



# Preliminary Studies of PMTs of Modules in Emergency Mode Using the Laser System

30/04/2013  
CERN-Oujda

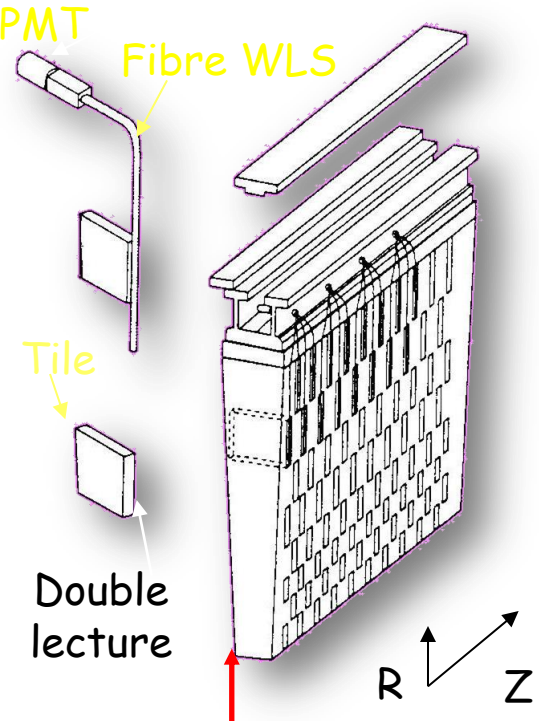
# Outline

- *General Description*
- *Motivation*
- *LB Modules in Emergency Mode*
- *EB modules in Emergency Mode*
- *Conclusion*

# General Description

## Mecanical Structure of Atlas Tile Module :

- Sampling calorimeter: **iron + Scintillating tiles**
- Signal transported by Wave Length Shifter optical fibers from scintillating tiles to the PMT's.



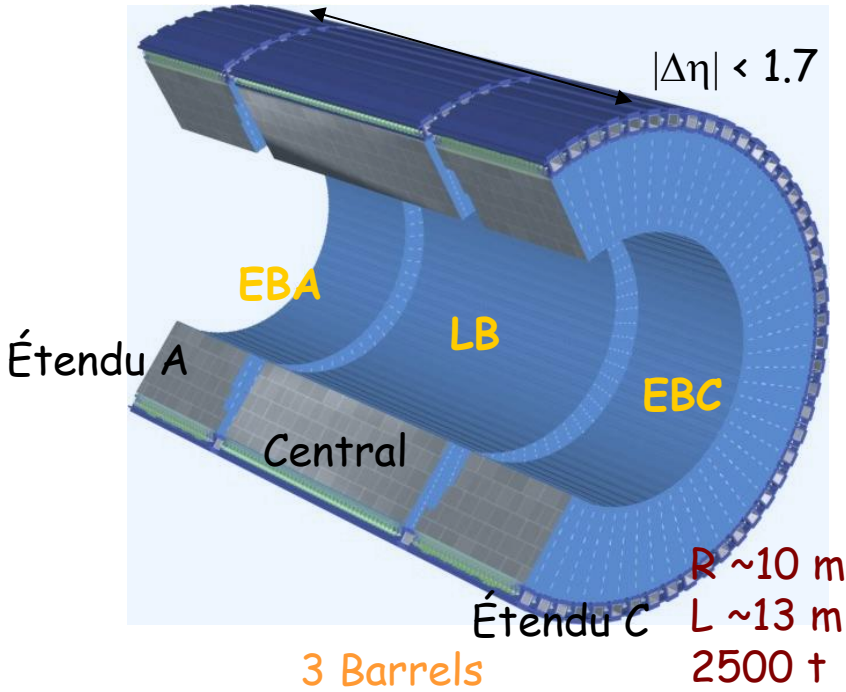
Hadrons and Muons  
(LASER for calibration)



Module  
(64 Modules/Barrel)

64 modules × 4

~460000 tiles, ~640000 fibers and ~10000 PMTs



# Motivation

- 3 TileCal modules are in EM in 2012;
- We don't know whether the PMTs in the EM are linear;
- Laser light can be used for such a study;
- The idea is to compare the responses of PMTs in EM and of PMTs in normal mode.
- Different runs containing different filters wheel are used, allowing to apply a specific attenuation factor from 3 to 1000 to the laser beam.
- **NB:** the runs we are using have been taken in period when only 2 modules are in EM.

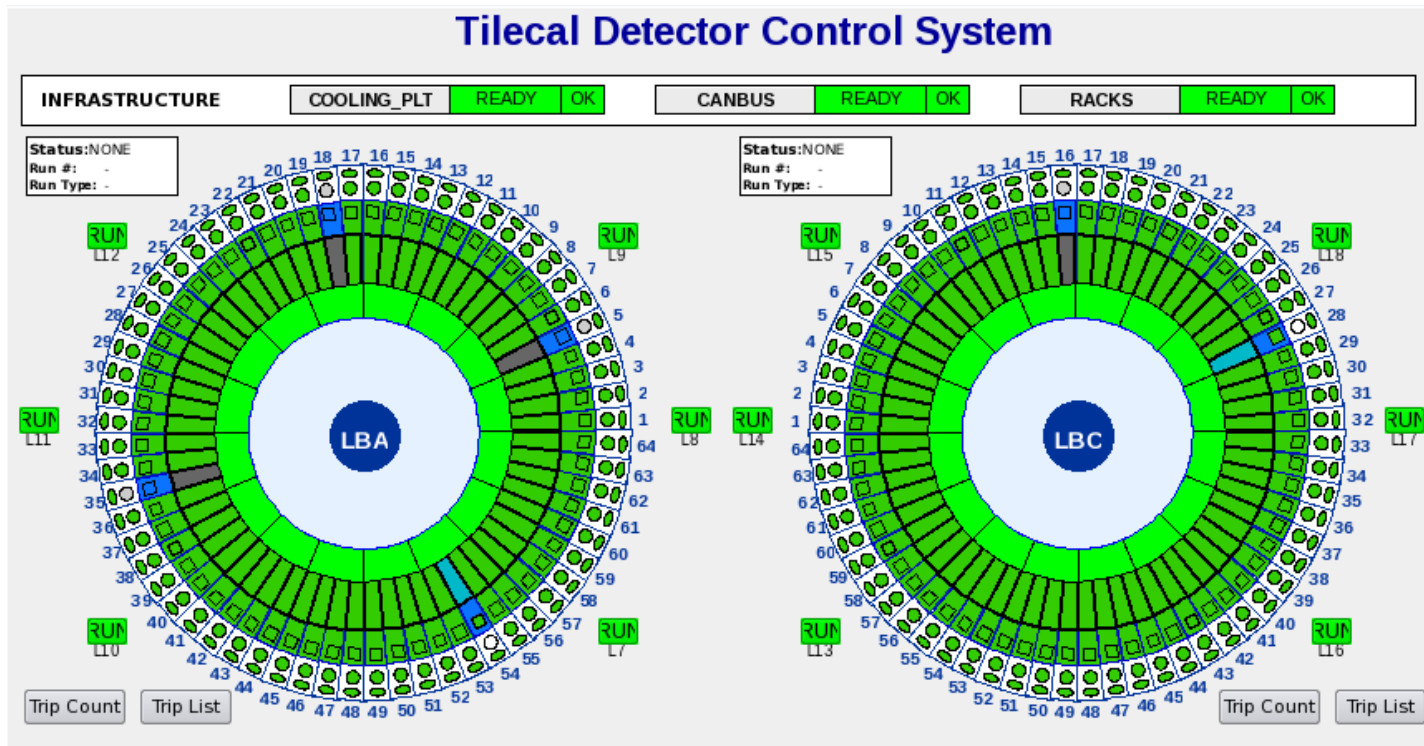
attenuation	filter wheel	run number
1	5	208762
3	6	208758
10	4	208767
32	3	208770
100	2	208772
320	8	208755
1000	7	208756

# 1. LB Module in EM

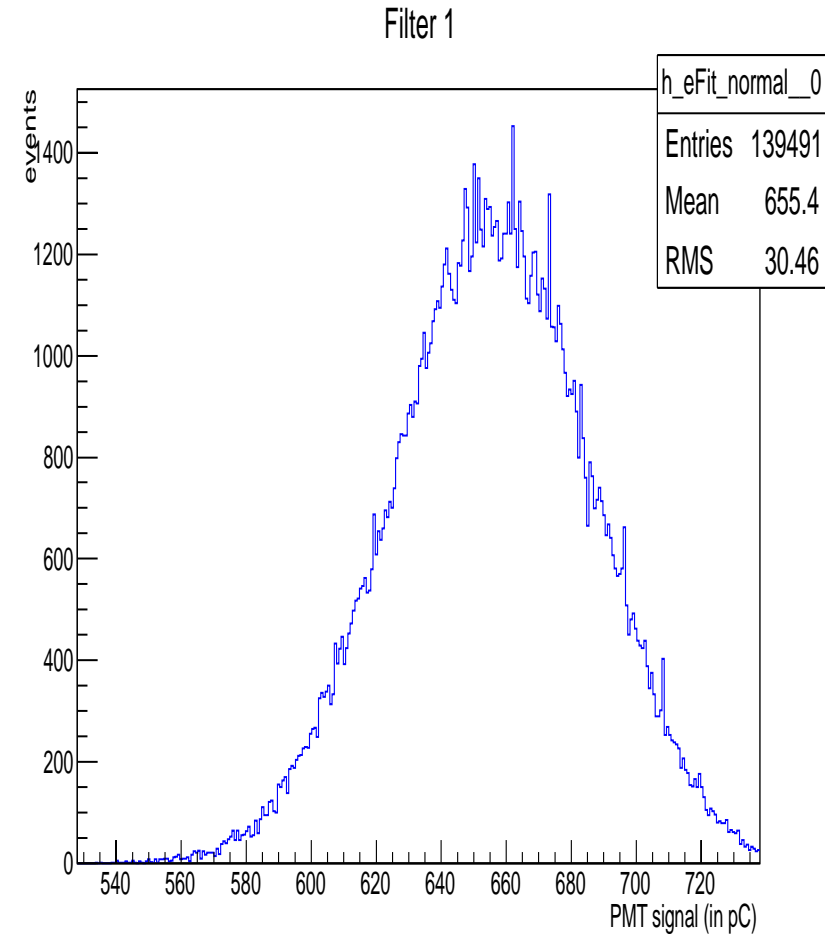
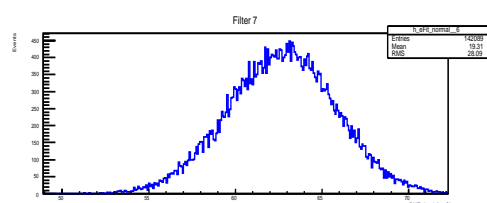
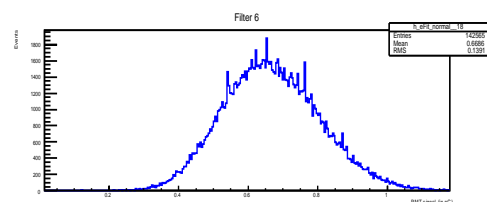
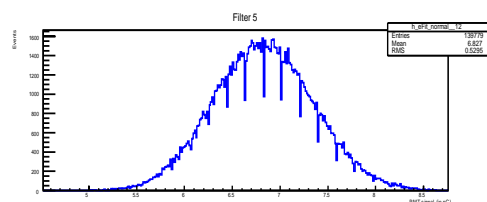
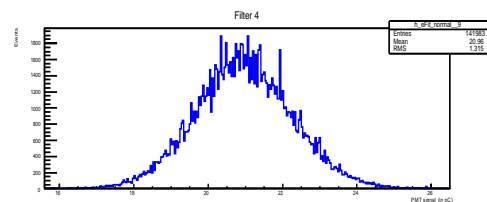
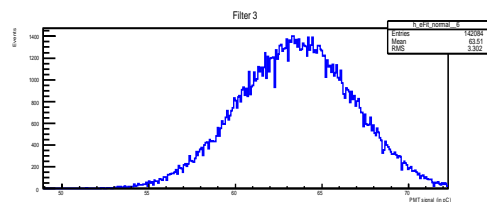
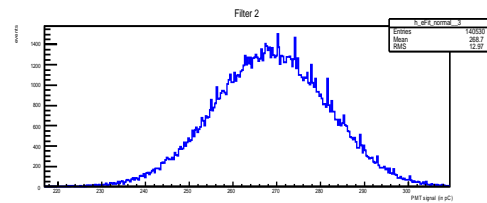
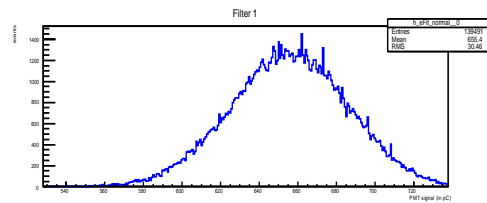
PMTr: PMT belong to Module in normal mode

PMT (EM): PMT belong to Module in Emergency Mode

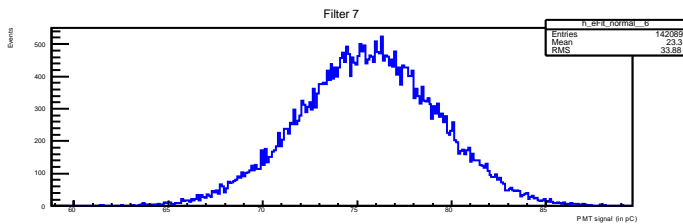
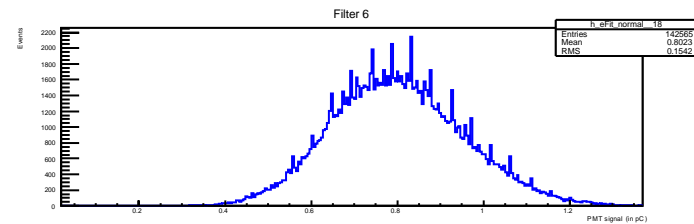
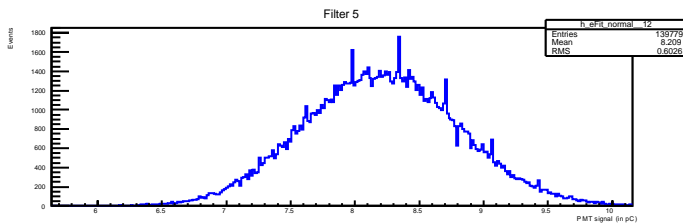
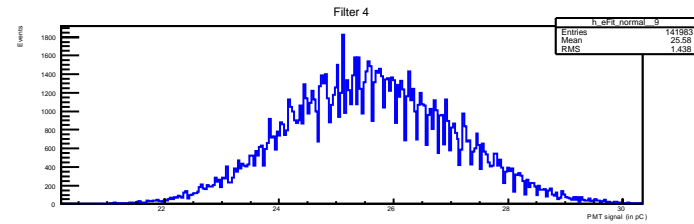
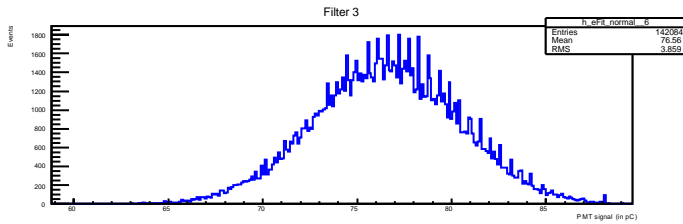
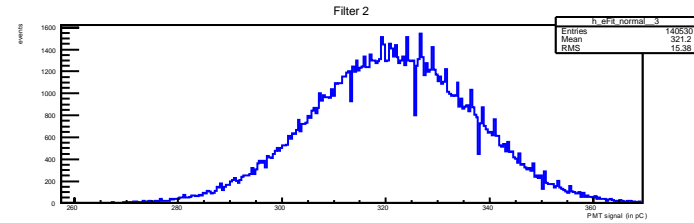
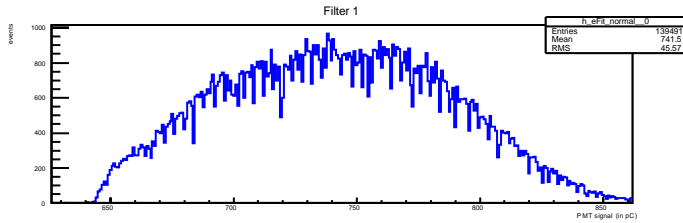
1. In this case we will use the property that one fiber can belong to PMTr and to PMT (EM) simultaneously.



# LB: PMT response of Module in Normal Mode Using Filters Attenuations



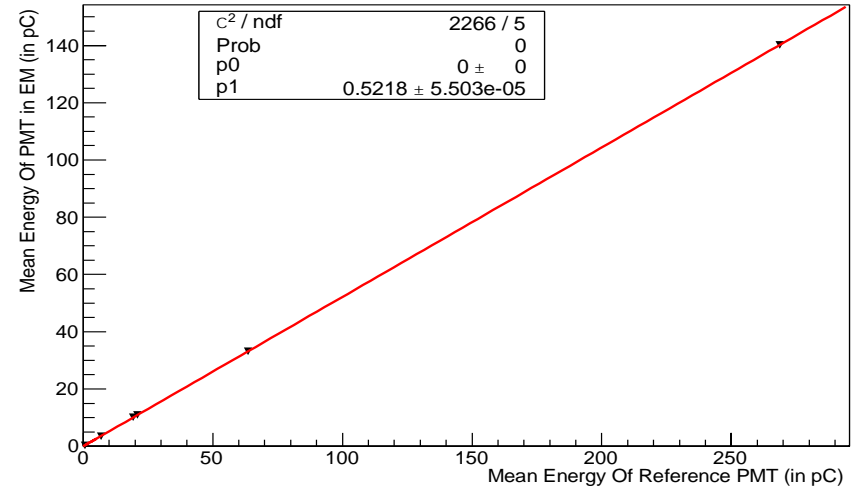
# LB: PMT response of Module in EM Using Filter Attenuation



# LB: Module in EM

- The mean energy of PMTs (EM) as function of mean energy of PMTr for :
- Module 28: -> LBA, PMTr 27

PMT(EM) vs PMT(ref)



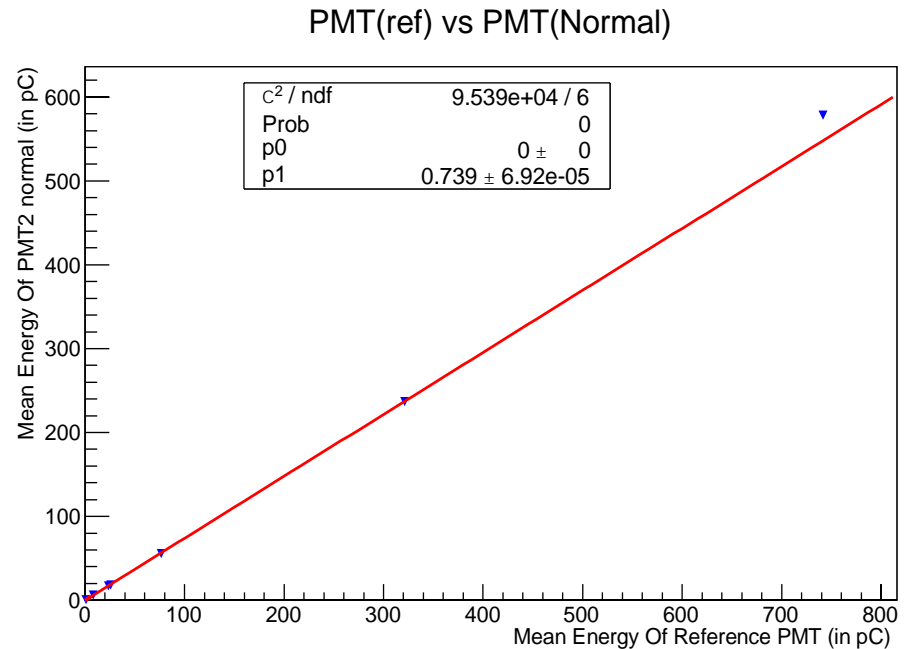
Filter	X error	Y error	X fit value	Y fit Value	(Yfit-Ymes)/Ymes
1	0.034591	0.017935	268.621331	140.210787	0.000315
2	0.008759	0.004701	63.679009	33.137730	-0.002708
3	0.003490	0.001626	21.052682	10.936442	-0.004447
4	0.001416	0.000704	6.760521	3.562413	0.004447
5	0.000368	0.000185	0.656977	0.348858	0.017641
6	0.074510	0.039017	19.367437	10.0774555	-0.003104



# LB: Module in EM

- For comparison we show also the plots obtained using two PMTs fed by the same fiber both belonging to module in normal mode
- Module 12: -> LBA PMTr 14  
-> LBC PMT 15

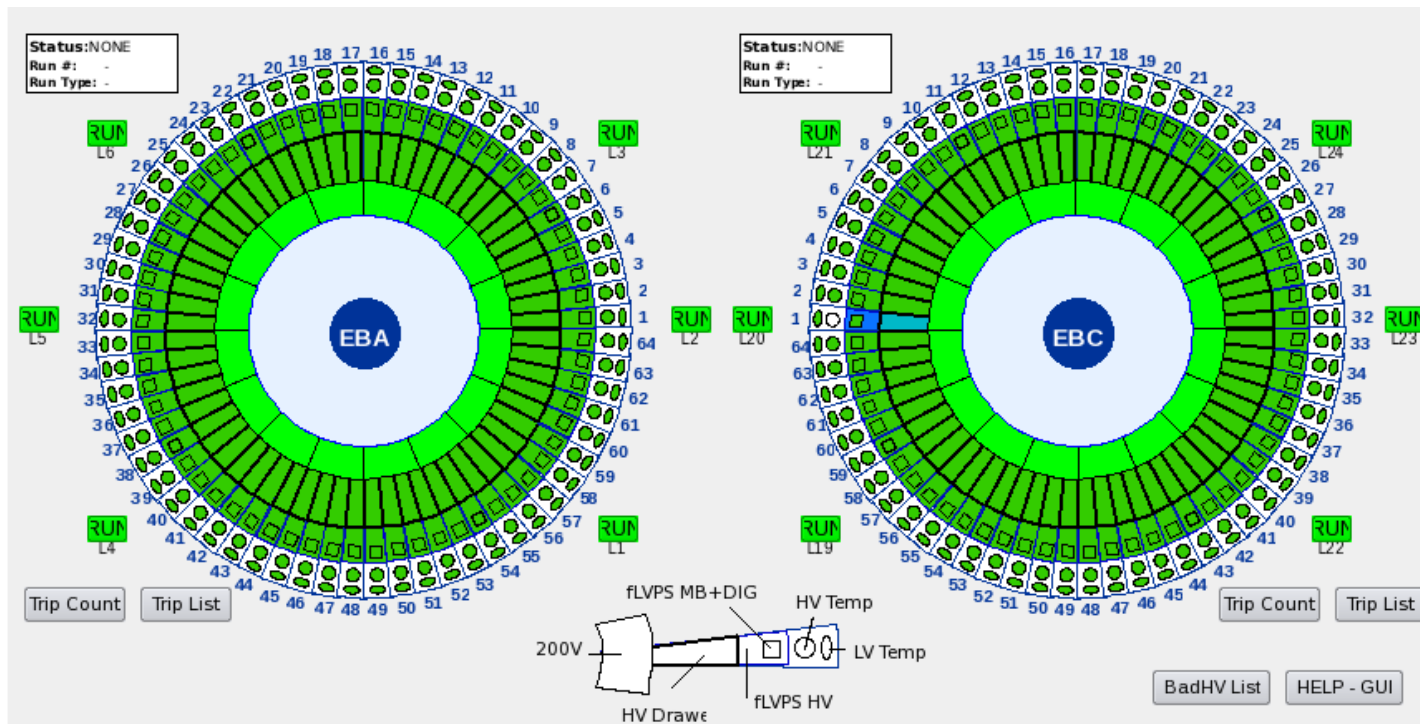
The latest point on the right is out of the linear shape; for high signal the PMT's are saturating.



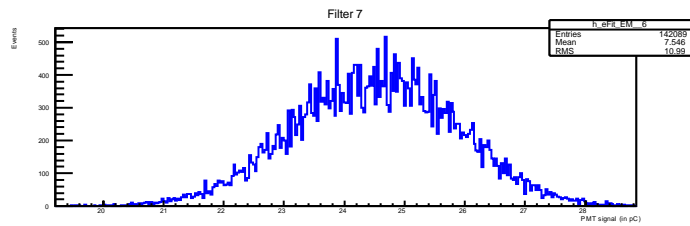
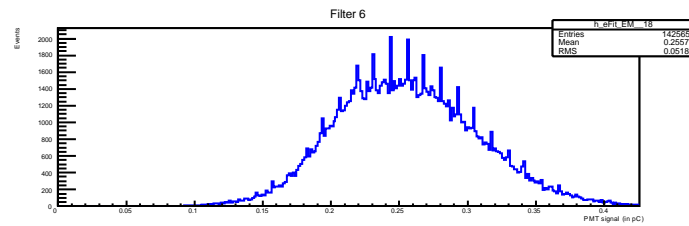
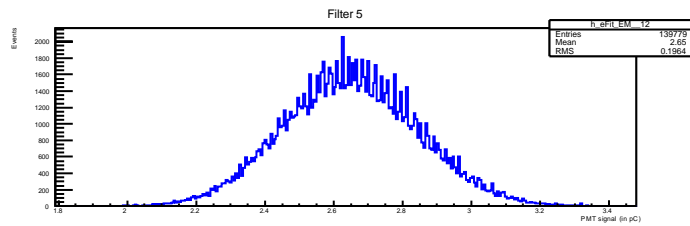
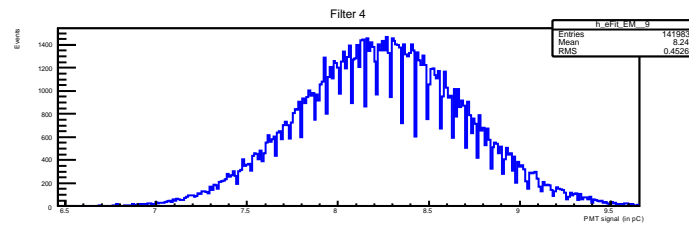
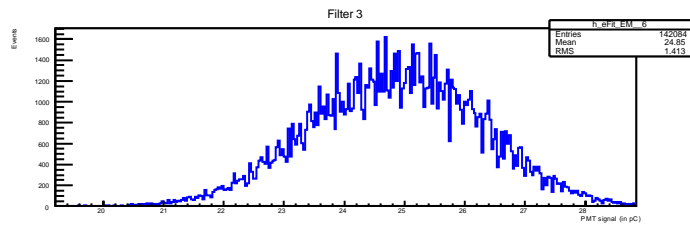
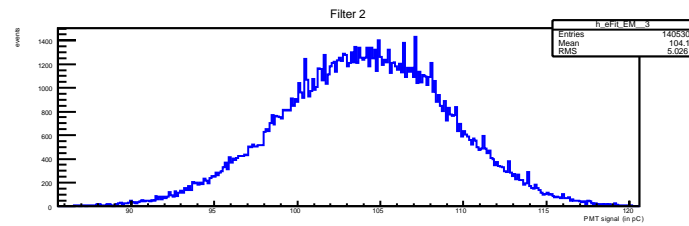
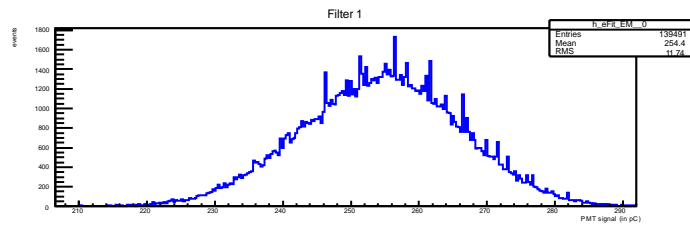
## 2. EB: PMTs Responses

In the Extended barrel case, each module is fed by one fiber,

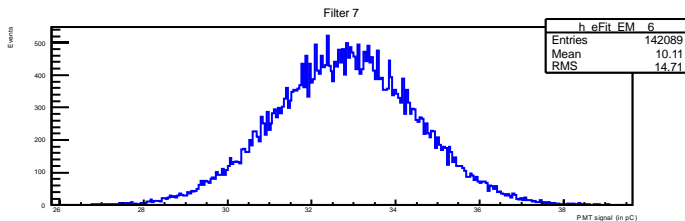
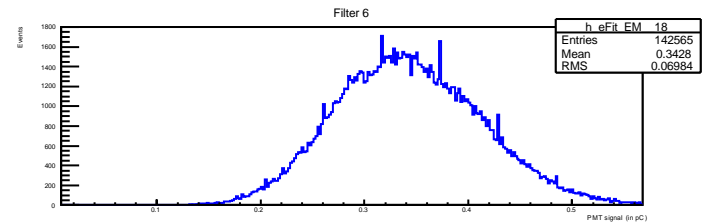
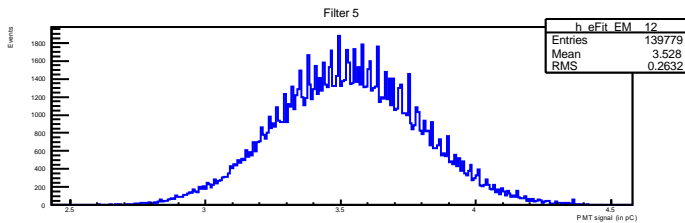
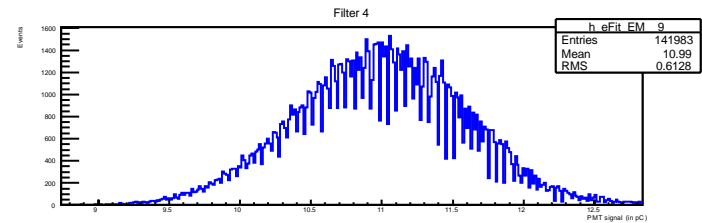
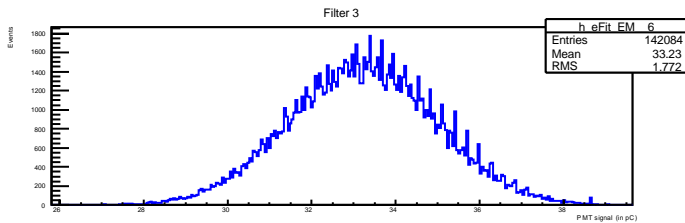
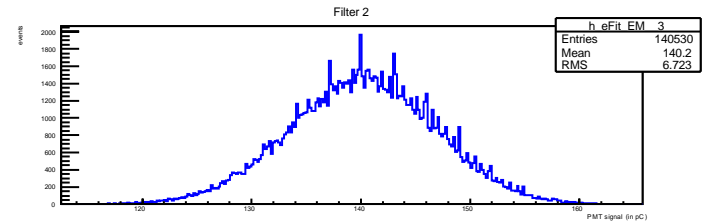
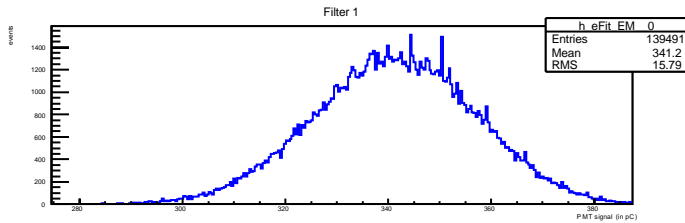
- > since PMT(EM) and PMTr cannot belonging to the same fiber , We use to study the linearity of PMT(EM) a PMTr of an arbitrary module in a given partition..



# 2. EB :PMT response of Module in normal mode



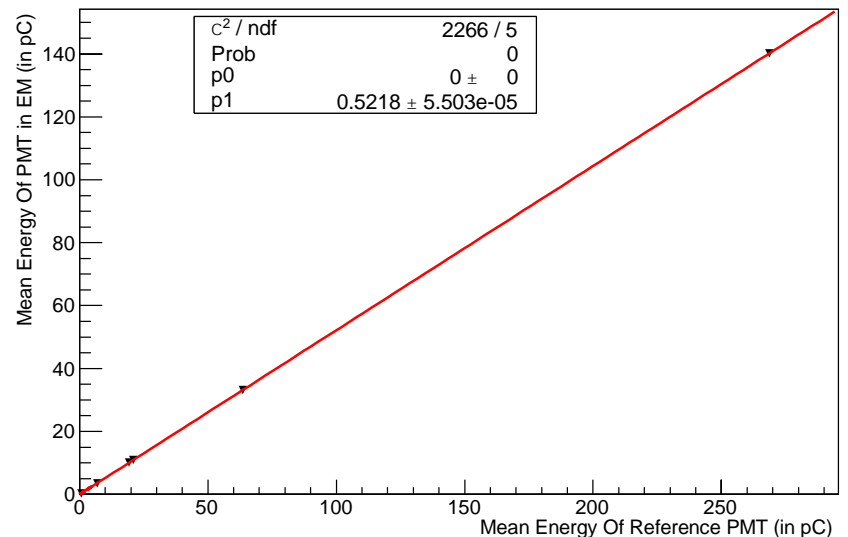
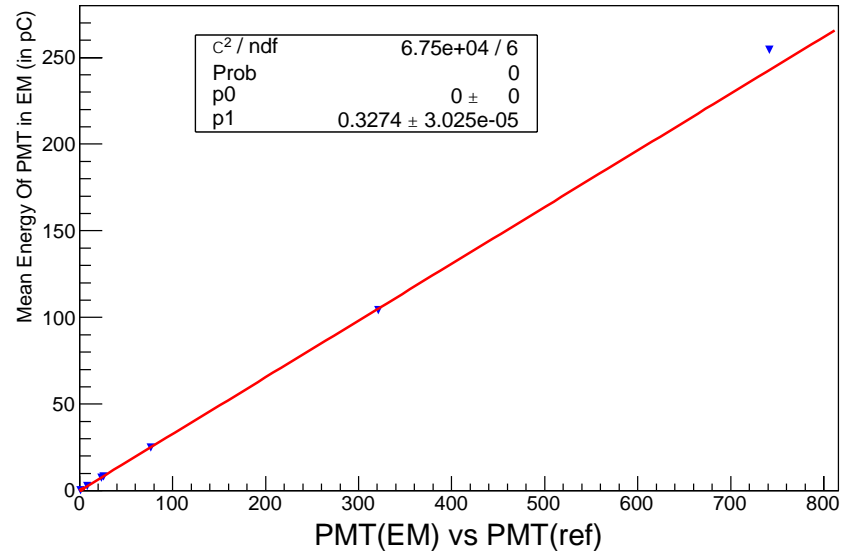
# 2. EB :PMT response of Module in EM



# EB: Module in EM

- Module 17 : ->EBA,PMTr12
- Module01 : ->EBC,  
PMT(EM)15
  
- Module 07 : ->EBA, PMTr 12
- Module 02 : ->EBC PMT 15.

PMT(EM) vs PMT(ref)



# Conclusion

- PMTs(26,27) responses at LB module 28 have maximal variation  $\sim 1.7\%$