

Update on PCAL studies at JLab

A. Daniel, J. Riso, S. Stepanyan, W. Tang, H. Voskanyan

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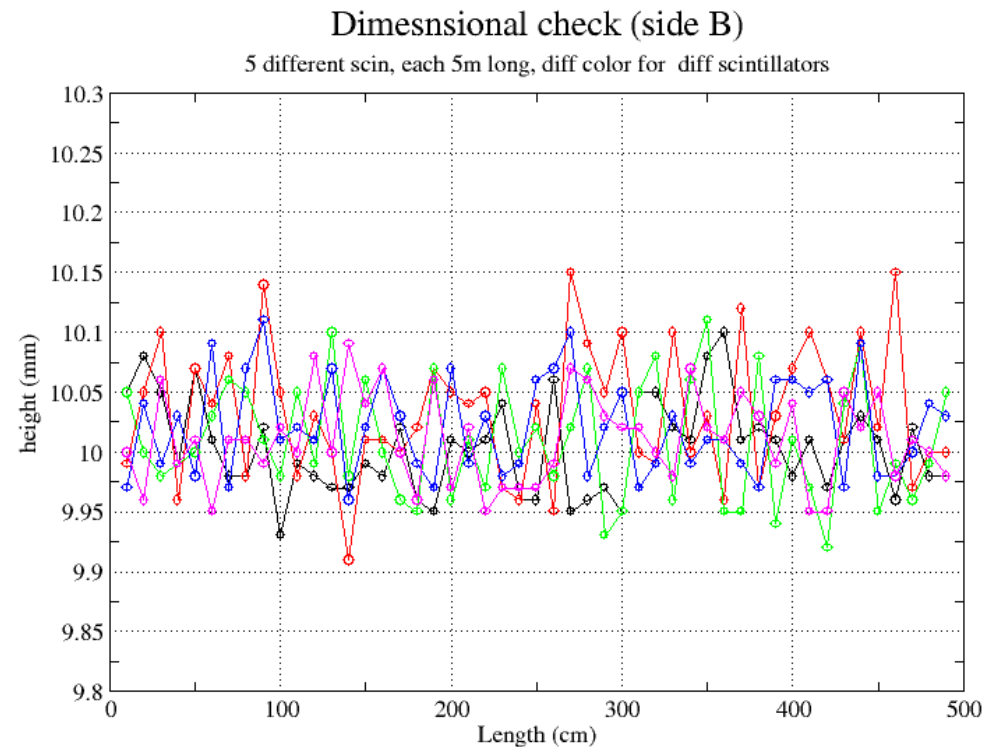
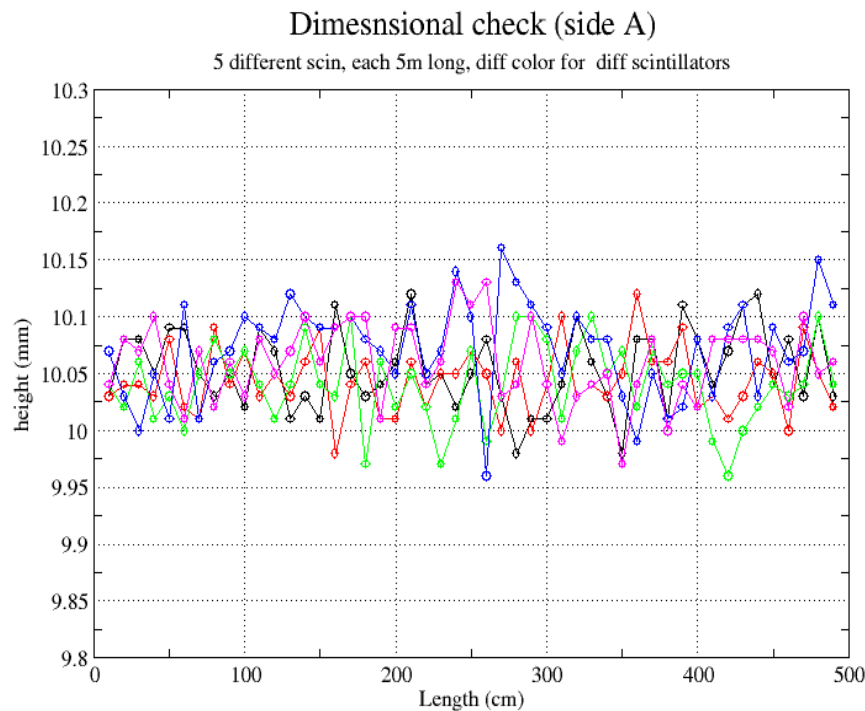
Outline

- **Dimensional check of the scintillators from Fermi lab.**
- **Longitudinal tests to understand the light response.**
- **Results with and without gluing.**

Dimensional check on the scintillators from Fermi lab

Fermi lab sent 30 scintillators for R&D purposes.

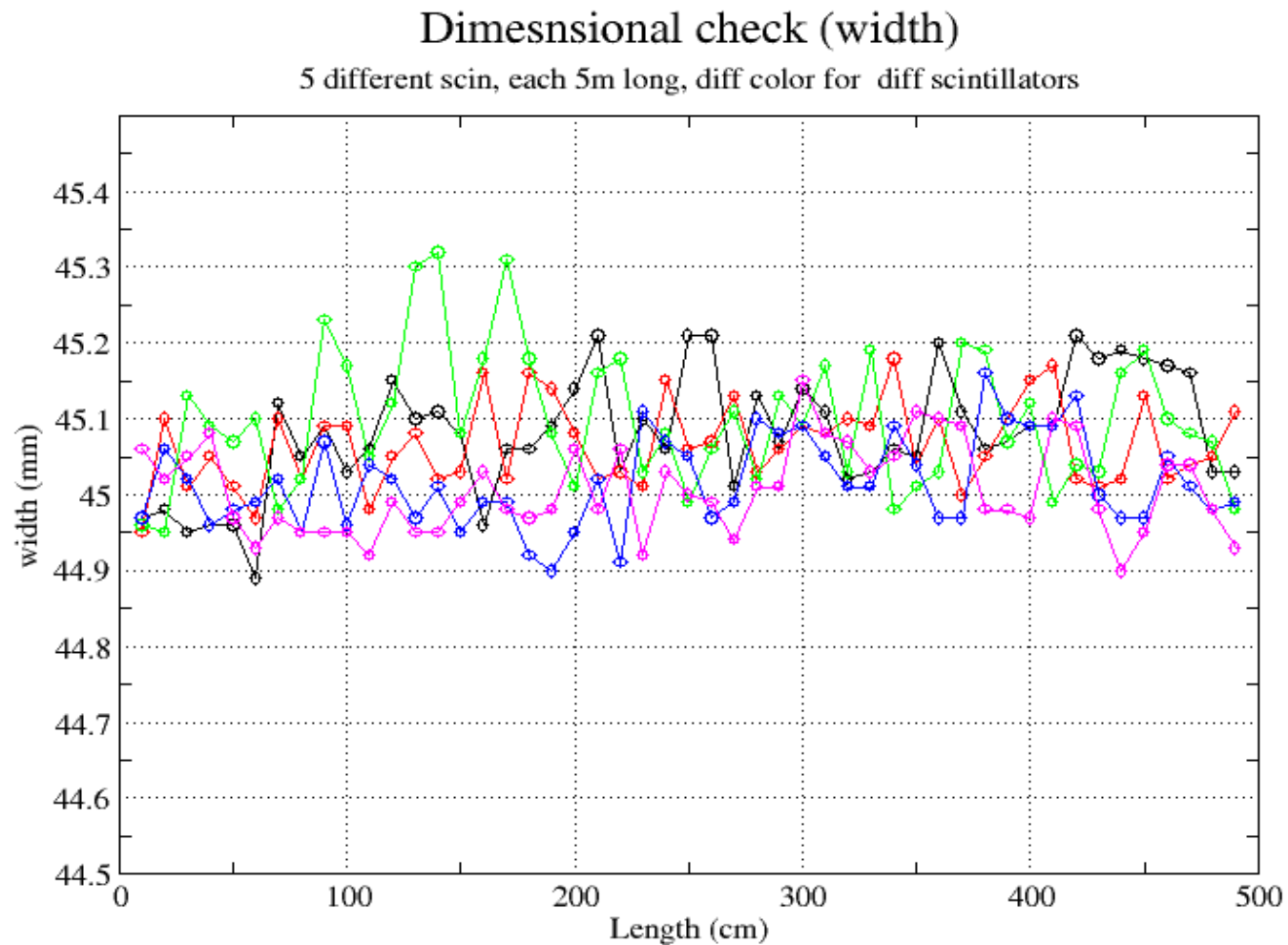
Nominal dimensional of a scintillator 500 mm x 45 mm x 10 mm



Thickness measurements from both sides (side A and side B)

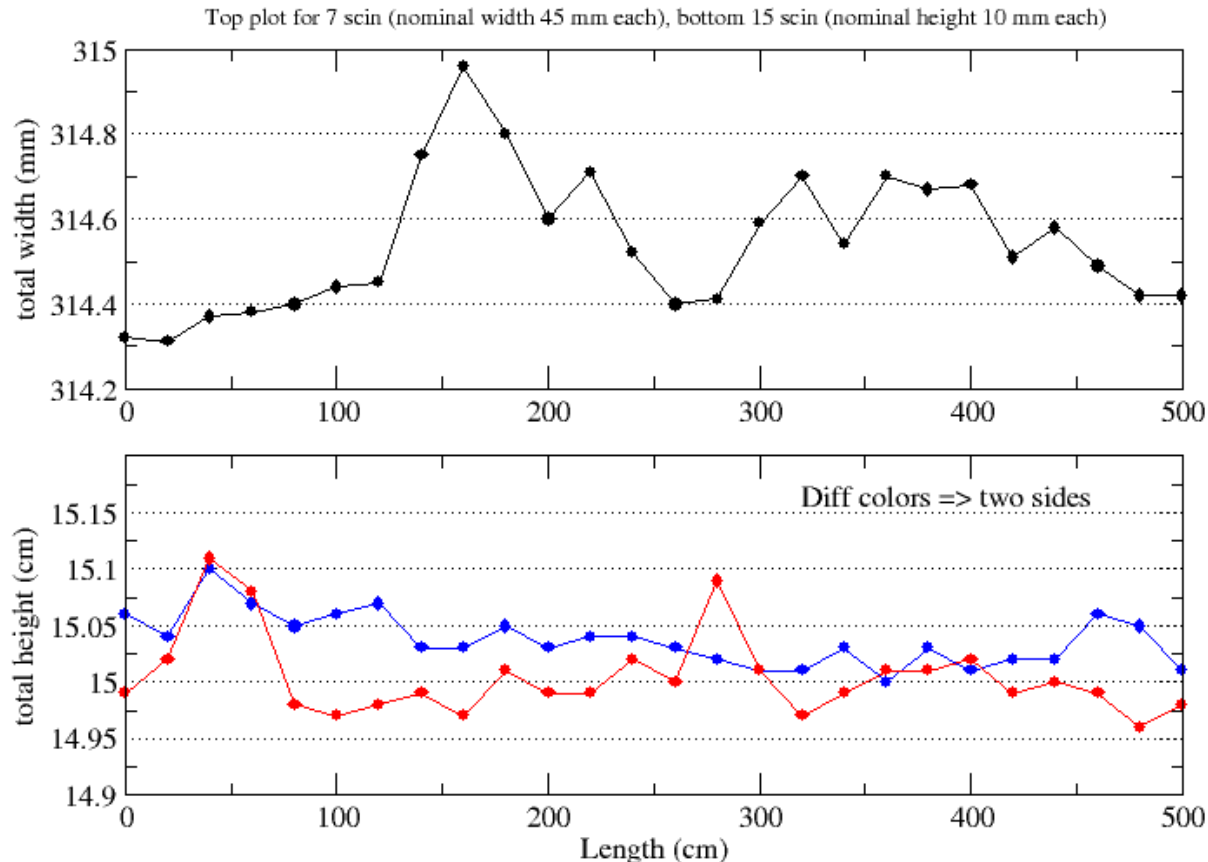
Dimensional check on the scintillators from Fermi lab

Nominal dimensional of a scintillator is 500 mm x 45 mm x 10 mm



Width measurements

Dimensional check on the scintillators from Fermi lab



- Nominal dimensional of a scintillator is 500 mm x 45 mm x 10 mm

- For the total width measurements 7 scintillators are arranged on the table; then measure the total width of the stack (nominal $7 \times 45 \text{ mm} = 315 \text{ mm}$)

- For the total thickness measurements 15 scintillators are arranged on the top of each other; then measure the total thickness of the stack from two different edges along the length (nominal $15 \times 1 \text{ cm} = 15 \text{ cm}$)

Total width and thickness of the scintillators stack.

Details of the longitudinal tests

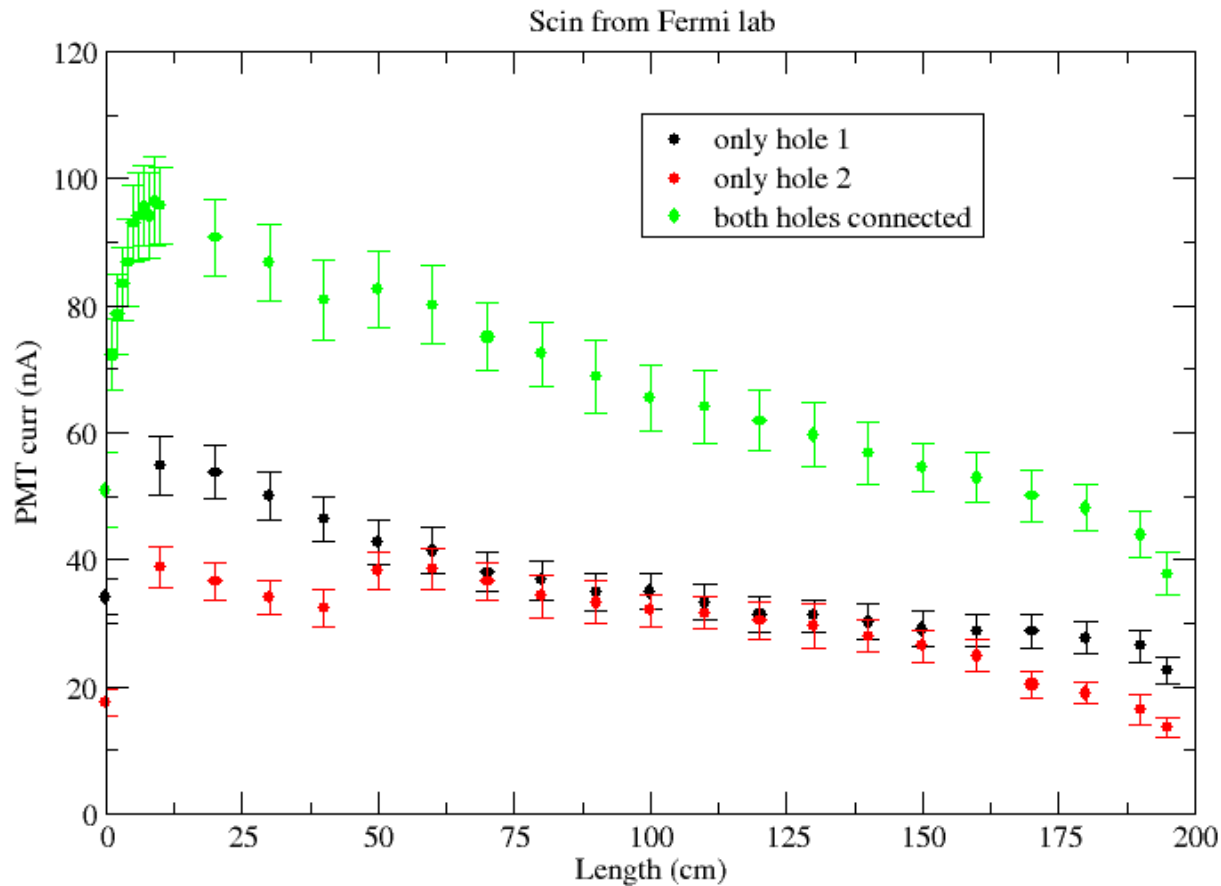
- ❑ We measured the average anode current from the photomultiplier with a digital multimeter (Keithley 2001).
- ❑ A (Hamamatsu R6095) photomultiplier tube was attached through an adapter (operated at 1300V).
- ❑ WLS fiber (Kurary multi-clad fibers) runs through the length of scintillator, then through adapter and then attached to photomultiplier.
- ❑ Gluing with BC600.
- ❑ Entire assembly placed inside dark box.
- ❑ For the measurements, source (^{90}Sr , 0.3 μCi) was placed on an adaptor and moved manually to the desired positions using a string attached to the adaptor.
- ❑ Most of the scintillators measured are more than 3m long.

Some pictures of the experimental setup



Measurements done at semi-clean room in EEL building

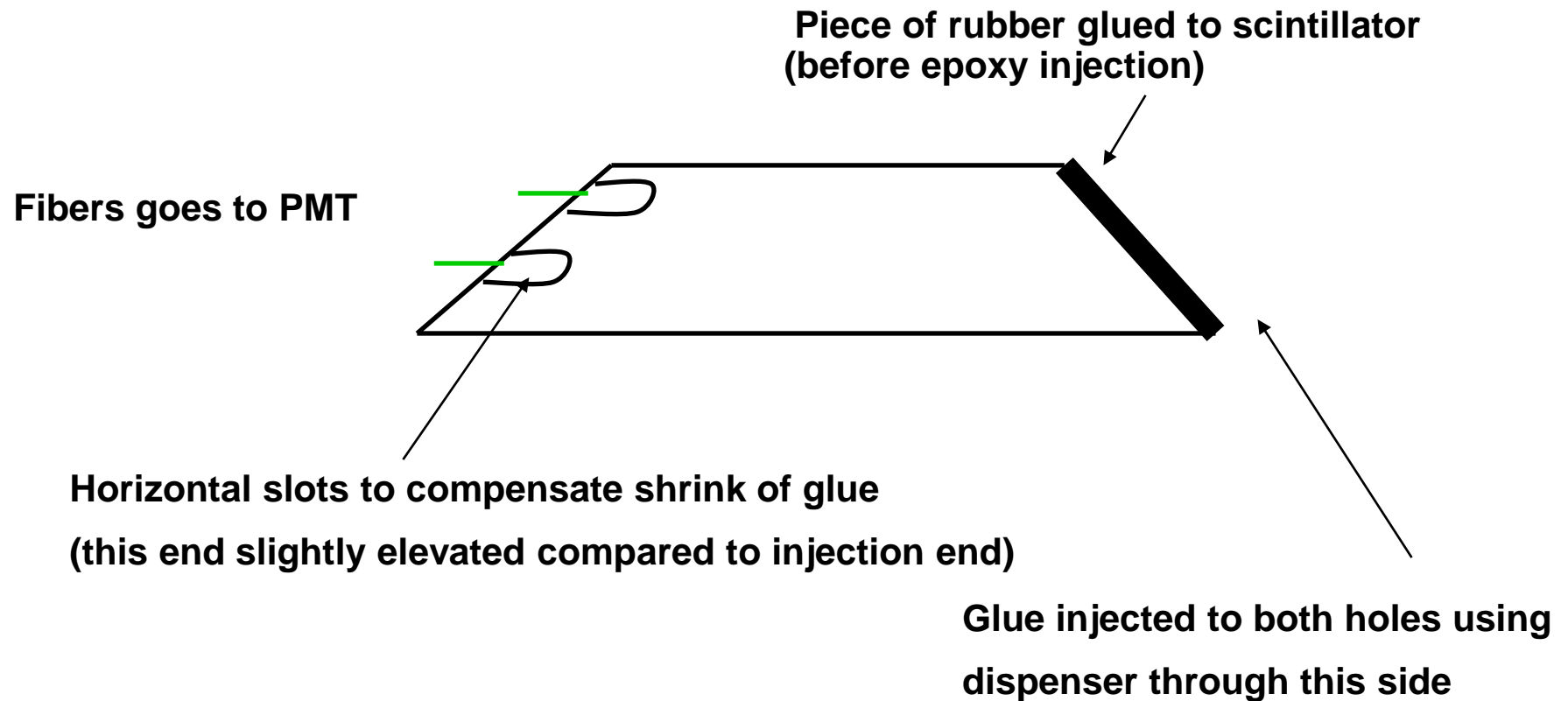
Representative plots; scintillator from Fermi lab (SC3)



Angle ~62.9 degree

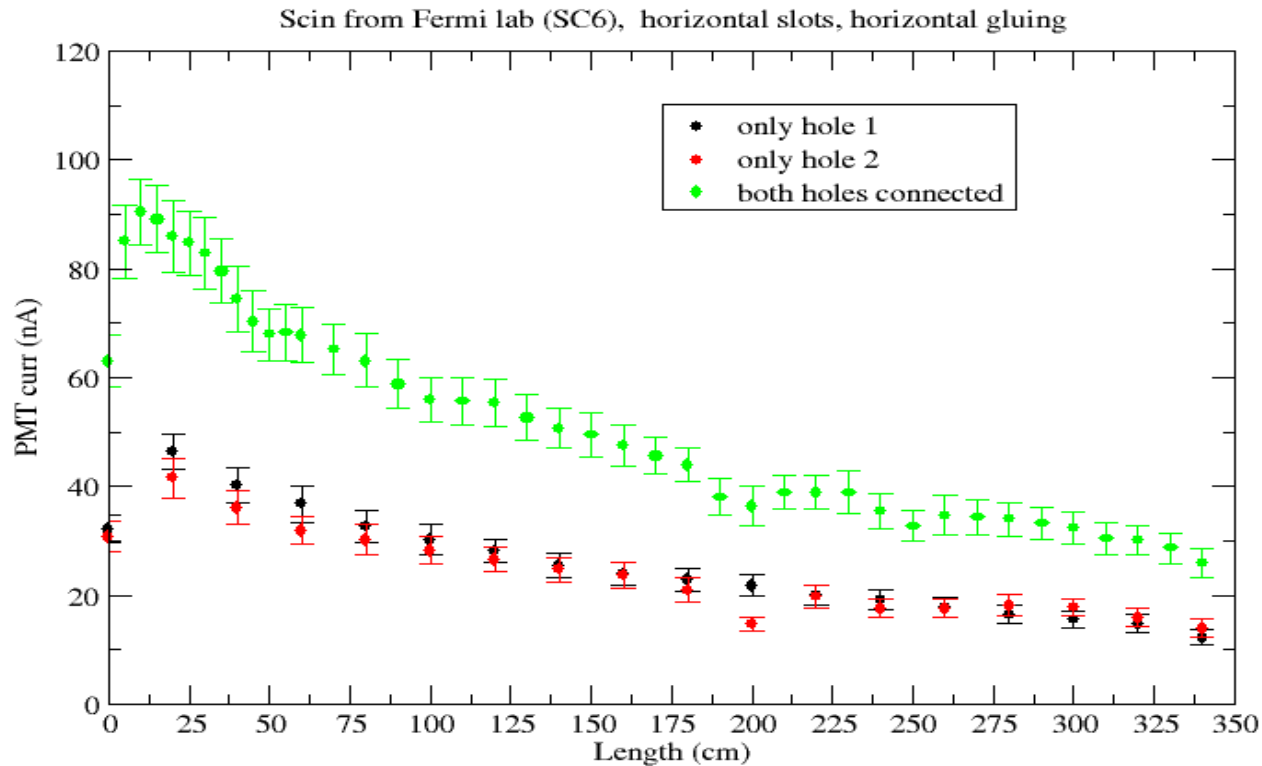
- ❑ Angular cut at both end
- ❑ Vertical gluing
- ❑ No slots (reservoir)
- ❑ Note the drop in current (red points in the above plot).

Representative plots; scintillator from Fermi lab (SC6)



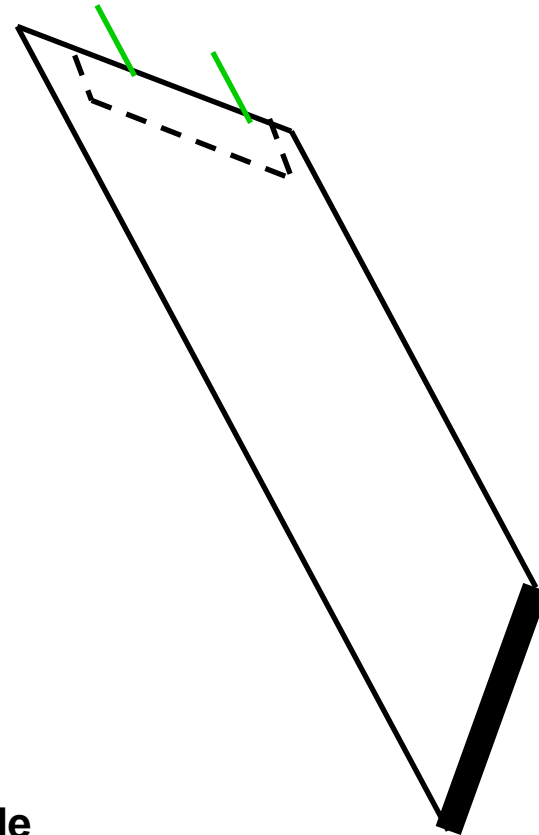
- Angular cut at both end
- Horizontal gluing, horizontal slots (reservoir)

Representative plots; Scintillator from Fermi lab (SC6)



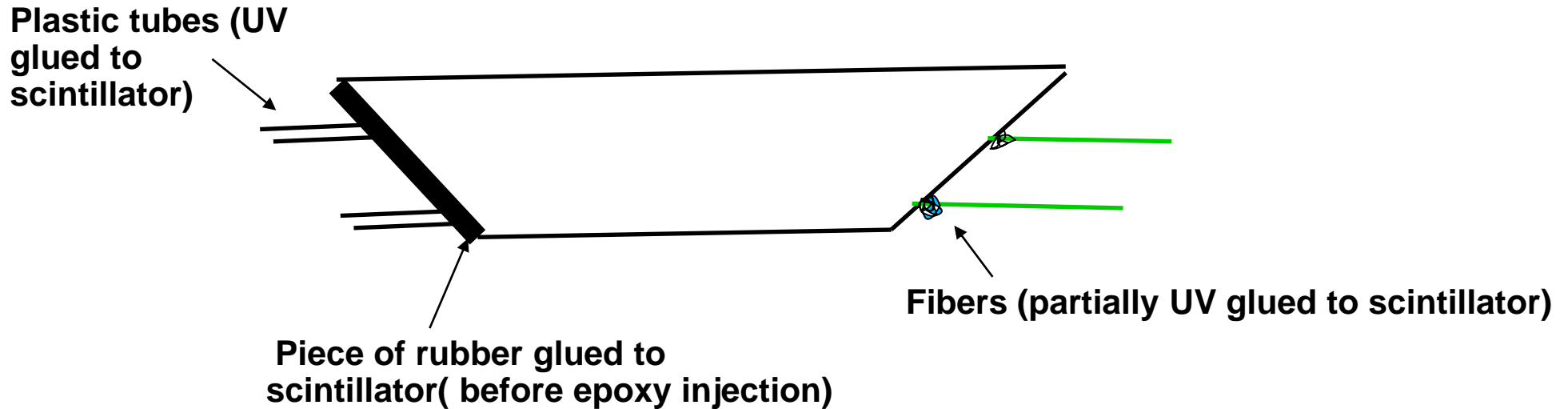
- Angular cut at both end
- Horizontal gluing, horizontal slots (reservoir)
- Difficulties in injection, still air pockets... drop in current.

Representative plots; scintillator from Fermi lab (SC3, part 2)



- Vertical gluing, rectangular slot on the top (reservoir)
- Reservoir ~35mm long and ~7mm deep and ~7 mm wide
- However, after gluing we noticed that about ~9cm shrink in hole A ~ 11cm drop in hole B.
- Hence, gluing not successful.

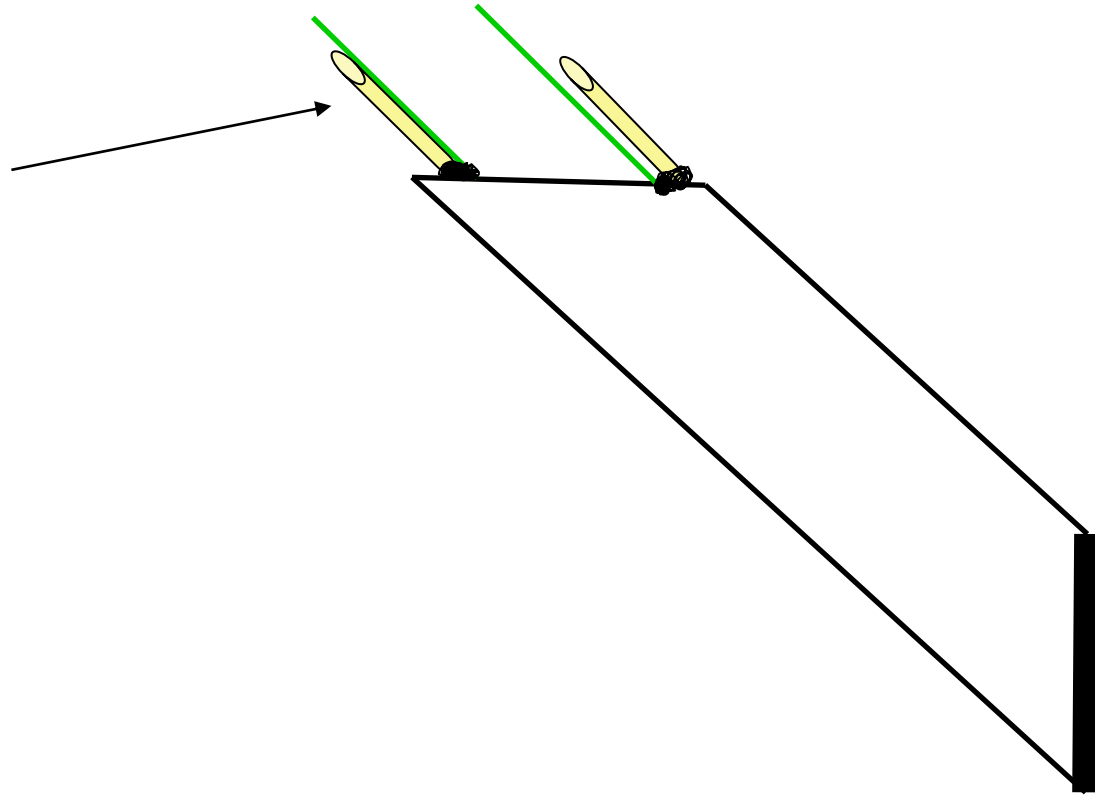
Scintillator from Fermi lab



- Horizontal gluing (at a small angle)
- Plastic tube at the injection side
- Fiber inserted before gluing and fixed with UV glue (there was a small hole for the air flow).
- Plan: rotate the assembly after injection so that the plastic tube will be on the top, and will later on acts as reservoir
- Lots of problem during injection, plastic melts, leak at the fiber end ...

Scintillator from Fermi lab (SC7)

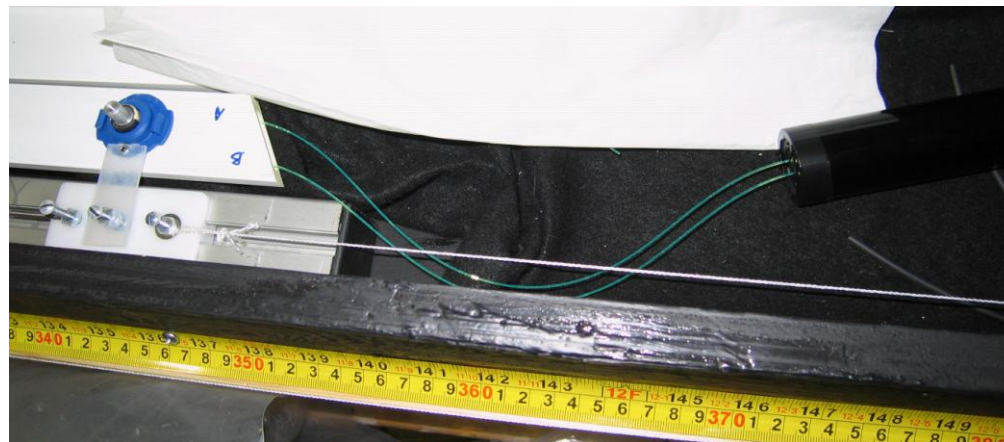
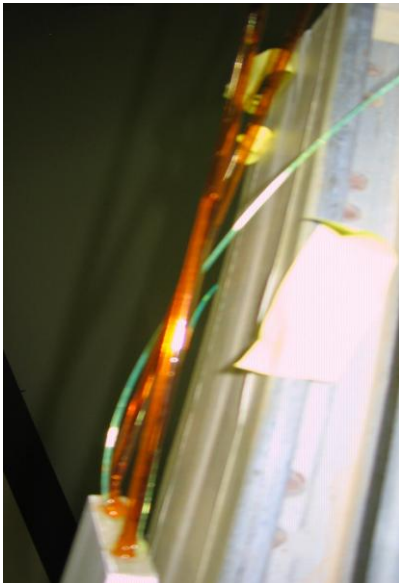
Kapton tube 4mm dia.



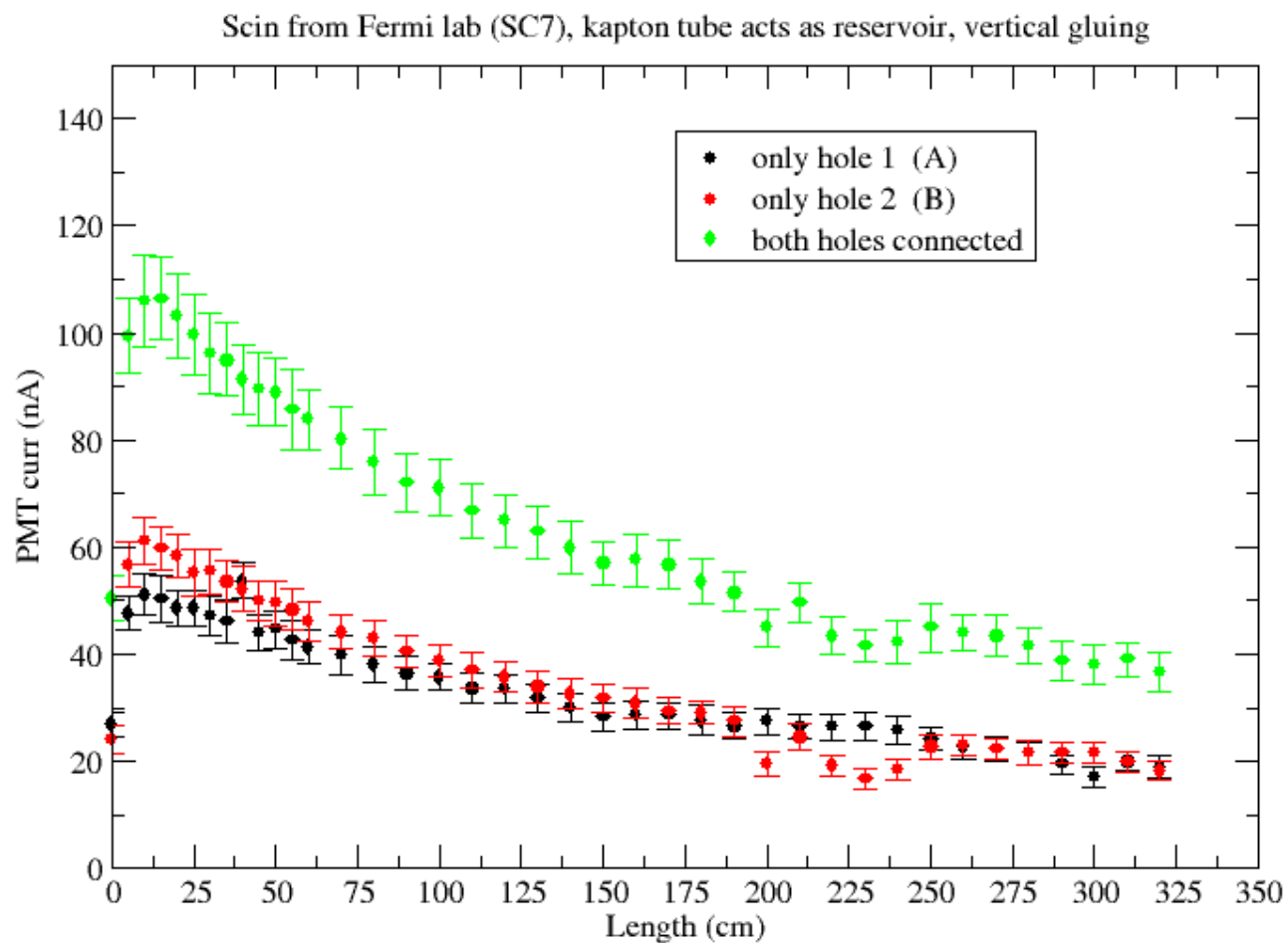
Piece of rubber glued to scintillator
(DP125; before epoxy injection)

- Vertical gluing.
- Fiber inserted before gluing.
- Small hole drilled near fiber end and UV glued Kapton (4mm inner dia.) tube there.
- Tubes near fiber end could be tricky, also needs to cut the tubes carefully after curing.

Some photos

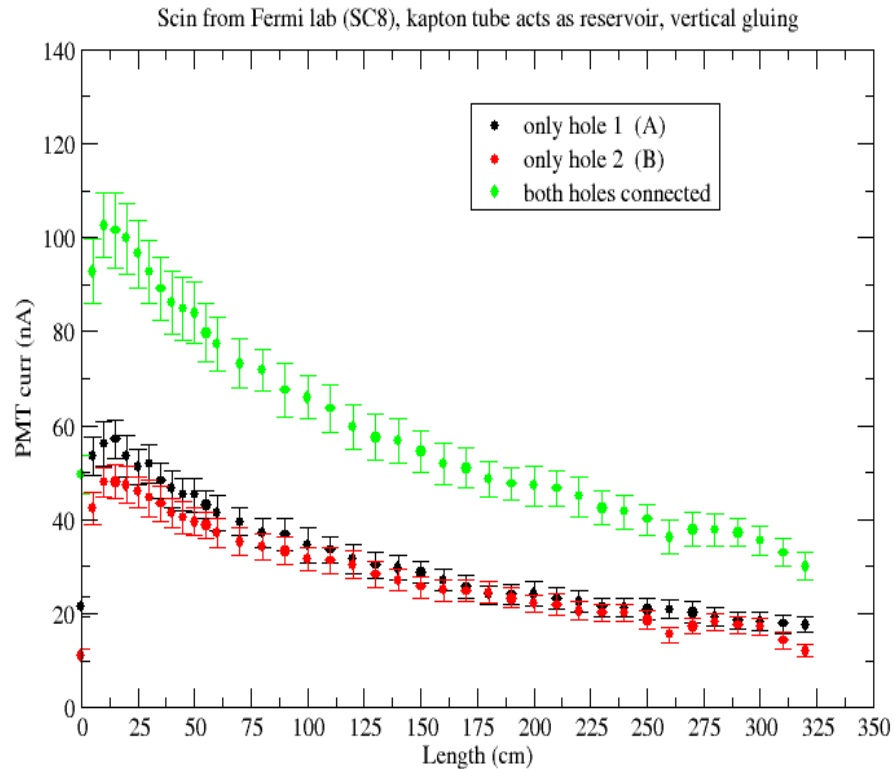


Scintillator from Fermi lab (SC7)

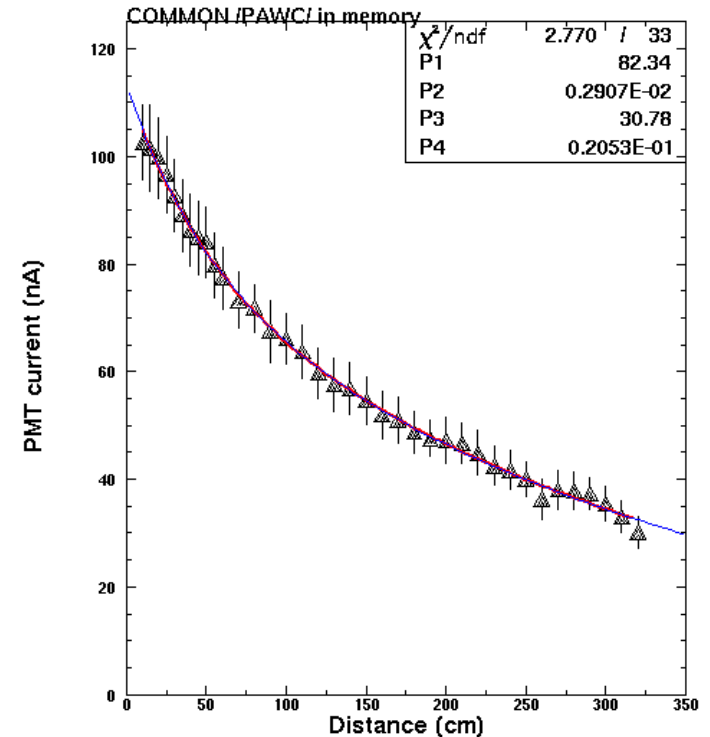


- Gluing process was okay, however, small air pockets exits.

Scintillator from Fermi lab (SC8)

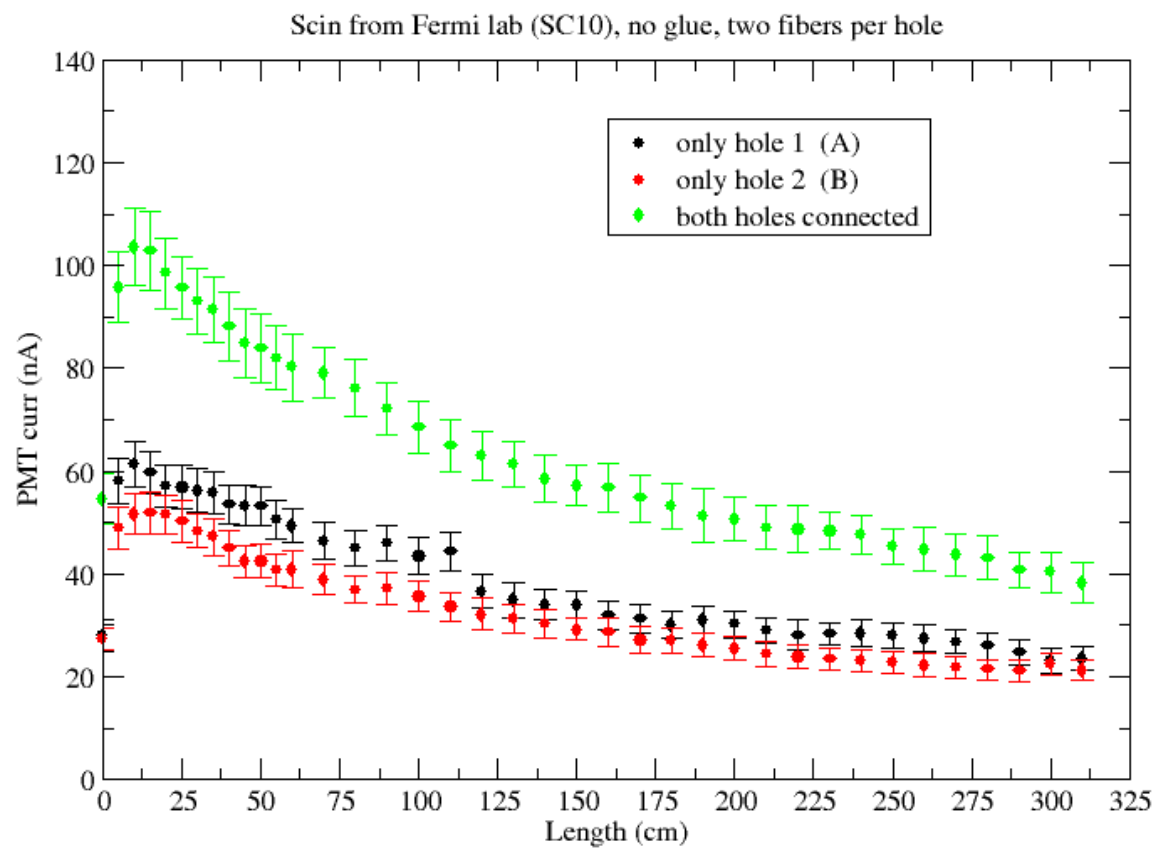


- Carefully repeated the above method (but nearly horizontal gluing).
- Very slow injection of the epoxy.



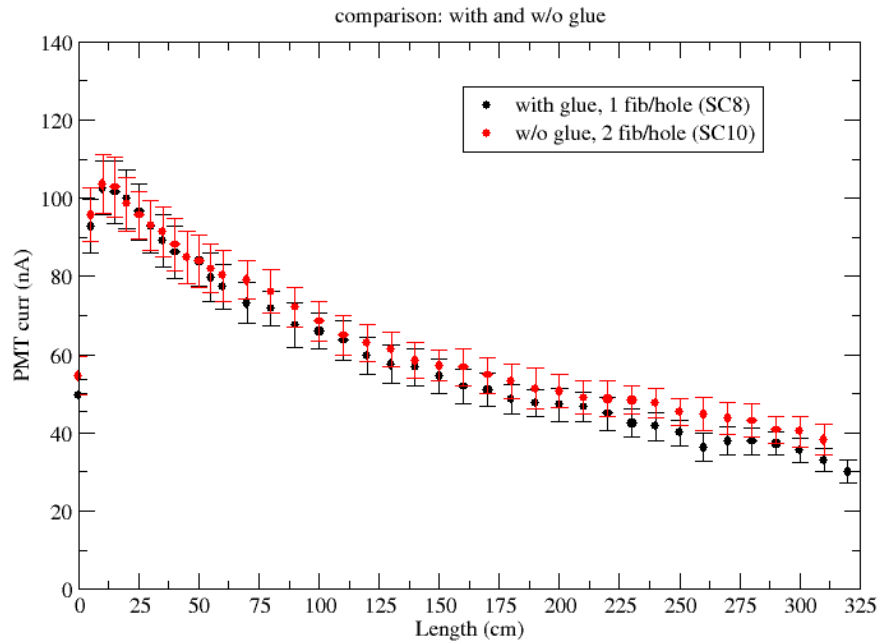
- Fit to double exponential
- Long atten len ~ 344 cm
- Short atten len ~ 49 cm

Scintillator from Fermi lab (SC10), No glue

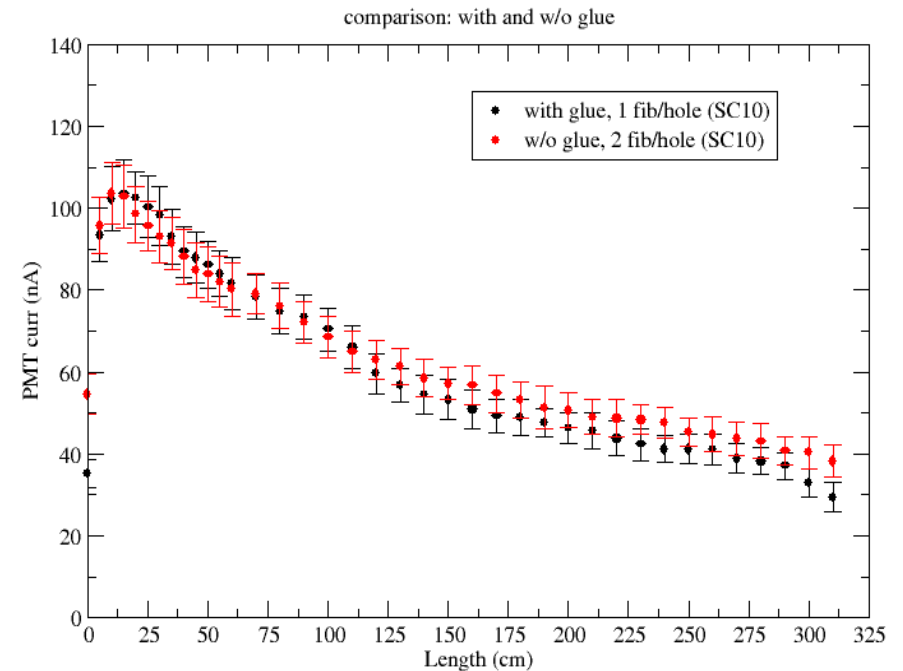


Two fibers/hole, total four fibers per scin

Scintillator from Fermi lab: comparison



- ❑ Black points, with glue , total two fibers per scintillator (SC8).
- ❑ Red points, with out glue, total four fibers per scintillator (SC10).



- ❑ Black points, with glue , total two fibers per scintillator .
- ❑ Red points, with out glue, total four fibers per scintillator. (both SC10)

Summary

- ☐ We did a dimensional quality check for the scintillators from Fermi lab.
- ☐ Did several extensive studies to develop a gluing procedure for the large scintillators.
- ☐ We measured the light transmission characteristics of the scintillators with and without gluing by measuring the PMT anode current.
- ☐ Even with careful gluing one can have small air bubbles/pockets, which might affect the longitudinal light response.
- ☐ Four fibers per scintillator (without glue) gives more or less the same response as two fibers per scintillator (with glue).