SBS Electromagnetic Calorimeter (ECAL) Development--UPDATE

by
Caesar R. Jackson (NCCU)

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 election from $p(\vec{e}, e', p)$.

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 --
Detector frame assembly (Mechanical designer @ YerPhi)

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

Super Modules in detector frame

Nuts and bolts for alignment vertical position of C-channel
Thermal insulation with Foam Glass blocks

Front View

Back View
Design Overview con’t

Frame Enclosure

Cabling and Patch Panel position

Back View

Front View

Door 78x31.5 in
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

** 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

- 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.
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) |