



SBS Electromagnetic Calorimeter (ECAL) Development--UPDATE

by

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ECAL Collaboration

NCCU · · JMU · · SBU · · YerPhi · · ANL · · JLab

SuperBigBite Collaboration Meeting

Jefferson Laboratory

July 14, 2017

Organization of Presentation

- **Design Overview**
- **Lead Glass and Light Guides**
- **Super Modules**
- **Concept for Continuous Heating of Pb Glass**
- **Cooling Concept for PMTs**
- **Status Updates--Design, Procurement, Lead Glass-Light Guides assembly, Other Activities**

Design Overview

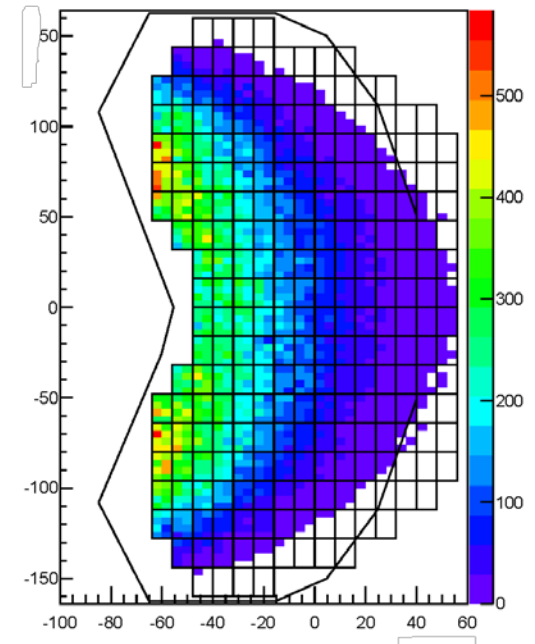
C-Shaped phase space for kinematics of elastically scattered electron from $p(\vec{e}, e'\vec{p})$.

Lead (Pb) glass absorber material attached to light guide in electromagnetic calorimeter.



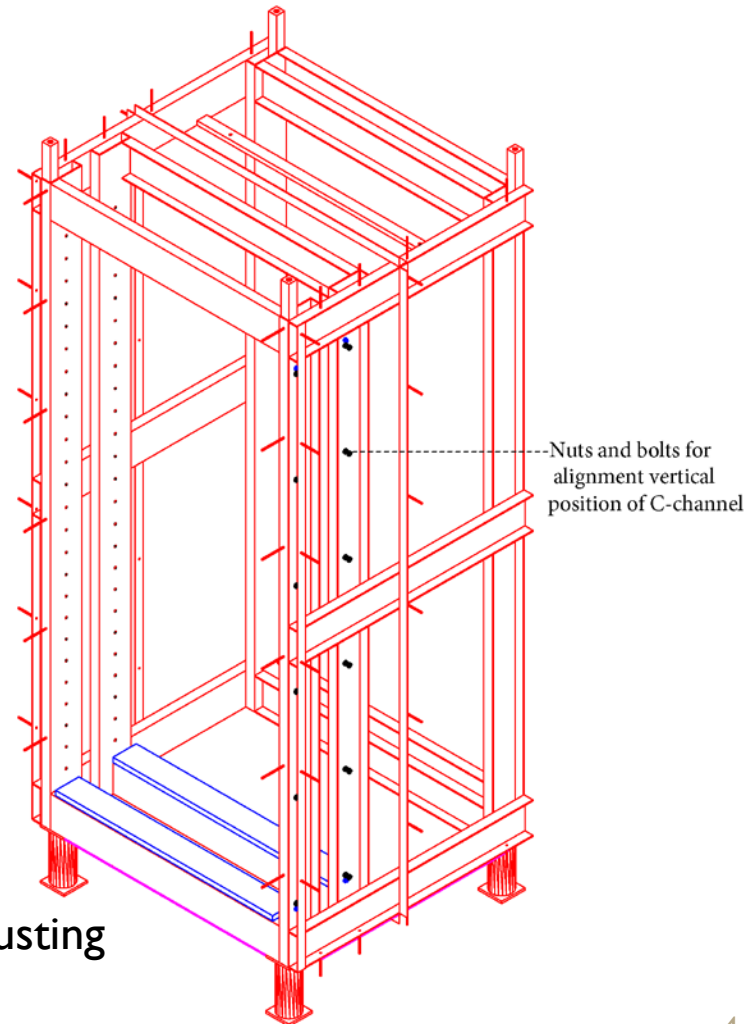
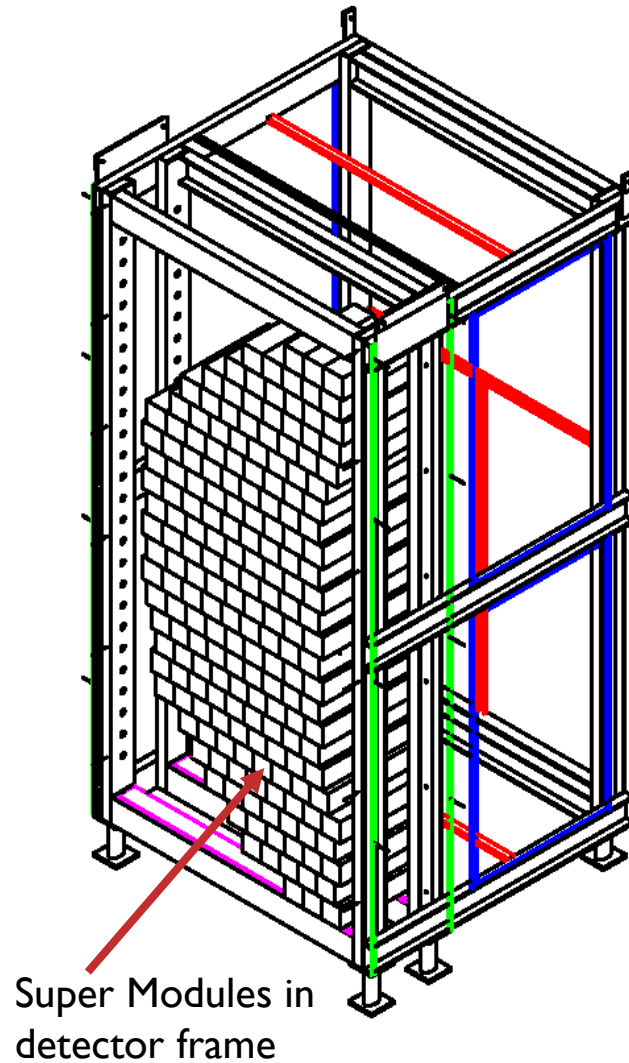
Nine Pb-glass/light guide modules comprise one ***Super Module***.

Proposed solution for radiation damage in the lead glass
-- ***in situ, continuous thermal annealing*** --



Design Overview con't

Detector frame assembly (Mechanical designer @ YerPhi)

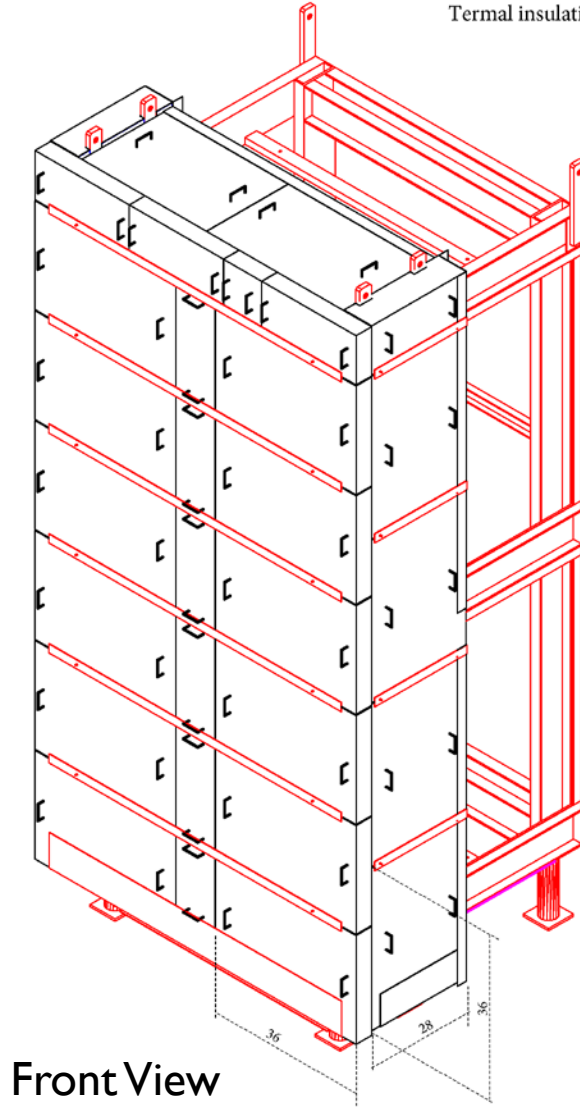


Detector frame assembly includes C-channel for adjusting position of Super Models

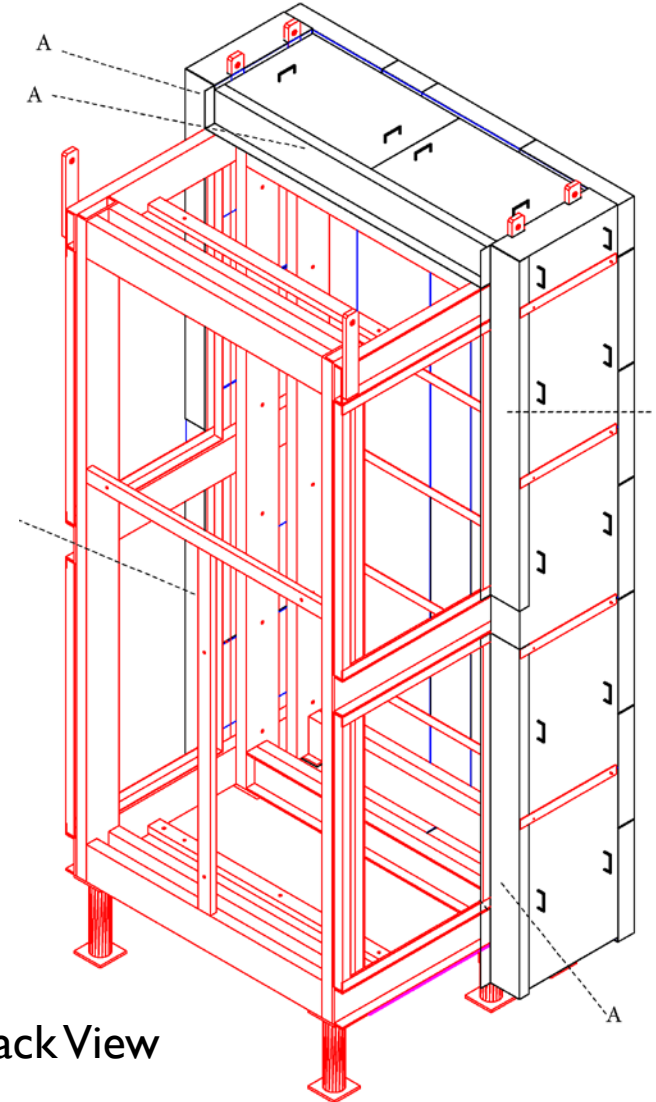
Design Overview con't

Thermal insulation

Thermal insulation with Foam Glass blocks



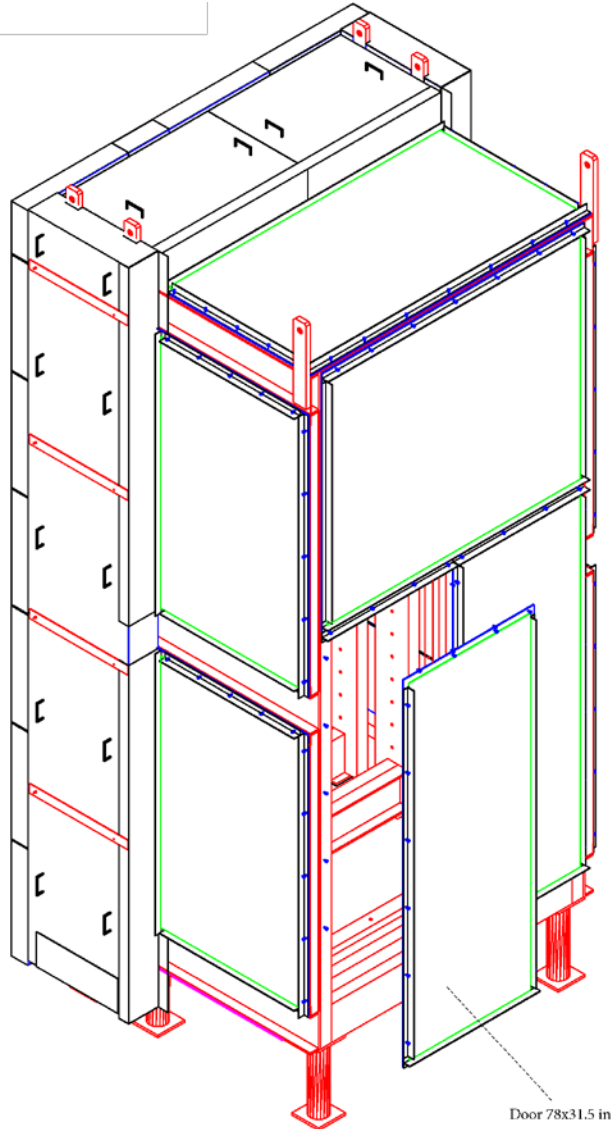
Front View



Back View

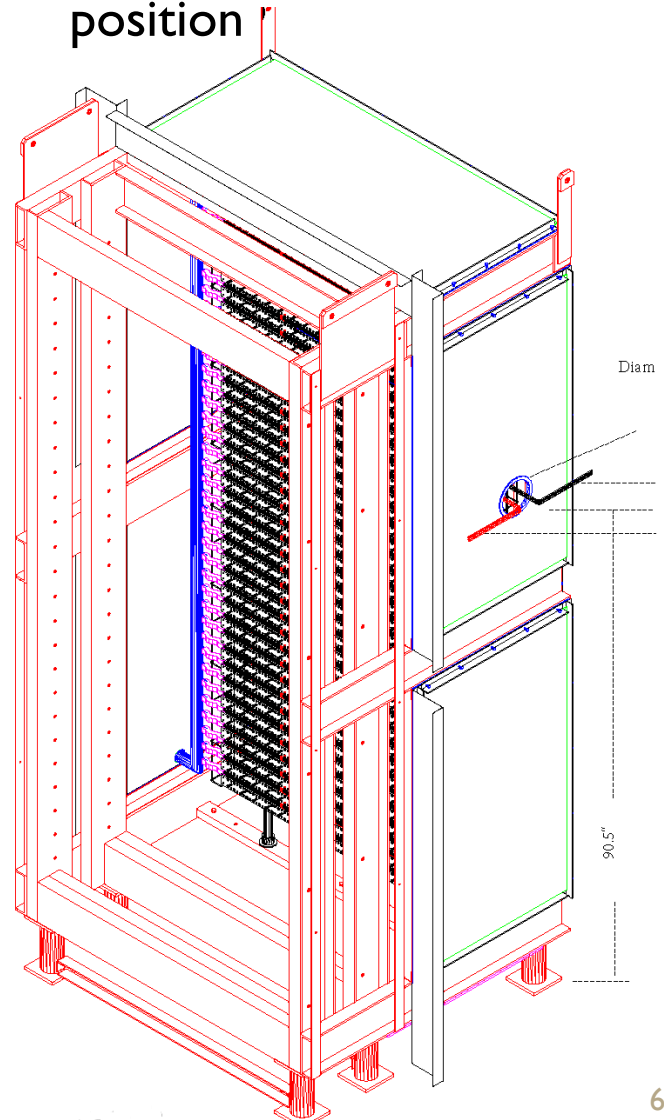
Design Overview con't

Frame Enclosure



Back View

Cabling and Patch Panel position



Front View

Lead Glass and Light Guides



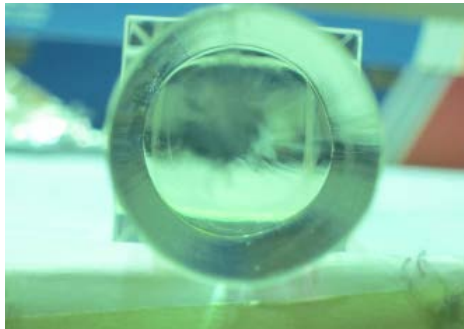
Problems:

Cracked Light Guides (BS33);
Detachment damage to Lead glass.

Solution:

New Light Guide Material (**BK7**)
Vendor: Jinan Bomix Glass Science
And Technology Co., China

Improvements



BS33 Glass



BK7 Glass

** Initially tested 50 BK7
light guides glued to Pb-glass

→ **No Cracks** after 5 cycles

** **BK7** → Nearly **twice light** collection of BS33

Lead Glass and Light Guides, con't



Joseph LaRoche, St. Mary's Univ

- Gluing of the light guides.
- Alignment & Centering Fixture.
- Curing in oven.
- Light transmission testing.
- Aluminum wrapping.
- 380 units complete.

Students:

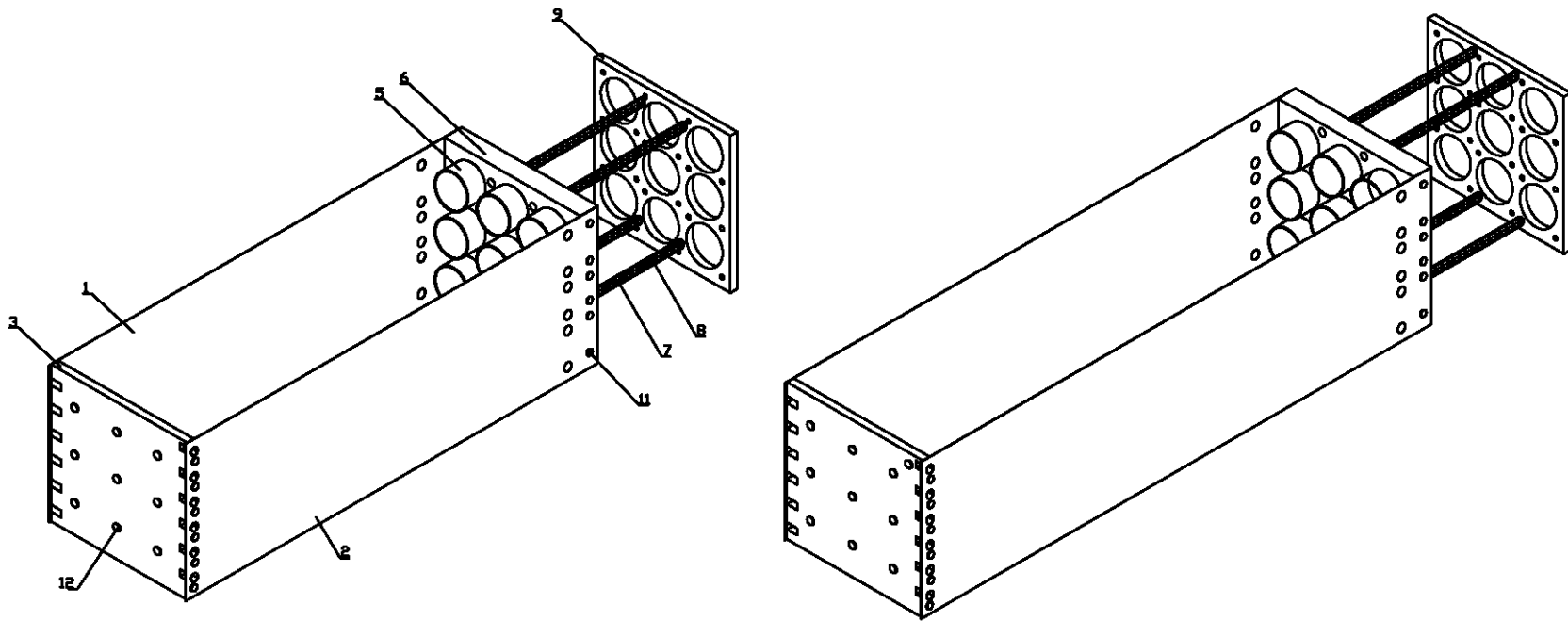
Joseph LaRoche, St. Mary's Univ.

Andrew Mayer, Christopher Newport Univ.

Super Module

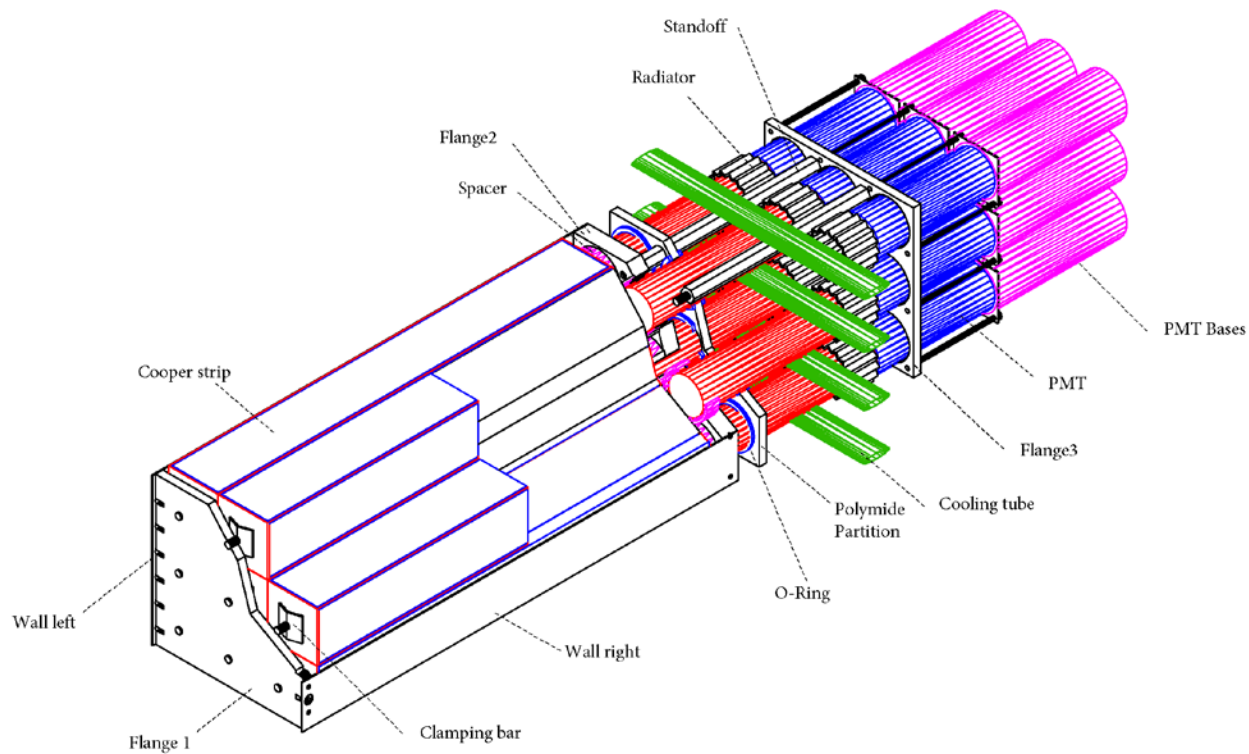
There are four types of super module (SM) assemblies, designated as SM1, SM2, SM3, and SM4.

The main rectangular enclosure to be manufactured will consist of **Titanium** material—wall thickness, 0.032 inches. Super modules SM1 (short) and SM2 (long) are paired, with length of one titanium enclosure longer than the other. Similarly, super modules SM3 (short) and SM4 (long) are paired.

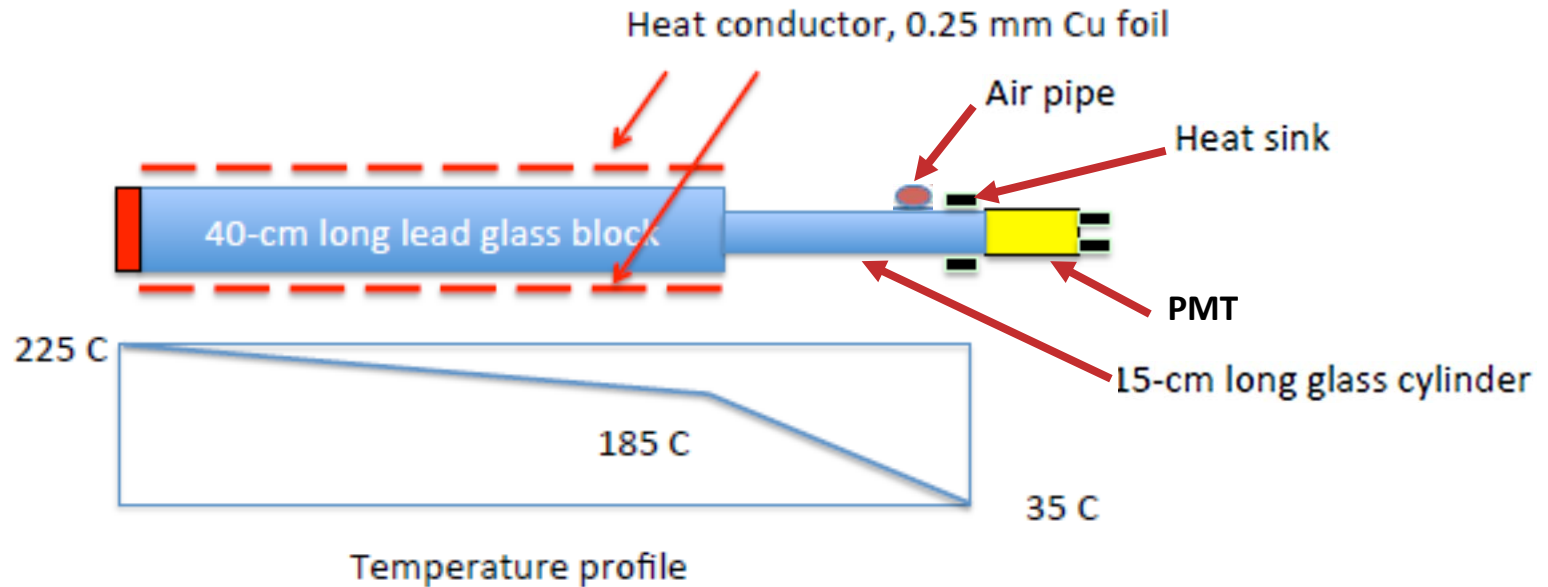


Super Module

Each super module is designed to contain 9 lead glass scintillators and support attachment of 9 boron silicate glass light guides connected to 9 photomultiplier tube bases.

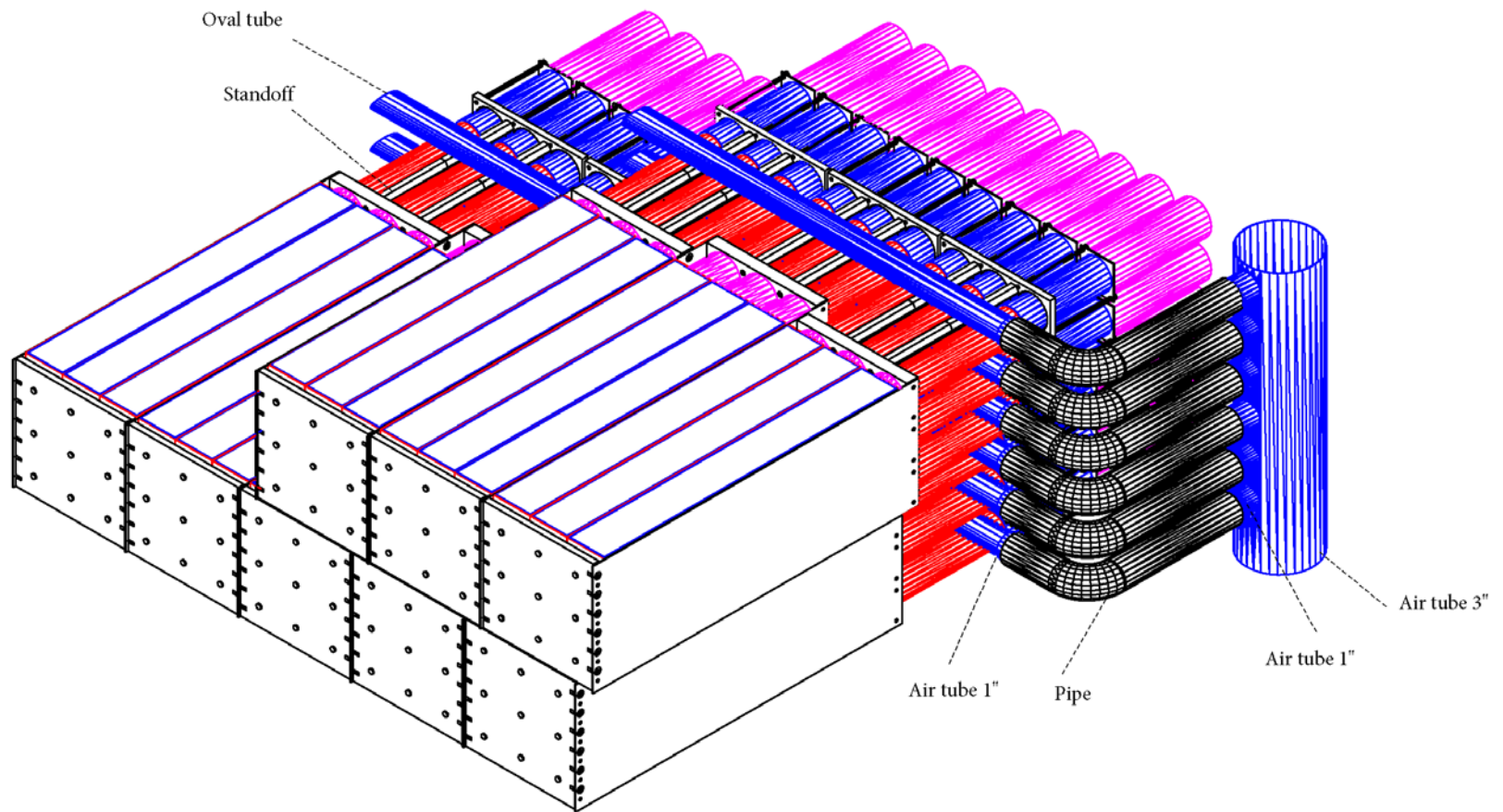


Concept for Continuous Heating of Pb Glass



- Underway: Thermal Analysis & Simulation of Cu strip heating and air jet cooling with COMSOL software (Riordan-ANL).

Concept for Cooling PMTs



- ❑ Underway: Thermal Analysis & Simulation with COMSOL software (Riordan-ANL).
- ❑ Planned: Empirical measurement and testing using C200 set-up (SBU/ANL).

Status Updates

Mechanical Design (YerPhi; JLab; ANL/SBU)	Super Model enclosure design (COMPLETE) Detector Frame design (≈ COMPLETE) Thermal Insulations and Frame Enclosure design (≈ COMPLETE) Heating & Cooling Design (In PROGRESS) Cabling and Patch Panel (≈ COMPLETE) Simulation and Testing of Heating and Cooling (In PROGRESS)
Material Procurement (NCCU)	Light Guides: 1000 pcs Received at JLab; 500 on order. High Temperature Glue: Received . Titanium Sheets: Being Shipped to JLab week of 07/10/17. Foam Glass: Ordered . Super Modules: Bid Request Posted @ State of NC.
Pb-Glass & Light Guides (JLab +)	Inventory and Cleaning of Pb-Glass ~ 1200 (Continuing) Pb-Glass/Light Guide Assembly & Test (Continuing)
Other Activities (NCCU)	YerPhi Visiting Scientist (November 2017)