Engineering Services Contract

PAYLOAD INTEGRATION & ENGINEERING

Biological Research in Canisters – Light Emitting Diode (BRIC-LED)

Prepared for ISS R&D Conference

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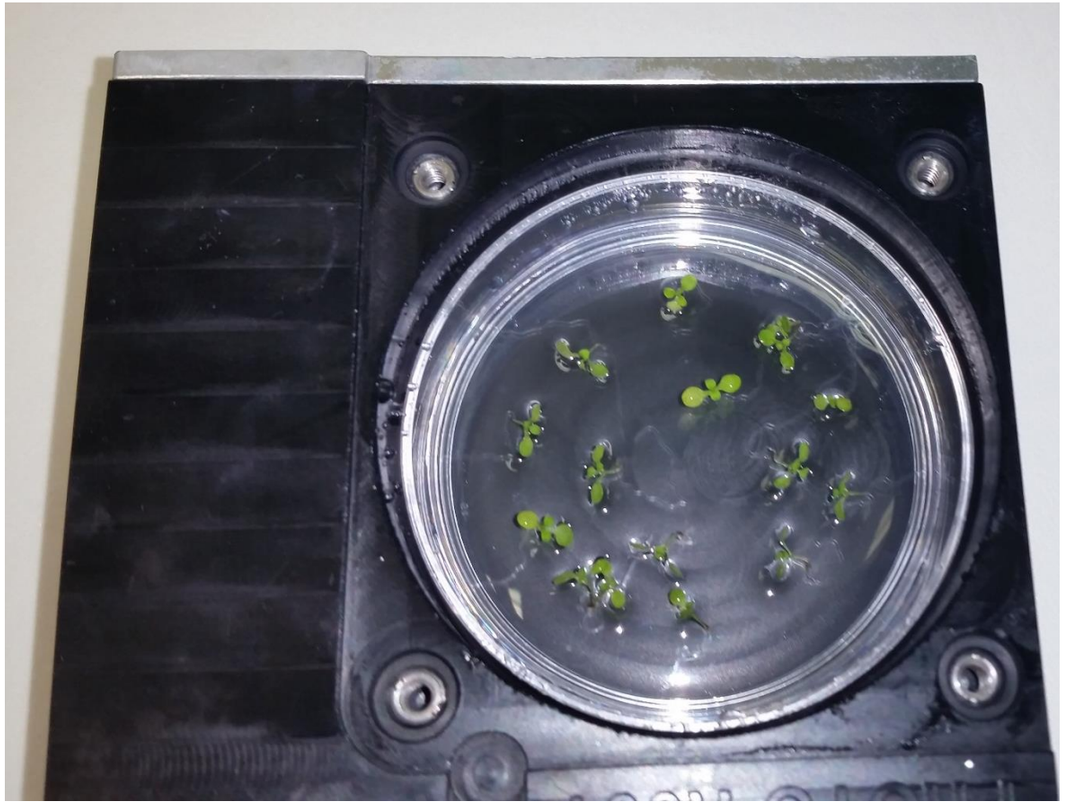
VENCORE

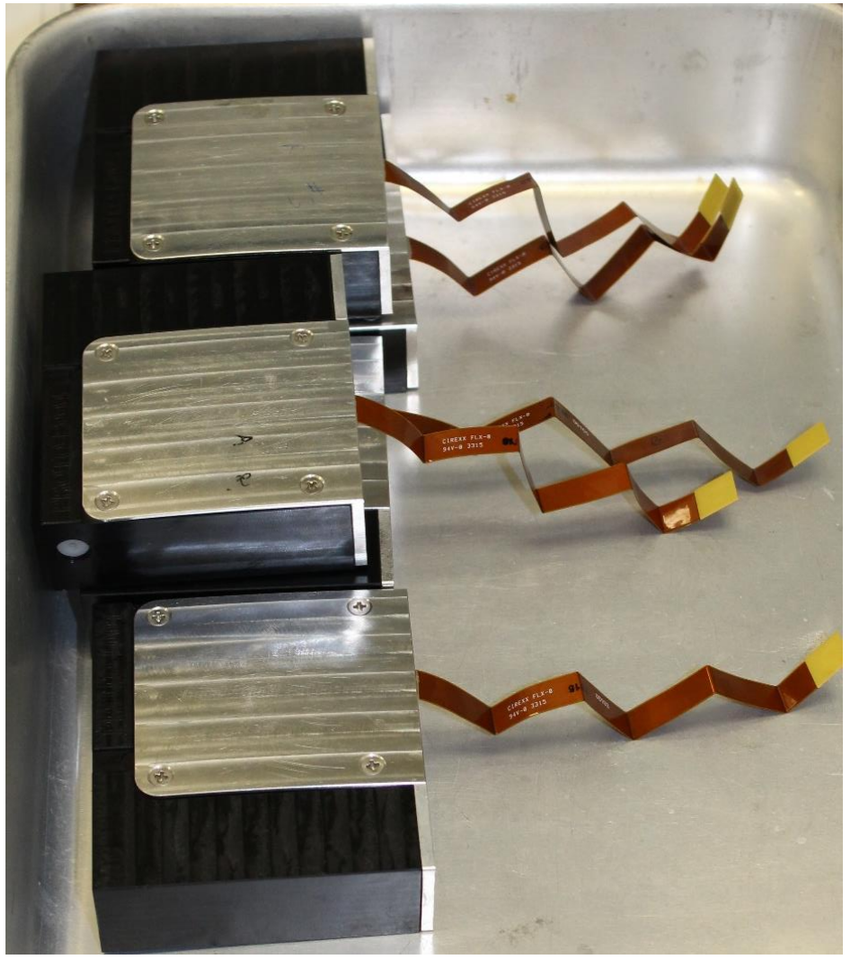
BRIC-LED OBJECTIVE:

Provide discrete illumination to biological specimens contained in 60mm Petri dishes that are subjected to a microgravity environment



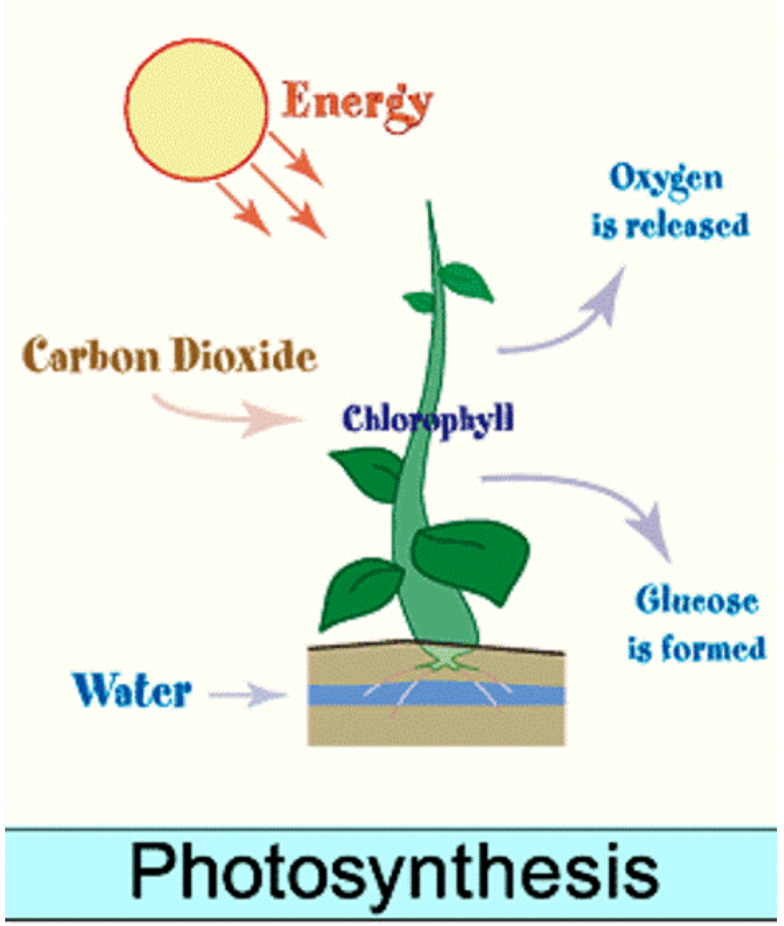
Outline

- **Microgravity Research**
  - Specimen Types
  - Possible Investigations
- **Hardware Overview**
  - Storage Tray & Locker
  - Canister
  - Petri Dish Fixation Units (PDFUs)
- **Operations Overview**
  - Process to Flight
- **Hardware Availability**
  - Hardware testing
  - Space X-12 Flight



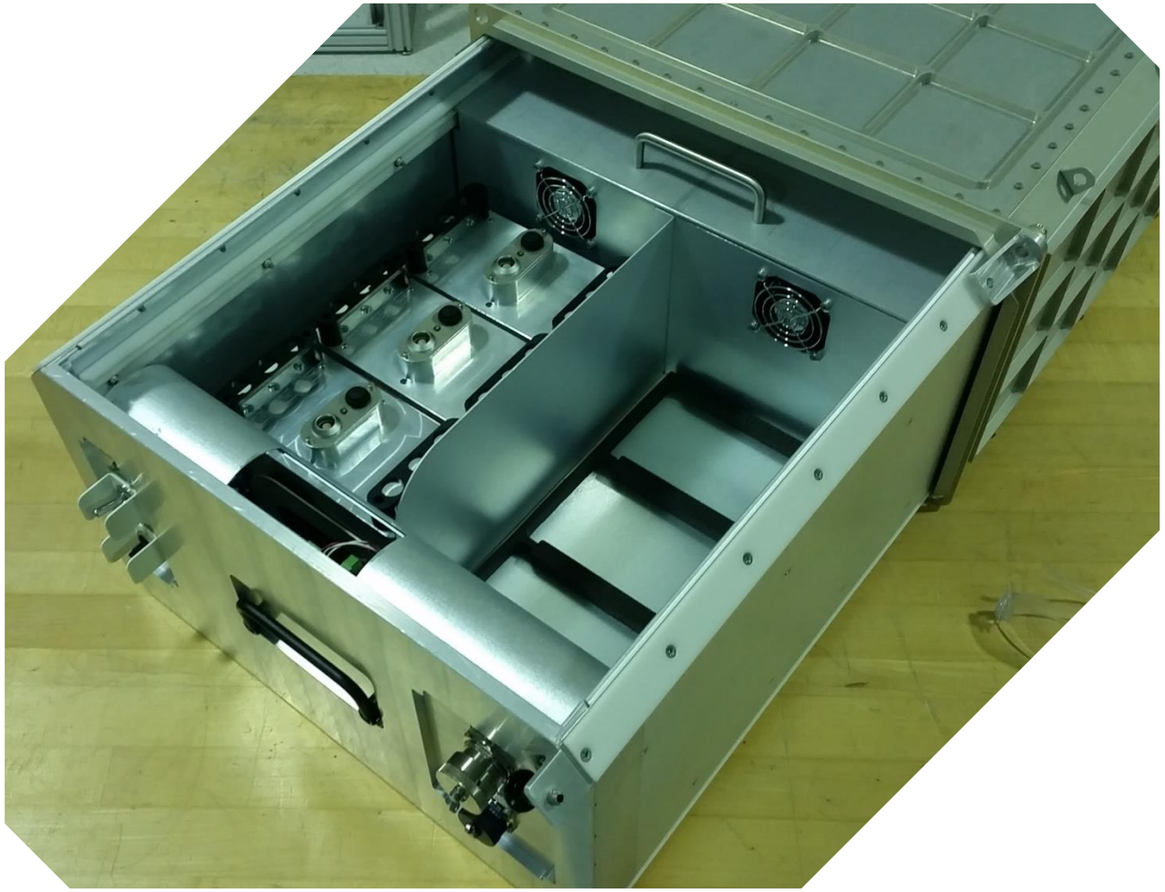
Microgravity Research in BRIC-LED

- **Specimen Types**
  - photoautotrophic organisms
    - plants, algae, cyanobacteria, mosses
  - heterotrophic organisms
    - microbes (bacteria, fungi)
    - invertebrates (C.elegans)
- **Possible Investigations**
  - investigate cellular and metabolic processes
    - photosynthesis, stress responses
  - chloroplast development
  - photochromic effects
  - phototropism
  - photoperiodism
  - various aspects of developmental and transcriptional biology in space
    - photo-morphogenesis



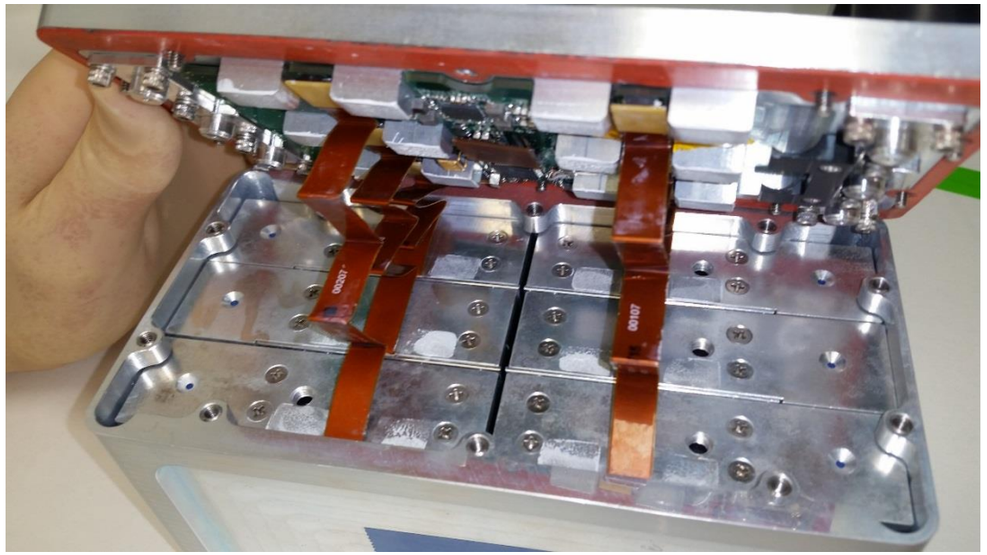
Hardware Overview – Locker & Tray

- **Resides indefinitely in US Lab on ISS**
- **Holds 6 BRIC Canisters**
  - Travel up/down each mission
- **KSC Ground Station controlled**
  - Commanding start/stop of experiment
  - Real time telemetry, includes
    - Tray and Canister temps
    - LED status
- **Forced air cooling to reject heat**
  - 1°C between Canisters
  - 3°C from EXPRESS AAA air



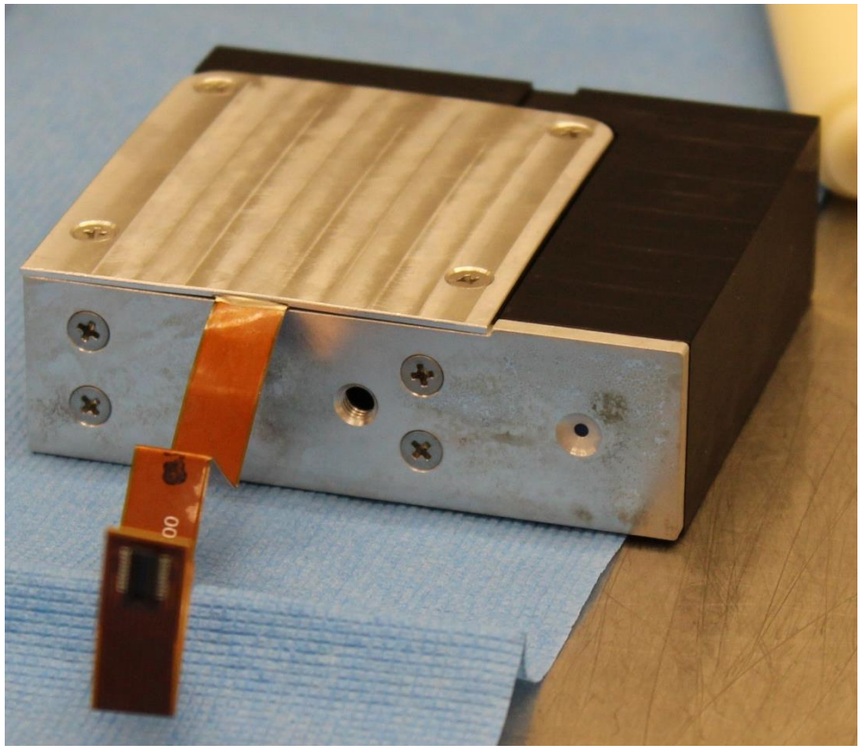
Hardware Overview - Canister

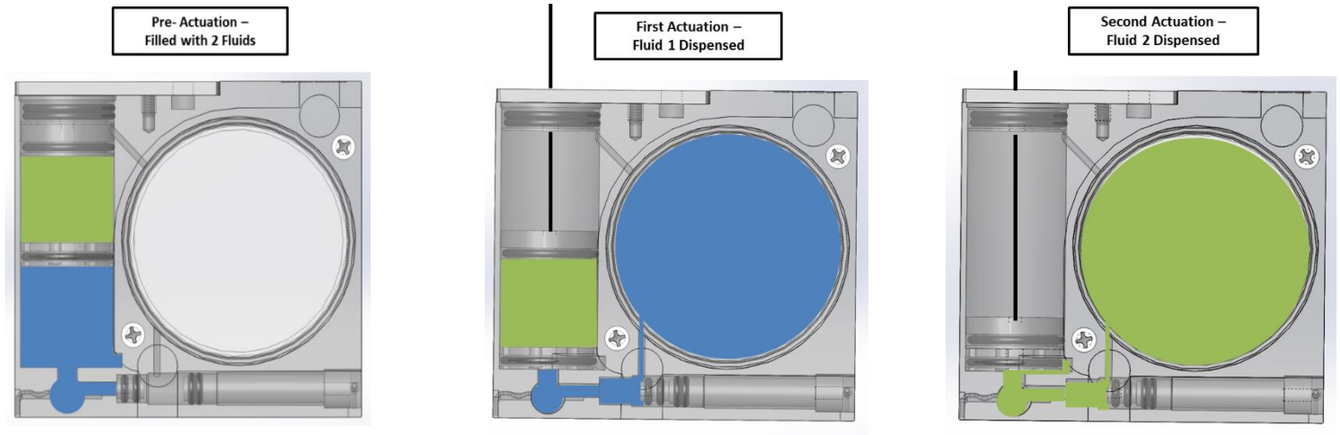
- Holds 6 PDFUs each containing 60mm Petri dishes
- Provides 3 levels of containment for up to Tox2 rated chemicals or BSL-2 biology
- Contingent crew start/stop experiment capable
- ISS Cold Stowage compatible (-100°C)
- Temp data logging of Canister air up to 90 days down to -100°C
- Low crew time required
- Scrub turn around hardware ready for late load insertion



Hardware Overview - Petri Dish Fixation Units

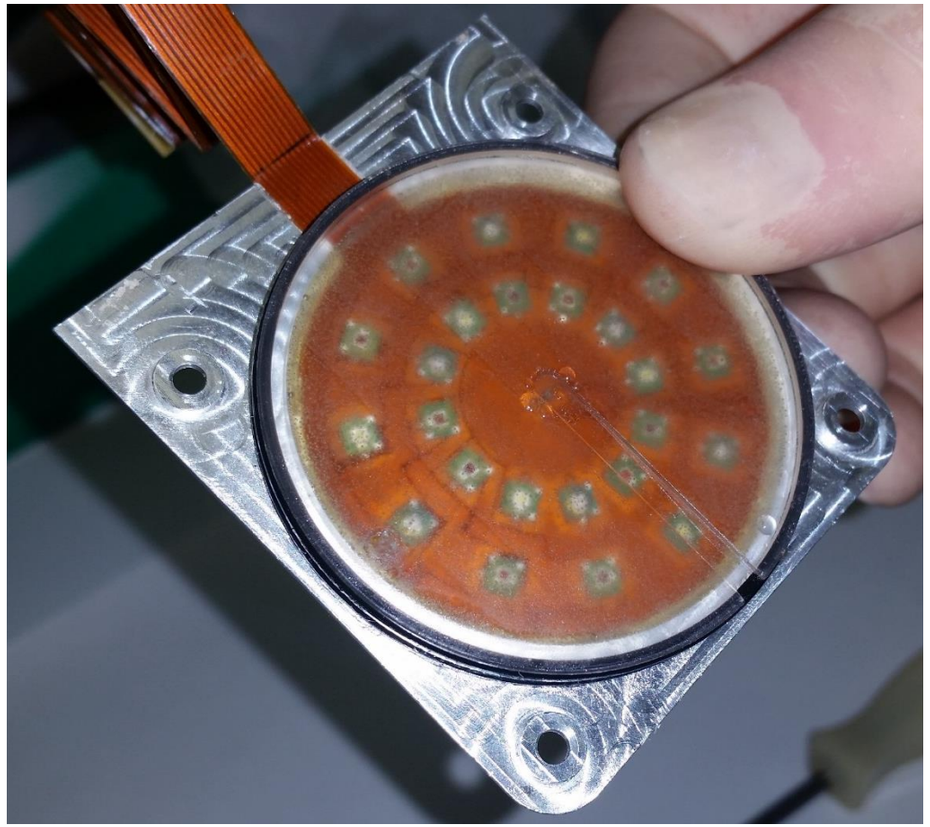
- **Specimen**
  - Up to 36 total 60mm Petri dishes available in one mission
- **Discrete Single or Dual Fluid Injections**
  - 17mL total fluid volume
    - Growth media and/or preservatives/fixatives
    - Compatible with aldehydes, RNA*later*, etc.





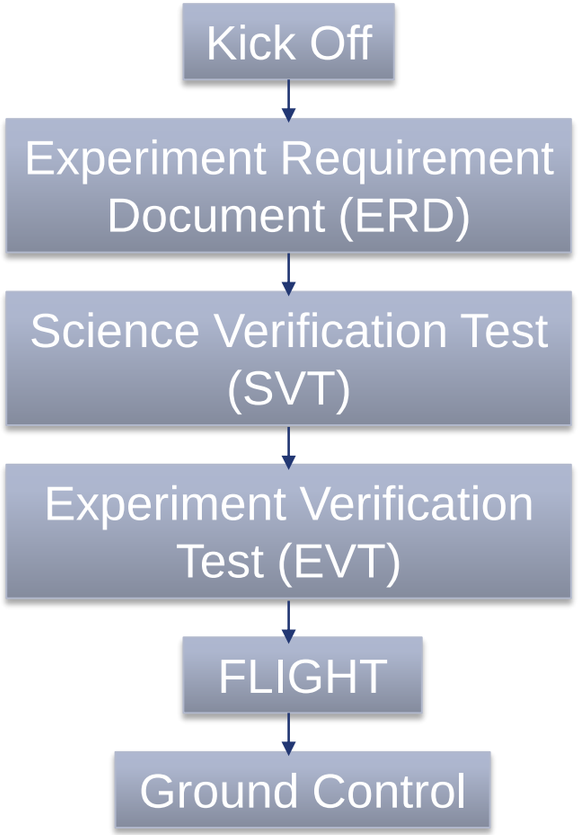
Hardware Overview - Petri Dish Fixation Units

- **Lighting**
  - Up to 55 µmol/m^2/s while maintaining 1°C between Canisters
    - capable of >150 µmol/m^2/s
  - 4 discrete LEDs types
    - currently ranging from 430-750nm (blue, red, white and far-red)
    - customizable wavelengths
  - Programmable lighting schedule with 1 sec (multi wavelength) resolution
  - >70% light uniformity
  - >10% intensity resolution control
  - Light tight from external sources



Operations Overview

- **Post Award, KSC conducts a Kick-Off meeting with the PI**
  - Explain KSC launch campaign process flow
  - Answer PI questions
  - Discuss schedule and target a mission
- **Project Scientist work with PI to identify experiment requirements**
- **Perform hardware and science integrated testing at Kennedy Space Center's Space Station Processing Facility**
  - Ensure successful flight mission!



Hardware Availability

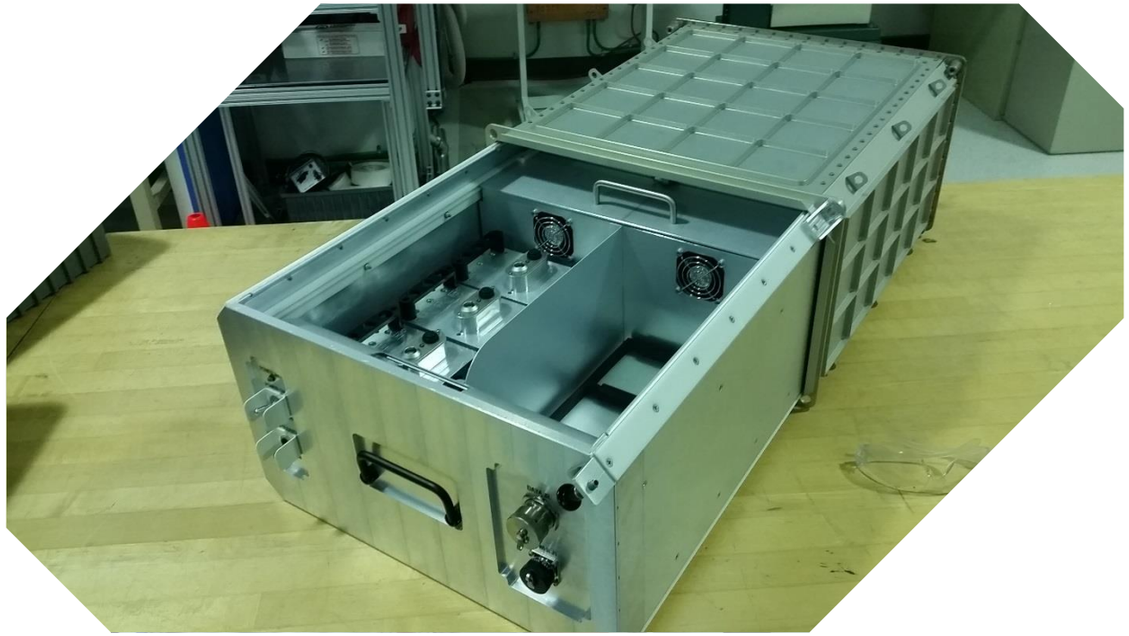
- **Currently in Design Certification Phase**
  - Successful Completed
    - Confidence Growth Test at 55 µmol/m^2/s
    - PDFU Autoclave Testing
    - PDFU and Canister Leak Tests; proving containment
  - Planned Testing
    - Thermal and Lighting Capability Testing

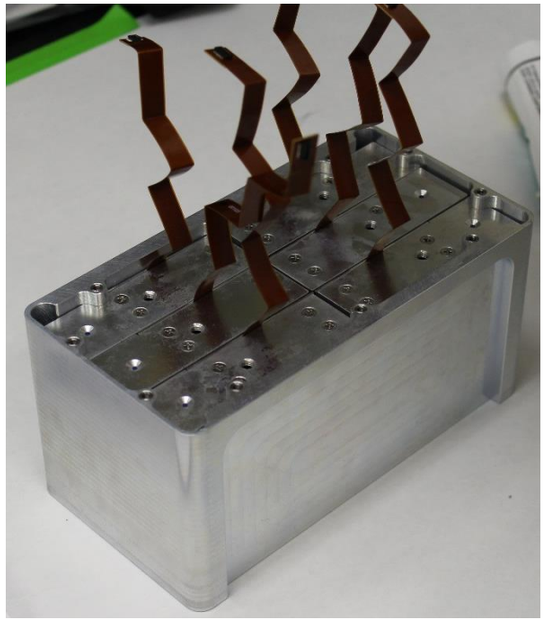
- **Tray is manifested on SpaceX-12, anticipated launch date 5/12/2017**

Come See Us!

Come to Booth ___ to see the BRIC-LED for additional engineering and science related questions.

- **Allison Caron, Payload Hardware Development Lead**
- **Stephanie Richards, Payload Research Scientist**





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