Beam test of JLC small tile calorimeter

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JLC CAL group @ Niigata

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1. Beam test set up

- 2 Super Layer setting
  - Staggered type
  - Non staggered type

→ We change this setting using optical fiber connectors and same PMT Holders(6)

- 10 Layer plane by plane read out
  - Inner 15 tiles : read tile by tile
  - Outer 10 tiles : lights merged to 1 channel

→We use another type PMT Holders(10)

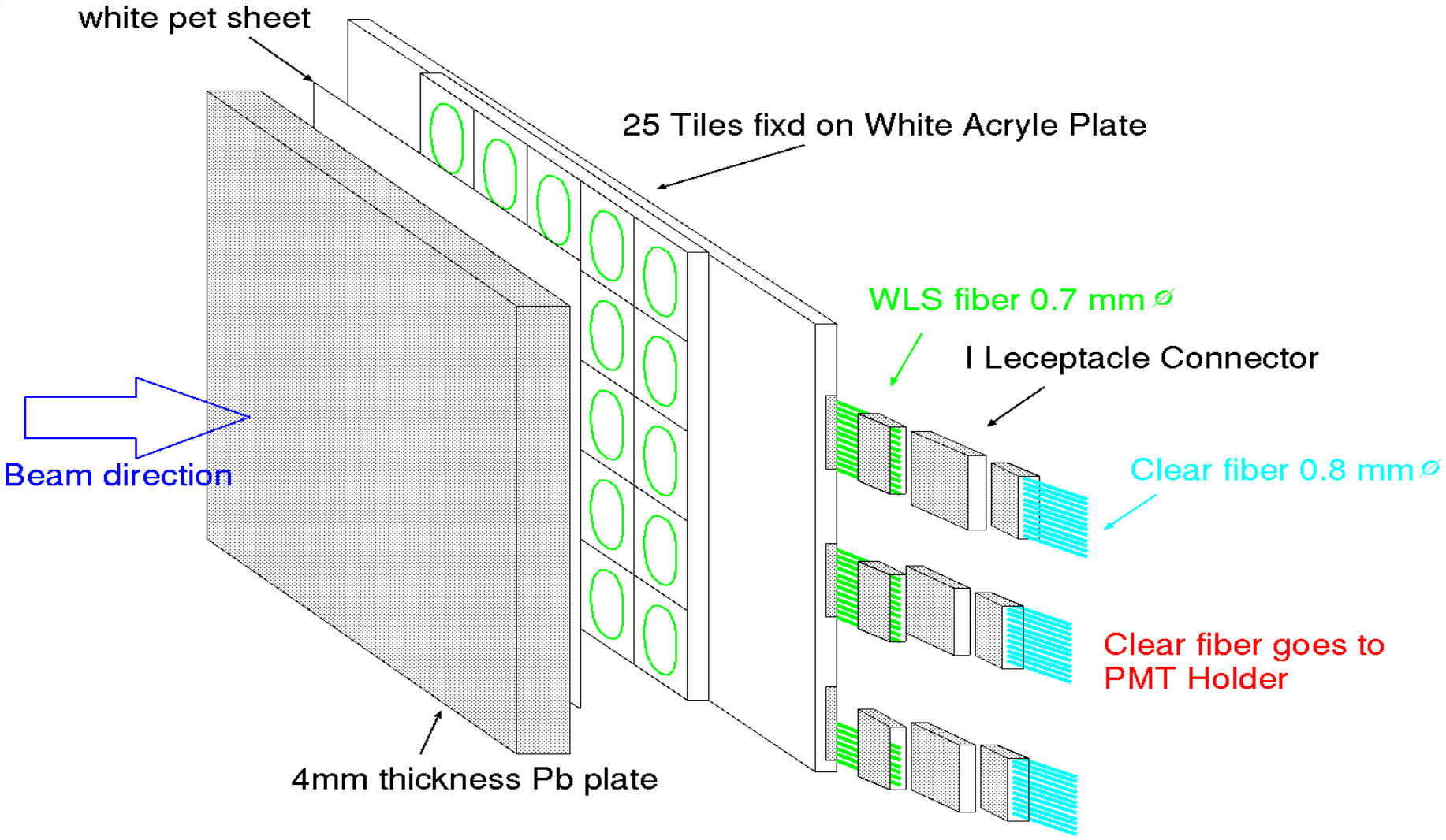
Super Layer setting

- 1 Layer
  - 25 tiles fixed on 1 acryl plane
  - White Pet film put on Lead plate (4mm)
  - Use optical fiber connector (10 fibers /connector)
- Super Layer
  - 5 Layers combined as 1 Super Layer
  - For better Uniformity, we make Staggered type tile

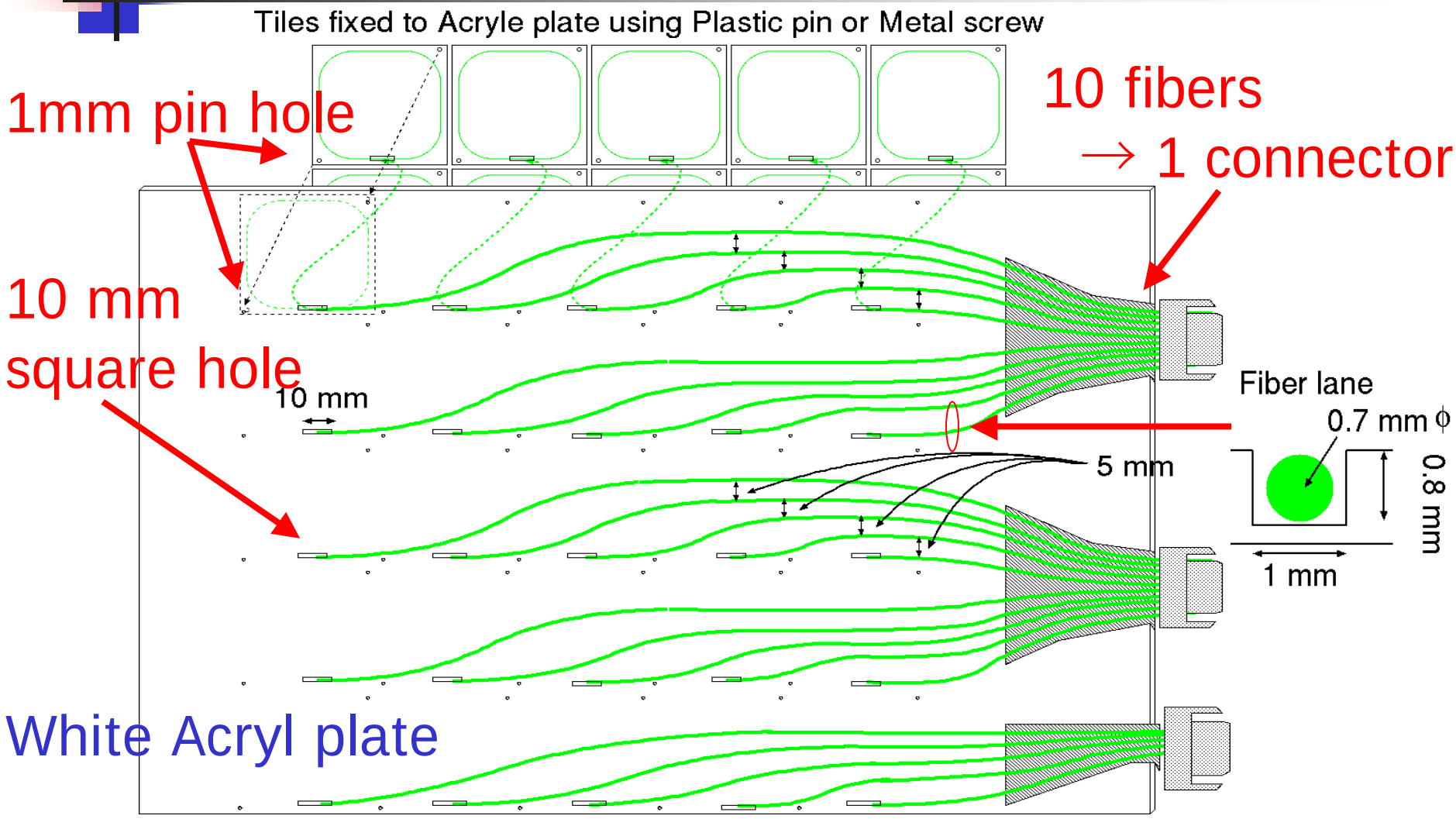
Staggered type=(square type)+(circle type)

lights merged!

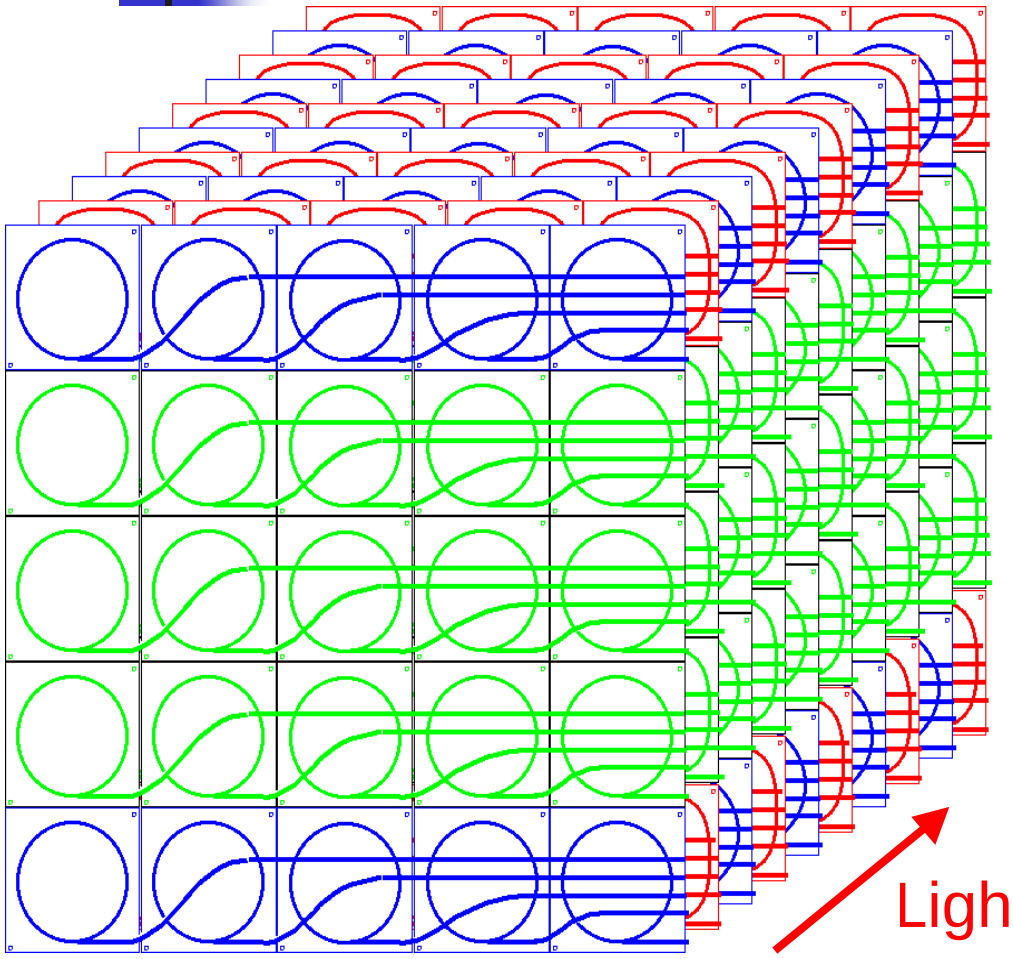
1 Layer

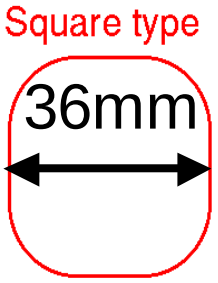

white pet sheet
25 Tiles fixd on White Acryle Plate
WLS fiber 0.7 mm ⌀
I Leceptacle Connector
Beam direction
Clear fiber 0.8 mm ⌀
Clear fiber goes to
PMT Holder
4mm thickness Pb plate

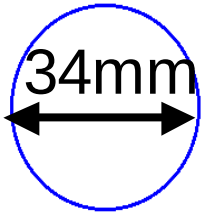
Acryl plate and tiles setting



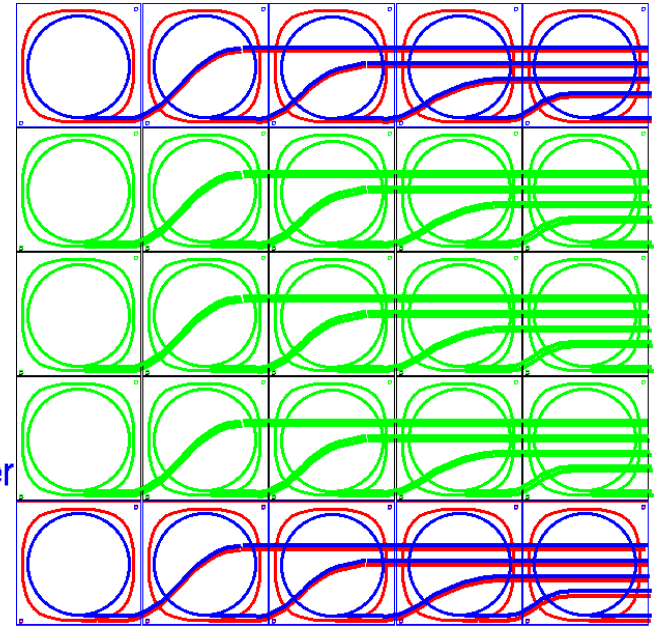
Staggered type setting





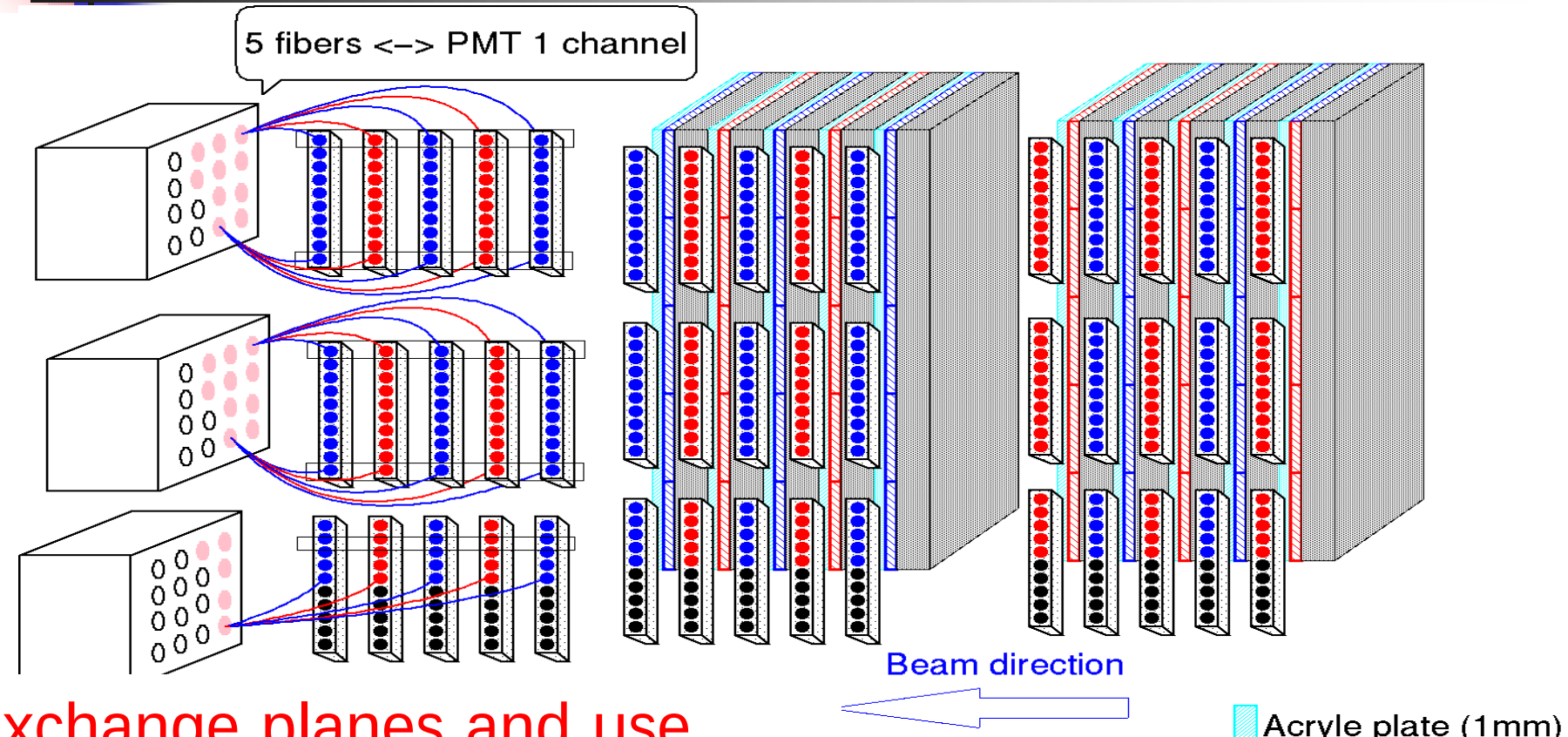


A little smaller circle type



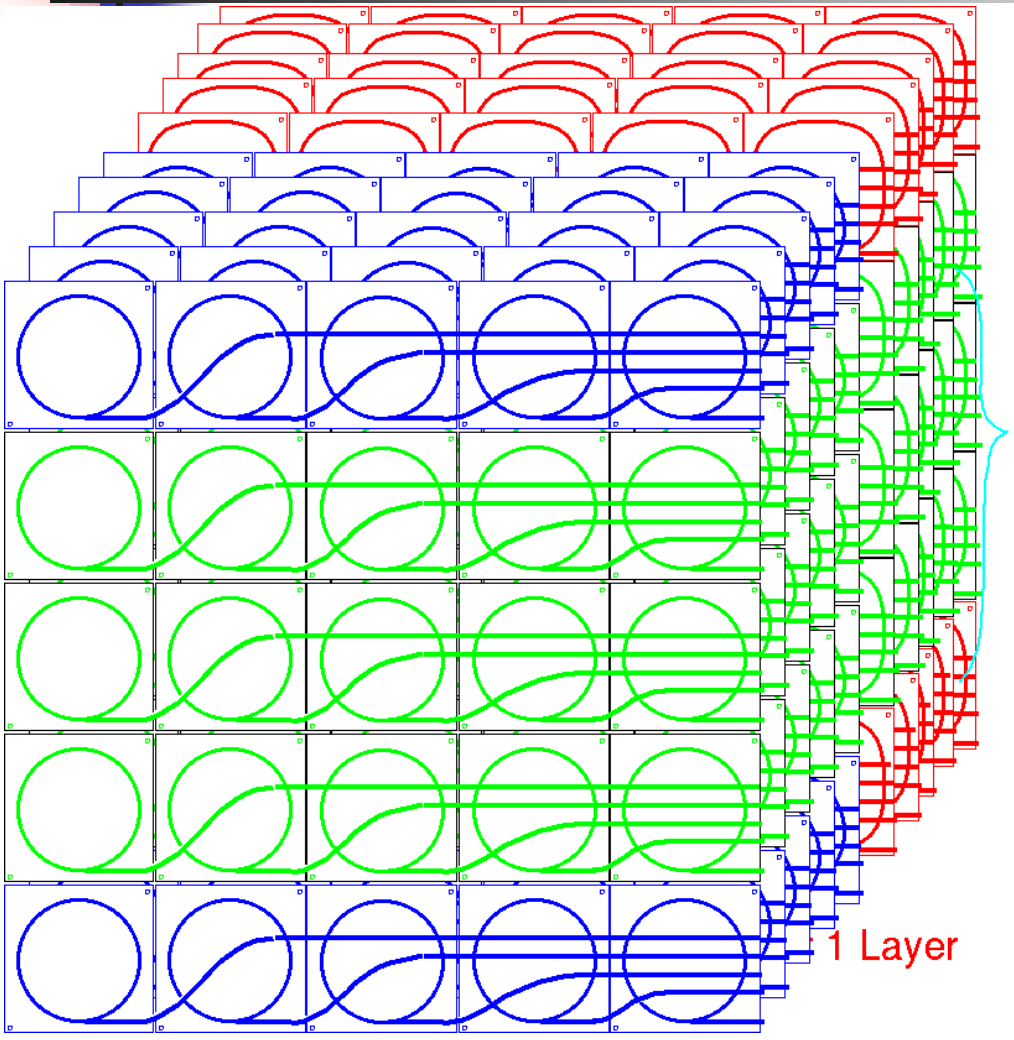
Light added in longitudinal direction

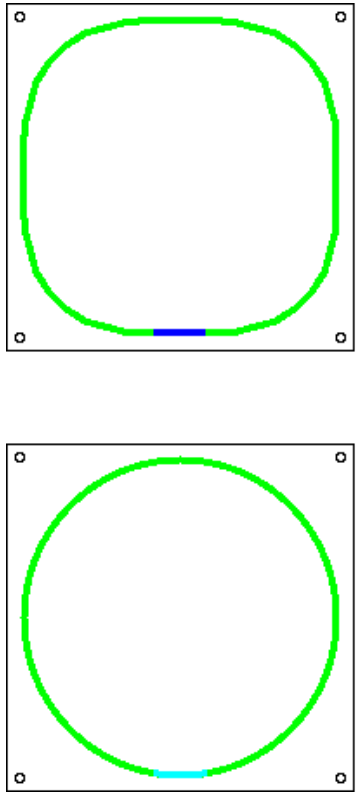
Staggered type setting



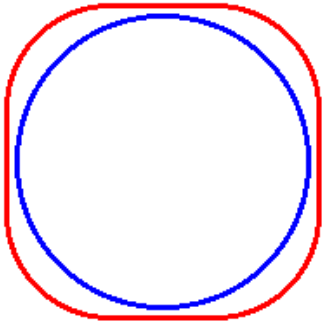
Exchange planes and use same PMT Holders when we take Non staggered data

Non Staggered type



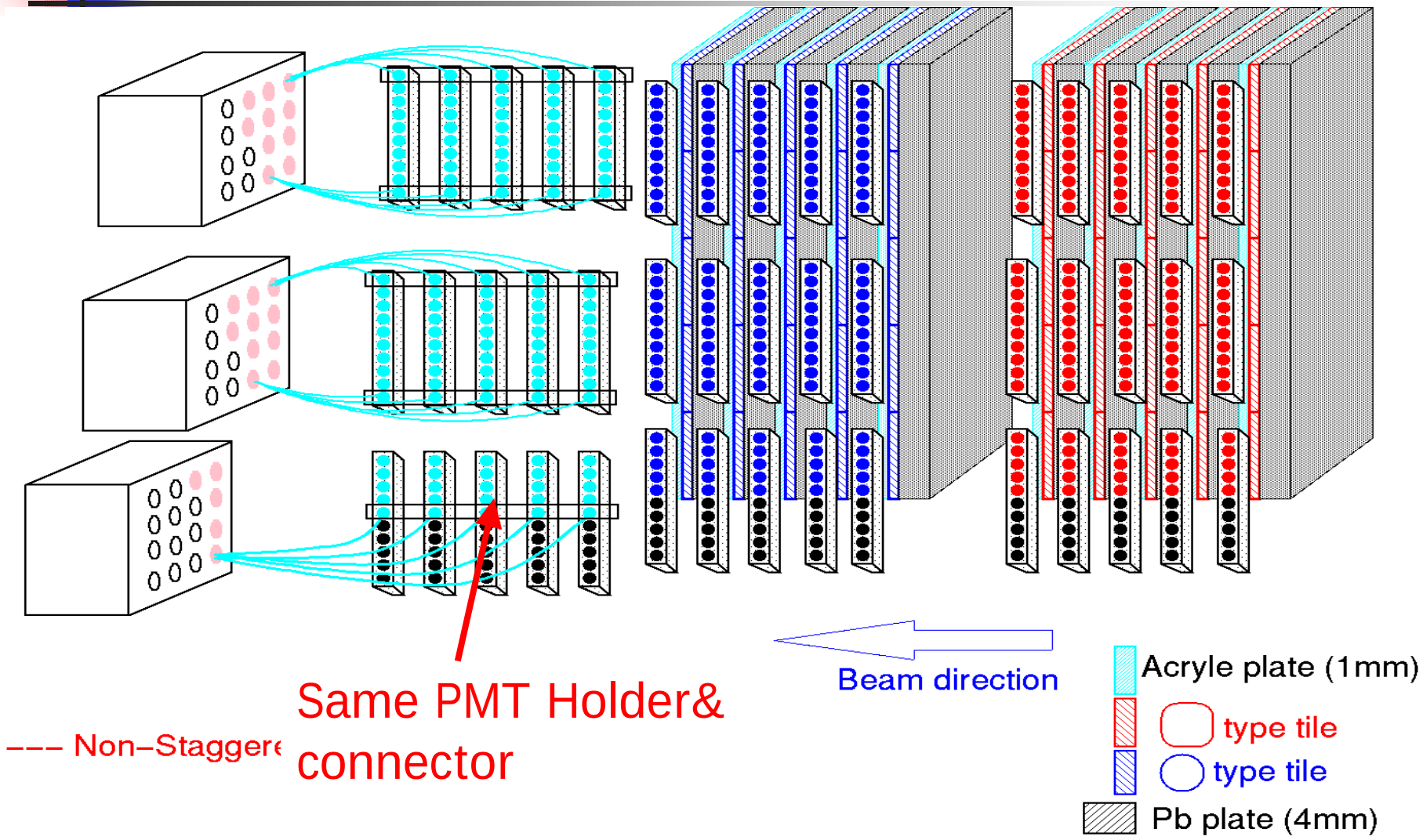


Square type

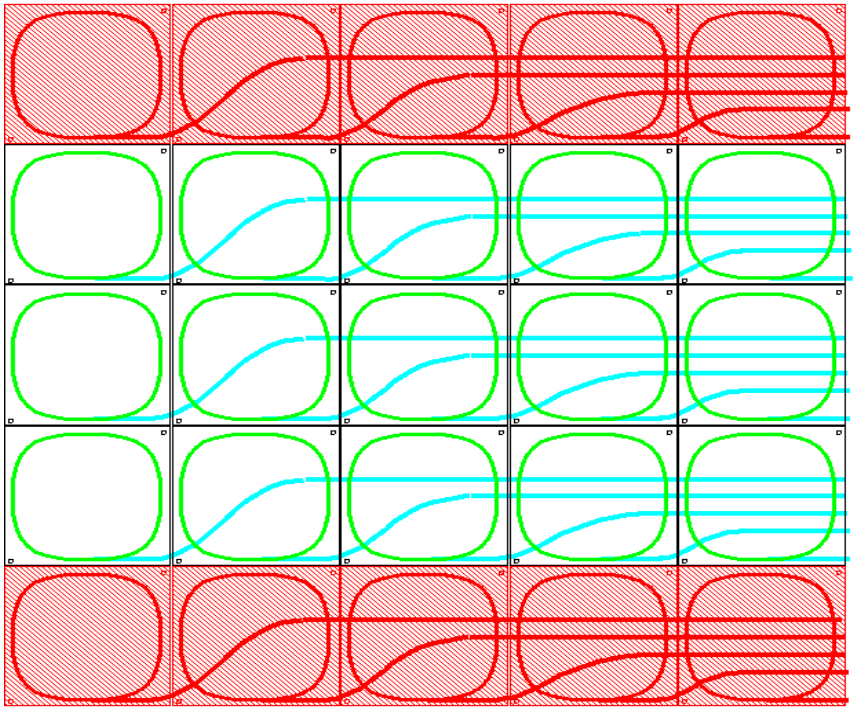


A little smaller
circle type

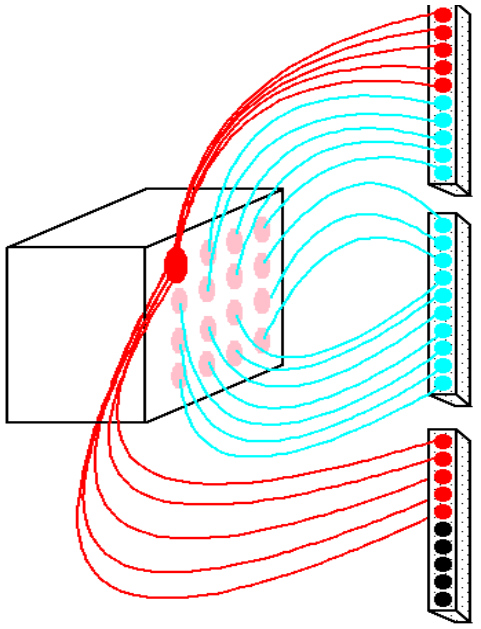
Non Staggered type



Plane by plane read out



PMT Holder <-> connector



Inner 15 tiles : read tile by tile

Outer 10 tiles : added 1 channel

Need 1 PMT for 1 Layer

→Total 10 PMT’s and PMT Holders we need

2. Study for calorimeter design

We have to check following dependencies of PH and check Compatibility calculations

- Fiber type dependence of PH
  (Y11 and Y7)
- Scintillator type dependence
  (BC412 and NE102A)
- Fiber length dependence (50-300cm)
  →For checking Attenuation length

Results of Compatibility calculation

- From compatibility calculations

  -SCINTI+WLS+PMT-

  - BC412+Y11+H6568 : 1.00
  - NE102A+Y11+H6568 : 0.84
  - NE102A+Y7+H6568 : 0.42

  → Compare this calculation with data

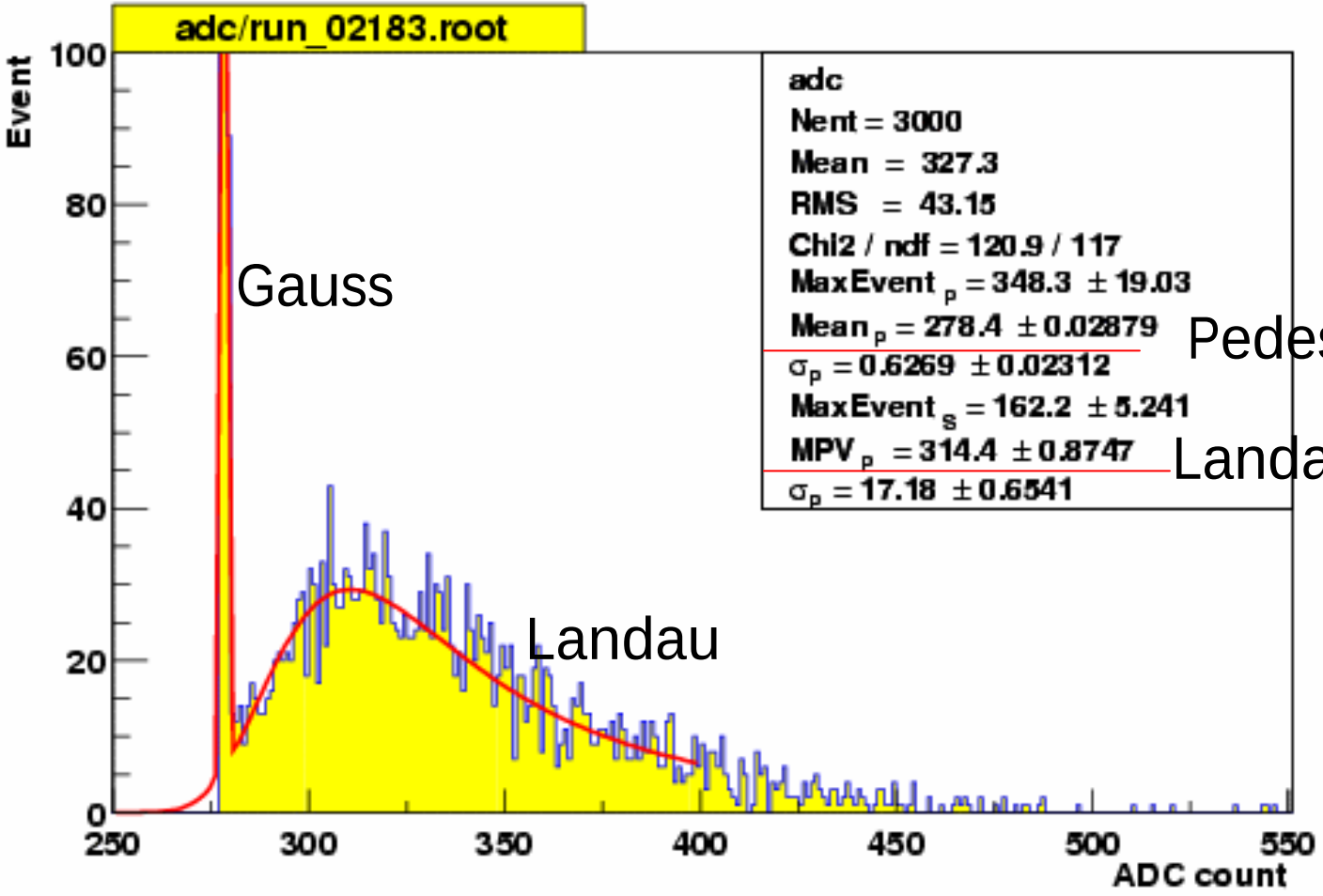
Data taking and analysis

- Use 3 tiles
  - middle : Signal
  - top&bottom : Trigger with coincidence
    (Use NE102A+Y11 for trigger)
- Fit Gaussian+Landau
- We use Pulse Height PH

  PH=s(Landau peak value) - p(Mean value)

  s: signal, p:pedestal

ADC data


adc/run_02183.root
Event
100
80
60
40
20
0
250
300
350
400
450
500
550
ADC count
adc
Nent = 3000
Mean = 327.3
RMS = 43.15
Chi2 / ndf = 120.9 / 117
MaxEvent_p = 348.3 ± 19.03
Mean_p = 278.4 ± 0.02879
σ_p = 0.6269 ± 0.02312
MaxEvent_s = 162.2 ± 5.241
MPV_p = 314.4 ± 0.8747
σ_p = 17.18 ± 0.6541
Gauss
Landau
Pedestal Mean
Landau Peak

Compare Data with Compatibility calculation

- PH(BC412+Y11,50cm) = 48.5±1.35
- PH(NE102A+Y11,50cm) = 40.3±1.03
- PH(NE102A+Y7,50cm) = 23.6±0.61

Ratio from the data

PH(BC412+Y11):PH(NE+Y11):PH(NE+Y7)

= 1±0.04 : 0.83±0.03 : 0.49±0.02

Ratio from calculation

(BC412+Y11) : (NE+Y11) : (NE+Y7)

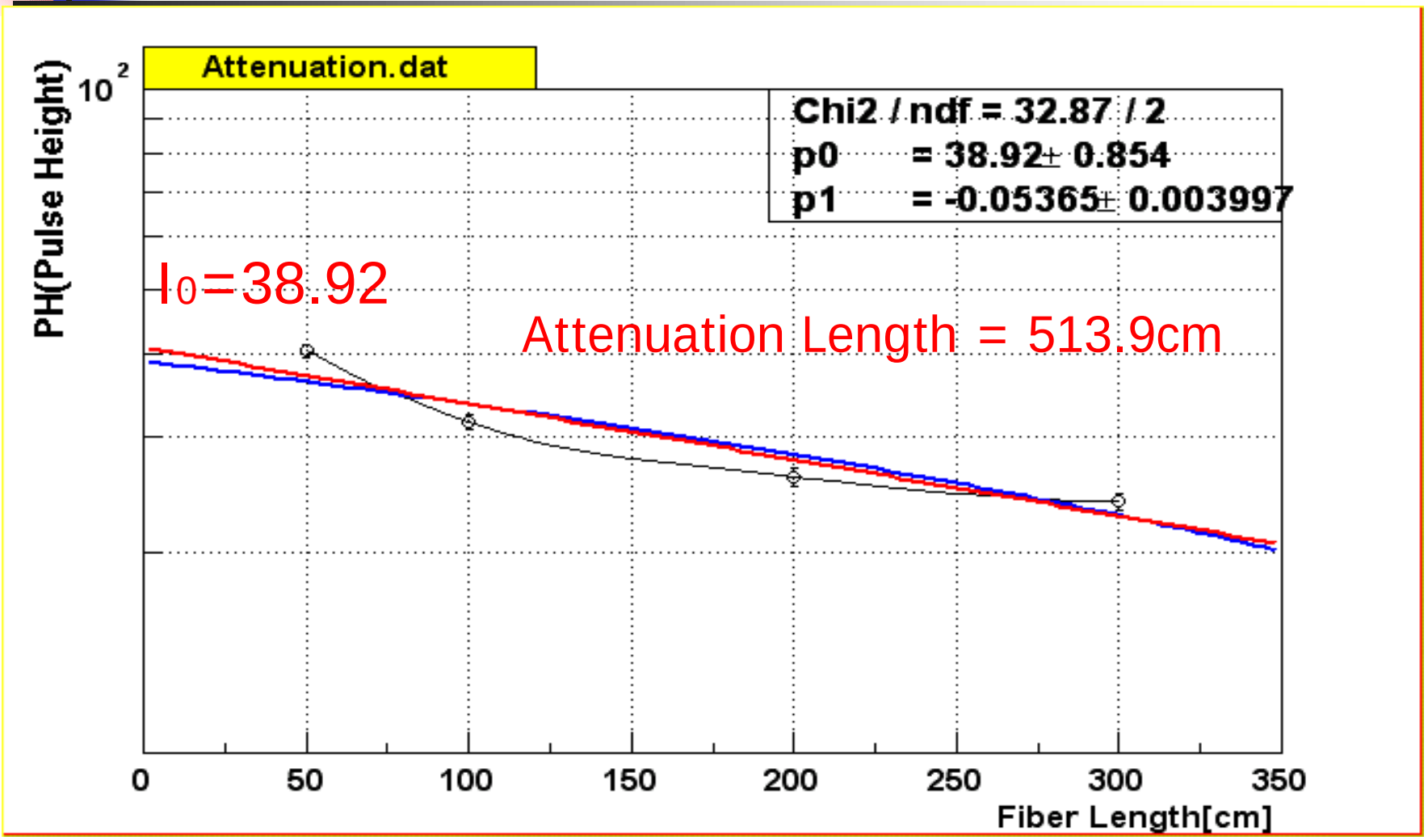
= 1 : 0.84 : 0.42 (Good agreement!)

Fiber length dependence

- Used NE102A+Y11
  - PH(50cm) : 40.3±1.01
  - PH(100cm) : 31.5±0.78
  - PH(200cm) : 26.1±0.80
  - PH(300cm) : 23.9±0.63
- Attenuation Length : λ

$$I = I_0 \mathrm{Exp}(-x/\lambda)$$

Results

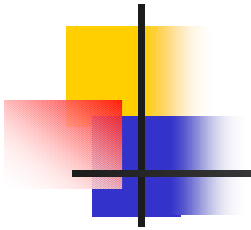

Attenuation.dat
Chi2 / ndf = 32.87 / 2
p0 = 38.92± 0.854
p1 = -0.05365± 0.003997
PH(Pulse Height)
10 2
I0=38.92
Attenuation Length = 513.9cm
0
50
100
150
200
250
300
350
Fiber Length[cm]

3. Jobs before Beam test

- Bench test study
  - Get one photo electron peak (Gain calibration)
  - Use 2 PMT’s for Trigger problem
- Check our design by Geant4 simulation
- Make our calorimeter modules as soon as possible!!

4. Badget

- Scintillator (21cmx21cm) : 24万円
  - 21cm x 21cm x 8枚 (1枚 3万円)
- Scintillator加工(1枚 1000円x250) : 25万円
- PMT(16万円x5本) : 80万円
  - H6568-10(Low Gain) x4本 (Total 10本必要)
  - H6568 (High Gain, For Bench Test) x1本
- AcrylPlate : 10万円
  - 26cm x 22cm x 6枚 x 2type (材料+加工費)
- Plastic Pin or Metal screw 500本 : 2万円
- White Pet Film (21cm x 21cm x 12枚) : 1万円
- ClearFiber(1Km) (250m程必要) : 10万円



- PMT Holder->connector (接着、研磨) :20万円
  - Super Layer　: 6 個
  - Tile by Tile　: 10 個
- Optical Connector (0.8mmφ) x 100set　:15万円
  - 1 set = Plug x 2 + I Receptacle plug

合計 187万円

Beam test design

- Beam test plan

  JLC CAL group Beam test

  →November 2002 @KEK