# SciBar detector

Hide TANAKA
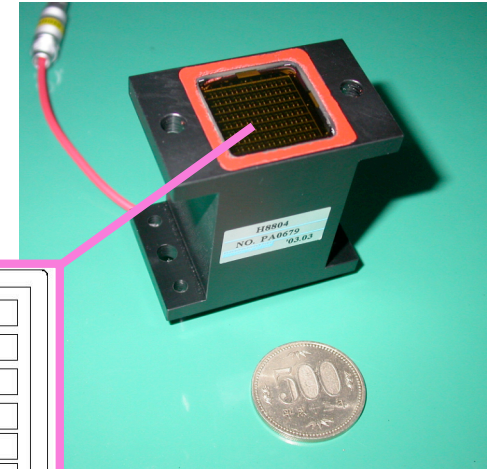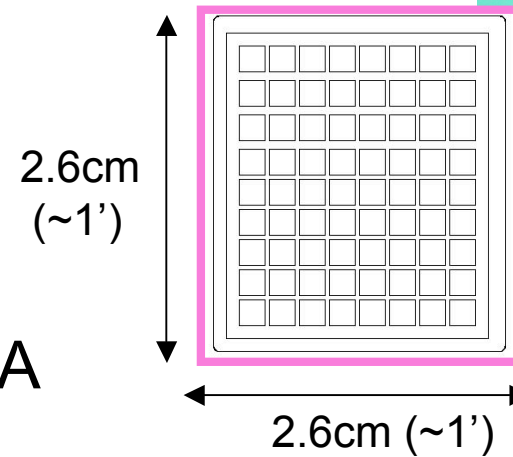
Kyoto Univ.

Feb. 20, 2007

SciBar detector overview

- Extruded scintillators with WLS fiber readout

- The scintillators are the neutrino target

- 2.5 x 1.3 x 300 cm³ cell

- ~15000 channels

- Light yields
  - 7~20 p.e./cm (for MIP)

- Detect short tracks (>8cm)

- Distinguish a proton from a pion by dE/dx

- Total 15 tons

➔ High track finding efficiency (>99%)

➔ Clear identification of ν interaction process

EM calorimeter

Extruded scintillator (15t)

1.7m

Multi-anode PMT (64 ch.)

WLS-fibers
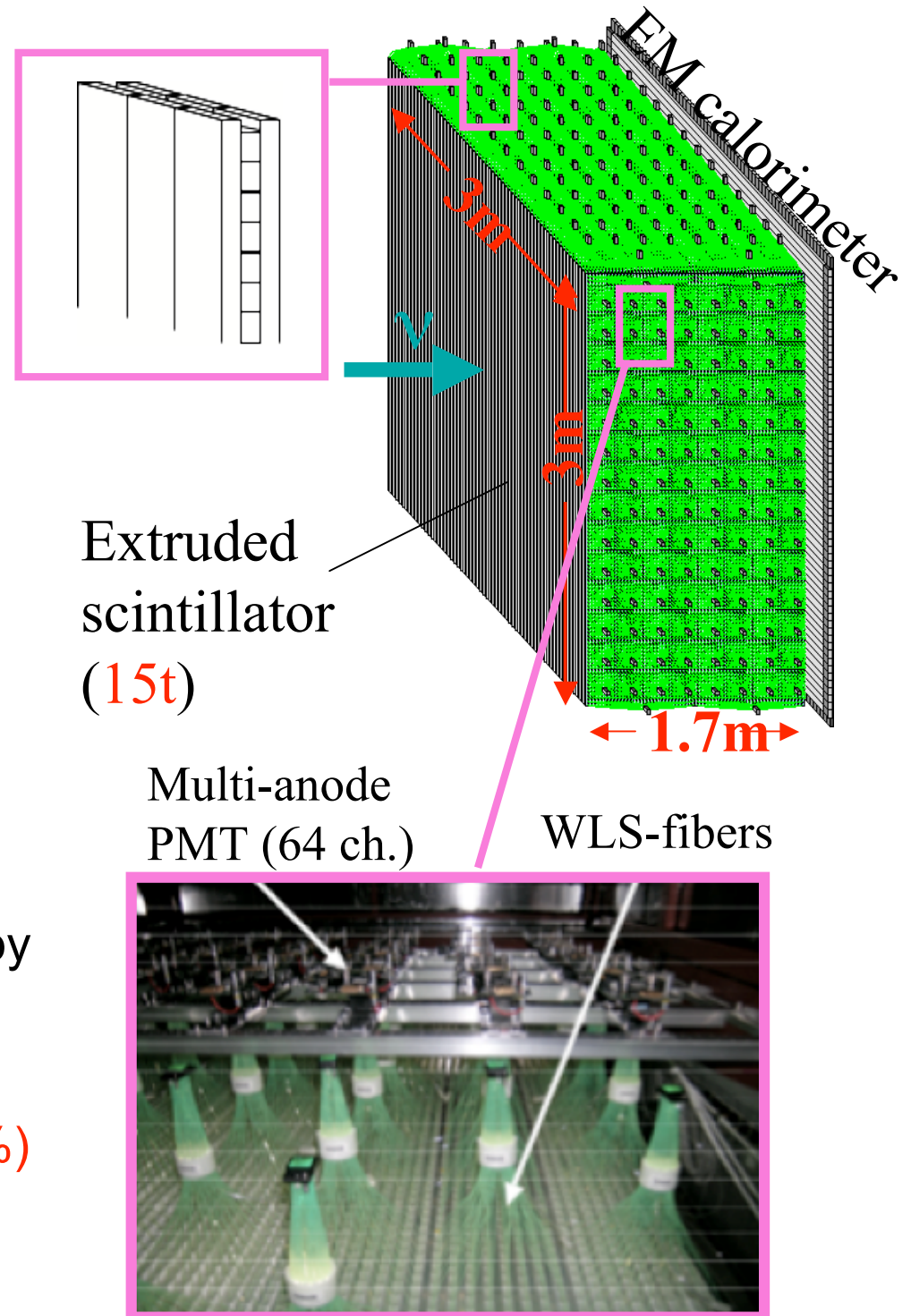
Multi-anode PMT

- Hamamatsu H7546 type 64ch. PMT
  - $2 \times 2 mm^2$ pixel
  - Bialkali photo-cathode
  - Lower power: <1kV, <0.5mA
  - Typical gain: 6×10^5
  - Gain uniformity: ~20% (RMS)
  - Linearity: up to ~200 p.e. (@6×10^5)

- Gain for all channel have been measured.

2.6cm (~1')

2.6cm (~1')

Measured gain distribution for all PMT-channels (14336 channels)

ID	4000
Entries	14336
Mean	1.0000
RMS	0.2111

98%

relative gain
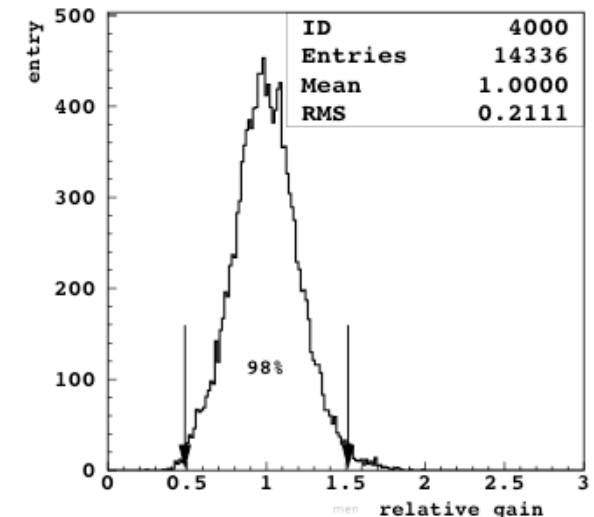
HV value for the PMTs

HV values for all MAPMTs

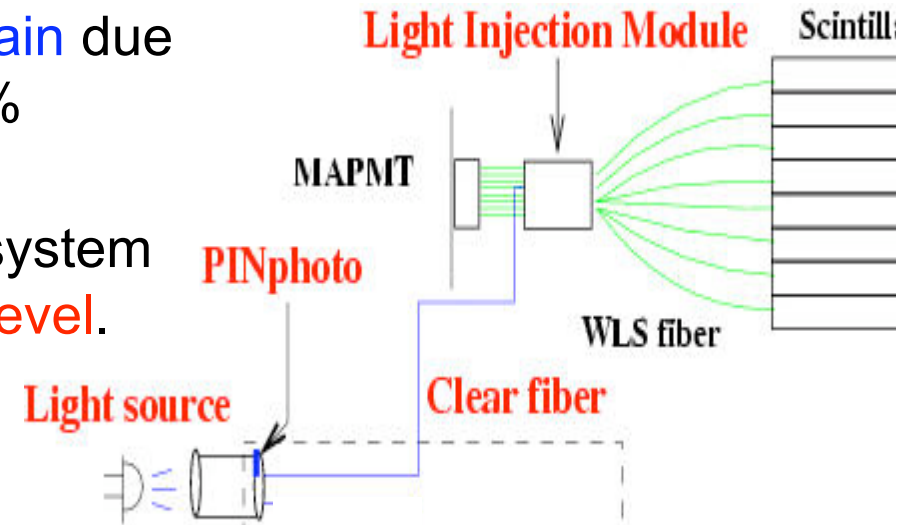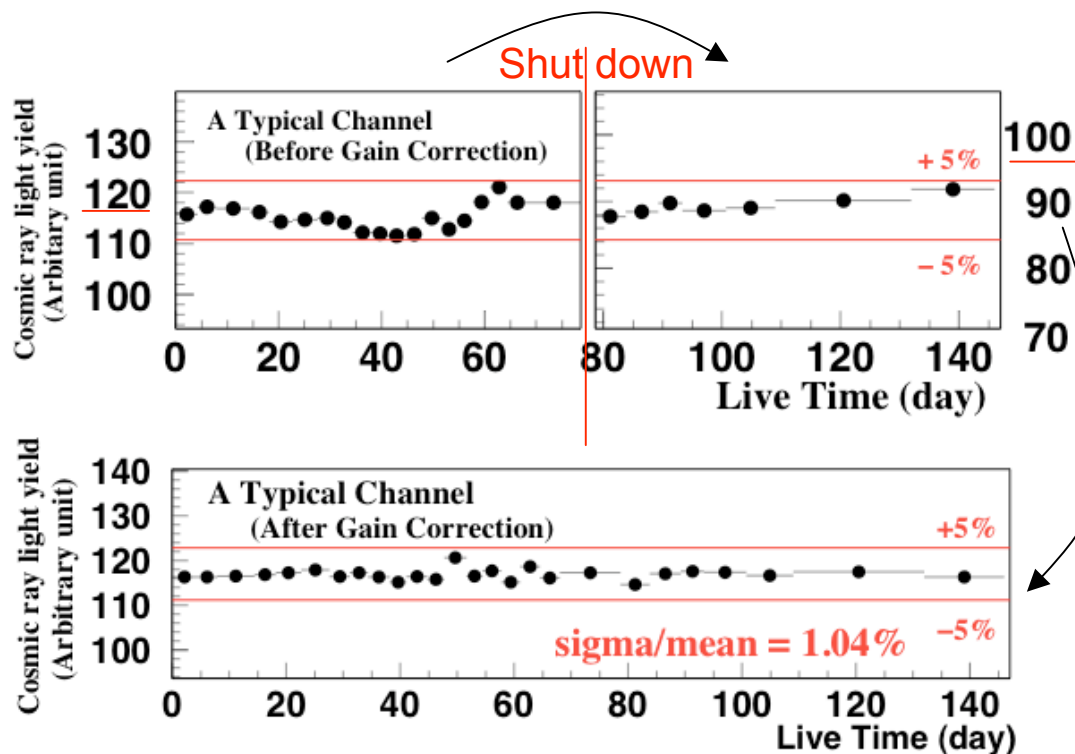- HV values are determined to realize that gain of each PMT channel is ~6×10^5

- HV value:
  - Average: 774V
  - Min: 705V
  - Max: 850V

ID	1000
Entries	224
Mean	774.3
RMS	23.36

700   900

HV value

ADC counts

HV value
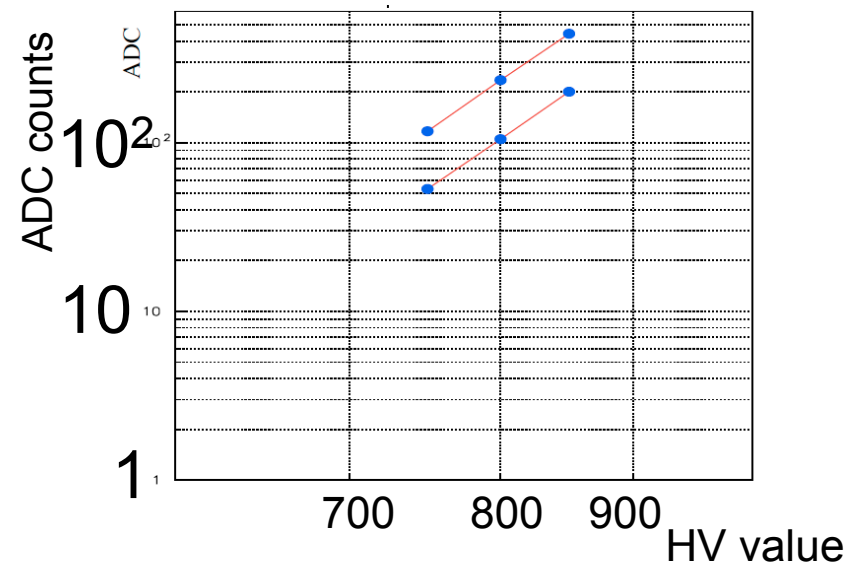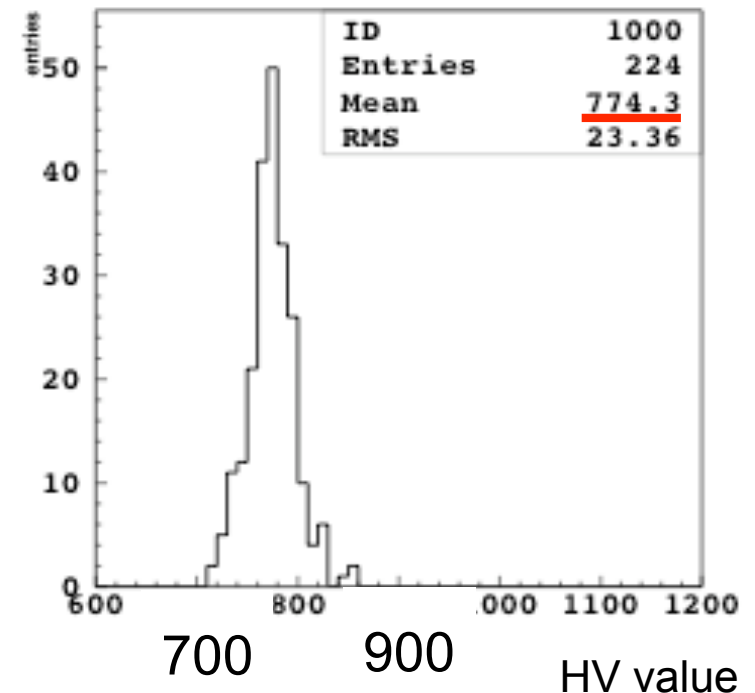
Gain calibration system

- Uses LED as a light source

- Performance of the system (in K2K);
  - We observed ~20% jump of PMT gain due to HV changes (corresponds to ~2% change: ex. 774V+/-15V)
  - → PMT gain were corrected with this system and the gain is stable at about 1% level.

Summary

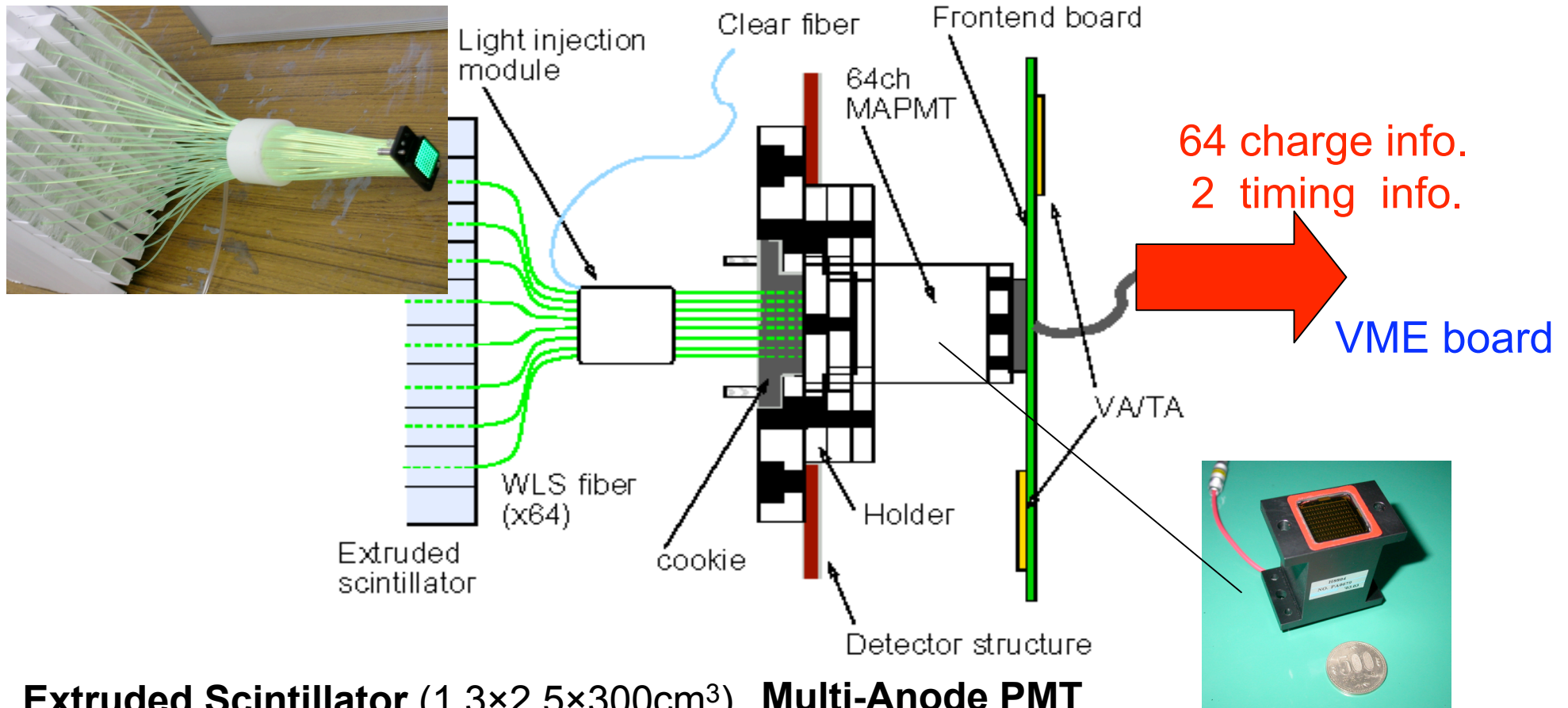- SciBar uses 224 MAPMTs with HV of ~750V
  (averag: 774V)
  - HV values are determined to realize ~6x10^5 gain of the PMTs
  - Gain uniformity: ~20%

- PMT gains are calibrated with a gain monitoring system, which uses LEDs.
  - The system works for 1% level calibration even ~20% gain fluctuation (~2% changes of HV, ex. 774V+/-15V) as seen in K2K.

    (Using the calibrated data, there were no big effect on physics analysis, including PID)
- Smaller HV fluctuation is better, of course.

Backup

SciBar Components

Light injection module

Clear fiber

Frontend board

64ch MAPMT

64 charge info.
2 timing info.

VME board

VA/TA

WLS fiber (x64)

Extruded scintillator

cookie

Holder

Detector structure

Extruded Scintillator (1.3×2.5×300cm^3)
 ・ made by FNAL (same as MINOS)
Wave length shifting fiber (1.5mmΦ)
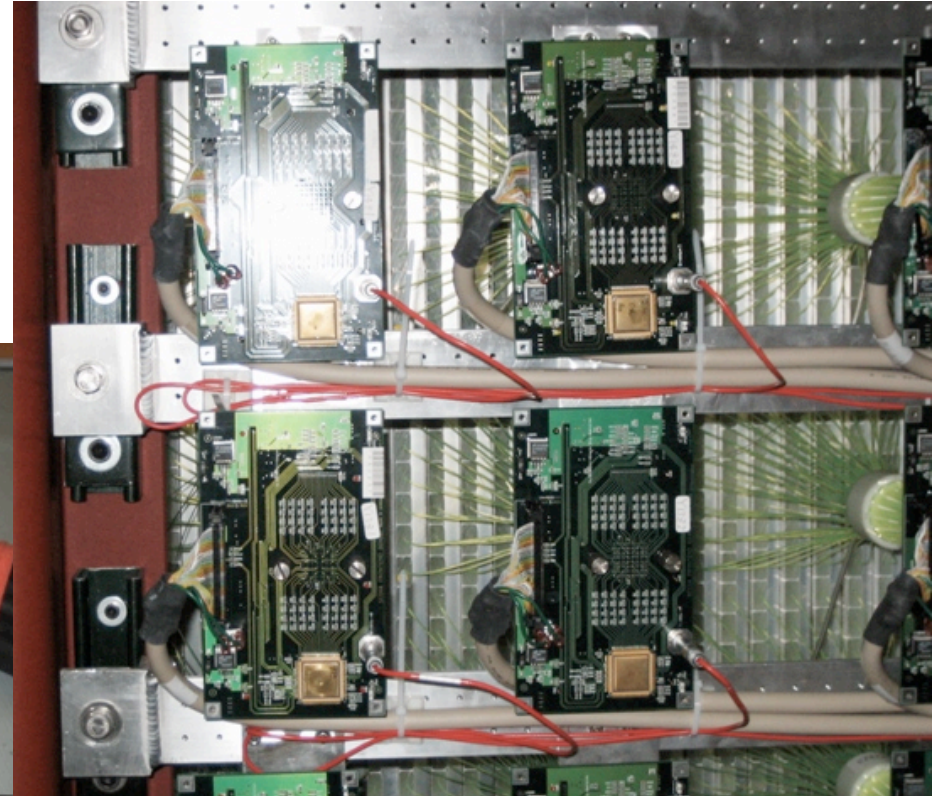 ・ Long attenuation length (~350cm)
 → Light Yield : 18.9p.e./cm/MIP

Multi-Anode PMT
・2×2mm^2 pixel (3% cross talk @1.5mmΦ)
・Gain Uniformity (20% RMS)
・Good linearity (~200p.e. @6×10^5)
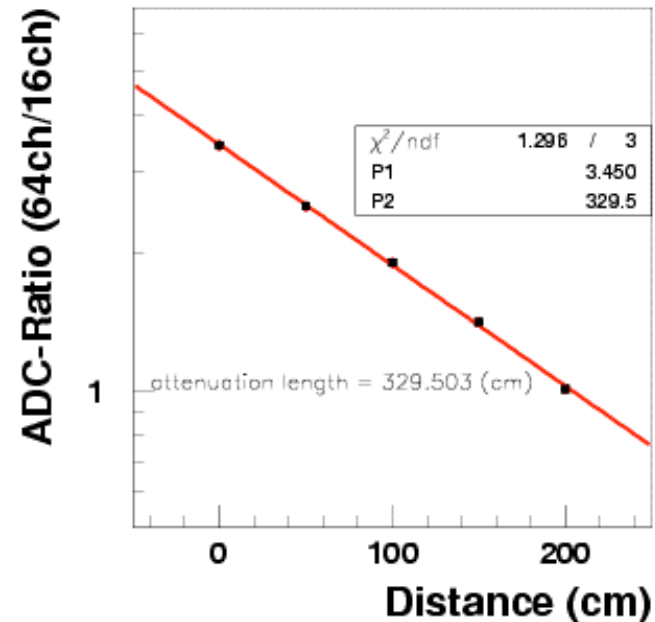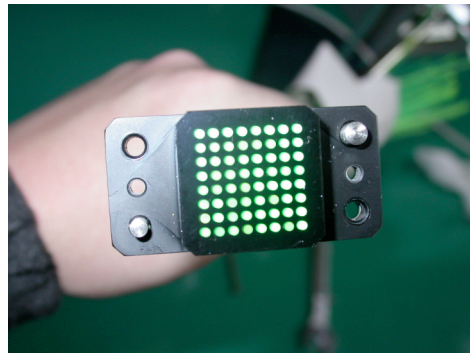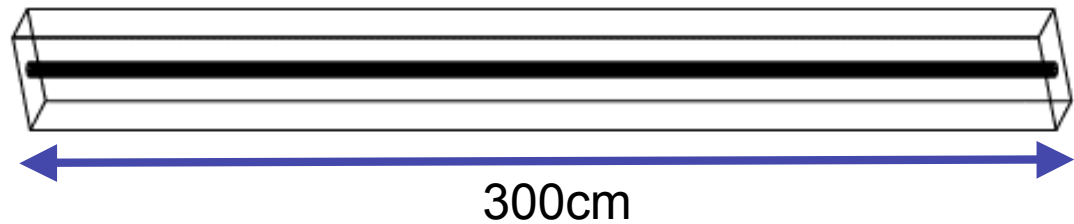**Readout electronics with VA/TA**
• ADC for all 14,400 channels
• TDC for 450 sets (32 channels-OR)
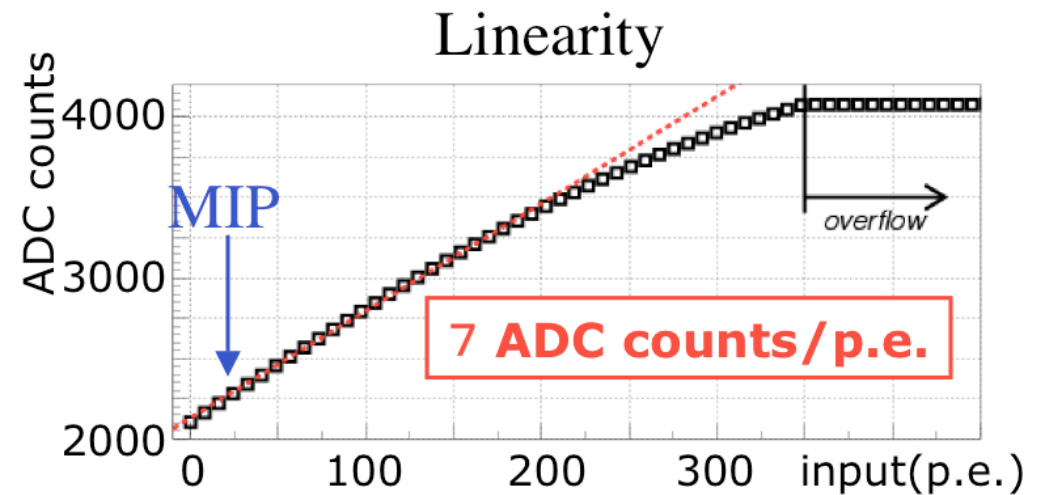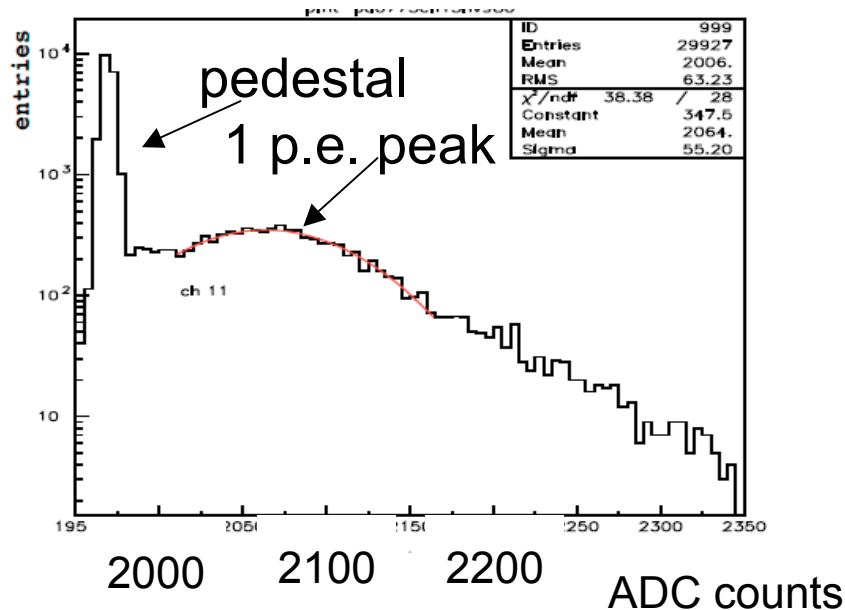
HV cable for SciBar

Scintillator and fibers

- Scintillator
  - 1.3cm x 2.5cm x 300cm
  - Made by Fermi lab.
- Fibers
  - Kurare Y11 type
  - 1.5 mmϕ WLS-fiber
  - Attenuation length ~330cm
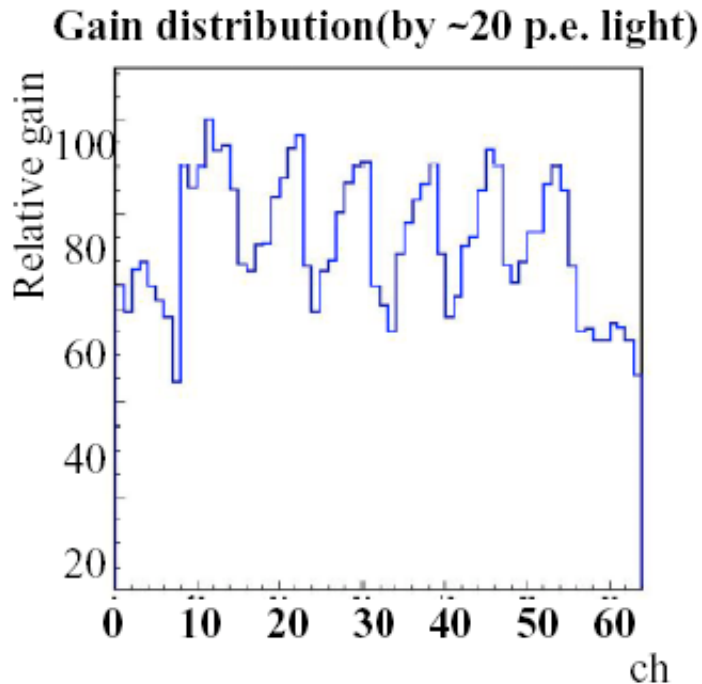   - All fibers are measured.

300cm

χ^2/ndf	1.296 / 3
P1	3.450
P2	329.5

attenuation length = 329.503 (cm)
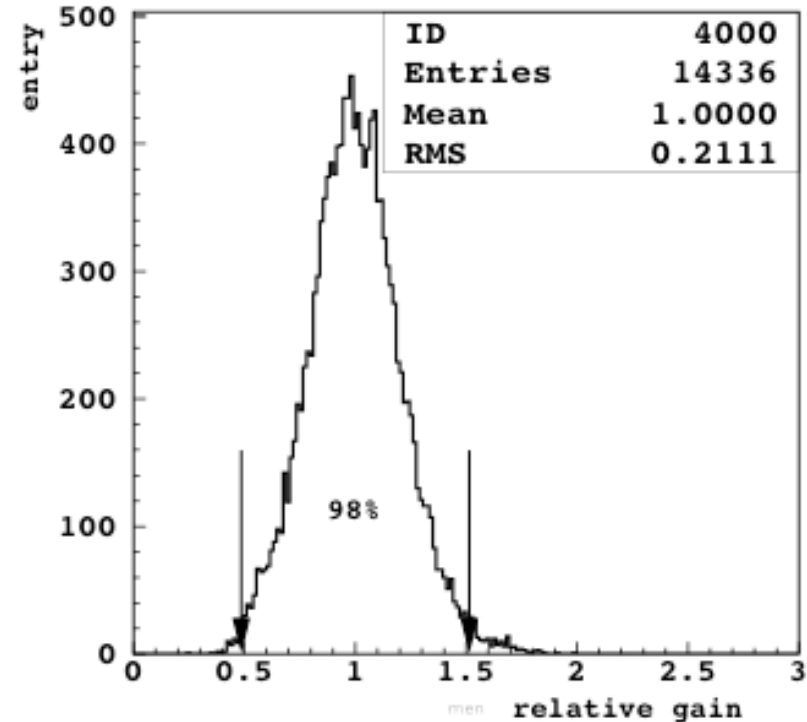
ADC-Ratio (64ch/16ch)

Distance (cm)

Readout spec.

- Good linearity up to ~200 p.e.
  - ~20 p.e. for MIP
- Pedestal level: ~2000 ADC counts

Uniformity of PMT spec.

Gain distribution(by ~20 p.e. light)

Measured gain distribution for all PMT-channels (14336 channel)

ID	4000
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Mean	1.0000
RMS	0.2111

- HV values are determined to realize that gain of each PMT channel is ~6×10^5
- Uniformity of gain: ~20%

SciBar event display
(K2K data)

CC-QE candidate

LED event