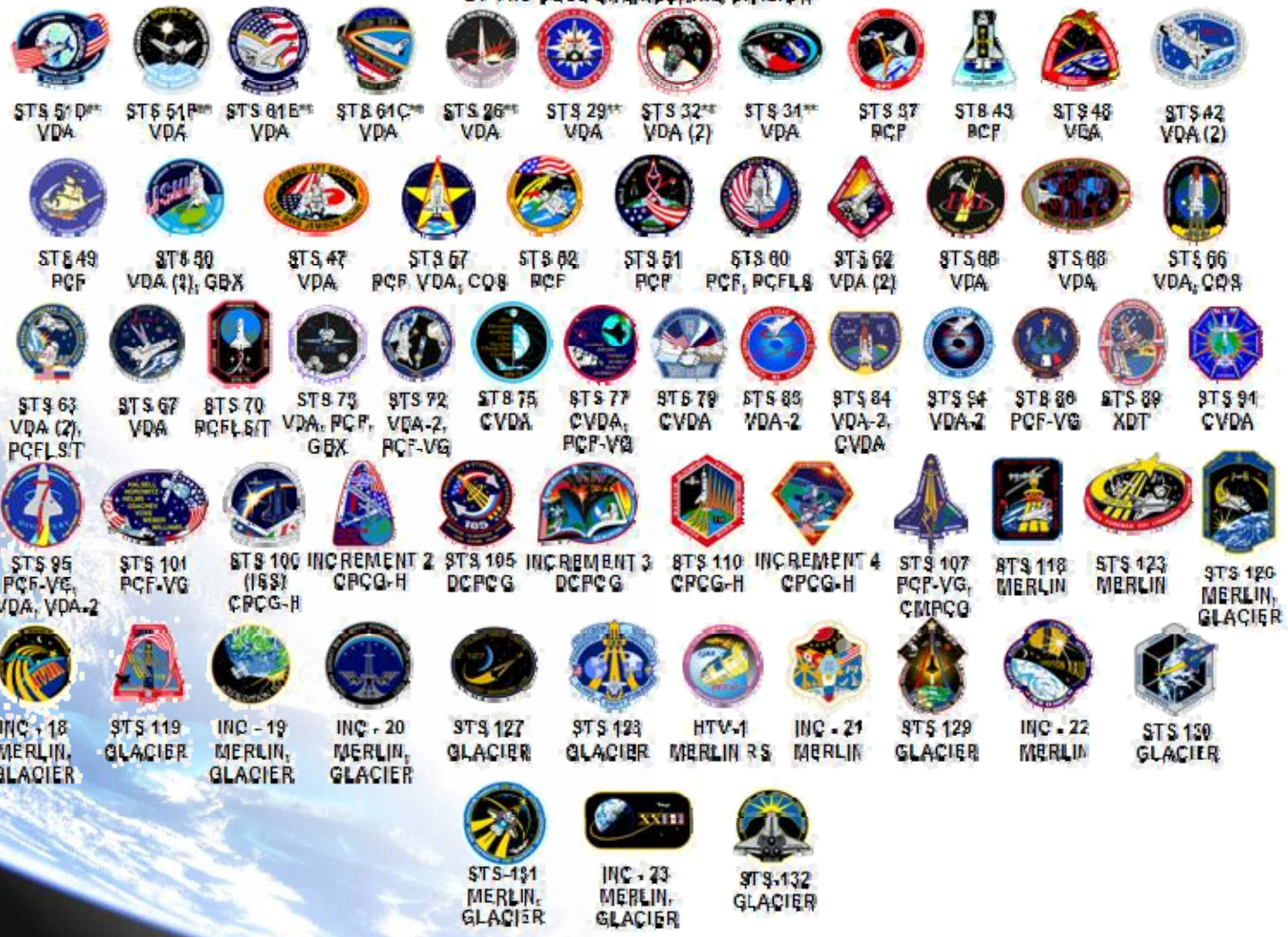
UAB Center for Biophysical Sciences and Engineering History

- *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 75 staff members are comprised of PhDs, Scientists, Engineers, technicians, Grad Students and Administrative personnel*
- *Since 1985 our organization has performed 64 different experiments on 52 different Shuttle Flights, on-board operations on both the ISS, and Space Station MIR*
- *We have also supported 31 other domestic and international experimenters with hardware and integration services*
- *Hardware development and Flight Certification for Space Flight Participant hardware on Soyuz and the Russian ISS Segment including the Russian Safety Process*
- *Power and Interface testing of GLACIER and MERLIN in SpaceX Dragon Vehicle*

CBSE SPACE FLIGHT HISTORY

UAB/CBSE SHUTTLE/ISS MISSIONS FLOWN AS OF MAY 2010

UNLESS OTHERWISE NOTED, EXPERIMENT SYSTEMS WERE DEVELOPED, FABRICATED, TESTED, INTEGRATED, AND SUPPORTED BY THE CBSE ENGINEERING DIVISION



CBSE
AVAILABLE HARDWARE SYSTEMS

MERLIN Hardware Overview

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***
- ***STS-131 (Shuttle-sortie)***
- ***STS-133 (Shuttle-ISS) - Planned 11/2010***

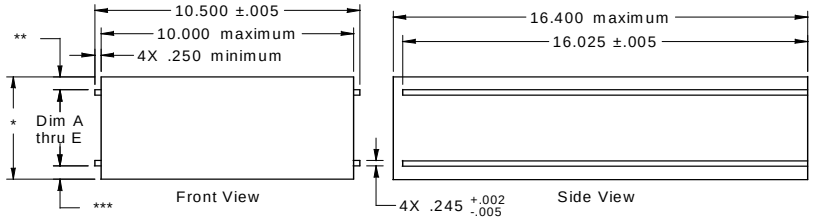
Microgravity Experiment Research Locker Incubator (MERLIN) Features:

- **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 ^{o}C to 48.5 ^{o}C on ISS. +4 ^{o}C to 48.5 ^{o}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)



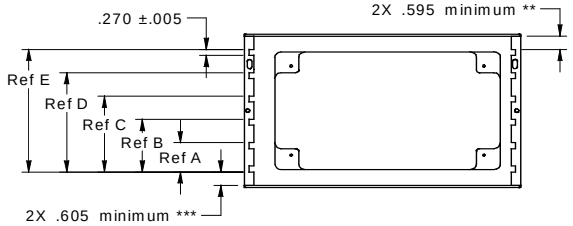
Mandatory MERLIN Payload Design Dimensions
(Other design dimensions and actual design may vary)
(dimensions in inches)

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.

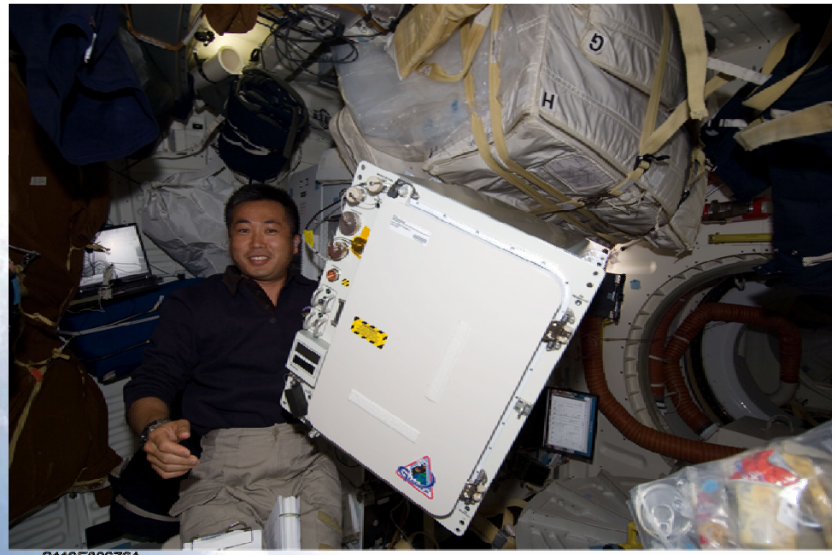
*** Subject to * dimension and .605 in. minimum in MERLIN Internal Volume.



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

MERLIN INTERNAL VOLUME INTERFACE

GLACIER Hardware Overview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STATUS: Shuttle/ISS Certified - 6 flight units available for use.

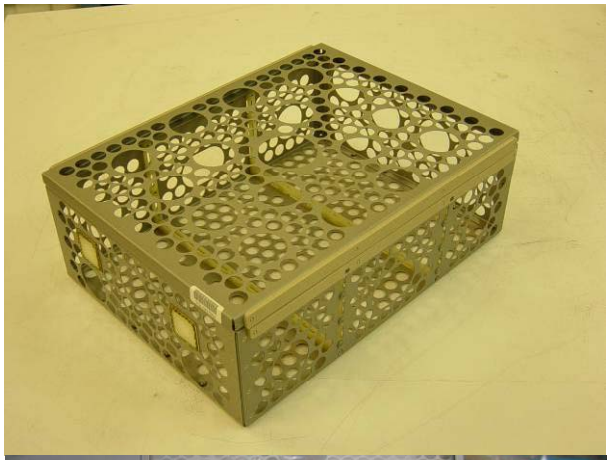
FLIGHT HISTORY:

- ***9 Flights, 3 ISS Flights, 6 Sortie Flights in Shuttle Middeck, 1 unit currently on ISS***

- **General Laboratory Active Cryogenic ISS Experiment Refrigerator (GLACIER) Features:**
- ***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. 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**

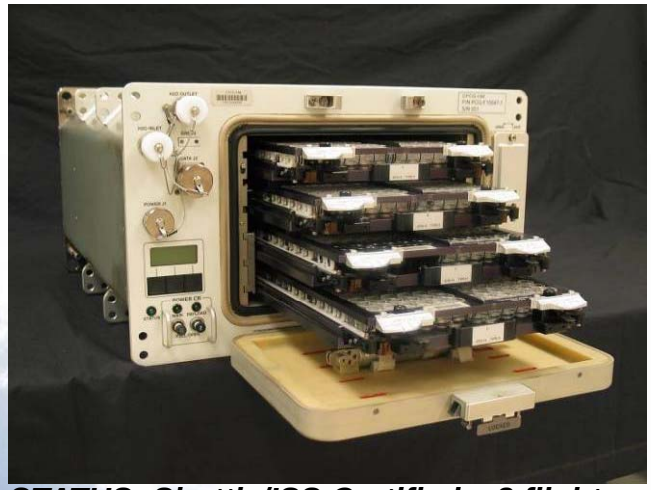
GLACIER Accommodations Overview

GLACIER COLD VOLUME



GLACIER SAMPLE TRAY

High Density Protein Crystal Growth



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

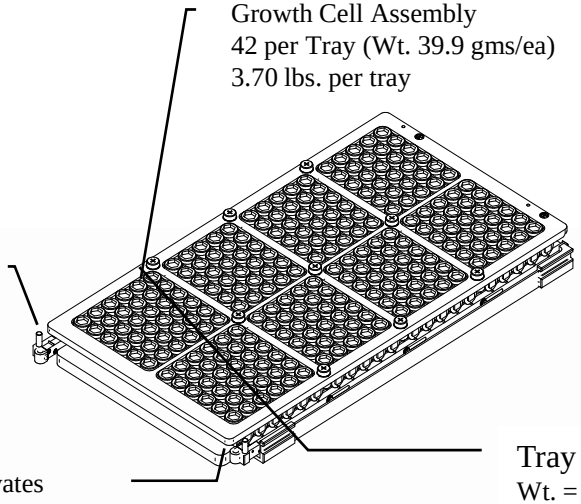
FLIGHT HISTORY: Inside CRIM-M

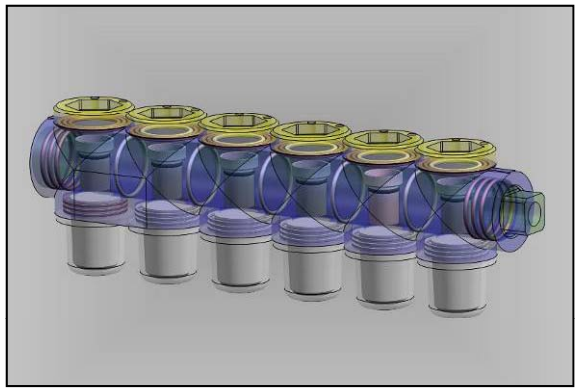
- ***STS-100 to STS-105 (Shuttle-ISS I-2)***
- ***STS-110 to STS-111 (Shuttle-ISS I-4)***
- ***STS-107 (Shuttle)***
- ***Upgrades from CRIM-M to MERLIN Interface implemented.***

Features:

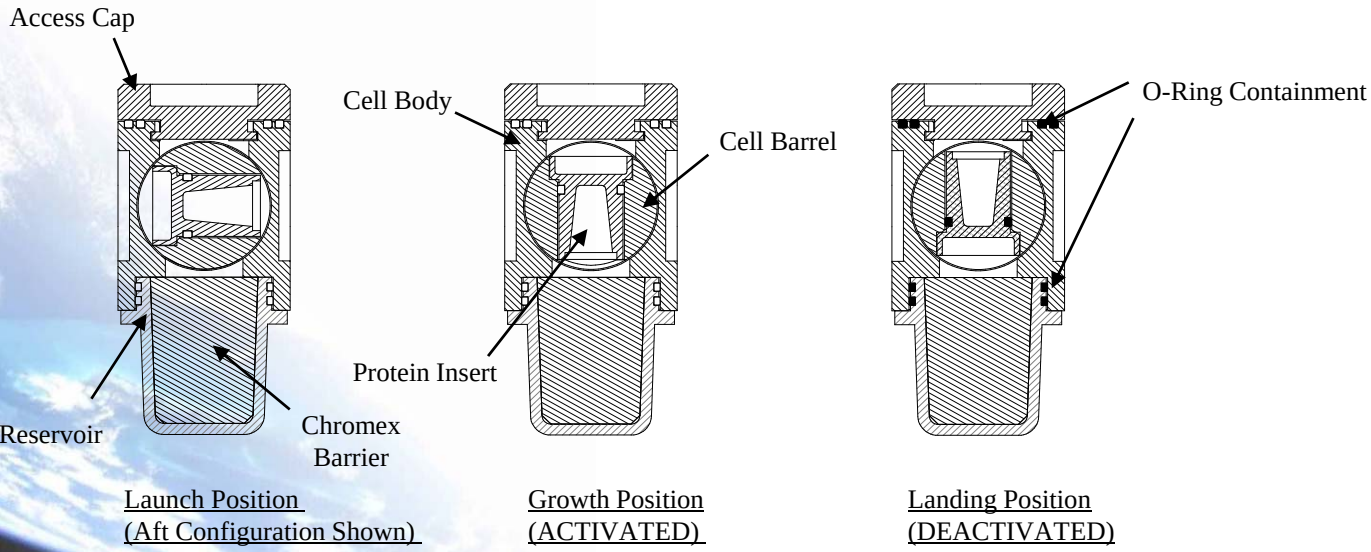
- **Design allows for multiple PI teams in 1 system**
- **Shuttle Middeck and ISS-EXPRESS Certified**
- **Individual Growth Cells available to PI teams for Ground based testing and condition refinement**
- **4 Tray configuration provides up to 1008 samples**
  - **4 Tray Assemblies per MERLIN.**
  - **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, samples may be activated/deactivated at different times**
- **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



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 µg is reached**
- **A passive container that provides multiple levels of containment**
- **Size: Ø 5.5” x 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***

Sample Containment Facility (SCF) Hardware Overview

Features:

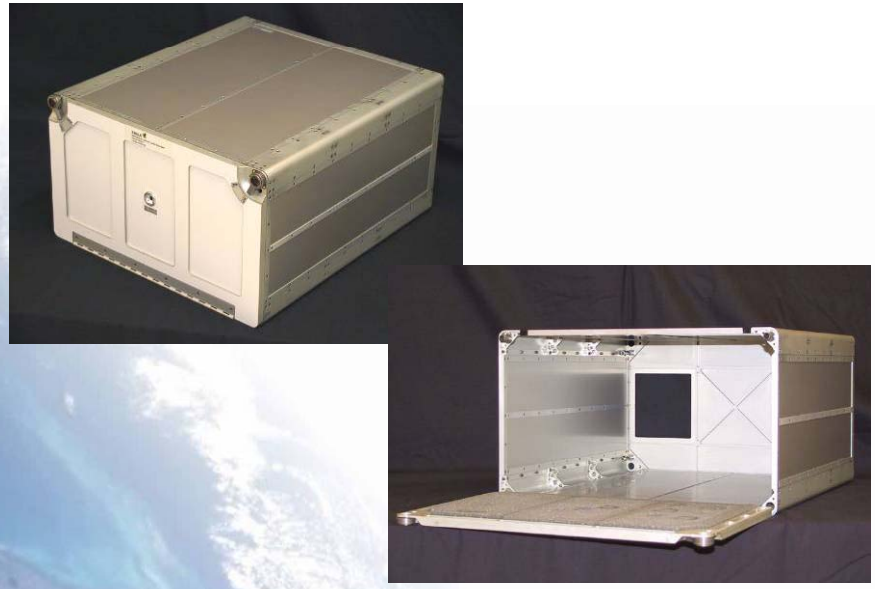
- **Containment structure designed to fit within MERLIN**
- **Provides sample bottles ranging from 500ml to 1ml**
- **May have up to 25 1ml bottles per containment tube, other multiple bottle configurations available**
- **Passive container that provides three levels of containment**

STATUS: Shuttle Certified – 1 flight unit available for use.

FLIGHT HISTORY: 14 Sortie flights aboard the Shuttle

EAGLE Hardware Overview

EXPRESS Air Generic Locker Equivalent (EAGLE)



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

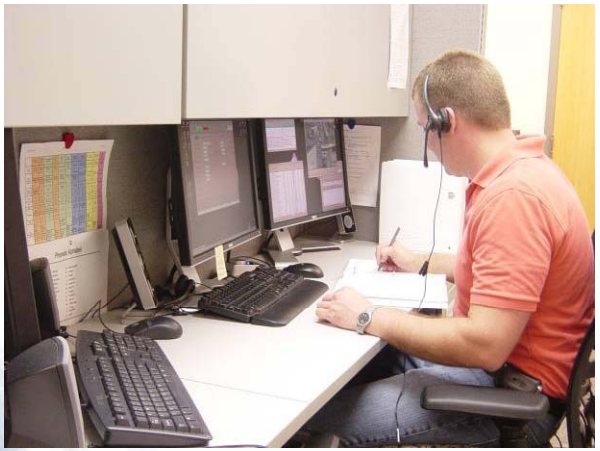
FLIGHT HISTORY:

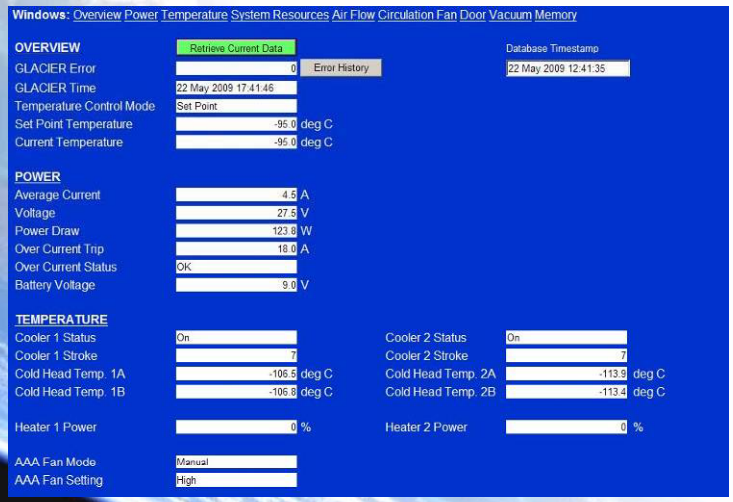
- ***STS-105 to STS-108 – MPLM ISS***

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**

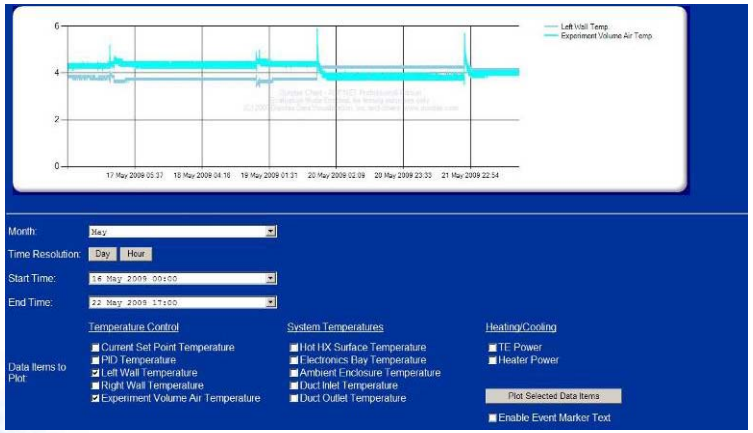
REMOTE OPERATIONS CONTROL CENTER





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**



UAB Center for Biophysical Sciences and Engineering Capabilities

- ***Extensive experience with Academic, Governmental and Commercial Research Organizations, both foreign and domestic***
- ***ISO 9001:2008 Certified with Certification to AS9100 expected this summer***
- ***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***