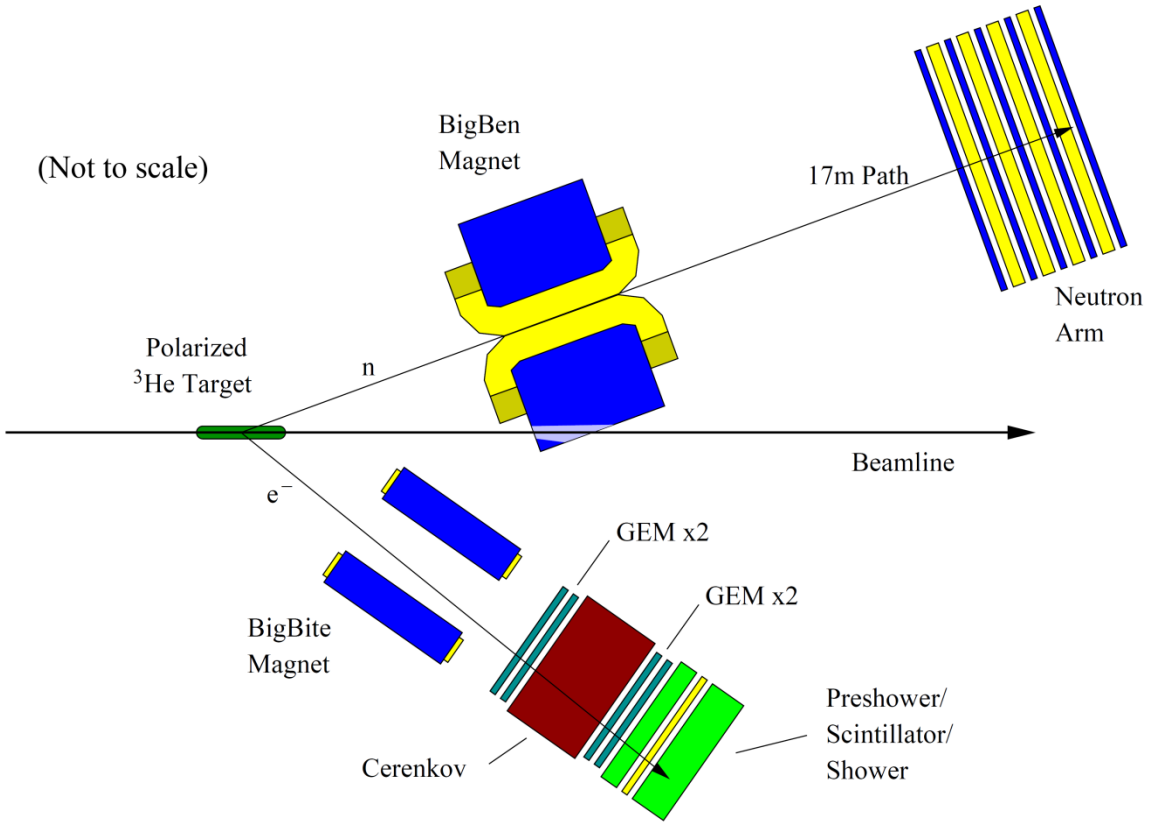
Status of the Electromagnetic Calorimeter for SBS/GEp5 at Hall A JLab

A. Shahinyan

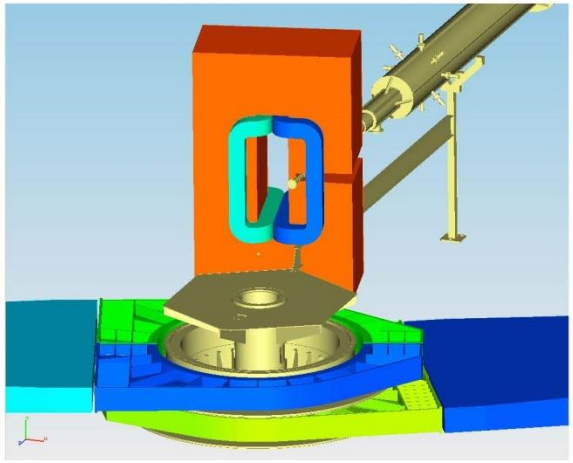
➢Outline

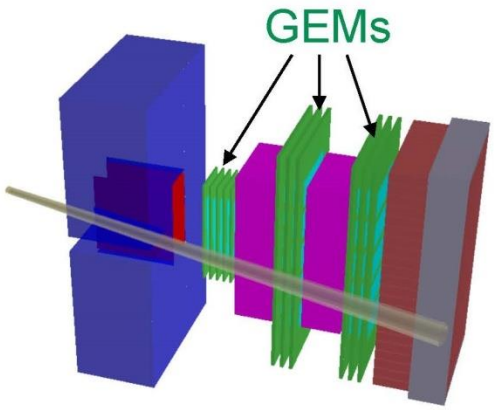
- ➢ Super BigBite Spectrometer
- ➢ SBS/ GEp5 experiment
- ➢ First thermal test a block of LG
- ➢ Test run of ECal 16 channels in 2015
- ➢ First thermal test of ECal prototype
- ➢ Second thermal test of ECal prototype
- ➢ Test of cooling system of prototype

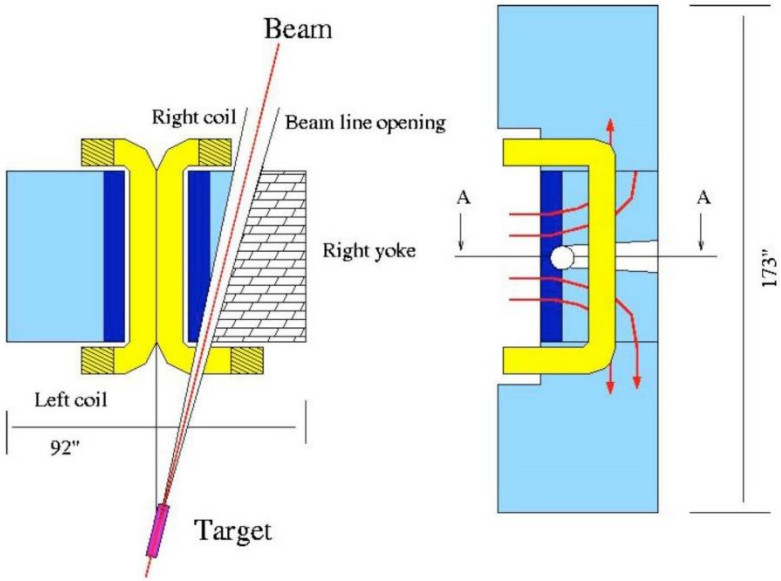
Super BigBite Spectrometer



Super Bigbite Spectrometer

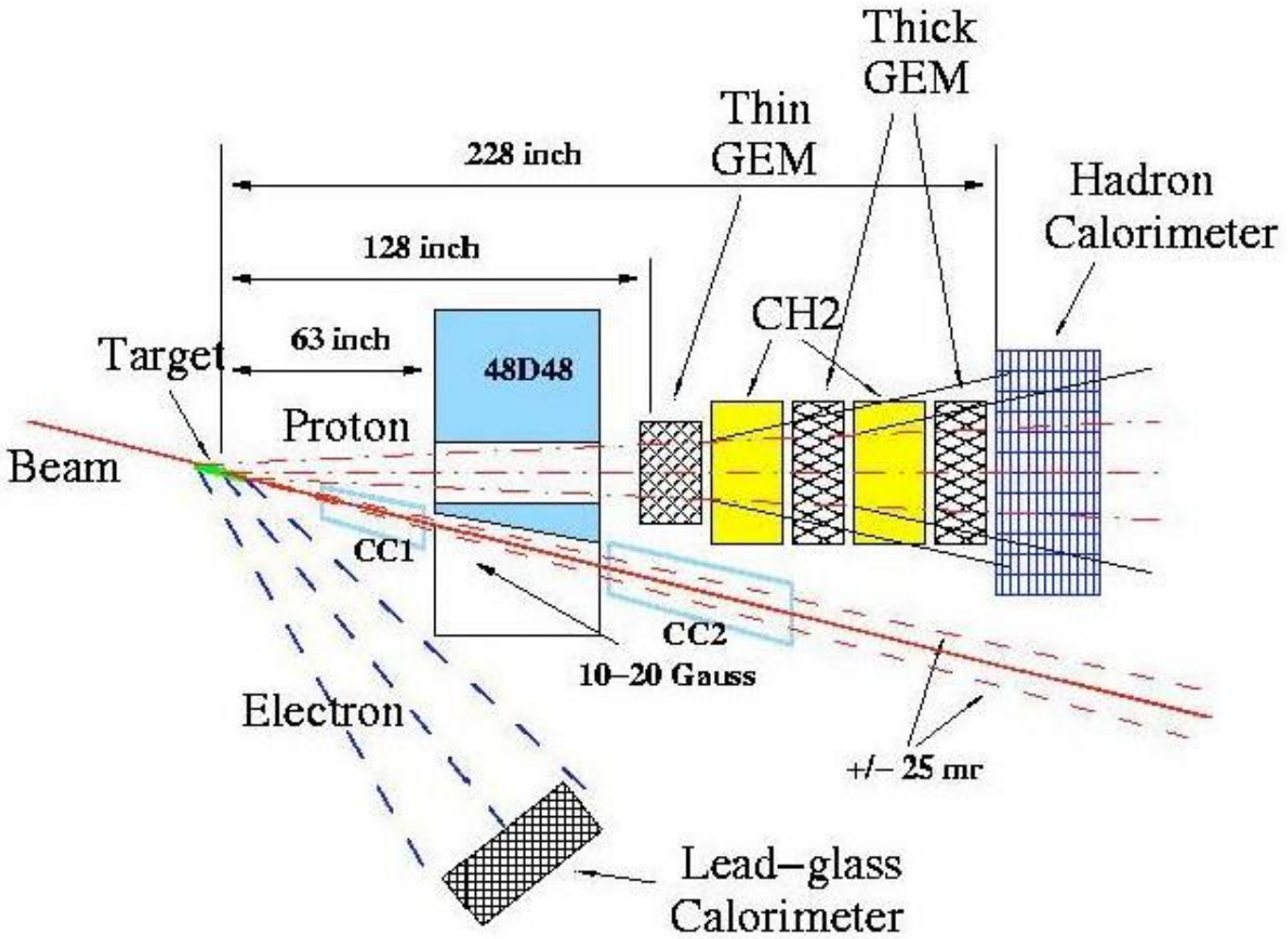




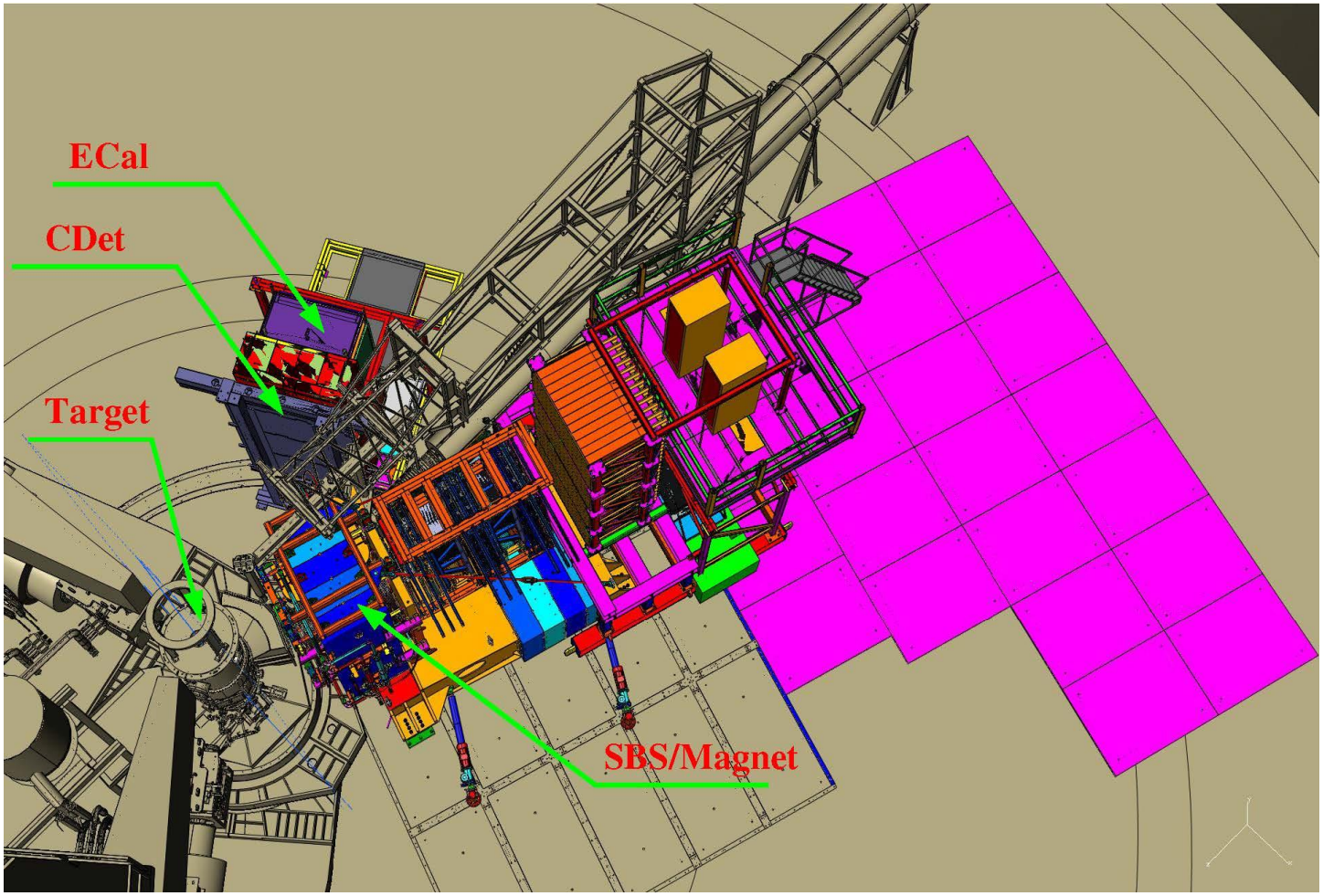


- Magnet: 48D48 - 46 cm gap, 2-3 Tesla*m
- Solid angle is 70 msr at angle 15 deg.
- GEM chambers with 70 μm resolution
- momentum resolution is 0.5% for 5 GeV/c
- angular resolution is 0.5 mr

SBS Layout and Parameters



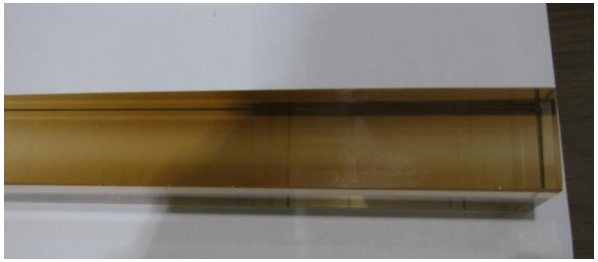
GEP5 - Large Acceptance Proton Form Factor Ratio Measurements at 13 and 15 $(GeV/c)^2$ using Recoil Polarization Method



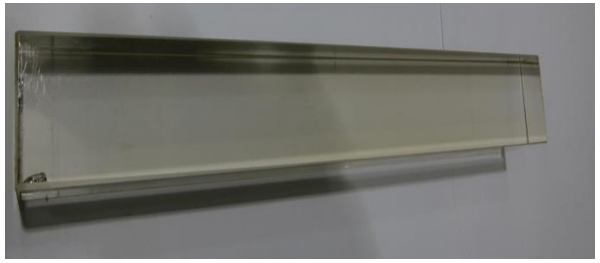
GEP5 Layout

The ECAL blocks under heat treatment

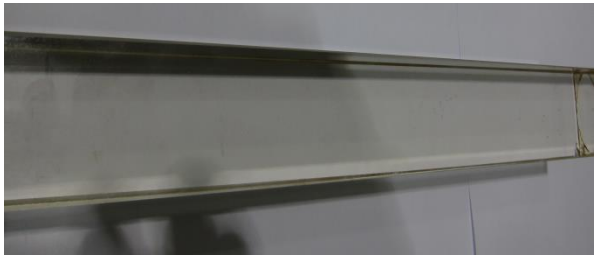
Irradiated (14 kRad) at ISU



after heat at 200^{o}C, 2 hours

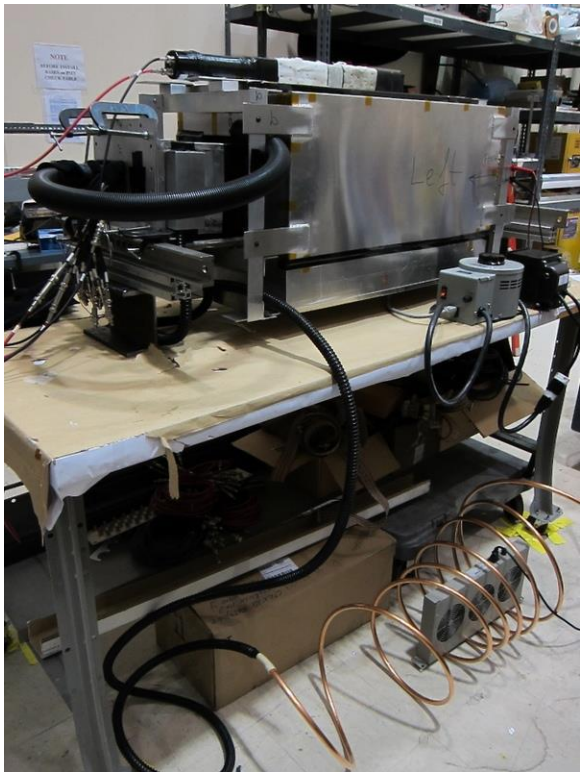


after heat at 225^{o}C, 1 hour

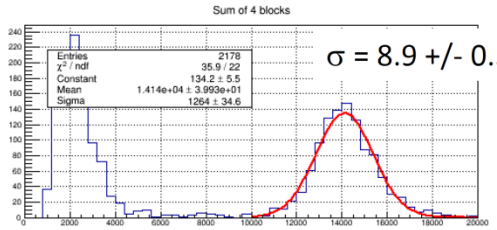


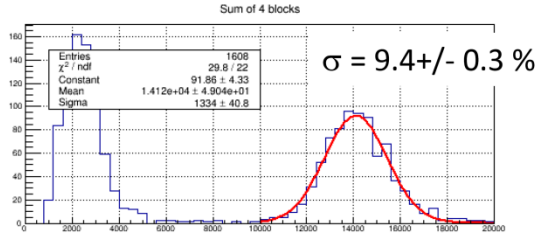
16 Channel Test Run

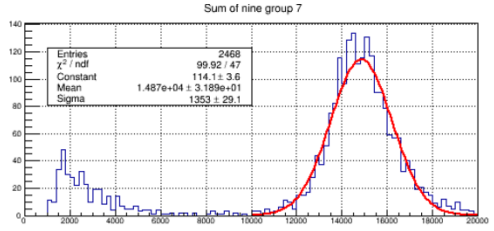
- Test run done in 2015.
- Required temperature setting at the front and back of lead glass blocks were determined (225℃ at the front, 185℃ at the back).
- Annealing at these temperatures keeps resolution nearly constant.

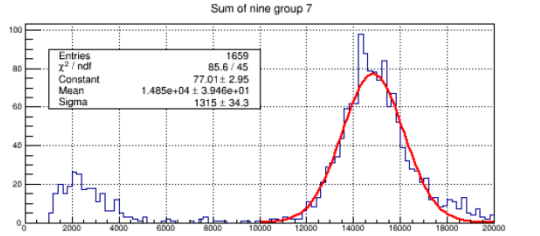


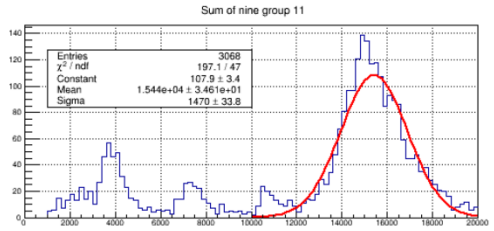
Cool air blows in back to cool PMT

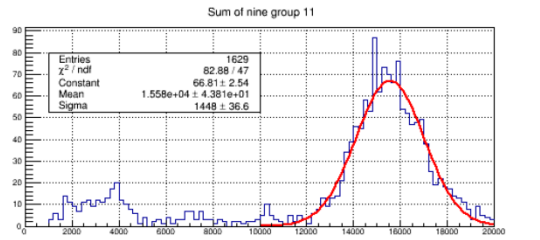










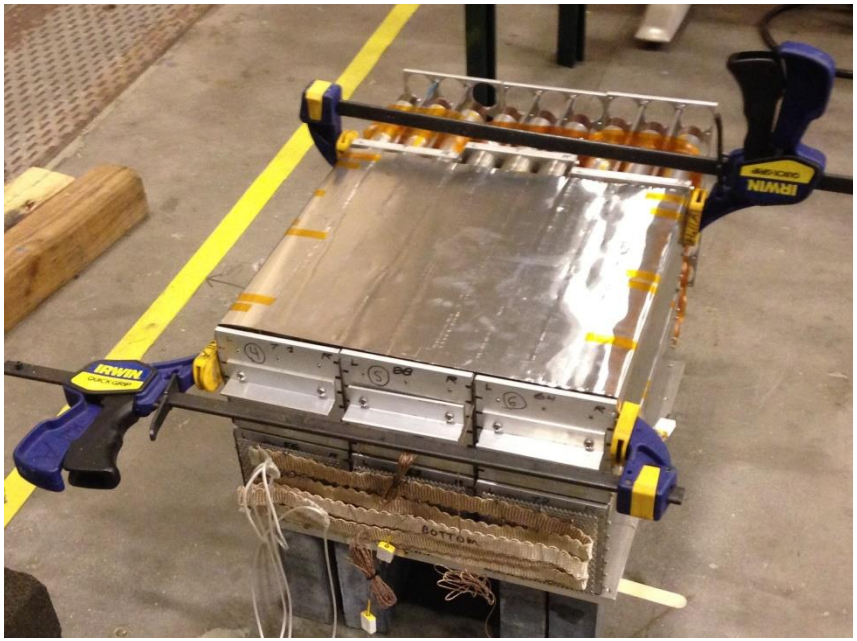


First ECal prototype test

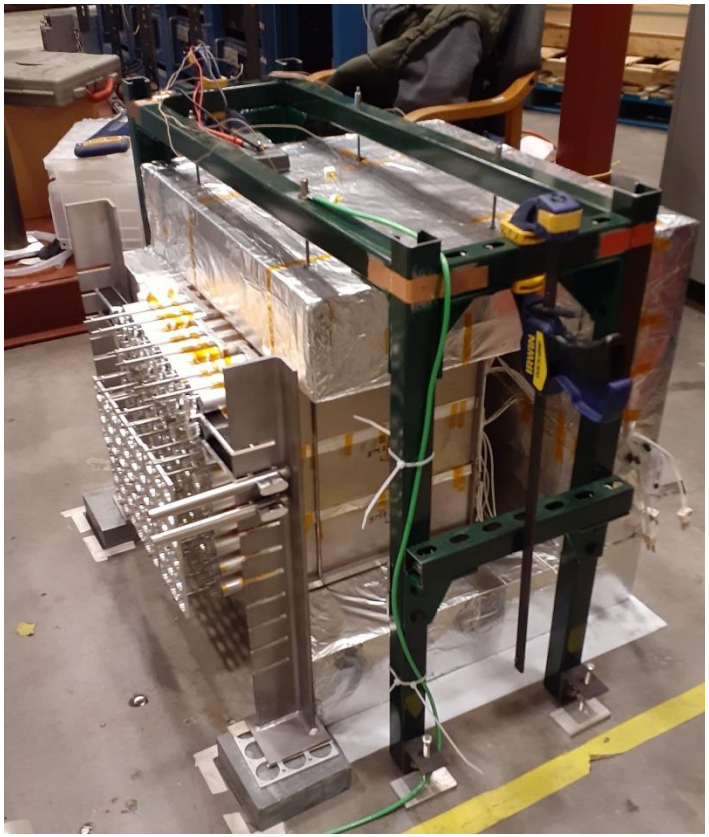
Prototype consists of 9 SM-s

1 heating tape attached to 3 SM-s

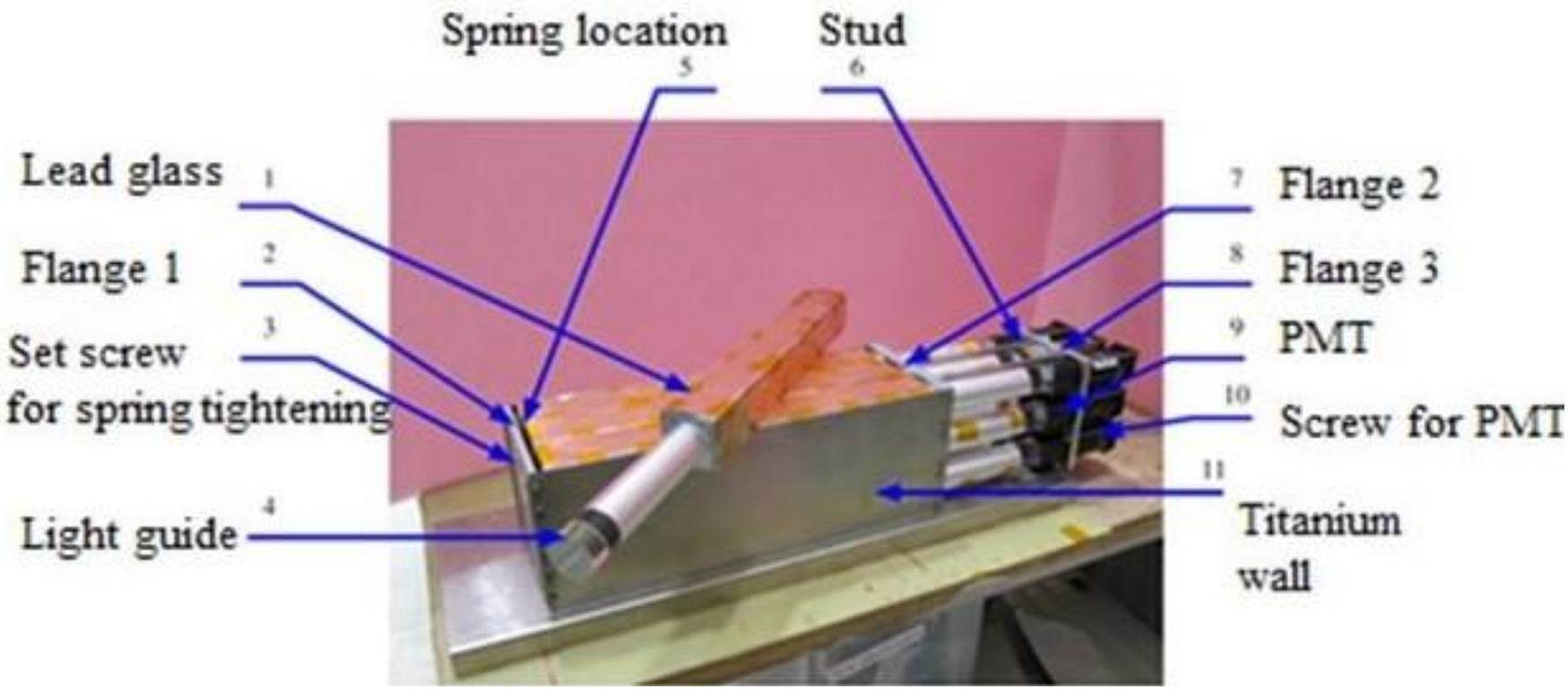
Heater power 830 W at 120 V



Prototype with foam-glass

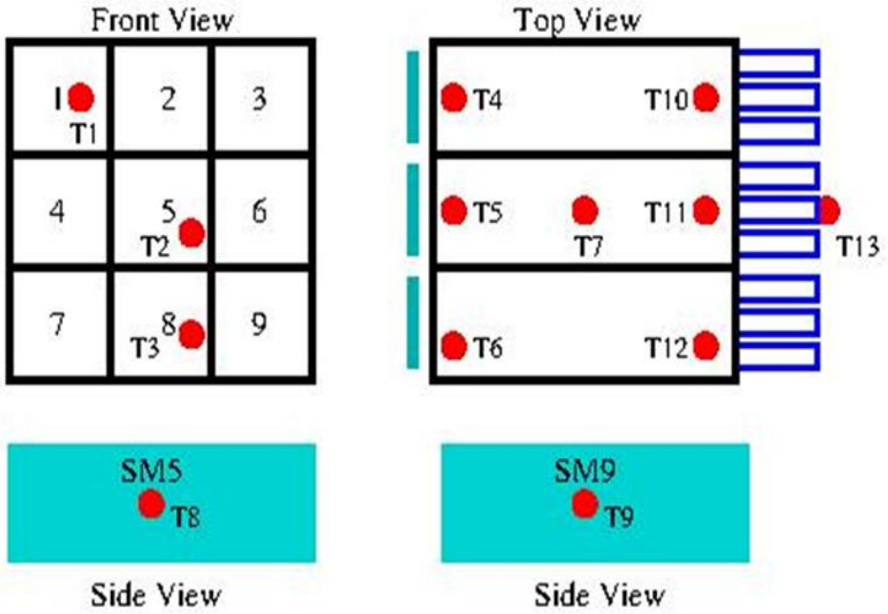


ECal SuperModule



ECal prototype test setup
Schematic view

Front and side view



Thermocouple position

- ***T1 – on flange 1***
- ***T2 – on flange 5***
- ***T3 – on flange 8***
- ***T4,5,6 – on LG front***
- ***T7,8,9 – on LG middle***
- ***T10,11,12 - on LG back***
- ***T13-on Light guide***

First test results

- All heaters were fed from variable transformers
- Heaters were attached to the front of SM-s, via perforated Al
- The perforated Al was attached to the front flange via ¼” thick Al bar
- At ~185 ℃ on the back of the lead glass block, temp. at the front of the lead glass block reached 250 ℃.
- At these conditions, temp. of the front flange was 360 ℃.
- Voltage at heaters was 57 V (total power 560 W).
- Temp-s of light guides reached 70 ℃.
- Results are not satisfactory, decided to conduct another test.

ECal Prototype

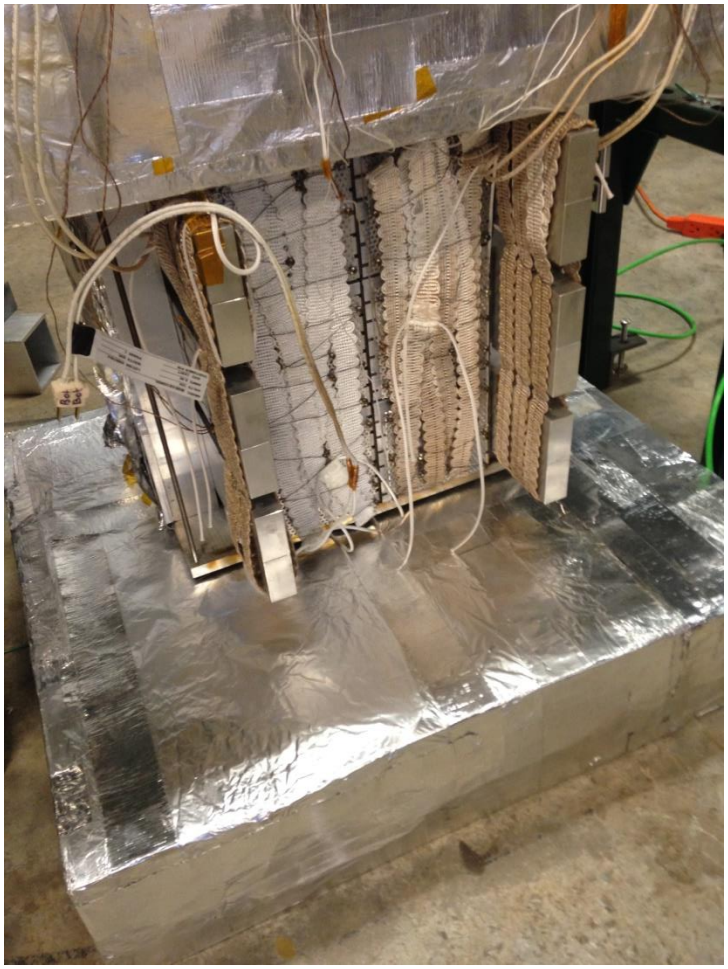
Prototype covered with foam-glass
Front view

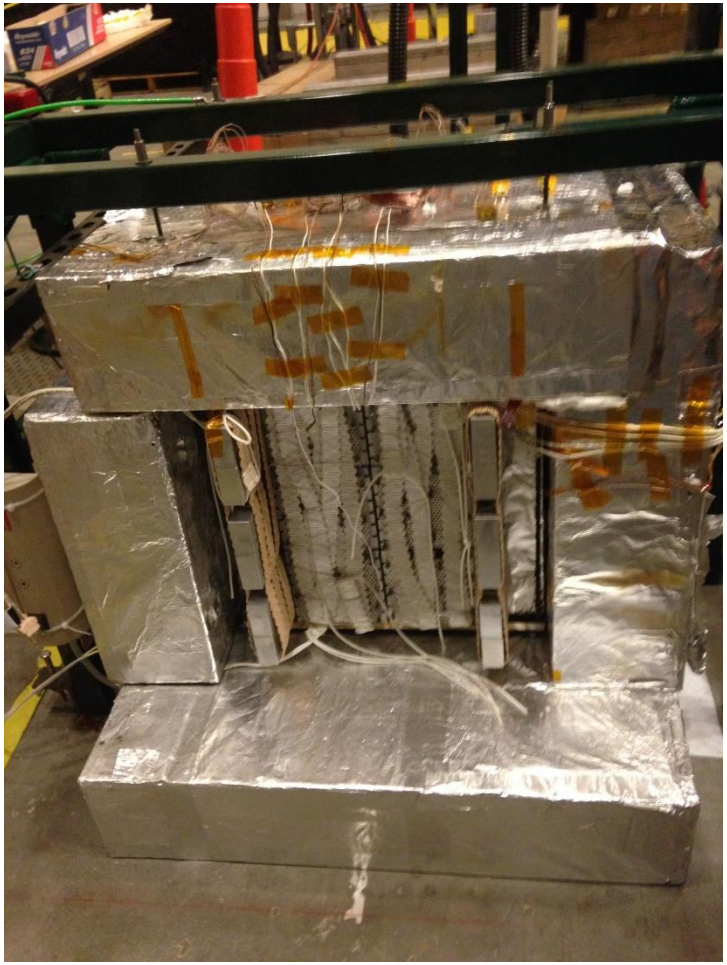
Prototype covered with foam-glass
Back view

Objectives of the 2-nd test

- After data analysis of the 1-st test, in order to achieve boundary temp-s 225℃ and 185 ℃ it was decided to heat blocks from sides as well.
- For the side heating, bars of high thermo-conductivity Al of 6063 type, of 1”x2” cross section, of lead glass block + 4” length were used.
- 2-nd prototype consisted of 6 SM-s.
- Against sides of SM-s 2 Al bars and 1” spacer was pressed.

ECal prototype second test setup

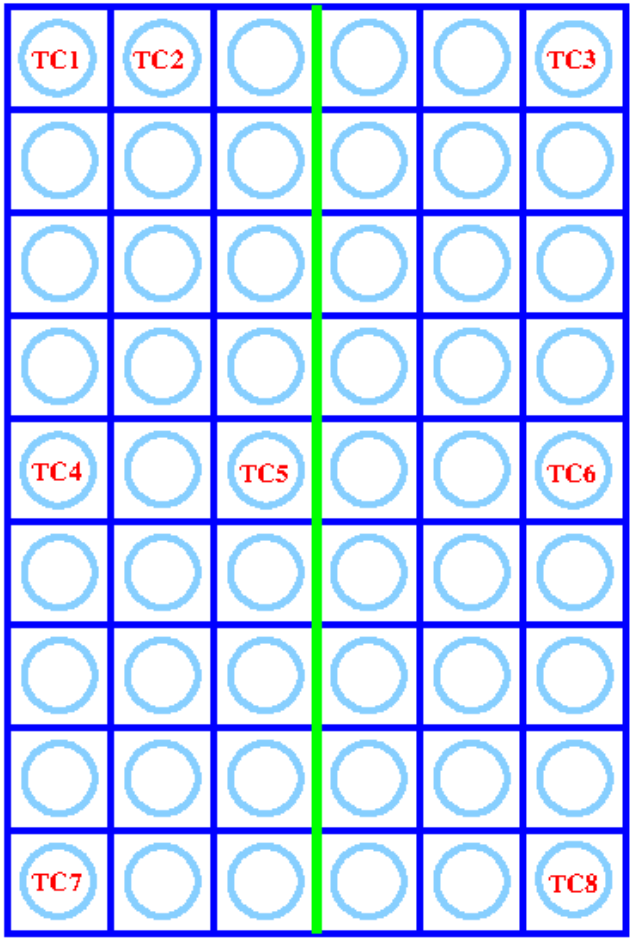




2-nd Test Results

- Achieved 250 ℃ at the front flange of SM
- At the front of lead glass block ~225 ℃
- At the back of lead glass block ~185 ℃
- At the end tip of the light guide ~70 ℃
- Heater voltage was 45 V, total power output 465 W
- Light guide cooling is needed.

Prototype Cooling System

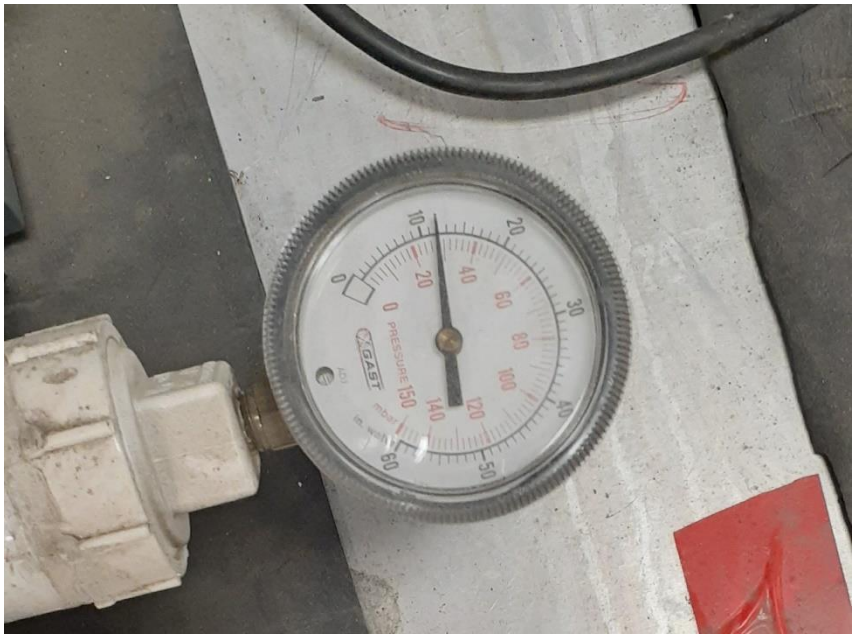


- Install 8 thermocouples
- Blower off max temperature was 70 degree C
- Blower off transformer output 45 V
- Blower on max temperature was 35 degree C
- Blower on transformer output 48 V

Thermocouple position on the light guide

Cooling system setup

Pressure of the blower 12” water



Conclusion

First Test

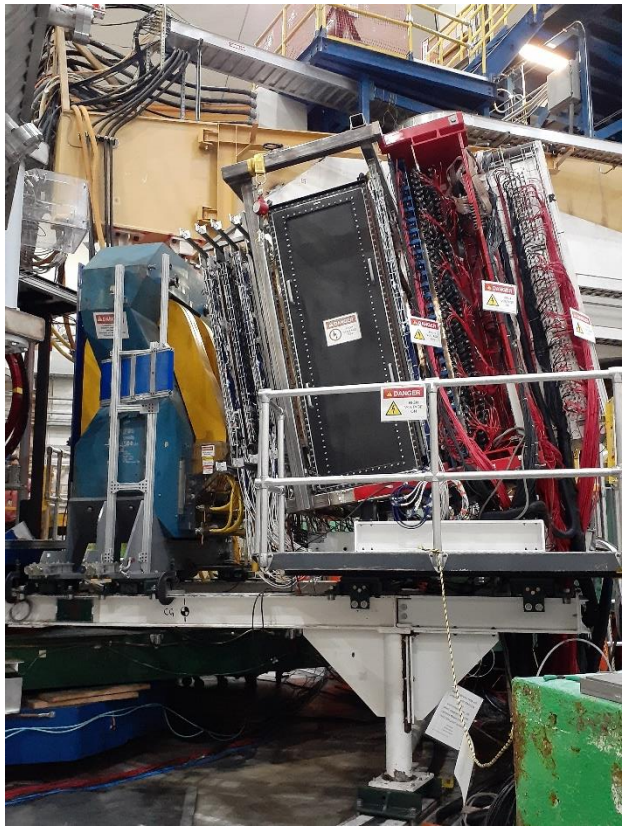
- Front flange temperature 360 degree C
- Front lead glass block temperature 250 degree C
- Back lead glass block temperature 180 degree C
- Light guide temperature 70 degree C
- Transformer output 57 V

Second test

- Front flange temperature 250 degree C
- Front lead glass block temperature 220 degree C
- Back lead glass block temperature 187 degree C
- Light guide max temperature 35 degree C with blower on
- Transformer output 48 V
- Necessary power for 1 SM is 90 W

SBS detector package for GMN experiment

SBS and GEM



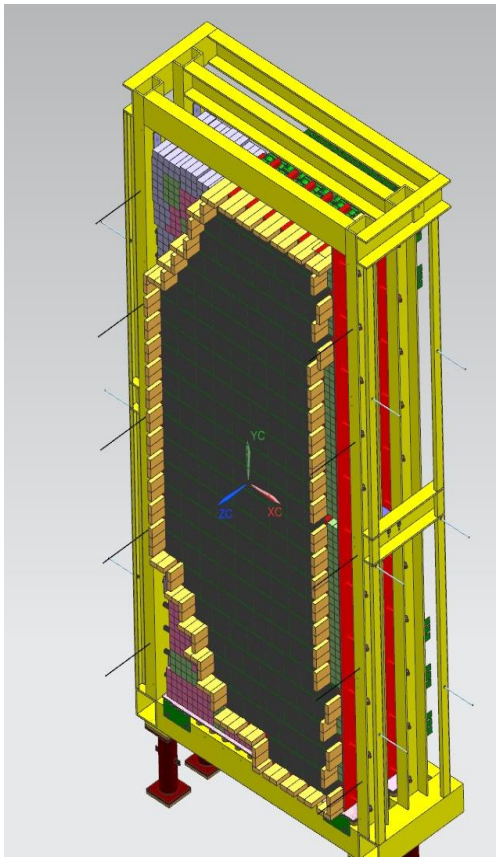
BigBite

HCAL

SBS/Ecal Frame

Ecal Frame with 2 layer Super Module front

Ecal Frame with 2 layer Super Module back



Ecal Frame with Super Module 3D

ՇՆՈՐՀԱԿԱԼՈՒԹՅՈՒՆ

Thanks Iuliia