ECAL for GEp/SBS

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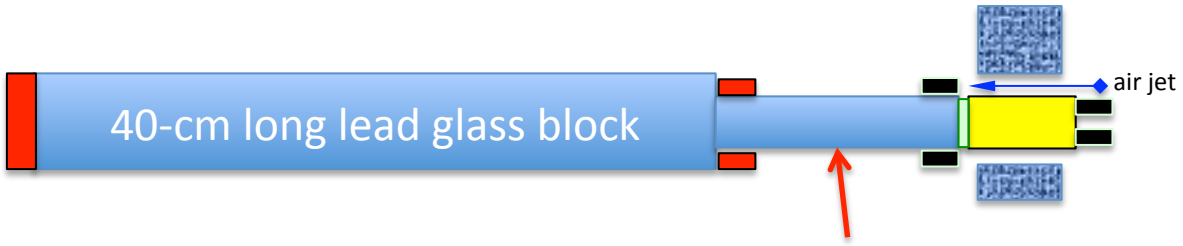
Electron Calorimeter for GEP

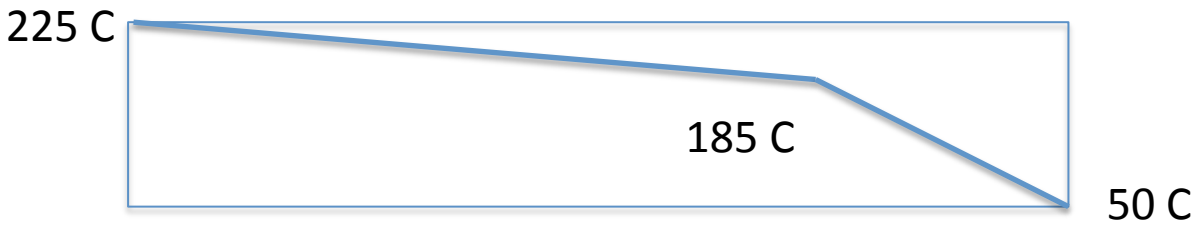
Performance Requirements

- Function: Detect 4 to 5 GeV Electrons
- Energy resolution: σ/E at least 10% for 3.5 GeV
- Spatial resolution: 6-8 mm
  (2 mm with upstream coordinate detector)
- Full luminosity: 26-29 degrees, 8×10^{38} Hz/cm^2
- Trigger: Overlapping segments correlated with the proton
  Trigger at threshold > 75% of elastic peak

The high temperature ECal



15-cm long, light guide



Temperature profile

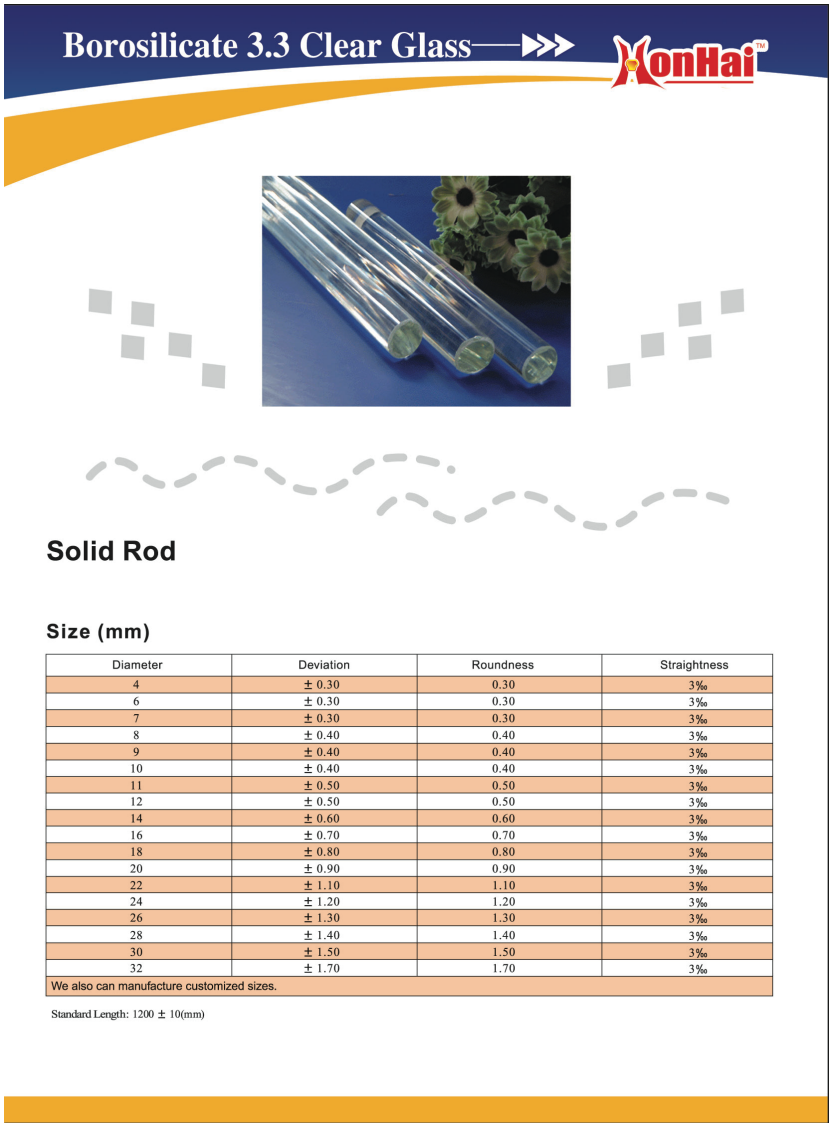
Power: 0.008x7x130/15 = 0.6 W heat leak through the light guide

The high temperature ECal

There were some concerns during ECAL development:

1) What is the required temperature?
2) What glue will be transparent at 200 deg. C?
3) What would energy resolution be in real conditions?
4) Thermal elongation of the glass vs. the PMT holding plate.
5) Funding for the High Temperature part of ECAL.
6) Production items:
   light guide glass cracks,
   proper wrapping for high T,
   light guide and PMT cooling,
   LG “uniform” heating => design of a rear heater.

Light guide story started in 2013



Light guide long story

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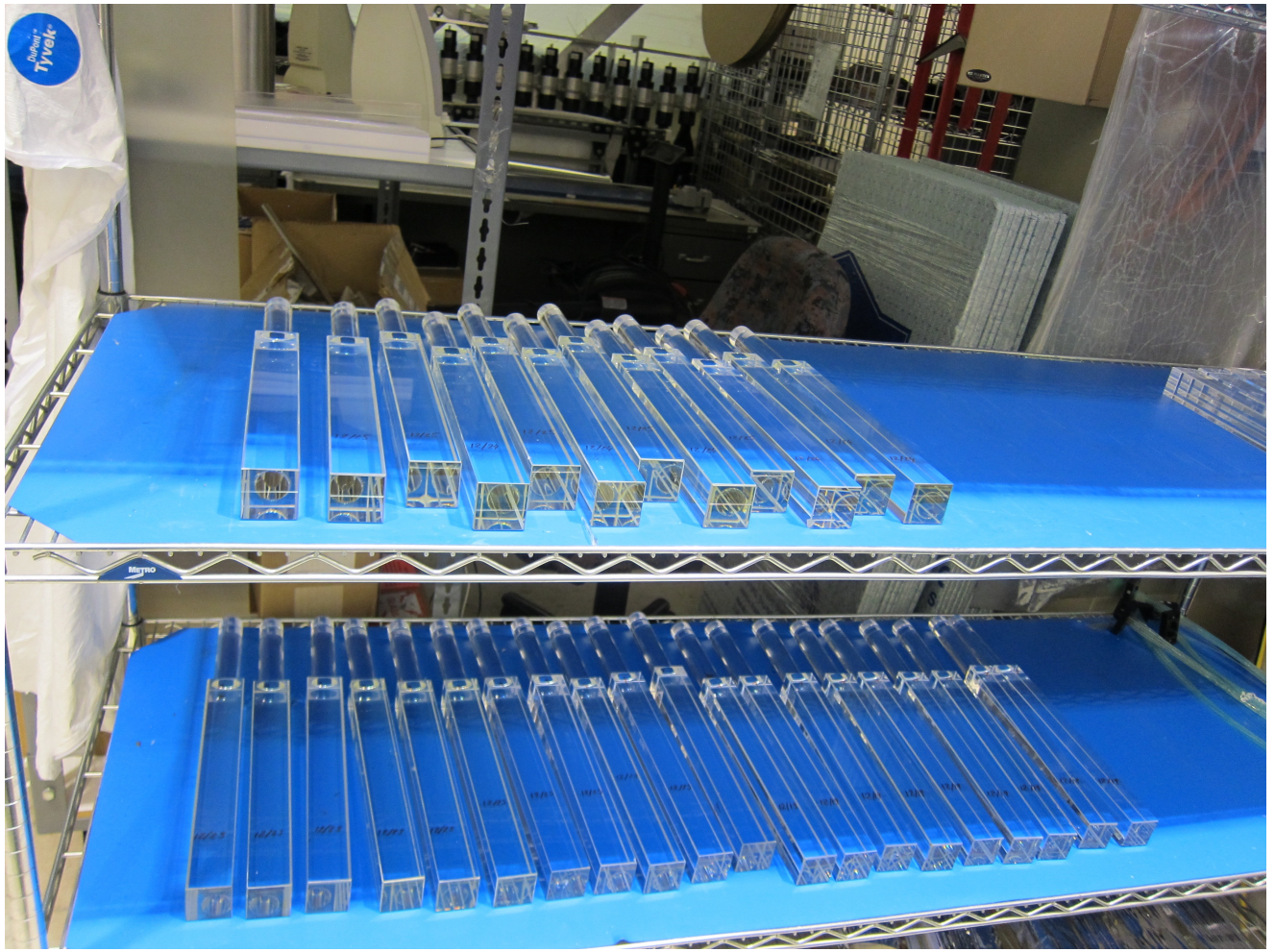
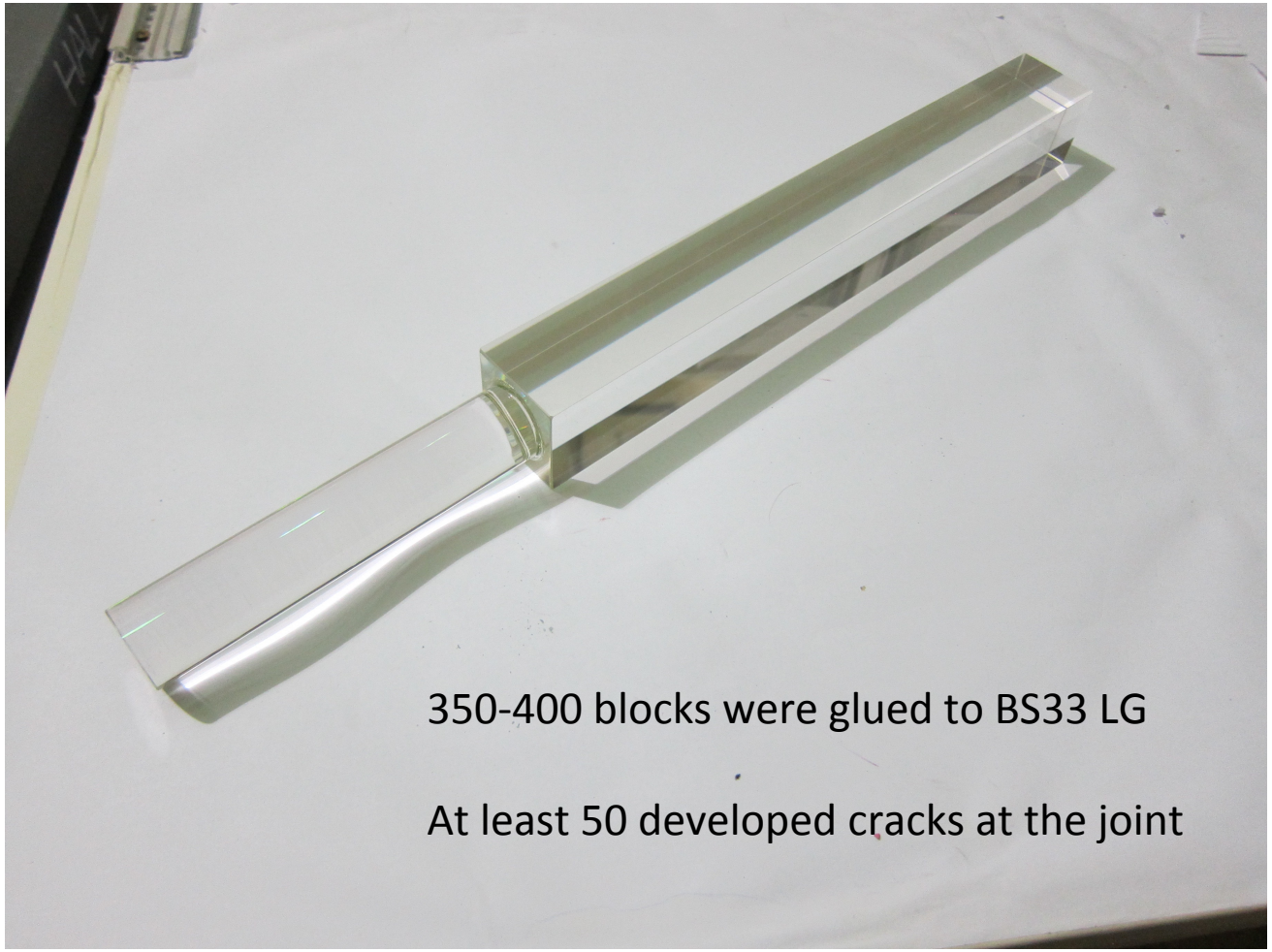
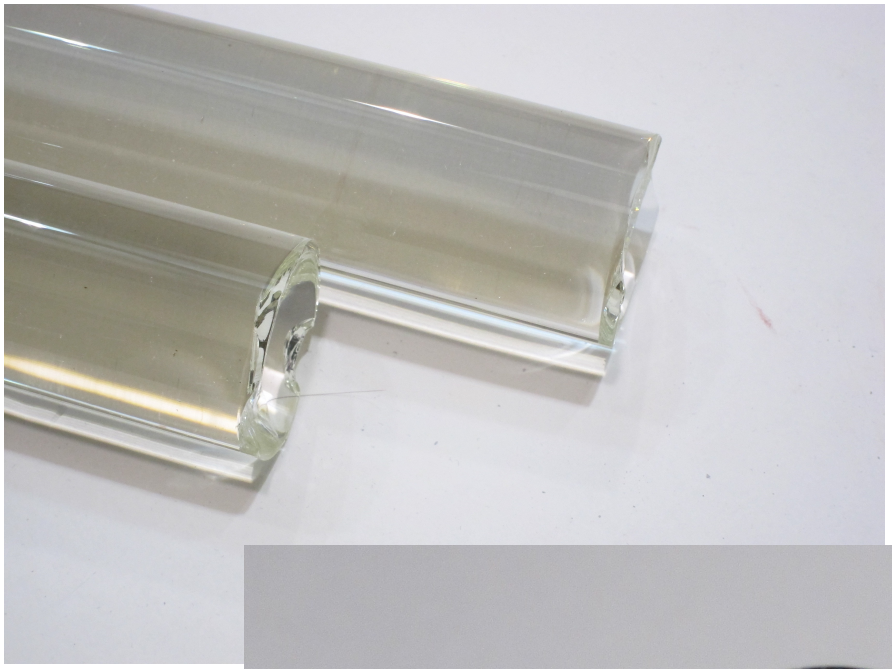
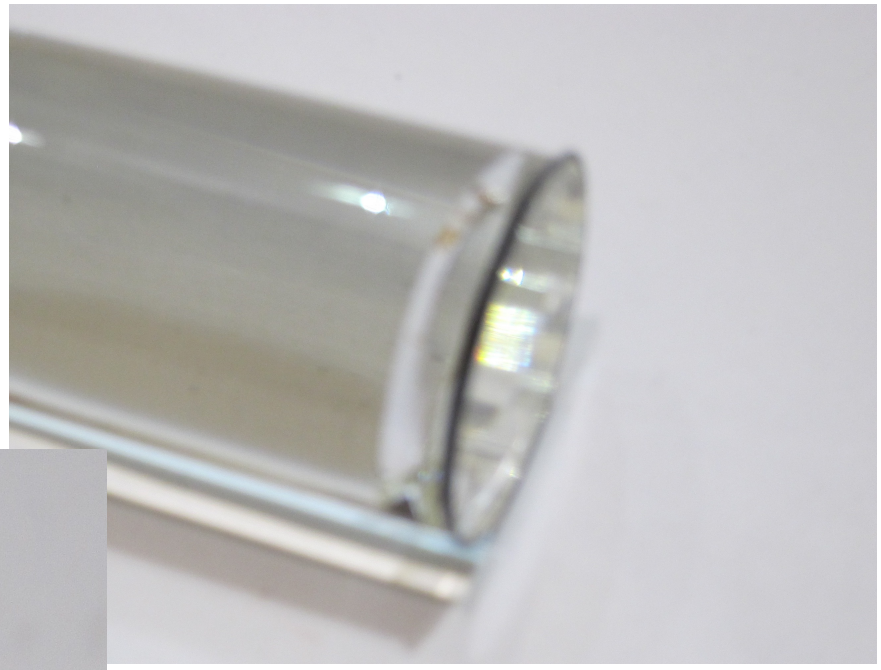


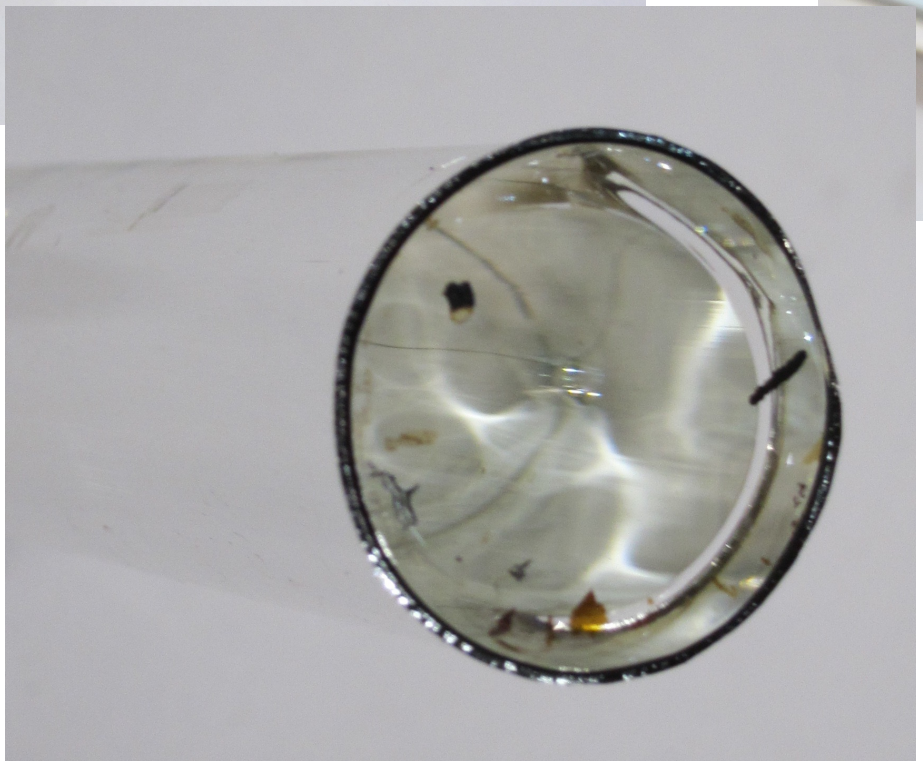
Light guide long story



Light guide cracks (BS33)

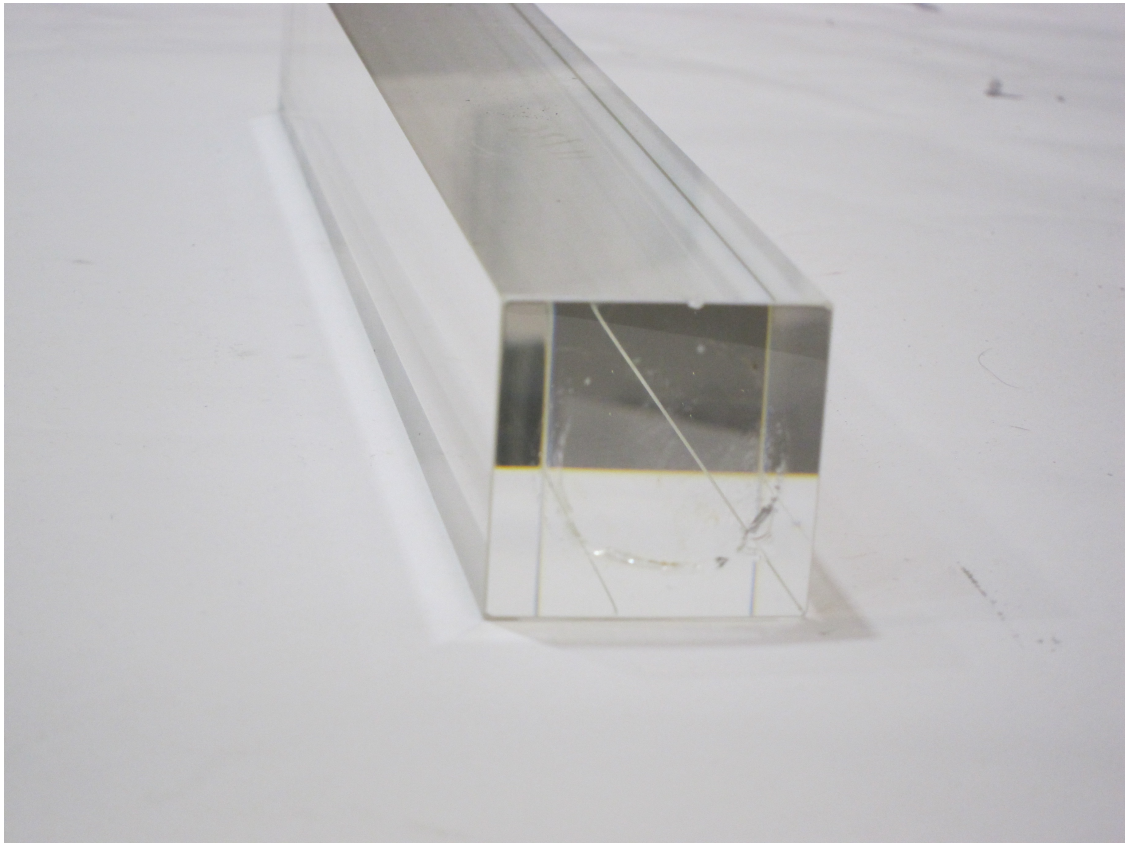






Residual damage on lead-glass block

"Ungluing" requires 340 C and left some damage



What are the reasons for cracking?

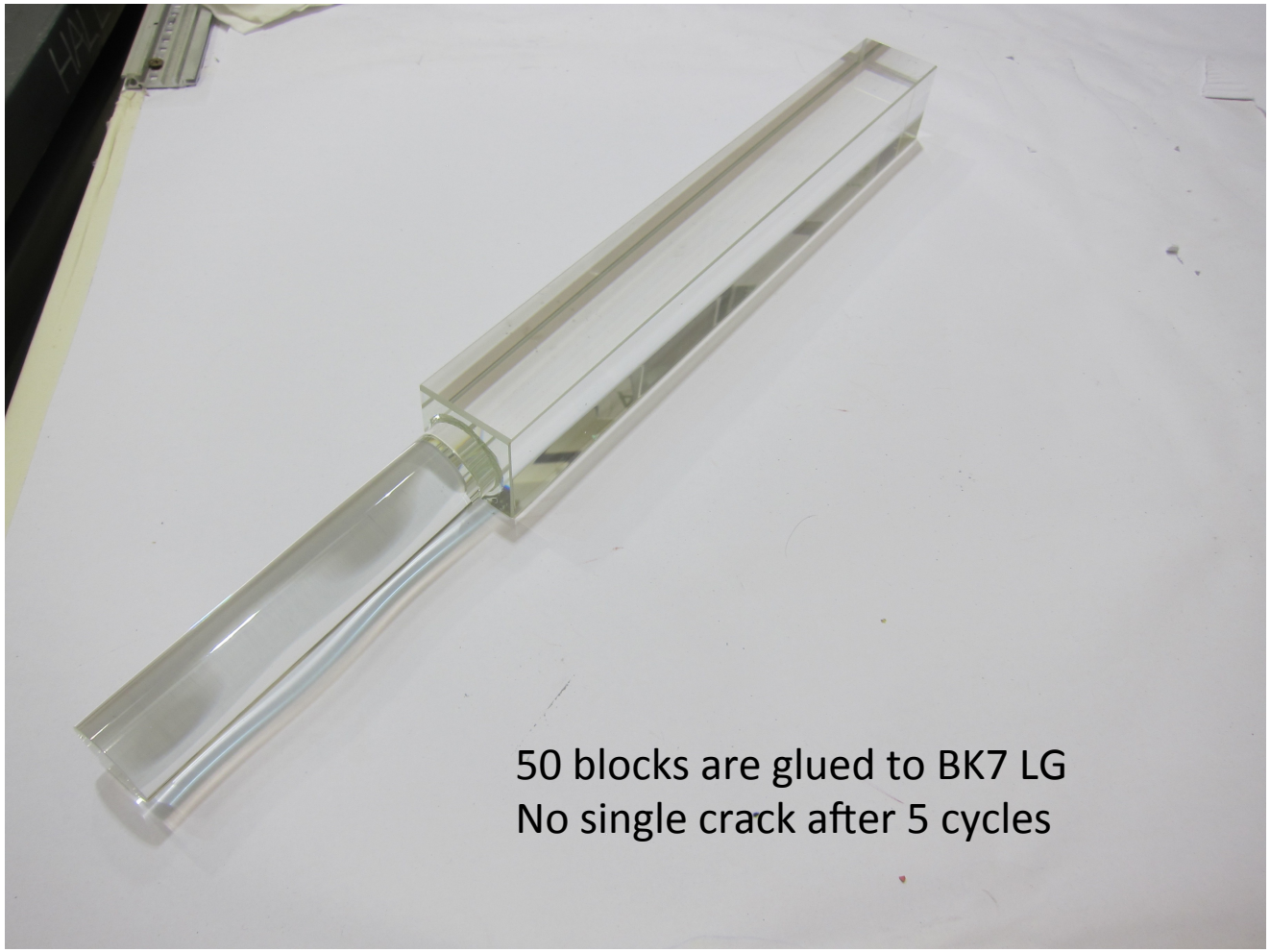
Many (hard push!) tests were performed with slowest heating/cooling;
several different regimes of gluing, glass annealing at 550 deg. C;
coating of the joint, increased glue thickness, … => no good solution

The coeff. of thermal exp. is 6.6 10^{-6} for the lead-glass but 3.3 10^{-6} for BS33

Need to find a better match to the lead-glass => BK7 (a = 7.0-7.2 x 10^{-6})

50 BK7 cylinders were ordered in October, obtained on December 19, 2016

Light guide long story



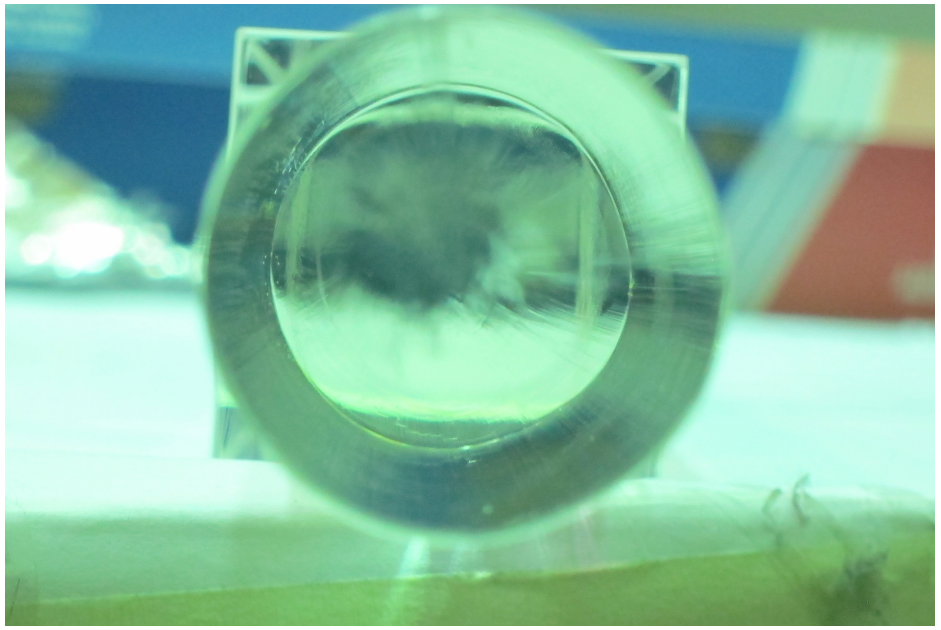
Light guides from BK7 and BS33

BK7

Cost is $12.80

$a = 7.1 \times 10^{-6}$

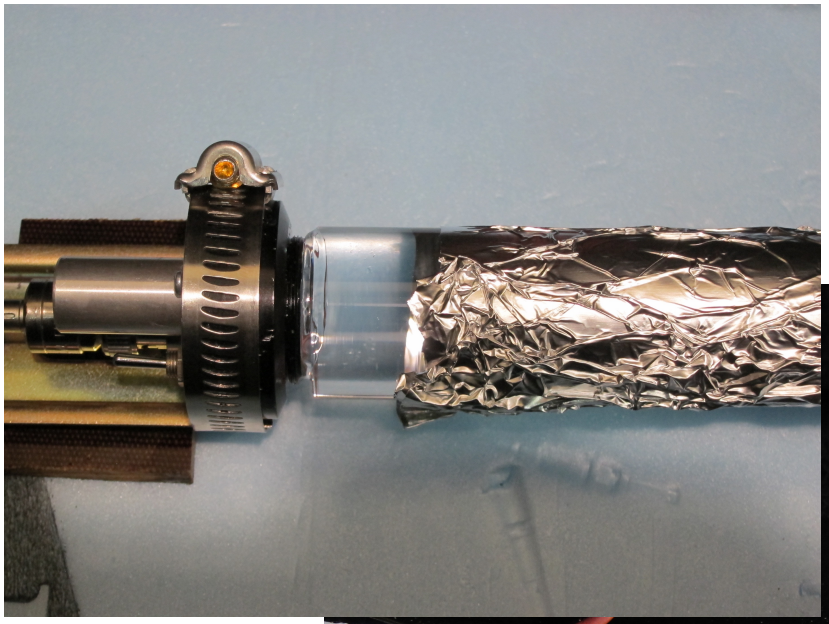
BS33

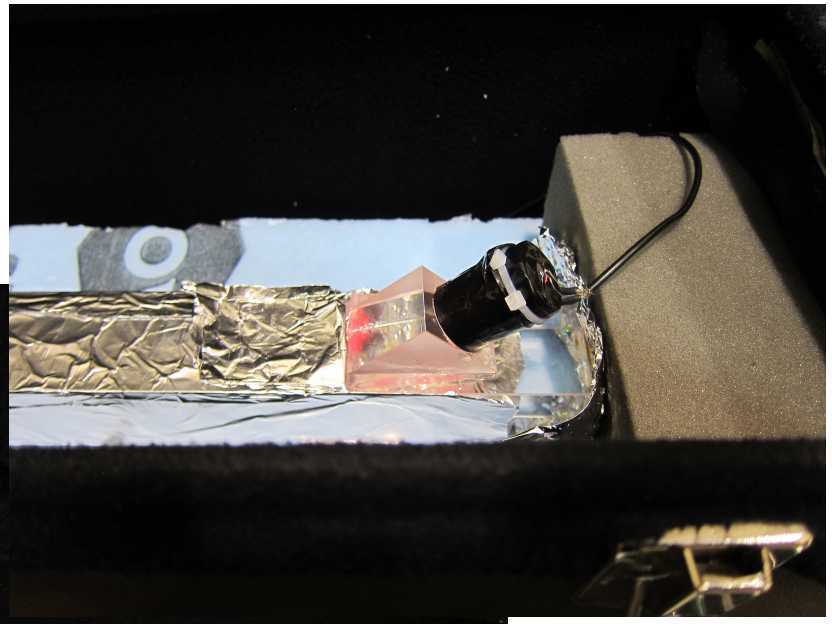


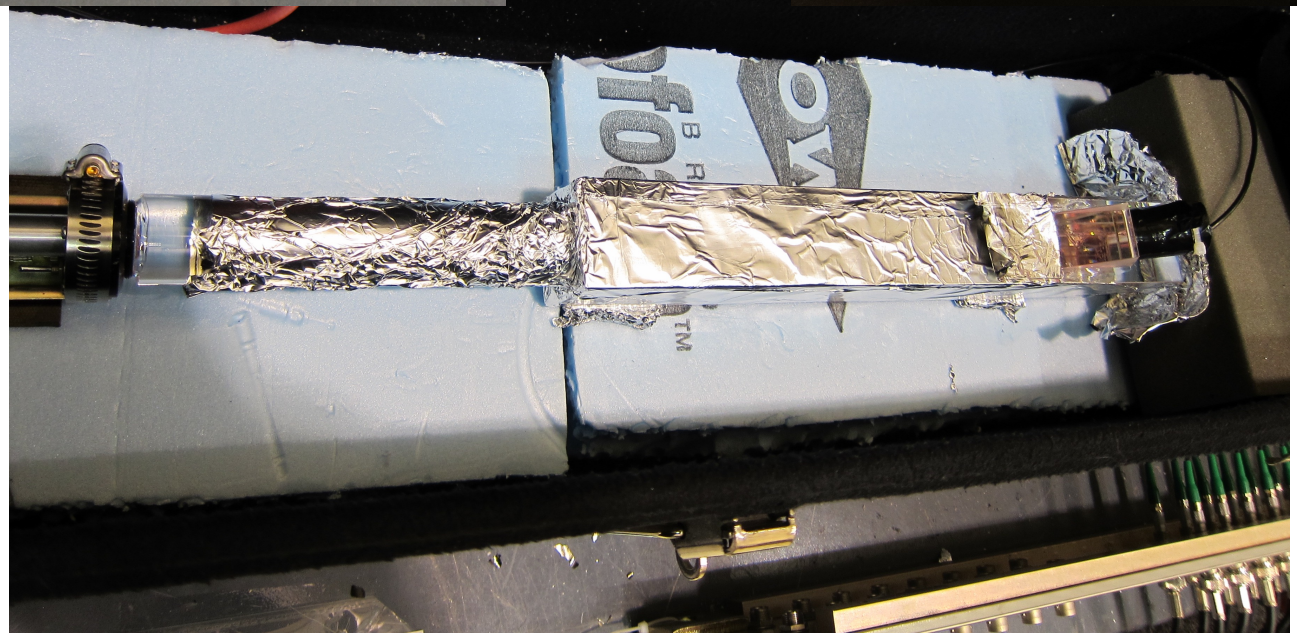
Cost is $8.50

$a = 3.3 \times 10^{-6}$

Light collection test stand







Light collection test results

A: Direct contact of a photo-detector to the lead-glass block => 66nA

B: Through the BK7 light guide => 62nA

C: Through the BS33 light guide => 33-56nA

D: Aluminum wrapping almost doubles the light collection

Light guide radiation hardness

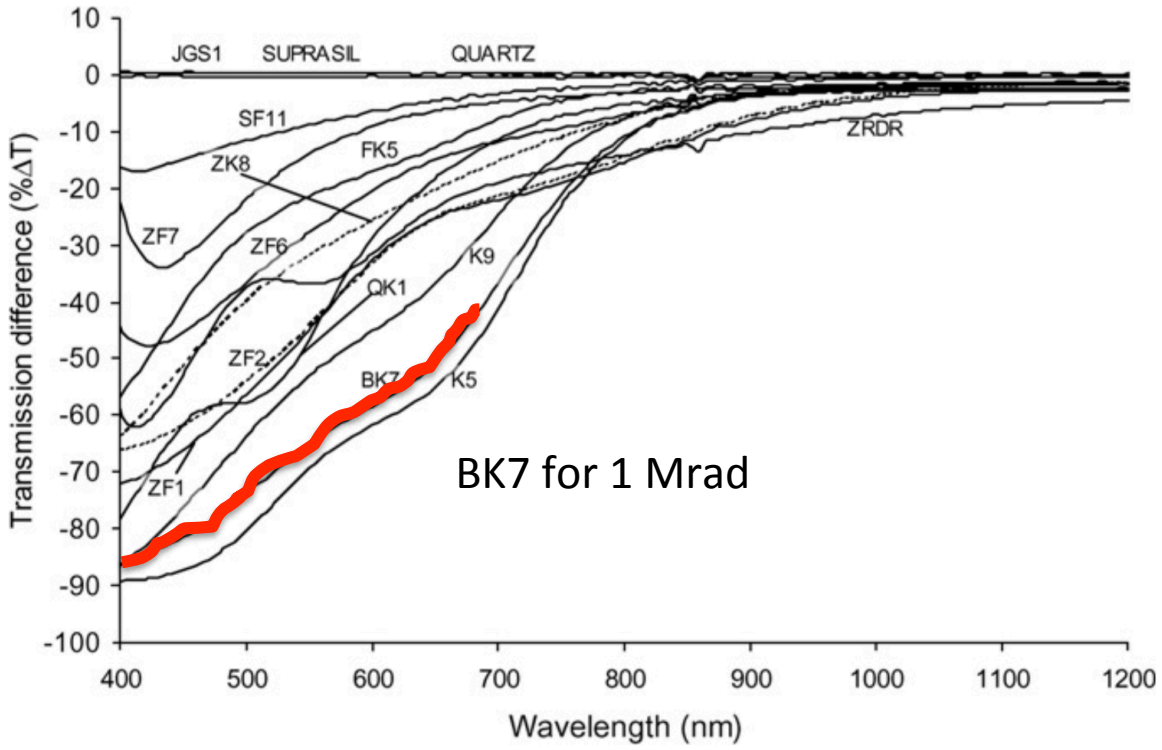


Fig. 10. Wavelength vs. transmission difference of various types of glasses before and after gamma irradiation (total dose ≈10 kGy).

To do plans

Order 1500 BK7 cylinders

Inventory and cleaning of ~1300 lead-glass blocks

Start gluing again in March (up to 20 per day)

Measure dimensions of each block