

# Outline of GLD-CAL beam test plan

- Fine segmented calorimeter with MPPC readout -

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- Detector design
- Mega strip scintillator plate
- WLSF and direct readout with MPPC
- Effect of saturation by GEANT simulation

# EM calorimeter Prototype

Thickness : Tungsten( -  $X_0$  ) = 3.5 mm **468 channels**

Scintillator = 3 mm

Air = 1 mm

Number of layers: 26 (18  $X_0$ )

$R_M \sim 2.1$  cm

Test @ DESY(2007. Feb-Mar)

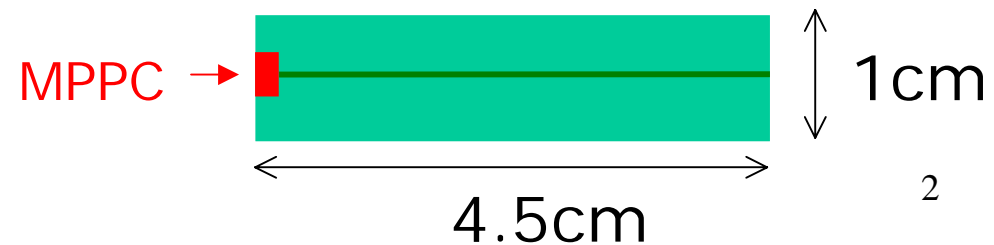
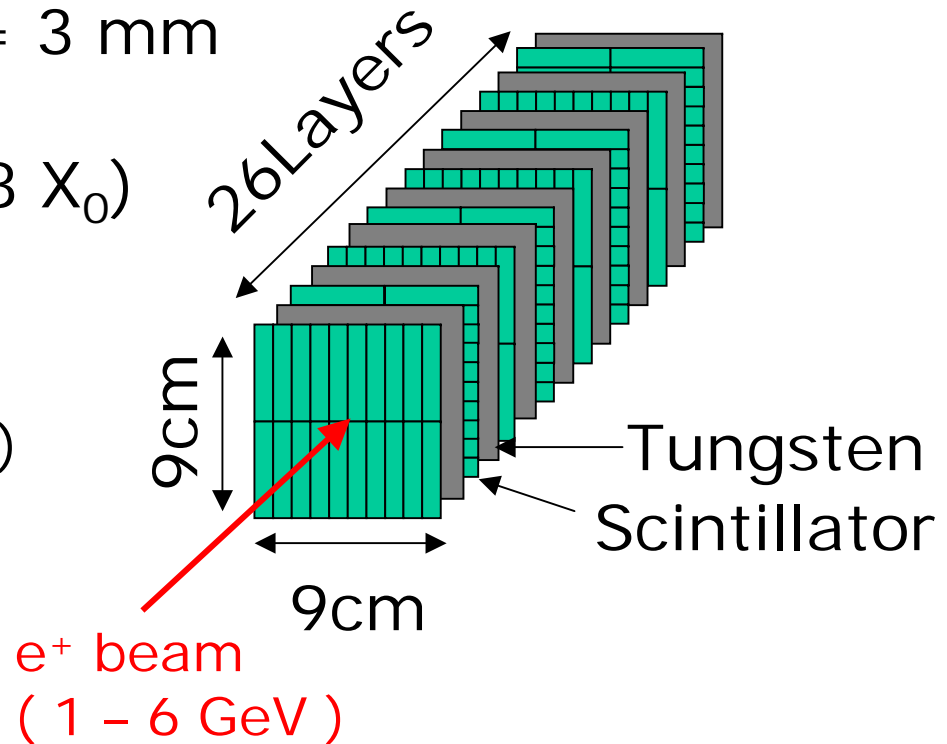
- **MPPC readout**

- Check basic performance

**Linearity**

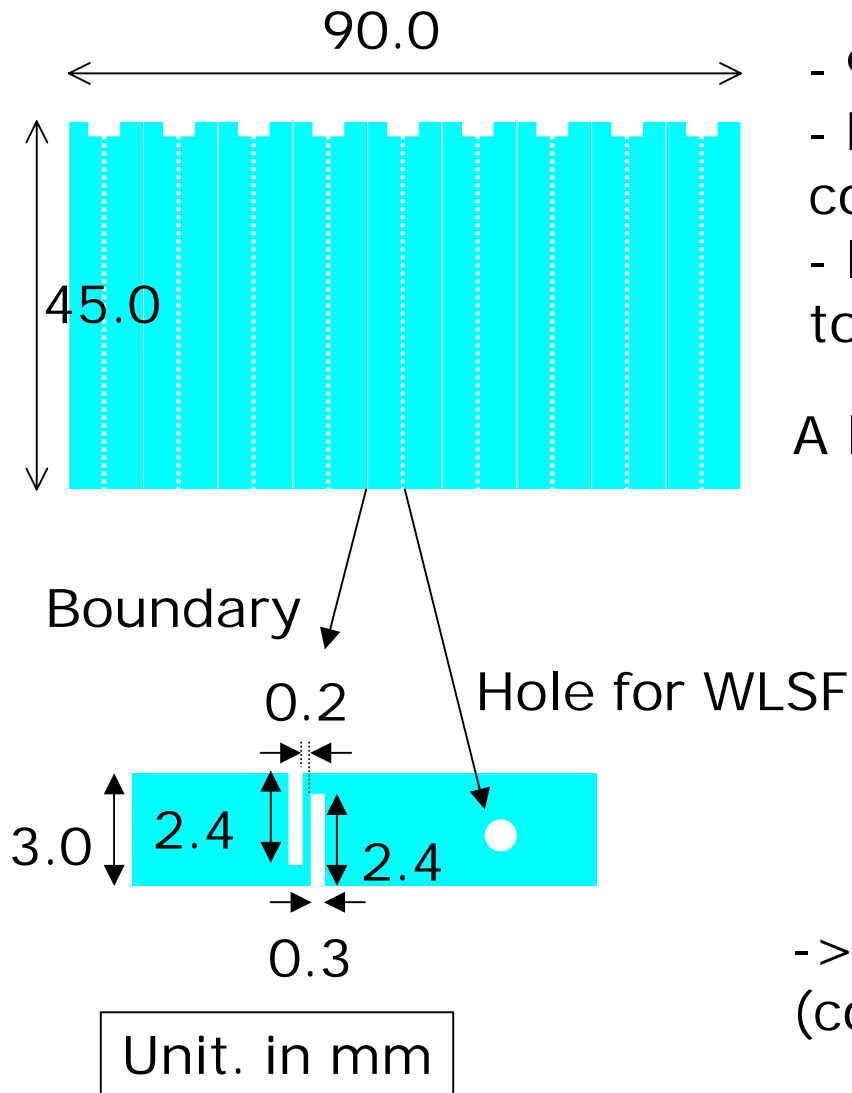
**Energy resolution**

**Spatial resolution**



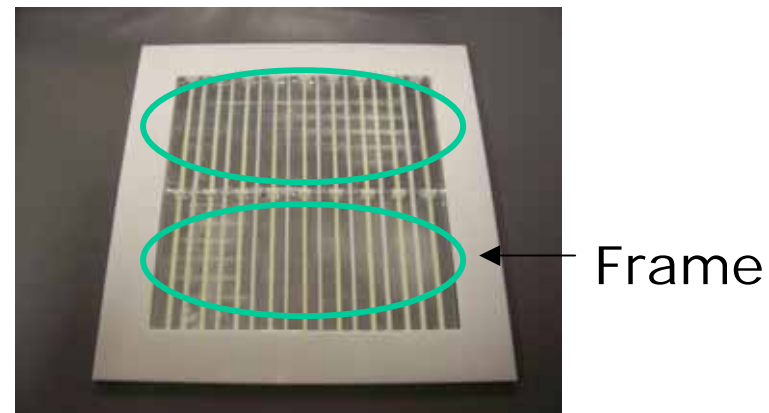
# Structure of a mega strip plate

One of the good solutions for fine segmentation



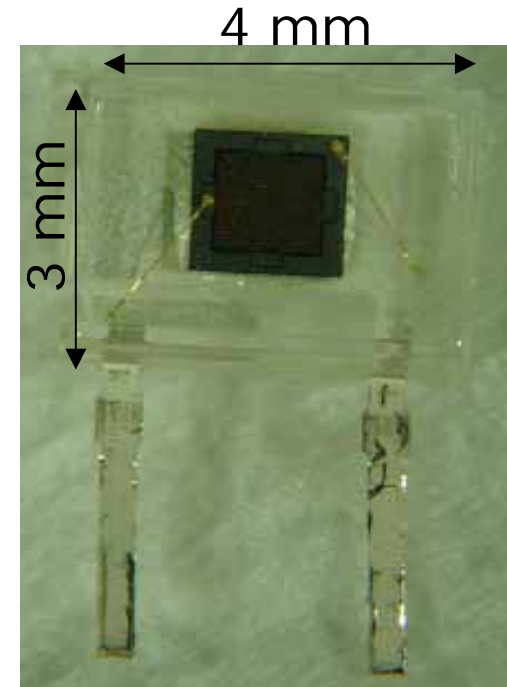
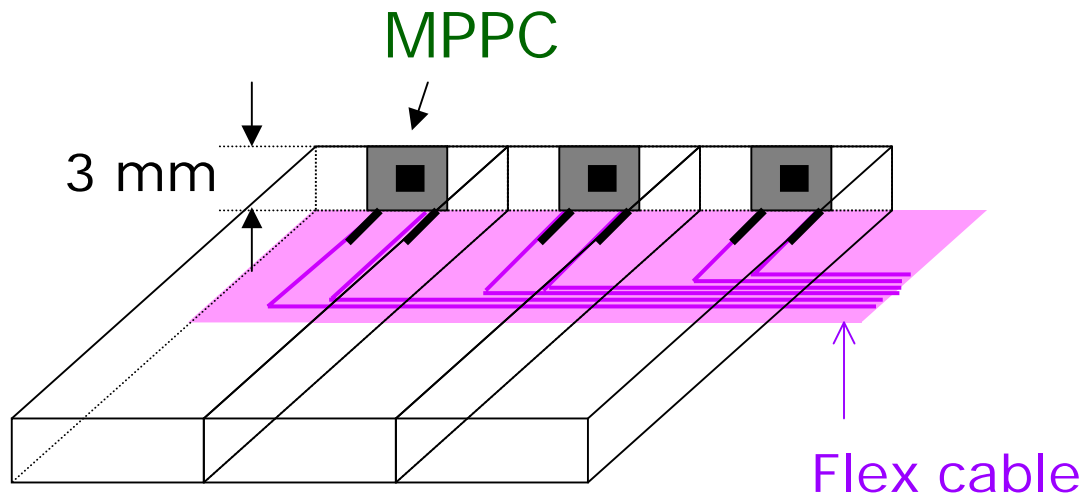
- 9 strip structure on a mega plate
- Boundary grooves : mechanically connected but optically separated
- Insert reflector films into the grooves to avoid light crosstalk

A layer consists of two mega plates



-> Easy for assembly and alignment  
(compared with array of simple strips)

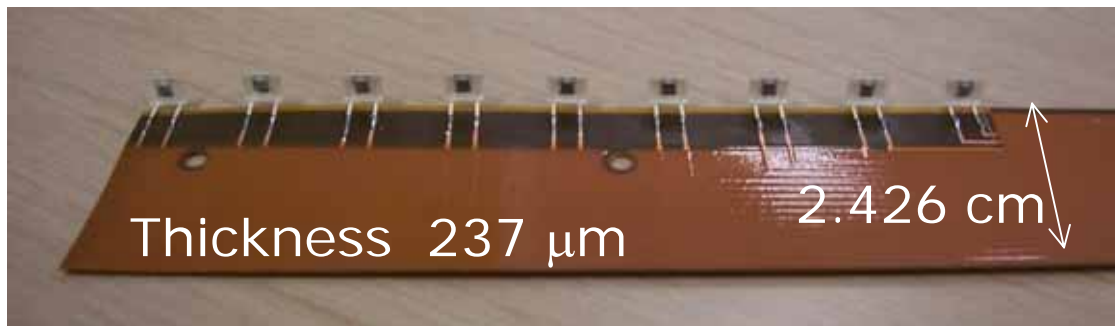
# 1600-pixel MPPC for the beam test



Thickness 1.3 mm  
Active area 1 x 1 mm<sup>2</sup>  
( HPK )

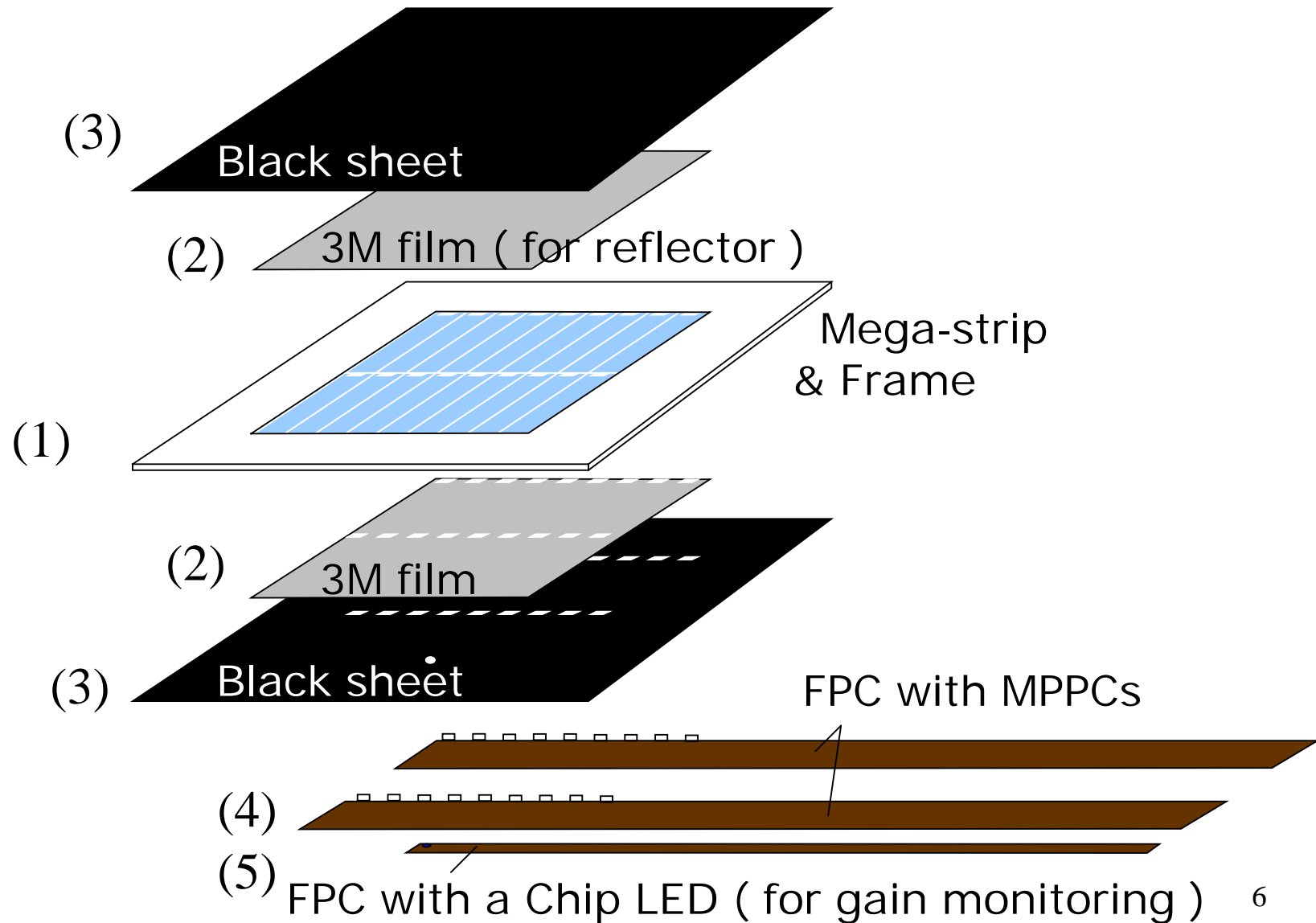
- This is the smallest package which HPK has already produced
- This package is suitable for attaching to the 3mm-thickness scintillator
- Legs of MPPC are bended and soldered with a Flex cable

# Flex cable with MPPCs

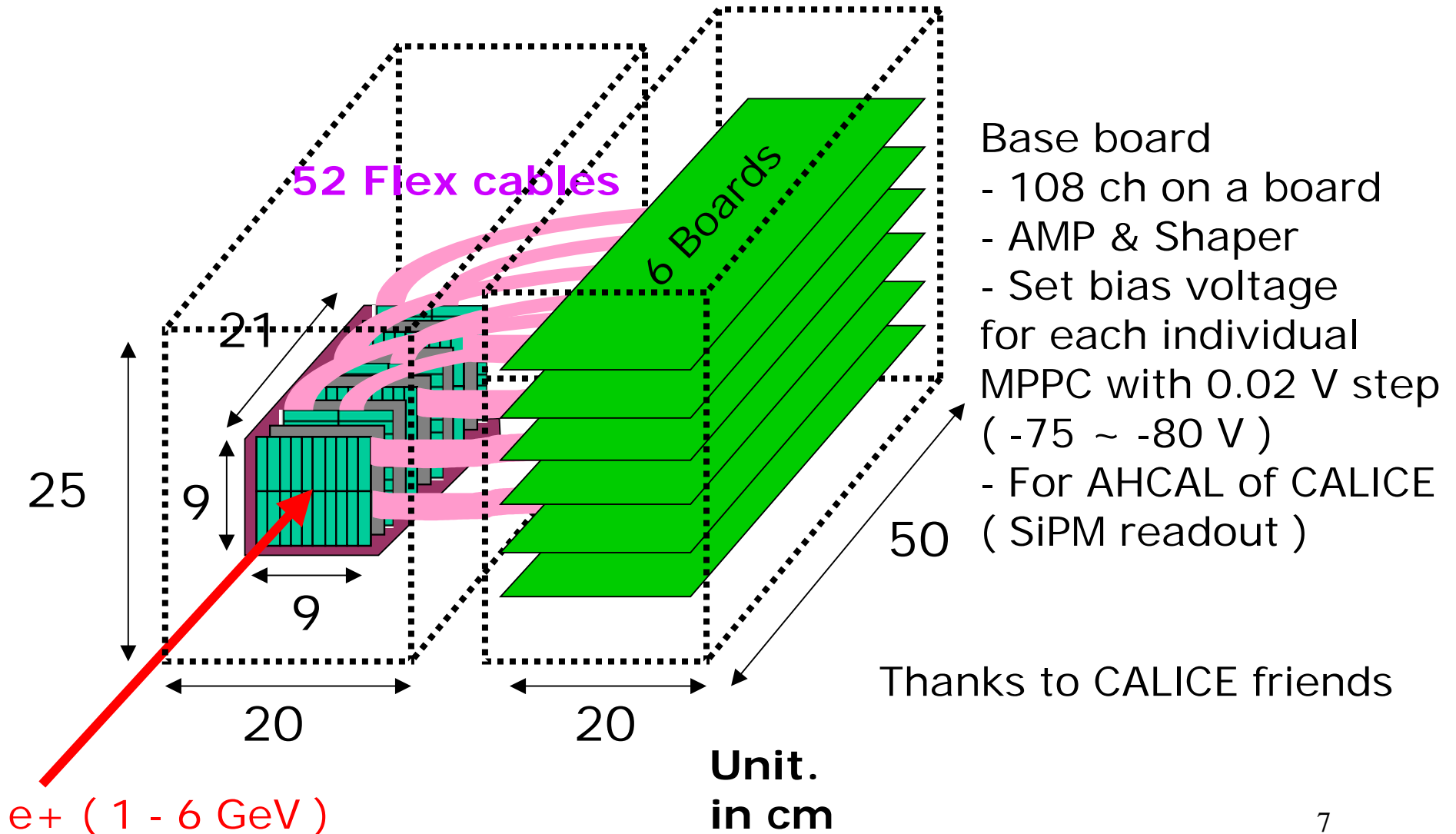


- 9 MPPCs are soldered with a Flex cable ( FPC )
- FPC is so thin that we can reduce space for readout

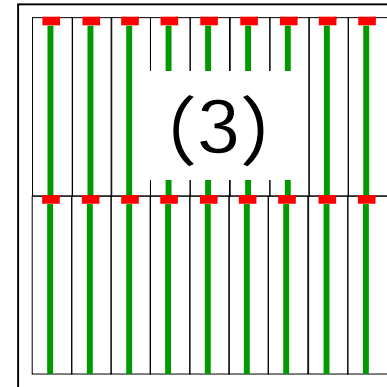
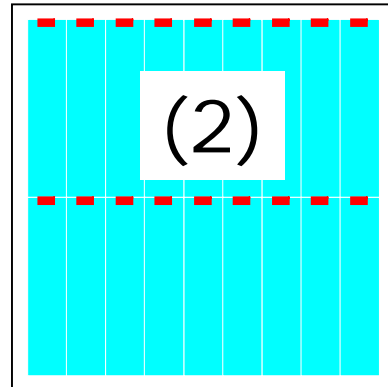
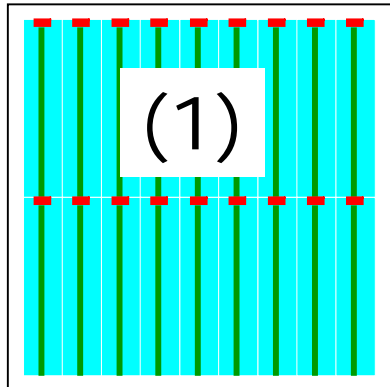
# Mega-strip assembly



# Setup of the beam test @ DESY



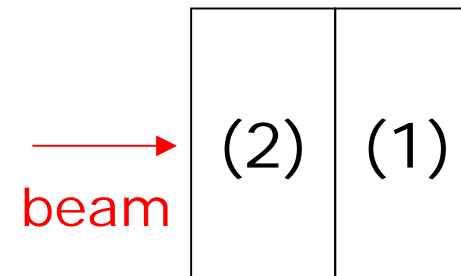
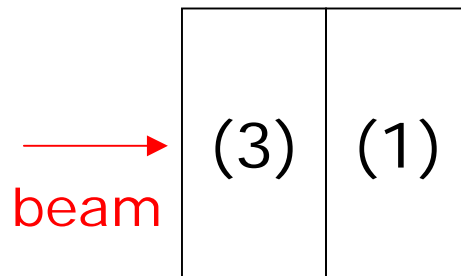
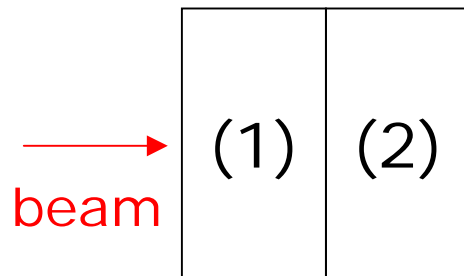
# Configurations of layers @DESY



Strip : Mega  
Readout : WLSF  
Layers : 13

Mega  
Direct  
13

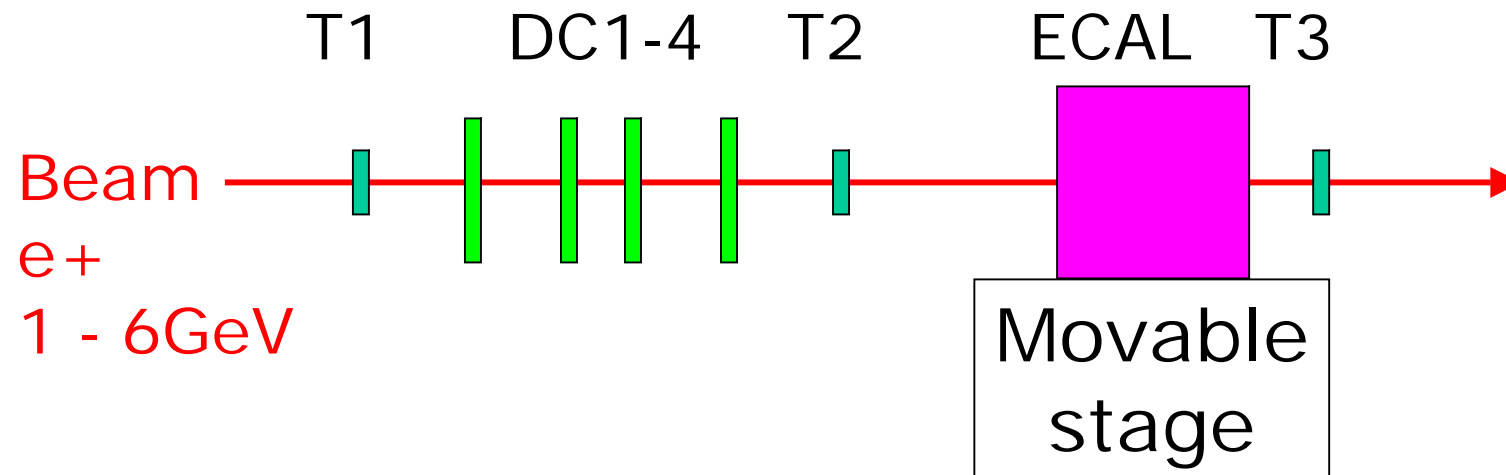
KNU ( Next talk )  
WLSF  
13



We will test three configurations

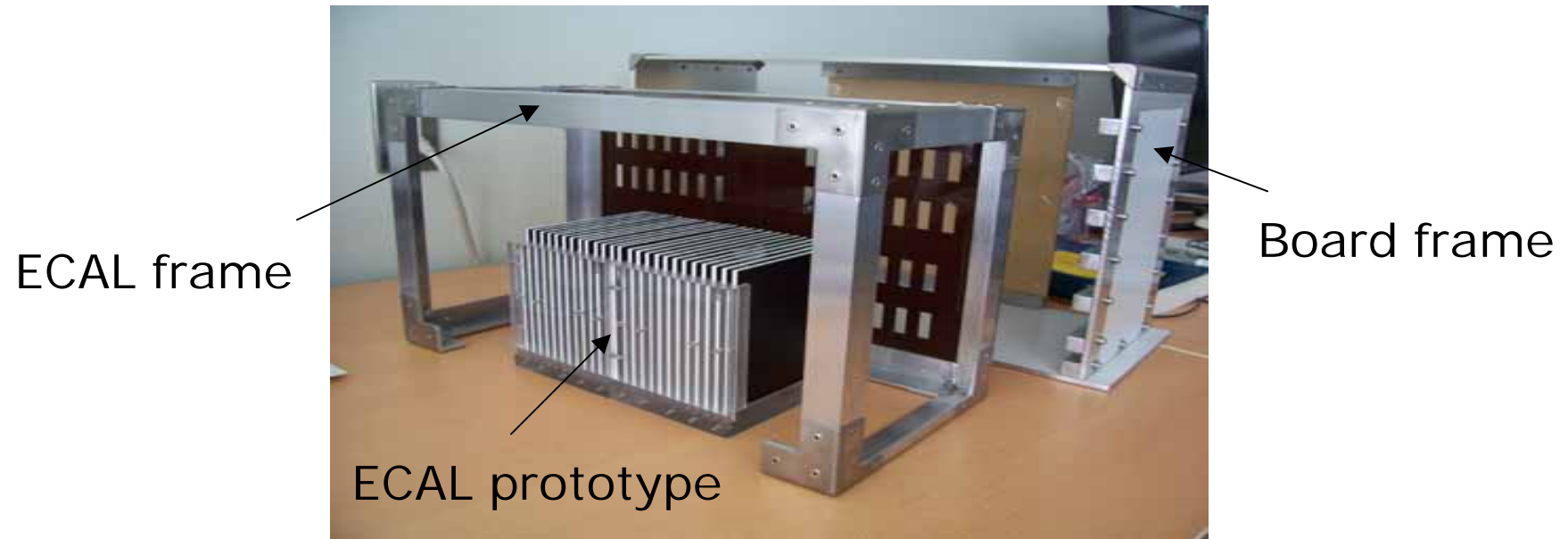


# DESY beam-line



T1 ~ T3 : Trigger counters ( 3 x 3 cm<sup>2</sup> )  
DC1 ~ DC4 : Drift chamber

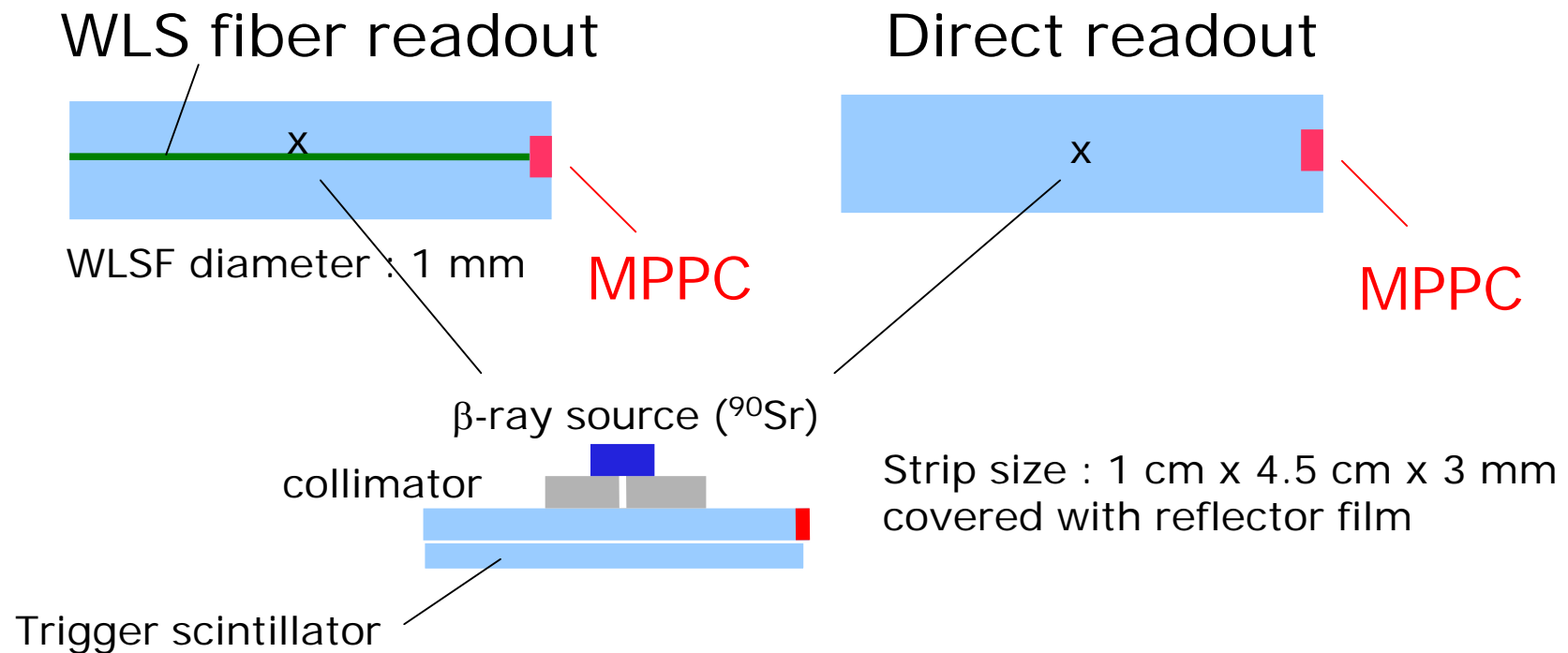
# Status



- Construction has been almost finished
- We will set MPPCs in the Mega strip and check the signal by  $\beta$  source after ACFA
- 15 FEB : Shipping to DESY

# Light yield measurement of the scintillator strip using MPPC

- Measure light yield with the MPPC
- Comparison between WLS fiber readout and Direct coupling

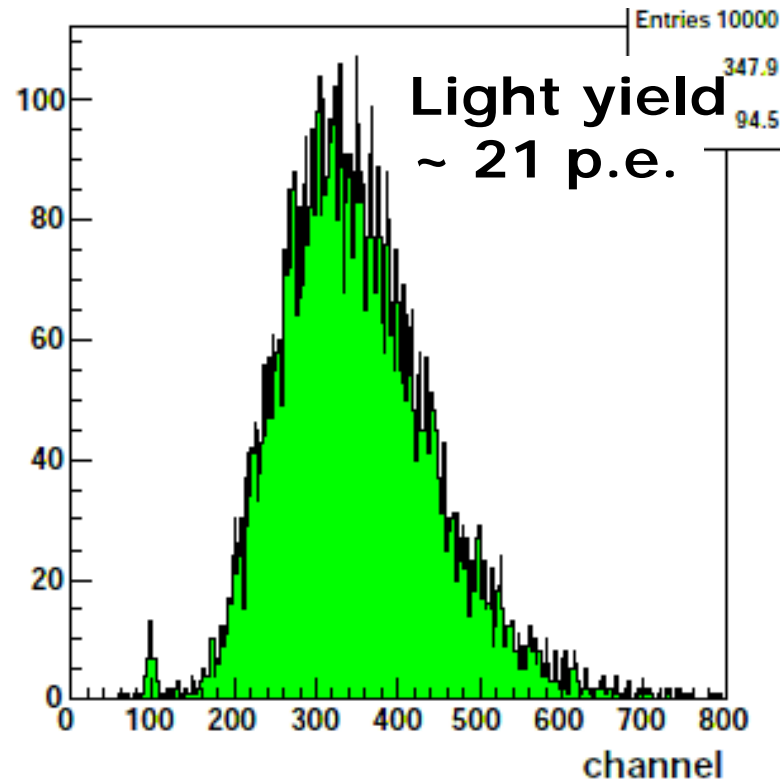


# Light yield for $\beta$ source

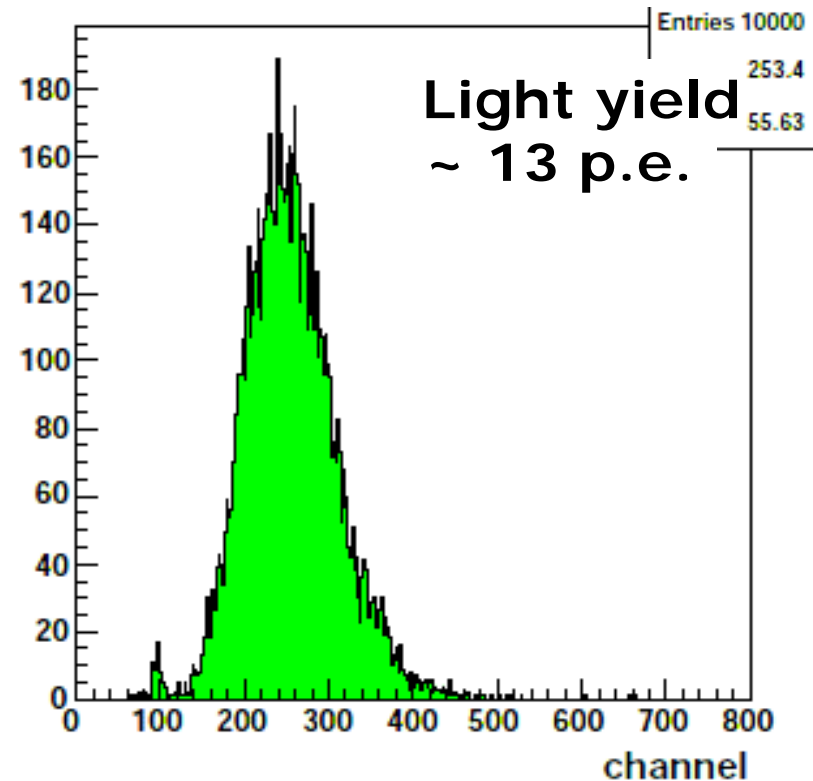
Bias voltage :  $V_0 + 2.1$  V

Temperature : 25 °C

WLSF readout



Direct readout



Direct readout shows ~60 % light yield of the WLSF readout  
Observed light yields are sufficiently large

# Effect of saturation by GEANT simulation

MPPC is a non-linear device

Saturated by # of pixels ( 1600 pix )

Need to check the effect to  
linearity and resolution

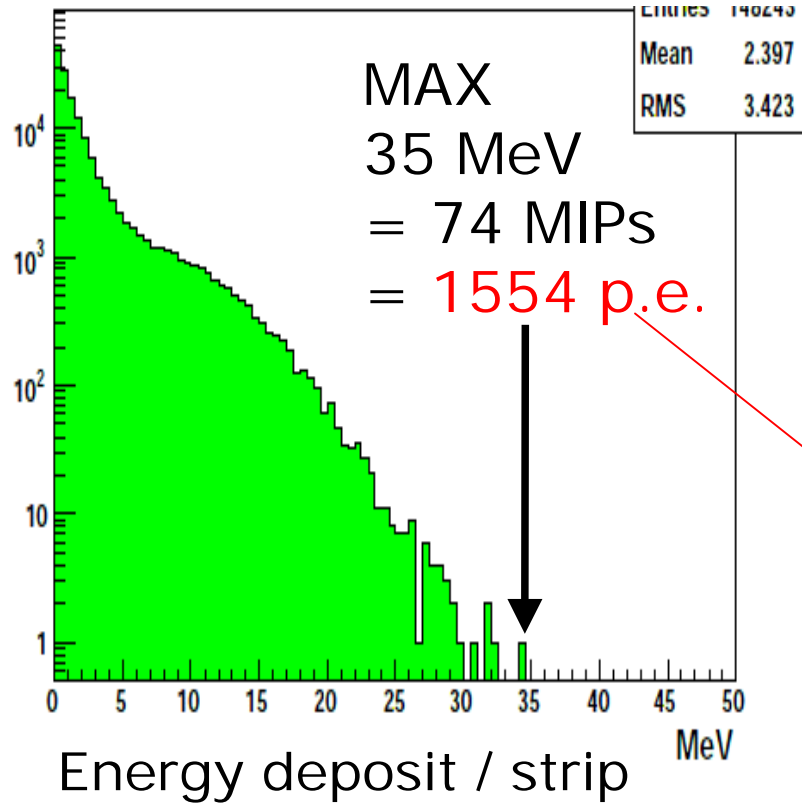
How big is the saturated effect by 1600 pix MPPC?

Can we correct the saturated response?

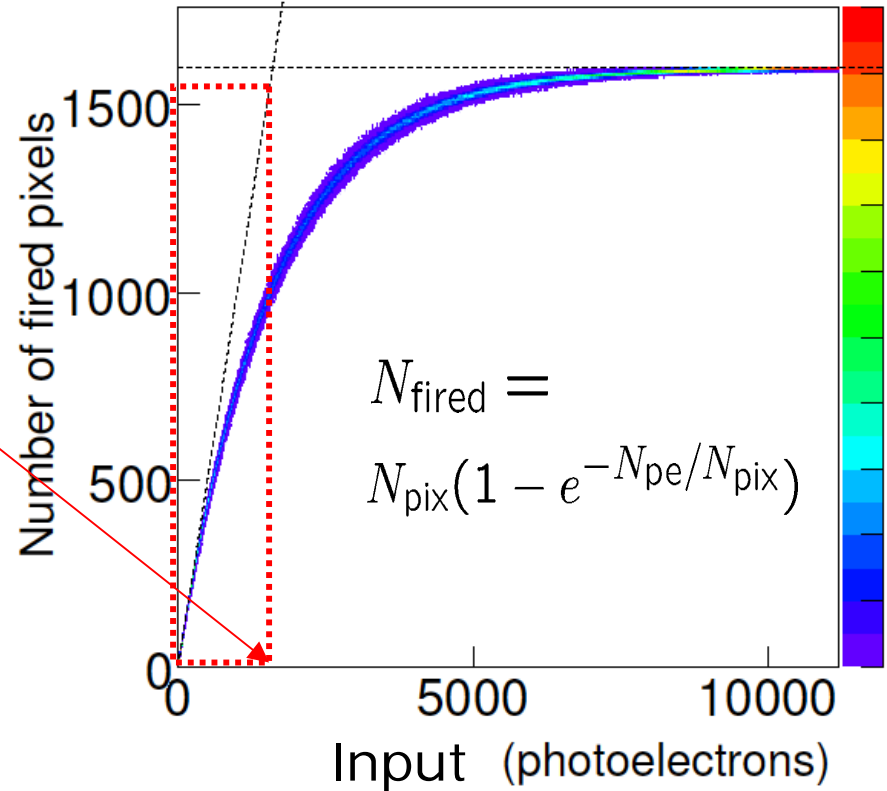
Is the dynamic range of MPPC sufficient for the beam test @DESY?

# Dynamic range of 1600 pix-MPPC @DESY

Result of G4 simulation  
 $e^+$  6 GeV ( max )

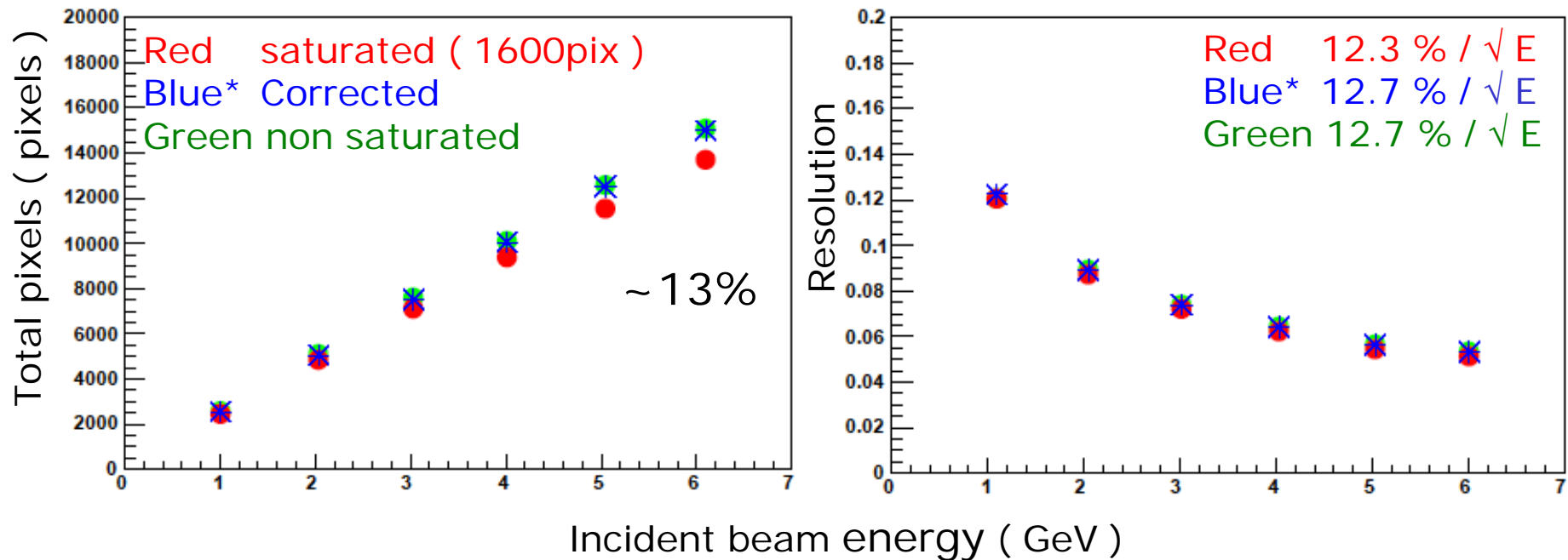


1600 pixel  
 saturated response curve



This red region is a little saturated

# Linearity and Resolution



- Non-linearity appears ~13%
- Saturation effect can be corrected with a correction curve
- We can use 1600 pix MPPCs @ DESY beam test (< 6 GeV)
- Variation of saturation curve over many MPPCs may make worse the linearity and resolution -> Need measurement

# Summary

- Construct and test ECAL prototype ( W / sciti. ) with 1600pix-MPPC
- Scintillator layers : Mega-strip and KNU strip
- WLSF readout and direct coupling
- Observed light yields are sufficiently large
- Dynamic range of MPPC is sufficient for the beam test @ DESY
- Add gain and temperature monitoring systems

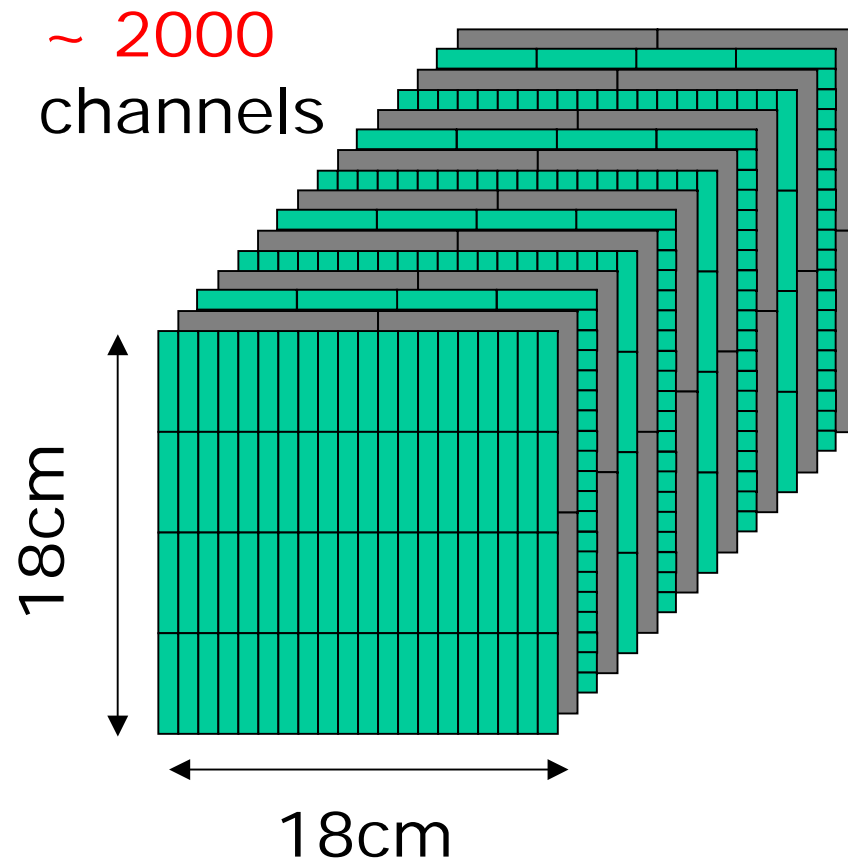
We will go to DESY with this prototype 25<sup>th</sup> Feb 2007



# Further beam test

Test @ FNAL (2007 - 8)

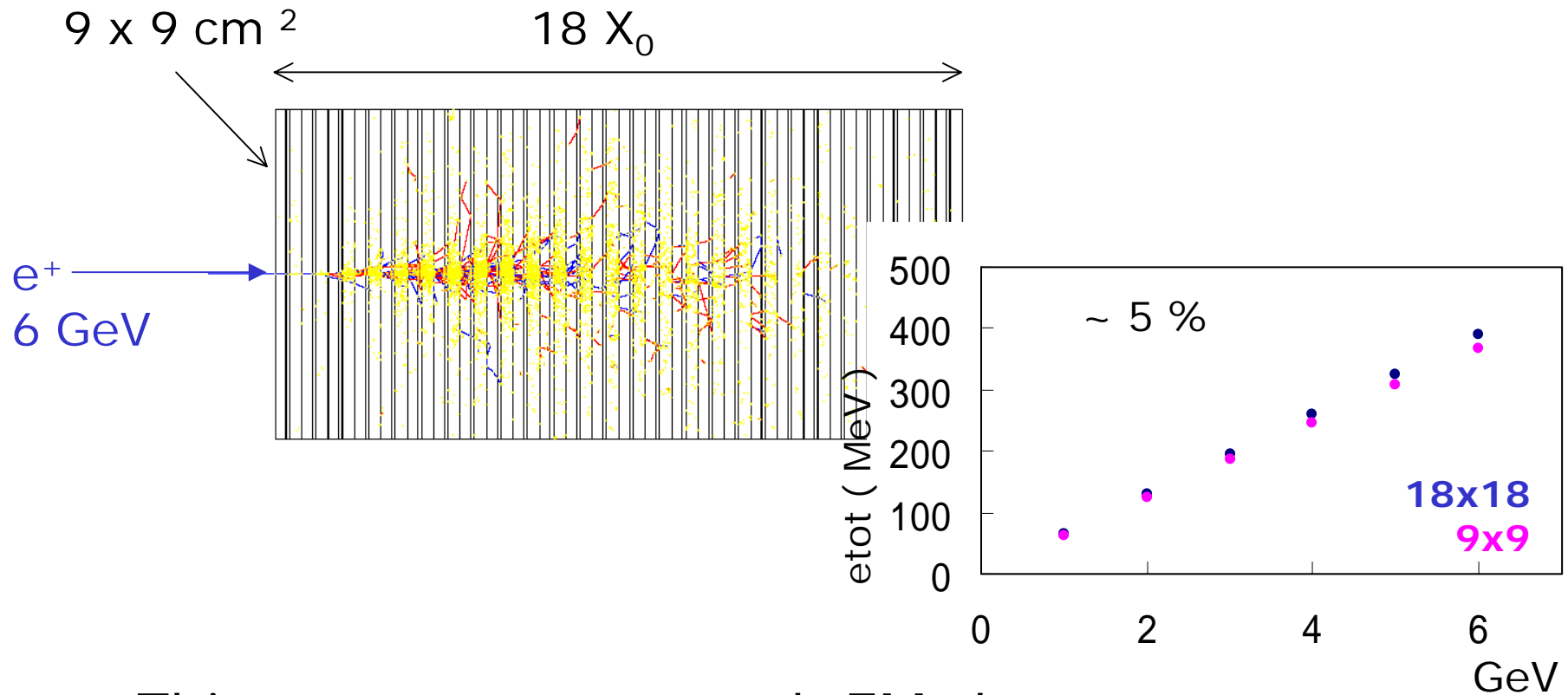
- 4 times cross-section
- MPPC readout
- Test at higher energy
- Combined with HCAL
- $\pi^0$  reconstruction in multi particle injection



backups

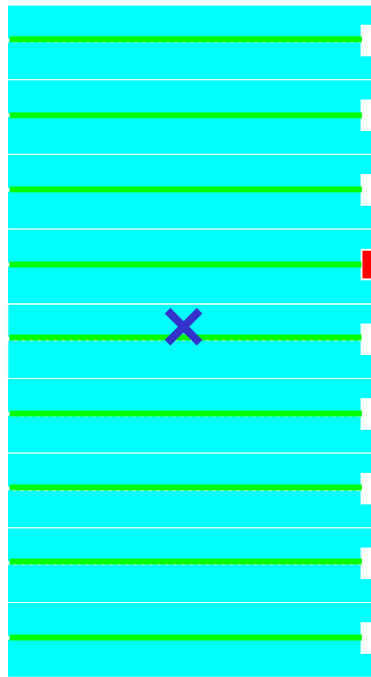
# An event example by GEANT4

Case :  $e^+$  6 GeV  
( the maximum energy of DESY b.t. )

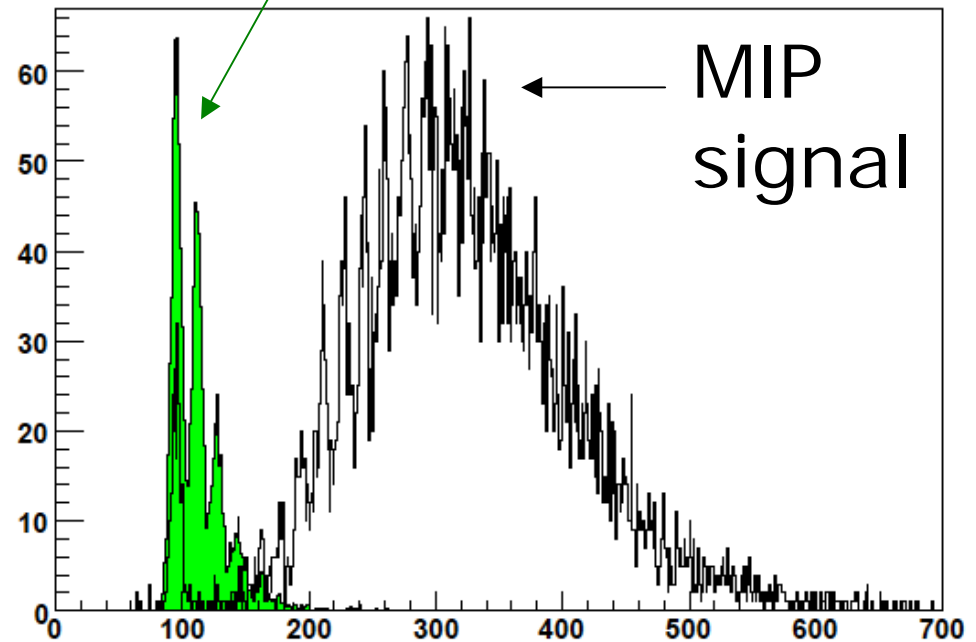


This prototype can catch EM shower

# Light Cross-talk of Mega-plate



Cross-talk  
0.07MIP



Light cross-talk is negligible