ECAL for GEp/SBS

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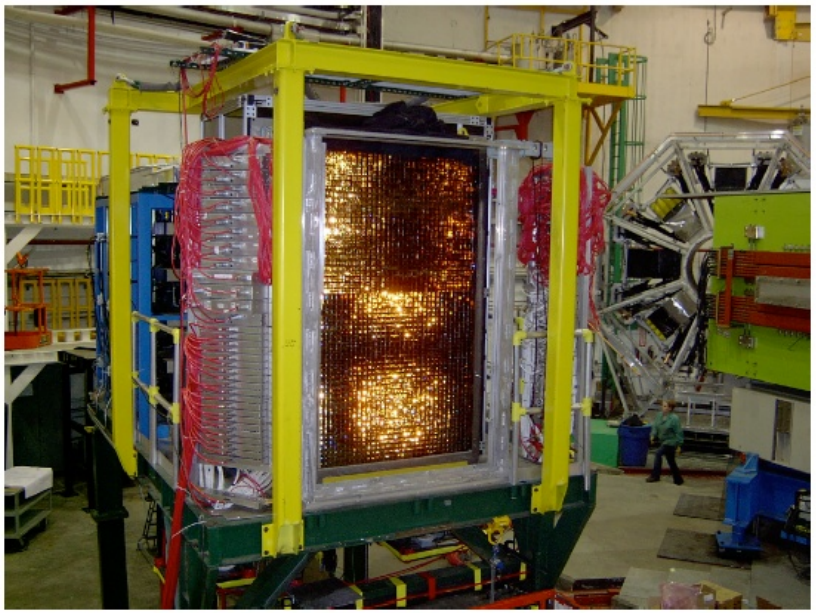
Electron Calorimeter for GEp

Performance Requirements

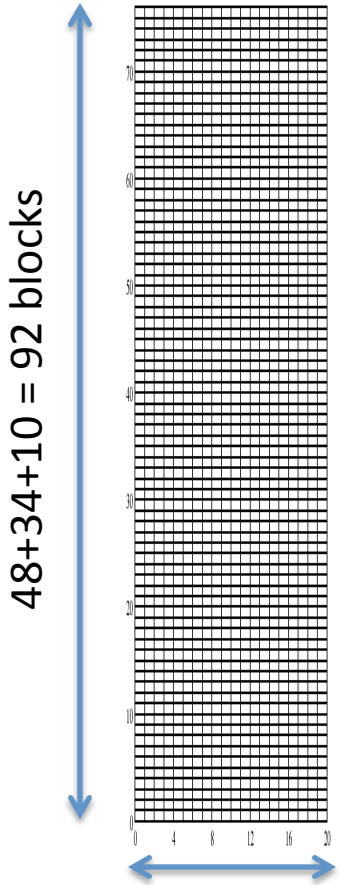
- Function: Detect 4 to 5 GeV Electrons
- Energy resolution: σ/E ~10% for 3.5 GeV electrons
- Spatial resolution: 6-8 mm
  (2 mm with upstream coordinate detector)
- Full luminosity: $8\ 10^{38}$ Hz/cm^2
- Trigger: Overlapping segments correlated with the proton
  Trigger at 75+% of elastic peak

BigCal for GEp experiment

Used in Hall C GEp3

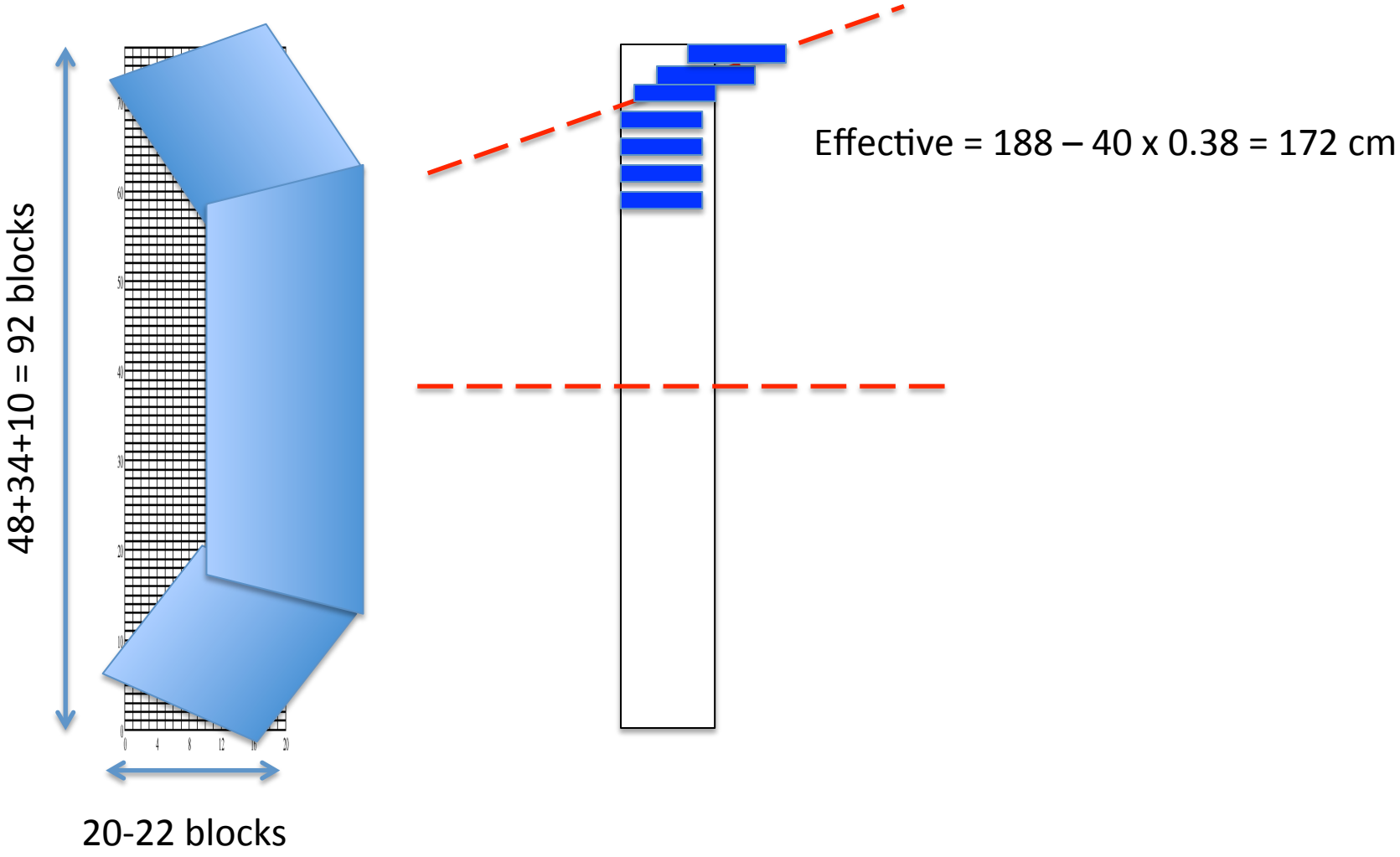


Reconfigure



- ECAL-SBS
- Configuration: (960 + 714 + 220) = 1894 blocks
- Block size : 4.2x4.2x40, 4x4x40, and 3.8x3.8x45 cm^3
- Area: 0.84 m x (2.02+1.36+0.38) m = 3.75 m^2

BigCal for GEp experiment



All transmission studies were performed for the wave length of 405nm

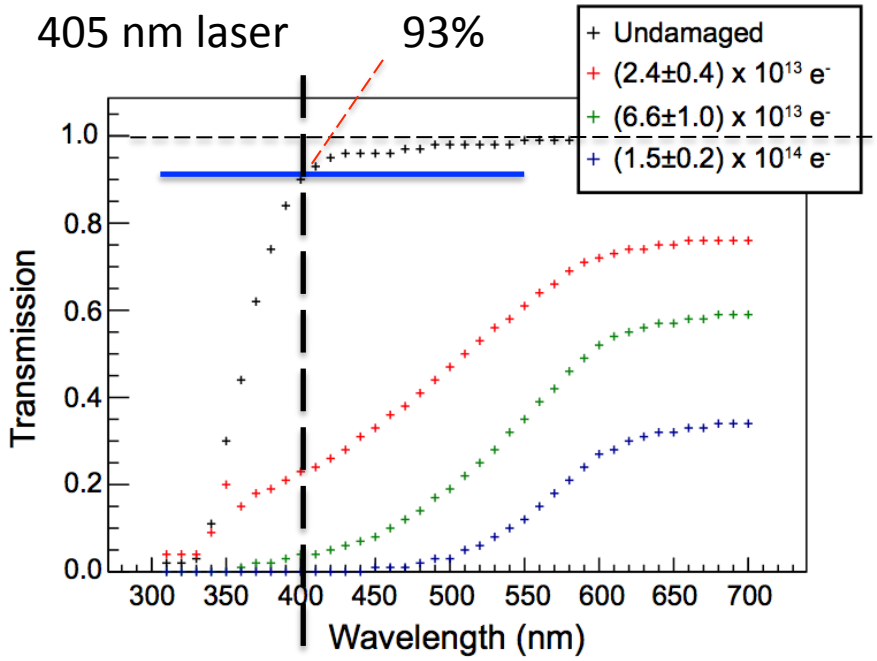


Figure 5: Transmission coefficient of 4 cm of lead glass as a function of wavelength for various amounts of radiation. Estimated errors are 2% (10%) for wavelengths above (below) 380 nm.

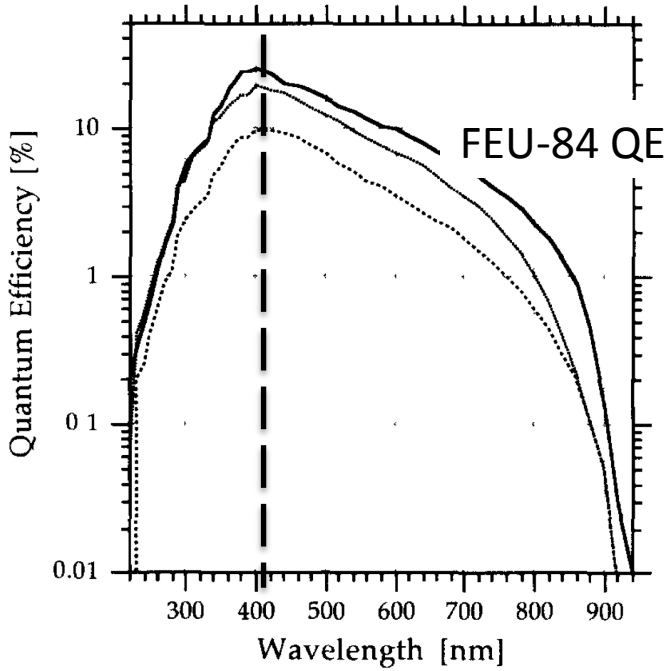
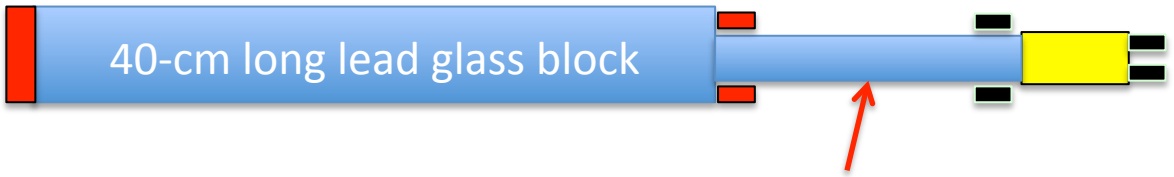
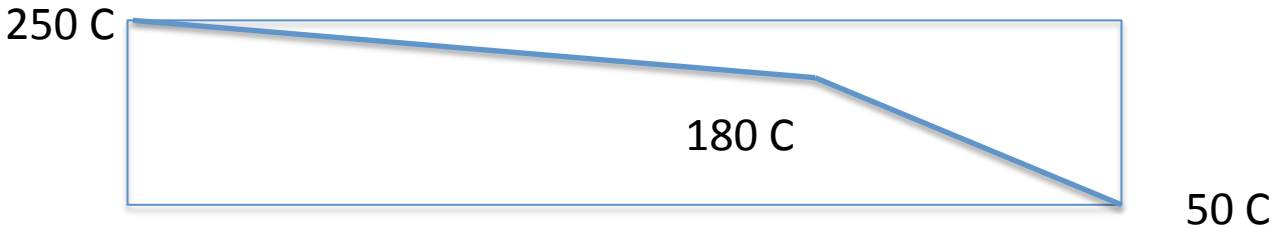


Fig. 4. The absolute quantum efficiency of three FEU-84-3 phototubes as measured by Hamamatsu Inc. using a calibrated source. Three tubes were selected, using the method described in the text, as having relatively high, medium and low relative quantum efficiencies.

The scheme under investigation



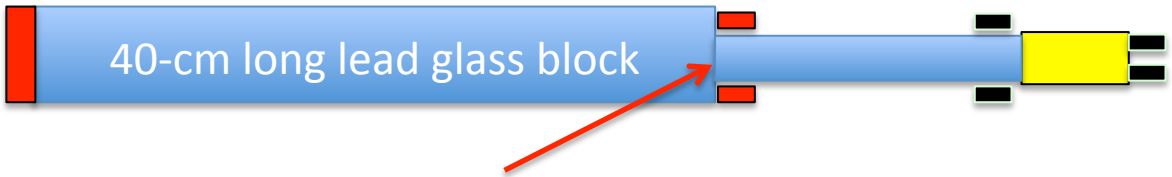
15-cm long, 33 BS glass



Temperature profile

0.008x7x130/15 = 0.6 W heat through light guide

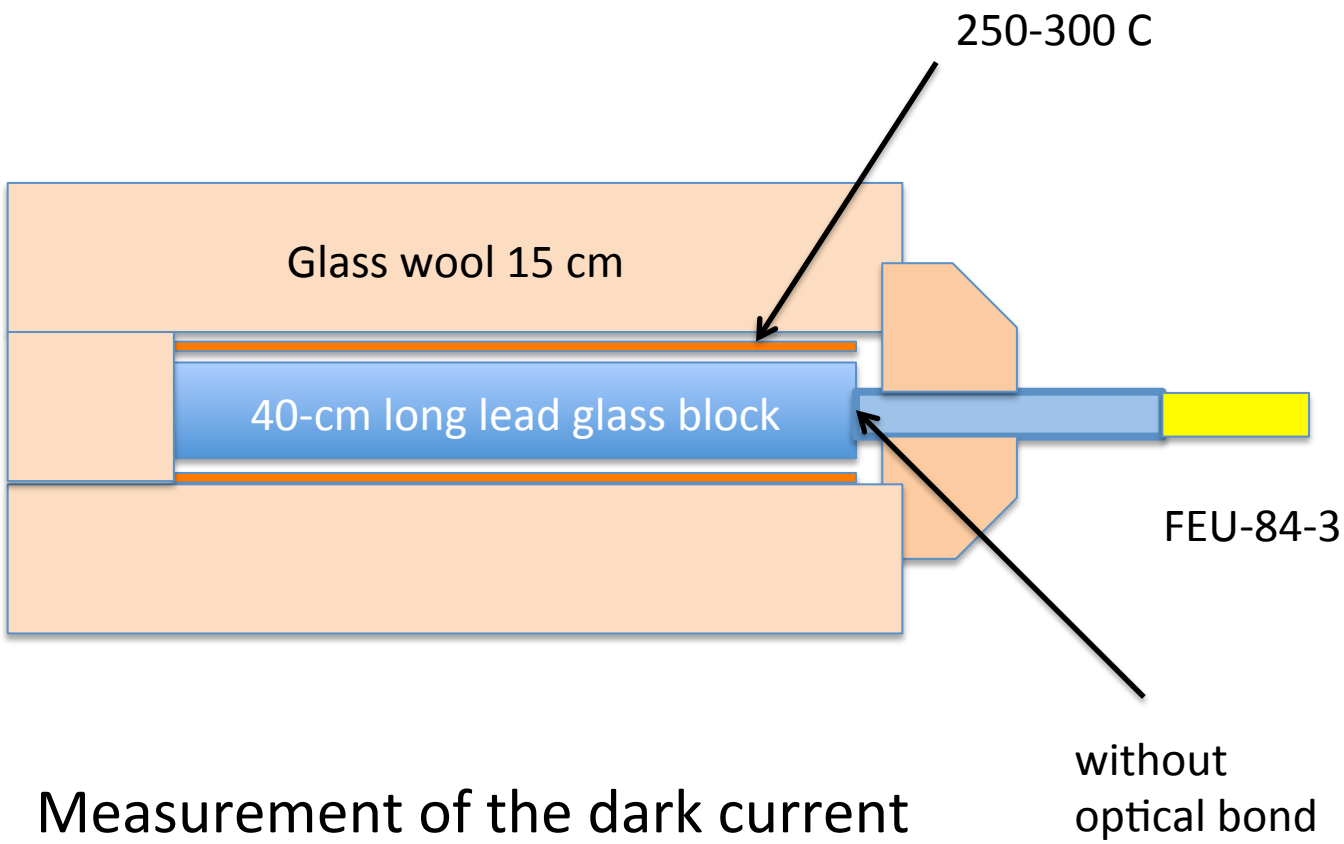
The scheme under investigation



Optical contact at 180 C

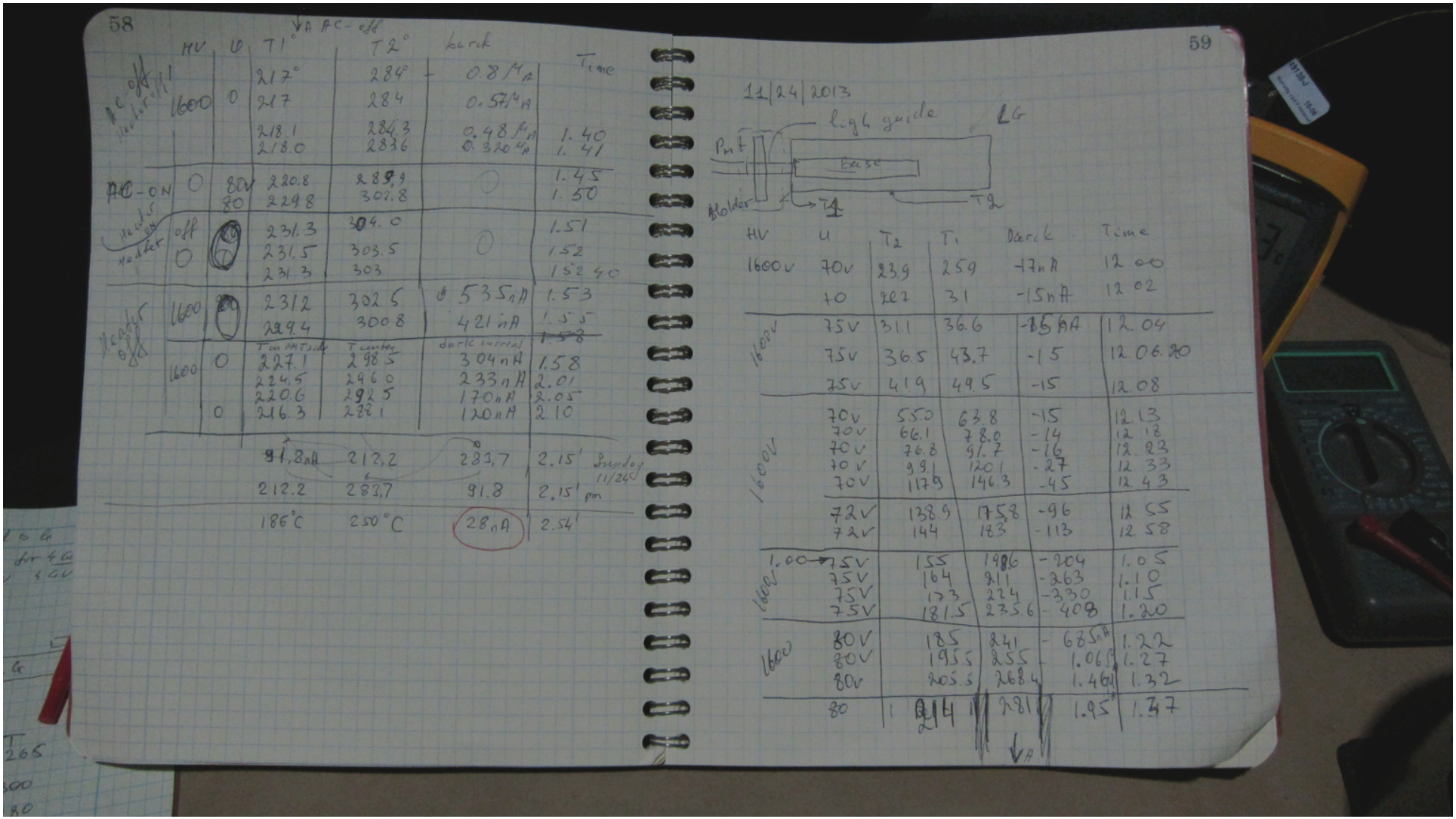
- Dow Corning OE-6630, 200 C, need test for 250 C
- Optical epoxy 353NDPK, 200 C, need to test at 250 C
- TRA-bond F202: clear epoxy: strong and good up to 250 C
- Frit bonding, can be used also

The dark current experiment



Measurement of the dark current

The dark current experiment



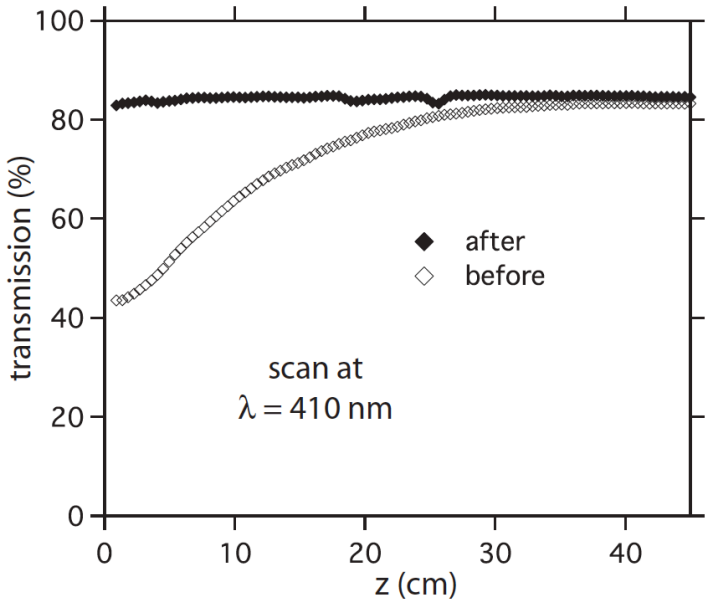
The dark current experiment

Conclusion:

At temperature 250 C of the lead-glass the PMT anode current is of 28 nA which is 1/10 or less of the projected beam induced anode current.

Hall D report

Figure 4.4 shows the transmission of light, at $\lambda = 410$ nm, through 4 cm of lead glass as a function of distance along the bar for a radiation-damaged bar before and after heat curing at 260 °C. The $z = 0$ position corresponds to the upstream end of the bar during data taking, *i.e.* the end of the bar closest to the source of the photon beam.



12 hours
at 260 C
household
oven

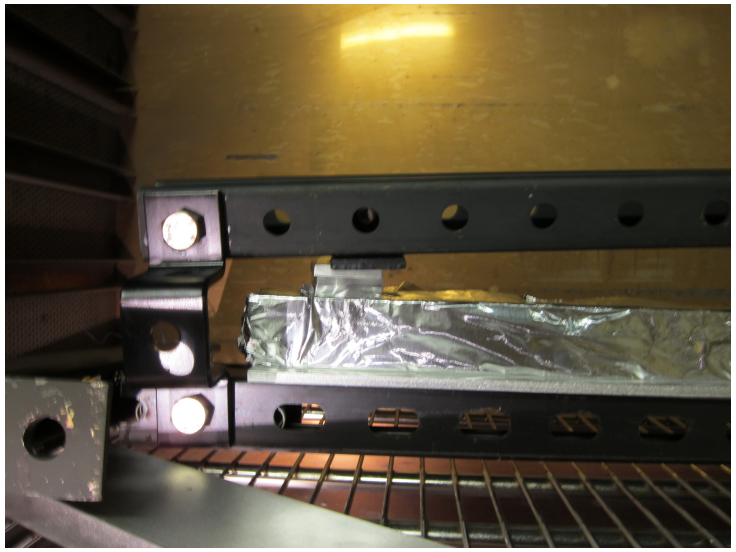
Figure 4.4: Transmission of light, at $\lambda = 410$ nm, through 4 cm of lead glass as a function of distance along the bar for a radiation-damaged bar before and after heat curing at 260 °C.

The ECAL blocks under heat treatment

Three measurements of the PD current: I0 = intensity direct; I1 – intensity through clear area; I2 – intensity through yellow area. I_1(calc) = I_0*0.88*0.93. Abs= $(I_1-I_2)/I_1$

#	Rad or T, C / time	type	I_0	I_1	I_1/calc	I_2	Absorb	comment
8	135 Gy	42	3.06		2.50	0.90	64%	
8	250 / 1	42	3.03		2.48	2.45	1.2%	
3	131 Gy	42	3.26			1.03		
3	225 / 1	42	2.90		2.37	2.31	2.5%	
2	130 Gy	42						
2	200 / 1	42	1.76		1.44	1.33	7.6%	
A	80kRad?	42	2.68			0.07		
A	225 / 1	42	2.53	2.06	2.07	1.95	5.3%	
B	80kRad?	40	2.61			0.05		
B	225 / 1	40	2.61	2.14	2.14	1.86	13%	
C	80kRad?	38	2.66	2.20	2.18	0.48	78%	
C	150 / 4	38	2.57	2.19	2.10	1.8	18%	

Mechanical stability of the glass bar



275 C for 20 hours

weight on the lever
20 kG x 10 (lever) over 16 cm^2

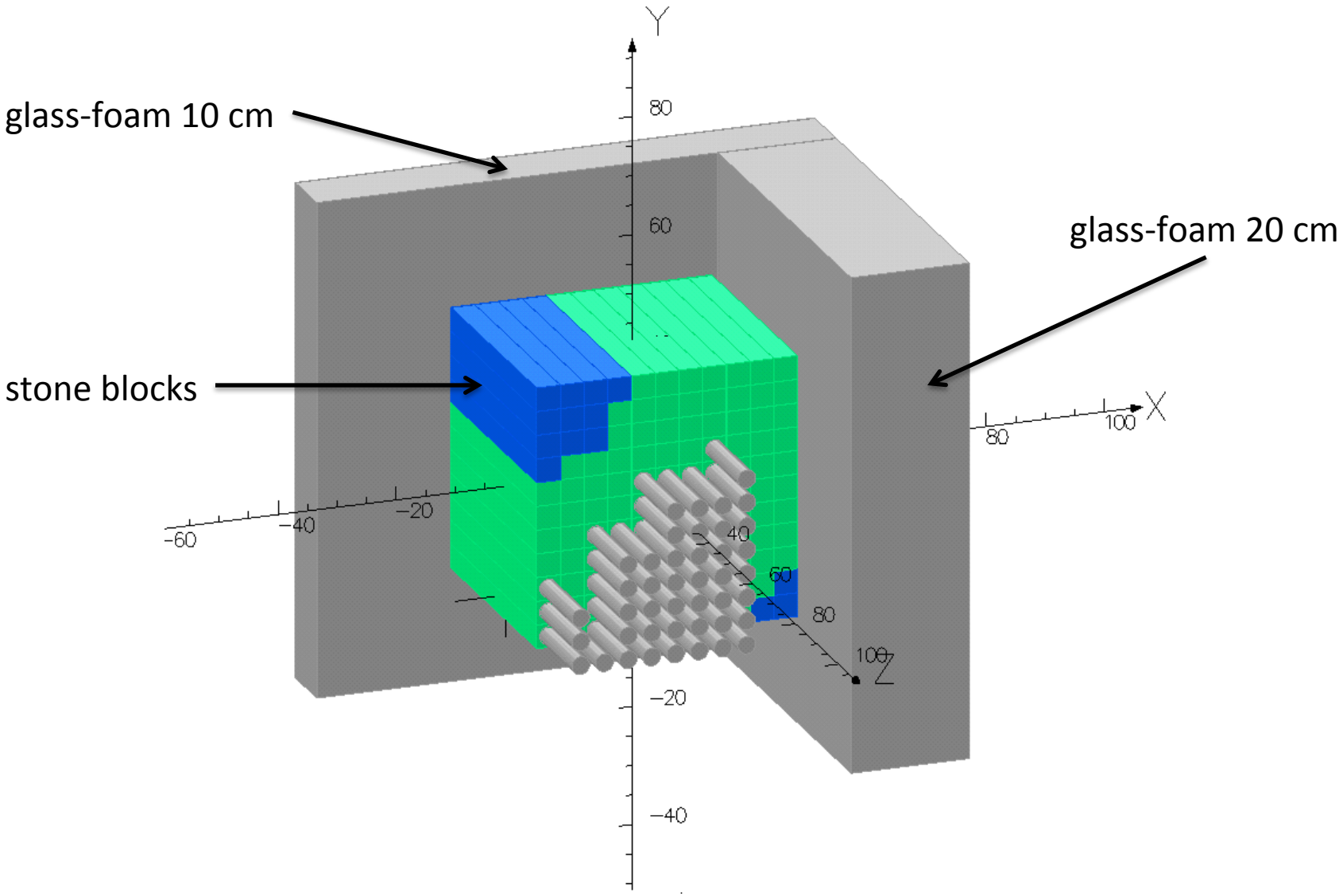
Effective time is 250 hours
of 3 m tall calorimeter

Non flatness in local area
is below 5 micron

To do for M200

1. 500 hours study of the optical coupling (NCCU, in progress)
2. $8.5 light guides (UVa, 50 are ordered)
3. design of the back heater (UVa, done) needs to be ordered
4. test of the LG cooler (Jlab, June)
5. design of the gluing fixture (Jlab, in progress)
6. design of M200 (will start soon)

A scheme of M200



The items to do for ECAL

1. Components

i) Lead glass blocks
ii) PMTs
iii) HV bases
iv) Front-end electronics
v) Cables (signal and HV)
vi) HV supplies
vii) Fastbus system
viii) NIM electronics

There are progress last month

2. Thermal annealing

i) Measurement of the dark current
ii) Irradiation of 8 blocks/ISU and more/RadCon
iii) Optical bond technology
iv) Mechanical stability at 275 C (eff. 250 hours)
v) Annealing tests at 275, 250, 225, 200, 150 C
vi) Design of the 10% prototype (M200)
vii) Budget of M200
viii) Construction of M200
ix) M200 test in Hall A in the fall of 2014

The milestones for ECAL

1. July 2014: Develop concept of annealing, float is 2 months
   i) Test
   ii) Design
   iii) Budget
2. May 2016: ECAL electronics is ready, float is 6 months
   i) Inventory
   ii) Design
   iii) Construction
   iv) Test
3. Sept. 2017: ECAL is ready for GEp5, float is 9 months
   A) Design
   B) Budget
   C) Construction
   D) Test