

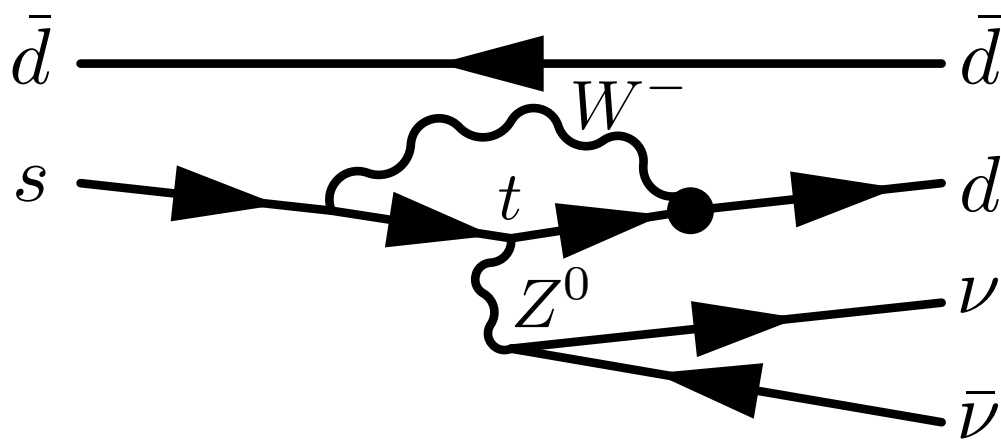
Beam Test @ FNAL Dec. '07

- 2007年度後期に行った研究(仮) -

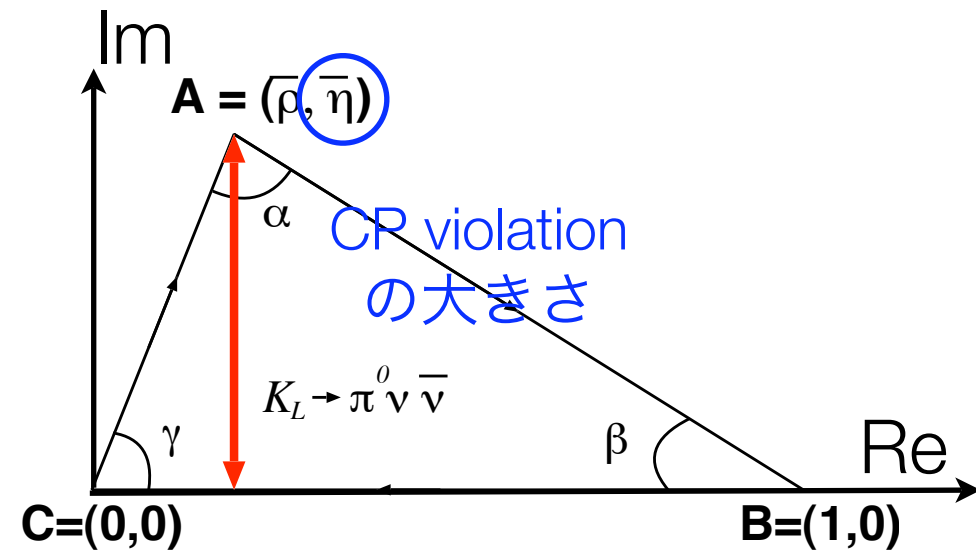
12/25/07 Eito IWAI

年末発表会

$K_L \rightarrow \pi^0 \nu \bar{\nu}$ 崩壊

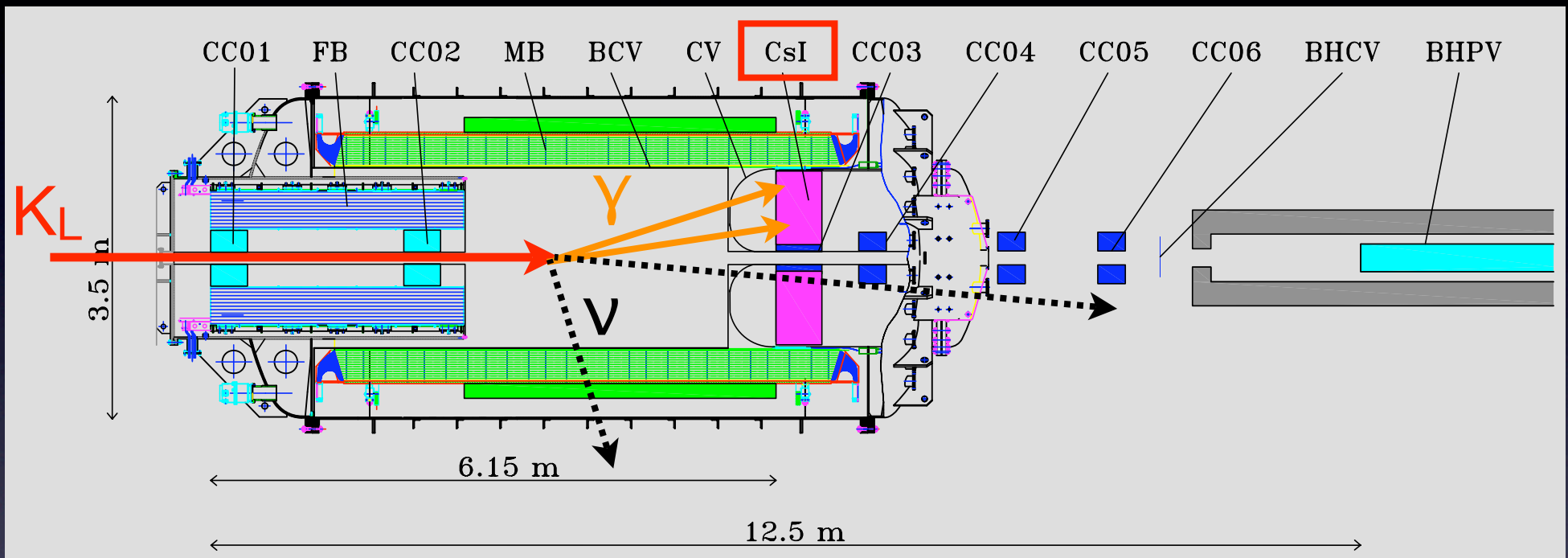


$K_L \rightarrow \pi^0 \nu \bar{\nu}$ 崩壊ダイアグラム



- ループを含むダイアグラム：New Physicsに感度がある！
- CPの破れの大きさを決めるCKM行列の複素成分 η を1%程度の小さな理論的不定性で測定できる
- ➔ 標準理論とそれを超える物理への良いプローブ：Golden Mode
- 非常に稀な崩壊 + 全てが中性の粒子：意欲的な実験！

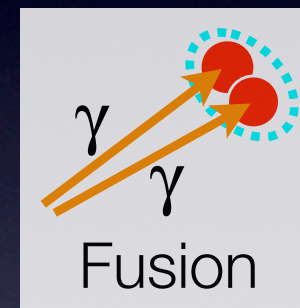
検出器とCsIカロリメータ



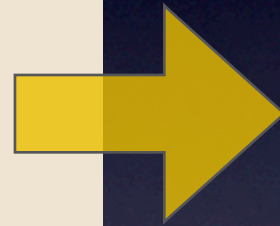
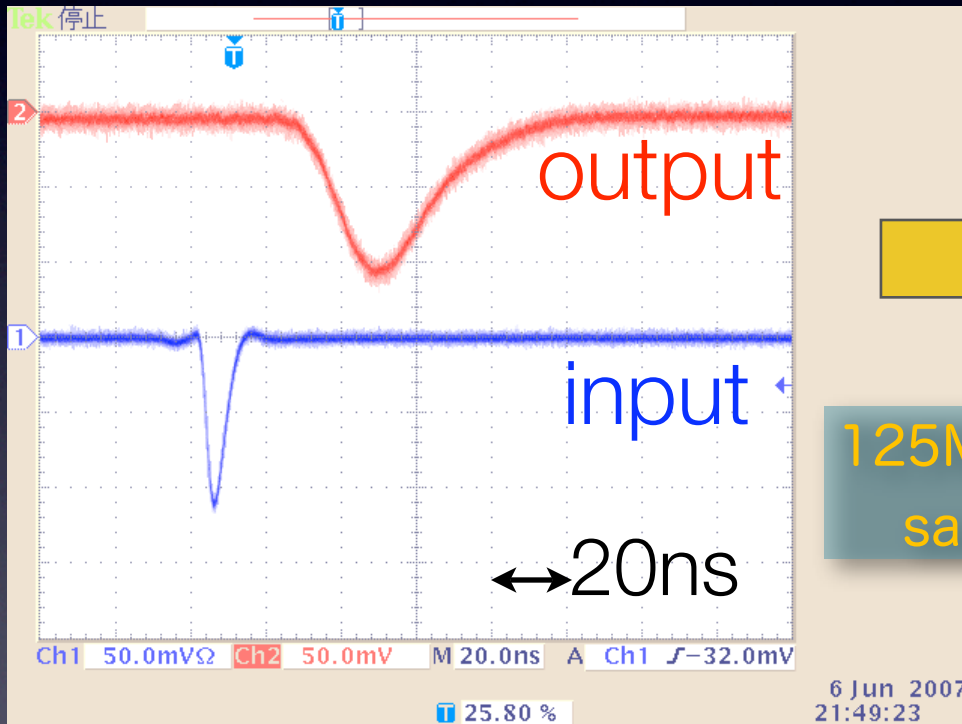
- Cslカロリメータ
 - 入射した光子のエネルギーと入射位置を測定
 - 2つの光子を観測した事象がシグナルの候補
- E391a実験で用いた各検出器をアップグレード

CsIカロリメータの問題点と対策

- 近い距離に入射した2つの光子を1つの光子と見誤る：Fusion事象
 - ▶ CsI結晶：7cmx7cmx30cm 500本 \Rightarrow 2.5cmx2.5cmx50cm 3000本
 - 超高レートで光子が入射、信号が時間的に重なる恐れ
 - ▶ Flash ADCによる波形読み出し
 - 1nsを切る分解能 + CsI結晶からの立ち上がり時間の早い信号
 - ▶ 500MHz のFADCが3000チャンネル \Rightarrow (予算的に) 実験不可能
- ➡ Bessel filter という波形変換フィルタを用いた125MHzのFADCによる波形読み出し

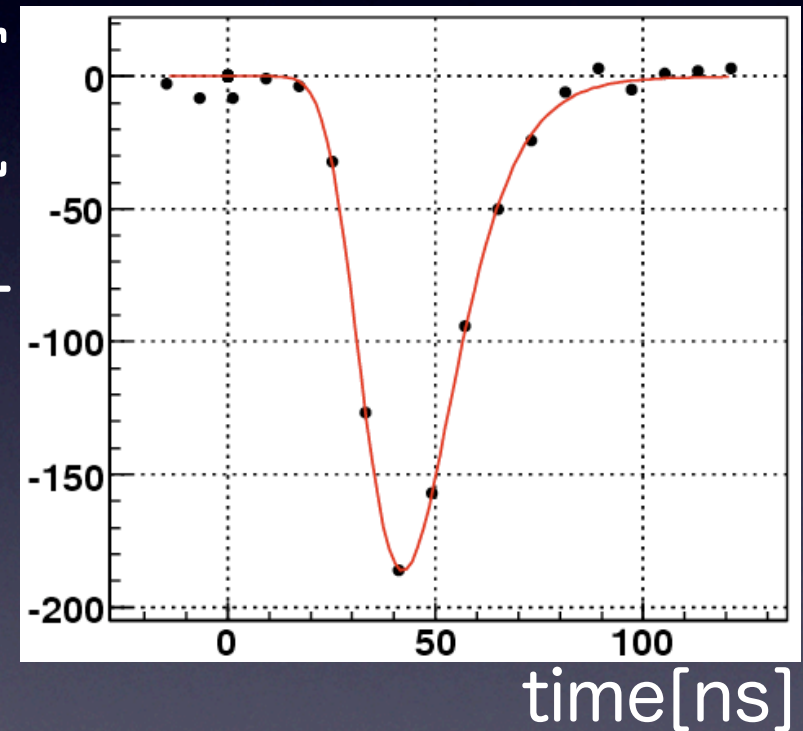


Bessel filter



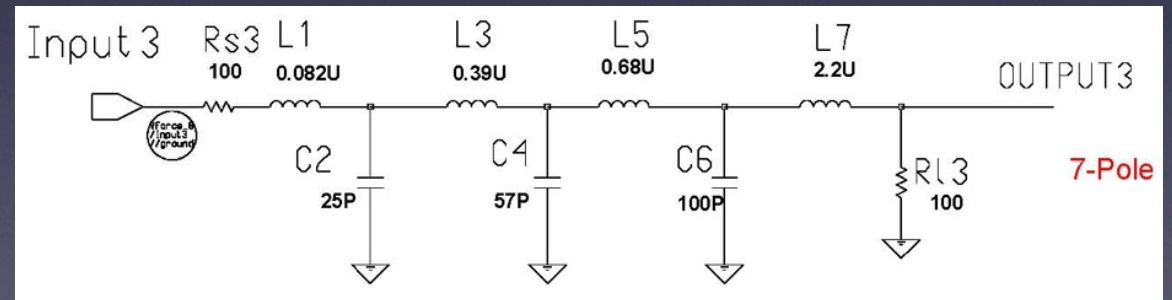
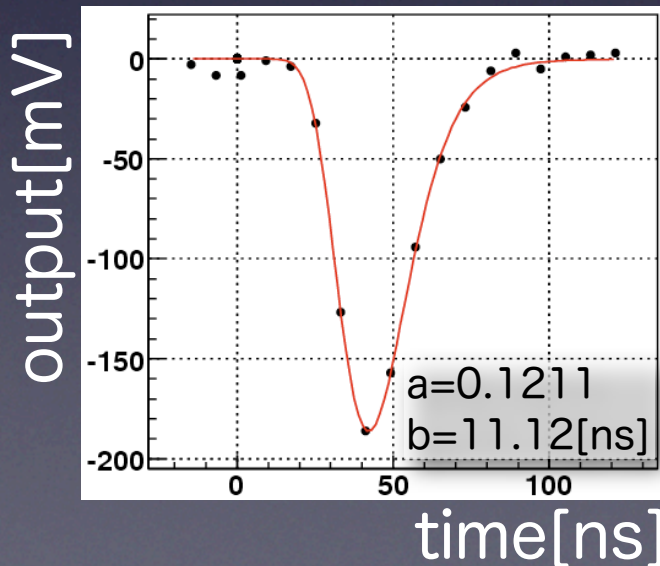
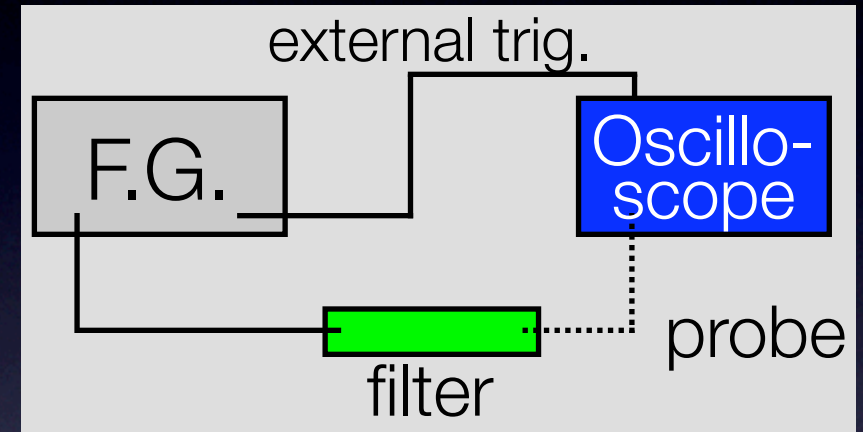
125MHz(8ns)
sampling

output[mV]



これまでの研究

- 入力信号 : Function Generator
- フィルタ : 7-pole test board
- パフォーマンス
 - σ_t : 0.25ns @ 300mV
 - σ_E/E : 1.3% @ 300mV(統計的揺らぎは含まず)

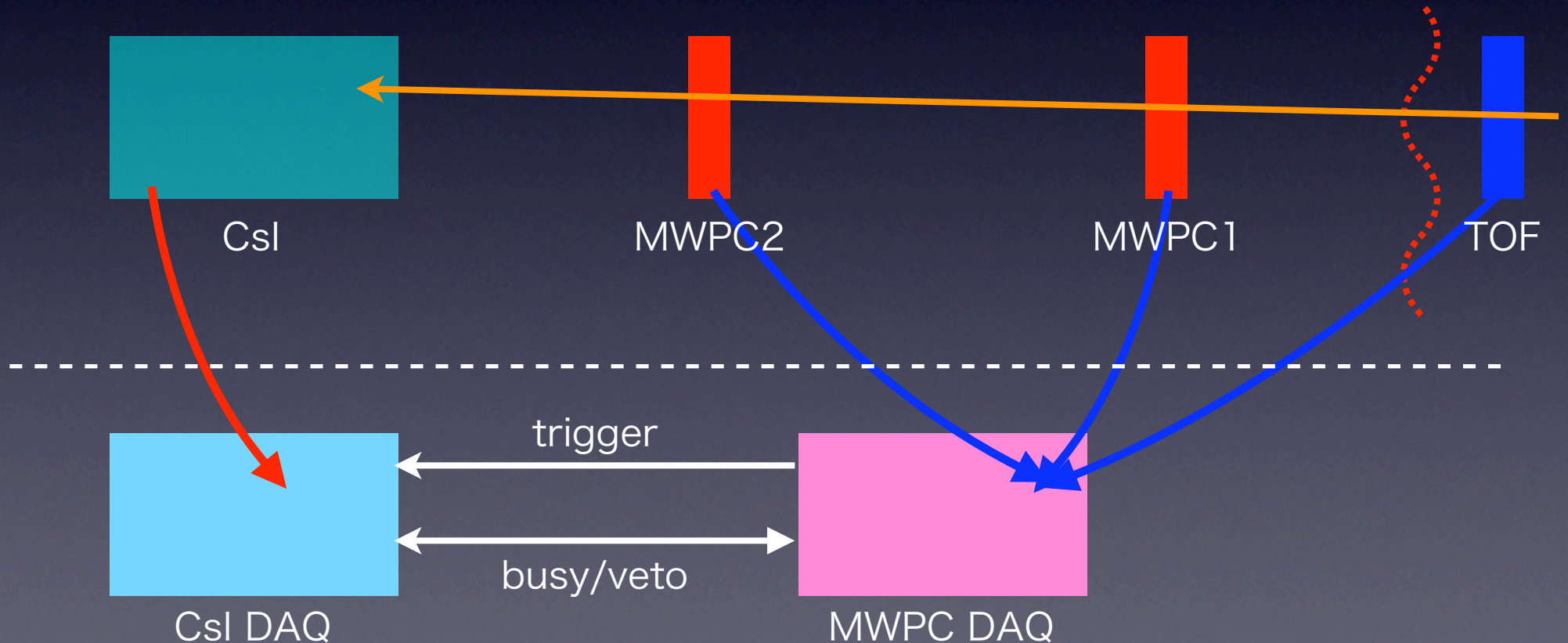


<7-pole test board の概要図>

beam test @ FNAL



- 12/10/07 - 12/17/07
- KTeV CsI + Bessel Filter + FADC

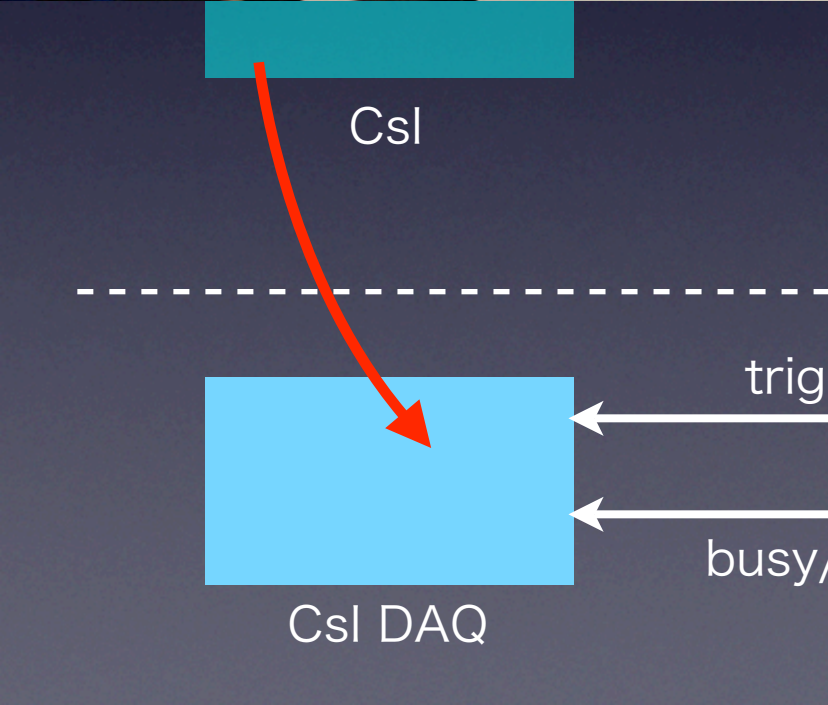




FNAL



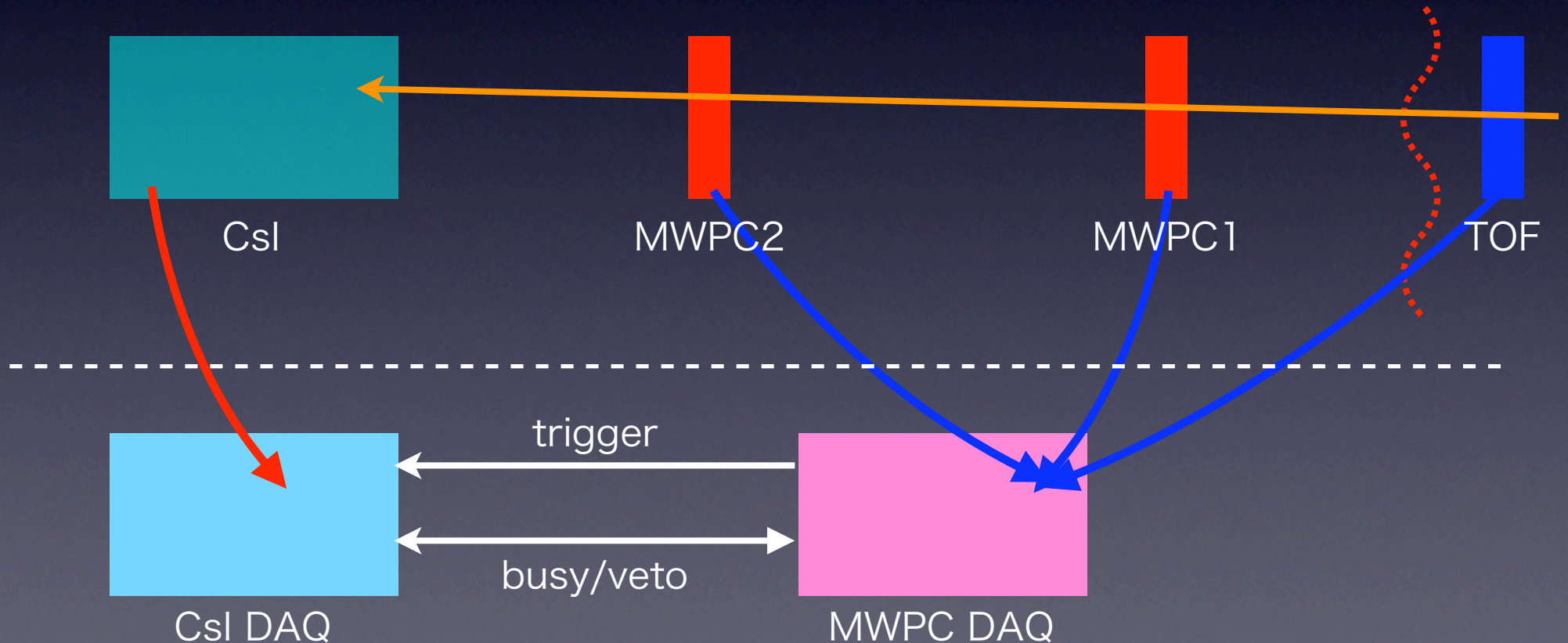
DC



beam test @ FNAL

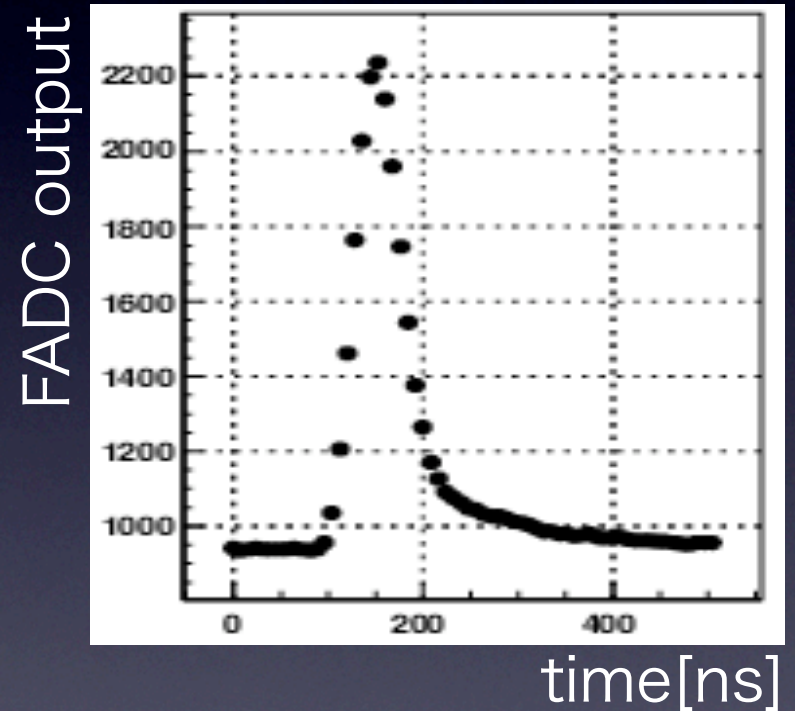


- 12/10/07 - 12/17/07
- KTeV CsI + Bessel Filter + FADC

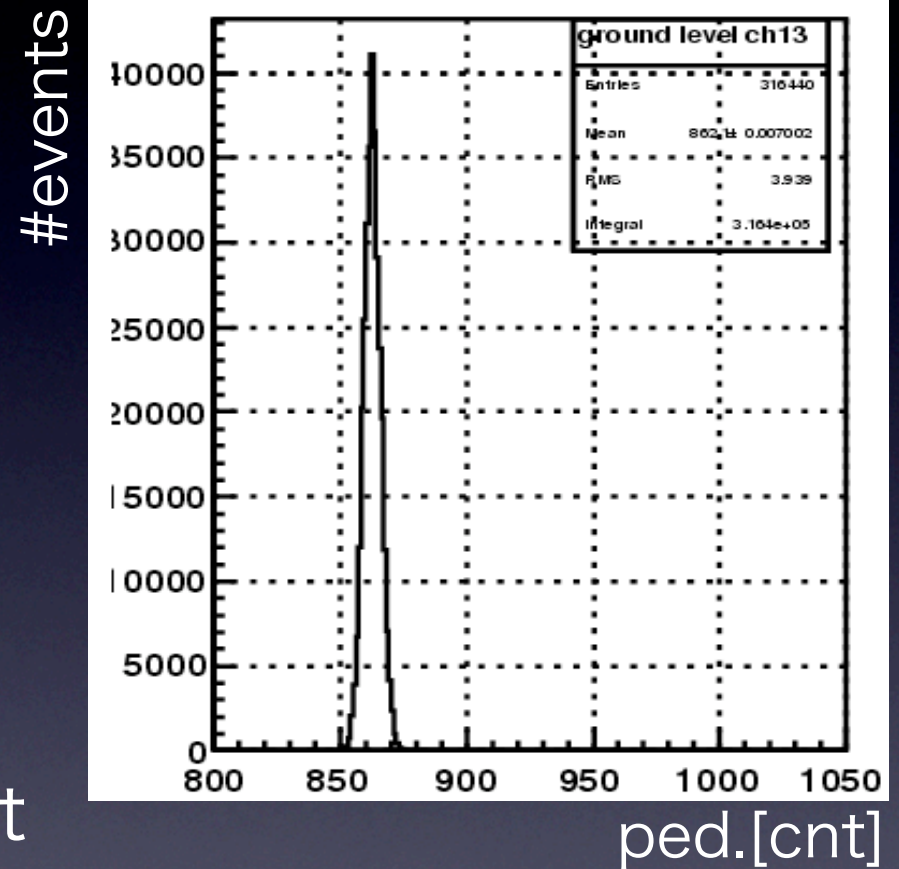
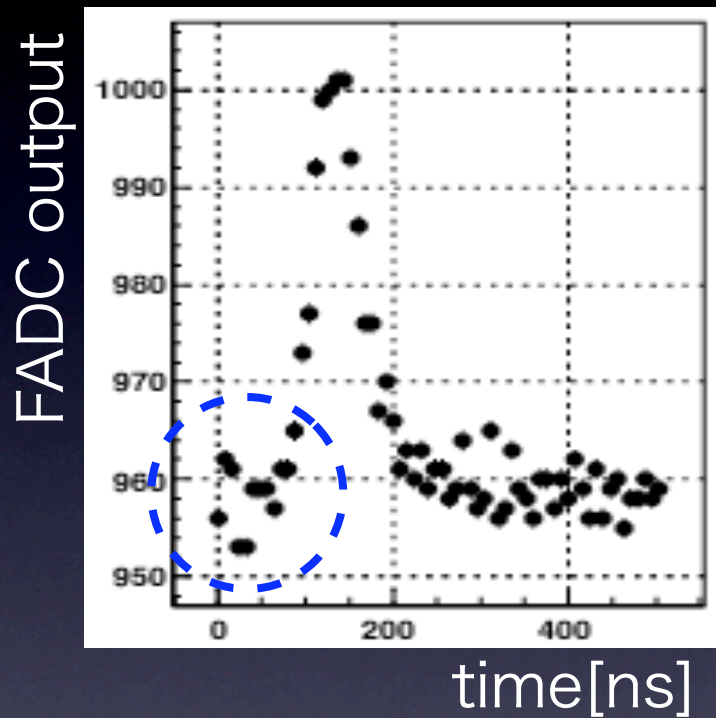


CsI data

- full range 14bit=16384
- 64 samples/event
- pedestal ~ 1000



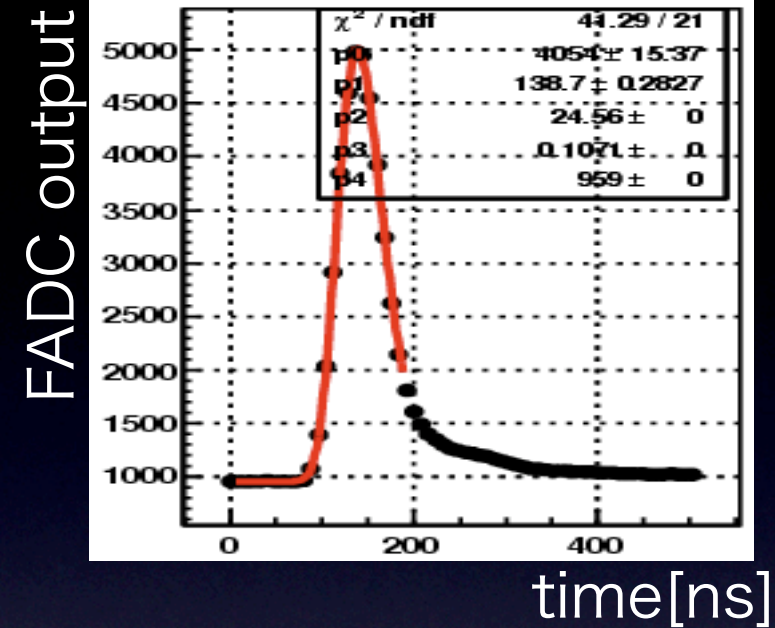
noise level



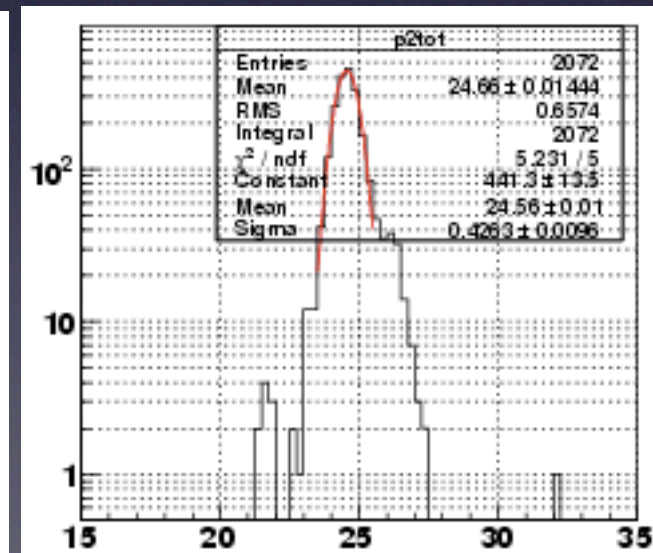
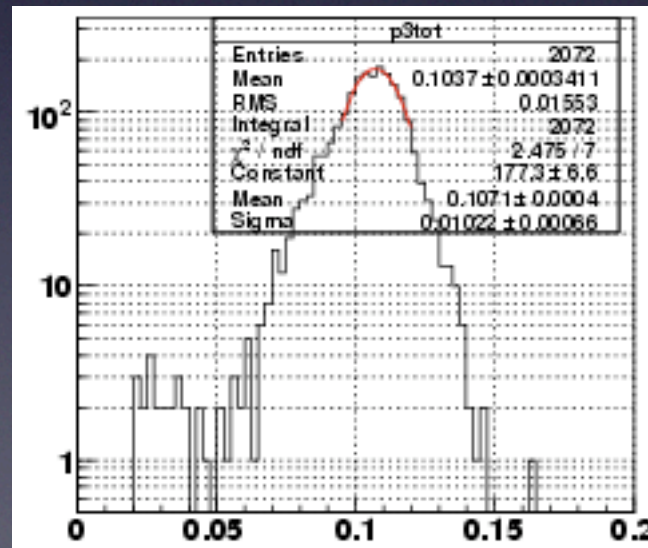
- noise level : ~ 4 count
- full range 280 mV $\rightarrow \sim 0.07$ mV
- full range 2 GeV $\rightarrow \sim 0.5$ MeV

fitting

- fitting function
 - Gaussian ($\mu, \sigma(t)$)
 - where $\sigma(t) = a(t - \mu) + b$



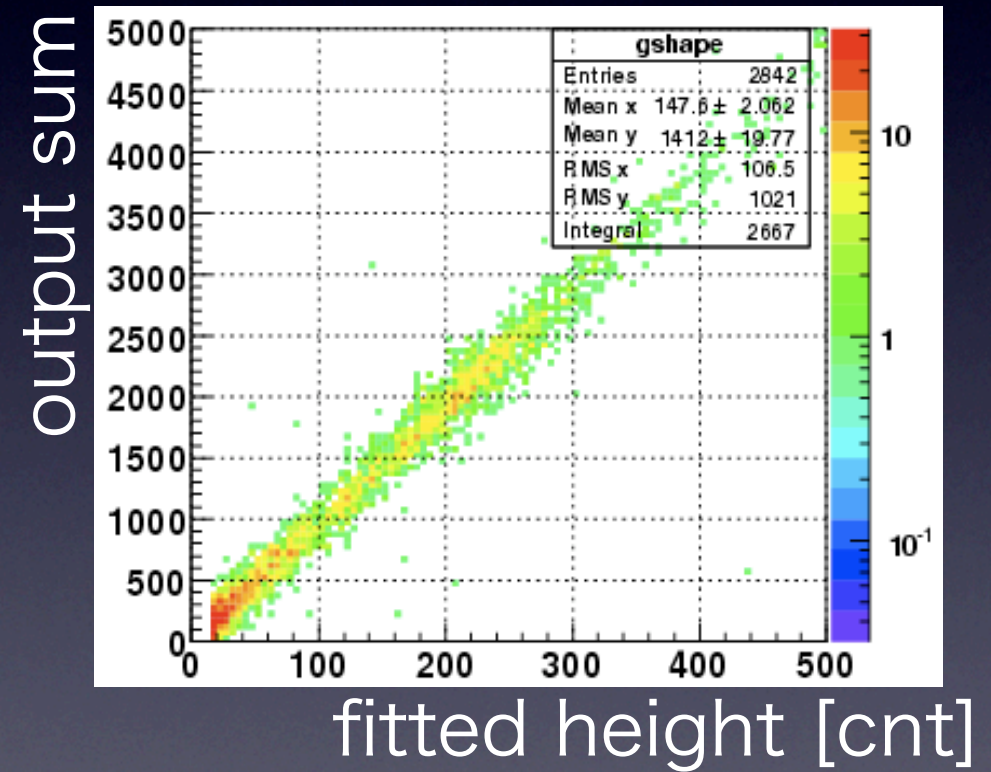
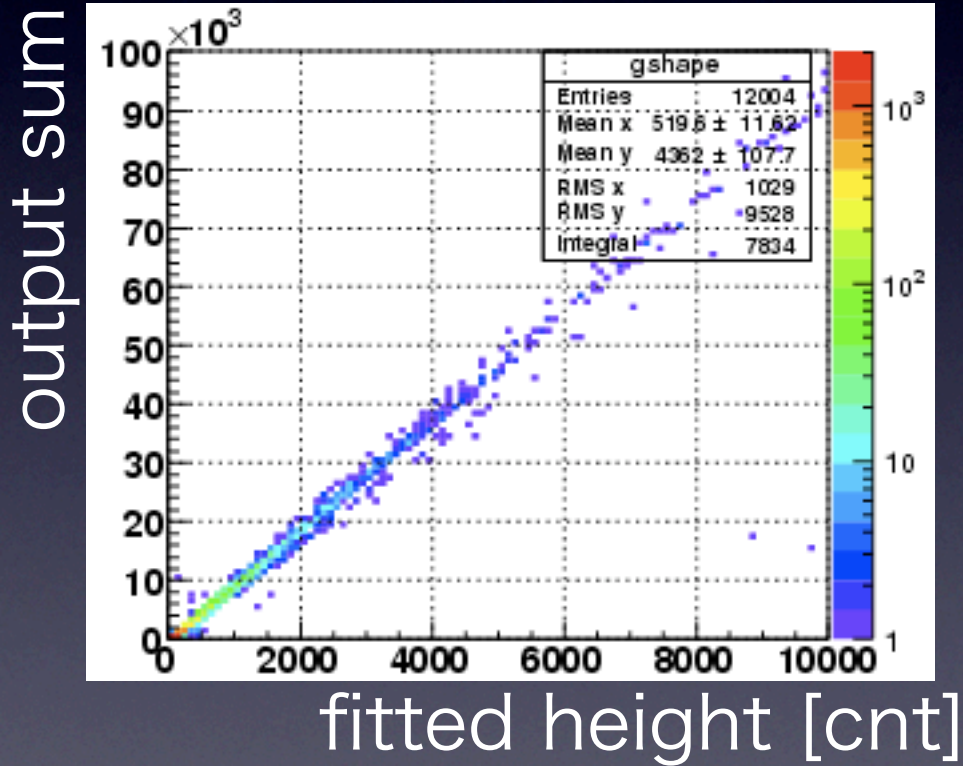
- $a=0.1071$
- $b=24.56[\text{ns}]$



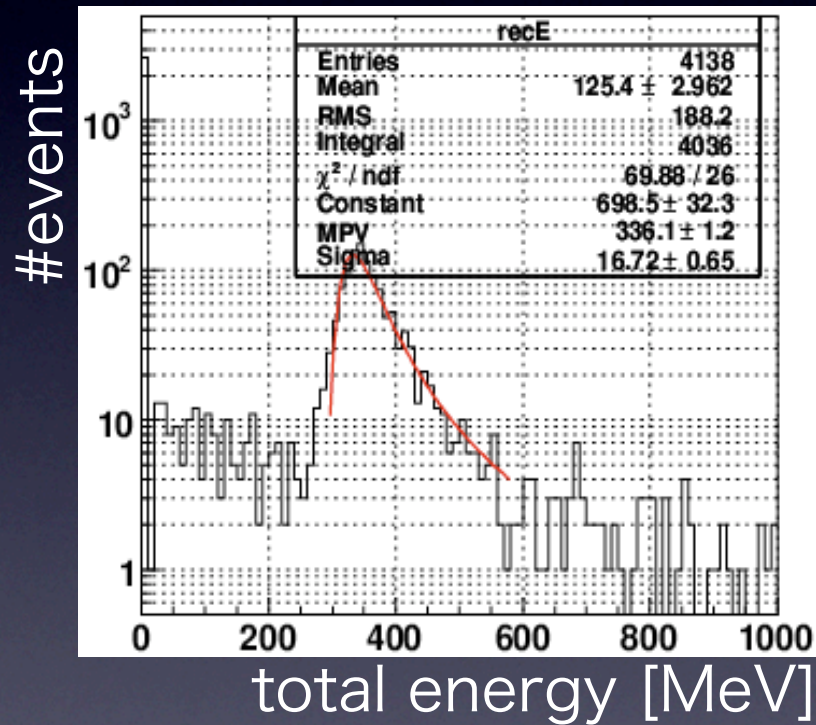
a

b[ns]

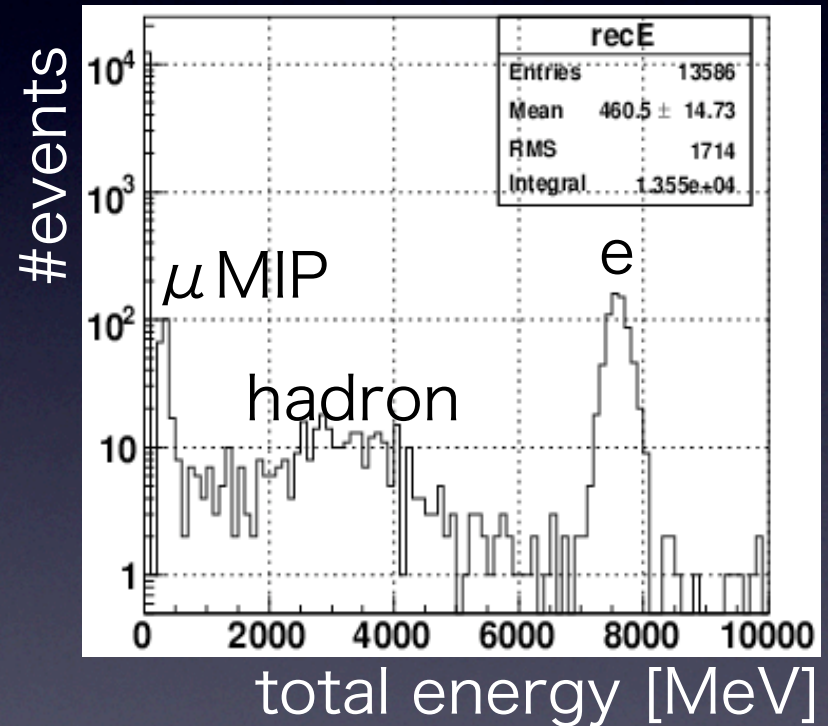
~ linearity



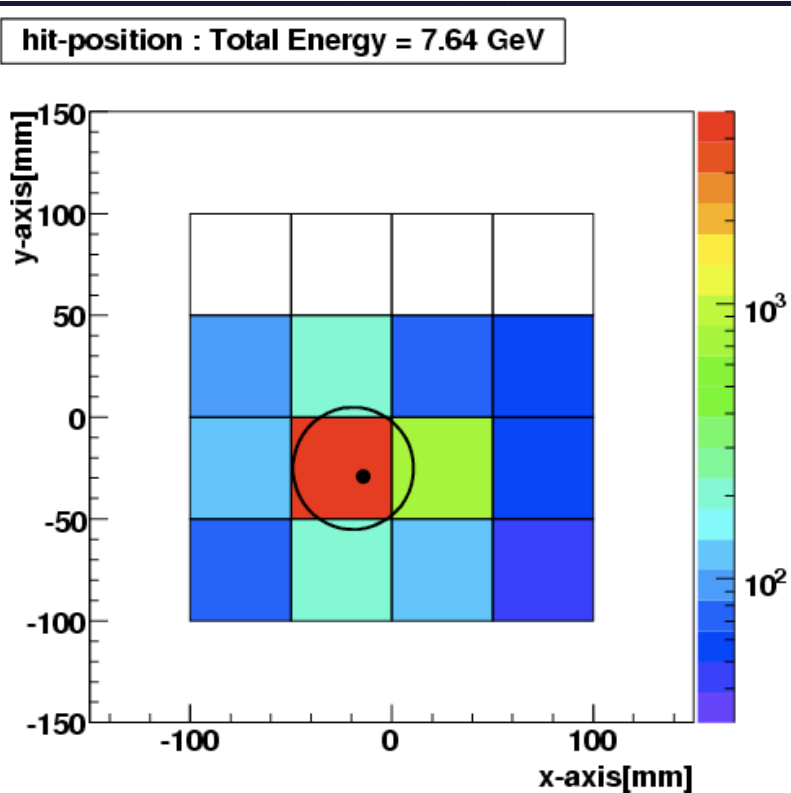
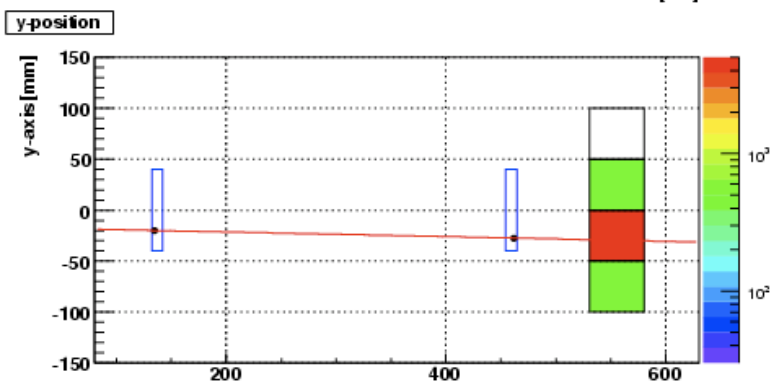
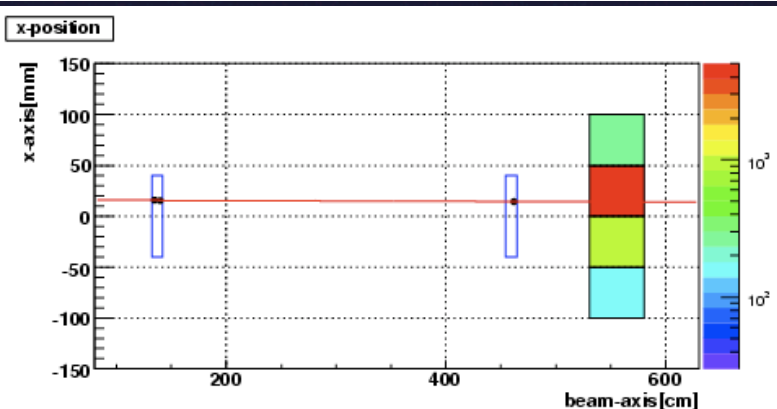
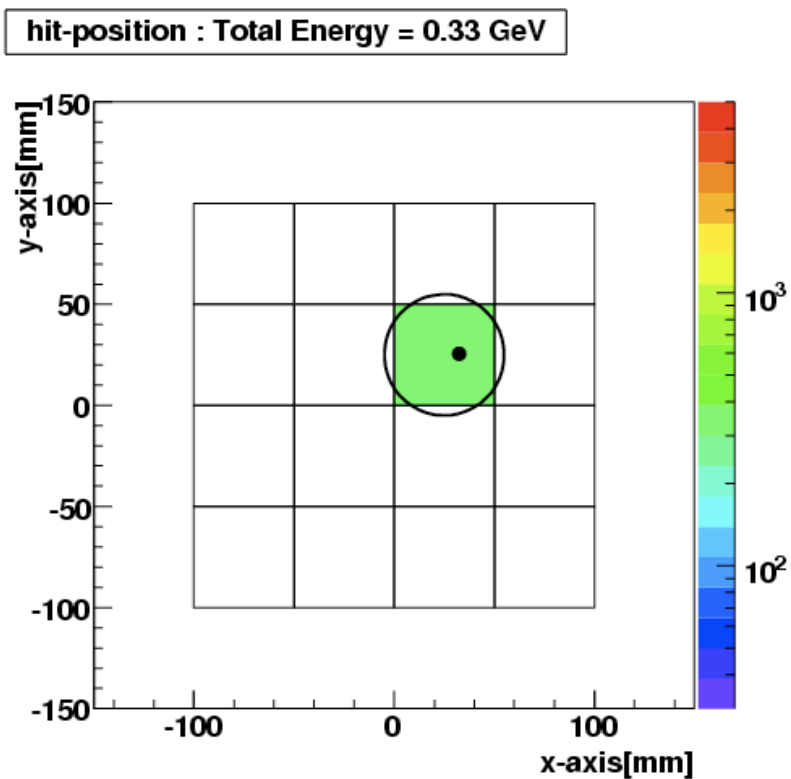
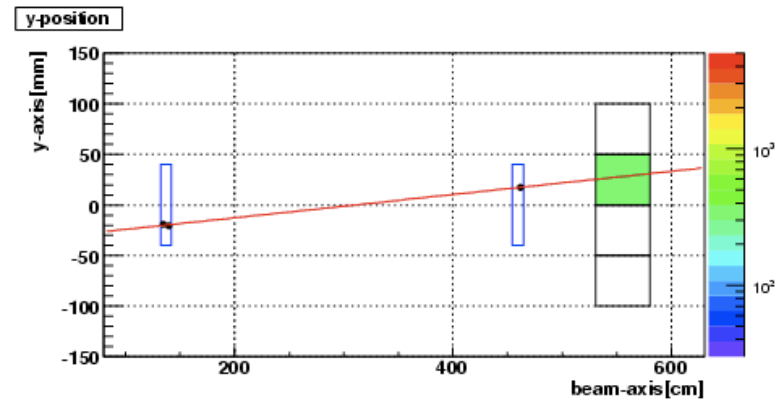
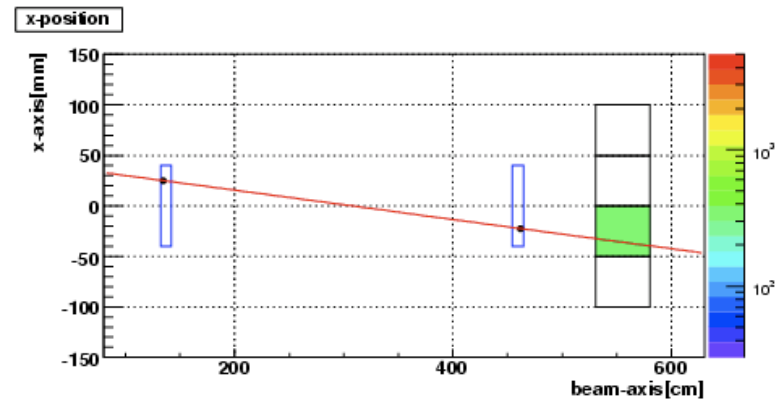
calibration



<8GeV/c charged>

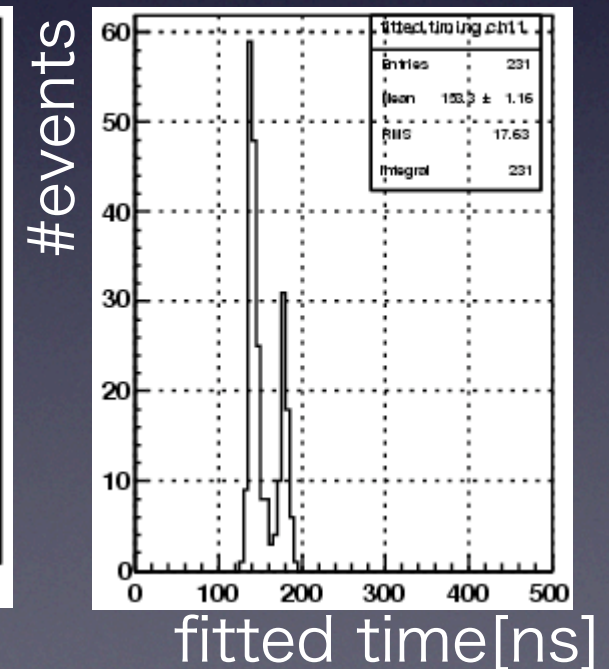
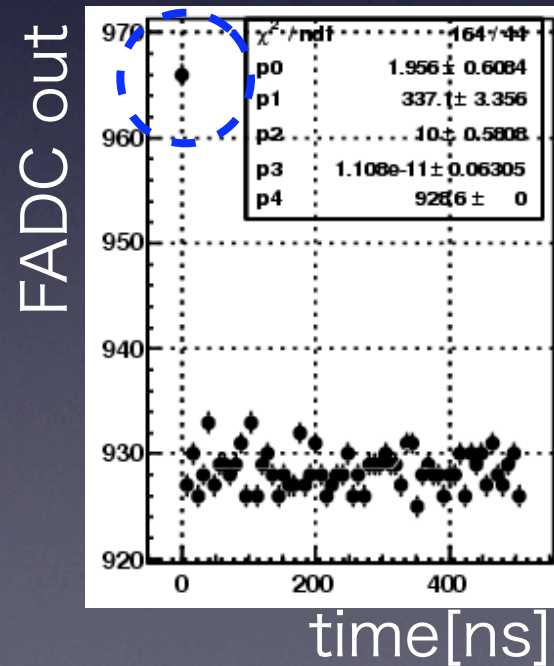
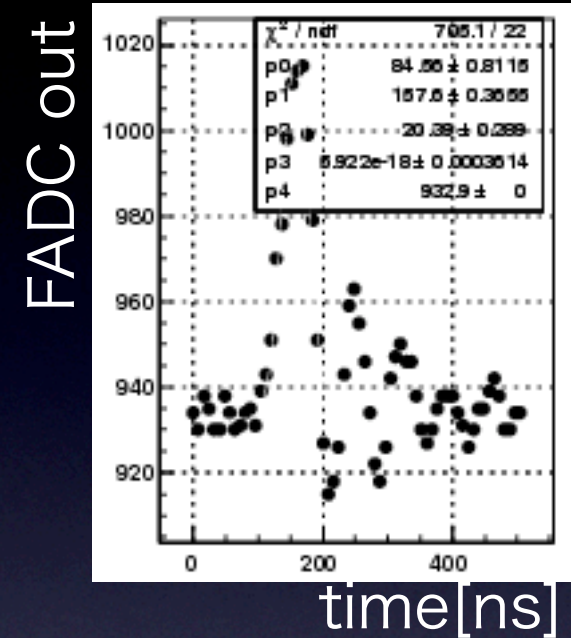


CsI 50[cm] ~ 350[MeV]



issues

- cross-talk (esp. #8-#11)
- CsI DAQ?
- peak shift??



Summary

- J-Parcで高感度な $K_L \rightarrow \pi^0 \nu \bar{\nu}$ 分岐比測定実験
- Bessel Filter + 125MHz FADC による波形読出
- beam test @ FNAL
 - Csl ~ FADC からの読み出しテスト
 - 基本的なパフォーマンスの確認
 - 改善点の確認
- overlap separation
- FPGA, VME
- 10x10 KTeV Csl read-out test