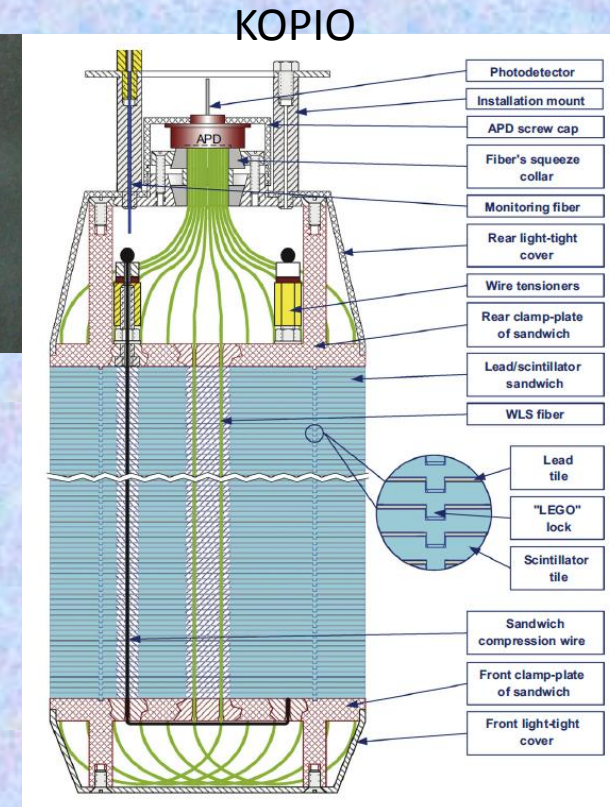
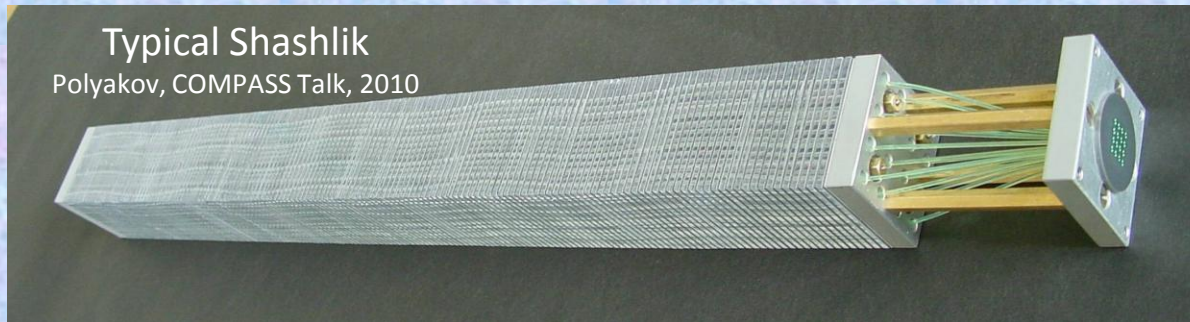
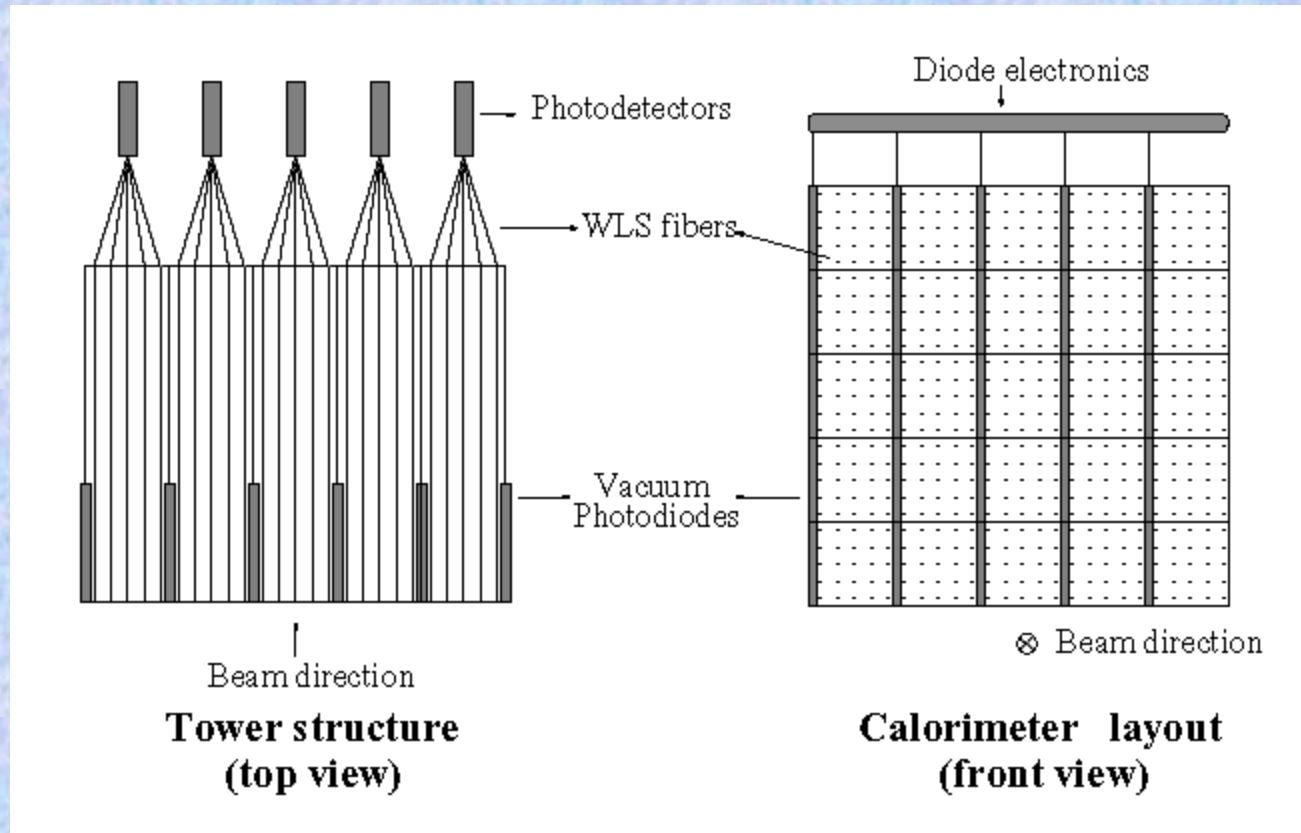


EC segmentation



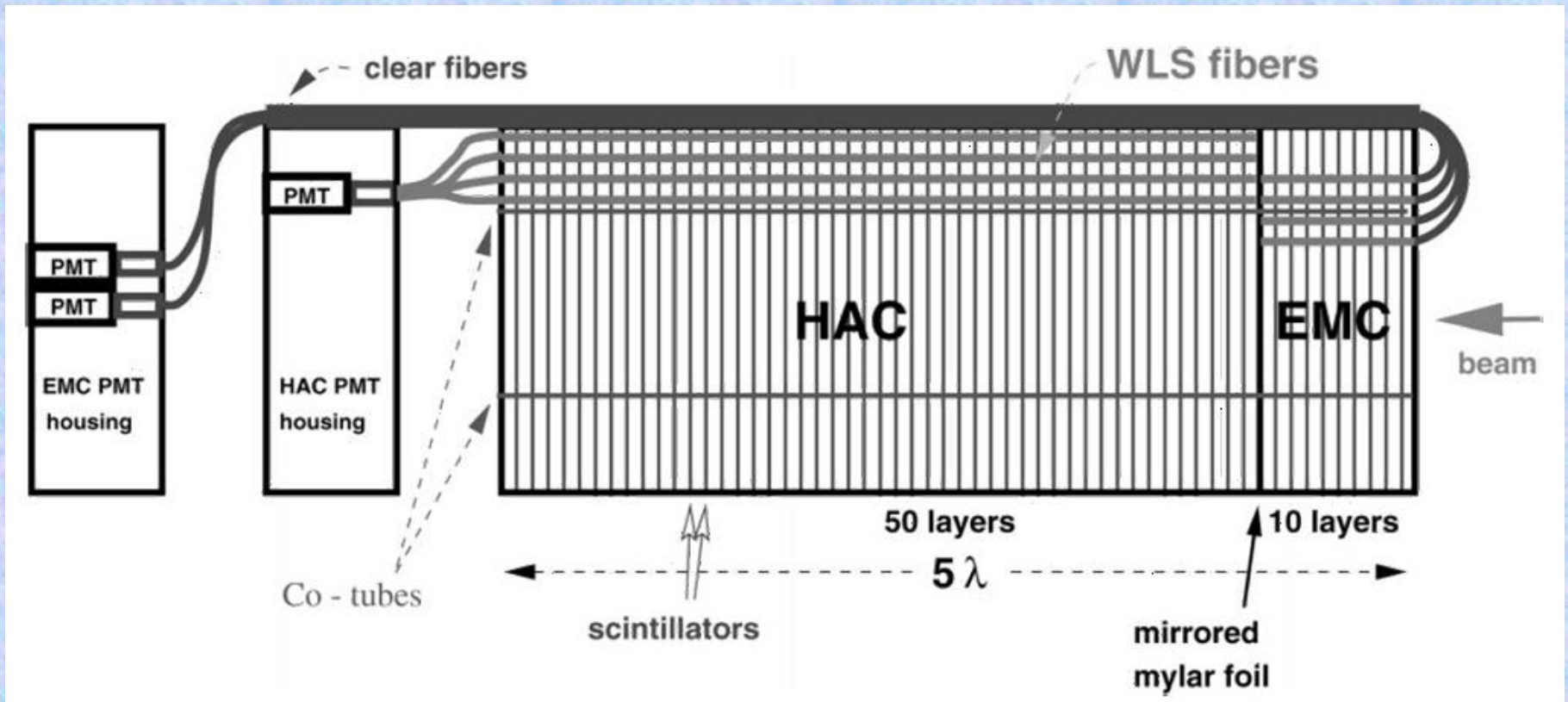
- Shashlyk calorimeter
 - Lead-scintillator sampling calorimeter
 - Fiber collects and reads out light
- Satisfy the SoLID requirement
 - Good energy resolution (tunable)
 - Radiation hardness $\sim 500\text{kRad}$
- Easier to collect and read out the light
- Well developed technology, many experiments

Option 1, readout preshower directly



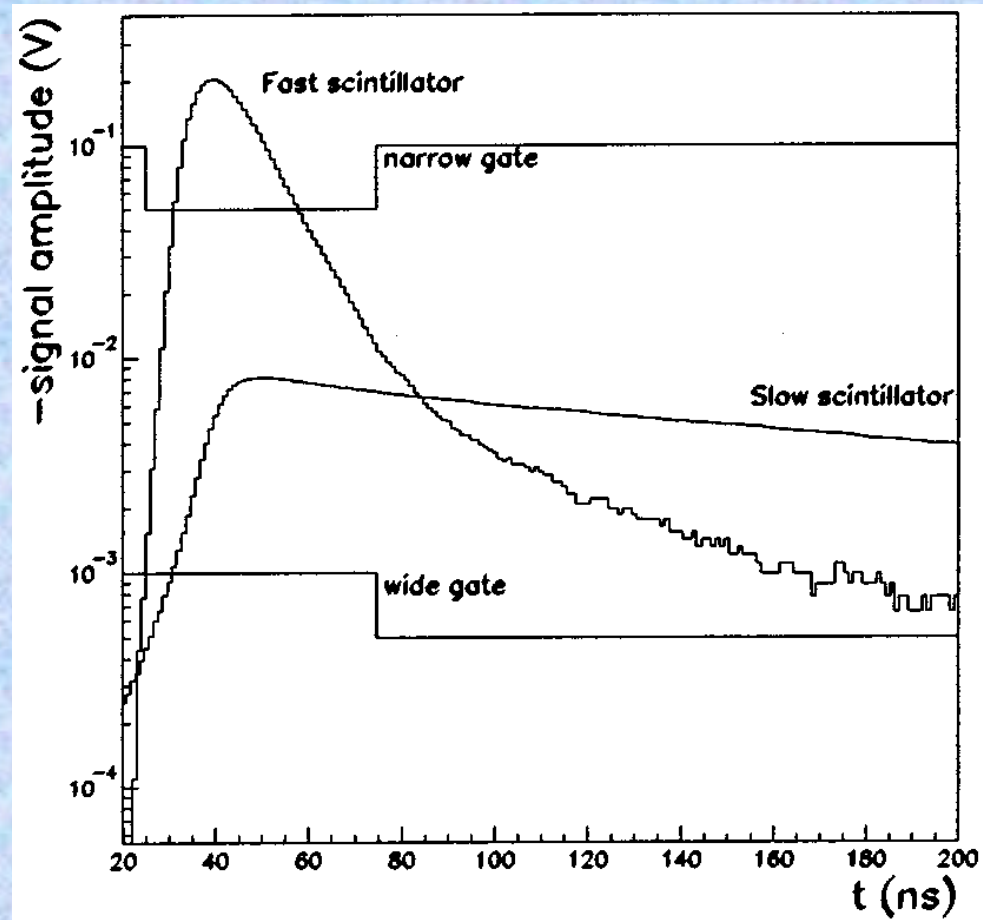
- Vacuum Photodiode or APD can't survive high rate environment?
- dead area?

Option 2, let fibers go back

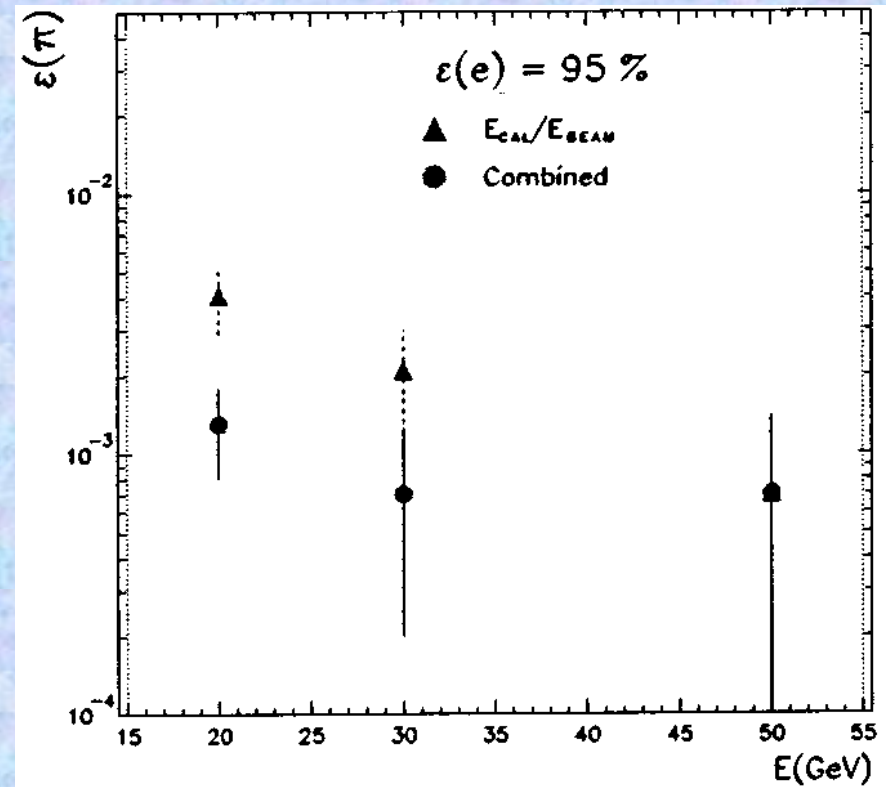
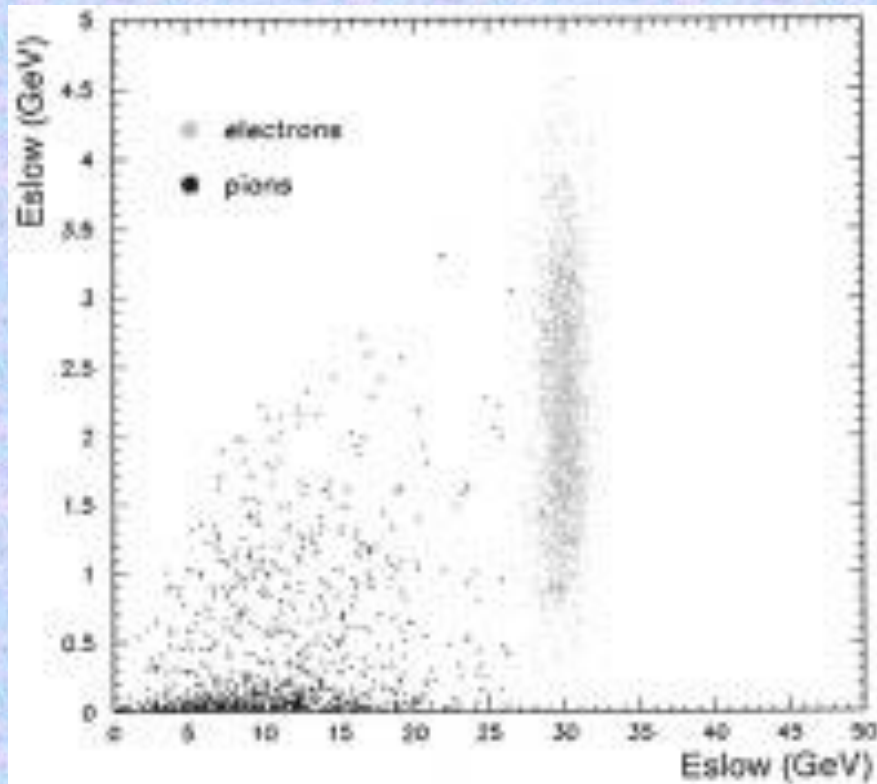


- Fiber bending, how flexible it is? Dead area? High rate?
- hiding in rod

Option 3, slow/fast scintillator



Option 3, fast/slow scintalator



PVDIS rate

Process	Geometry	
	Open	baffles
DIS total	2500 kHz	110 kHz
DIS $W > 2 \text{ GeV}$, $X > 0.20$	1500 kHz	110 kHz
DIS $W > 2 \text{ GeV}$, $X > 0.55$	35 kHz	12 kHz
DIS $W > 2 \text{ GeV}$, $X > 0.65$	8 kHz	3 kHz
π^- $p > 0.3 \text{ GeV}$	2300 MHz	140 MHz
π^- $p > 1.0 \text{ GeV}$	460 MHz	70 MHz
π^- $p > 2.0 \text{ GeV}$	26 MHz	8 MHz
DIS $X > 0.20$ $E_{CALOR} > E_{thr}(R)$	680 kHz	102 kHz
π^- $E_{CALOR} > E_{thr}(R)$	540 kHz	120 kHz
π^- $E_{CALOR} > E_{thr}(R)$ pileup	$\sim 10 \text{ kHz}$	$< 2 \text{ kHz}$

Table 3.3: Calculated DIS and pion rates in the spectrometer.

SIDIS rate

Process	Rate Forward angle 11 GeV	Rate Large angle 11 GeV	Rate Forward angle 8.8 GeV	Rate Large angle 8.8 GeV
$(e, e\pi^+)$	1467 Hz	192 Hz	810 Hz	117 Hz
$(e, e\pi^-)$	1010 Hz	120 Hz	554 Hz	73 Hz
single e^-	88.5 kHz	11.0 kHz	151 kHz	16.5 kHz
high energy photon	623 kHz	51.5 kHz	596 kHz	37 kHz
single π^+	2.90 MHz	20.2 kHz	2.5 MHz	13.4 kHz
single π^-	1.77 MHz	14.5 kHz	1.47 MHz	9.2 kHz
single K^+	226 kHz	5.9 kHz	185 kHz	4.1 kHz
single K^-	54.6 kHz	1.2 kHz	39.9 kHz	0.6 kHz
single proton	1.15 MHz	13.8 kHz	0.99 MHz	9.4 kHz
low energy photon	200 MHz	-	200 MHz	-

prototype

- 1. option 2, test manufacturing and performance.
- 2. option 3, test with flashADC and try to reach better energy resolution and e/pi separation

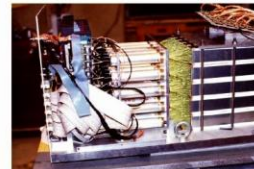
CALEIDO^a: A Shashlik e.m. Calorimeter with Longitudinal Segmentation

Requests for Calorimetry at Linear Collider:

- High granularity
- Good energy resolution ($\sim \frac{10\%}{\sqrt{E}}$ @ 1%)
- Read-out in high magnetic field (3 – 4 T)
- Longitudinal segmentation: e/π separation, γ direction reconstruction

⇒ Shashlik Calorimeters:

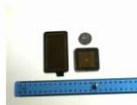
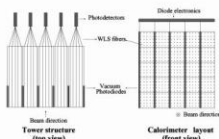
- Scintillation light collected by optical WLS fibers
- Compact, modular, easy to operate
- No dead zones



Longitudinal Segmentation, 2 solutions:

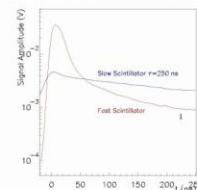
CALEIDO 1

Insertion of Vacuum Photodiodes in the first 8 X_0



CALEIDO 2 (preliminary)

Use 2 Scintillators with different time response



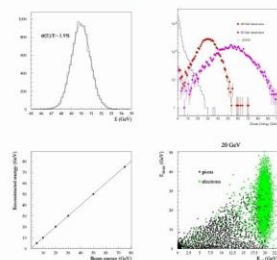
25 towers, 1 mm Pb + 1 mm scintillator sampling ($5 \times 5 \times 36 \text{ cm}^3 \sim 25 X_0$)

Back side read-out: Hamamatsu Phototetodes/APD

Top side read-out: EMI/Hamamatsu Photodiodes

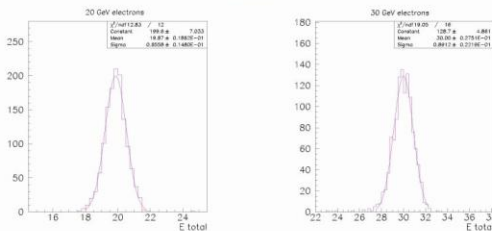
Slow Scintillator BC-444 ($\tau \sim 250 \text{ ns}$) in the first 5.2 X_0 . Signal sampled with 2 different gates (NARROW = 55 ns, WIDE = 600 ns). Light Yields Ratio $\frac{Q_{FAST}}{Q_{SLOW}} \sim 2$ to be optimized.

CALEIDO 1



$$\frac{\sigma(E)}{E} = \sqrt{\left(\frac{0.6\%}{\sqrt{E}} + 0.5\%\right)^2 + \left(\frac{0.130}{E}\right)^2}$$

CALEIDO 2



e/π Separation (CALEIDO 2) :

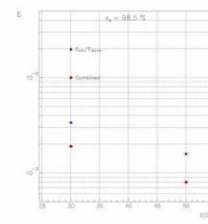
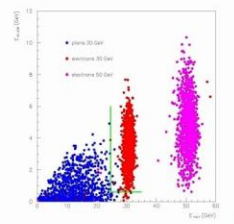
e/π Separation exploiting:

- E/p
- Fast/Slow Scintillator Responses

⇒ Separation better of factor ~ 2 w.r.t. E/p

$\epsilon_\pi = 8 \times 10^{-4}$ for $\epsilon_e = 98.5\%$

$\epsilon_\pi < 5.6 \times 10^{-4}$ (95% C.L.) for $\epsilon_e = 95\%$



Pion Efficiency