C200 Project: Thermal Curing scheme for Lead-glass Calorimeter

Tao Ye

Stony Brook University

June, 2016, HUGS

C200 Project

- a R&D project of Super Bigbite Program
  - Electromagnetic calorimeter(ECal): TF1 lead-glass
  - $\sim$ 200 ECals: $\sim$ 10 % of the full detector.

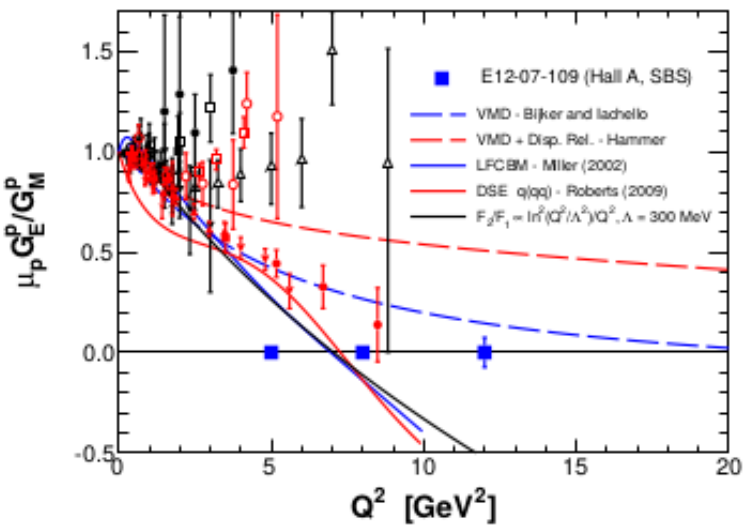
C200 Project

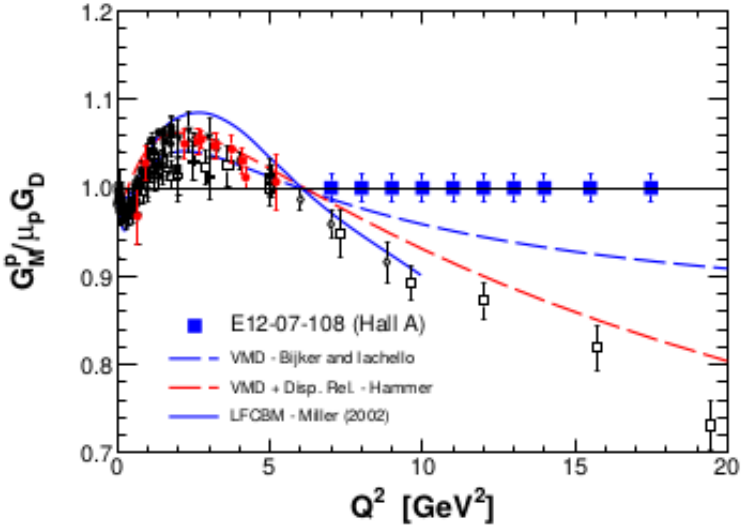
- a R&D project of Super Bigbite Program
  - Electromagnetic calorimeter(ECal): TF1 lead-glass
  - $\sim$ 200 ECals: $\sim$ 10 % of the full detector.
- Super-Bigbite Program
  - Form factor measurements: G_E and G_M at high Q^2
  - Ready by the end of 2017

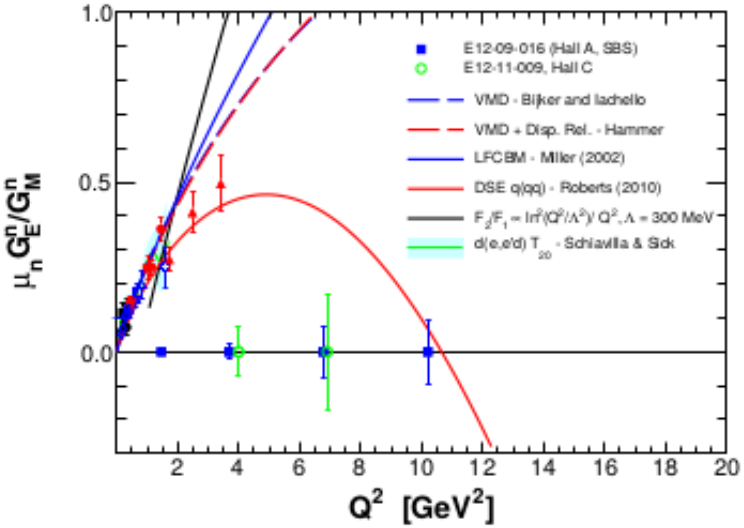
C200 Project

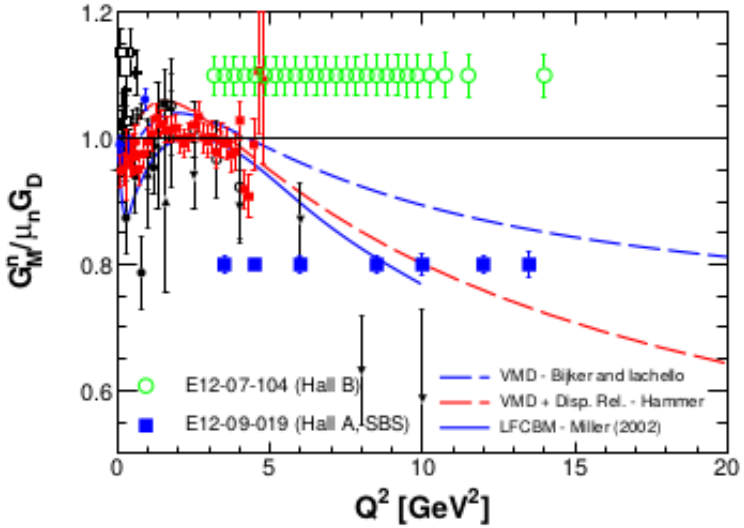
- a R&D project of Super Bigbite Program
  - Electromagnetic calorimeter(ECal): TF1 lead-glass
  - $\sim$ 200 ECals: $\sim$ 10 % of the full detector.
- Super-Bigbite Program
  - Form factor measurements: G_E and G_M at high Q^2
  - Ready by the end of 2017
- Featuring
  - High luminosity capability 10^{38}s/cm^2
  - Small scattering angle, down to 3.5 $^\circ$
  - Large solid angle, up to 70 msr
  - Gas Electron Multiplier(GEM) chamber

High Q^2 measurements for form factor



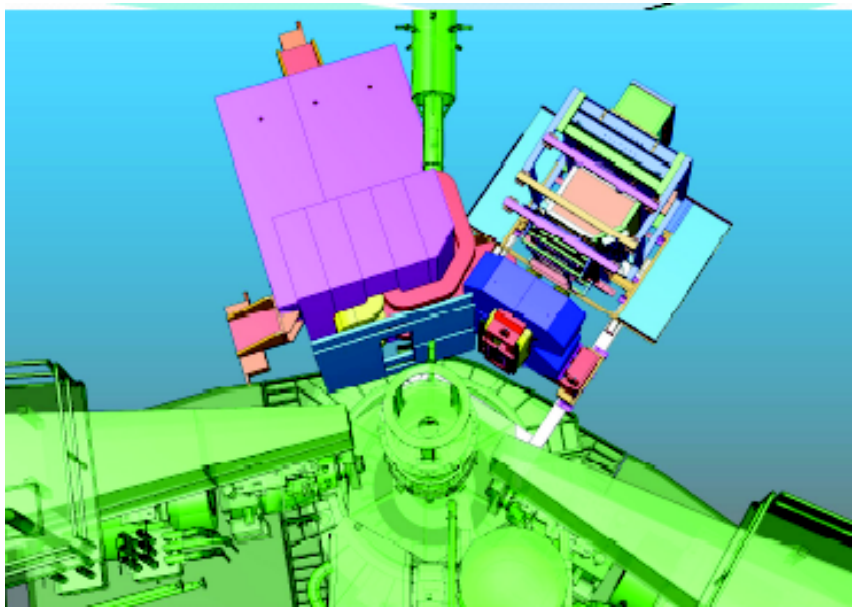


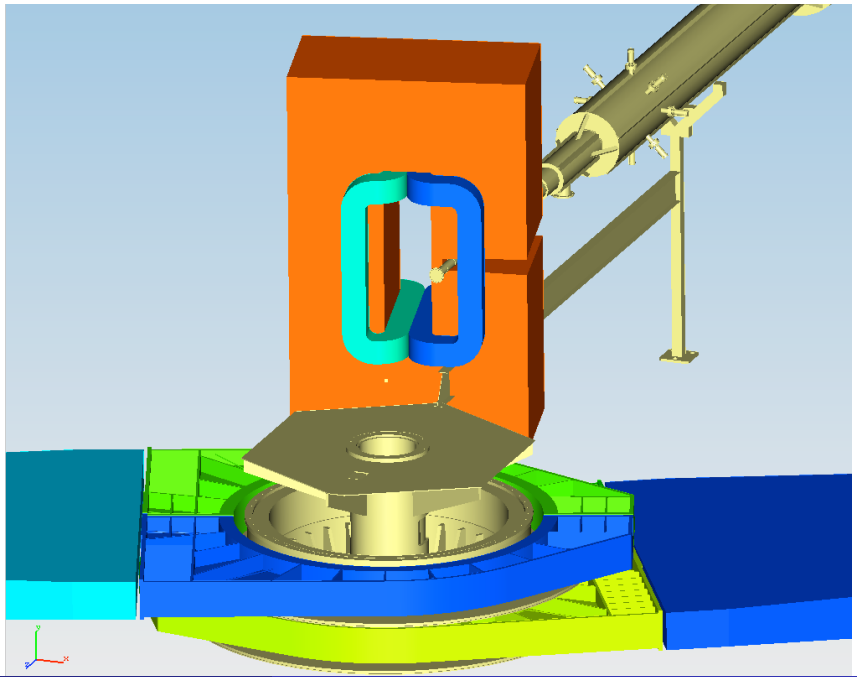


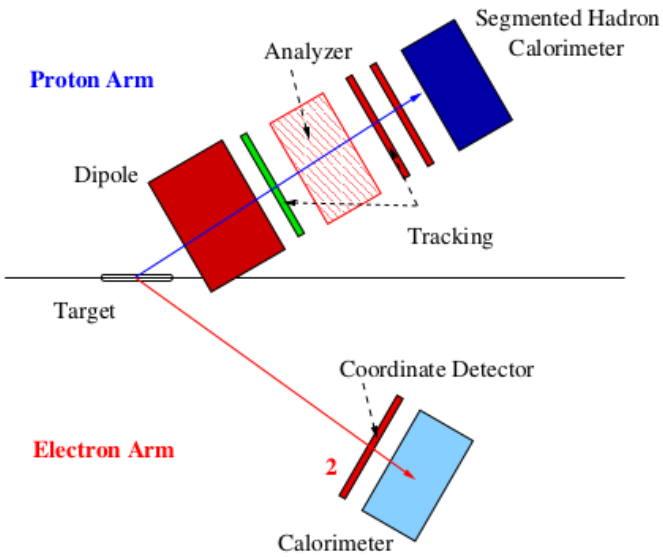


Super-Bigbite: Apparatus

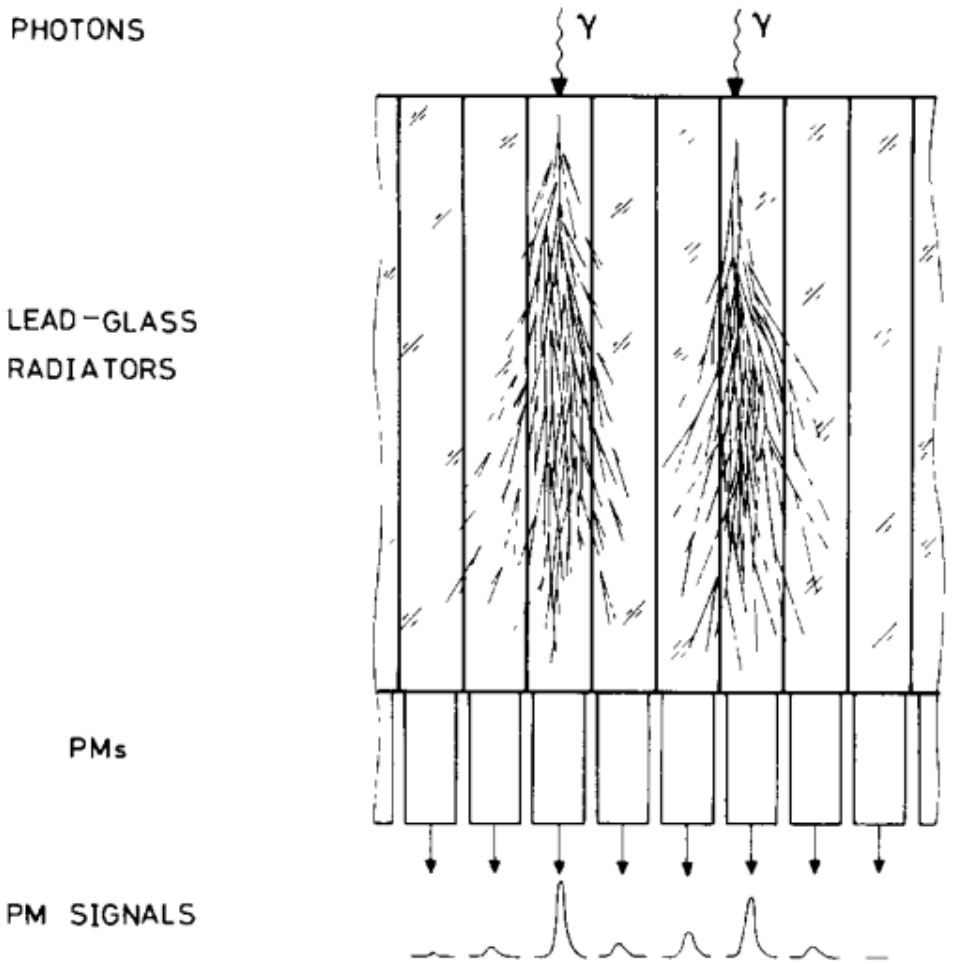
- A Dipole magnet: from BNL
- Tracking detector: using GEM
- Coordinate Detector
- Hadron/electronmagnetic calorimeters







Electromagnetic Calorimeters for G_E^p

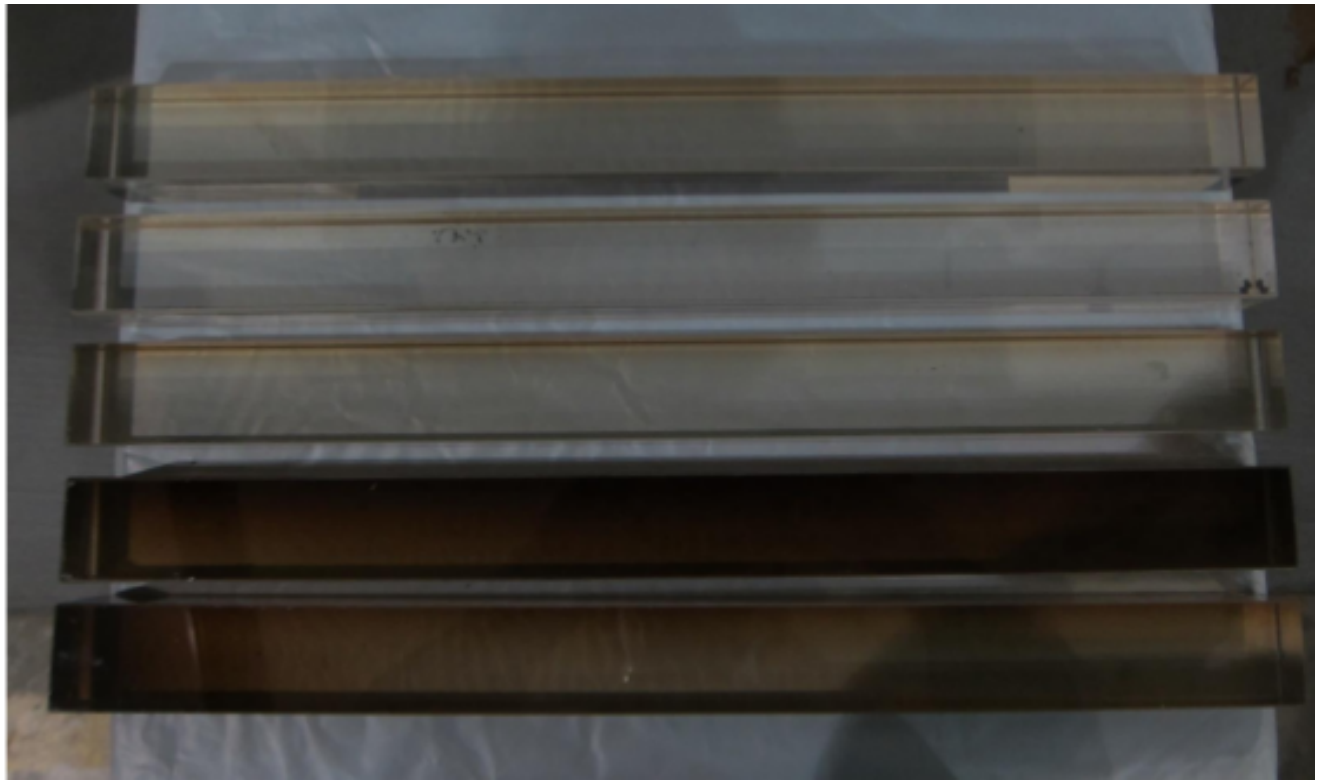


- TF1 Lead-glass : 4cm*4cm*40cm
- Cherenkov radiator from electron shower (γ)
- ECal: measures position/energy of incident particle

*NIM A 248 (1986) 86-102

Radiation damages

- Radiation damages: Darkening of lead-glass
  - decreases transparancy
  - degrades energy resolution
- ECal for G_E^p requires curving under high does radiation rate.
- UV curing is inefficient under high does rate



C200: Overview

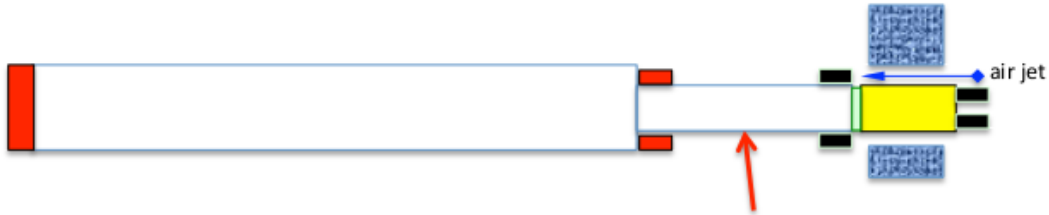
2015 DOE review

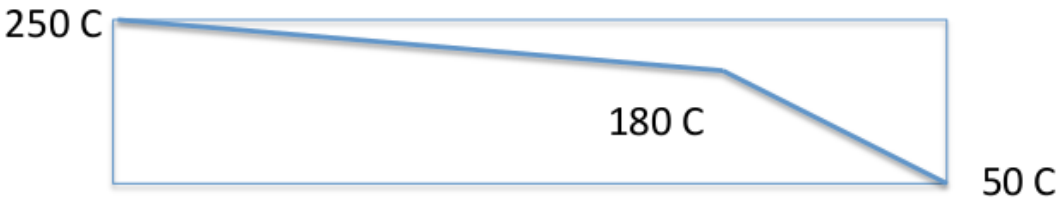
Implementation of an ECAL annealing scheme on the scale of the full detector assembly will take some further R&D which poses some risk. The C200 prototype test appears to be a reasonable next step...

Goals

- searching for a damages curing method for running continuously
- test it on a detector with $\sim$ 200 ECal elements

Curing Scheme





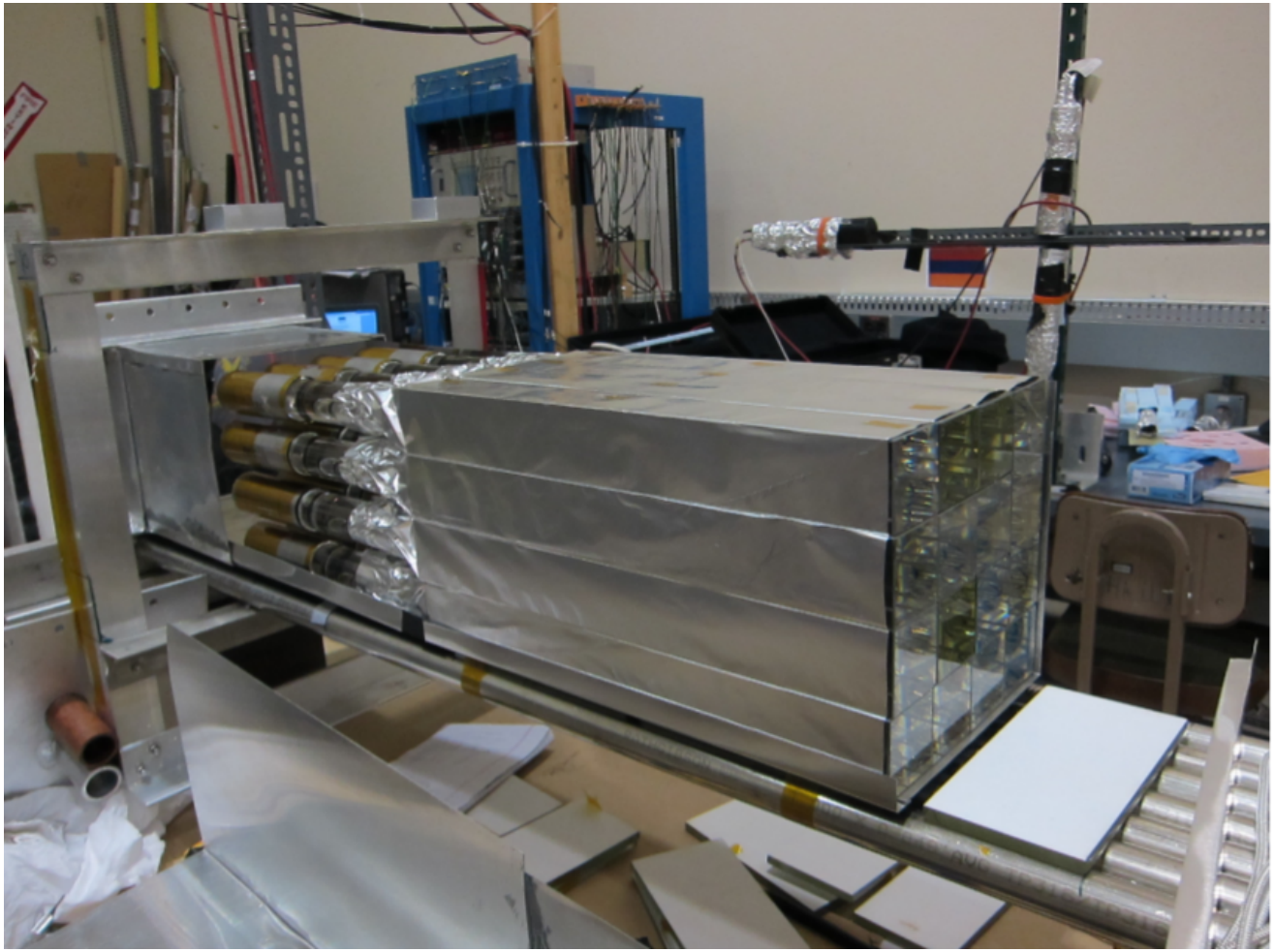
Temperature profile

Power: 0.008x7x130/15 = 0.6 W heat leak through the light guide

A desired temperature distribution

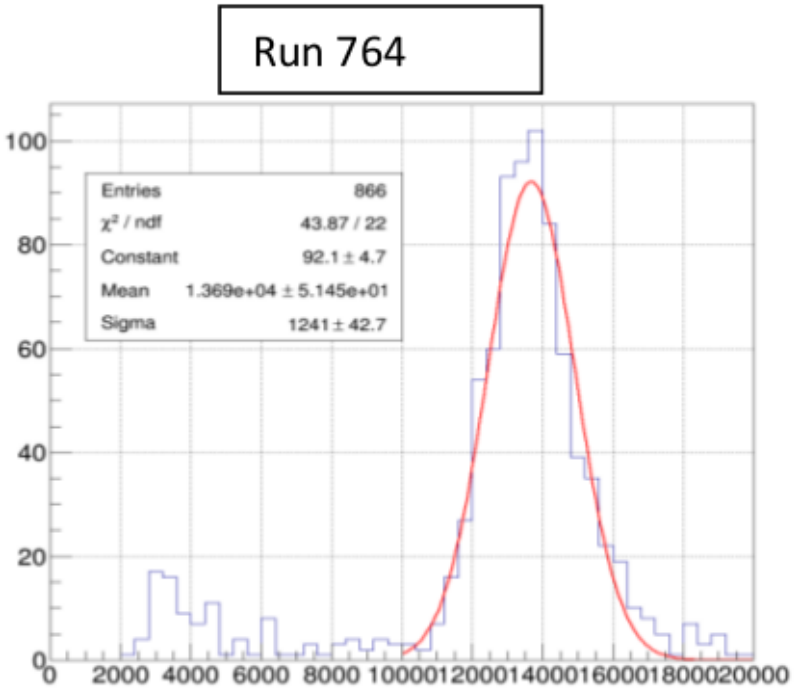
- $\sim$ 250 $^{\circ}$C on lead-glass
- $\sim$ 50 $^{\circ}$C on PMTs

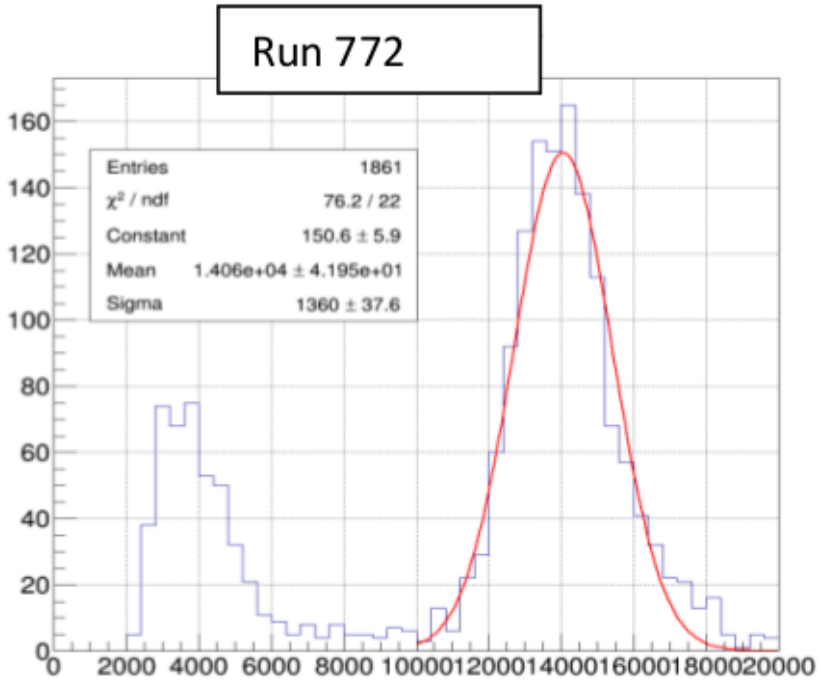
C16 prototype



- 4×4 blocks of ECals.

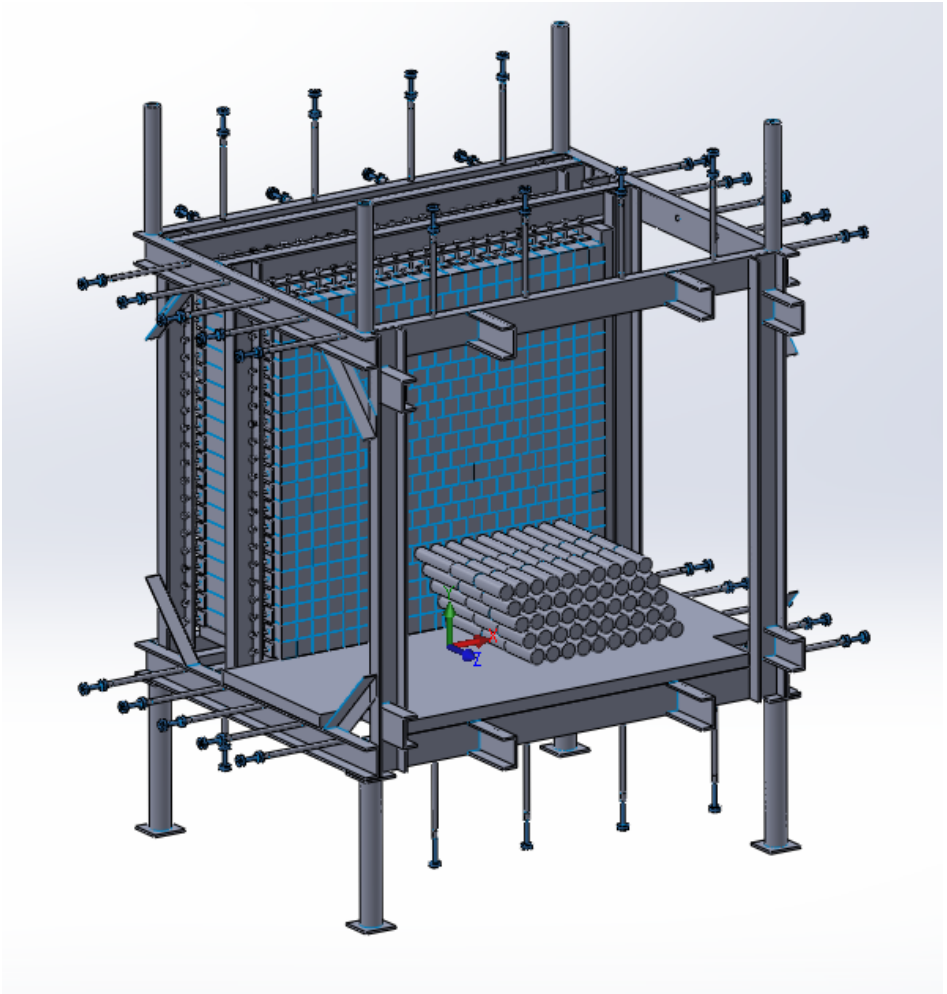
C16: Beam test



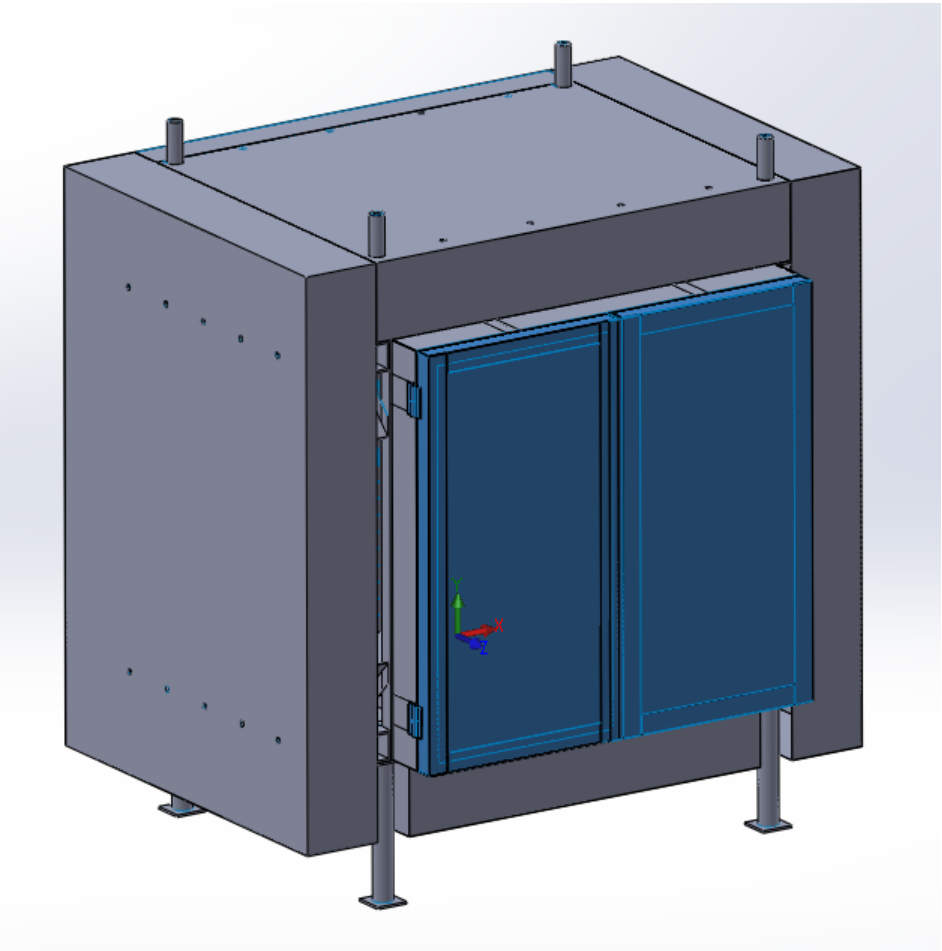


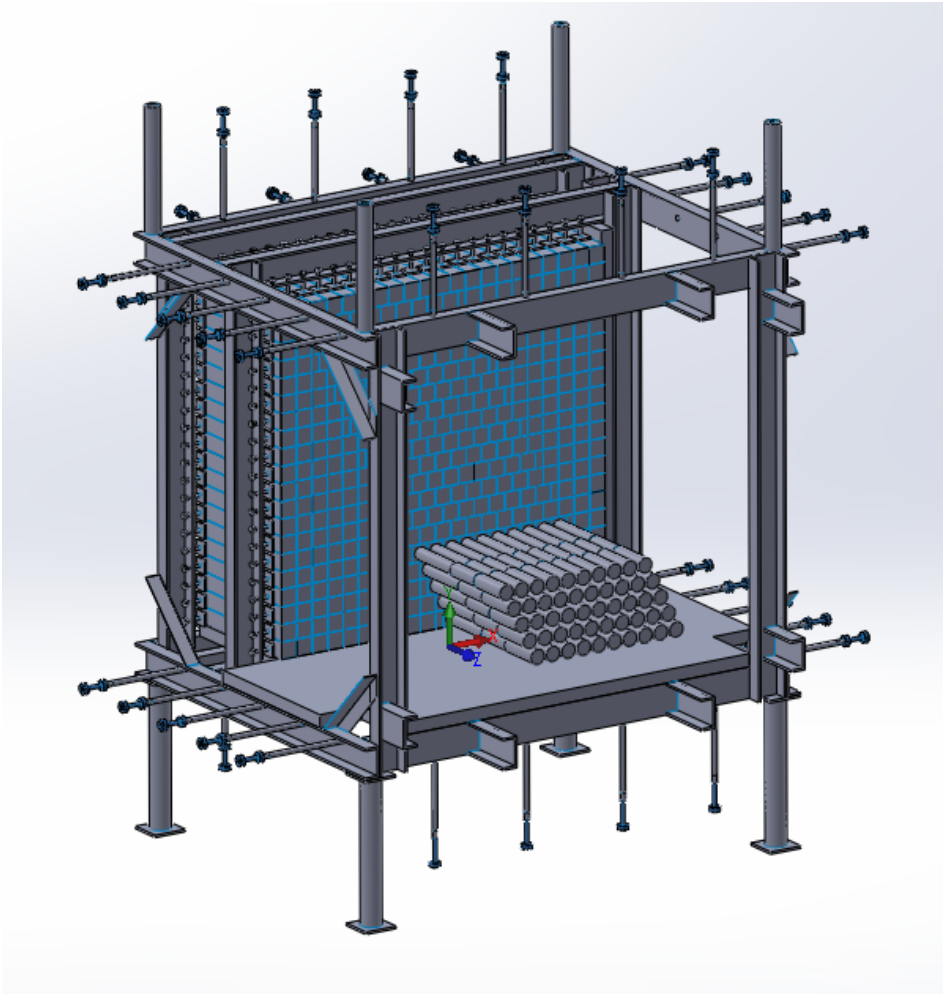
- Before: 9.1% , After(heating):9.7%
- C16: a proof-of-principle for heat annealing
- Next step - C200: to understand what is required for full scale

C200 Design

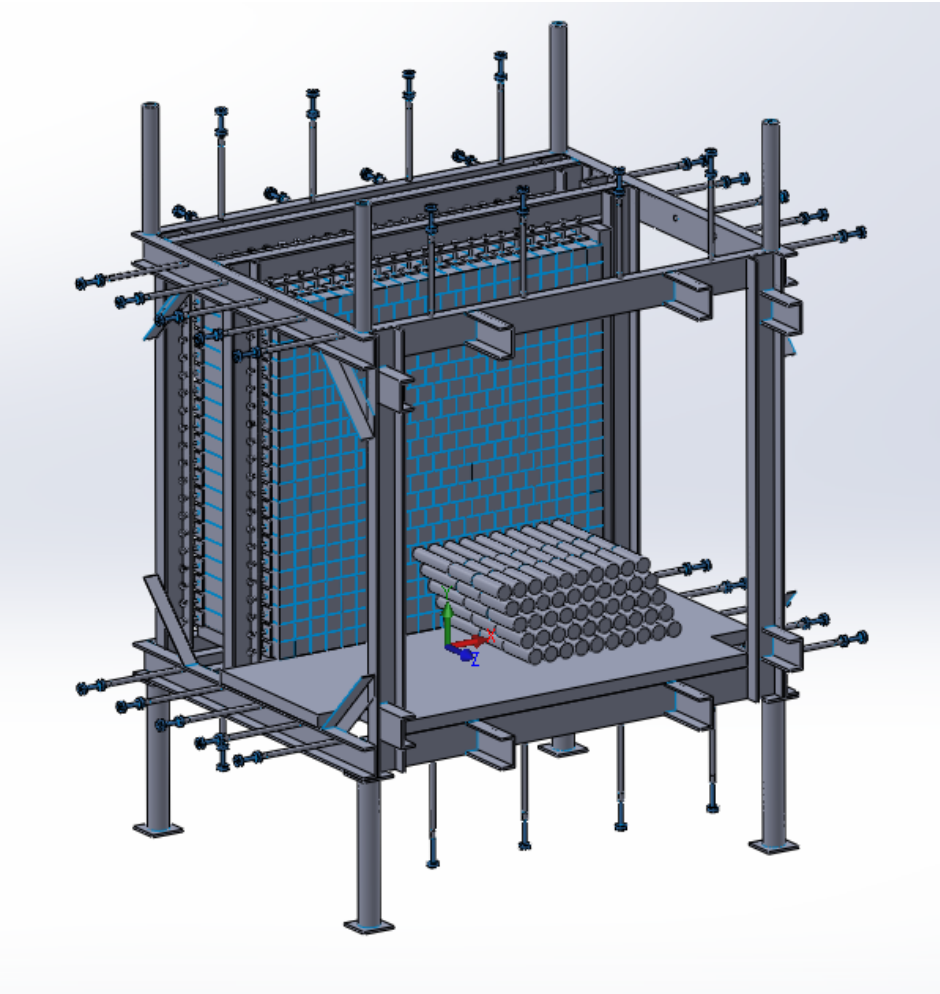


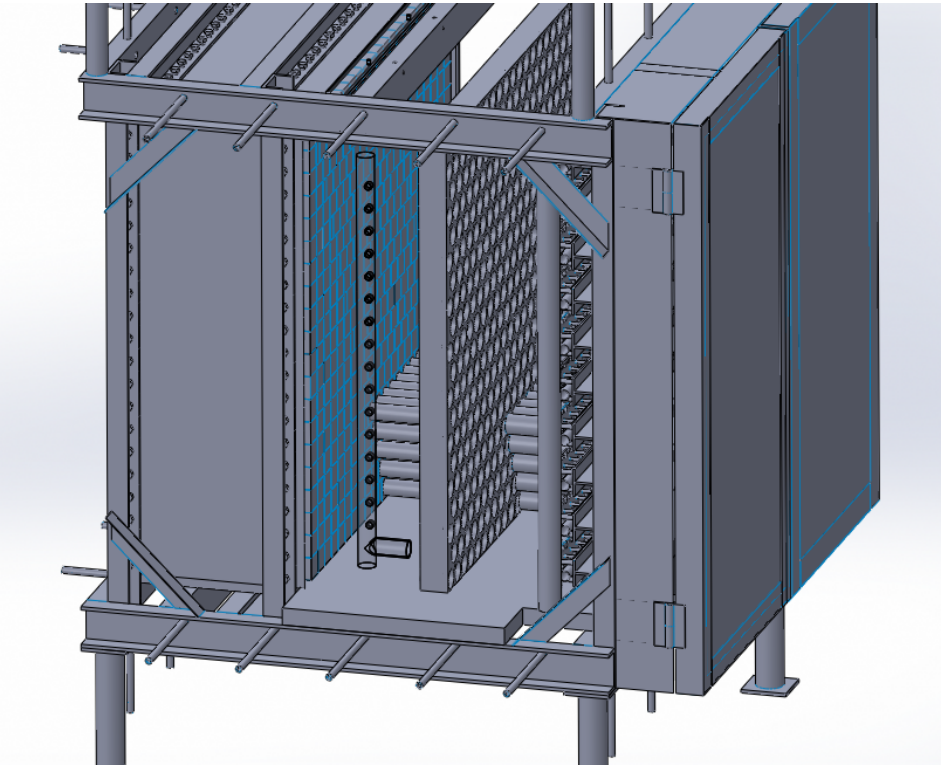
C200 Design



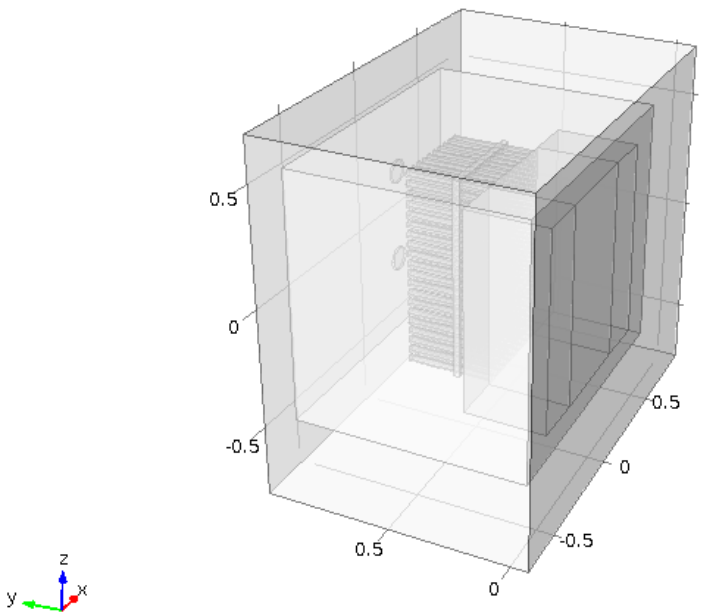


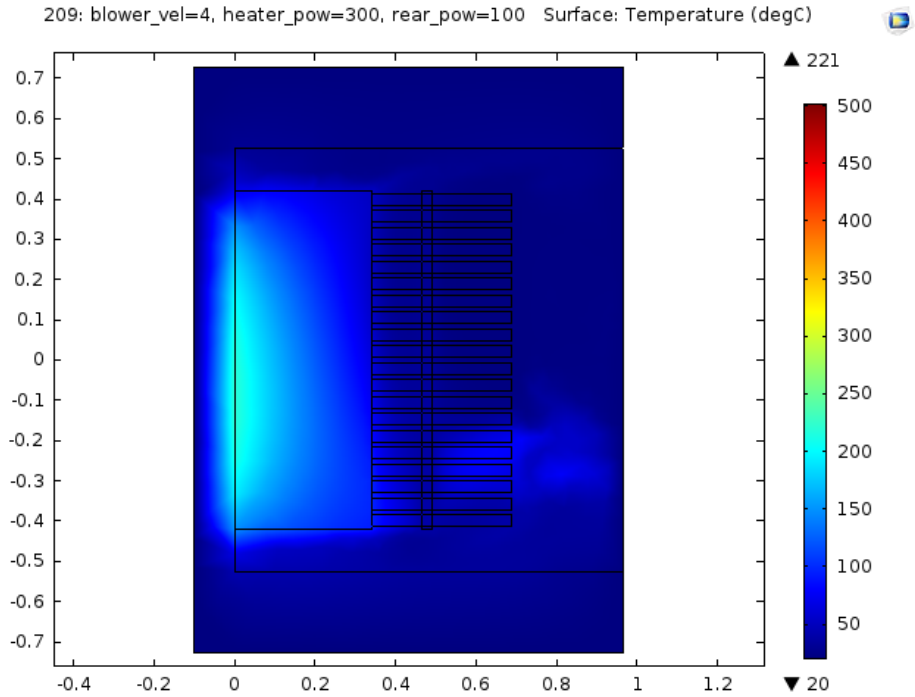
C200 Design





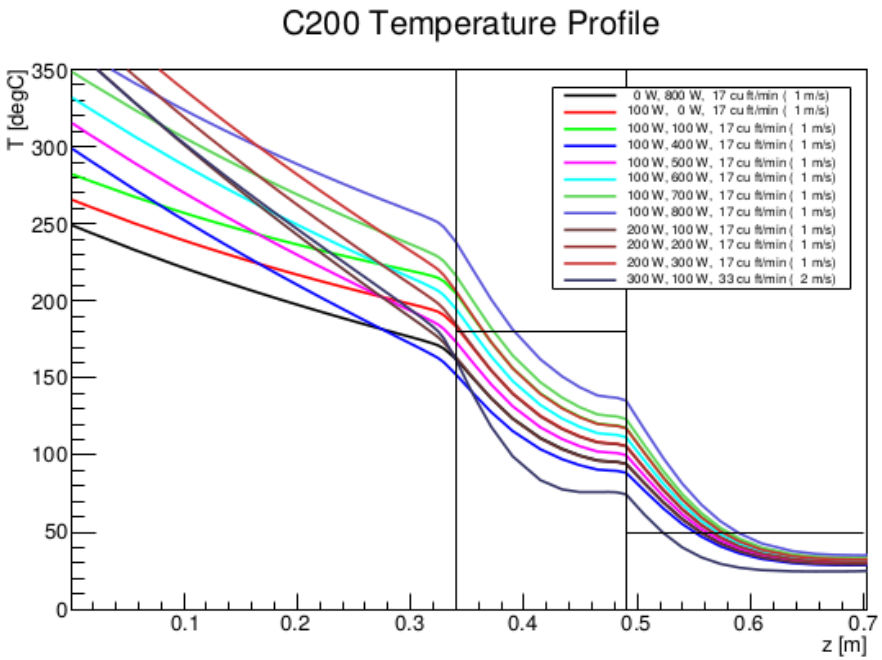
C200: COMSOL Simulation

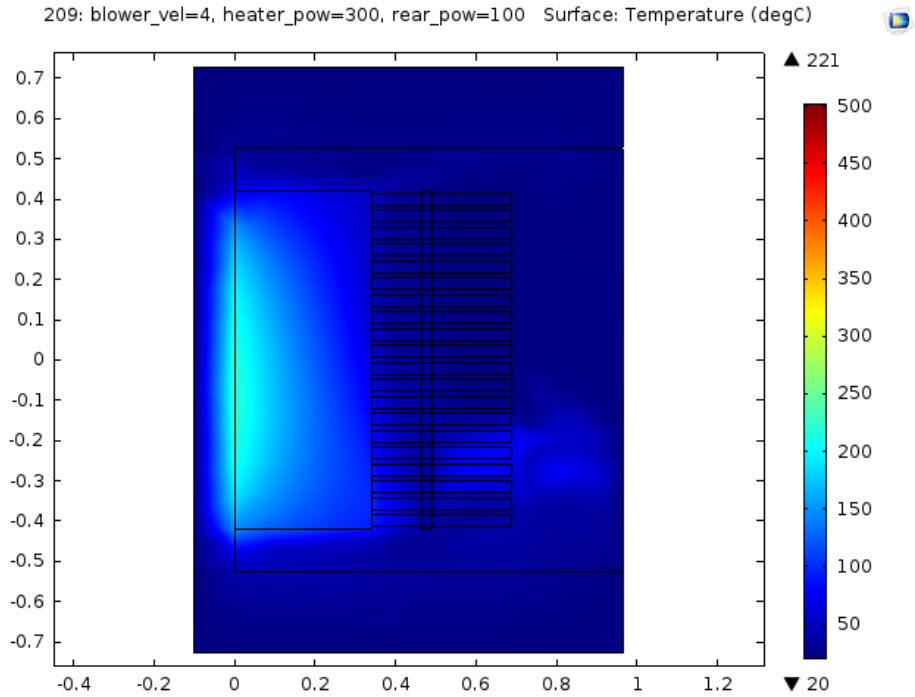




- Desired temperature profile is achieved.
- C200 is being assembled
- Guided with simulation results, a test run will start at this summer.

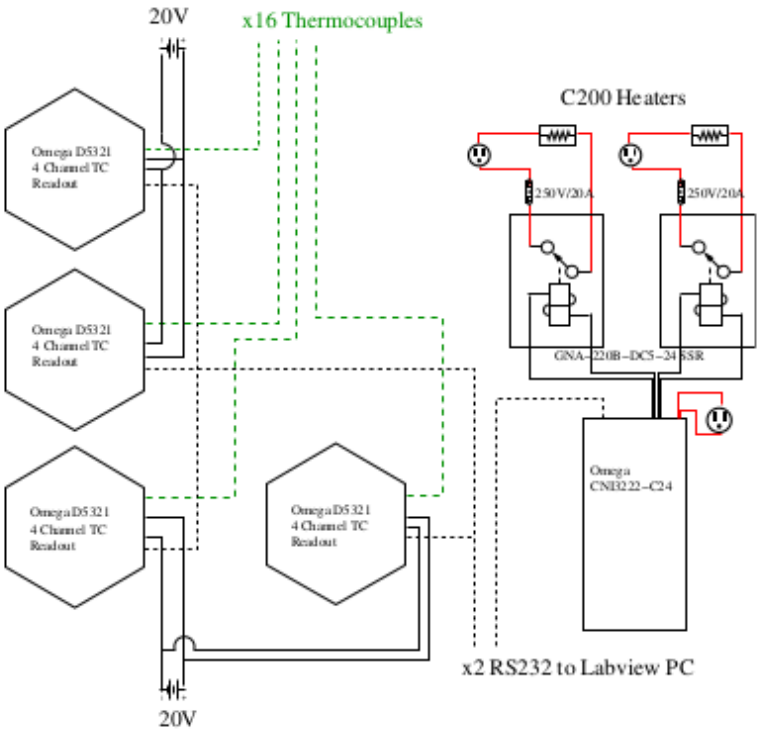
C200: COMSOL Simulation

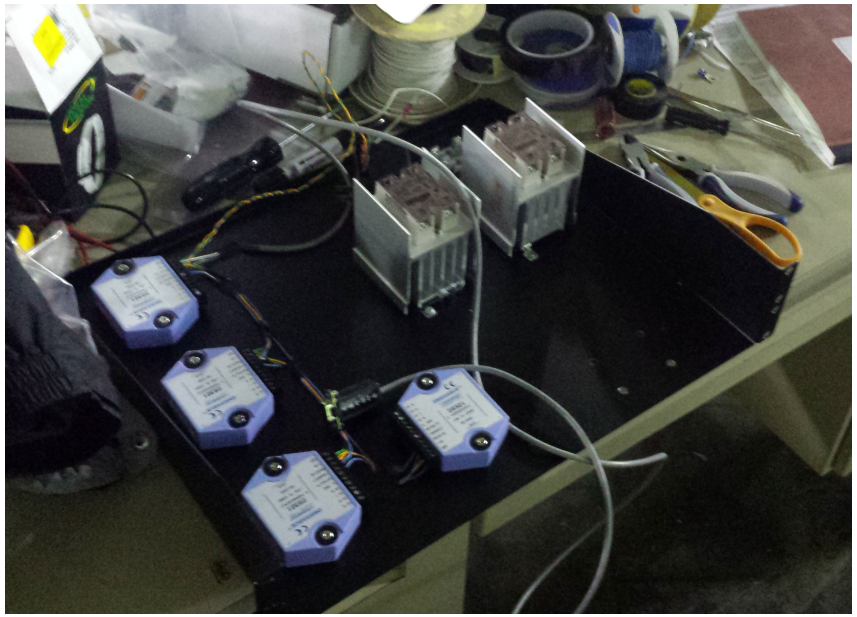




- Desired temperature profile is achieved.
- C200 is being assembled
- Guided with simulation results, a test run will start at this summer.

C200: Data Acquisition and Control modules





- 16 thermal couples + readout modules
- Control : temperature control + solidstate relay

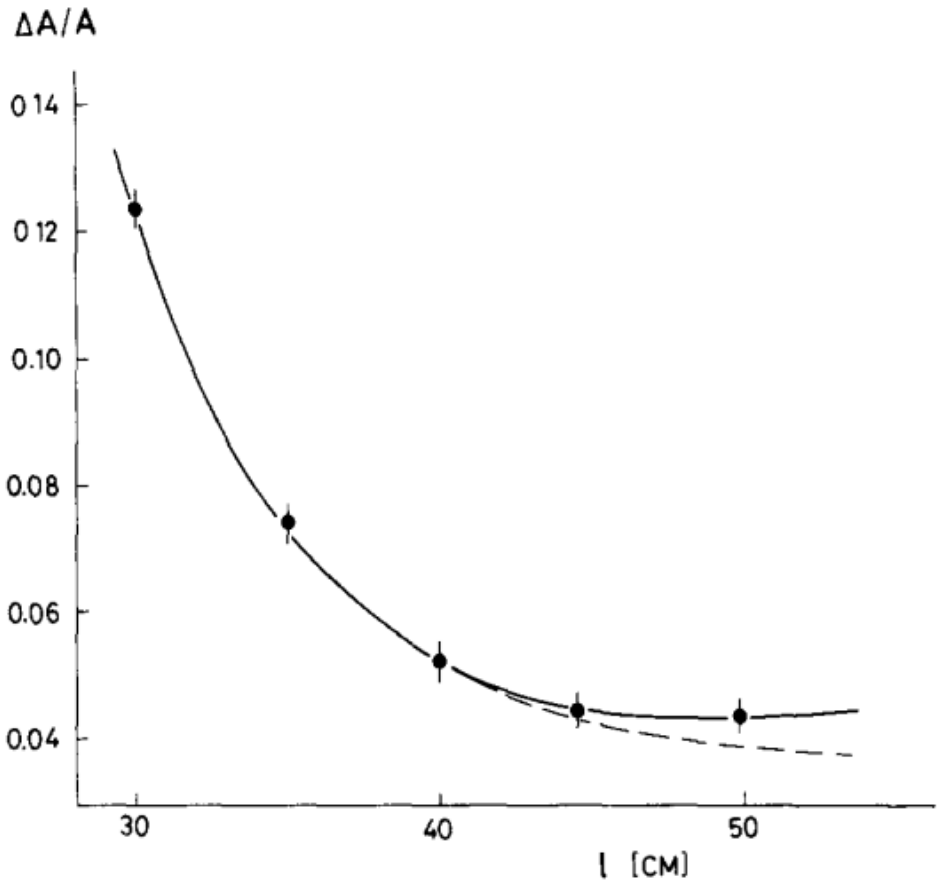
Summary

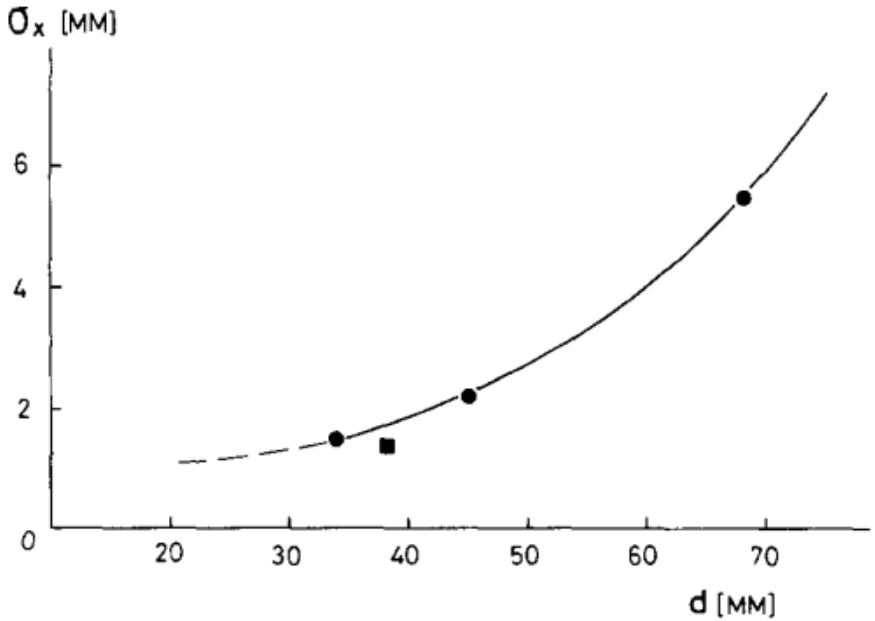
- As a fraction of Super-Bigbite program, C200 offers a lot of interesting challenges to be solved.
- C16 provides a proof of thermal curing method
- C200 prototype will tests the operation at large scale

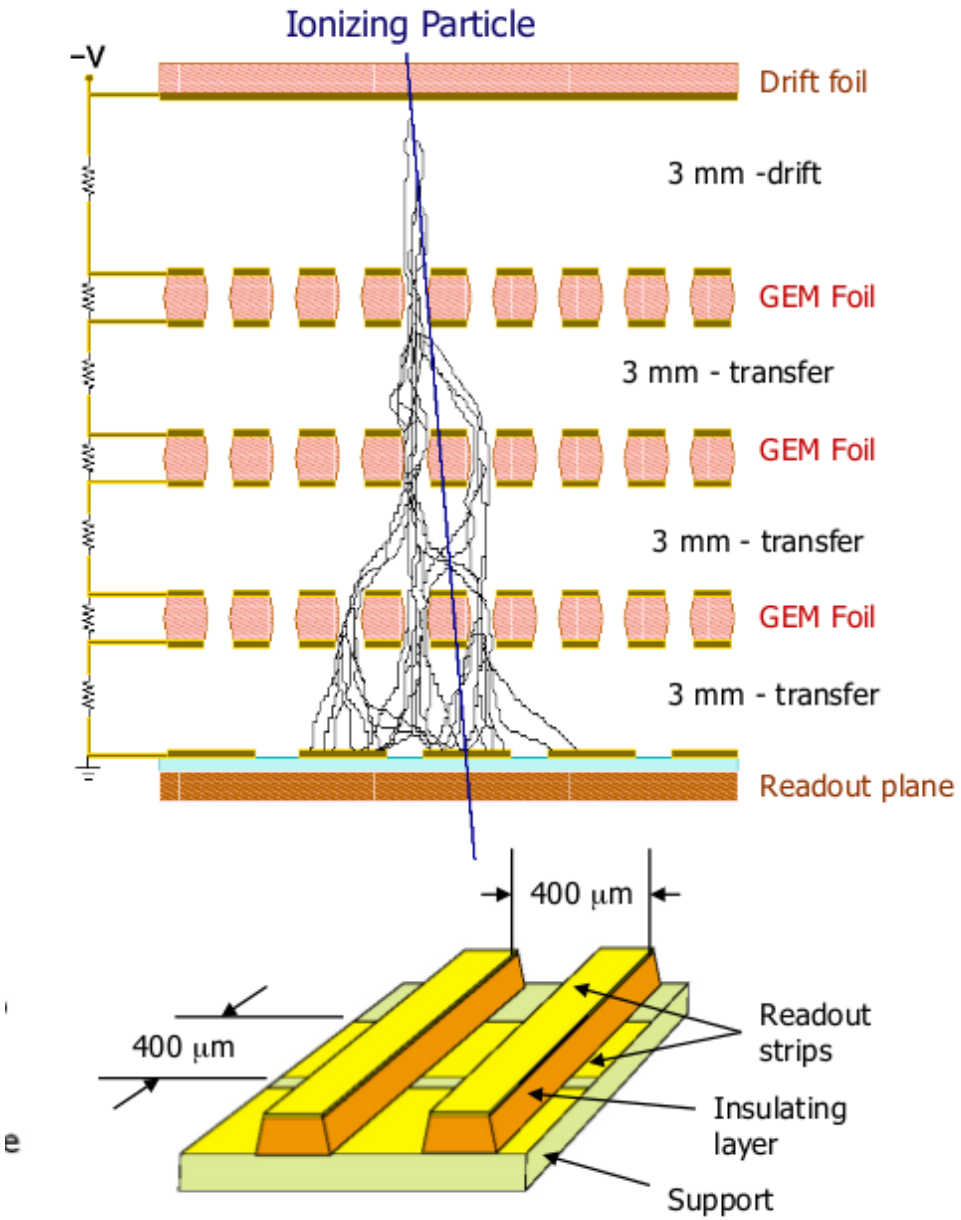
BACK UP

back up slides

Lead-glass: size





NIM A 248 (1986) 86-102

GEM chamber and electron avalanche