# **ECal Updates**

Jixie Zhang

#### SoLID Collaboration Meeting

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# Outline

- 1. Update on Ecal R&D
- 2. Update on FTBF beam test result
- 3. Update on Jlab beam test preparation
- 4. To-do list



### Diameter of the Supporting Rod of Ecal Module

The rods in the existing modules are about 3-mm diameter.

To avoid sagging of modules, Paul requested the use of 6-mm diameter (minimum) or 8-mm diamater (preferred) stainless steel rods, 6 rods per module.

This causes 3% inactive material by volume.



Simulation done by Ye Tian shows that the 8-mm diameter rods will have noticeable effect on the Ecal performance. 6-mm diameter is acceptable.

# Ecal R&D Updates (1)

#### SDU is studying the radiation effect of fibers

Irradiation test at Institute of Modern Physics, Lanzhou, China



Total Neutron Fluence [1/cm<sup>2</sup>]



	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Total Irradiatio (MeV/cm <sup>2</sup> ) By simulation(uncertainty 10%)	8.6E+11	1.4E+12	2.8E+12	3.7E+13	1.1E+14 (Not tested)
Test material	clear fiber	clear fiber BCF91A-MC scintillator	clear fiber BCF91A-MC scintillator	clear fiber BCF91A-MC scintillator	BCF91A-MC scintillator

•For all tested fibers and scintillators:

Didn't see any difference in appearance and mechanical

properties

Same color/elasticity after irradiation

# Ecal R&D Updates (2)

SDU continues testing the fiber end reflector and fiber connector and so on



TiO<sub>2</sub> glue



The new connector for 100 Fibers together. Not tested yet 1 connector for each tower Made by CNC or 3D printer

Component	Material choice	
Scintillator	Kedi HND-S2 (China)	
Reflective layer	Powder painting	
WLS Fiber	BCF91A-MC/Kuraray Y11-MC?	
Fiber end mirror	TiO2 glue	
Fiber connector	Chunhui connector?	
Coating	TiO2 glue	

#### FTBF Result: Energy Resolution



#### Energy resolution for run 1066 (10 GeV)

Original : 0.096, New Gain: 0.091 (-6%), Preshower\_Nonlinear: 0.088 (-3%), Position Dependence: 0.064 (-27%) Original : 0.096, New Gain: 0.091 (-6%), Preshower\_Linear: 0.084 (-7%), Position Dependence: 0.058 (-31%) ~10% improvement in energy resolution by gain and preshower correction ~30% additional improvement from position dependence correction

#### **FTBF Result: Position Resolution**



After including the beam spread into the Geant4 simulation, we got the position RMS as:

dX = 0.67 dY = 0.56

### JLab Beam Test

Main goals:

- Test Ecal and SPD under conditions close to the high-rate and high-radiation environment expected for SoLID.
- Test GEMs with VMM readout and the DAQ system in the high-rate and high-radiation environment.
- Need to make sure ECal at high rate can distinguish pion MIP from background, and electrons from pions.
- Are there serious pileup problems?
- The test includes 2 parts:
  - low rate test at large angle in June-Sep 2022;
  - high rate test at small angle from Sep 2022.

# Cherenkov Prototype from Temple



before re-coating



after re-coating



Cherenkov is now in working condition, but some channels are noisy.

# Noisy signal

- The noisy signal has a period about 5us, +/-20 mv amplitude.
- The noisy channel might change each time it is re-assemble.
- Noise shows up even if the HV is turned off but some HV cable is connected to other MaPMT. It will vanish if the whole crate is turned off.
- Dirty power supply is one of its source
- We ground the crate, no obvious change
- Manually ground BNC connecters will reduce the magnitude of noise
- Turning off the normal HV crate even without it connected to anything. There we still some noise added when connecting to the new power supply but at a much lower level.
- We conclude that this noise is from the test lab environment.



# Add Holding Stripe to Protect the Connection





#### Possible Reason for the Mirror Mis-alignment



This screw head is too big. It is touching the rod that the mirror is fasted to which not allow the mirror to touch the 45 deg surface of the rod.

### Stand



Hall C beam line is 13 feet high

We need to build a ~50 inches high table sitting on top of this stand

Our detectors will be mounted on the top of the newly built table, has the same height as the beam line.

# The Table

- A) 3 GEM detetors
- B) SC1
- C) SPD or LASPD + 1 GEM detector
- D) SC2
- E) Shielding





- The size of the table is 42 x 196 inches.
- Scintillators will be placed vertically. A 20x30 cm) hole is digged between Cherenkov and Ecal.
- The Ecal is mounted on a rotatable plate, which allows to have +/-15 deg rotation.
- Aluminum led boxes are designed to hold lead bricks to shield the MaPMT and the side of the Ecal.
- Mounting structure will be built using 80/20 aluminum blocks.

#### **GEM** Detector Status



- Only 3 10x10 GEM detectors available, still need the 4<sup>th</sup>.
- No spare APV25 chips or MPD readout electronics. Need to borrow from SBS or Moller
- Some VMM chips and readout will be shipped to Jlab in Mid-May. Its DAQ and firmware are not ready to use.

#### **Other Detector Status**





- Cherenkov is in working condition
- 3 Ecal modules are in working condition
- 1 LASPD is good
- 1 SPD and 3 preshowers do not work. Might be bad PMT.

### To-do

- $\circ$  Gold is to make all detectors in working condition by May 20<sup>th</sup>.
- Perform an installation in the Hall C machine shop to check all mounting structure and then move everything to the hall by the end of May.
- Need to fix SPD and preshower.
- Hall C technicians are working on the table, led boxes and rotation parts.
- Need the 4<sup>th</sup> GEM. Need VMM chips and its readout electronics. Need experts to work on VMM DAQ.