π^0 efficiency study with 3-prong τ decay

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Me

- (End of) 2nd year PhD student at IJCLab (Building 200)
- Working on τ lepton at Belle II (asymetric e^+e^- collider, B-factory)
- Currently working on π^0 efficiency correction factor for service task

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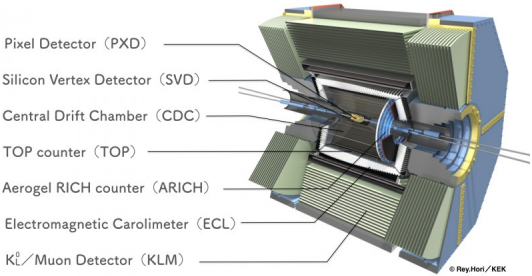
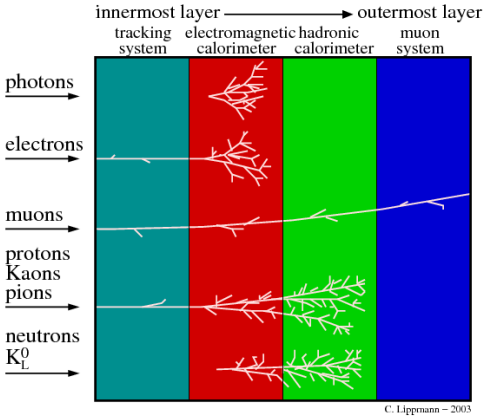
Belle II and SuperKEKB

Belle II is the detector associated with SuperKEKB accelerator.

- Located at KEK in Tsukuba, Ibaraki (Japan)
- e^+e^- asymetric collider
- So-called B-factory
- Most recent achievement : New world record of instanteneous luminosity at $5.1.10^{34}\text{cm}^{-2}\text{s}^{-1}$ (27/12/2024)

Belle II detector





π^0 efficiency is linked in great part to calorimeter efficiency : $\pi^0 \to \gamma\gamma$ ($> 98\%$)

Introduction

The aim is to get an efficiency correction given by the double ratio

$$\frac{\epsilon^{\text{data}}}{\epsilon^{\text{MC}}} = \frac{N_{\pi^0}^{\text{data}}}{N_{\text{event}}^{\text{data}}} \div \frac{N_{\pi^0}^{\tau\bar{\tau}} + N_{\pi^0}^{q\bar{q}} + ...}{N_{\text{event}}^{\tau\bar{\tau}} + N_{\text{event}}^{q\bar{q}} + ...}$$

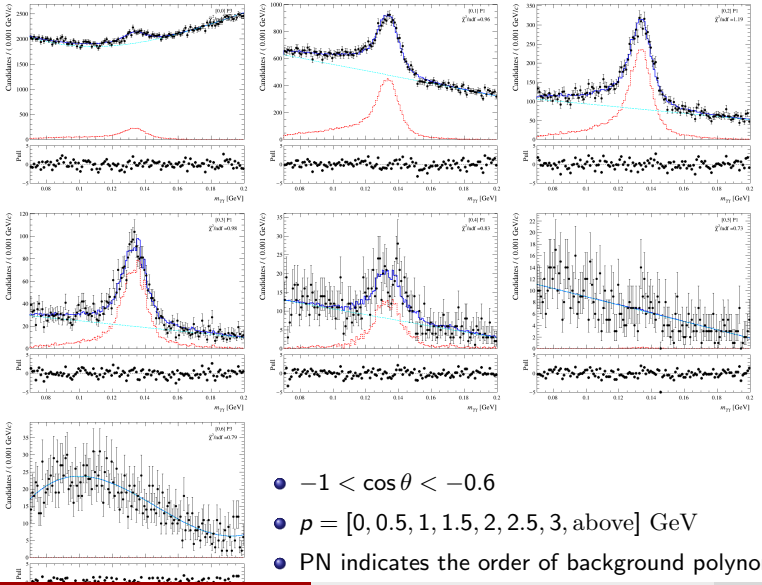
assuming an accurate simulation of τ decays.

We use the 3×1 prong (=charged tracks) topology :

- Signal side $\tau \to \pi^-\pi^+\pi^-(n\pi^0)\nu_\tau$
- Tag side $\tau \to e\nu_\tau\bar{\nu}_e$

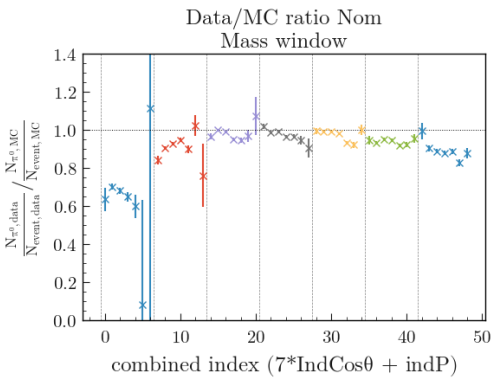
We use 365.29fb^{-1} of data and MC15rd (up to 4x luminosity of data)
$\longrightarrow$ After selection : 6 276 946 events.

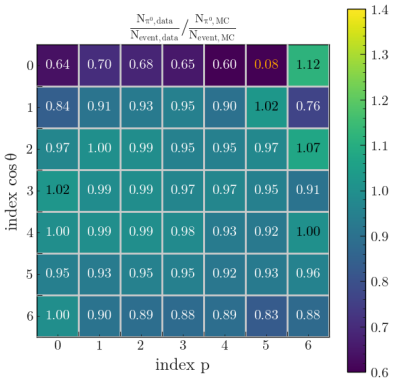
TauNom $M_{\gamma\gamma}$ template fit



- $-1 < \cos\theta < -0.6$
- $p = [0, 0.5, 1, 1.5, 2, 2.5, 3, \text{above}]$ GeV
- PN indicates the order of background polynominal

Nom π^0 efficiency correction (preliminary)





Efficiency correction factors in 1D and 2D of $\cos\theta$ and p bins.

- Error is statistical only

Questions ?