

# $\pi^0$ efficiency study with 3-prong $\tau$ decay

Flavien CALLET (IJCLab)

IDPASC Summer school 2025 @IJCLab : 15/07/2025

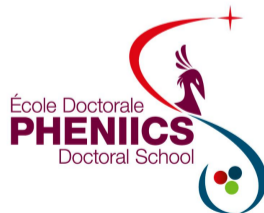


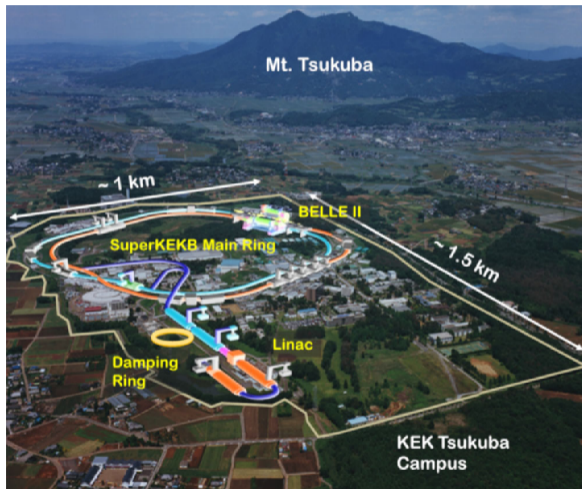


(End of) 2nd year PhD student at IJCLab  
(Building 200)

Working on lepton at Belle II (asymmetric  
 $e^+e^-$  collider, B-factory)

Currently working on  $\theta$  efficiency correction  
factor for service task





Belle II is the detector associated with SuperKEKB accelerator.

Located at KEK in Tsukuba, Ibaraki (Japan)

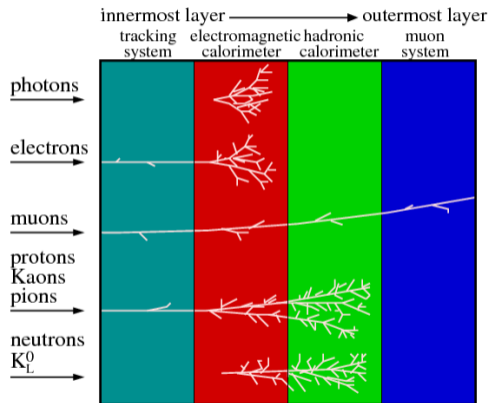
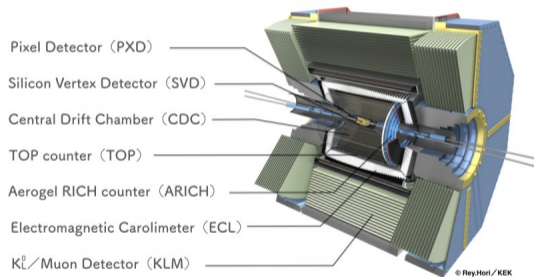
$e^+e^-$  asymmetric collider

So-called B-factory

Most recent achievement : New world record of instantaneous luminosity at  $5.1 \cdot 10^{34} \text{cm}^{-2} \text{s}^{-1}$  (27/12/2024)



## Belle II detector



C. Lippmann – 2003

$\mu$  efficiency is linked in great part to calorimeter efficiency :  $\mu / \text{hadronic} (> 98\%)$

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

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

assuming an accurate simulation of  $\tau$  decays.

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

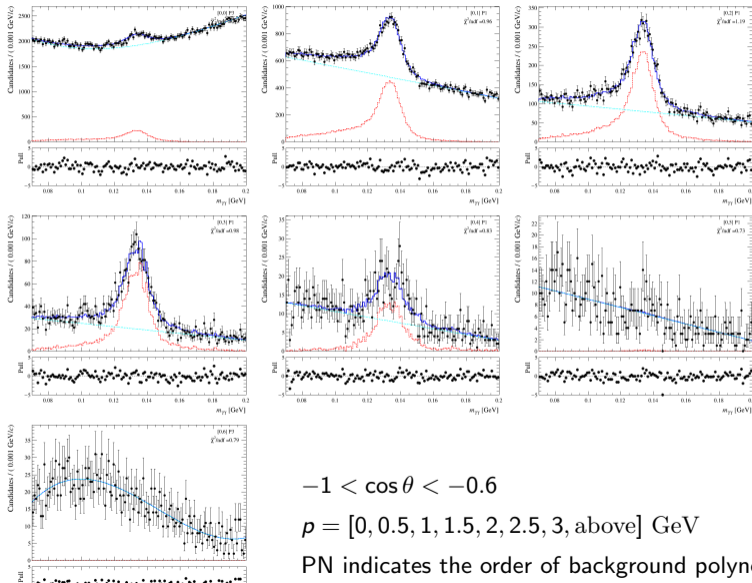
Signal side :  $\tau \rightarrow \pi^0 + (n \text{ } \tau)$

Tag side :  $e^+ \tau^- e^-$

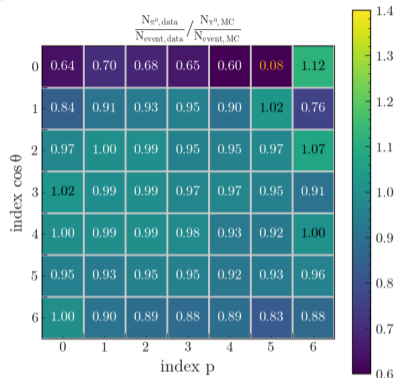
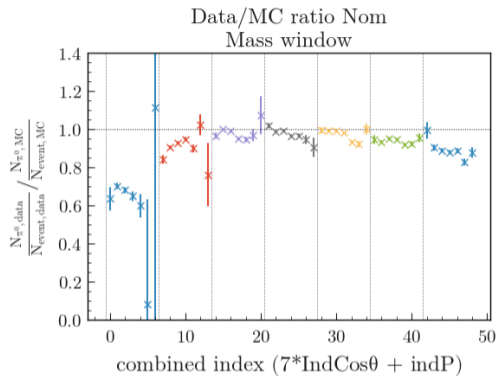
We use 365.29fb<sup>-1</sup> of data and MC15rd (up to 4x luminosity of data)

! After selection : 6 276 946 events.

# TauNom $M$ template fit



# Nom $\pi^0$ efficiency correction (preliminary)



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

Error is statistical only

