Electron-Muon Ranger (EMR)

Progress Report

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[3]Università degli Studi dell'Insubria and INFN, Sezione di Milano Bicocca, Italy

MICE Collaboration Meeting 32
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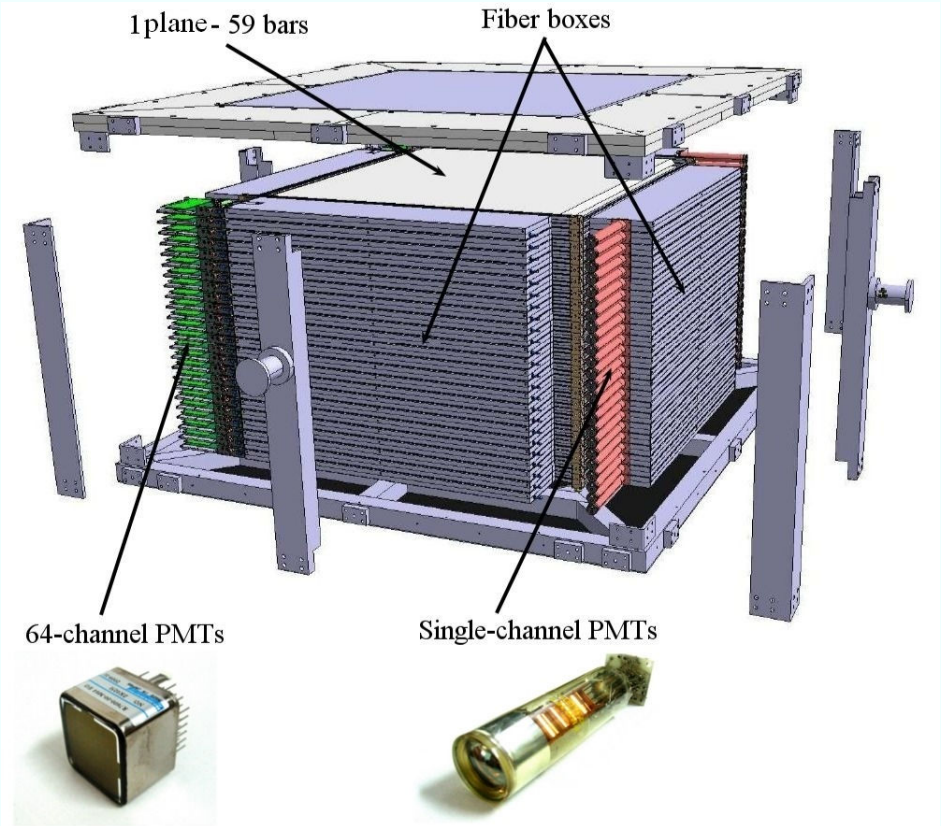
EMR Overview



EMR detector is designed to fully stop muons from the MICE cooling channel, provide distinct signatures for muons and electrons and measure their range.

Characteristics

- 24 modules (module = 2 X&Y planes)
- 59 triangular scintillator bars per plane $\rightarrow$ 2832 bars
- light is collected by WLS fiber transfered to PMTs by light guide
- total energy per plane is detected by single-channel PMT (PHILIPS)
- energy in every bar is detected by 64-channel PMT (HAMAMATSU)
- readout is performed by custom made electronics based on MAROC/FPGA ISICs and CAEN fADC
- custom made buffer board stores all hits (time over threshold) within MICE spill gate; pulse hight information is available at low rate

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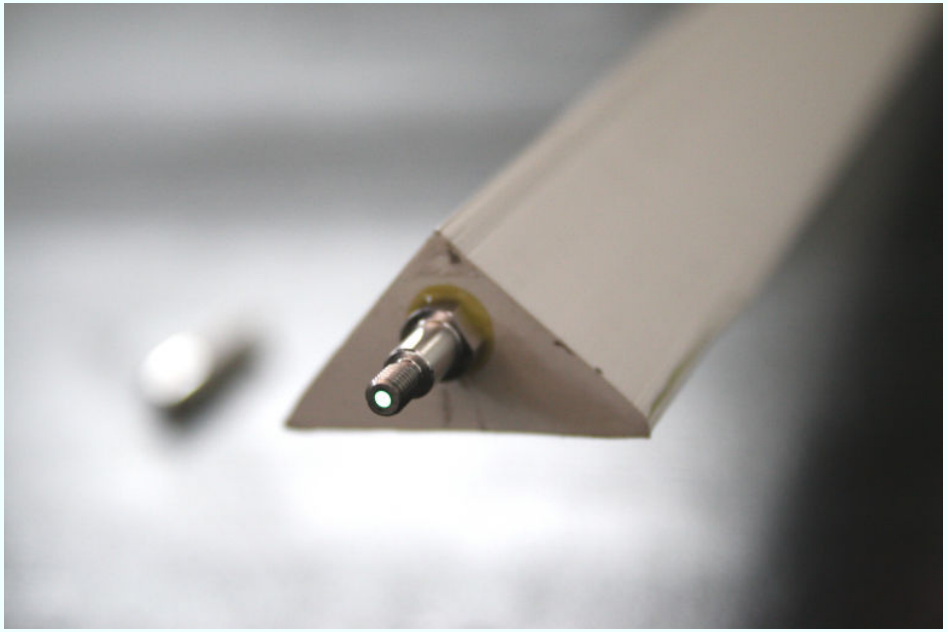
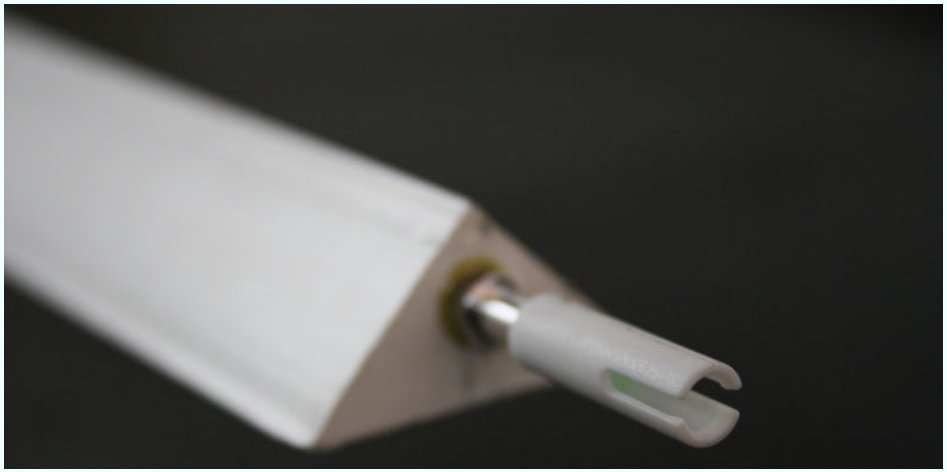
WLS-to-Light-Guide Coupling

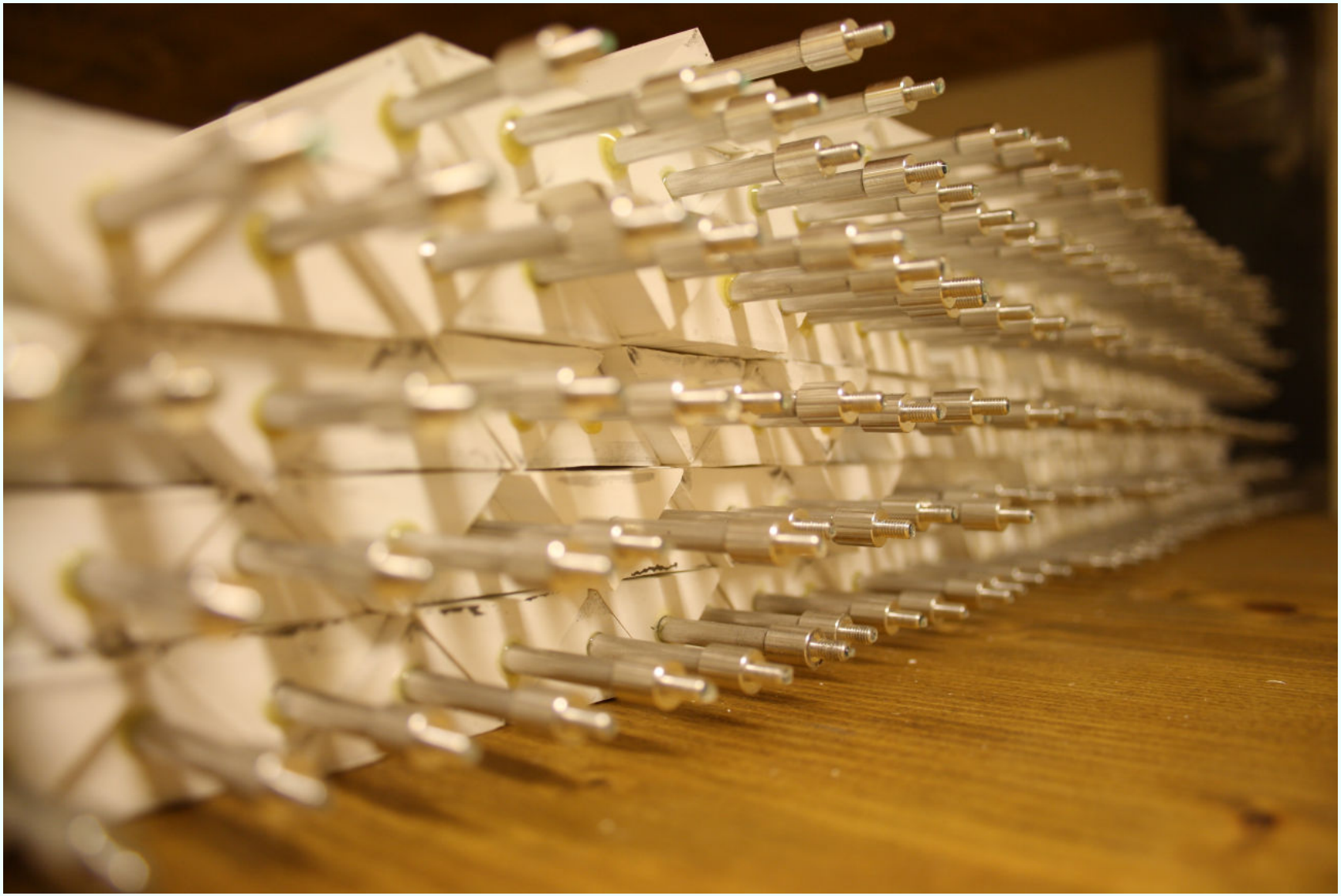




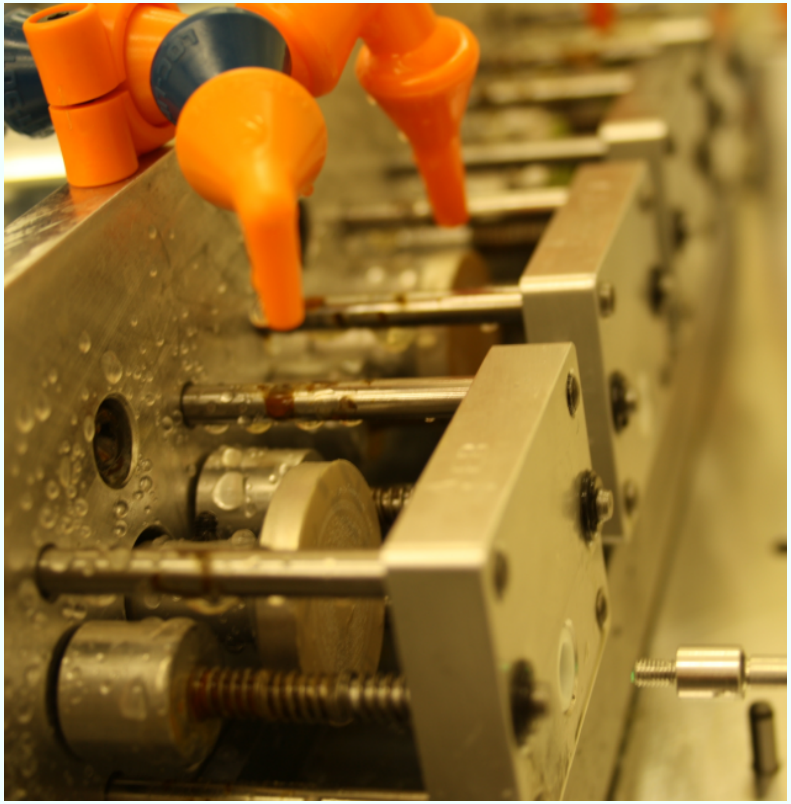
- All connectors manufactured (plastic injection and machining)
- Light guide selected and tested
- Light losses and attenuation parameters measured
- Special polishing stand for bar connectors assembled

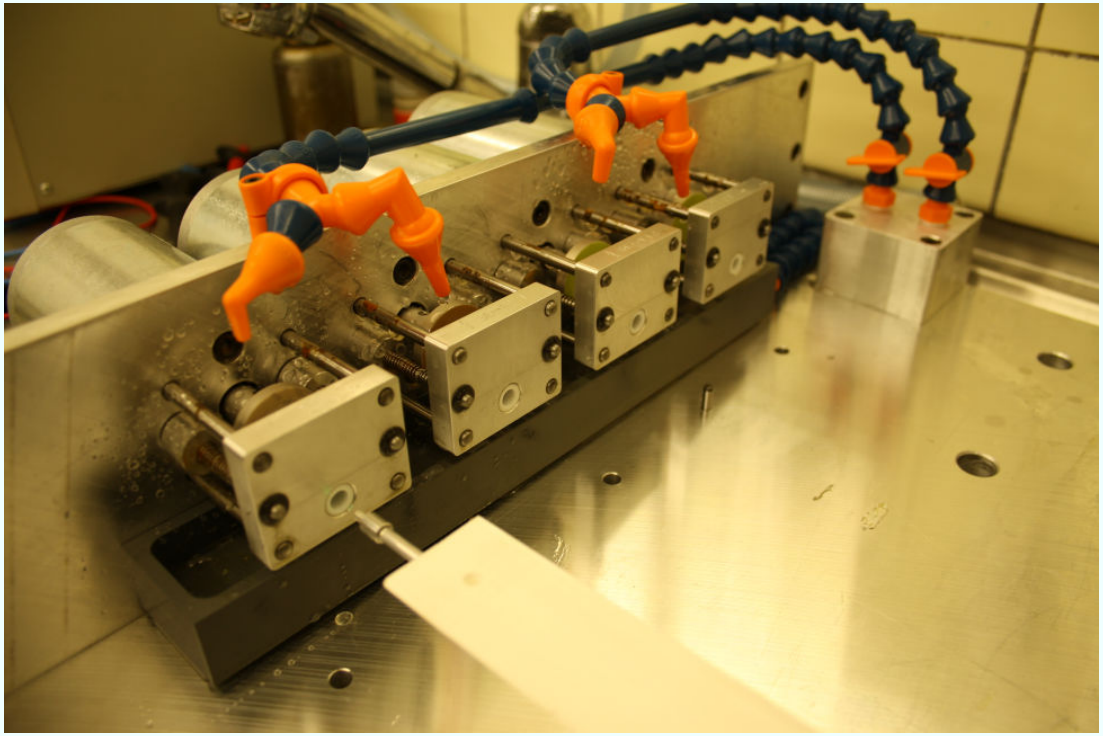
New Module Assembly
without lightguides

Reprocessed Bars



Polishing Stand





- 5664 connectors (on bars) need to be polished
- 4 motors equipped with different polishing papers from course to fine grade

Light Guide

SH6001-2.2

Super Eska™ Polyethylene Jacketed Optical Fiber Cord
V-2Y 1P1470/1500

Manufacturer: Mitsubishi Rayon Co. LTD.
Manufacturer's PDF Data Sheet
RoHS Certification: Yes

Structure		
Core Material		Polymethyl-Methacrylate Resin
Cladding Material		Fluorinated Polymer
Core Refractive Index		1.49
Refractive Index Profile		Step-index
Numerical Aperture		.50
Number of Fibers		1
	Unit	Value
Core Diameter	µm	1380 - 1560
Cladding Diameter	µm	1410 - 1590
Approximate Weight	g/m	4.0
Jacket		
Material and Color		Polyethylene (black)
Indication on Jacket		None
	Unit	Value
Sub-unit Diameter	mm	0
Outer Diameter	mm	2.2 ± .07
Fiber Tensile Strength	N	118

Applications: General purpose simplex cable for data and sensor applications

Spool Length: 500 m

Sectional View

Part Number: SH6001-2.2
Price (per spool)

1 to 2	$ 940.50
3 to 9	$ 869.00
10 to 19	$ 792.00
20 to 39	$ 737.00
40 to 99	$ 671.00
100+	$ 605.00

Quantity 1

Part Number: IF C E1500
Price (per meter)

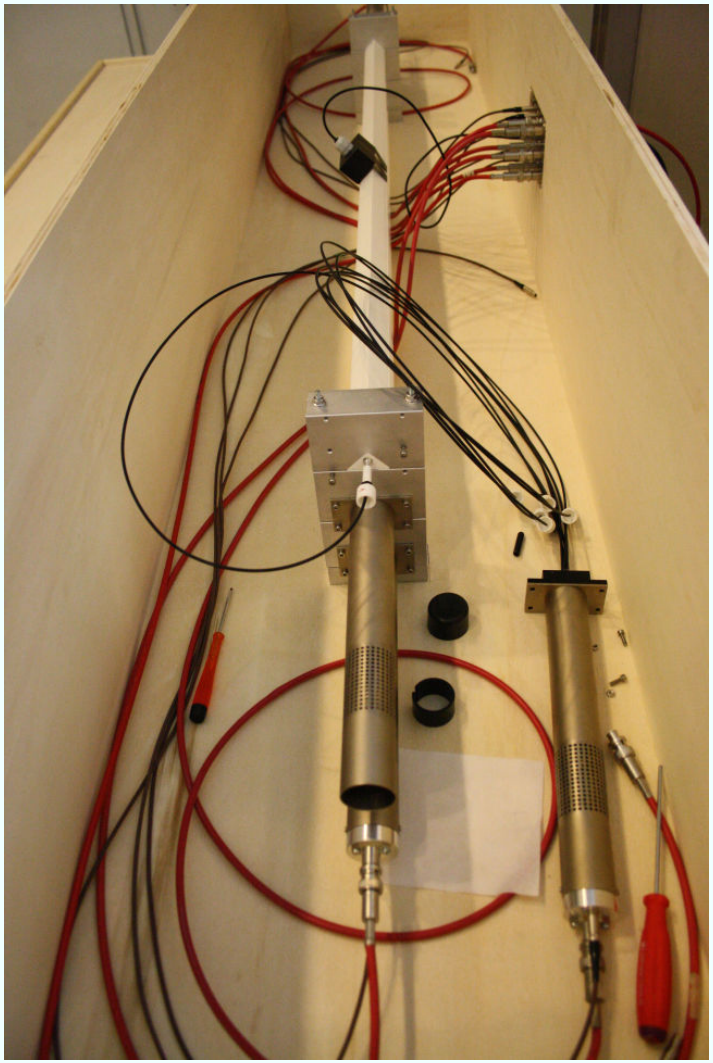
$3.80

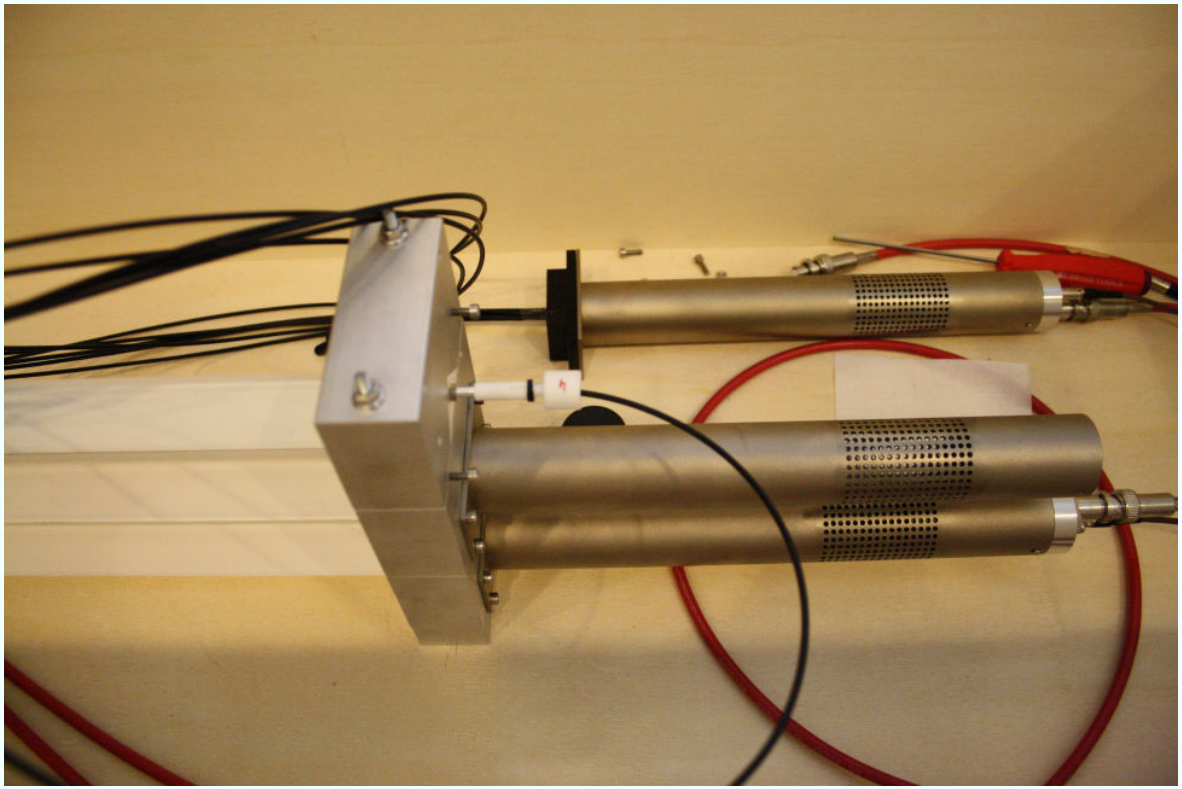
Quantity 1

Convert Feet to Meters:
100 feet = 30.48 meters

Convert Meters to Feet:
100 meters = 328.08 feet

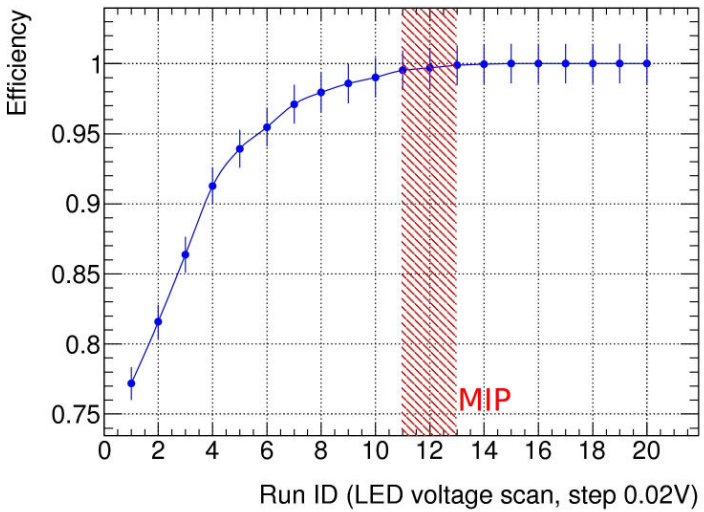
Test Bench

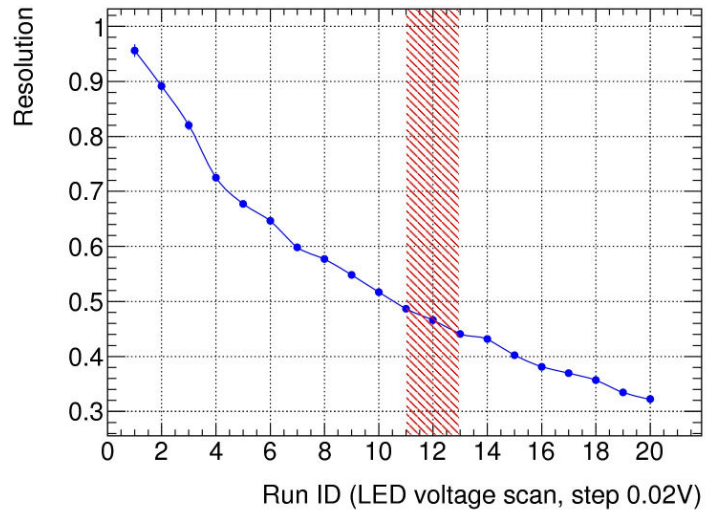


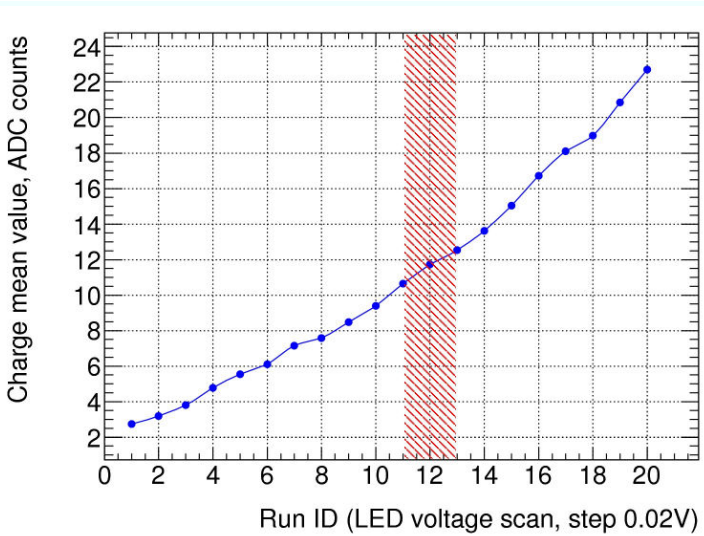


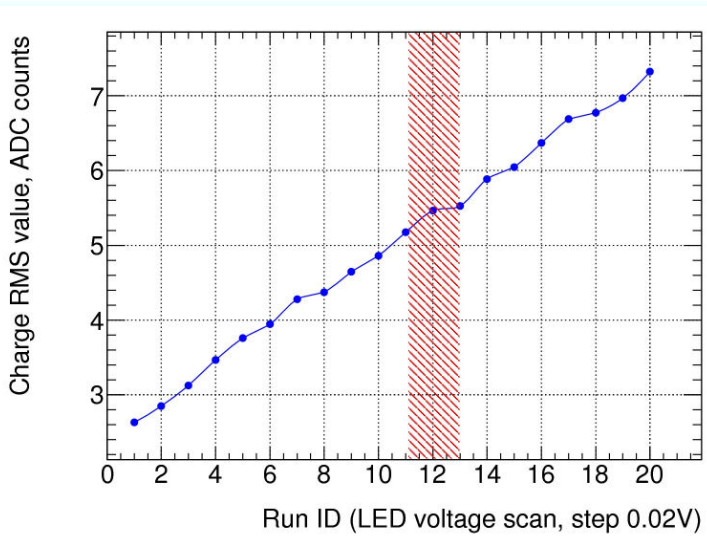
- It is used to measure the attenuation in WLS fiber, light losses in connectors etc.
- Light source: LED or scintillation from cosmic muons

LED Voltage Scan (1)

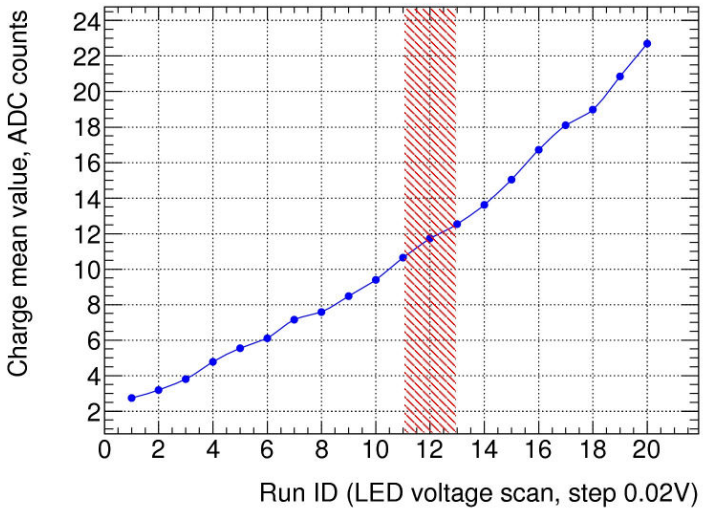


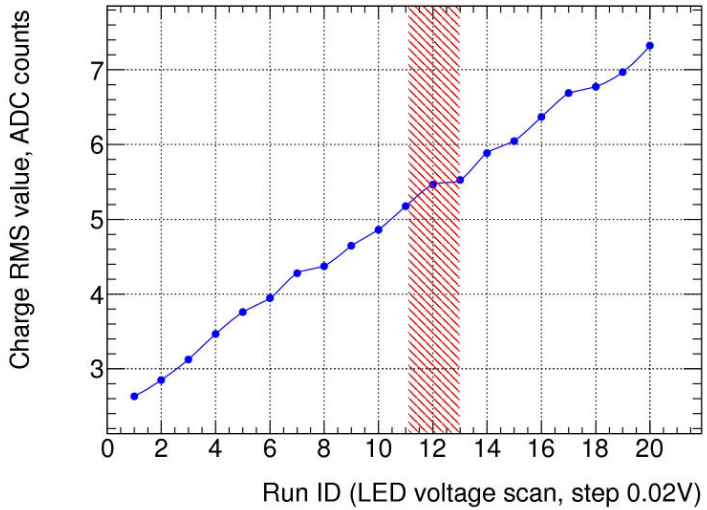


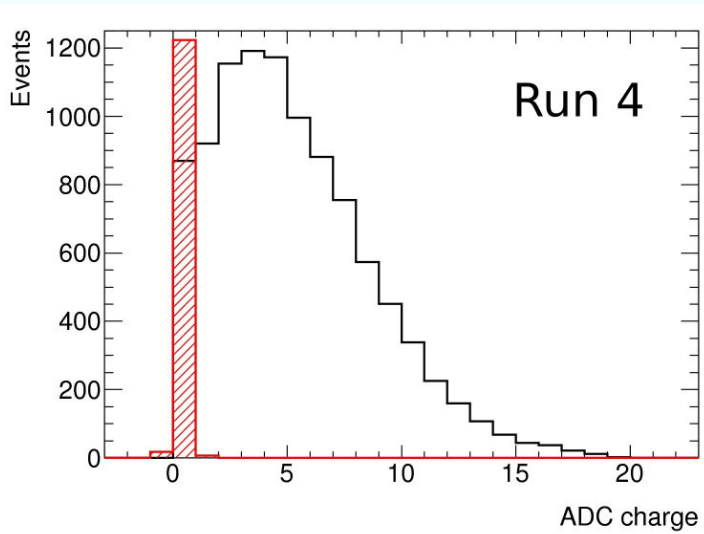


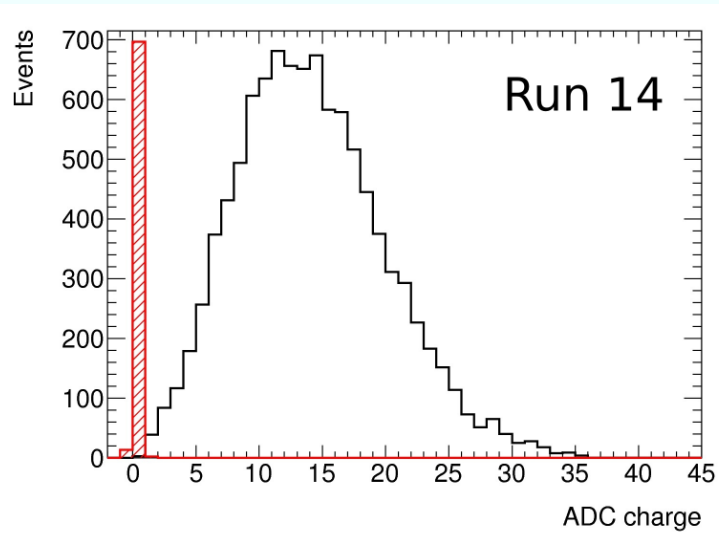


LED Voltage Scan (2)

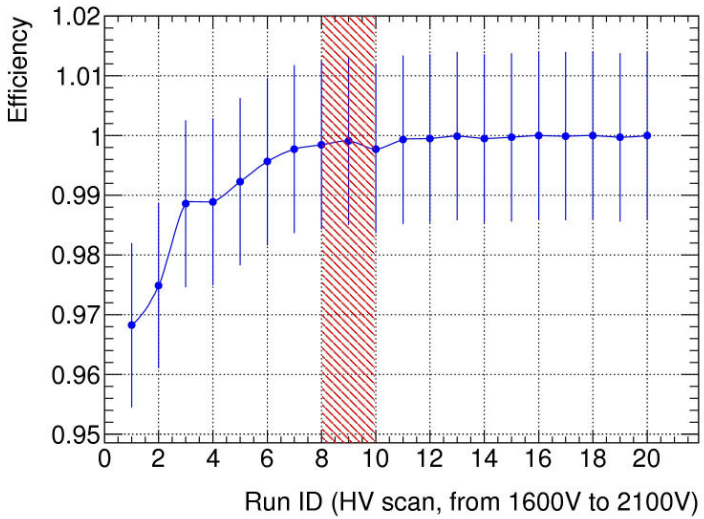


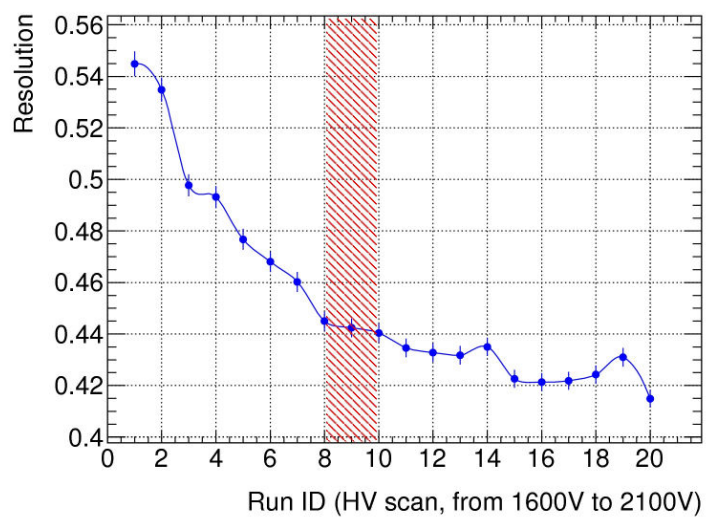


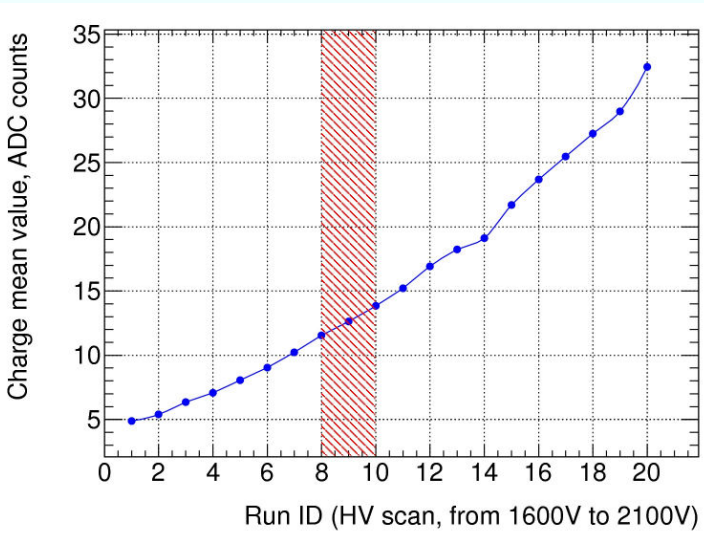


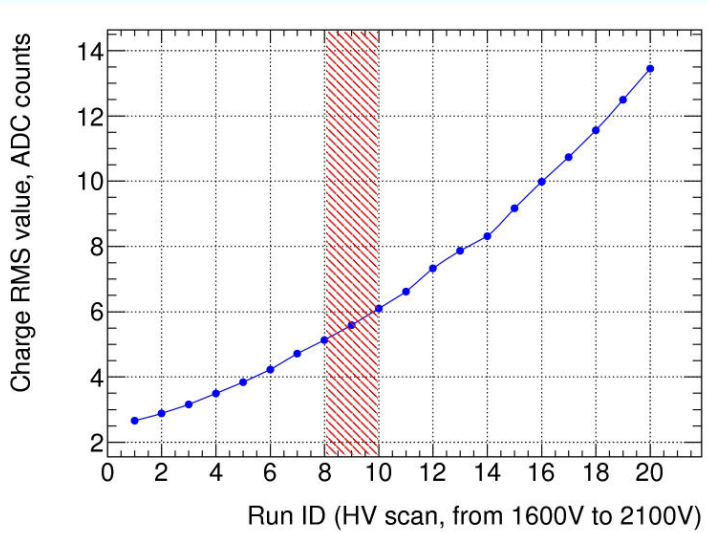


PMT High Voltage Scan

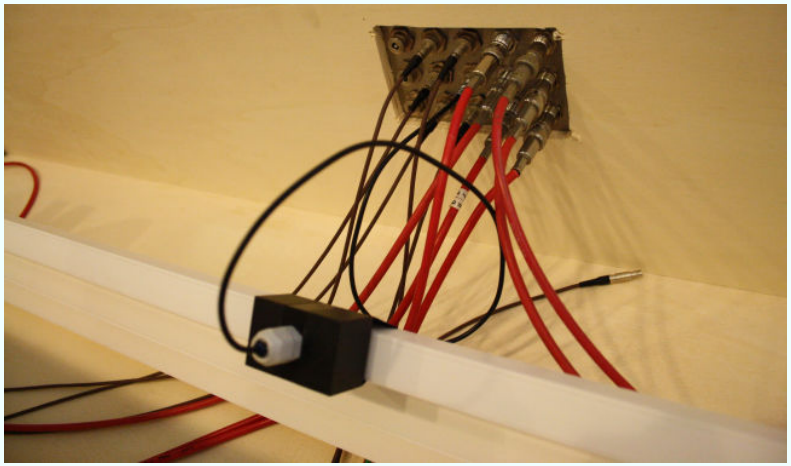


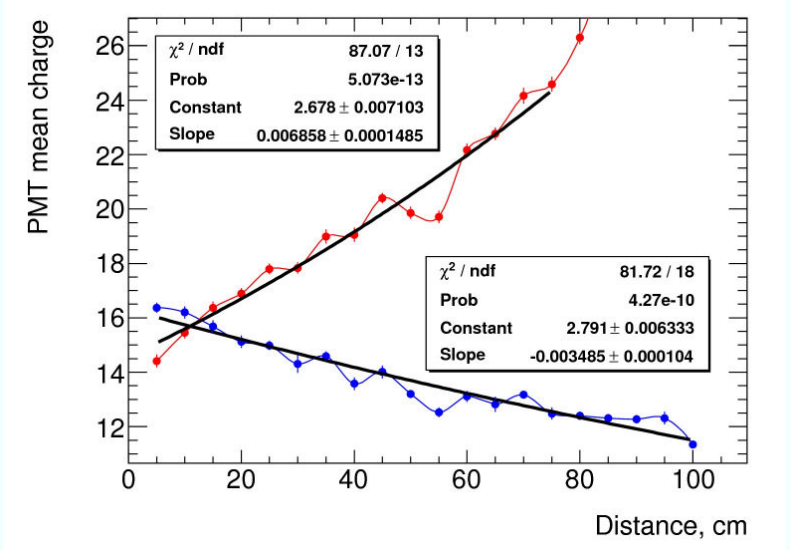


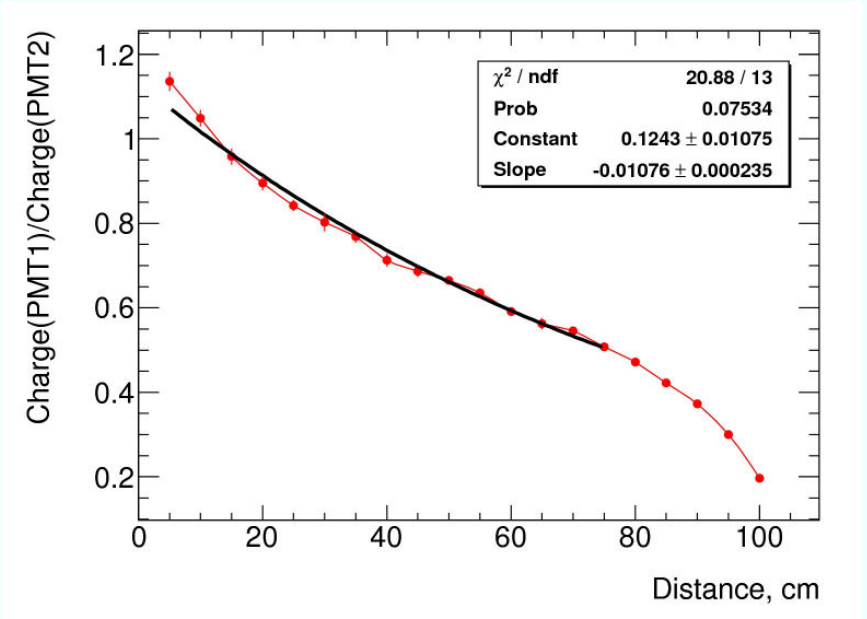




Light Attenuation in WLS fiber





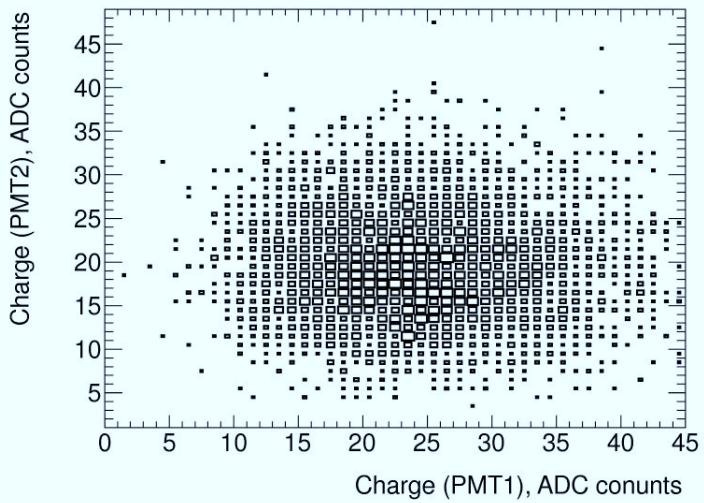


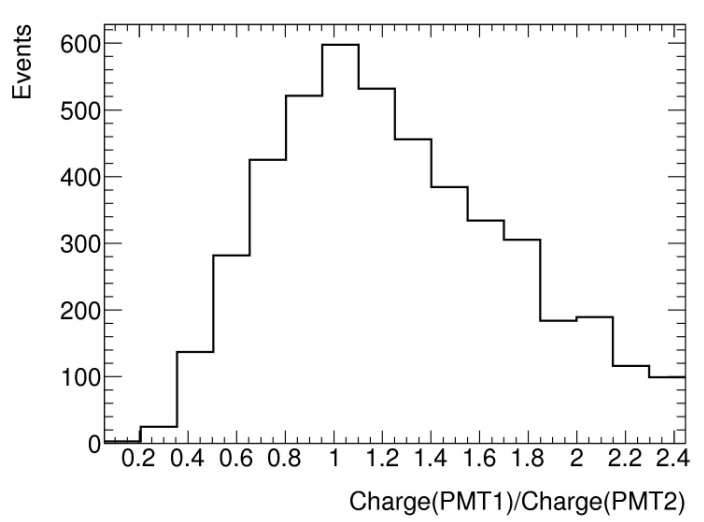
Light attenuation in WLS fiber:

- 1 m - 42%
- 1.2 m - 48%
- 2 m - 66%

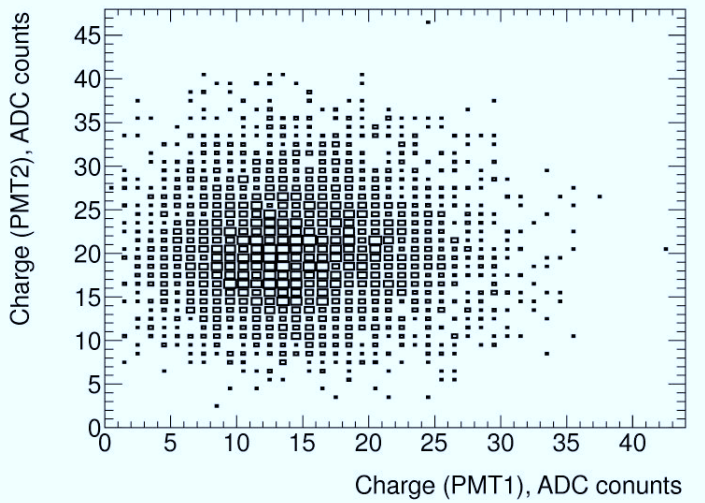
Dual Signal Readout

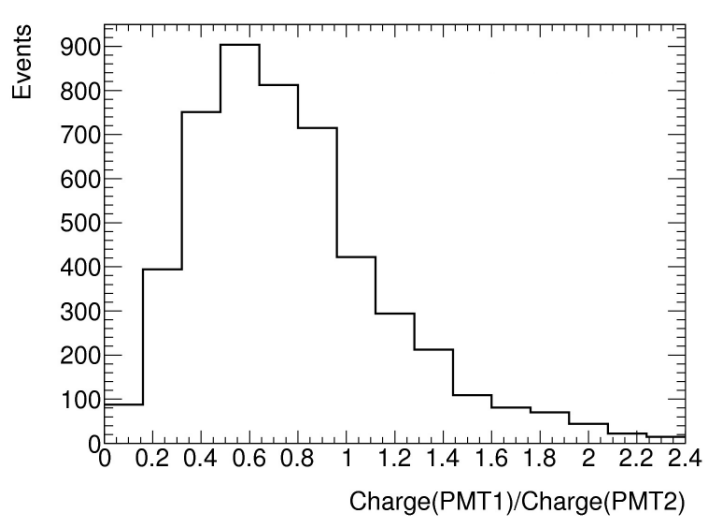
without clear fiber



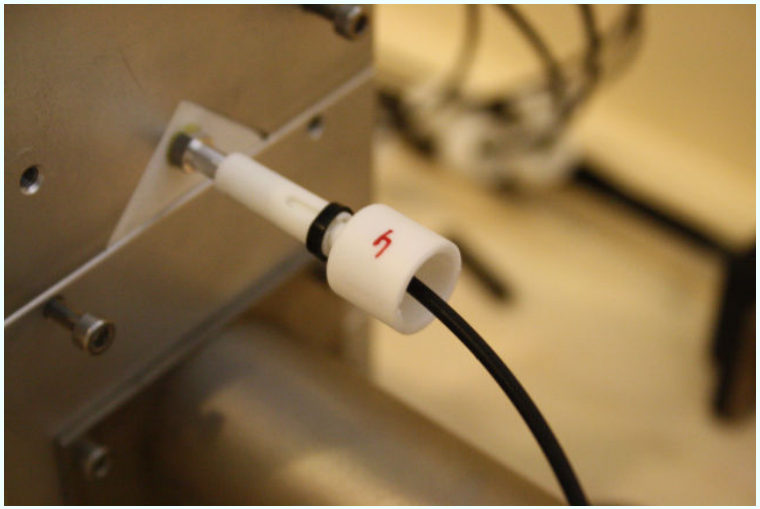


with clear fiber

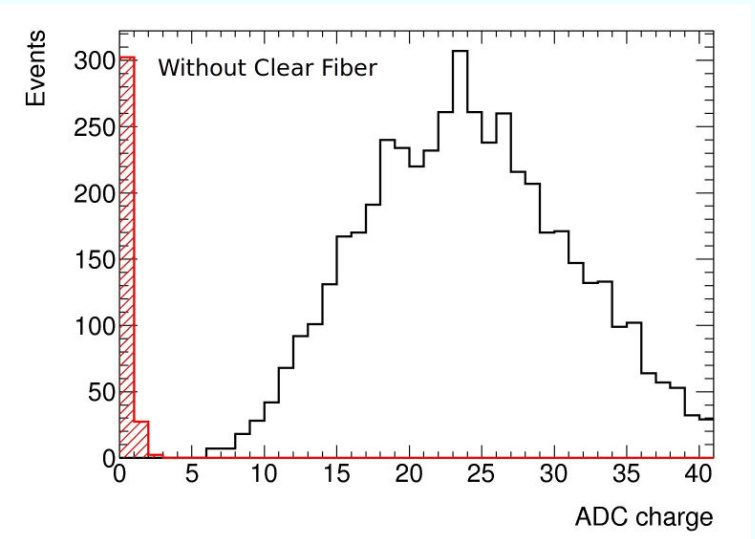


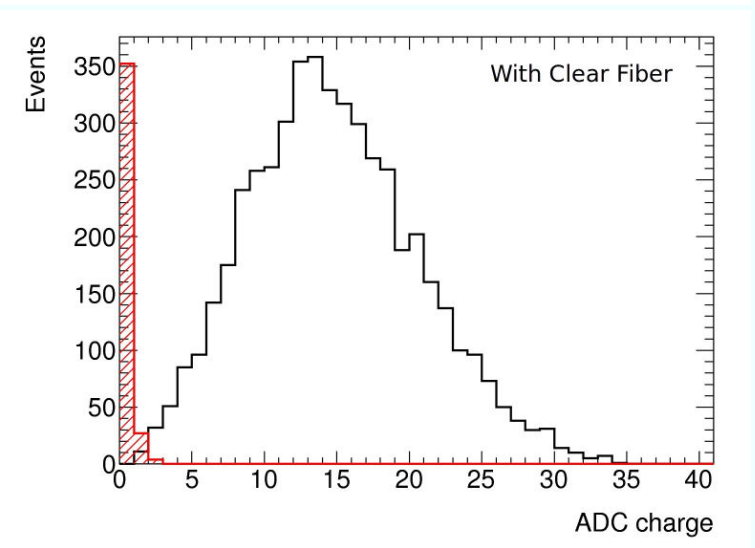


Light Attenuation in Clear Fiber

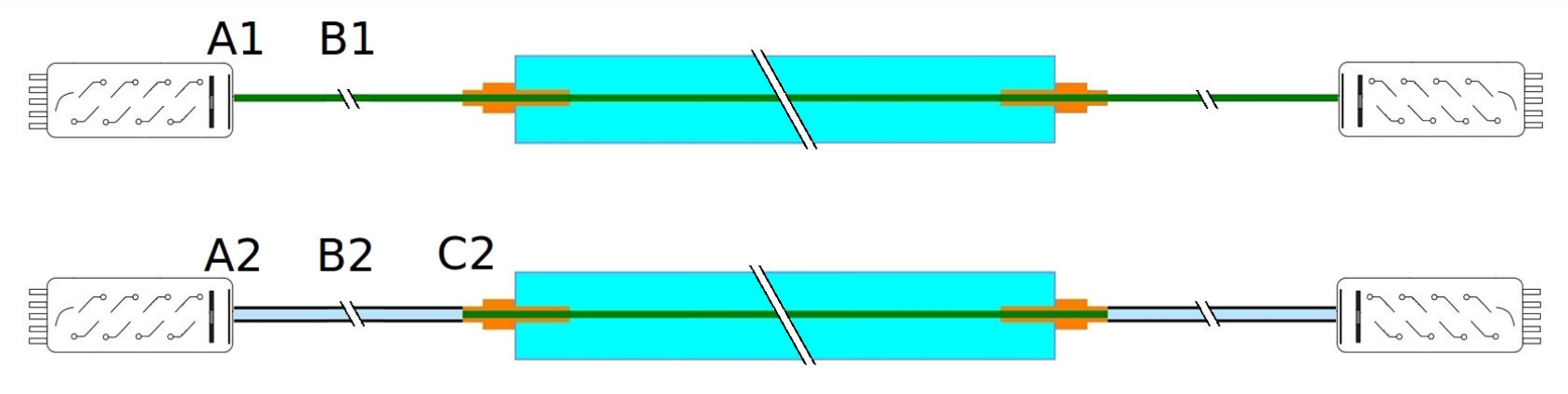


Light attenuation in clear fiber and losses in the connector consitute 38%. It is mainly due to insertion loss.





Comparison Between Old and New Configuration



A - insertion loss, B - attenuation in fiber, C - insertion loss

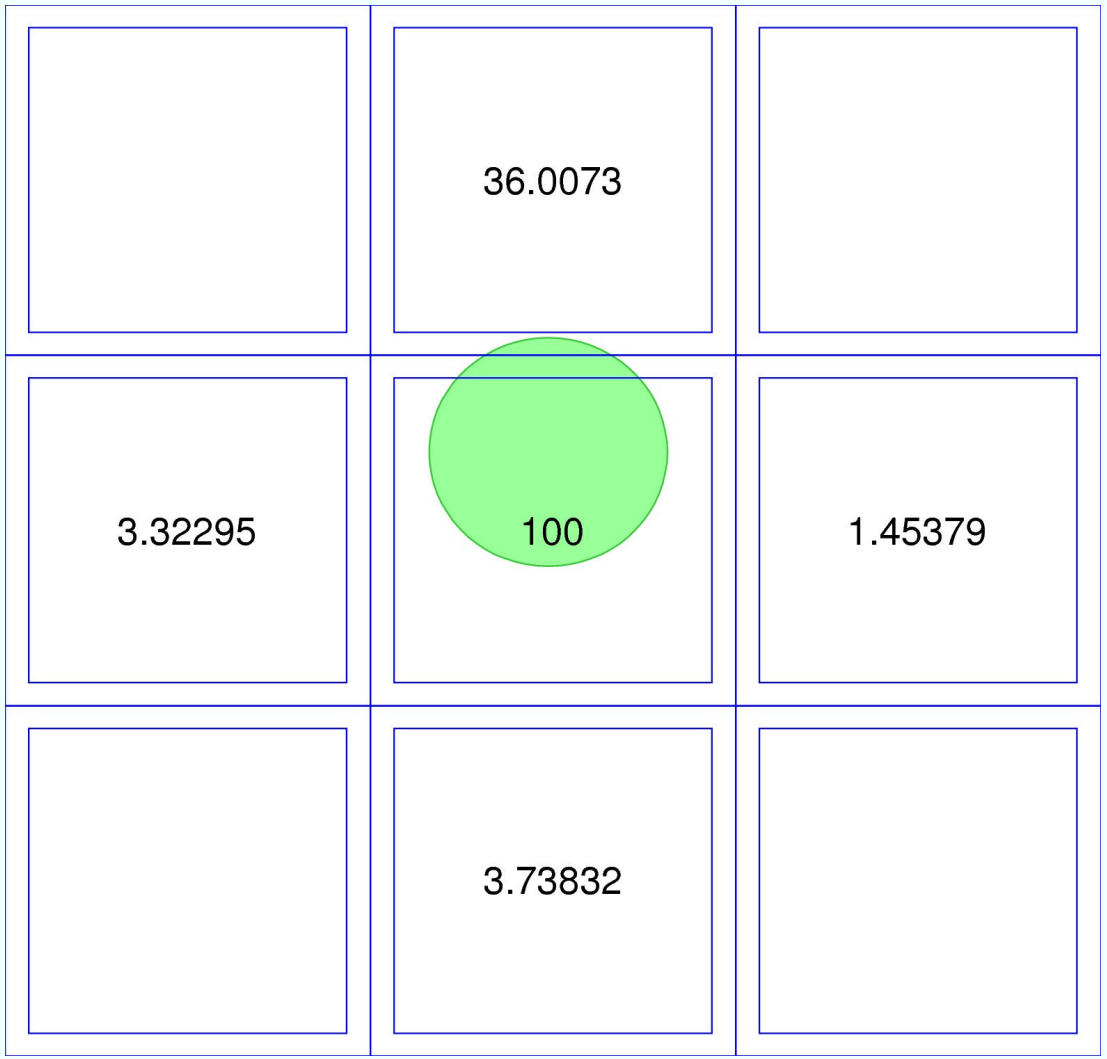
WLS Fiber Only

A1 = unknown
B1 = 48%

WLS+Clear Fiber

A2 = unknown
B2+C2 = 38%

Cross-Talk in 64-ch PMT



- Cross-talk due to larger clear fiber cross-section is well within acceptable limits and comparable with anode cross-talk
- More attention will be paid to the misalignment of the fiber with respect to a PMT mask

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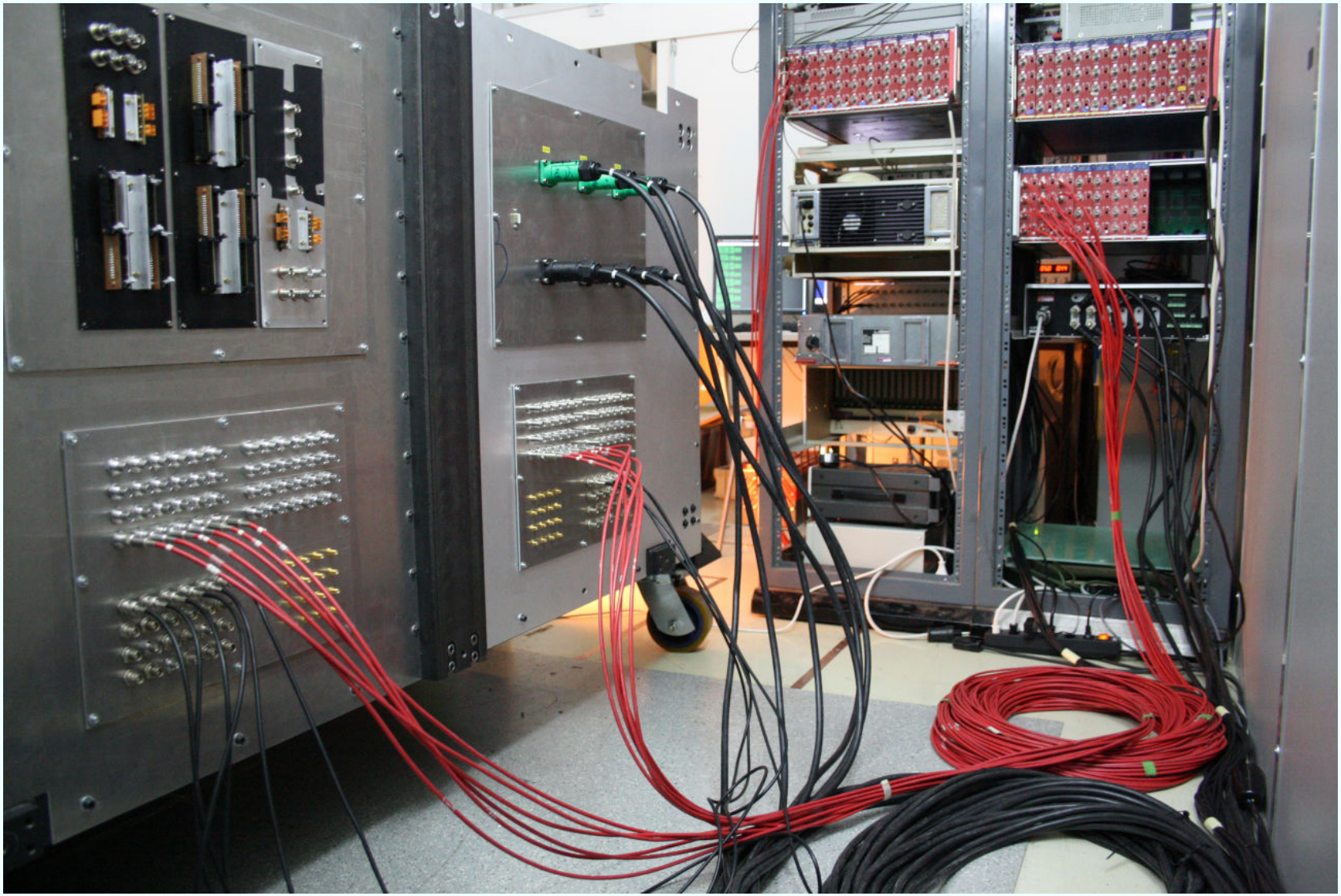
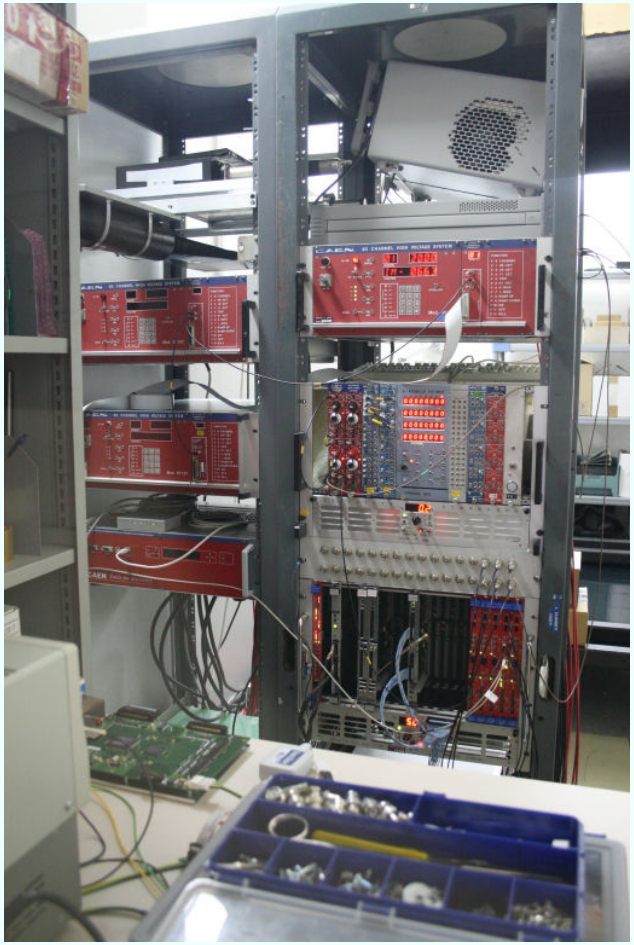
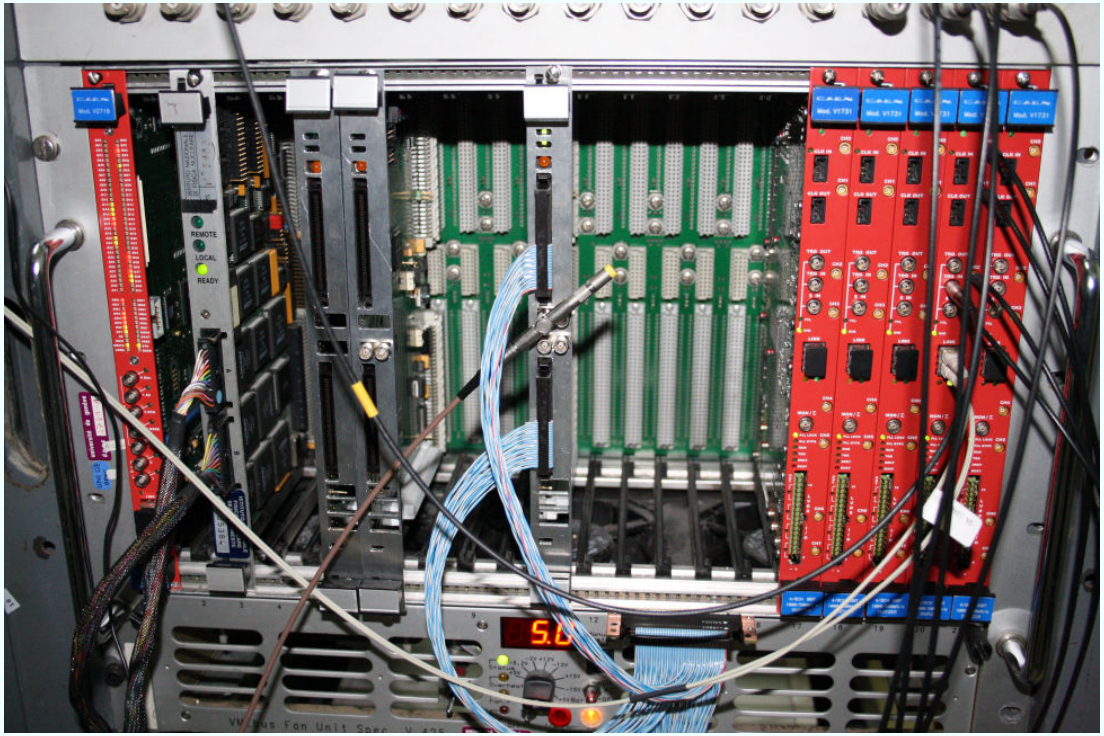
Cabling



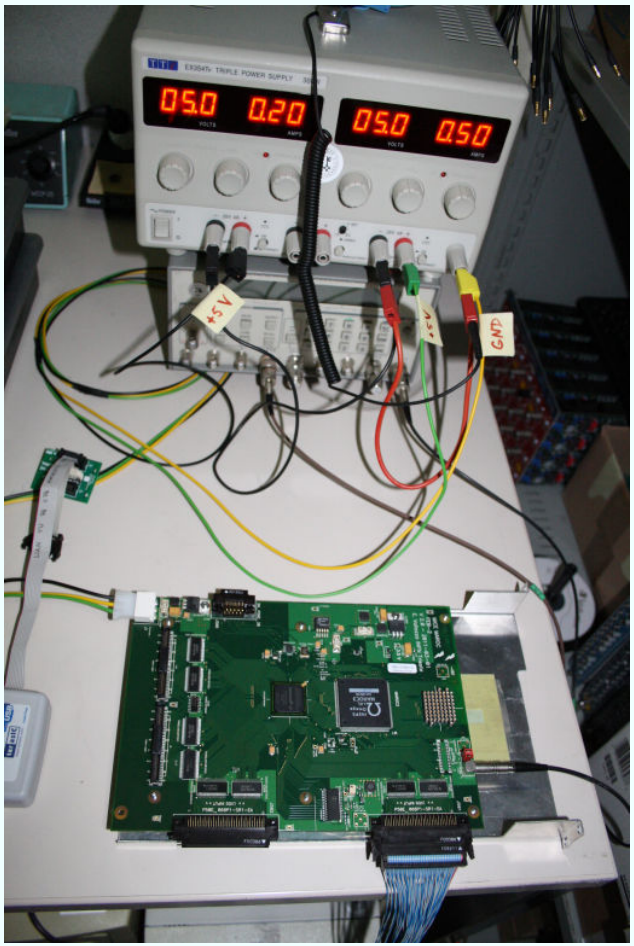
Electronics Racks

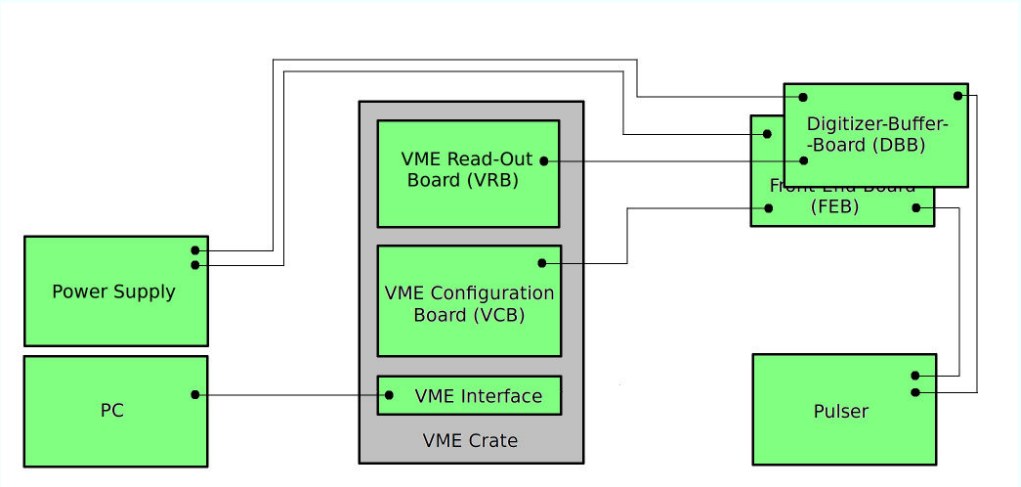




- All high voltage and low voltage channels set up
- Monitoring and testing equipment set up
- All available boards are under tests

FEB/DBB Test Bench





It is used to:

- test Front-End and Buffer Boards
- develop DAQ software
- test 64-ch PMTs

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EMR Schedule

EMR Planning

						January					February				March				April					May			
Step	Task	Total number	Rate per day	# days	# weeks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	Old bars adapter gluing	1000	60	17	3			1.0C	0.5C 0.5J	0.5C 0.5J																	
2	New bars gluing	2000	60	33	7						0.5C 0.5J	0.5C 0.5J	0.5C 0.5J	0.5C 0.5J	0.5C 0.5J	0.5C 0.5J	0.5C 0.5J										
3	Bar's connectors polishing	3000	60	50	10						1.0S	1.0S	1.0S	1.0S	1.0S	1.0S	1.0S	1.0S	1.0S	1.0S							
4	Bar's LED testing	3000	60	50	10						0.5S	0.5S	0.5S	0.5S	0.5S	0.5S	0.5S	0.5S	0.5S	0.5S							
5	Clear fiber connectors gluing	6000	150	40	8								0.25S	0.25S	0.25S	0.25S	0.25S	0.25S	0.25S	0.25S							
6	Clear fiber connectors polishing	6000	150	40	8								0.75S	0.75S	0.75S	0.75S	0.75S	0.75S	0.75S	0.75S							
7	PMT connector gluing	48	1.2	40	8								0.25S	0.25S	0.25S	0.25S	0.25S	0.25S	0.25S	0.25S							
8	PMT connector polishing	48	1.2	40	8								0.25S	0.25S	0.25S	0.25S	0.25S	0.25S	0.25S	0.25S							
9	Module assembly	24	0.6	40	8								1.0L 0.5F 0.25R	1.0L 0.5F 0.25R	1.0L 0.5F 0.25R	1.0L 0.5F 0.25R	1.0L 0.5F 0.25R	1.0L 0.5F 0.25R	1.0L 0.5F 0.25R	1.0L 0.5F 0.25R							
10	EMR full assembly and packing	1	0.2	5	1																1.0L 0.5F 1.0R						
11	Shipment through CERN	1	0.1	10	2																	-	-				
12	installation at RAL	1	0.2	5	1																			1.0L 1.0R			

- Additional manpower (master students) is available

Thank you for your attention!