Commissioning of the SITE spectrometer

N. Drenska, *R. Faccini*,C. Gatti, S. Martellotti, F. Tani, P. Valente

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Standard Configuration

- Fibers+PMT+Readout electronics
  - Relevant parameters: light from fibers/PMT signale (DY12 is sull of all dinodes)/electronics saturation
- Large noise observed
  - Readout dinamic range limits signal on PMT to ~1V
  - Large noise induced on the PMT+Electronics chain when laser+gas are present ➔ Plasma related
  - In design conditions of screening noise ~1V peak-to-peak
    - In absence of either gas or laser noise negligible (few mV)
  - With simple improvements in screening (with aluminium foil) and getting further away from the interaction point we obtained a reduction of a factor 4

A Threefold Way

1. Develop a backup detector reading fibers with CCD instead of PMT

2. Study the nature of the noise

3. Make the default detector work:
    1. Screening
    2. Dynamic range

Noise studies

Config A	Config B	Amp(A)/Amp(B)
HV=500V piano interazione	HV=500V piano interazione	0.63
HV=0V	HV=500V	0.64
no HV cable	HV=500V	0.64
HV=500V WRAPPED?	HV=500V	0.91
HV=500V MAROC ON	HV=500V	0.97
HV=500V PMT orientato nel verso del laser	HV=500V	0.45
HV=0V	HV=500V	0.48
HV= on, posizione canonica	HV=500V	0.20
Nel pozzetto di Pb sul magnete, B=0.05T	Vicino sul magnete	0.11
Nel pozzetto di Pb sul magnete (connesso maroc) B=0.1T	Dietro al muro	0.42

Conclusions:

- HV and p.s. irrelevant
- reduction by 30% when PMT oriented towards IP
- lead shield improves by a factor 6
- behind the wall improves by a factor 9

New idea

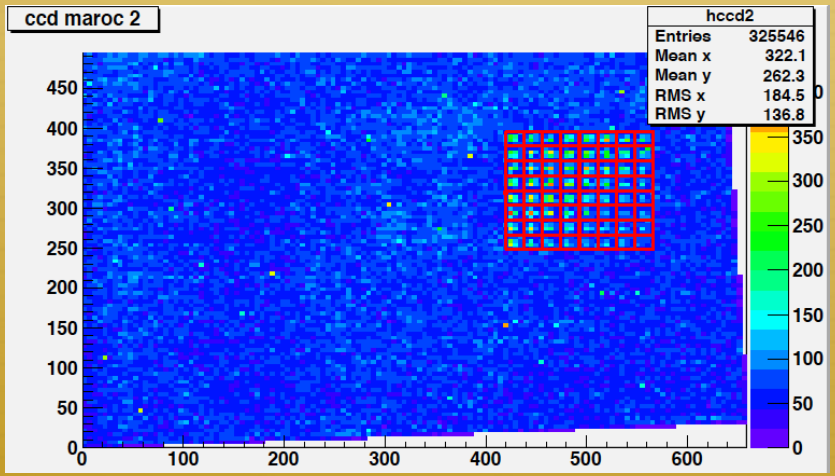
Idea: push the PMT HV to have a larger signal and attenuate it (a factor 10?) before entering the MAROC

Considerations:

- maroc response: 30ADC/mV
- Saturation: 700ADC/channel → 23 mV/ch (!) →1.5V/ PMT
- At which level does the PMT saturate? Which is the correct attenuation coefficient?

Fibers + CCD

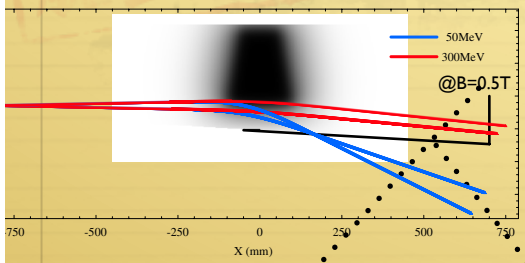
- Making use of existing cameras and read-out software we have developed the code to extract the light per fiber and translate it into an energy spectrum



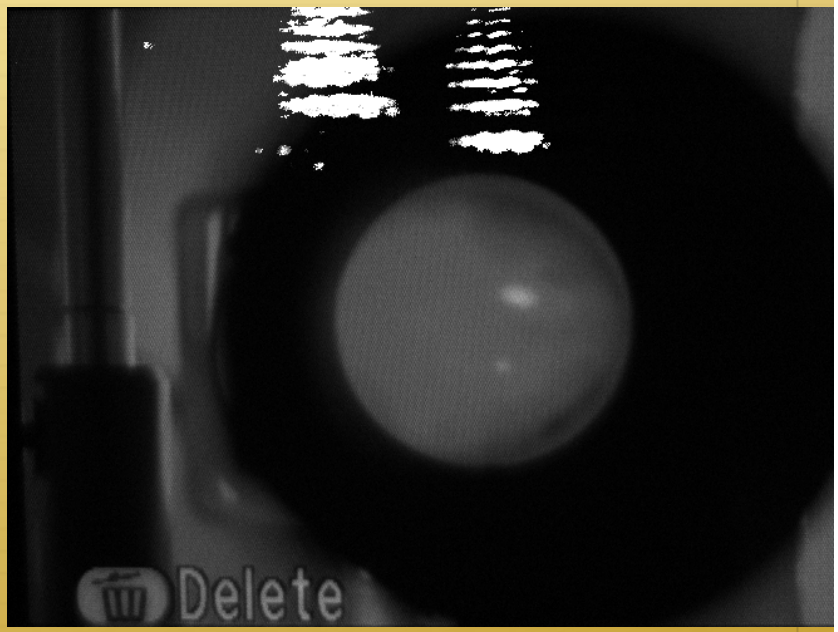
Difficulties:
- definition of boxes
- Noise subtraction
- Interacalibration between cameras

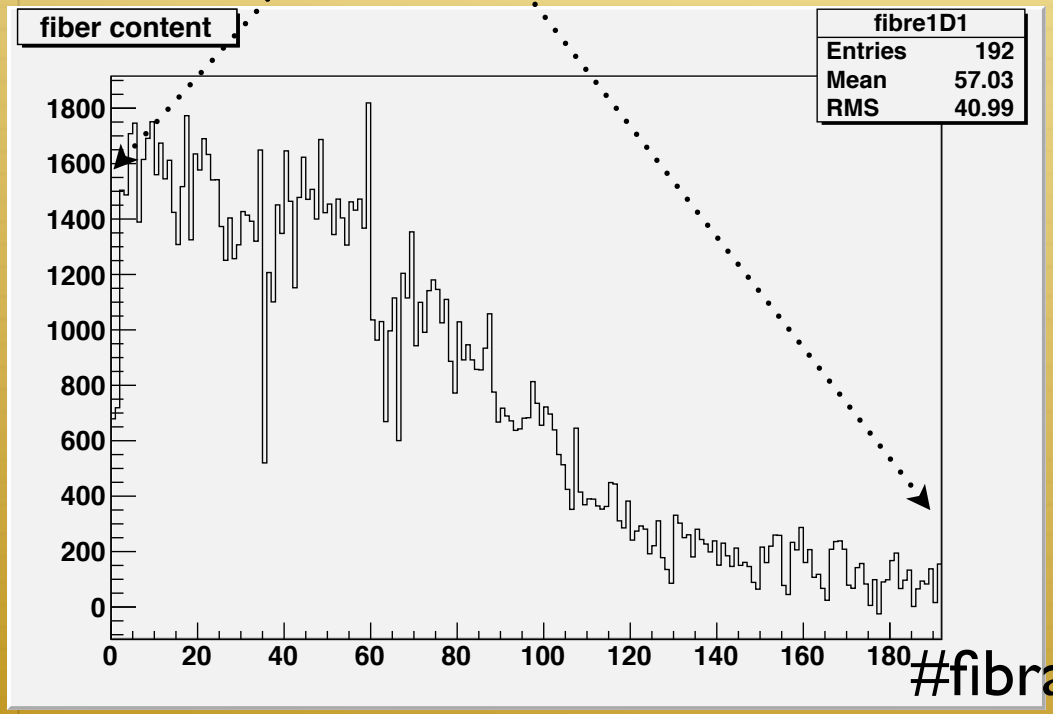
- Proof that it works in the next slides

B = 0

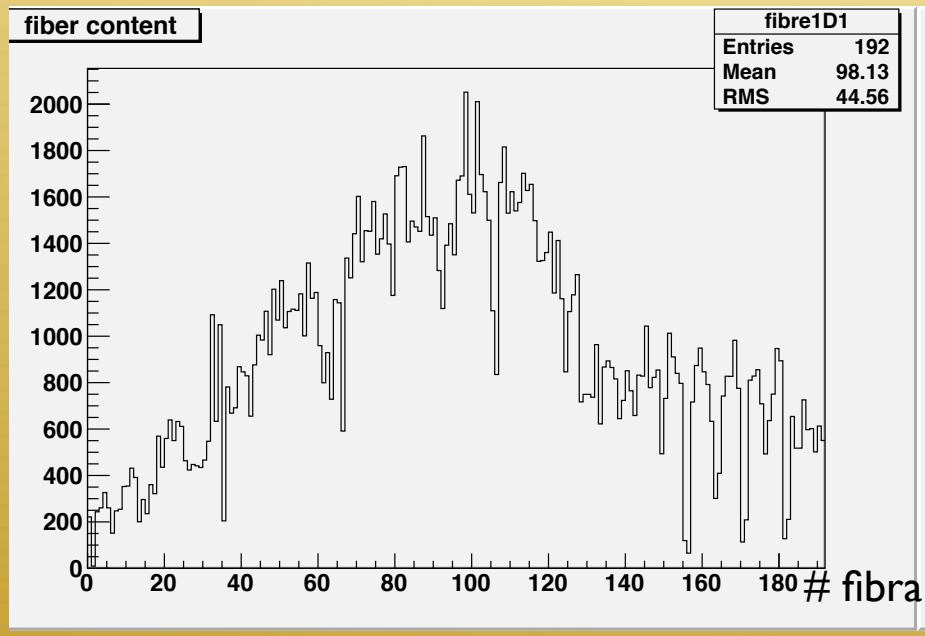


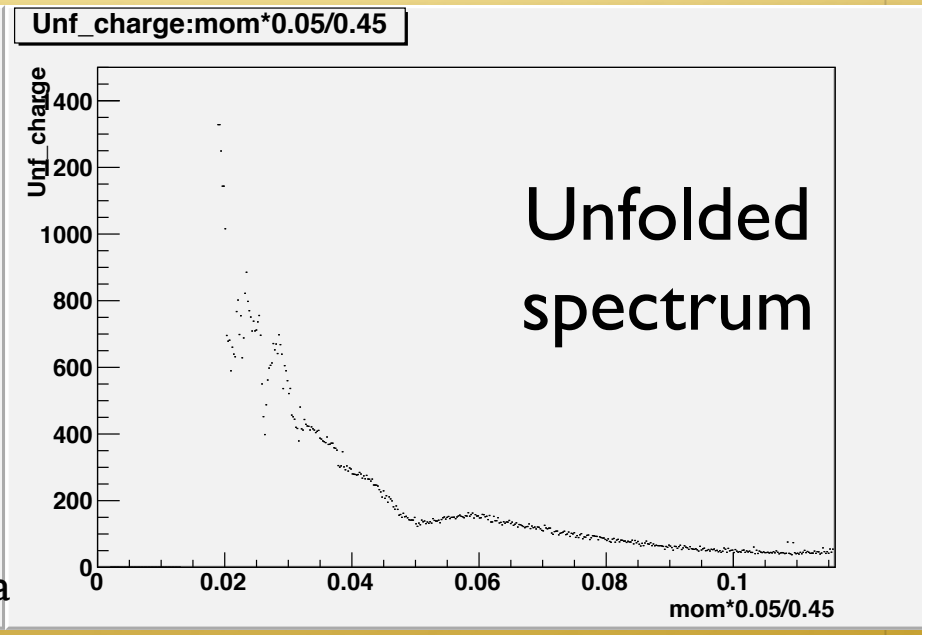
Immagini LANEX @ 30cm dal gas



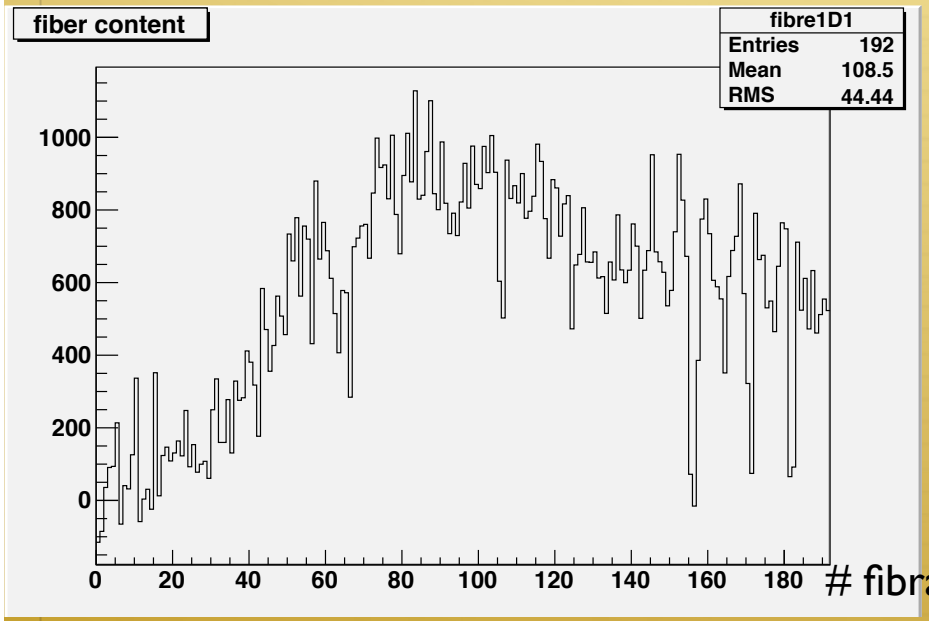


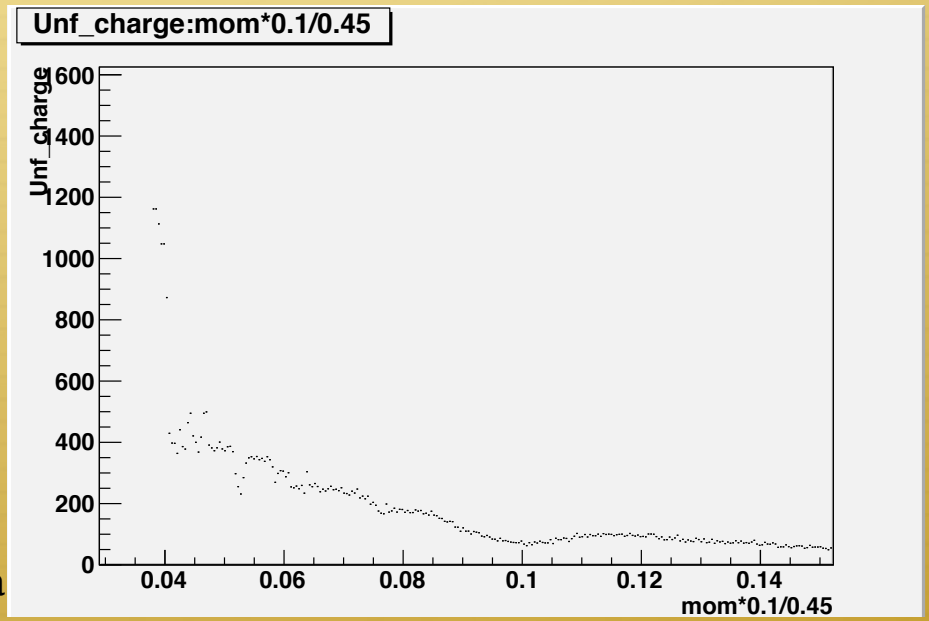
B = 50mT


fiber content
fibre1D1
Entries 192
Mean 98.13
RMS 44.56
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0 20 40 60 80 100 120 140 160 180
fibra

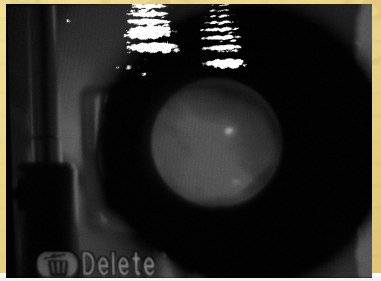

Unf_charge:mom*0.05/0.45
Unf_charge
400
200
1000
800
600
400
200
0
0 0.02 0.04 0.06 0.08 0.1
mom*0.05/0.45
Unfolded spectrum

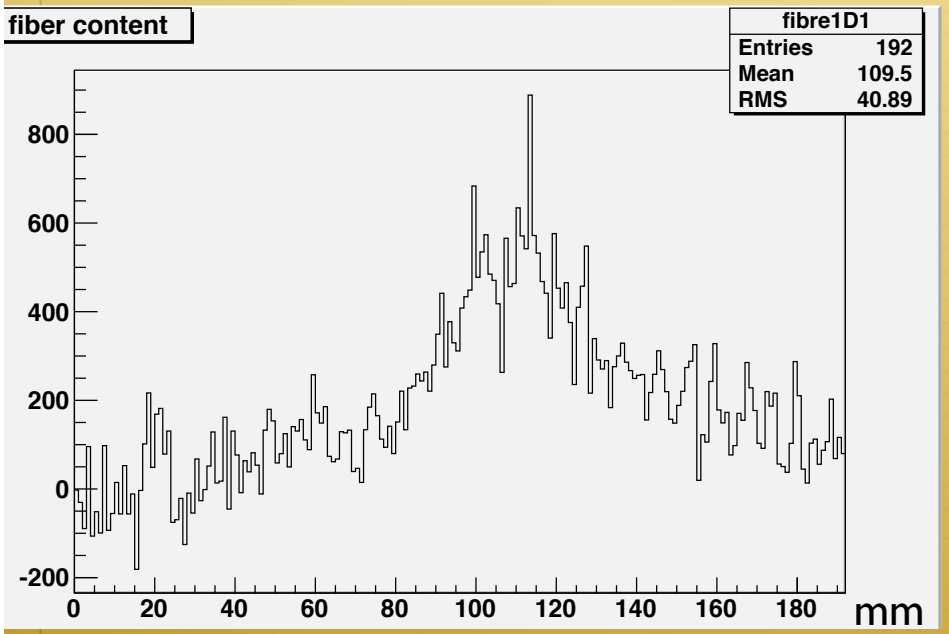
B = 100mT

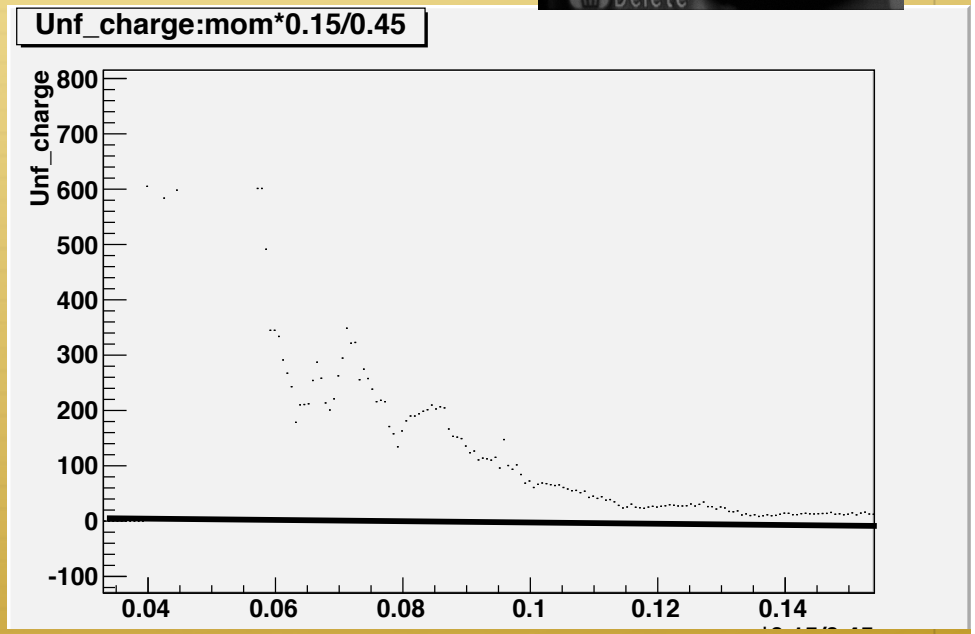

fiber content
fibre1D1
Entries 192
Mean 108.5
RMS 44.44
1000
800
600
400
200
0
0 20 40 60 80 100 120 140 160 180
fibra


Unf_charge:mom*0.1/0.45
Unf_charge
600
400
1200
1000
800
600
400
200
0
0.04 0.06 0.08 0.1 0.12 0.14
mom*0.1/0.45

B = 150mT


Delete


fiber content
fibre1D1
Entries 192
Mean 109.5
RMS 40.89
800
600
400
200
0
-200
0 20 40 60 80 100 120 140 160 180
mm


Unf_charge:mom*0.15/0.45
Unf_charge
800
700
600
500
400
300
200
100
0
-100
0.04 0.06 0.08 0.1 0.12 0.14

Fibers+CCD

- Ongoing activity: hardware
  - Bought two new cameras
  - Installation is a semi-permanent configuration (awaiting for default DAQ to work) and design of supports
  - Integration of DAQ in the SPARC control system
- Ongoing activity: software
  - Improve algorithm for noise subtraction
  - Improve intercalibration

Study of the nature of noise

- Meeting with Ruggero Ricci and Valerio Bocci and Riccardo Lunadei from the Roma1 Electronic LAB
  - Measure current on plate and loop di distinguish between capacitive and inductive components
  - Measure noise in absence of electric connection between the interaction and spectrometer chambers
  - Improve grounding (reference ground cable now available)
- From literature largest component is in the THz range. Contacting THz experts in Roma1 (Lupi and Calvani) to investigate the problem

Future of "default" detector

- Improve screening/grounding:
  - Mu-metal
  - avoid the smallest leakage (not easy)
  - Screen also cables
  - Use single reference ground for everything
- Distance
  - Fibers to prolong 4-5 meters away are available
- Increase dynamic range
  - Change electronics (move to standard ADC)
  - Expensive … last resort