Coordinate Detector fabrication status

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for Idaho State University
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Fabrication

- 168 Scintillator Blocks: finished.
- 168 Fiber Bundles : 58 (100% done) + 30 (75% done); plan-88.
- Diamond cutting machine needs new ball bearings.
- Module assembling: 1 module (50% done)

Quality assurance

- Refraction on fiber channel and scintillator response.
- Fiber treatment and optical properties.
- Module assembling accuracy.

Refraction and Fiber Acceptance.

$\mathrm{Sin}(\alpha)=r/d$

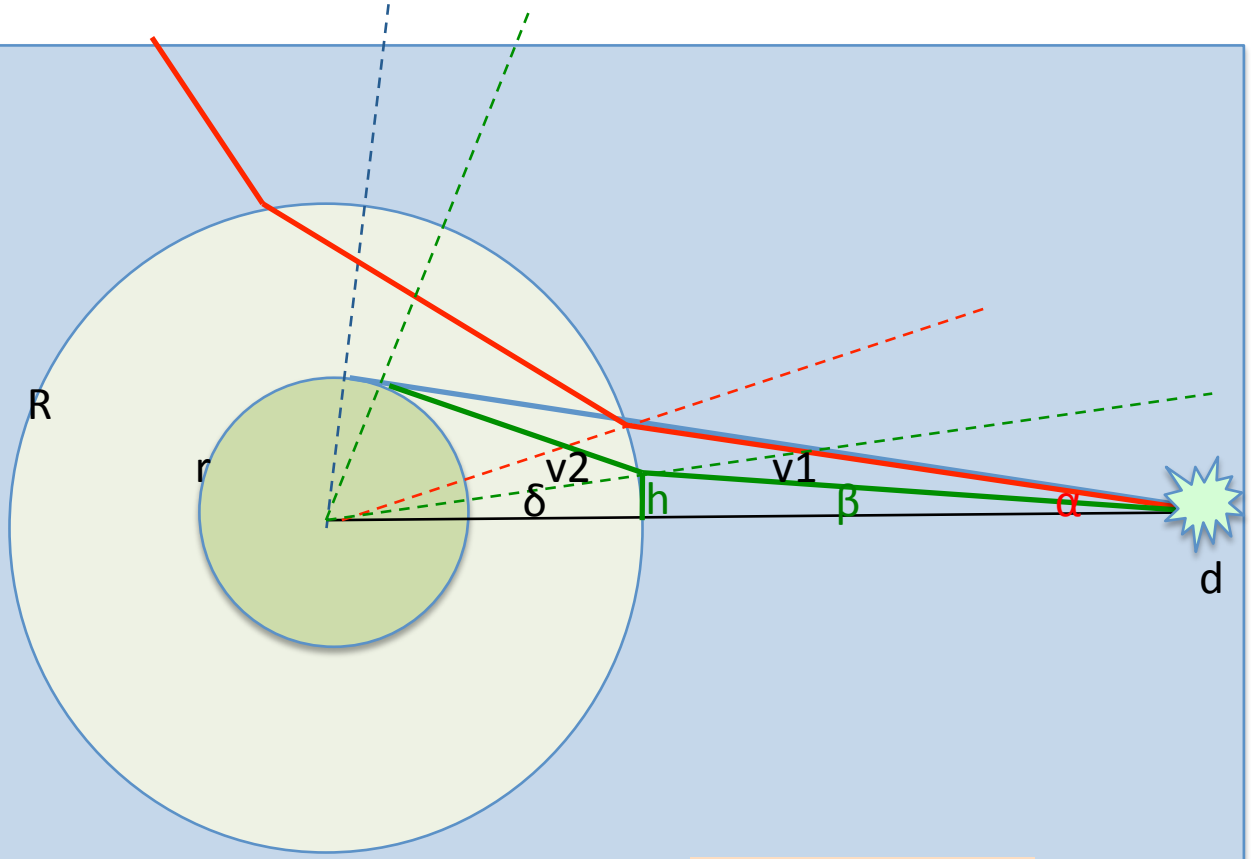
$\mathrm{Sin}(\beta)=h/(d-R)$

$\mathrm{Sin}(\delta)=h/R$

$\mathrm{Sin}(v2)/\mathrm{Sin}(v1)=n$

$\mathrm{Sin}(v2)=r/R$

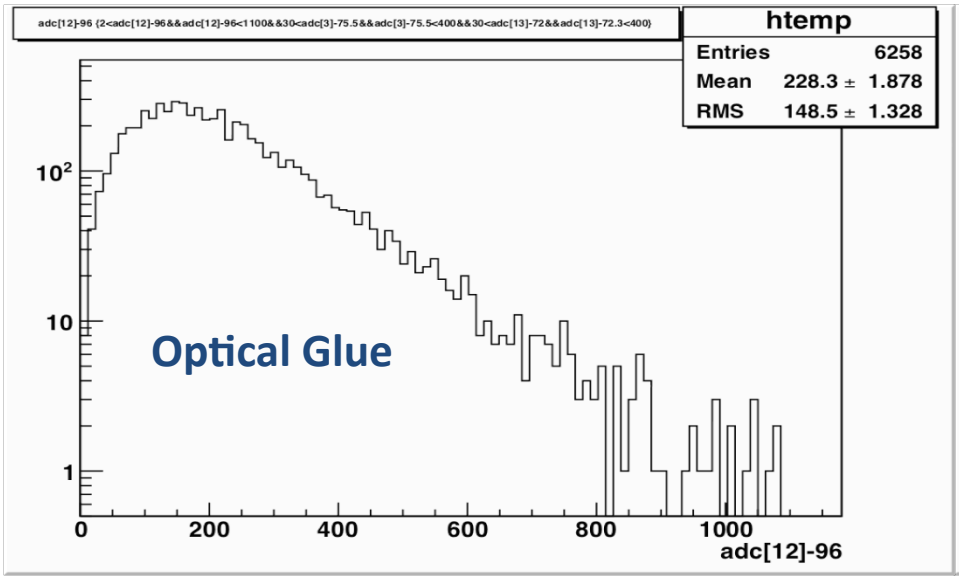
$\delta+\beta=v1$

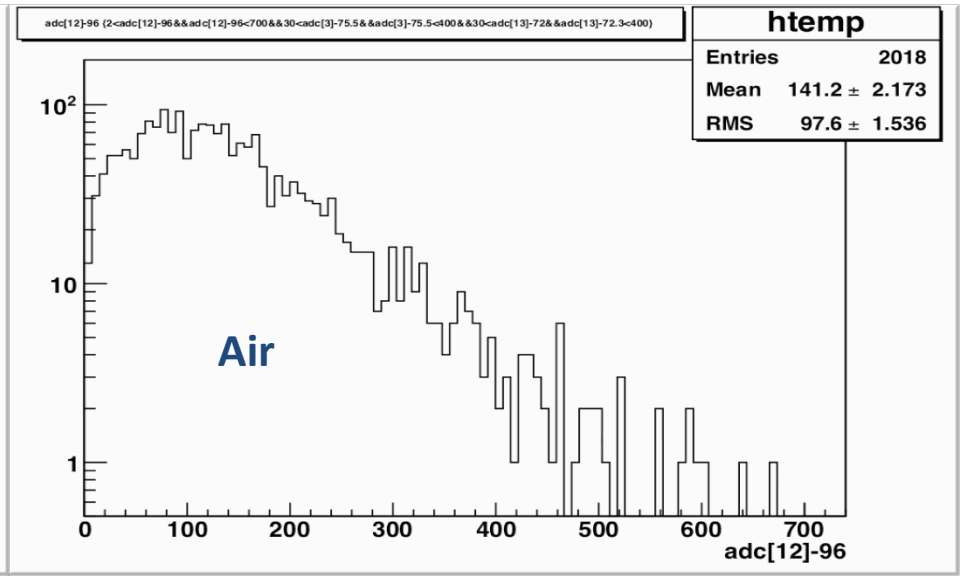


$$\beta \approx n^{-1}\alpha$$

- Acceptance with Air Channel is n times lower.

Refraction and Number of Primary Photo Electrons (NPPE). Measurements.



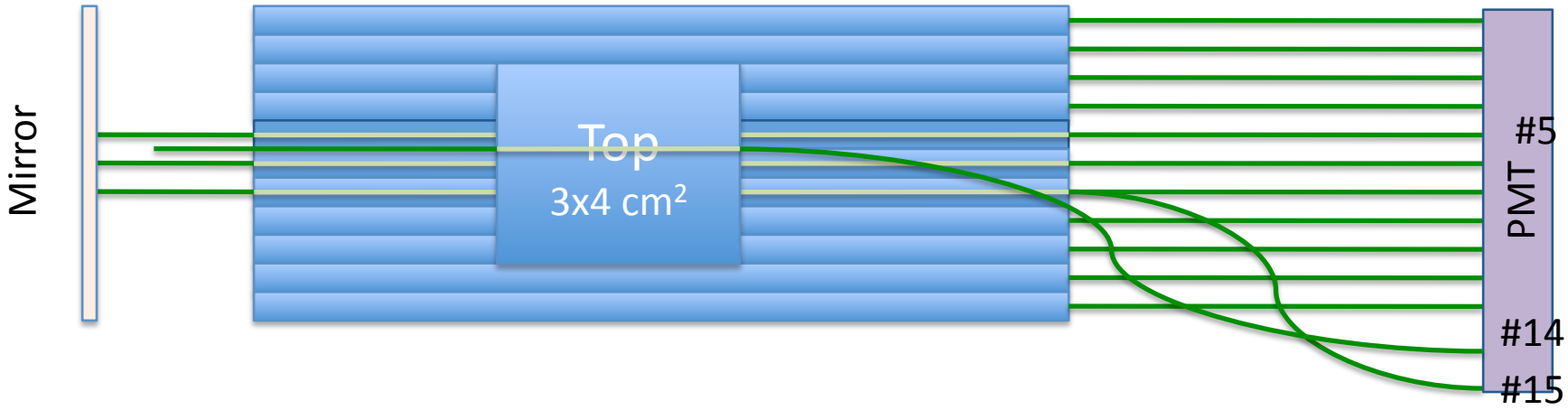


- Optical Glue in Scintillator Channel results in 1.6 higher NPPE.

Quality assurance.
What is the Number of Primary Photo Electrons (NPPE).

Test setup

1) Standard CDet Block of 14 scintillators + Top & Bottom Trigger telescope.
2) Range of cosmic particles ~4 cm (normal to slide) ;
3) Acceptance ±20° along fibers; ±2° across fibers.

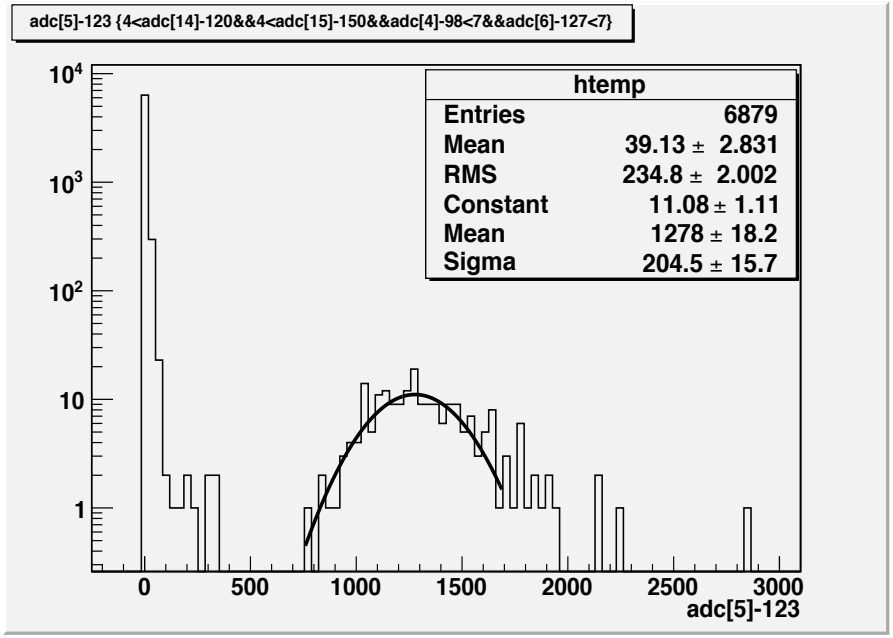


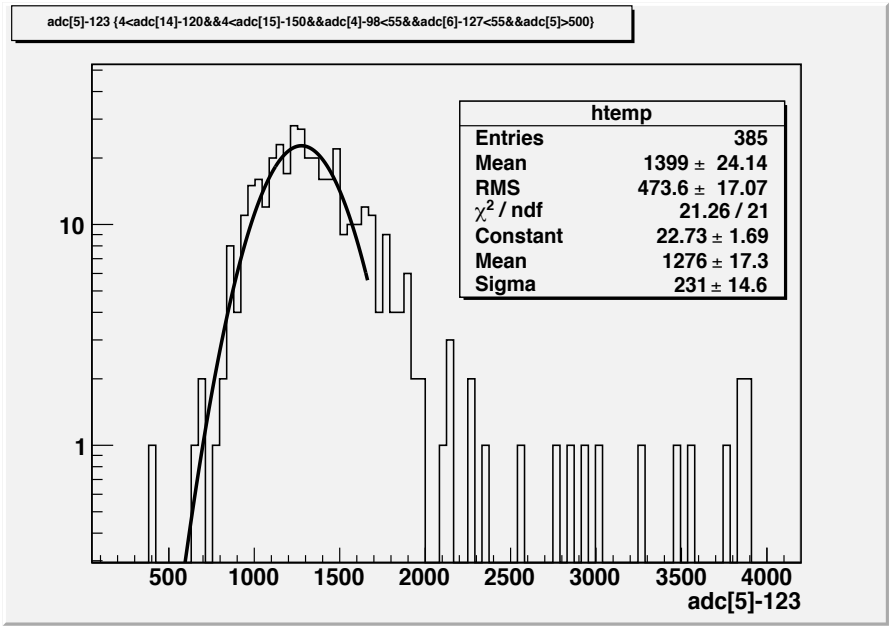
We study

pedestal subtracted spectra for adc(5) provided:

1) good signal from Top and Bottom- adc(14)>10 & adc(15)>10
2) no signal in two adjucent scintillators- adc(4) < 5 & adc(6) < 5

Quality assurance.
Results for Number of Primary Photo Electrons.

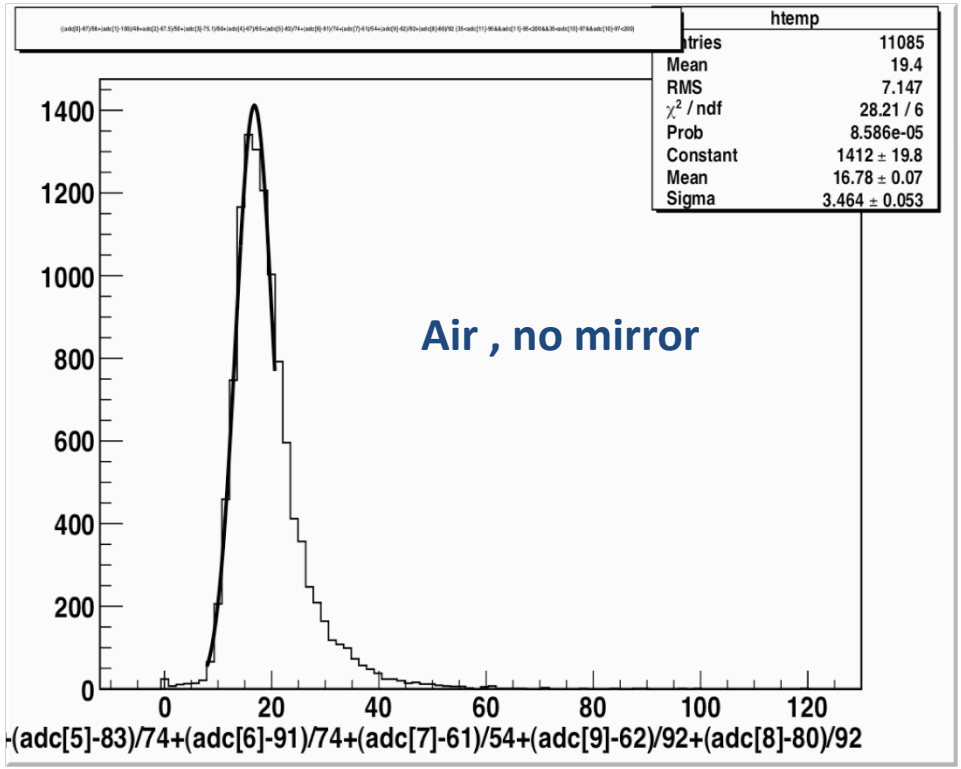




Provided pure statistical fluctuations NPPE= (Mean/Sigma)**2

- Depending on the fit area we find NPPE ≈ 30 ± 4.
- Do we need to improve NPPE ?

Comparison with Data obtained in 11/06/2015.
Cumulative Response of 10 scintillators to cosmic tracks .



$\text{Mean} \approx N_{ppe}$

$\text{Sigma} \approx \sqrt{N_{ppe}}$

$N_{ppe} = (\text{Mean}/\text{Sigma})^2$

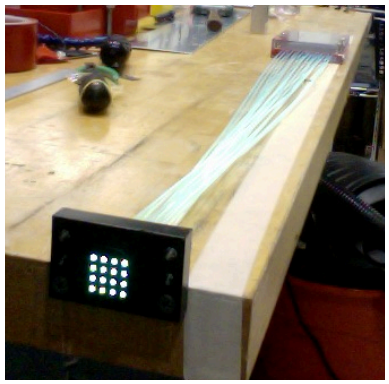
$N_{ppe} = (16.8/3.46)^2$

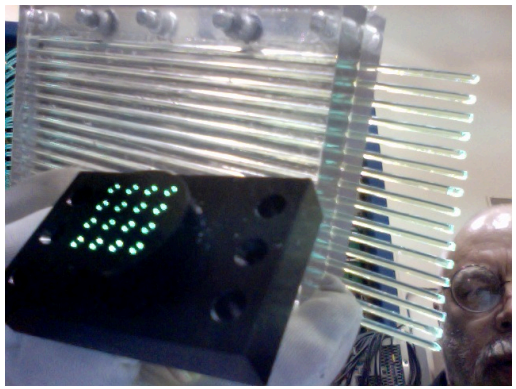
$n_{ppe} = 4.7 \ \text{cm}^{-1}$

- Expectations with mirror (×1.6): NPPE ≈ 30 along 4 cm side of CDet.
- Agrees with previous slide: (30 ± 4).
- Do we need to improve NPPE ?

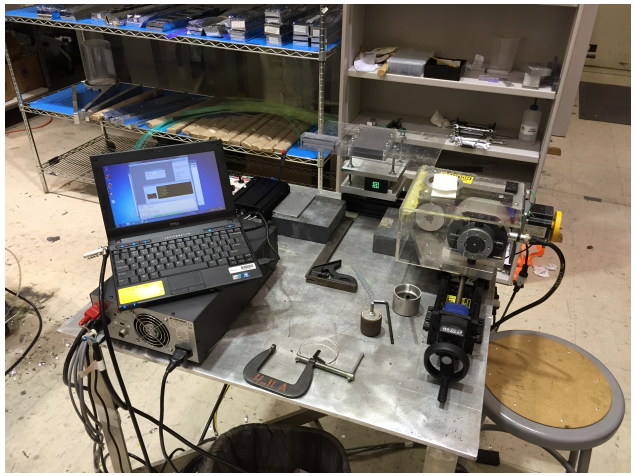
Fabrication of fiber bundles.

Diamond cutting bit

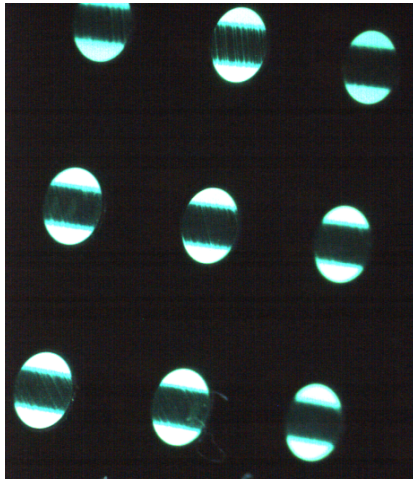




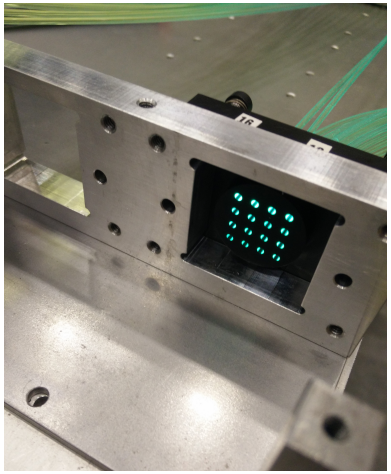
Scintillator side is prepared for cutting



Cutting machine

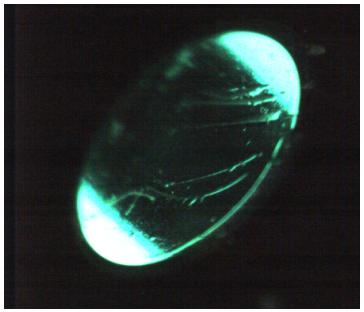


Machined PNT side

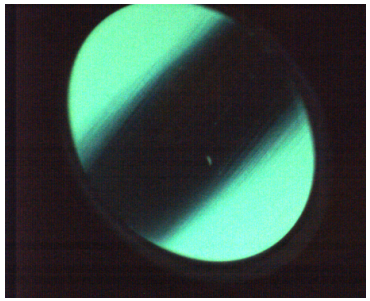


Mounted Bundle

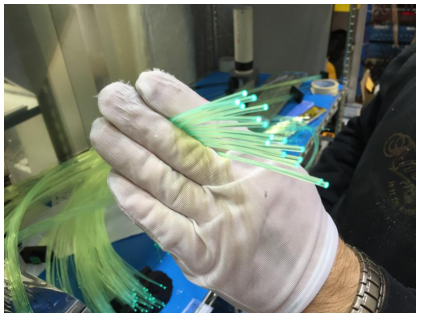
Quality Assurance.
Effect of machining technique.



- Old technique. Cracks shows up within ~2 monthes.

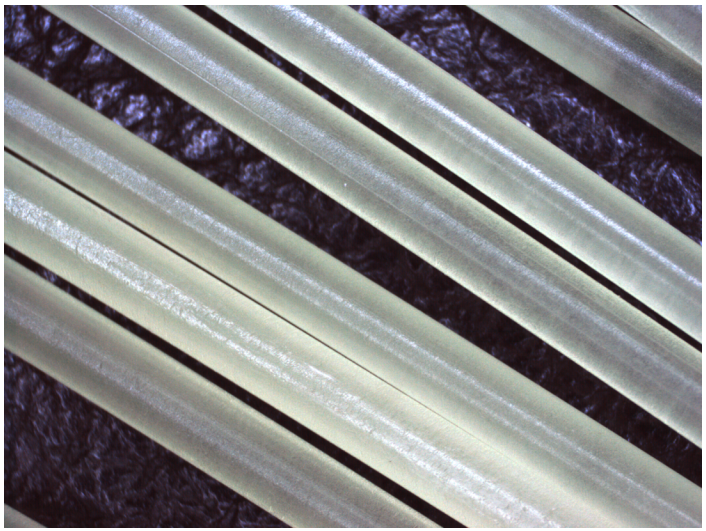


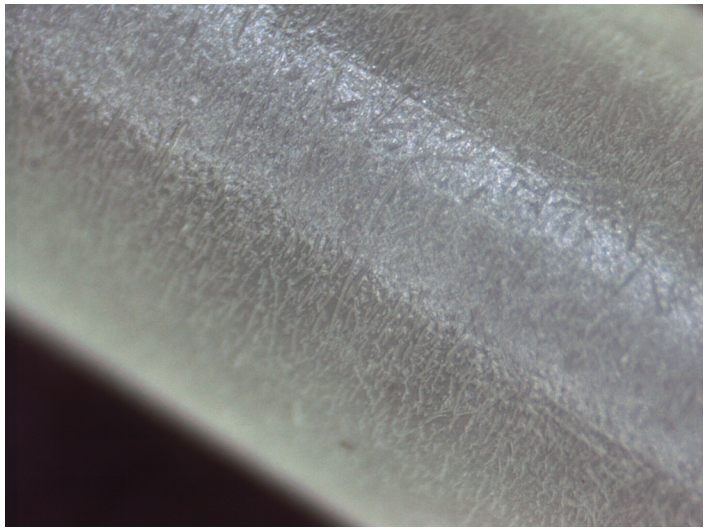
- Improved, but more time consuming technique.
  Shows no cracks after 2 monthes.



Quality Assurance.
Effect of cleaning using alcohol containing mixtures.

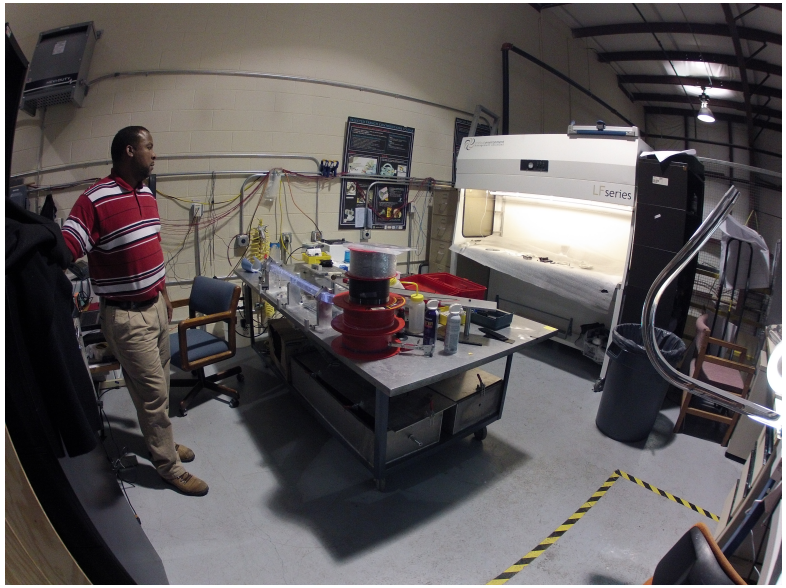
A bundle of 16 fibers has been used for scintillator block's testing





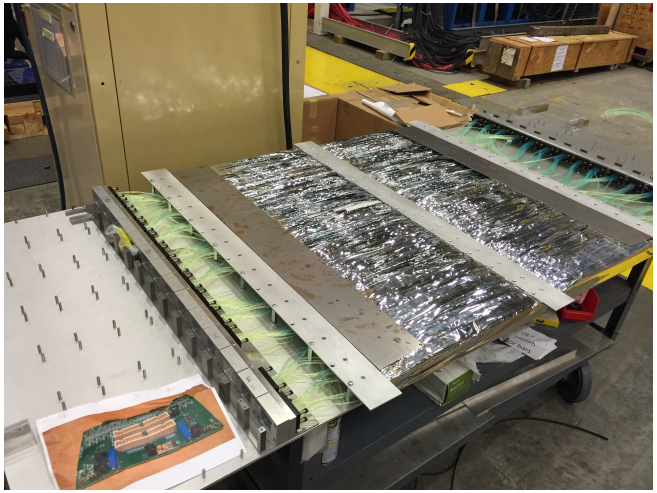
- Cleaning fibers using alcohol results in obviously worse fiber transmittance.
- Damaged 16 fiber bundle was replaced with a new one.
- The last shows similar damages after insetting into several scintillator blocks.
- Apparently because scintillator's channels were cleaned using alcohol.
- What may happen to the inner surface of fiber channels?

Quality Assurance.
Using Compressed Air Line for Hall B upgrade in 2010-2014.

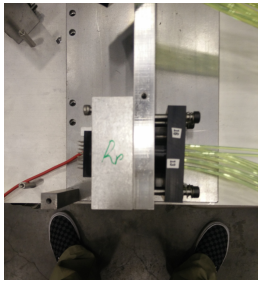


- Air flow at room temperature is safe and efficient
- May be used for CDet construction.

Central Module Assembling



Nov-2015. Accuracy is of 3 mm



- PMT Readout and DAQ successfully tested and NPPE estimated.
- Top+Bottom+Central modules must create uniform surface.
- Therfore Scintillator **Blocks must be positioned with sub-millimeter accuracy.**
- Some annex **parts should be designed** for precise adjustment.

Conclusion and Outlook

- Fabrication of 14-**Scintillator Blocks** is **finished.**
- **Fiber Bundle** fabrication is in **progress and improved.**
- This technique takes **more time.**
- Using **alcohol** should be avoided.
- **Delay** due to "screaming" ball bearings **is possible.**
- Expected nominal **performance of scintillator**: NPPE ≈ 30 .
- It is **sufficient**?
- **Precision** module **assembling technique** - to be developed.