Preparations for RICH II

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and the Detector Support Group
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- Tentative timeline
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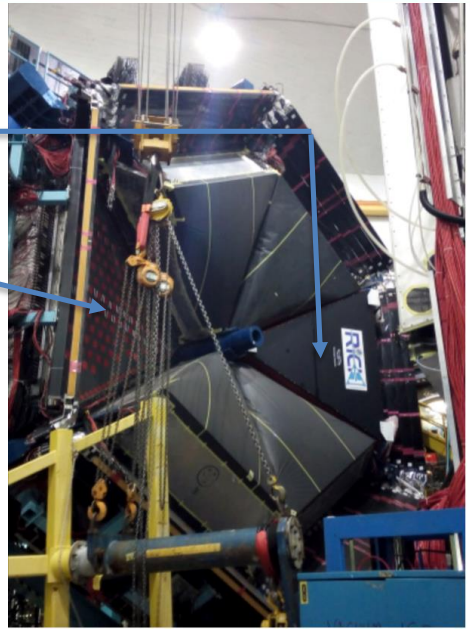
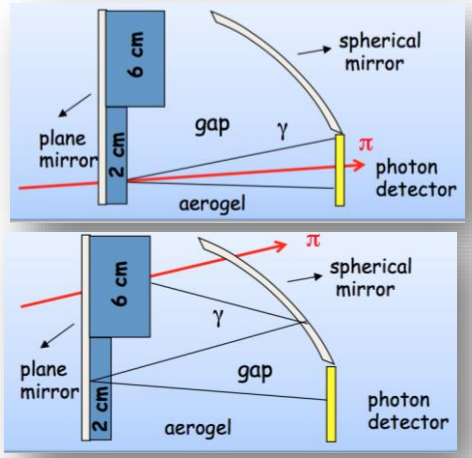
RICH for CLAS12

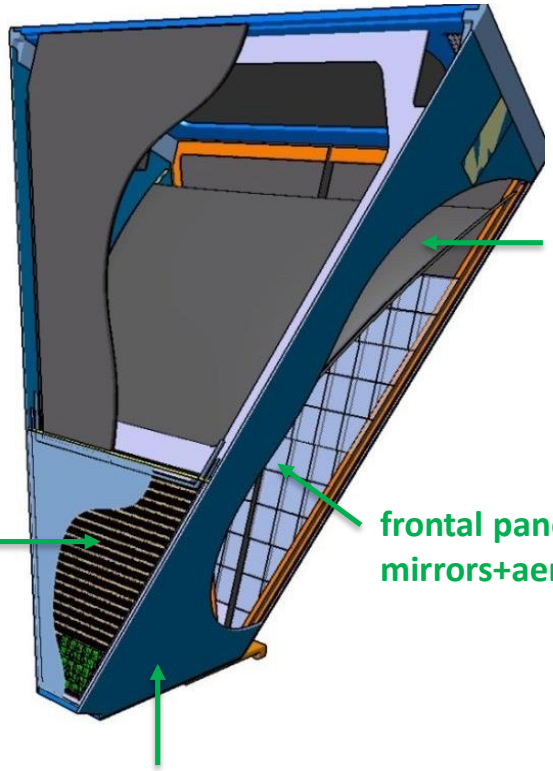
The RICH detector replaces 2 sectors of the LTCC to improve the π-k separation in the momentum range 3-8 GeV/c

- 1st sector installed in January 2018
- 2nd sector installation foreseen by the end of 2021



Hybrid solution: **proximity gap and mirror focusing to reduce the instrumented area**





spherical mirror

frontal panel mirrors+aerogel

readout MAPMT + Front-End Electronics

lateral mirrors

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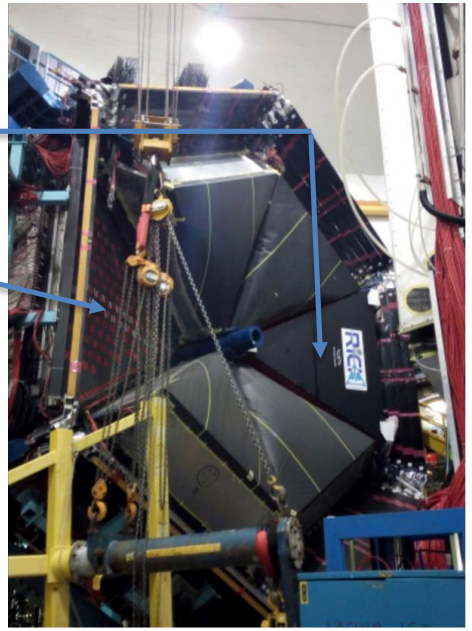

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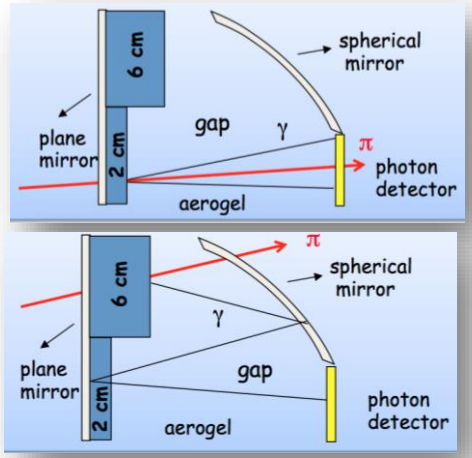
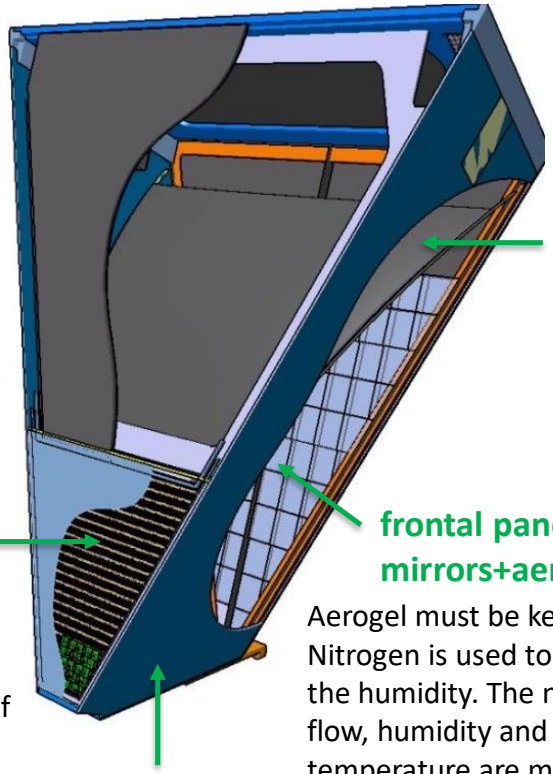




spherical mirror

readout MAPMT + Front-End Electronics

The detector's electronics is air-cooled. Humidity and Temperature inside the electronics panel are monitored. When any of the monitored items goes out of the set limits, the high voltage and low voltage systems are turned off.

frontal panel mirrors+aerogel

Aerogel must be kept dry. Nitrogen is used to control the humidity. The nitrogen flow, humidity and temperature are monitored.

lateral mirrors

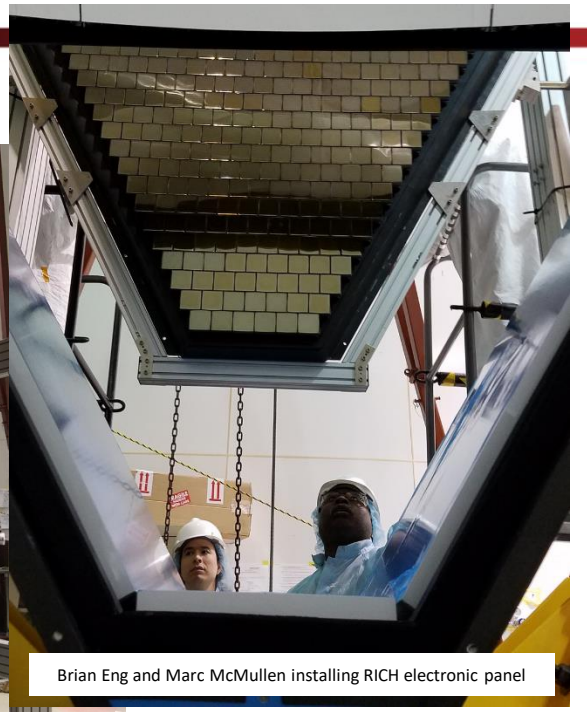
DSG involved in many tasks:

- Tests of spherical mirrors
- Develop temperature interlocks
- Develop EPICS Monitoring systems
- Tests of electronics
- Installation

RICH Sector 4 Assembly Photos

Mindy Leffel and Pablo Campero constructing RICH's assembly structure

DSG and INFN Collaborators in front of assembled RICH I



Brian Eng and Marc McMullen installing RICH electronic panel

Tyler Lemon performing acceptance tests on spherical mirrors

Tentative Timeline

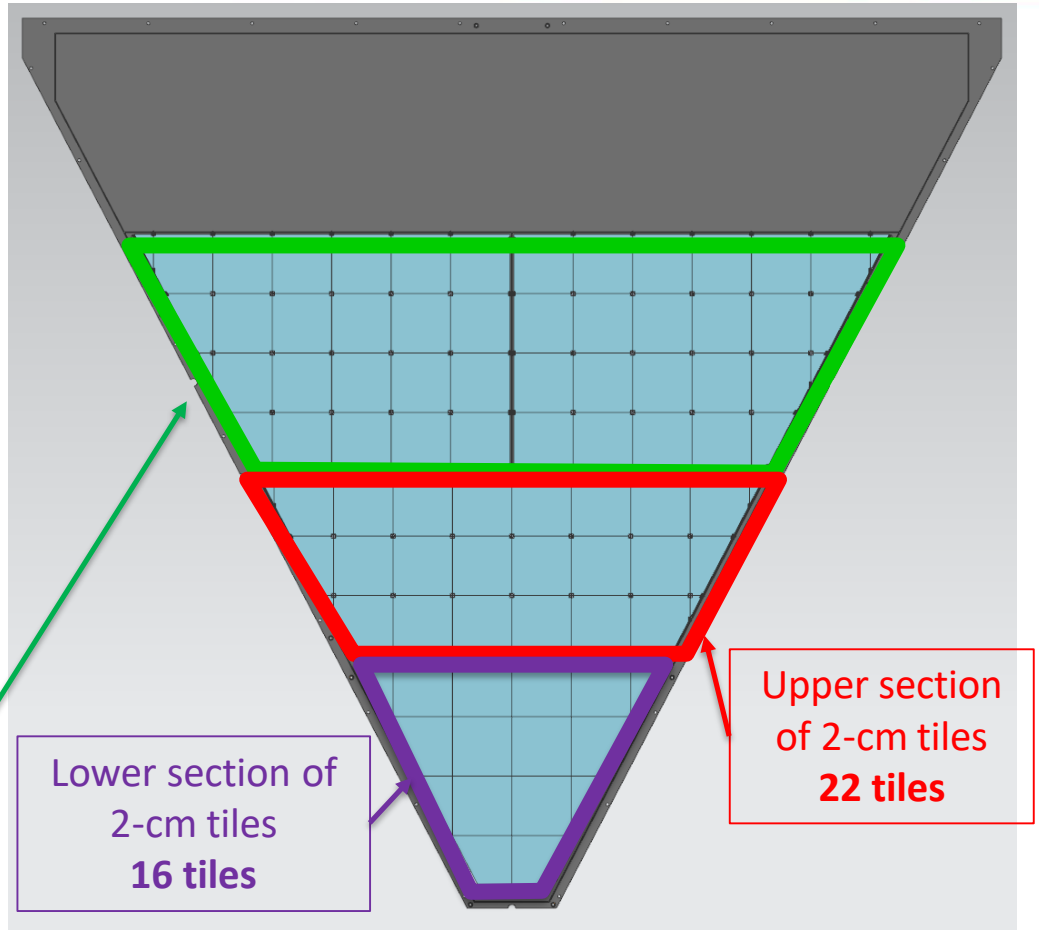
- Timeline discussed in meeting on November 23, 2020
  - DSG Meeting Minutes

Milestone	Tentative Time
Planar mirrors shipped from Italy	February 2021
Detector shell shipped from Italy	Early 2021
Next aerogel shipment arrives at JLab	Early 2021
Detector shell received at JLab	Spring 2021
Spherical mirrors received at JLab	Spring 2021
Start assembly	May 2021
Spherical mirror support received at JLab	Summer 2021
Installation in Hall B	Fall 2021

- Upon shipments' reception, adequate space will be needed to temporarily store two large crates
  - Size of crates to be determined
  - Crates contain:
    - Detector shell
    - Front panels
    - Electronics panel
    - Assembly hardware

RICH Aerogel – Front Panel

- Silica-based aerogel tiles
  - Must be kept in sub-5% RH environment to prevent tiles from absorbing moisture
    - Moisture absorption lowers tiles' effectiveness as a Cherenkov radiator



Double 3-cm layer of tiles
48 tiles per layer
96 total 3-cm tiles

Lower section of 2-cm tiles
16 tiles

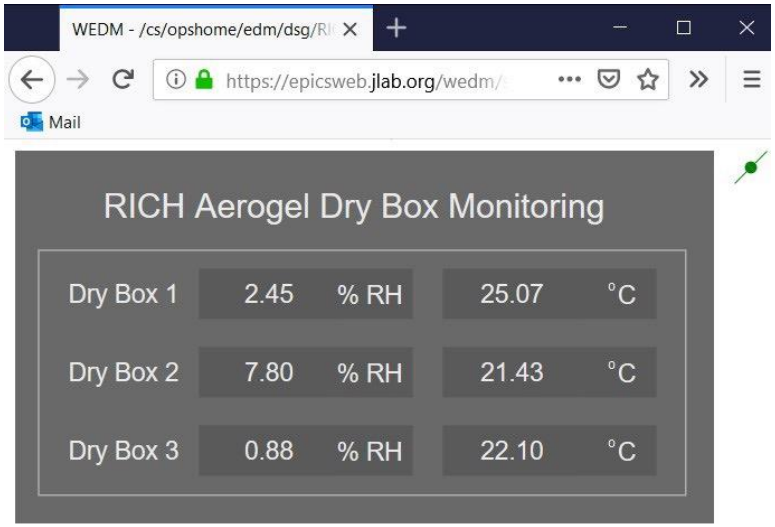
Upper section of 2-cm tiles
22 tiles

DISREGARDING ANY DIFFERENT TILE GEOMETRIES:
96 total 3-cm tiles + 38 total 2-cm tiles
= 134 total tiles

Aerogel for RICH

- To ensure that the tiles are always in a humidity environment less than 5% RH, they are stored in dry boxes
- Located in the EEL, the boxes use a desiccant to maintain the selected humidity level, in the range of 1–50% RH.
- An EPICS client has been added to the cRIO monitoring the environment in the three dry boxes and two GUIs have been developed, one CSS and one WEDM, both of which enable remote monitoring of the dry boxes.

WEDM dry box monitoring screen.



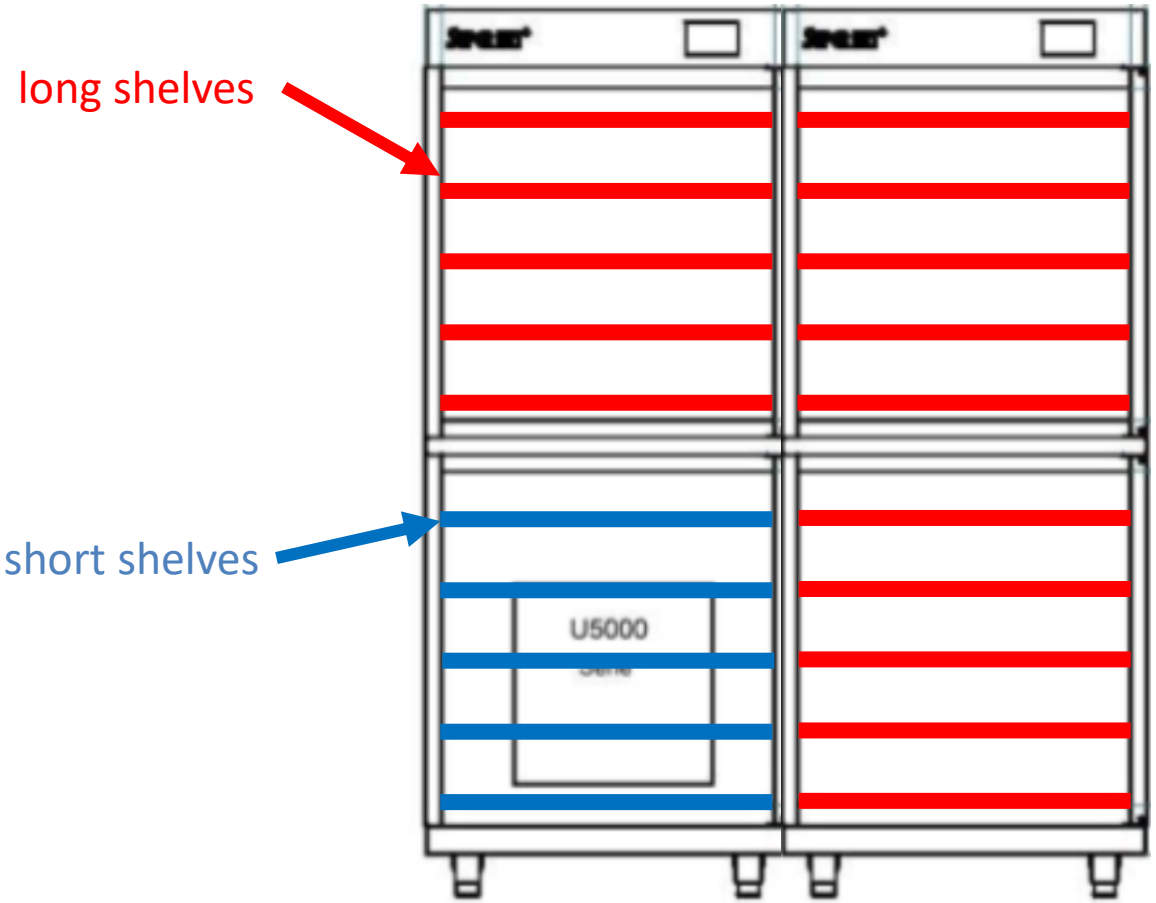
Super Dry MSD Series Dry Cabinet

- One main unit plus one expansion unit
  - 2400 L total
  - Main unit's dryer unit can dry up to three additional expansion units
- 0.5% RH level capability
- 120 V power
- Eight shelves are standard
  - Two "short" shelves in lower section of main unit
    - Shelves are shorter because drying unit extends into storage space
    - Shelf dimensions: 735 mm x 580 mm
  - Six "long" shelves in upper section of main unit and in entirety of expansion unit
    - Shelf dimensions: 735 mm x 740 mm

Sales photo of main unit (left) and expansion unit (right). In normal operation, both units are fastened together to create one, sealed volume

Super Dry MSD Series Dry Cabinet

Shelves Needed



Sketch showing main unit, expansion unit, and all shelves

- Propose buying 20 shelves
  - Five short shelves
    - Store six tiles each
  - 15 long shelves
    - Store nine tiles each
- **Total storage capability: 165 tiles**
  - ~10 cm between shelves is more than adequate for 3-cm tiles

Super Dry MSD Series Dry Cabinet
Additional Features

- Standard through-hole penetrations
  - Allows connection of Honeywell **humidity** sensors and Omega RTDs (Resistance **Temperature** Detector) to cRIO
- All shelves are retractable
- Optional nitrogen connection
  - Connections for two flow modes
    - Continuous purge
    - Temporary make-up purge
      - For quickly decreasing humidity

Optional nitrogen connection

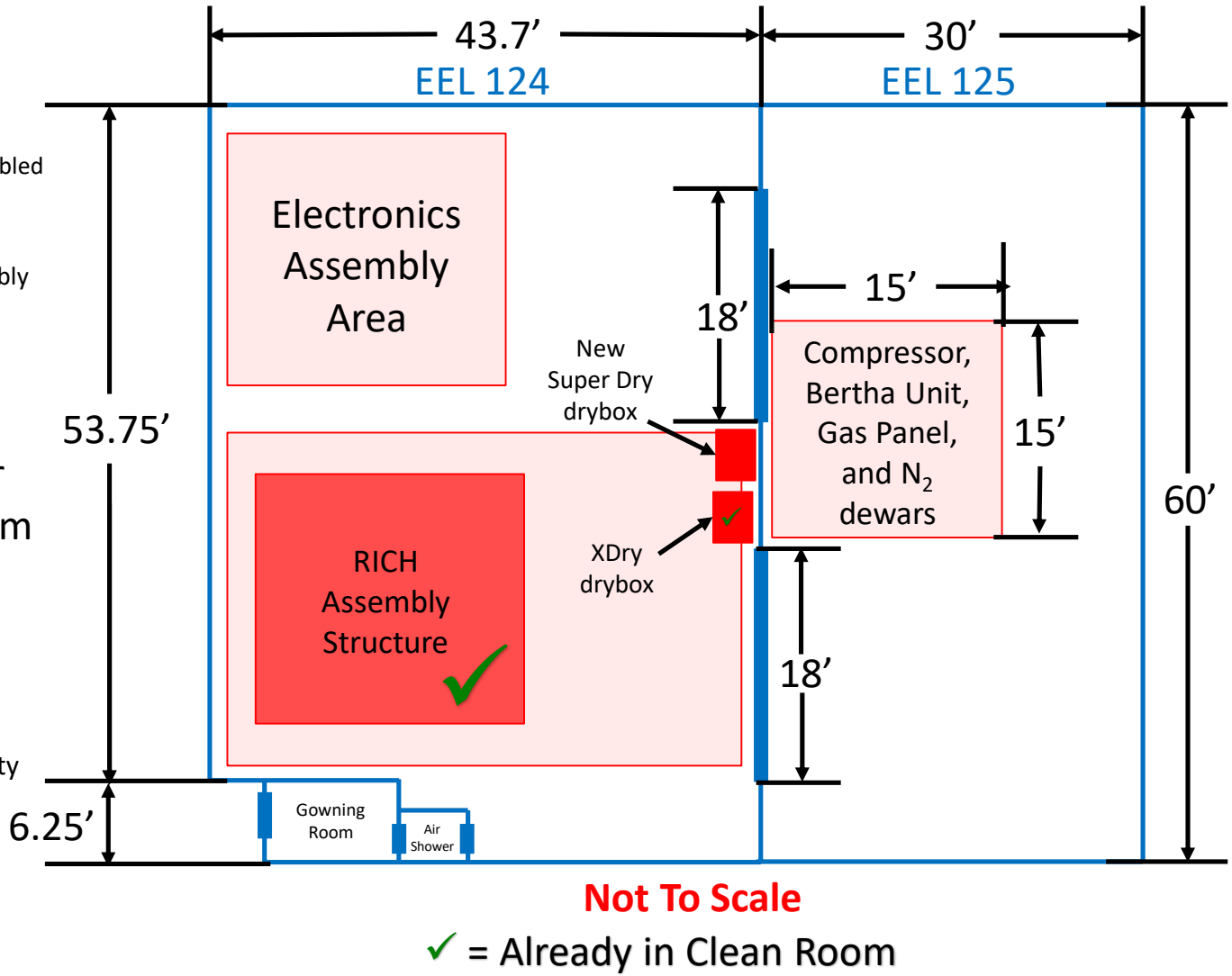
Plan to Protect Aerogel During Power Outages

- Planned power outages
  - Set up dry cabinet with rotameters in continuous purge mode
- Unplanned power outages
  - Use dry cabinet in supplementary make-up purge mode
    - Internal components of nitrogen connection are normally open, allowing flow when there is no power
- One standard gas bottle would last ~2.5 days if flow is set to one volume exchange per day
  - ~7000 L (255 cubic feet) per bottle
  - Goal of one volume exchange per day

Volume Exchanges per Day	Approximate Flow Rate (slm)	Flow Duration (days)
0.5	~1	~4.5
1	~2	~2.4
2	~4	~1.2

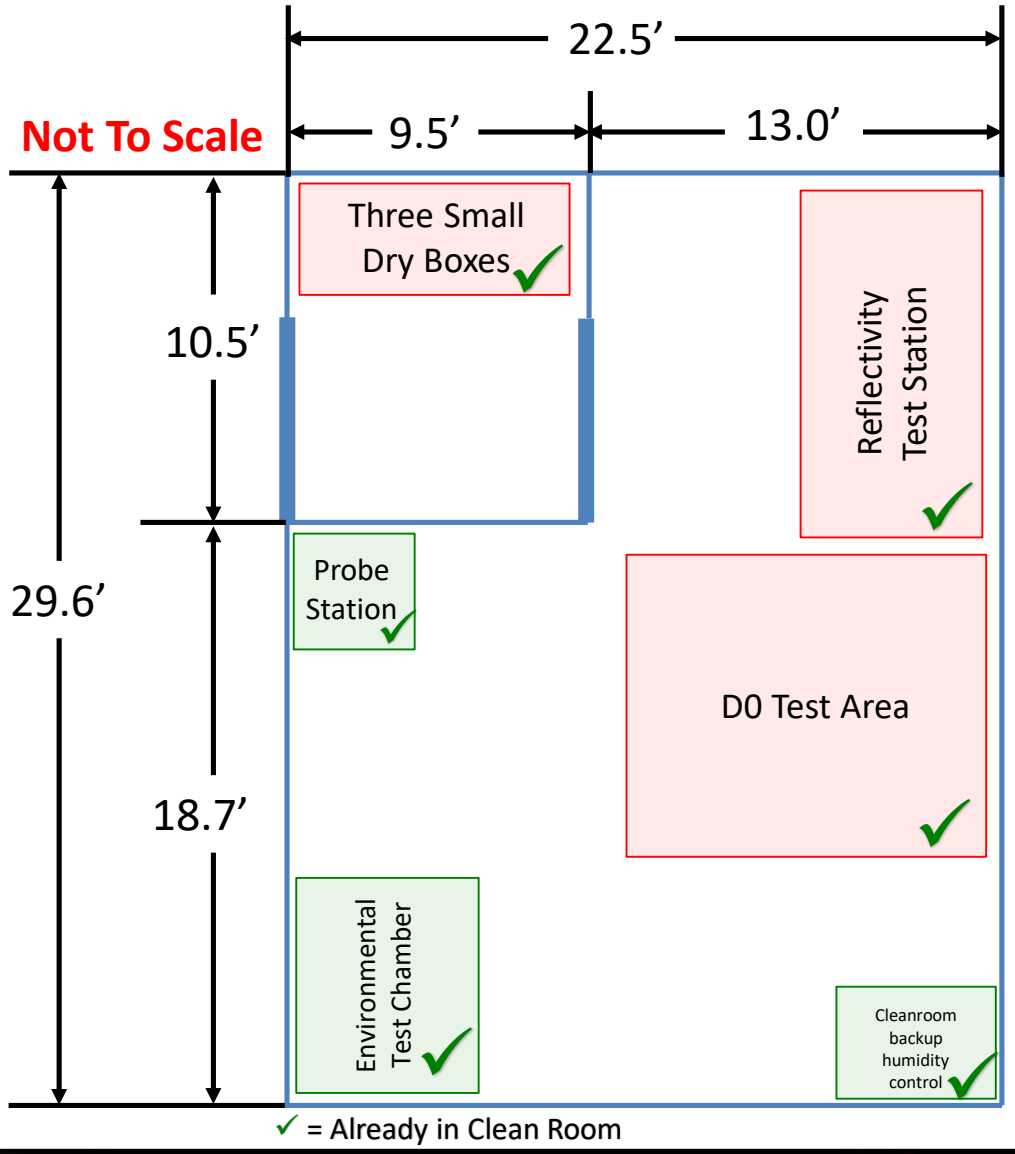
Space Requirements

- EEL 124 Clean Room
  - Main assembly area with structure
    - Structure already assembled in room
  - Electronics assembly area
    - Electronic panel assembly support
    - Electronics rack
  - New Super Dry cabinet
- EEL 125 Semi-Clean (or "Shower Curtain") Room
  - Air-cooling compressor
  - Bertha unit for powering compressor
  - Gas panel with air tank
  - Nitrogen dewars for humidity control



Space Requirements

- EEL 121 small cleanroom
  - Mirror storage
  - Reflectivity test area
    - Test table
    - Additional table for PCs
  - D0 test area
    - 2 m long, unobstructed stretch with optical tables at both ends



Conclusion

- The installation of the 2nd RICH module in CLAS12 is foreseen by the end of 2021
- RICH II needs to store 134 aerogel tiles in low humidity environment before installation into detector
- A Super Dry MSD Series dry cabinet with one main unit, one expansion unit, and 20 shelves will allow storage of 165 tiles
  - Contingency plan for aerogel during power outage will use dry cabinet's nitrogen rotameters
- Tentative timeline and space requirements determined for assembly