

Electron-Muon Ranger (EMR)

EMR Schedule

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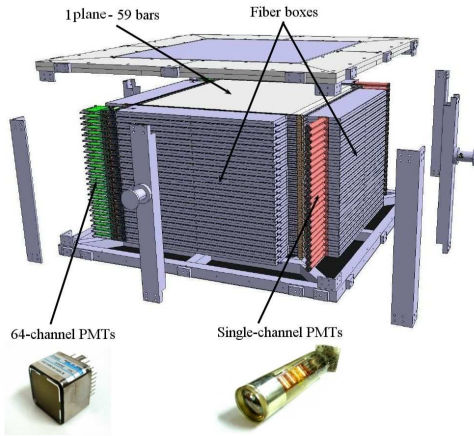
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MICE Schedule Review, May 24, 2011

EMR Design: Reminder

Horizontal View



Characteristics

- 24 modules (X-Y planes)
- 48 planes
- 59 bars per plane
- 2832 bars
- 3m WLS fibers per bar
- 8.5 km WLS fibers
- single and 64-channel PMTs per plane
- 3072 + 48 channels

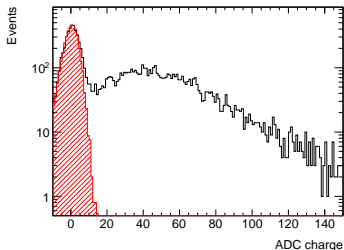
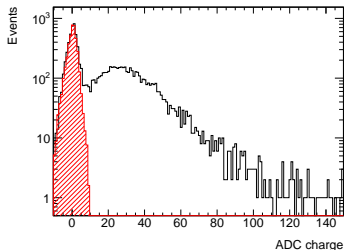
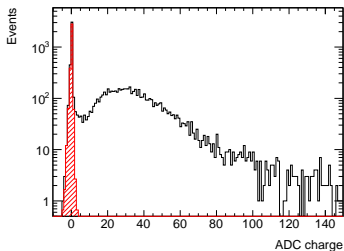
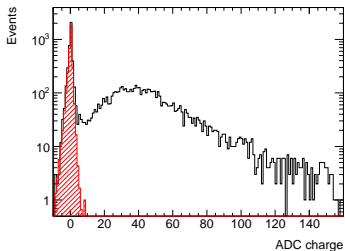
EMR Assembly for Test in June



- 6 planes are installed inside box and will be shipped to RAL
- patch panels are being manufactured
- lower supporting frame has been adapted to fit KL frame
- all work will be finished in two weeks (max)
- after tests everything will be shipped back to UNIGE

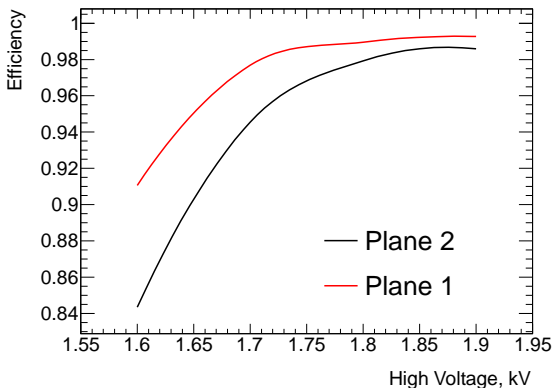
Total Charge (in ADC channels) per Plane. MIP's

Planes 1 to 4. High Voltage = 1900 V



Efficiency of Planes 1 and 2 VS High Voltage

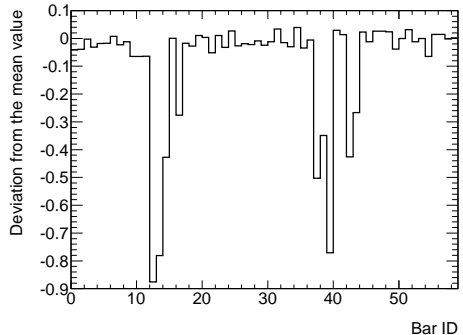
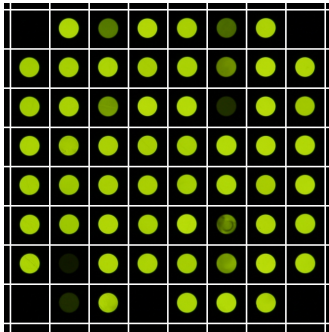
Planes 3 and 4 together with Scint.Det. are used for trigger.



- efficiency curves significantly different between two planes
- this is a sign of broken fibers (see next page)

Digital Image Analysis of WLS Fibers

- LED lights one single-anode connector and camera take an image of the multi-anode connector (left)
- digital analysis of the photo clearly indicates broken fibers (right); see the summary on the next page



Summary of Digital Image Analysis

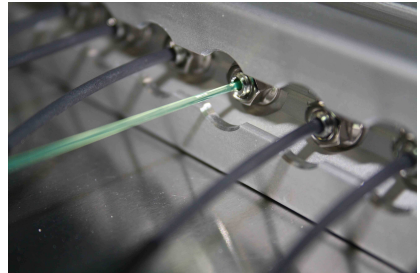
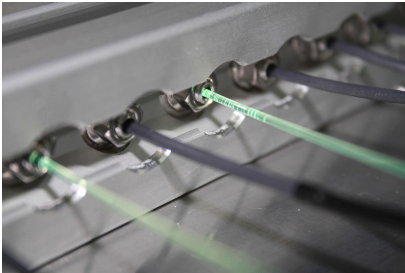
Plane ID	Broken bars	#	Suspicious bars	#
1	6 / 14	2	5 / 47 / 48 / 57 / 59	5
2	6 / 9 / 11 / 39 / 59	5	30	1
3	13 / 14 / 15 / 38 / 39 / 40 / 43	7	17 / 44	2
4	3 / 29	2	1 / 5 / 6 / 16 / 30	5
5	-	0	30	1
6	-	0	1 / 2 / 6 / 31	4
7	2 / 27 / 30	3	14 / 46 / 59	3
8	25 / 30 / 43 / 59	4	2 / 29 / 33	3

- Broken – more than 30% less luminous then others
- Suspicious – from 10 to 30% less luminous then others

tested bars	472
broken bars	23
suspicious bars	24
percentage of faulty bars	10%

Broken Fibers

- example of broken (left) and good (right) WLS fiber
- the damage is caused by stretching the fiber against aluminum insertion tube during manipulation of the bars and polishing of PMT connectors
- to solve this issue it was proposed to decouple WLS fibers and PMT connectors and use clear fiber to transfer the light from bar to PMT



Decoupling WLS fibers and PMT connectors

Proof of principal

About 30% of light is lost in WLS fiber from bar to PMT. Attenuation in clear fiber is less, but some light is lost in connectors. If this loss is less than the gain from changing to clear fiber, then we go for this solution.

Pros

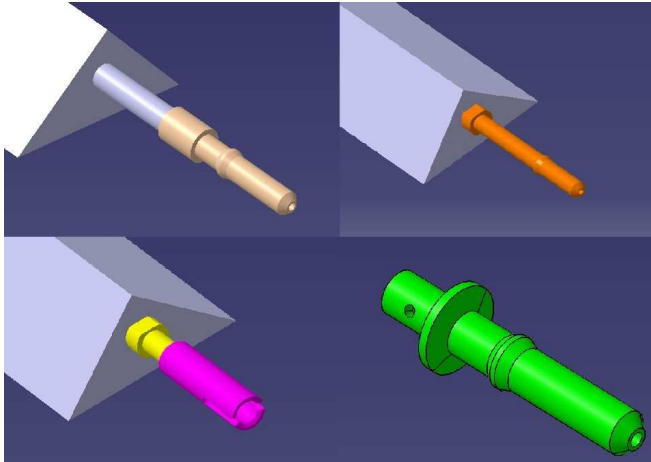
- no possibility to damage WLS fiber during handling
- broken bars can be easily replaced
- possibility to correct the mapping of channels if there was a mistake
- (in the future) possibility to connect SiPMT directly to the bar

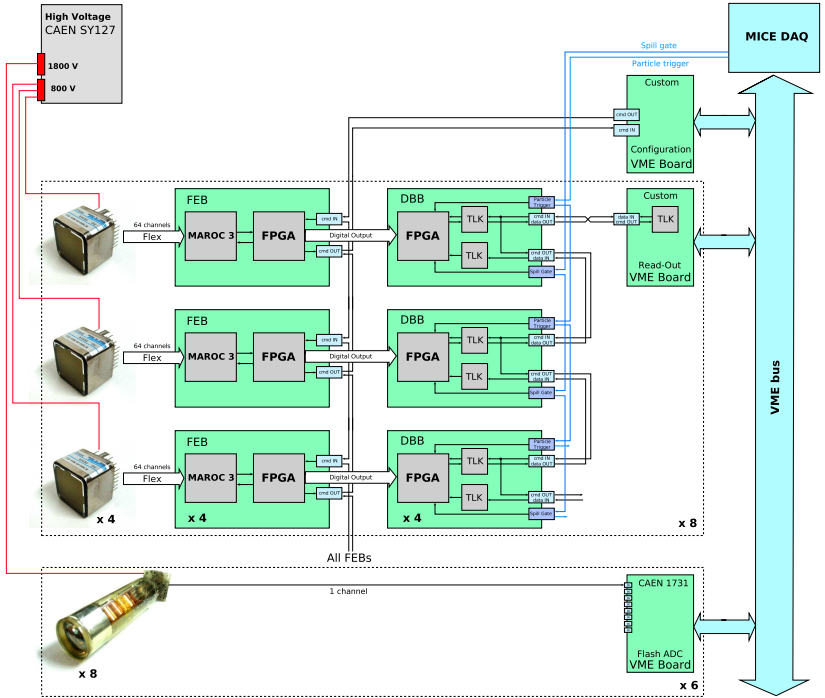
...and Cons

- need to mold the connectors
- all the connectors must be well polished

Ideas of new connectors

- The green connector is identical to the commercially available but with different inner diameter of the hole.





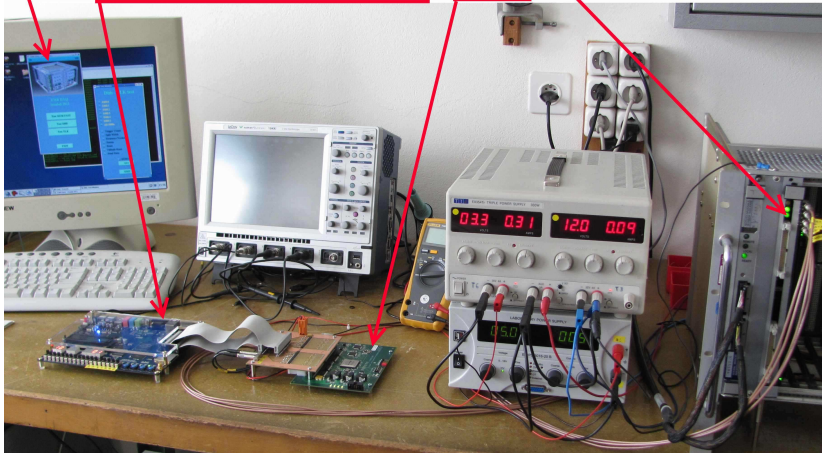
Tests bench for Digitizer-Buffer Board (DBB)

Test DAQ Software

Test Signal Generator

DBB

VME Read-Out Board



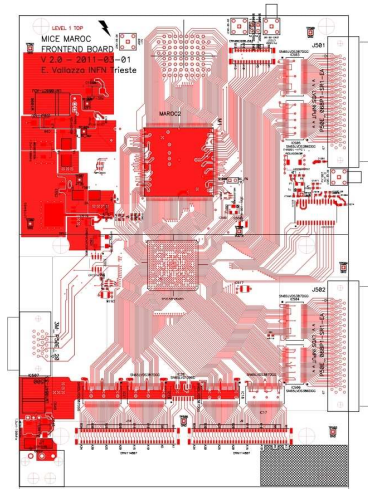
Output of the test program

- **DBB works as expected**
- production of other 4 boards has been launched

```
***** Send Data
Command format: 0x50a1 [101000010100001]
Expected reply: 0xd080 [1101000010000000]
Received reply: 0xd080 [1101000010000000] - OK
Spill Number: 0x2 [10] 2
Trigger Count: 0xa [1010] 10
Hit Count: 0x49 [1001001] 73
Channel ID: 0x3f 63      Leading Edge  0x3000      Hit time: 0x10 16
Channel ID: 0x3f 63      Trailing Edge 0x2000      Hit time: 0x20 32
Channel ID: 0x0 0        Leading Edge  0x3000      Hit time: 0x42 66
Channel ID: 0x0 0        Trailing Edge 0x2000      Hit time: 0x52 82
Channel ID: 0x3f 63      Leading Edge  0x3000      Hit time: 0x88 136
Channel ID: 0x3f 63      Trailing Edge 0x2000      Hit time: 0x98 152
Channel ID: 0x1 1        Leading Edge  0x3000      Hit time: 0x9a 186

Channel ID: 0x3d 61      Leading Edge  0x3000      Hit time: 0x1c09 7505
Channel ID: 0x3d 61      Trailing Edge 0x2000      Hit time: 0x1ce9 7401
Channel ID: 0x3e 62      Leading Edge  0x3000      Hit time: 0x1d51 7505
Channel ID: 0x3e 62      Trailing Edge 0x2000      Hit time: 0x1d61 7521
Trailer found: 0xe080 [1110000010000000]
Status: 0x0 [0]
Spill Number: 0x2 [10] 2
Spill Width: 0x61a82 [1100001101010000010] 400002
Time elapsed: 33645 us
Wait 1966355 us for the next spill...
```

New Front-End Boards (FEB)



- first batch of FEB's has been manufactured
- tests are ongoing in Como, Italy
- firmware already exists
- VME configuration boards also available

Detailed Schedule for June

- **Shipment:** from 7th to 13th
 - will be sent directly from UNIGE
- **Mechanical work:** from 14th to 17th
 - responsible: R.Bloch, L.Nicola, R.Asfandiyarov
 - if needed they may stay for two days more
- **Electronics installation:** from 20th to 27th
 - responsible: R.Asfandiyarov, J-S.Graulich, Y.Karadzhov, V.Verguilov

Full EMR Installation

- In the light of recent developments (decoupling WLS fibers and PMT connectors) we propose to **schedule the full EMR installation at RAL on January 15th next year**. This also may allow to install magnetic shield at the same time.
- preliminary analysis of fiber connectors is promising:
 - digital photo analysis: 5 to 20% loss
 - topical number from fiber manufacturer: 5% loss
- this week I will make more thorough checks with fiber connectors using LED light pulses
- will make a prototype model to validate the idea
- 2-3 weeks to produce molding matrices
- should be able to resume production in July