日本物理学会　第72回年次大会
会場　大阪大学（豊中キャンパス）
期間　2017年3月17日（金）～20日（月）

19pK34-7

J-PARC E36実験: $\Gamma(K^+ \to e^+\nu_e)/\Gamma(K^+ \to \mu^+\nu_\mu)$測定によるレプトン普遍性破れ探索実験のガンマ線測定最適化の研究

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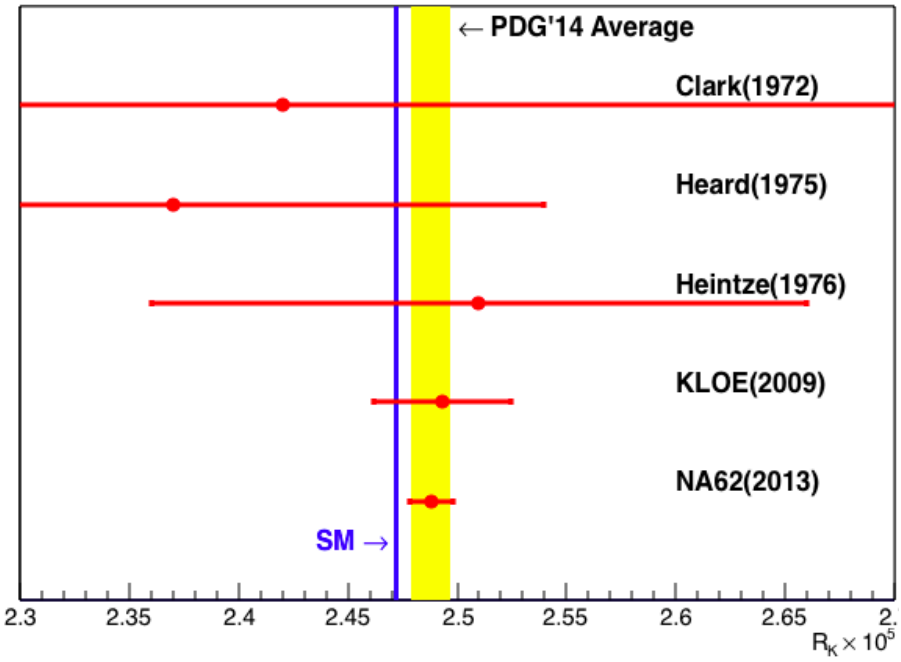
[3)] 高エネルギー加速器研究機構

レプトン普遍性破れ探索研究



	$R_K \times 10^5$	$\Delta R_K / R_K$
KLOE(2009)	$2.493 \pm 0.025 \pm 0.019$ (stat) (sys)	1.26%
NA62(2013)	$2.488 \pm 0.007 \pm 0.007$ (stat) (sys)	0.40%
SM	2.477 ± 0.001	0.04%
Initial goal of E36		0.25%

$$R_K^{SM} = \frac{\Gamma(K^+ \to e^+ \nu_e)}{\Gamma(K^+ \to \mu^+ \nu_\mu)} = \frac{m_e^2}{m_\mu^2}\left(\frac{m_K^2 - m_e^2}{m_K^2 - m_\mu^2}\right)^2 (1 + \delta_r)$$

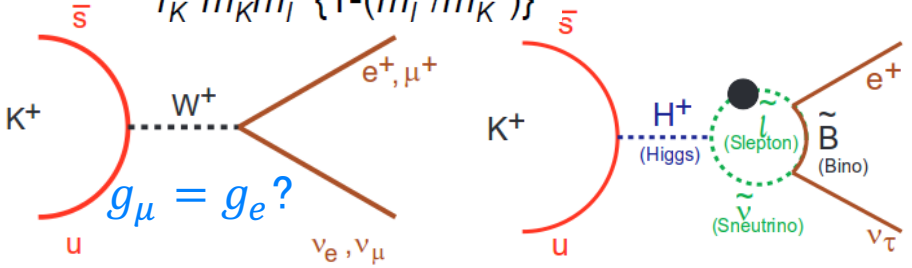
helicity suppression

radiative correction

$K^+ \to l^+ \nu_l$

$\Gamma(K_{l2}) = g_l^2 (G^2/8\pi) f_K^2 m_K m_l^2 \{1-(m_l^2/m_K^2)\}^2$

Candidate Model: MSSM with LFV



$$R_K^{LFV} = R_K^{SM}\left(1 + \frac{m_K^4}{M_{H^+}^4} \cdot \frac{m_\tau^2}{m_e^2} \Delta_{13}^2 \tan^6 \beta\right)$$

$$\sim R_K^{SM}(1 + 0.013_{\max})$$

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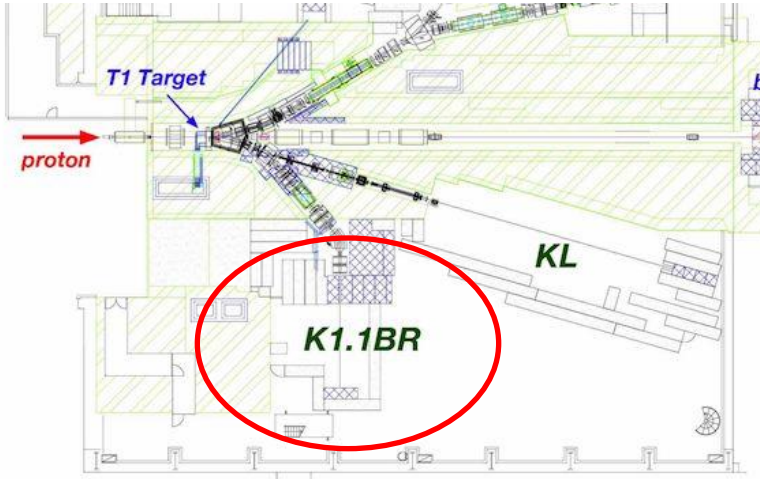
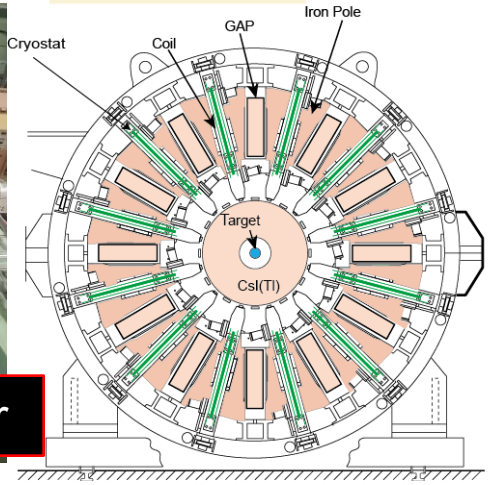
J-PARC E36実験

Phys. Run: October, 2015 – December,2015

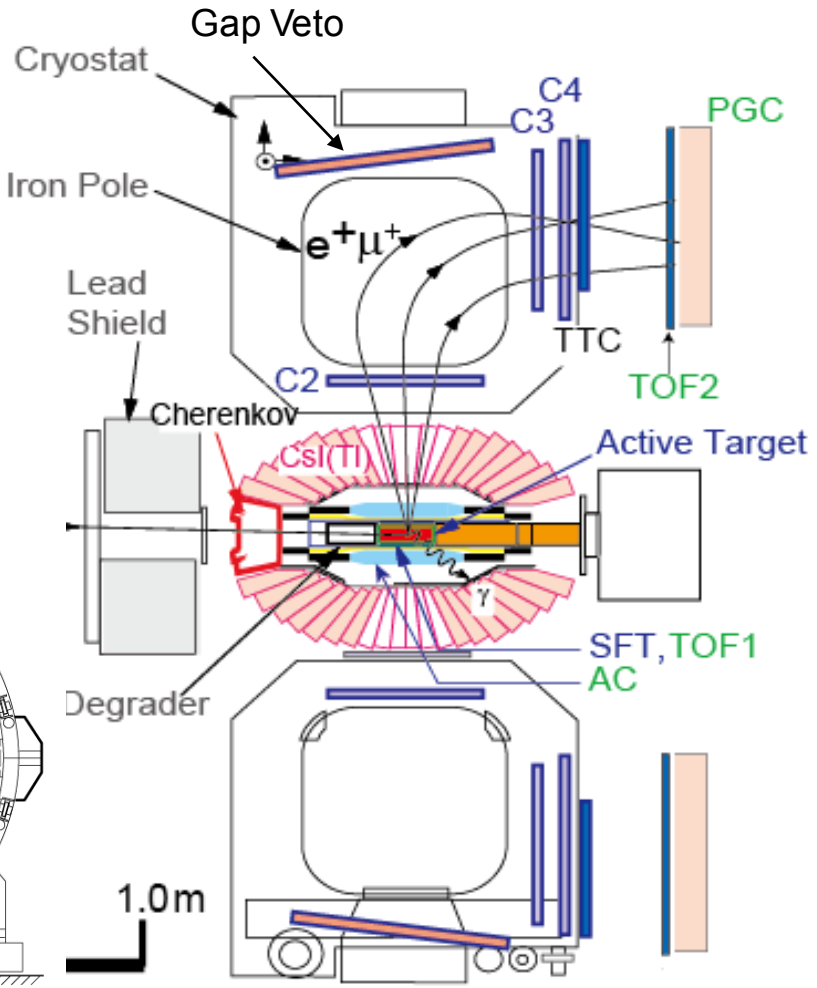


J-PARC Hadron Hall

End View



Side View

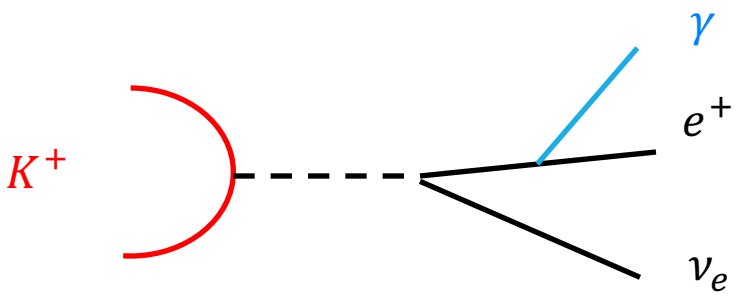


$Ke2\gamma\ (K^+ \to e^+\nu_e\gamma)$崩壊事象

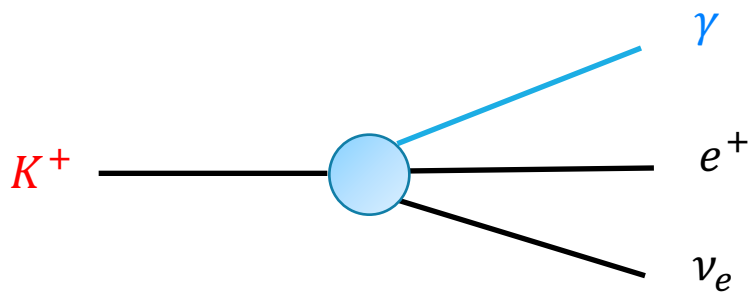
$$R_K^{SM} = \frac{\Gamma(Ke2\,) + \Gamma(Ke2\gamma(IB))}{\Gamma(K_{\mu 2}\,) + \Gamma(K_{\mu 2\gamma}\,(IB))}$$

Background: $Ke2\gamma$ (SD)

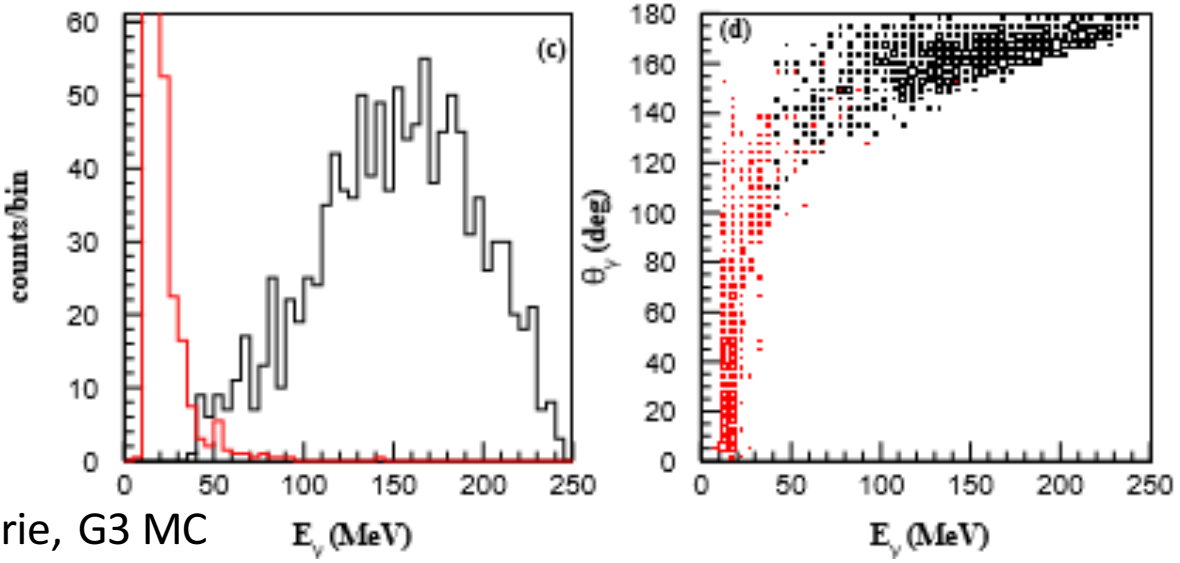
$Ke2\gamma$: $K^+ \to e^+\,\nu_e\,\gamma$



Internal Bremsstrahlung (IB)



Structure Dependent (SD)

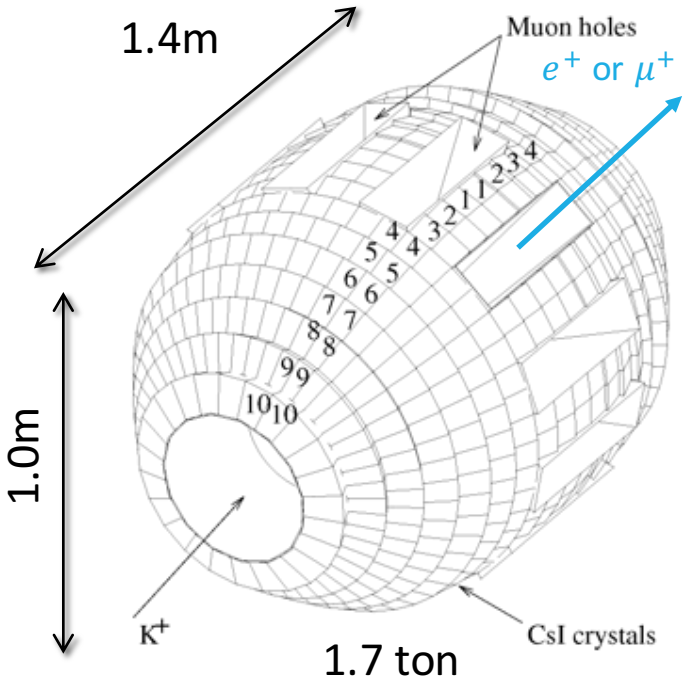


K. Horie, G3 MC

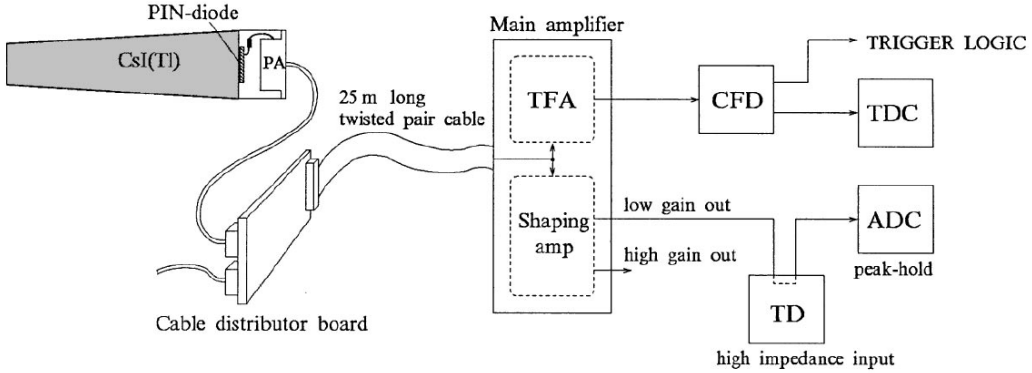
$\Gamma(Ke2\gamma(SD)) \sim 9.4 \times 10^{-6}$

CsI (Tl) カロリメータ

768 CsI(Tl) crystal modules

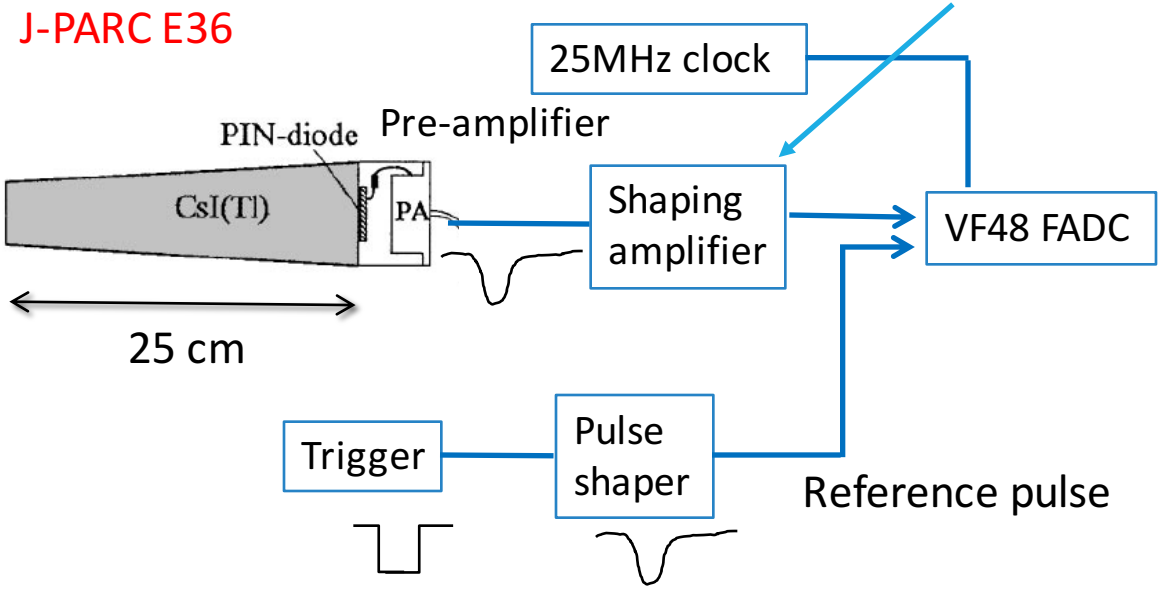


KEK-PS E246

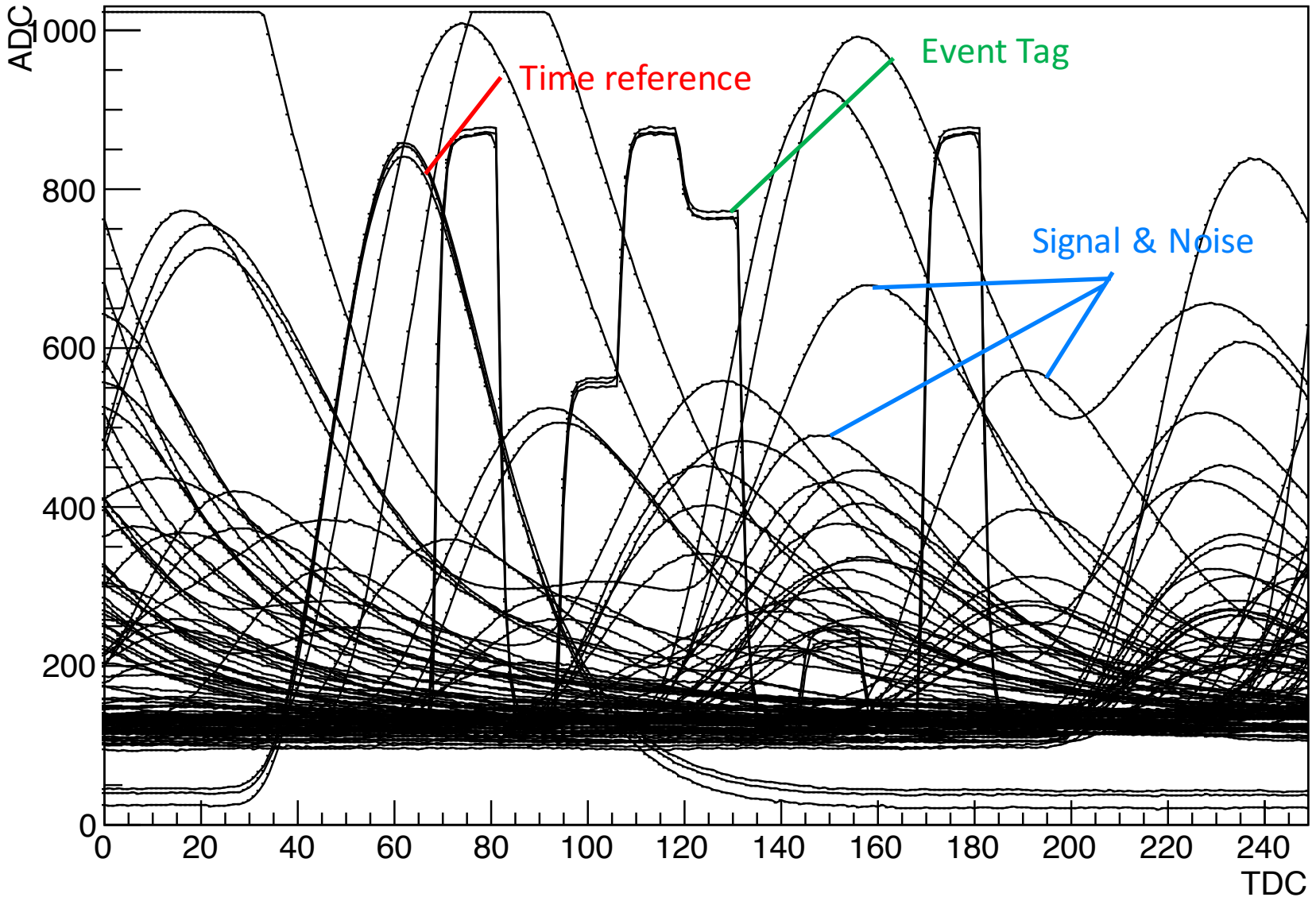


J-PARC E36

時定数～1 μs

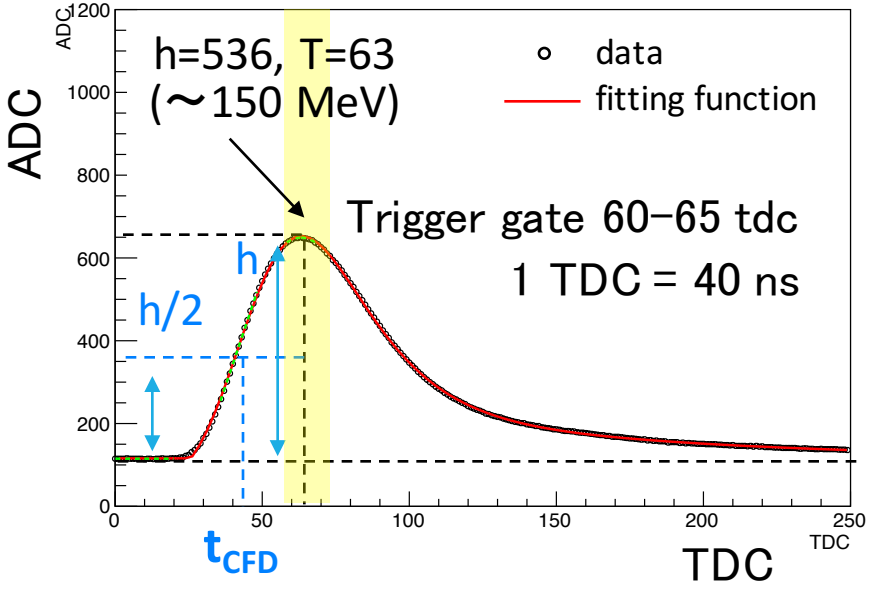


1イベントの波形データ

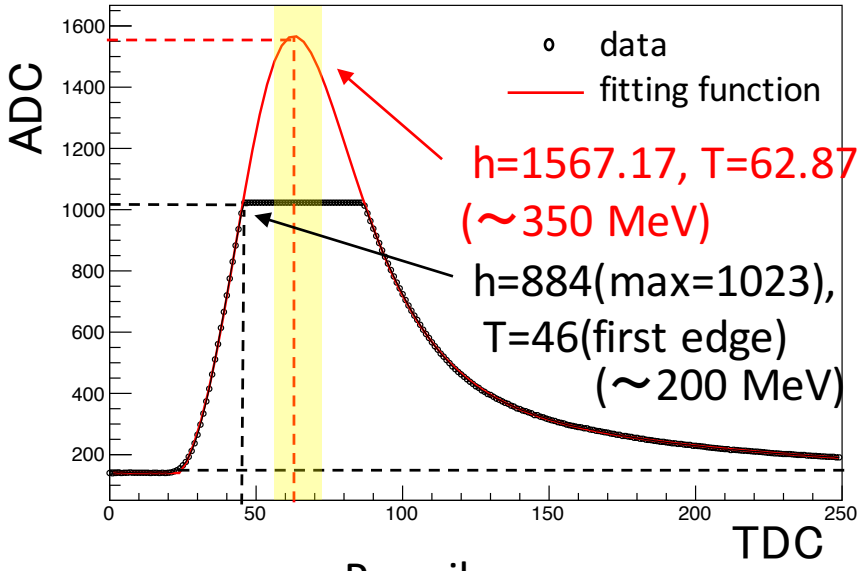


波形解析

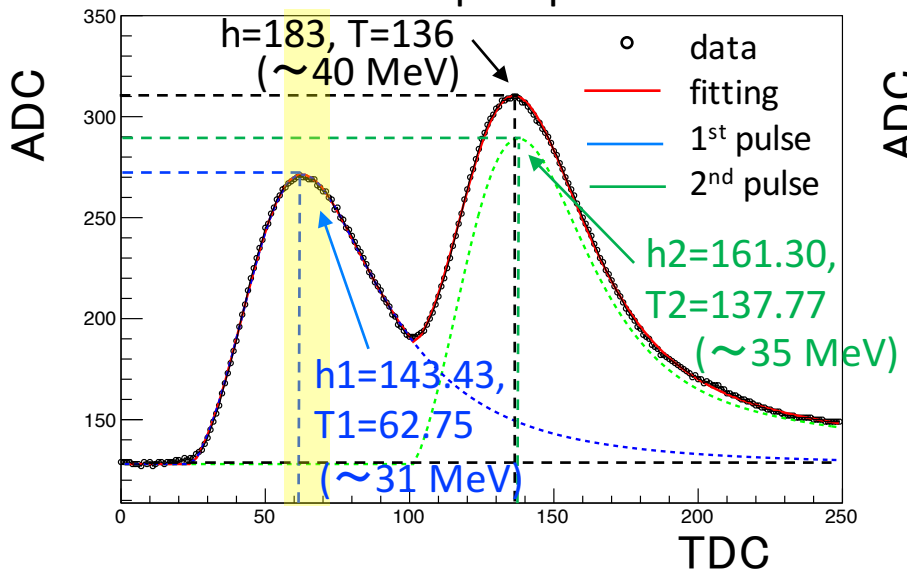
Typical pulse



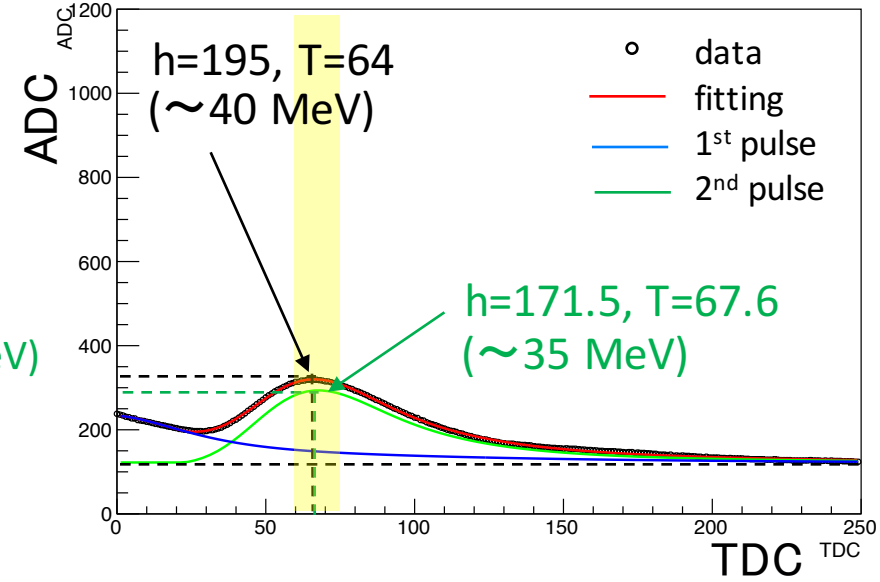
Overflow pulse



Post-pileup

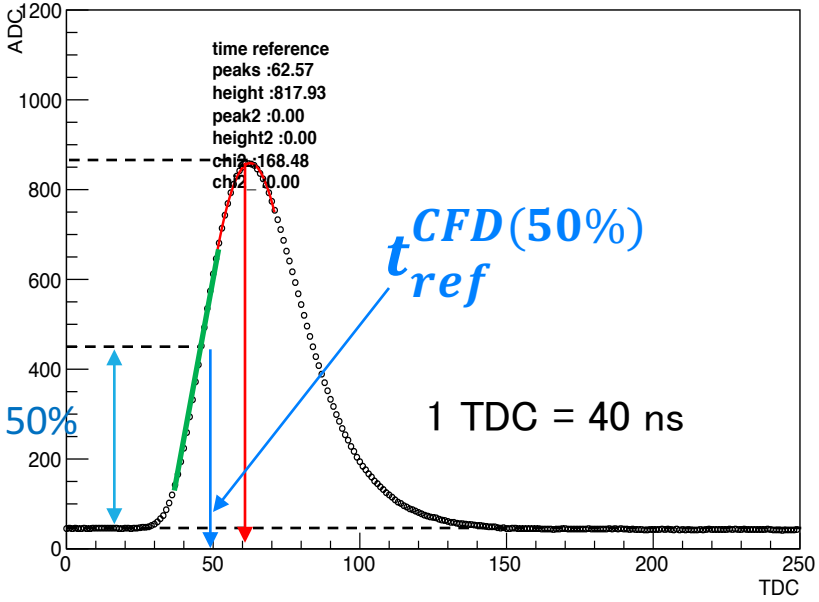


Pre-pileup

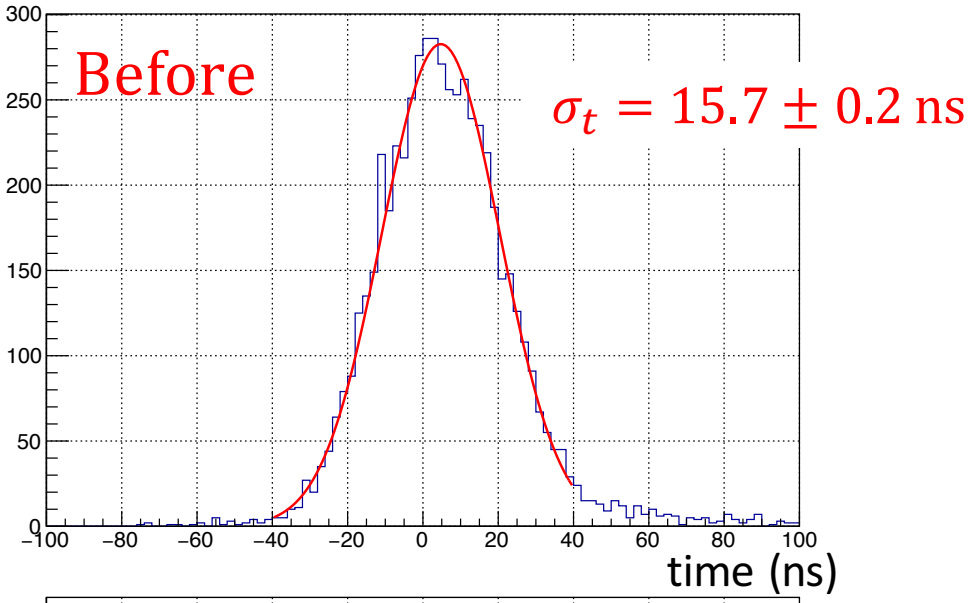


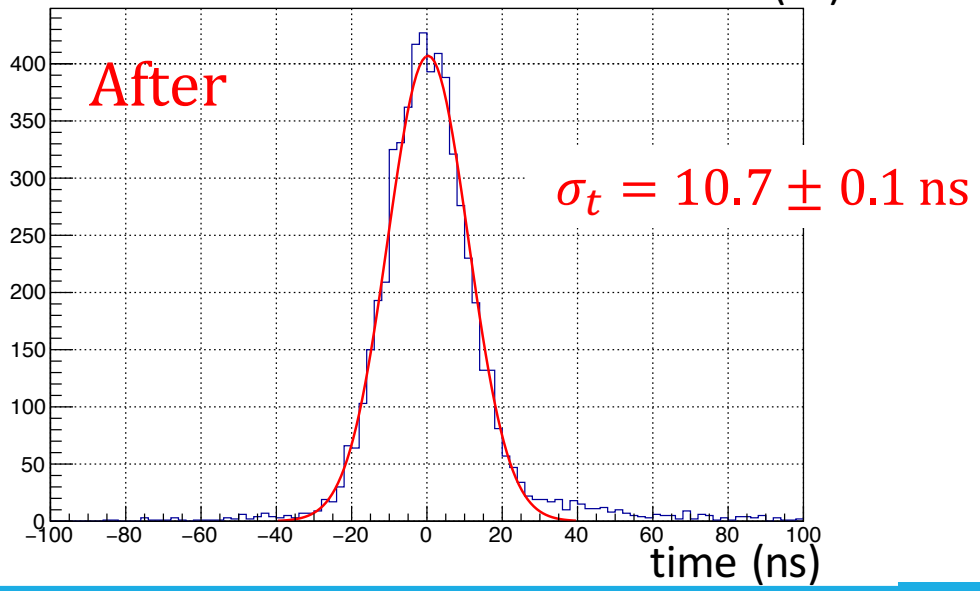
時間分解能評価

Time reference



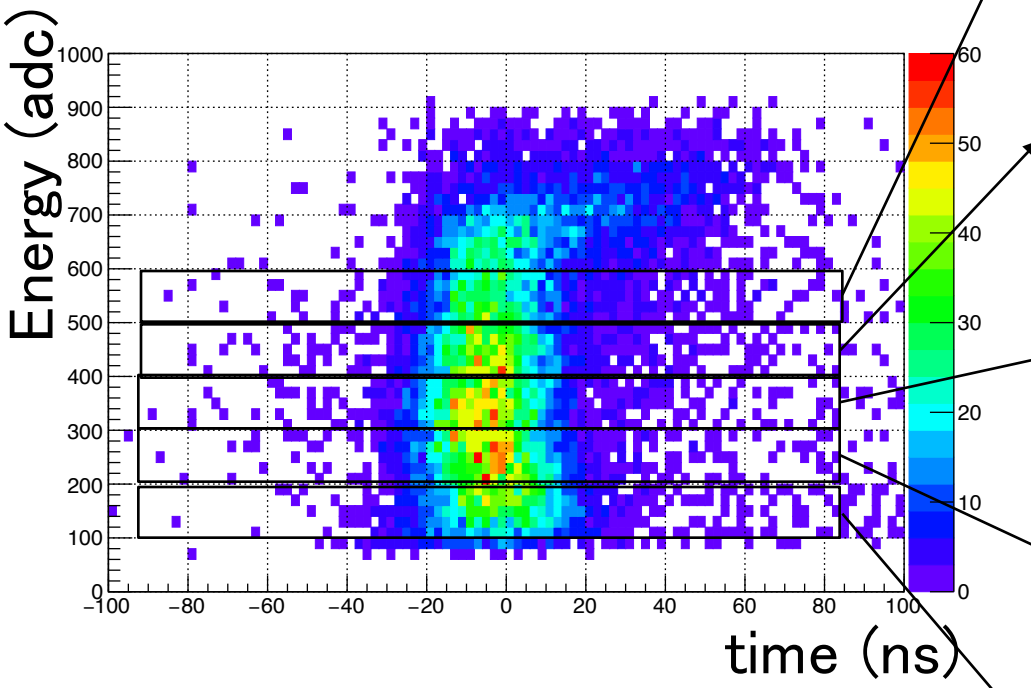
$$t = t_{signal}^{CFD(50\%)} - t_{ref}^{CFD(50\%)}$$

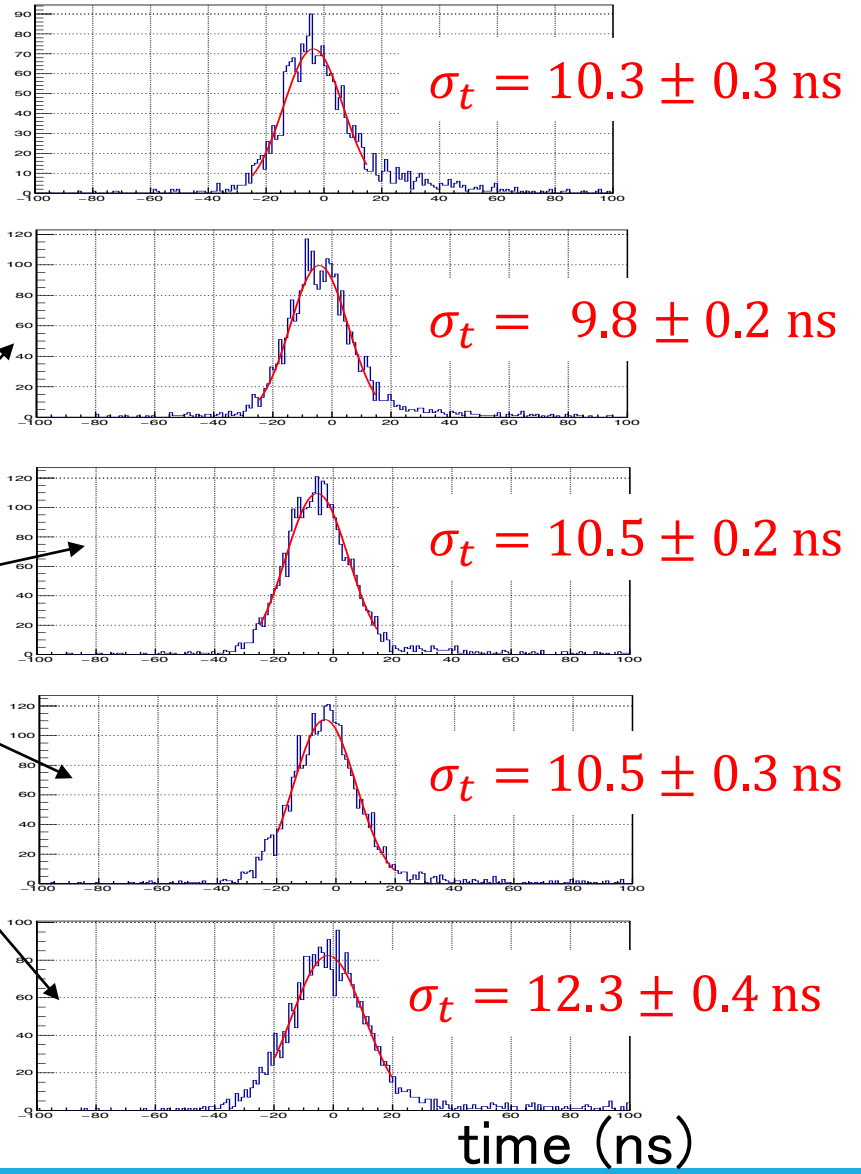




$K\mu2$崩壊を用いた時間分解能評価（1）

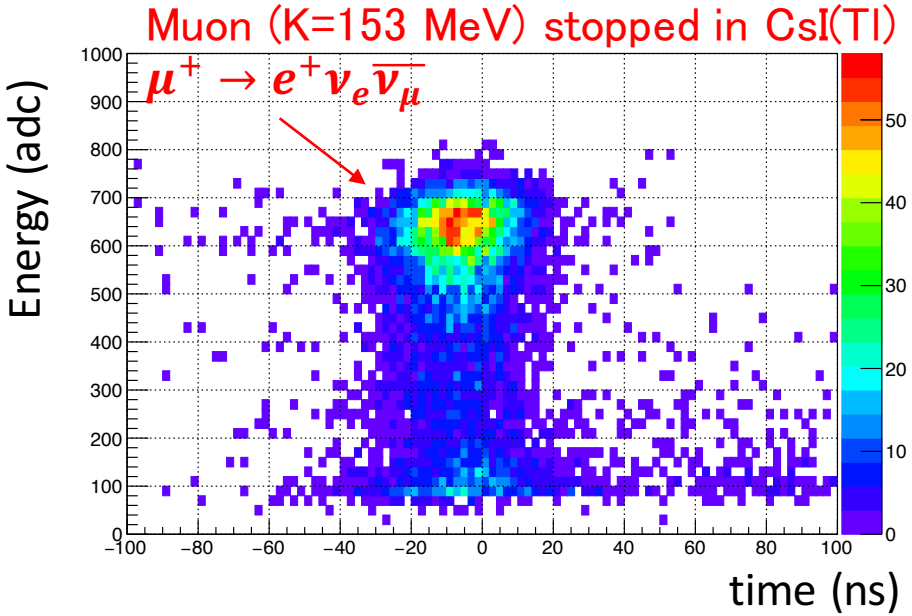
Muons stopped at CsI(Tl)

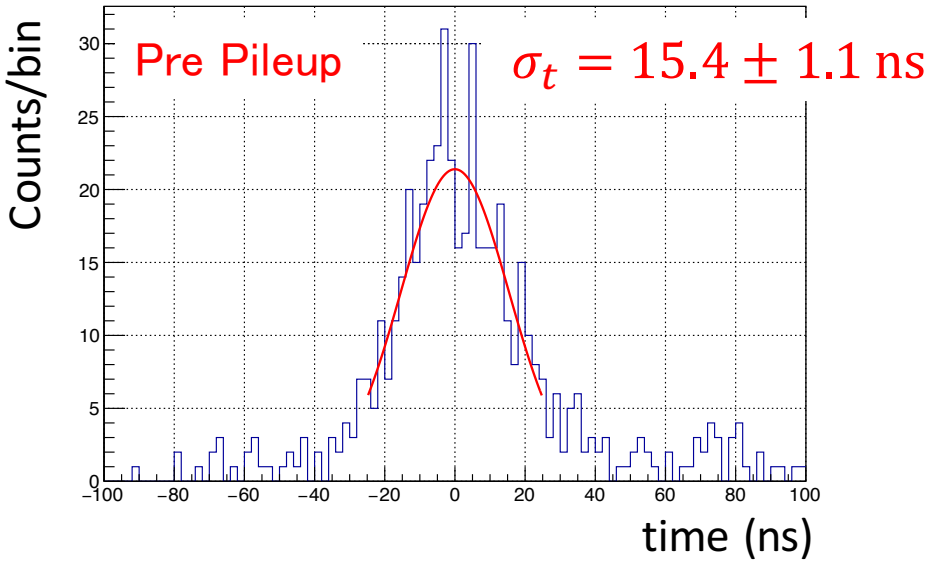


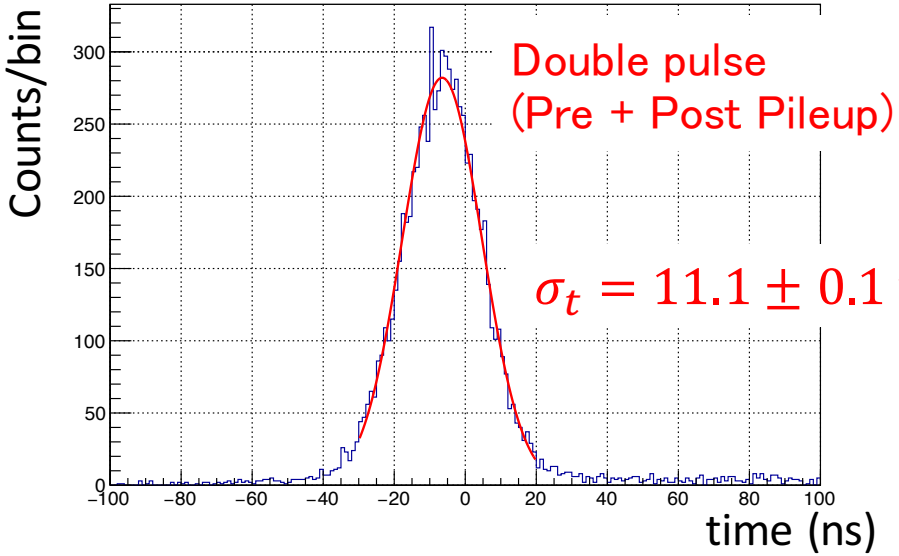


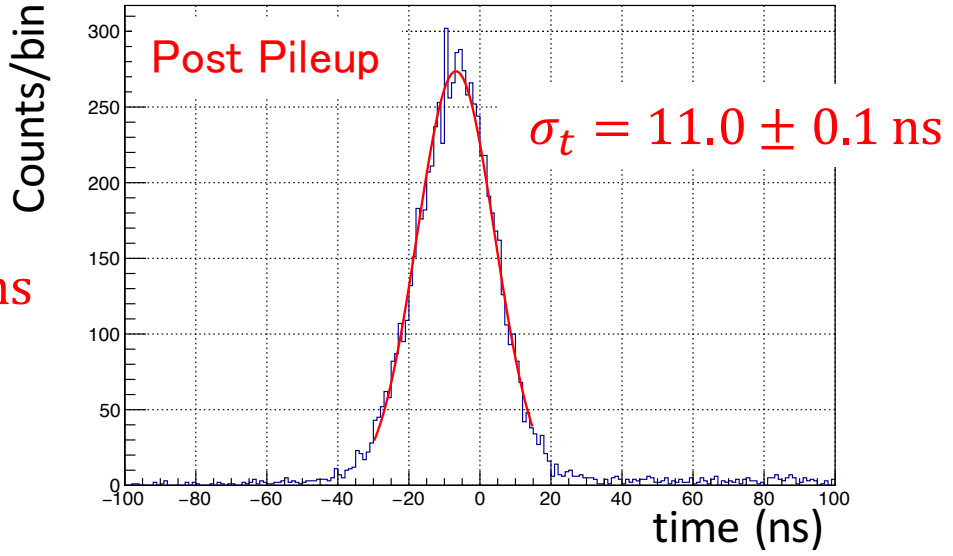
The timing resolution dose not depend on the photon energy strongly.

$K\mu2$崩壊を用いた時間分解能評価 (2)





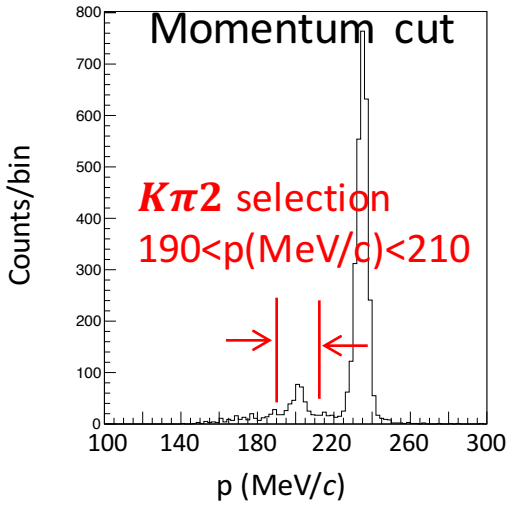




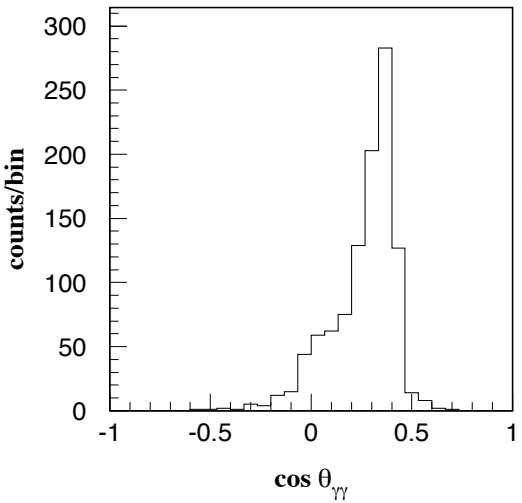
Preliminary

$K\pi 2$ ($K^+ \to \pi^0\pi^+$)崩壊事象

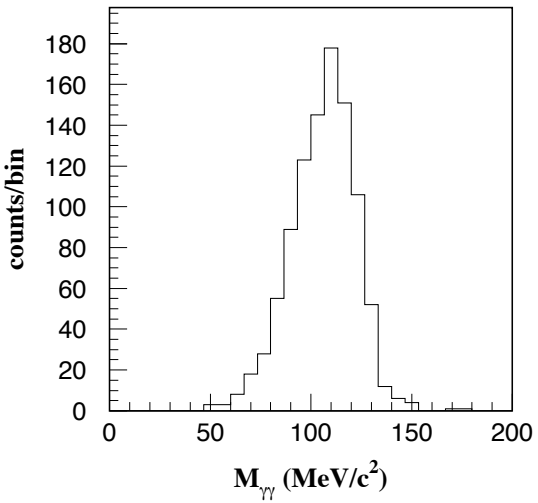
Charged particle Momentum cut



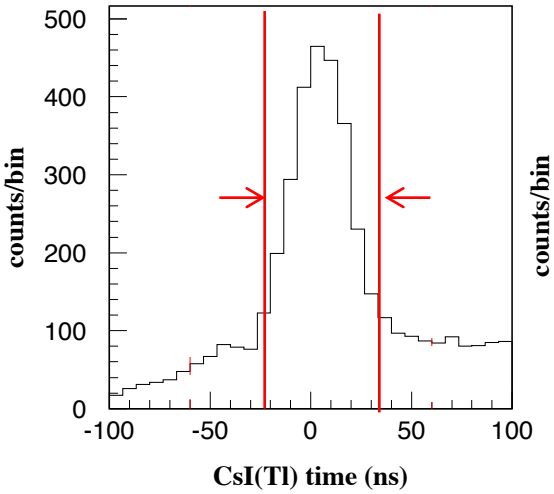
Opening angle of 2γ



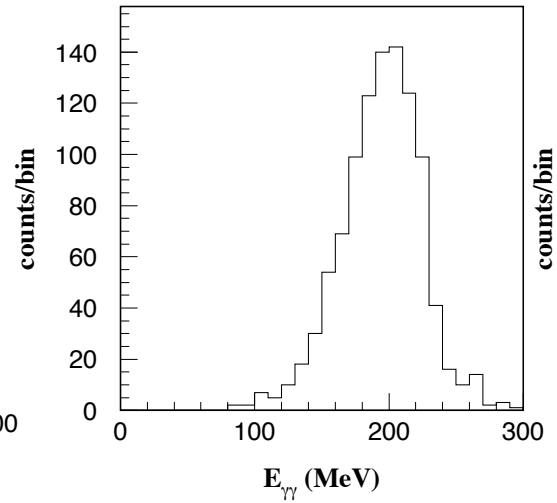
Invariant mass of π^0



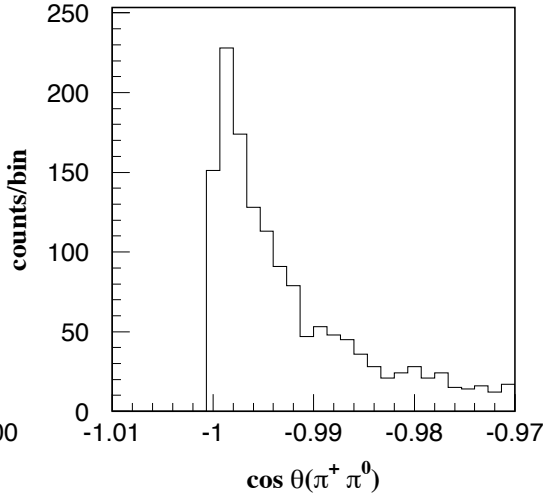
Gamma ray timing cut



Energy of 2γ



Opening angle of $\pi^+\pi^0$



まとめ

- 波形解析による時間分解能評価(σ)
- Time referenceで補正することで分解能が向上
  9.8–10.5 ns（the single pulse）
  11 ns（the post pileup pulse）
  15 ns（the pre pileup pulse）

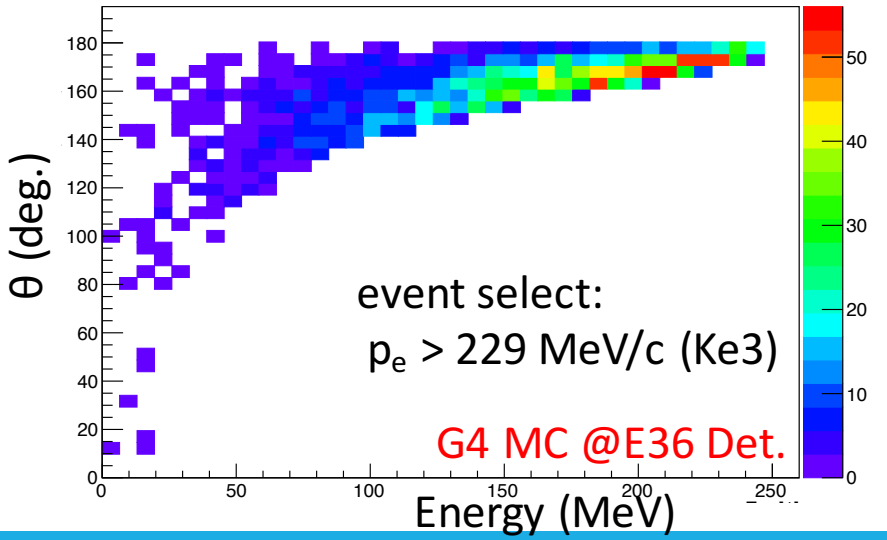
- 物理解析に適用
  - Kpi2事象について妥当な結果が得られた。

今後の課題

- γ線解析の最適化の継続
- $Ke2\gamma$の解析
  - SD Form Factorの決定
  - R_KのBG study

>>>>> 19pK31-10 大阪大理　堀江圭都

Preliminary



TRECK – E36 Collaboration

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TRIUMF

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