

Electromagnetic Calorimeter of Super BigBite Spectrometer at JLab Hall A

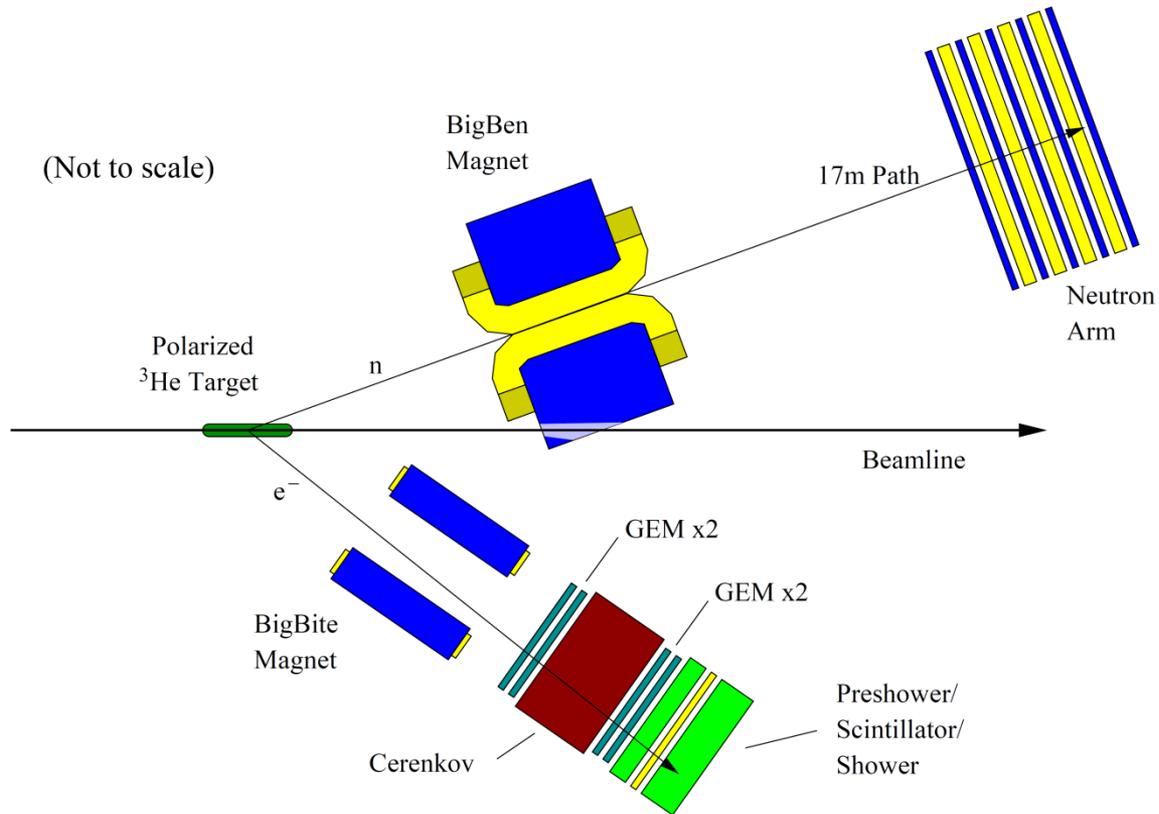
A. Shahinyan

**A.Alikhanyan National Science
Laboratory**

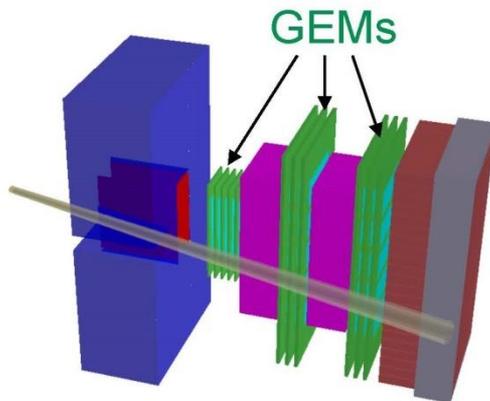
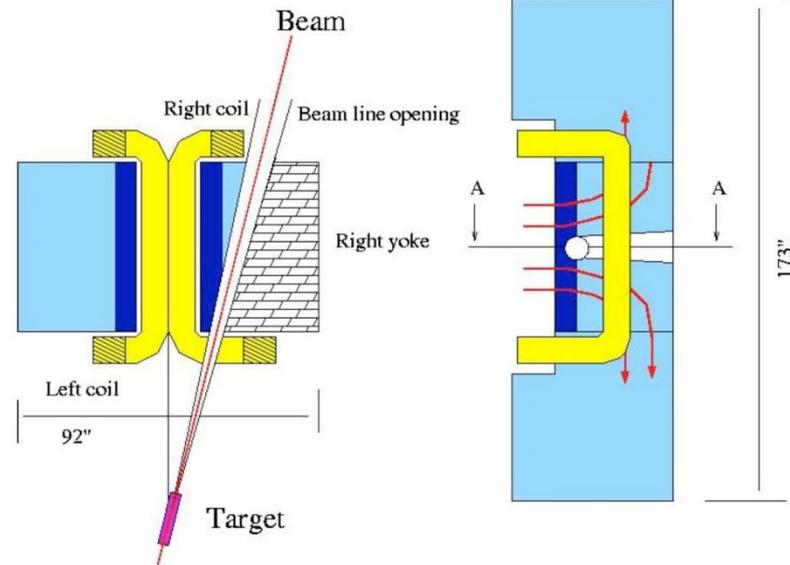
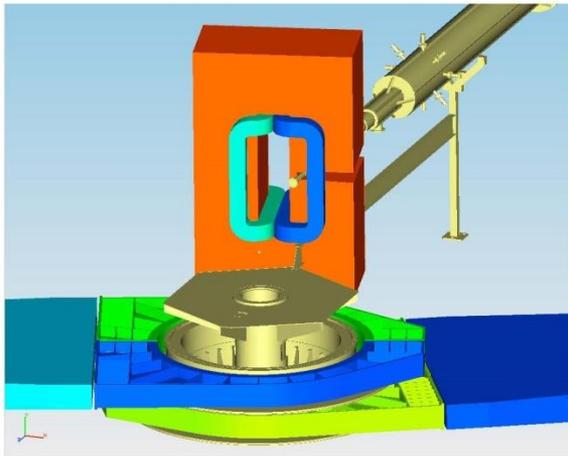
Contents

- SBS
- Experiments
 1. GEP5
 2. GMN
 3. GEN2
- SBS ECAL
- Summary

Super BigBite Spectrometer

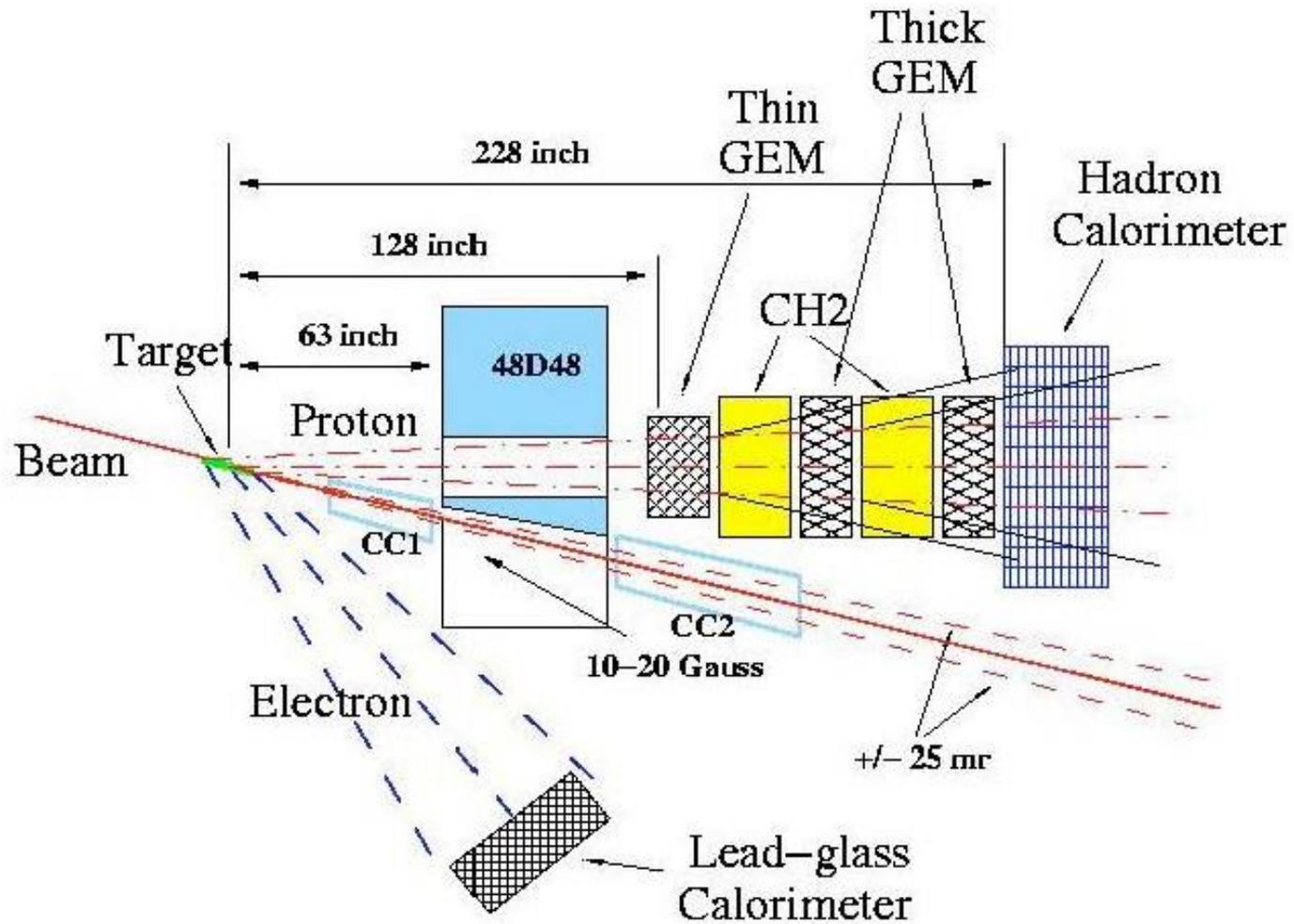


Super Bigbite Spectrometer



- Magnet: 48D48 - 46 cm gap, 2-3 Tesla*m
- Solid angle is 70 msr at angle 15 deg.
- GEM chambers with 70 μm resolution
- momentum resolution is 0.5% for 5 GeV/c
- angular resolution is 0.5 mr

SBS Layout and Parameters



Parameters of SBS

	$\theta_{central}$, degree	Ω , msr	D, meter	Hor. range, degree	Vert. range, degree
Solid angle	3.5	5	9.5	± 1.3	± 3.3
	5.0	12	5.8	± 1.9	± 4.9
	7.5	30	3.2	± 3	± 8
	15	72	1.6	± 4.8	± 12.2
	30	76	1.5	± 4.9	± 12.5

Resolution:

Momentum $\Rightarrow \frac{\sigma_p}{P} = 0.0029 + 0.0003 \times p [\text{GeV}]$

Angular $\Rightarrow \sigma_\theta = 0.14 + 1.3/p [\text{GeV}]$, mrad

Momentum acceptance $\Rightarrow P$ range from **2 – 10** , GeV/c

Experiments

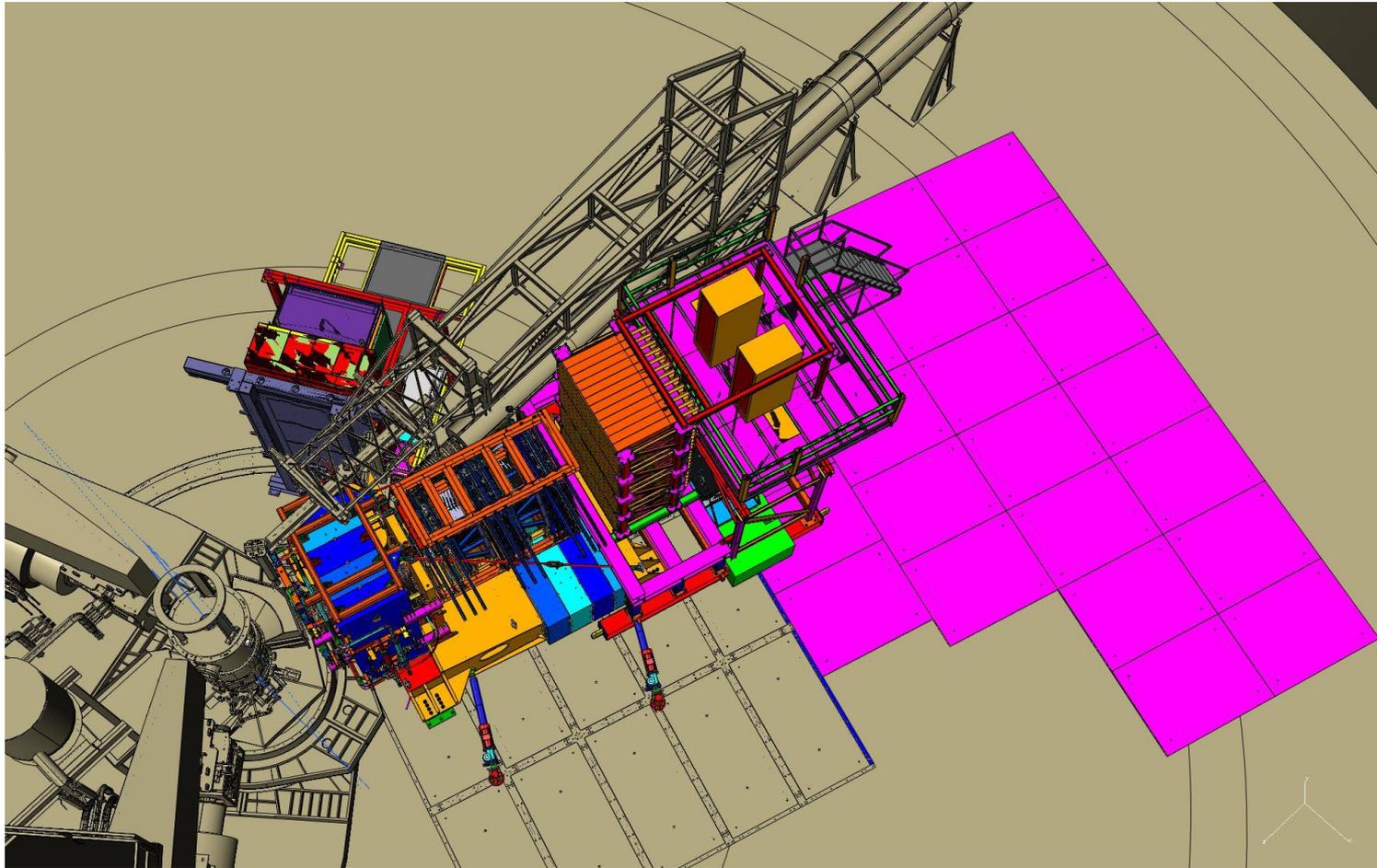
GEP5 - Large Acceptance Proton Form Factor Ratio Measurements at 13 and 15 (GeV/c)² using Recoil Polarization Method

GMN - Precision Measurement of the Neutron Magnetic Form Factor up to $Q^2 = 18.0$ (GeV/c)² by the Ratio Method

Transversity - Target Single-Spin Asymmetries in Semi-Inclusive Pion and Kaon Electroproduction on a Transversity Polarized ³He Target using Super BigBite and BigBite in Hall A

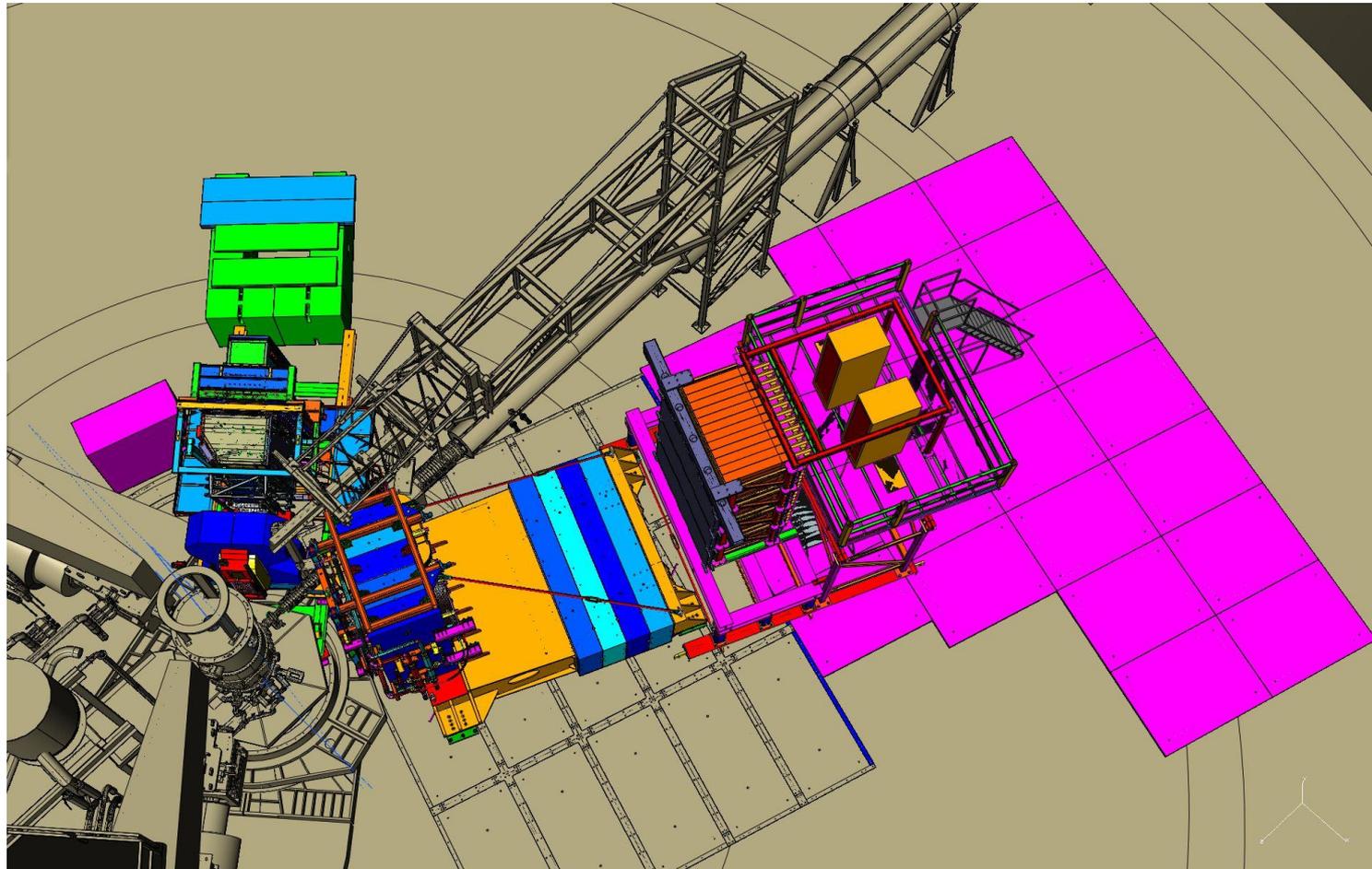
GEN2 - Measurement of the Neutron Electromagnetic Form Factor Ratio G_E^n/G_M^n at High Q^2

GEP5 - Large Acceptance Proton Form Factor Ratio Measurements at 13 and 15 (GeV/c)² using Recoil Polarization Method



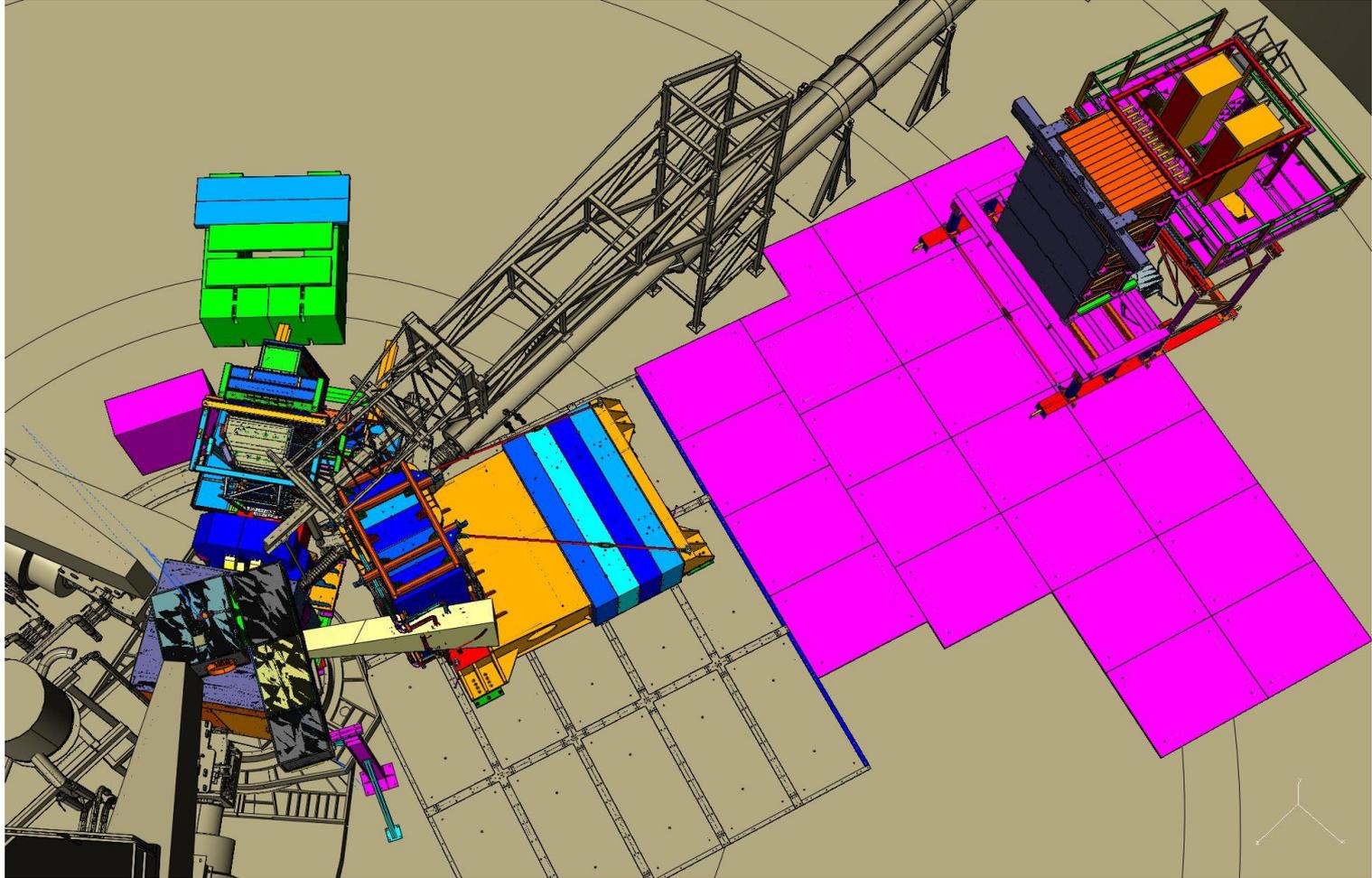
GEP5 Layout

GMN - Precision Measurement of the Neutron Magnetic Form Factor up to $Q^2 = 18.0 \text{ (GeV/c)}^2$ by the Ratio Method



GMN Layout

GEN2 - Measurement of the Neutron Electromagnetic Form Factor Ratio G_E^n/G_M^n at High Q^2



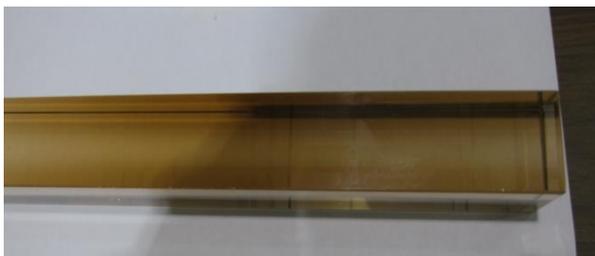
GEN2 Layout

SBS ECAL

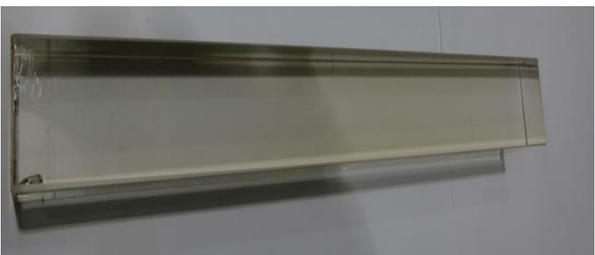
- ECAL Blocks
- ECAL Modules Gluing process
- Test ECAL Blocks
- ECAL Counters
- ECAL C16 Test Results
- ECAL Frame
- HV System

The ECAL blocks under heat treatment

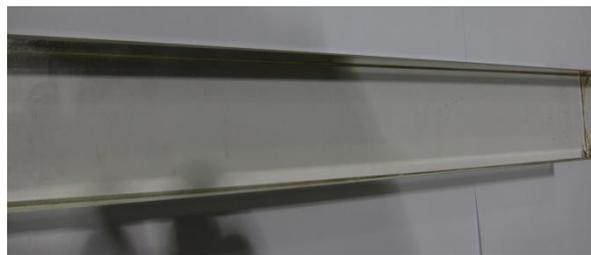
Irradiated (14 kRad) at ISU



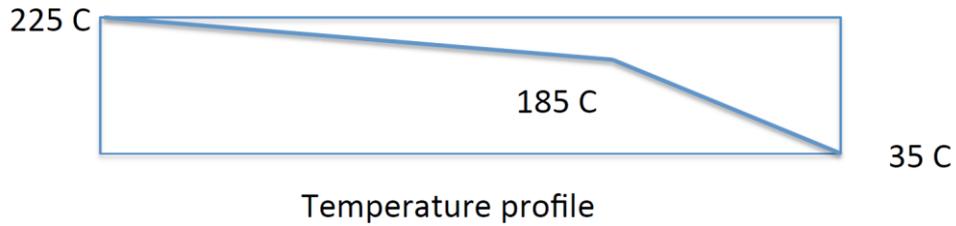
after heat at 200°C, 2 hours



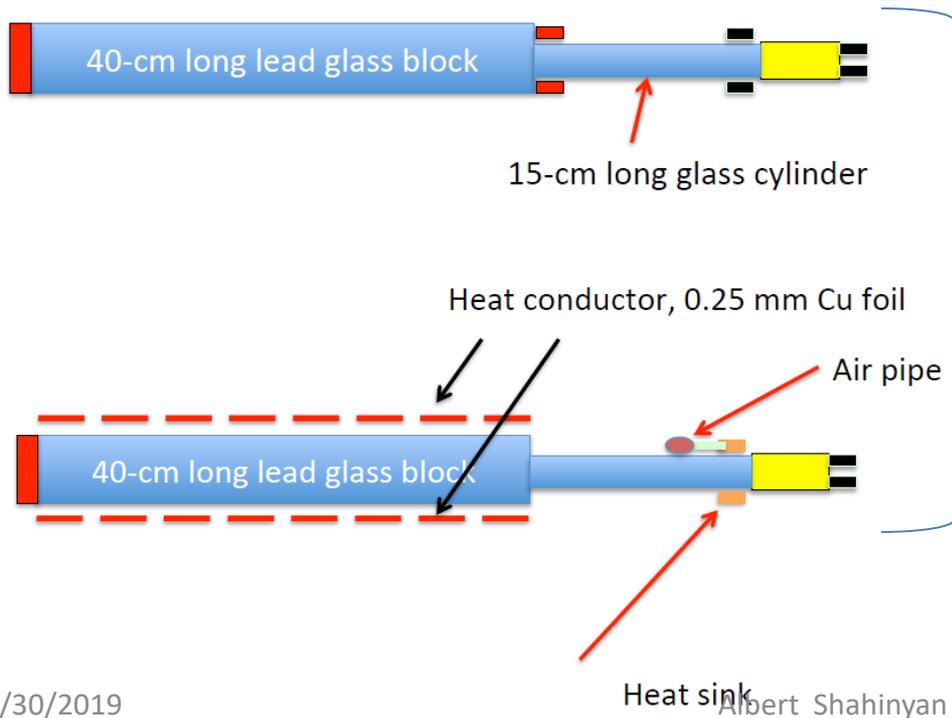
after heat at 225°C, 1 hour



ECAL blocks



Required temperature profile

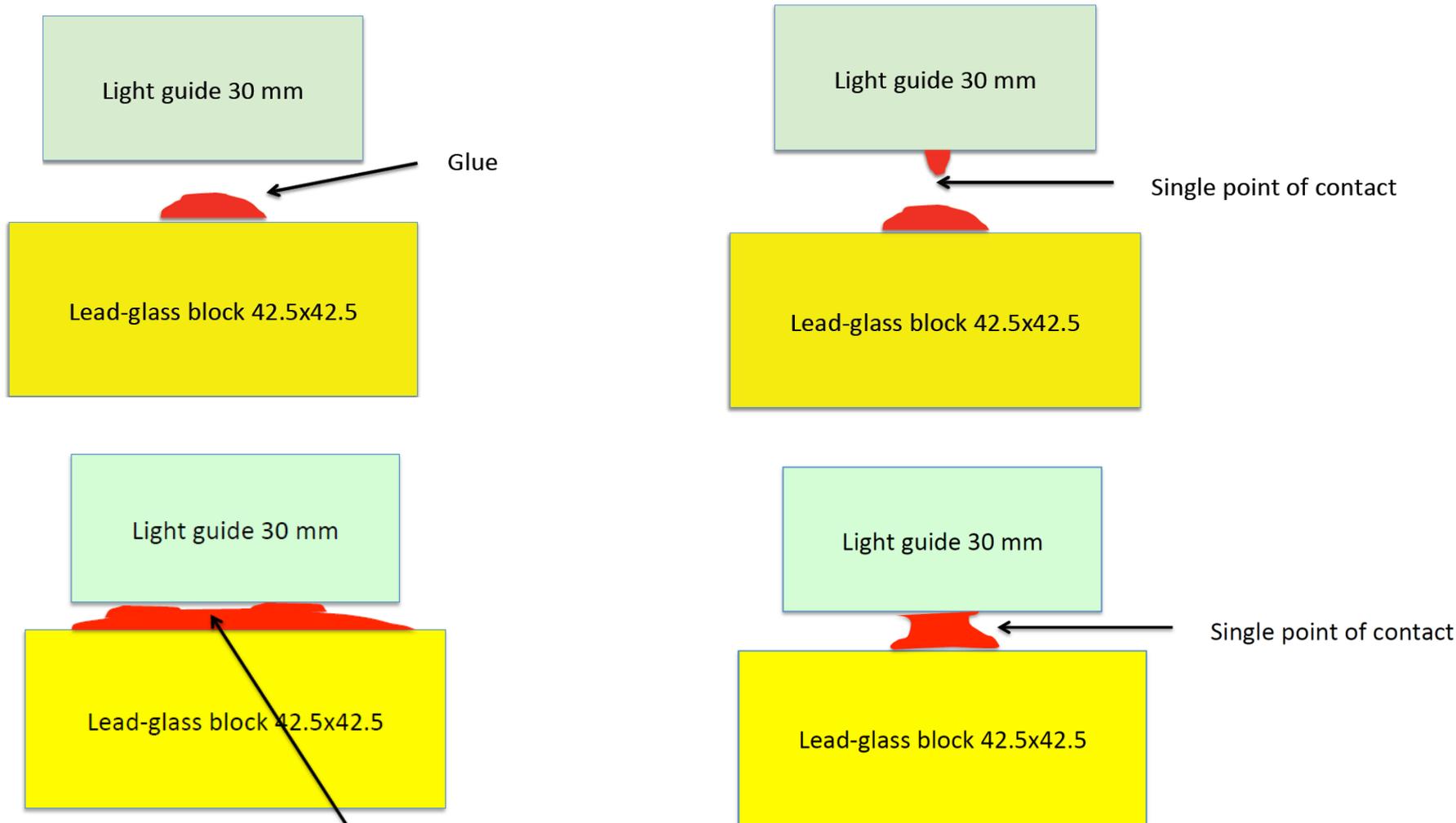


Two ideas to achieve this T-profile
The second version is preferred

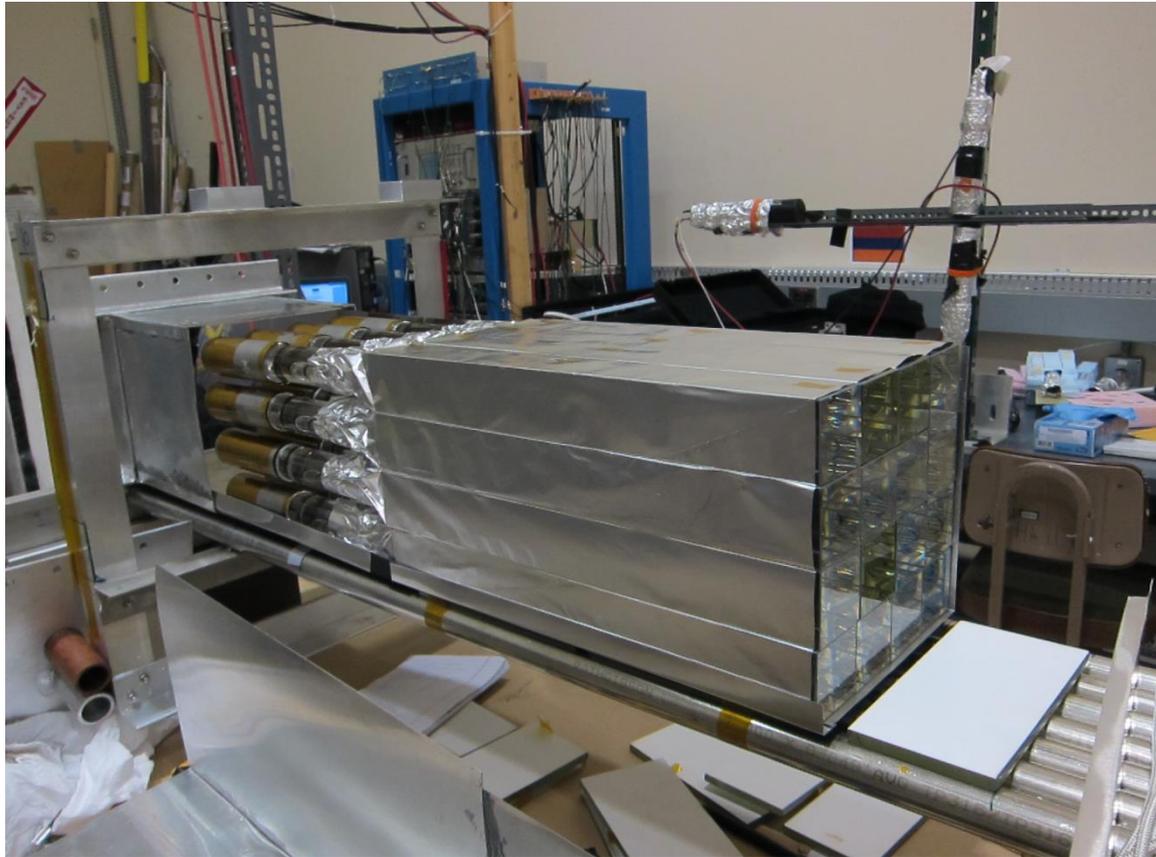
Gluing procedure for lead glass and light guides



Gluing of the light guides air bubbles problem and solution



ECAL 16

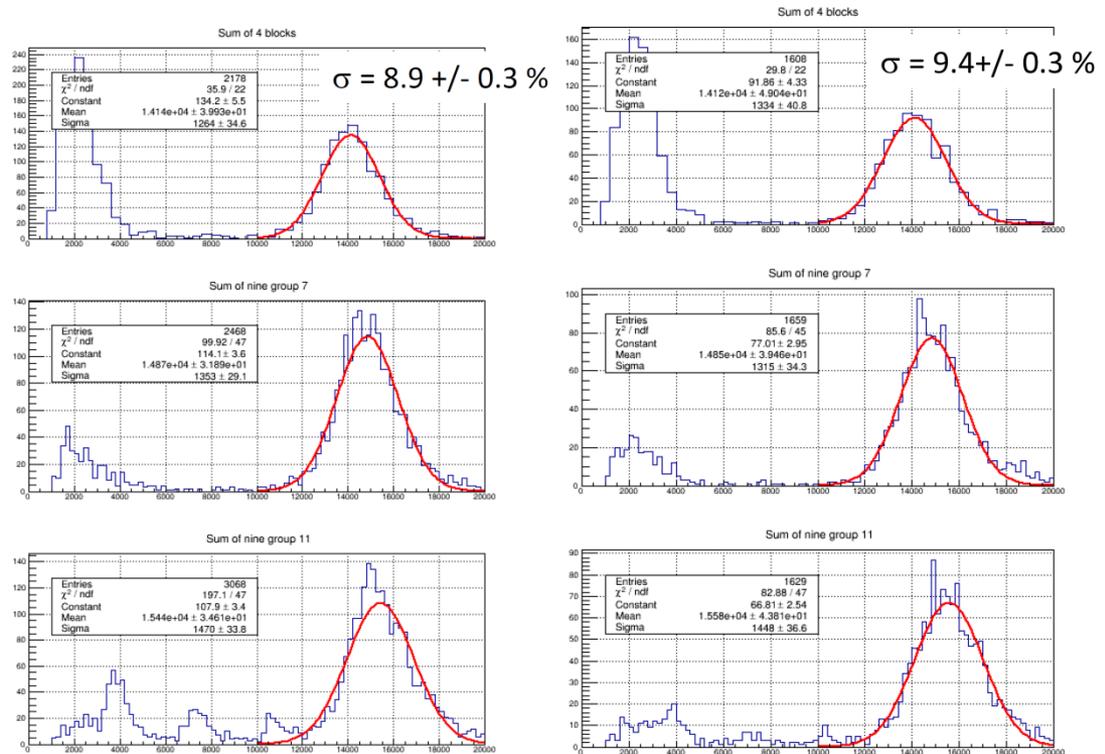
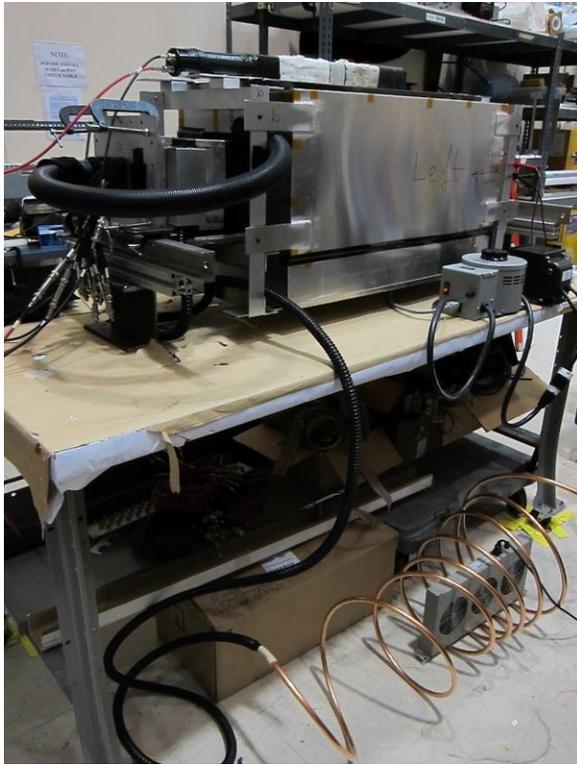


ECAL 16



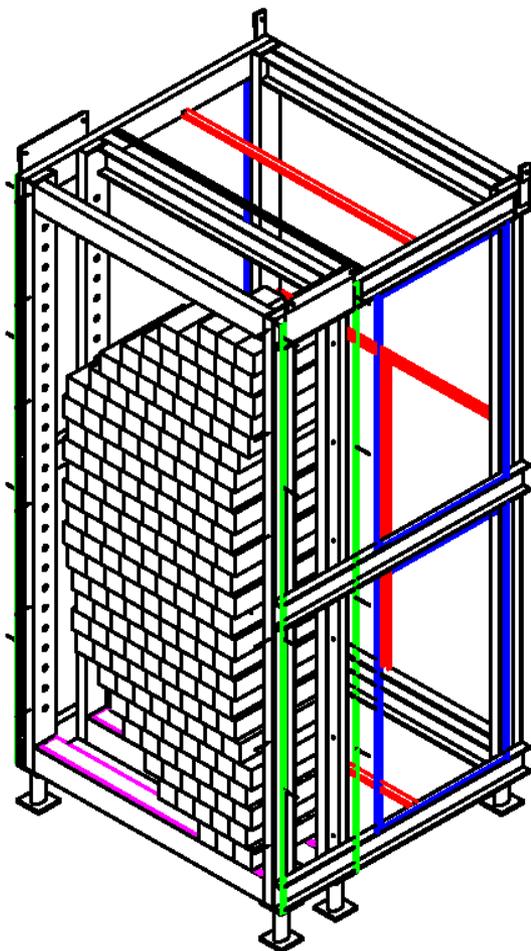
C16 Beam Test Results

- Test done between April 30th at 17:00 to May 2nd at 10:00 am on 2015
- Beam energy = 2.056 GeV, 15 cm LH2 target. (10 deg, 6.1m) 0.8Krad/hr
- DAQ system used RHRS scintillators as trigger and readout the C16 in FADC250

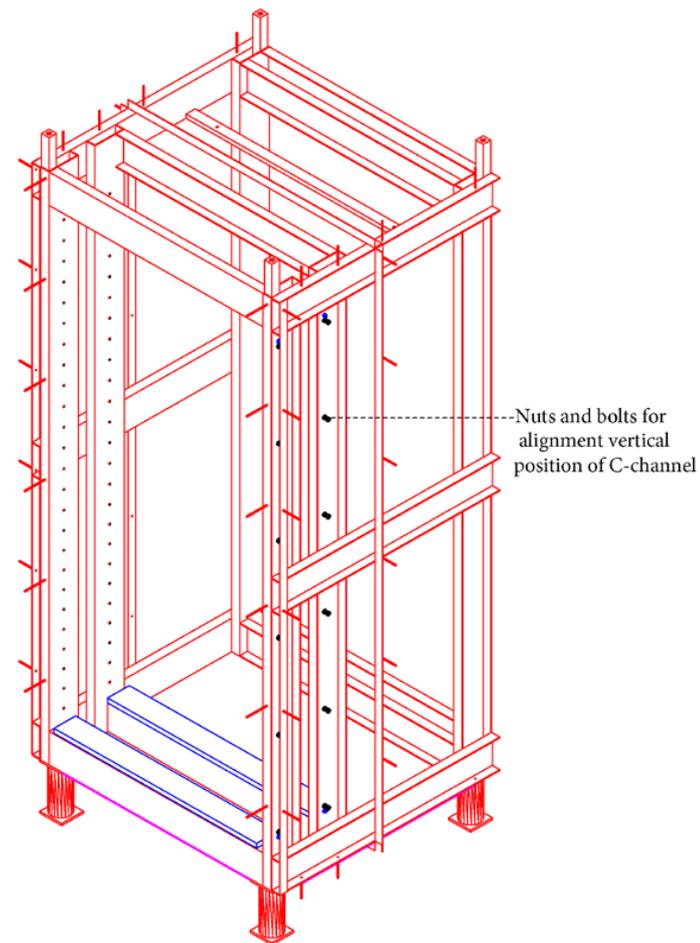


Cool air blow in back to cool PMT

ECAL Frame



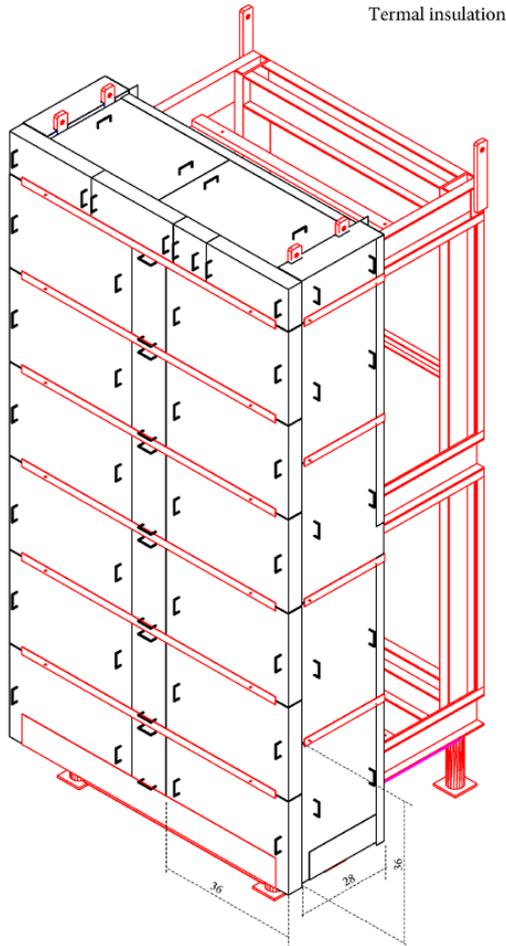
Super Modules in detector frame



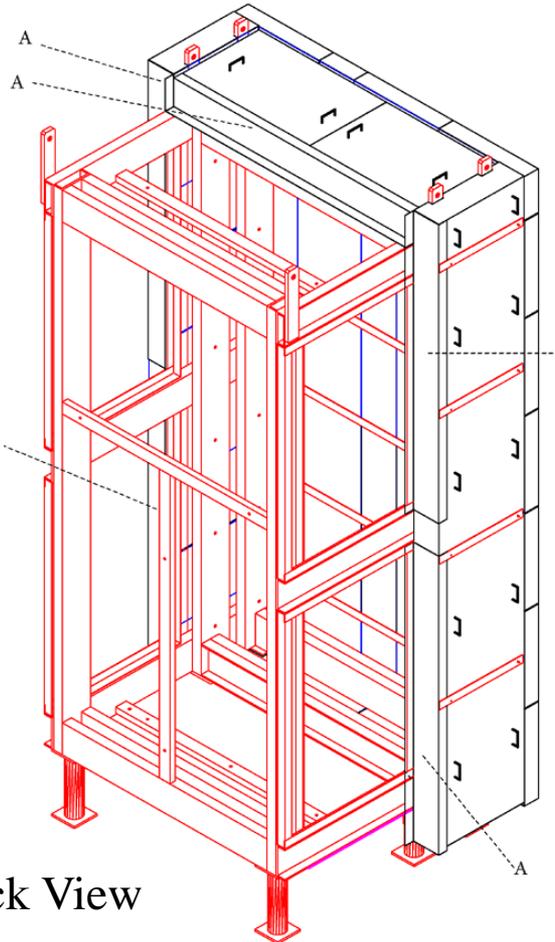
Detector frame assembly includes C-channel for adjusting position of Super Models

ECAL Frame

Thermal insulation with
Foam Glass blocks



Front View

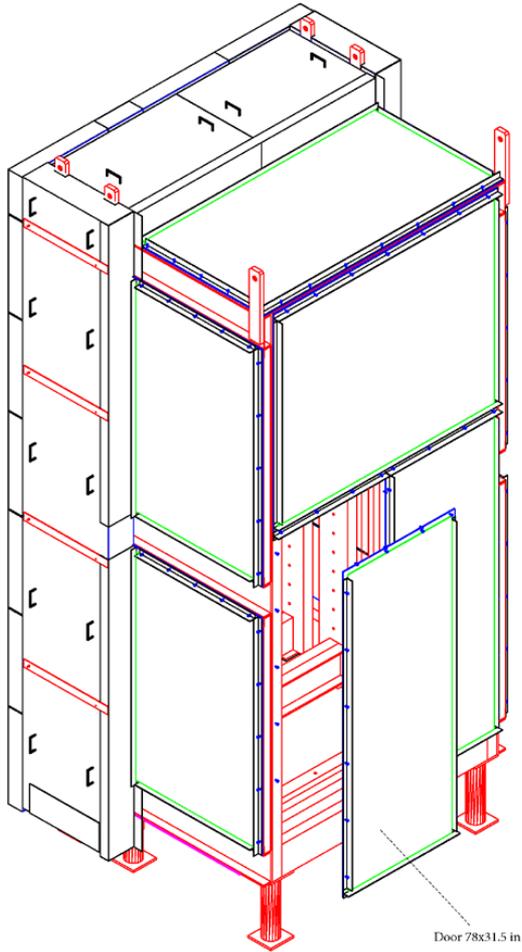


Back View

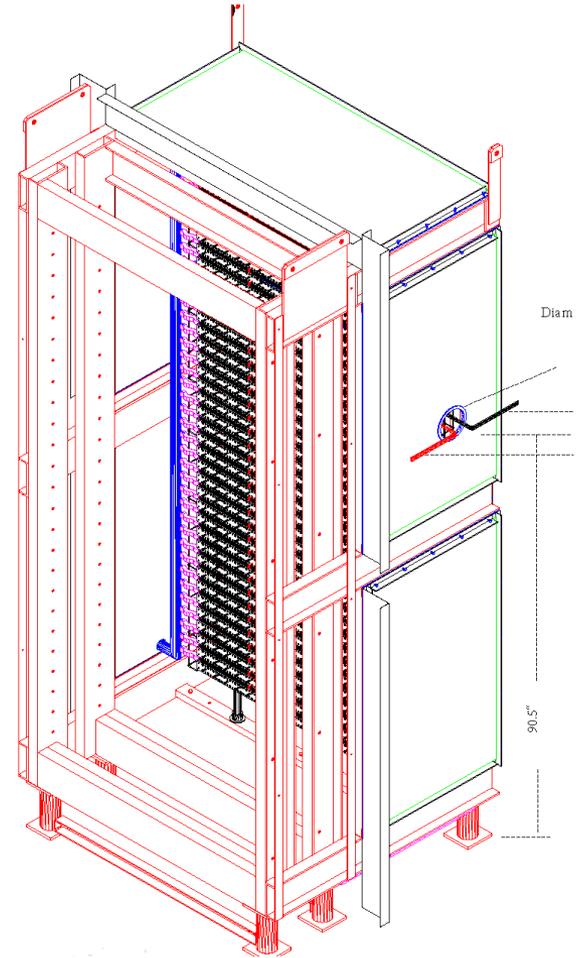
ECAL Frame

Frame Enclosure

Cabling and Patch
Panel position



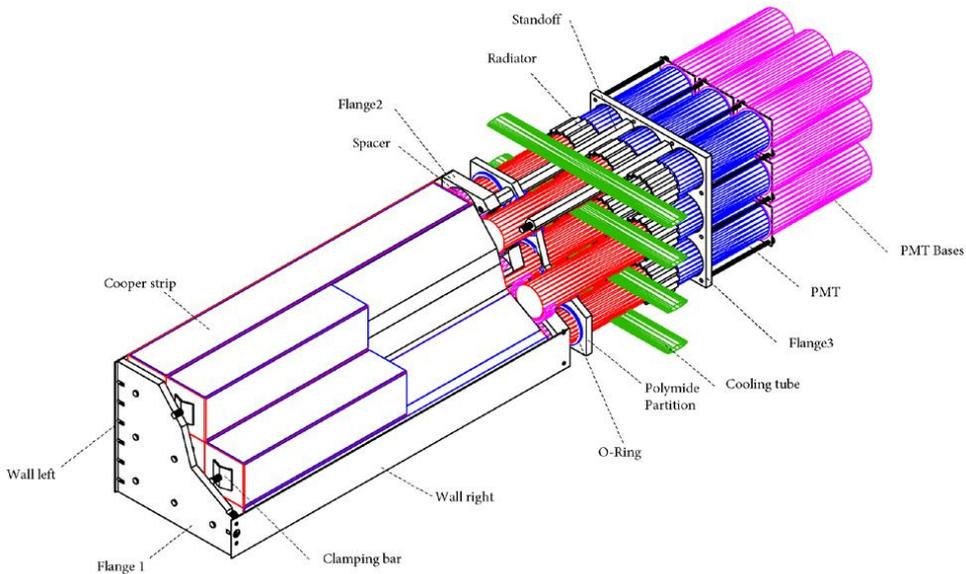
Back View



Front View

ECAL super module

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



Schematic View



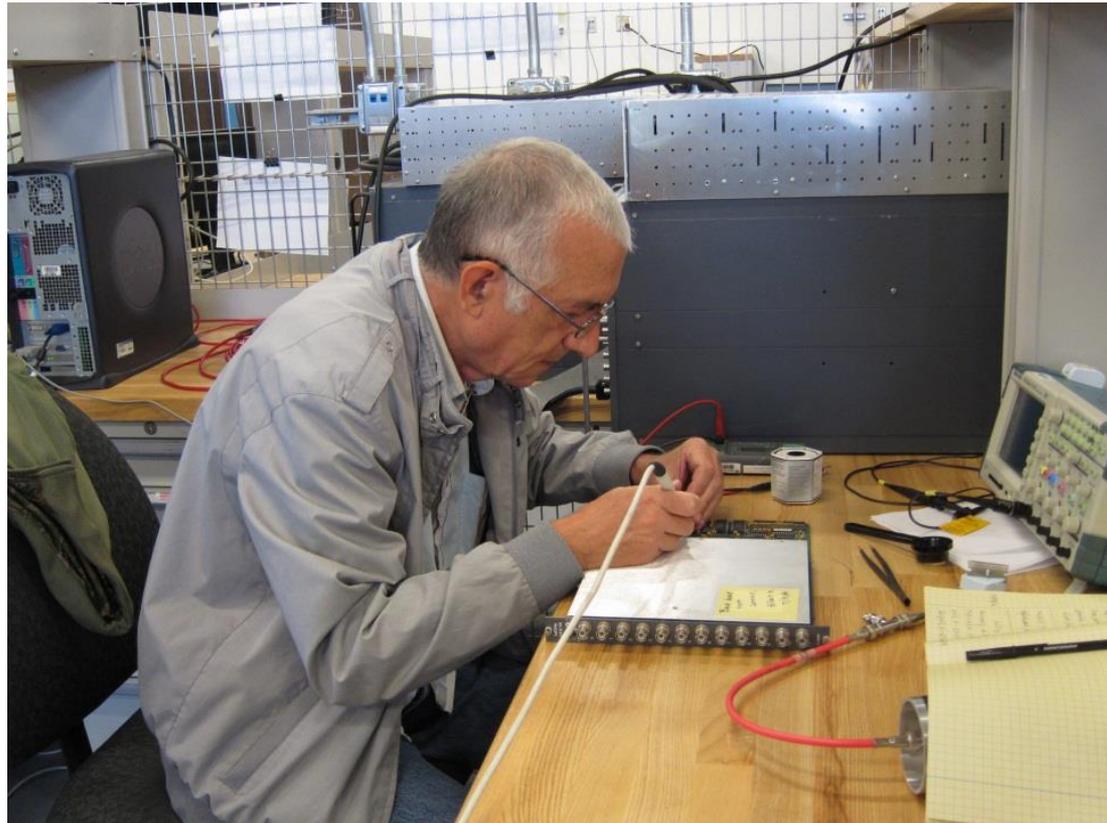
Really View

HV System for SBS/Ecal



**ECAL HV system, consist 10
crates LeCroy**

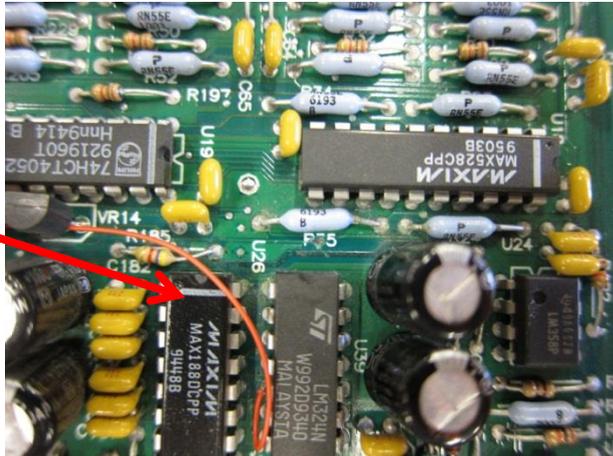
Repairing of defected modules



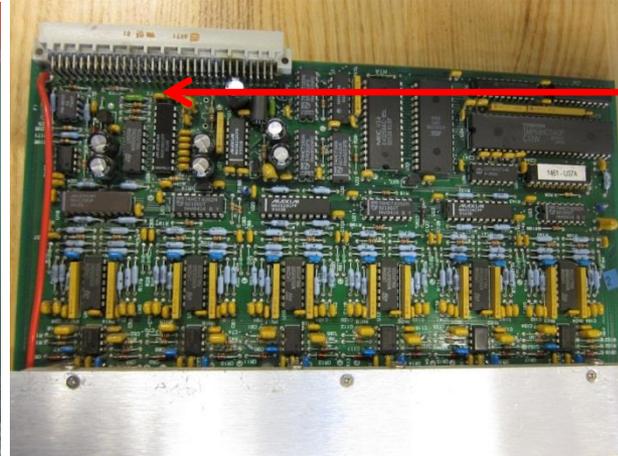
Karen Ohanyan is repairing one of the broken modules

Examples of defected modules

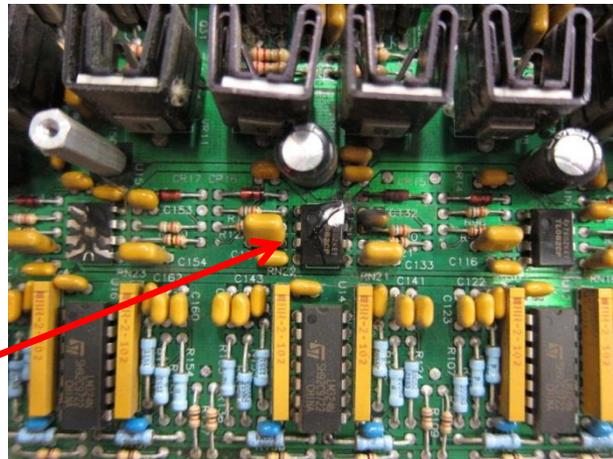
Lost contact, jumpered



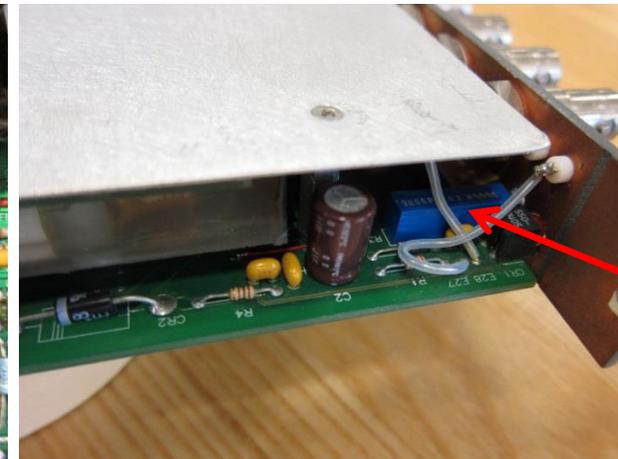
Burned fuse, replaced



Blowed Chip, replaced



Broken potentiometer, replaced



Summary

- Mechanical design Ecal frame –completed
- Super module mechanical design-completed
- 192 each super module mechanically assembly
- 1000 each lead glass and light guide- glued
- Ecal frame ordered

Thank You

ՇՆՈՐՀԱԿԱԼՈՒԹՅՈՒՆ