SBS Electron Calorimeter

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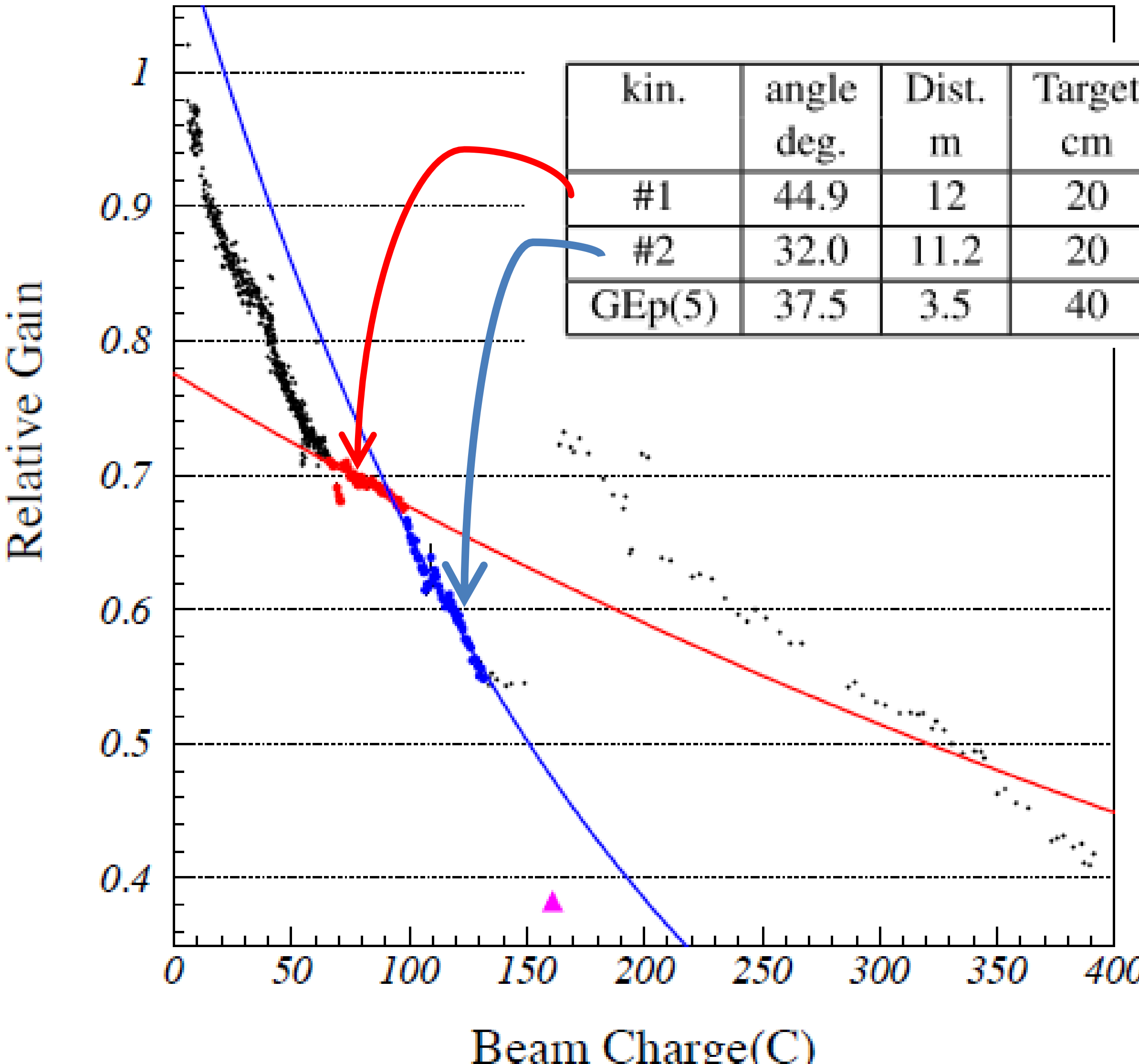
ECal in SBS GEp experiment

- ECal detects scattered electron at about 30 deg and 5m from 40cm LH2 target at beam current of 70uA.
- Trigger on coincidence between the ECal and HCal detectors. Need ECal trigger level at 90% of the elastic peak energy to reduce accidental and true inelastic trigger rate to acceptable levels.

- In original plan to reuse the 1744 TF-1 lead glass blocks from Hall C BigCal .
- TF-1 is susceptible to radiation damage.
- During Hall C experiment,
  - The trigger level was at 50% of the elastic peak.
  - The rate of damage was slow enough that PMT HV could be adjusted as necessary to compensate.
  - The radiation damage was cured by UV radiation during the middle of the experiments.

Gain loss during Gep-3



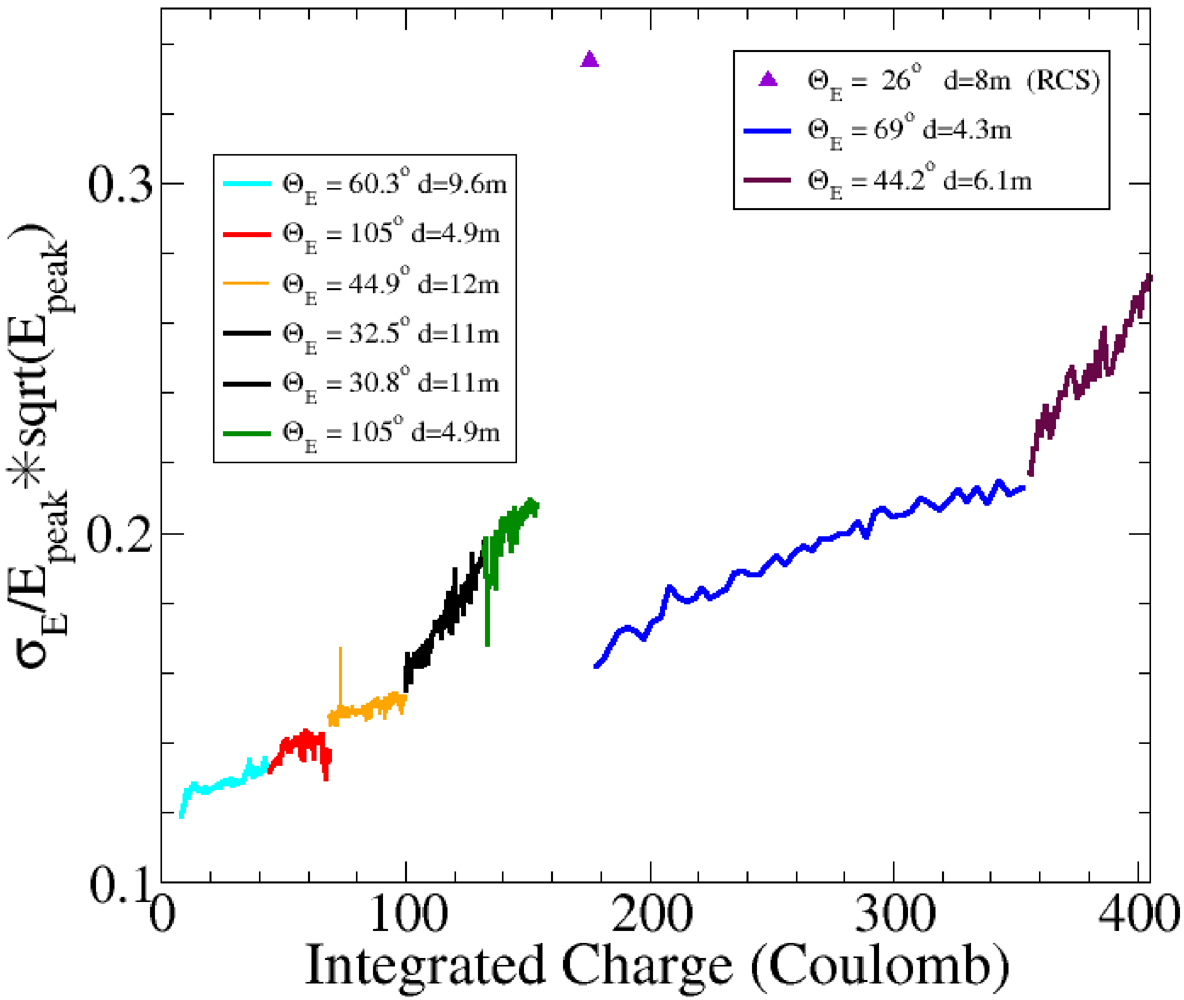
kin.	angle deg.	Dist. m	Target cm	E GeV	Gain loss rate b	soft photon flux J/cm^2/C
#1	44.9	12	20	2.839	0.14%/C	0.0039
#2	32.0	11.2	20	3.539	0.53%/C	0.013
GEp(5)	37.5	3.5	40	3.539	~ 6.7%/C	0.17

- Expect 13x increase in rate of gain loss for Gep5
- For 75uA beam ,

  0.87% gain loss/hr

Plots and work by Wei Luo

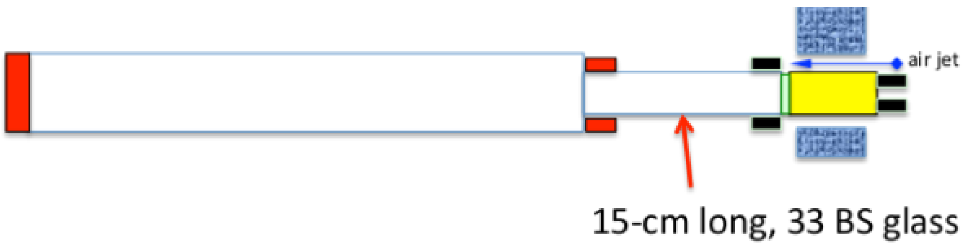
Energy Resolution during Gep-3

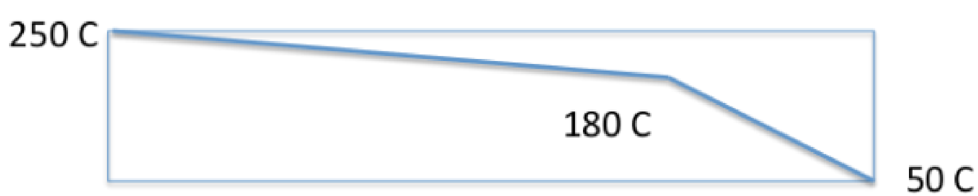


- Θ = 32.5 slope of 0.15%/C during Gep3
- Assume factor of 13 increase for Gep5 so 1.95%/C.
- In 8 hour period expect 2% additive increase in energy resolution

Which annealing technique to use?

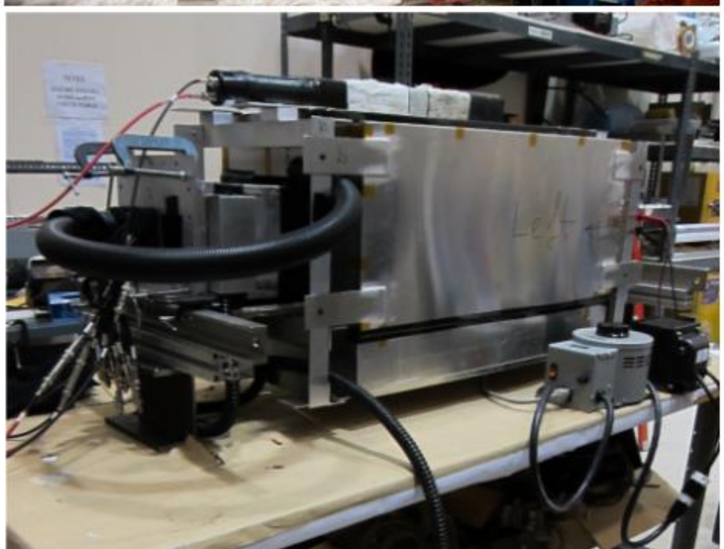
- Need to improve rate of UV curing. Found that even with higher intensity UV , the curing rate rate would only reach a steady state of level of 60% of maximum gain with energy resolution of 20%/sqrt(E). Not acceptable.
- Test showed that continuous thermal annealing, curing rate larger enough to counteract the damage rate without dropping gain and resolution would not be affected.
- Decide at SBS 2014 Summer Collaboration meeting to use continuous thermal annealing.



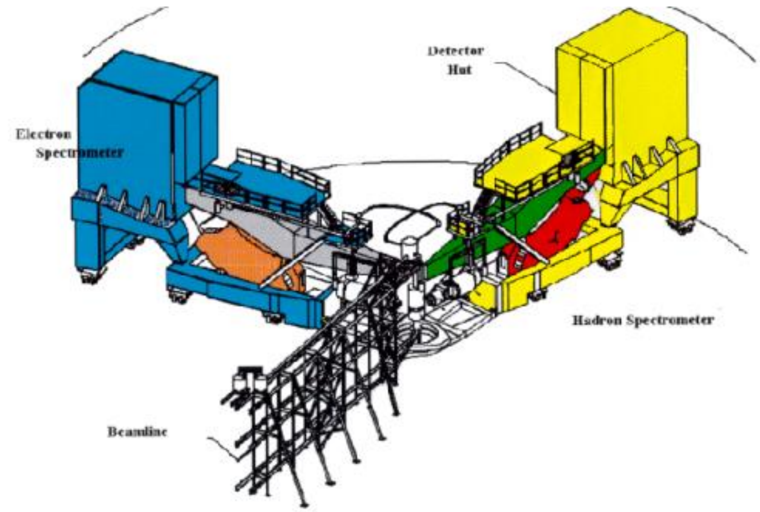


Temperature profile

Test of annealing in beam



C16, 4x4 array of lead glass inside an oven



- Place with HRS coincident ep trigger
- Accepted 31° e^-
  E' = 1.6 GeV, d = 6.9 m
- Dose rate several times G_E^p configuration
- Place at 10°, E = 2.1 GeV, 15 cm LH_2, 20 μA target 7 hours for damage - test at 31° again

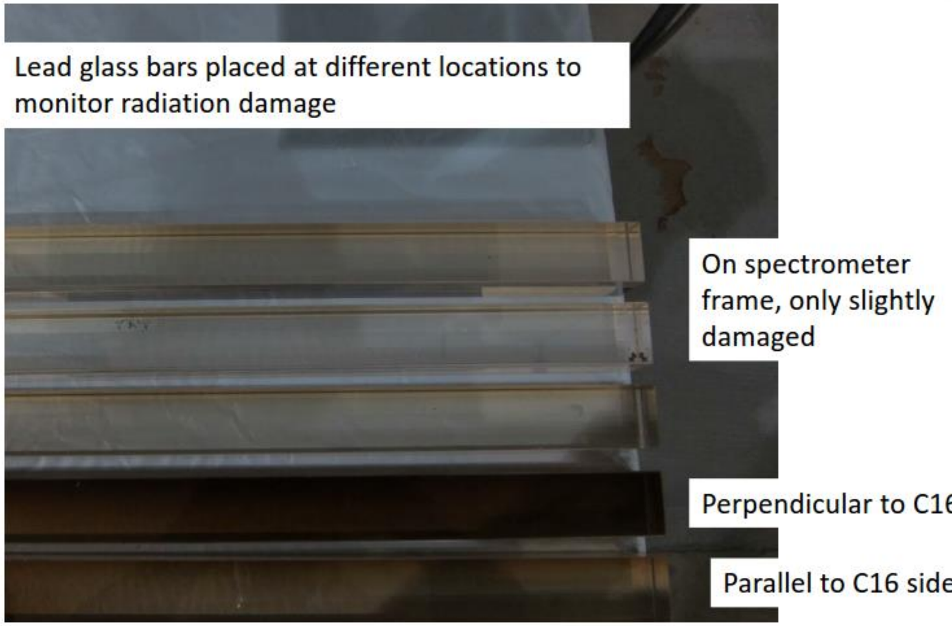
Test of annealing in beam

Energy resolution before irradiation	8.1 +/- 0.2 %
Energy resolution After irradiation	8.9 +/- 0.2 %

Change in gain after irradiation for each block

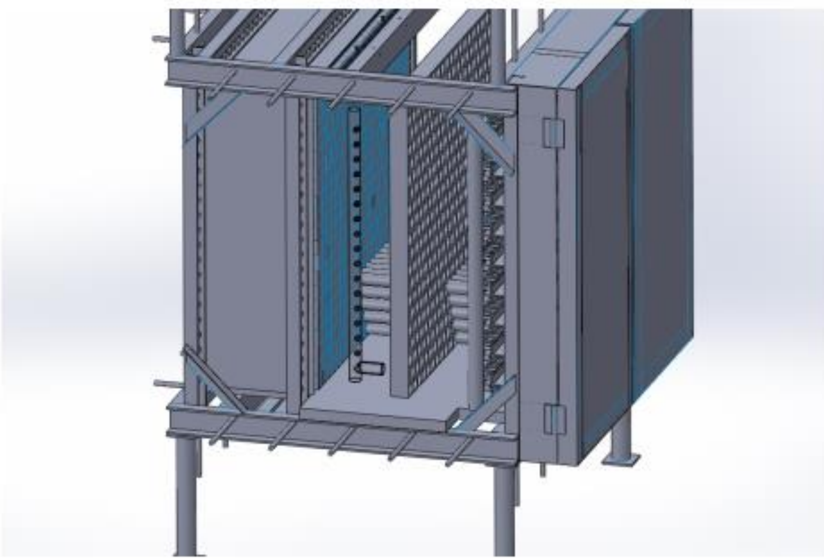
0.92	0.82	0.89	0.67
0.86	0.89	0.93	0.71
0.87	0.89	0.86	0.67
0.67	0.82	0.86	0.87

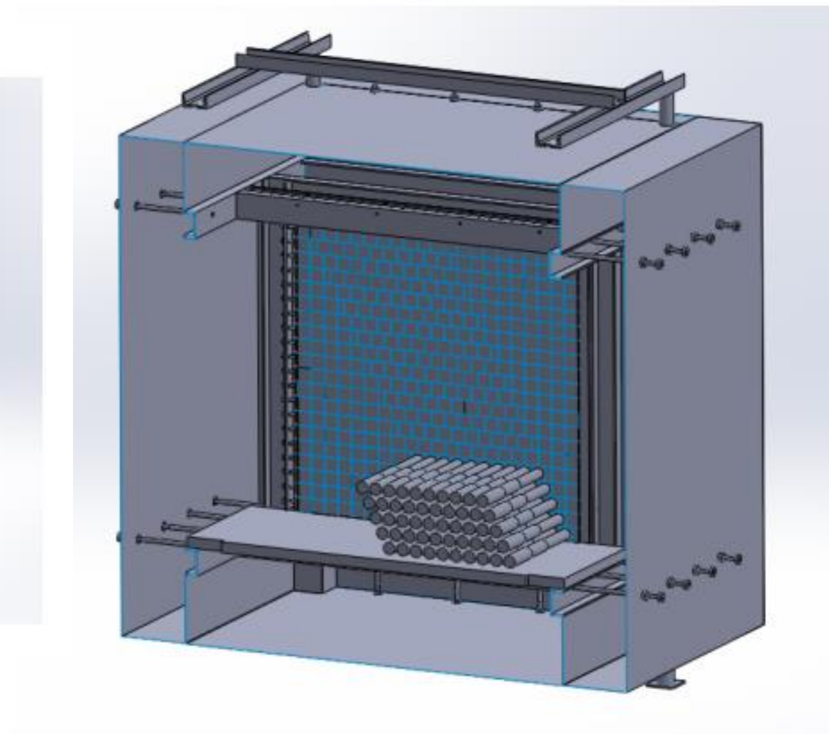
Damage after 7 hours with C16 at 10^o



C200 prototype

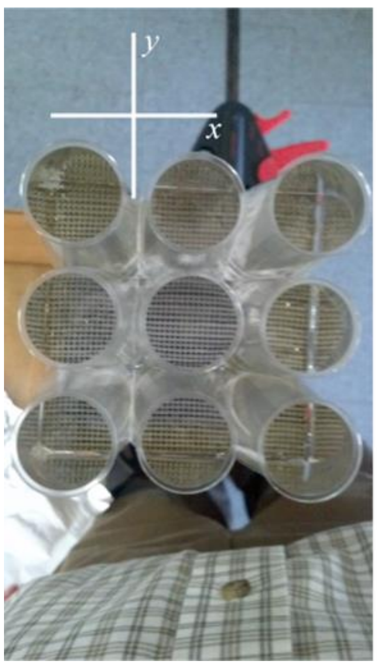
- Seamus Riordan, StonyBrook, building a prototype with 200 blocks to develop the techniques and design for the large 2000 block detector.
- Main frame for C200 will be completed by end of January and testing will begin.
- Goal is to have results by June 2016.

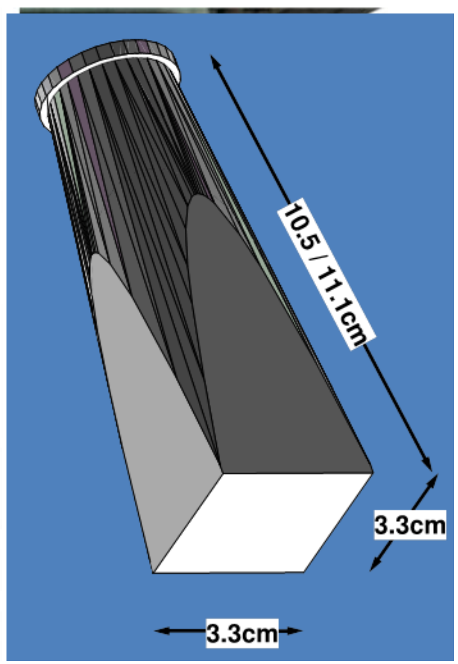




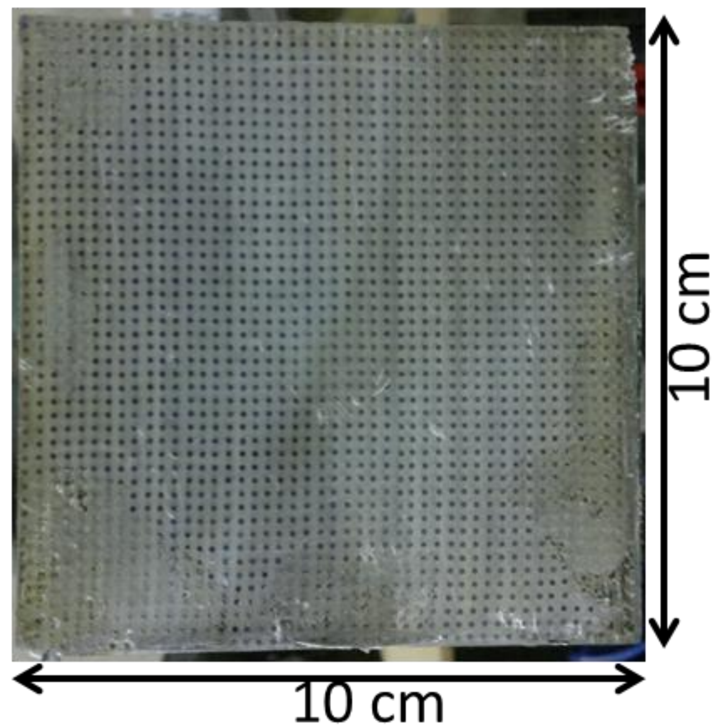
New possibility for ECal

- In December 2015, Brookhaven offered using the E864 lead-scintillating fiber hadron calorimeter.
- Individual modules 10x10x117cm. Need to cut lengthwise and then use light guides to divide in 5x5cm section.





Example of test at BNL with 3.3x3.3cm



Summary

- Need to a comparison of cost, risk and affect on the experiment for three choices
  - Original UV curing
  - Continuous thermal annealing
  - Repurpose BNL calorimeter

- Last SBS DOE review and recommendation:

"The Laboratory is urged to evaluate the ECal project including the technical feasibility of the annealing solution, and ECal project cost and schedule, by summer 2016."