

Progress of the Gaseous Detector on Jet Studies with PID

--- A preliminary study

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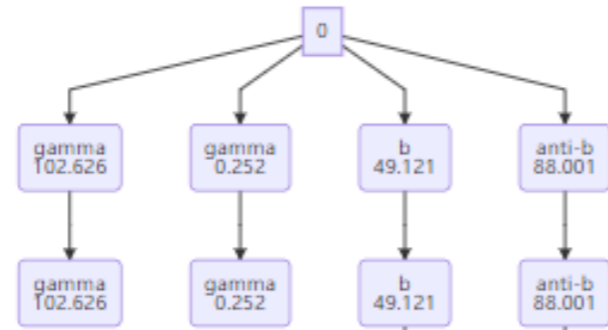


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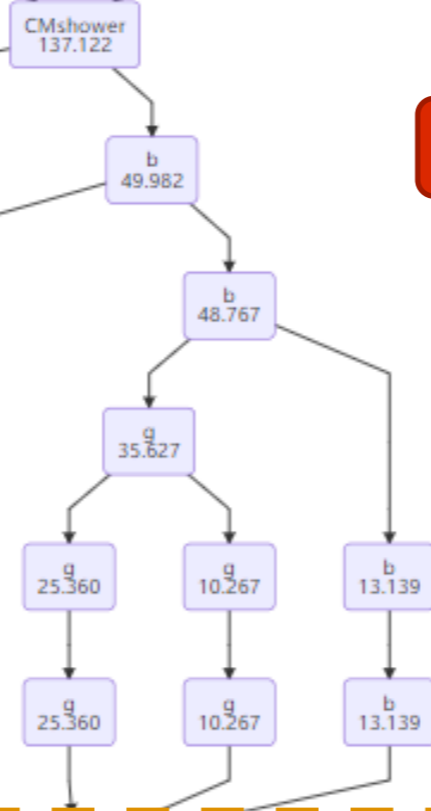
Introduction

- A event in detector: collection of final state particles
- A particle: 4 + 3 + 3 variables
 1. $P4$: (E, p_x, p_y, p_z) or (E, m, θ, φ) ... $(E^2 = p^2 + m^2)$
 2. Where it starts: impact parameters, not available for neutrals.
 3. Where it ends: K_S, Λ, B, D ... , only applicable for long lived particles.

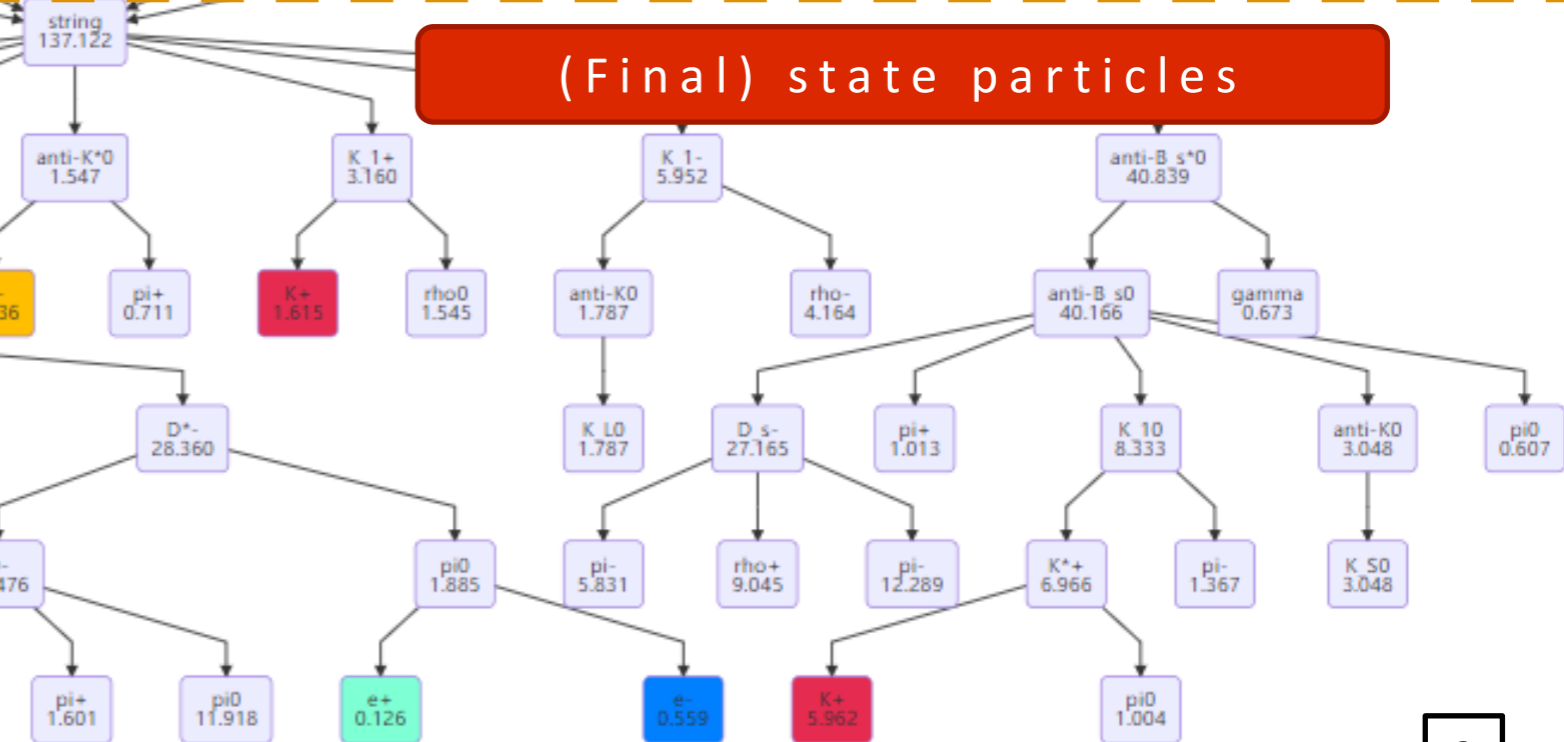
$$e^+ + e^- \rightarrow \gamma_{ISR} \gamma_{ISR} b \bar{b}$$



Hard process



Fragmentation



(Final) state particles

For high energy, this formula is a good approximation,

i.e., $H \rightarrow \mu\mu$

$$m^2 \approx 2E^+E^-(1 - \cos \theta)$$

but for low hadron in a low energy jet

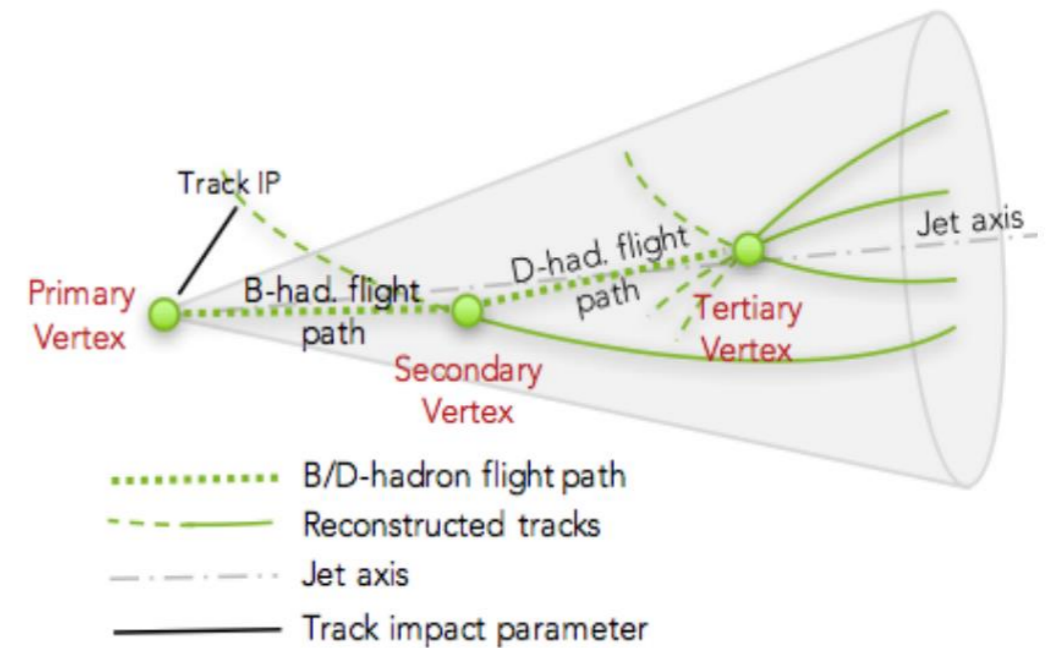
PID makes differences



Add PID information

$$m^2 = 2E^+E^- - 2p^+p^- \cos \theta + 2m_\mu^2$$

Jet is a collimated bunch of hadrons flying roughly in the same direction.



For a jet

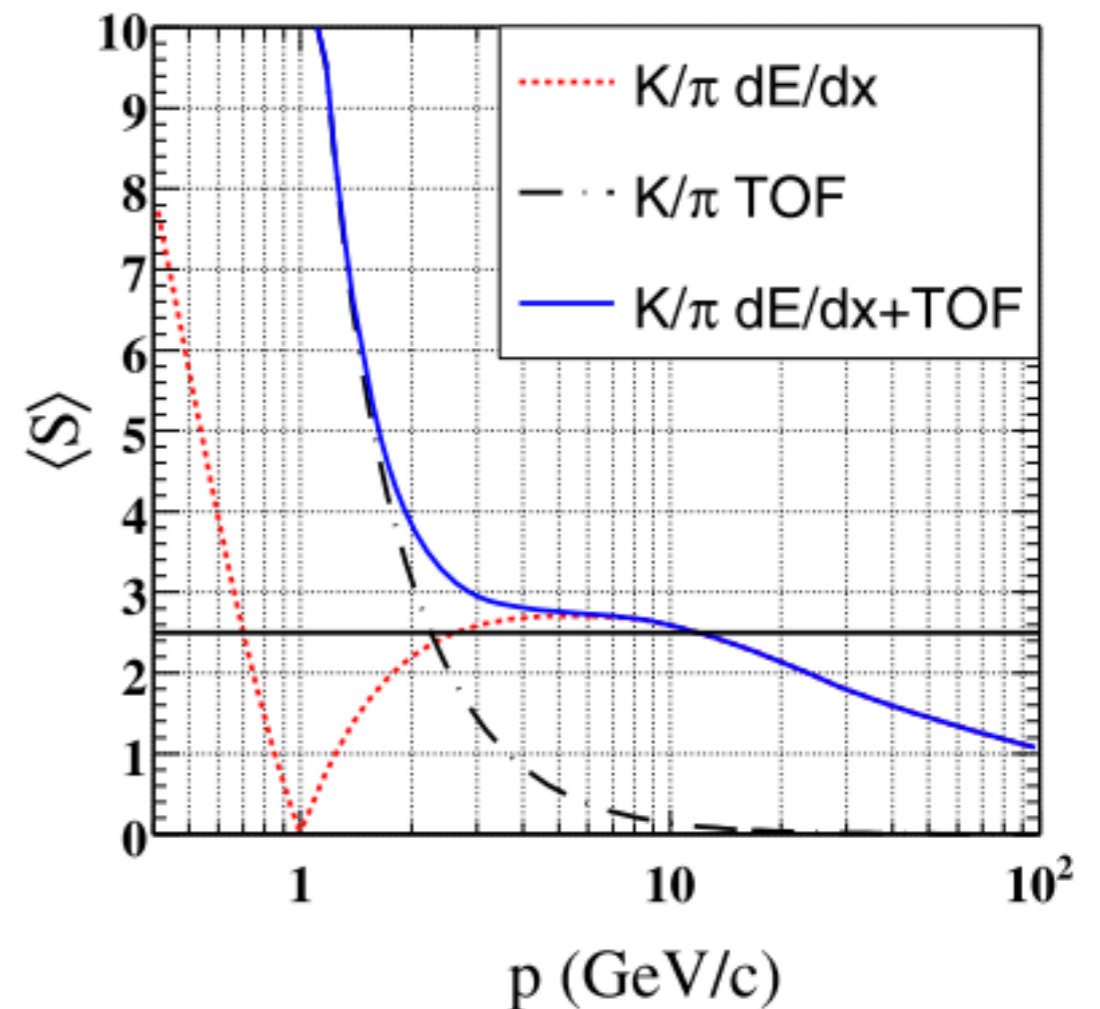
$$m_{jet}^2 = \sum_{ij} m_{ij}^2$$

Where $m_{ij}^2 = 2E_i E_j - 2p_i p_j \cos \theta_{ij}$

We need to know all m_i 's

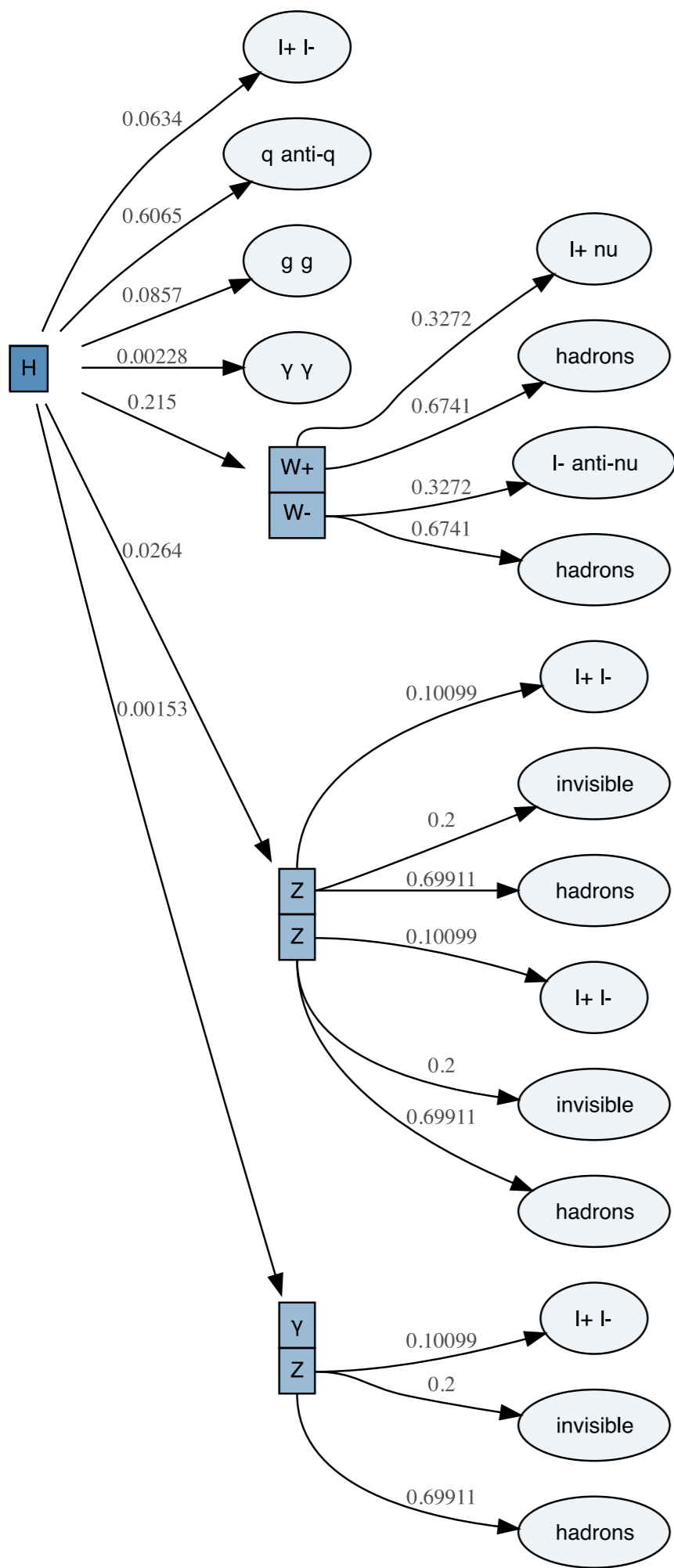
$$m_i = m_{ii}$$

- dE/dx of TPC or DC with the cluster-counting approach can provide very promising PID;
- Working together with a TOF (50 ps time resolution): K/π separation up to 20 GeV at 2.0σ separation;
- From a physics point of view, jet energy/mass resolution, jet flavor tagging, and jet charge desire good hadron PID.



dE/dx and/or TOF are used for K/π separation.

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~8% decays of the Higgs ha no jet and >90% w/i jets

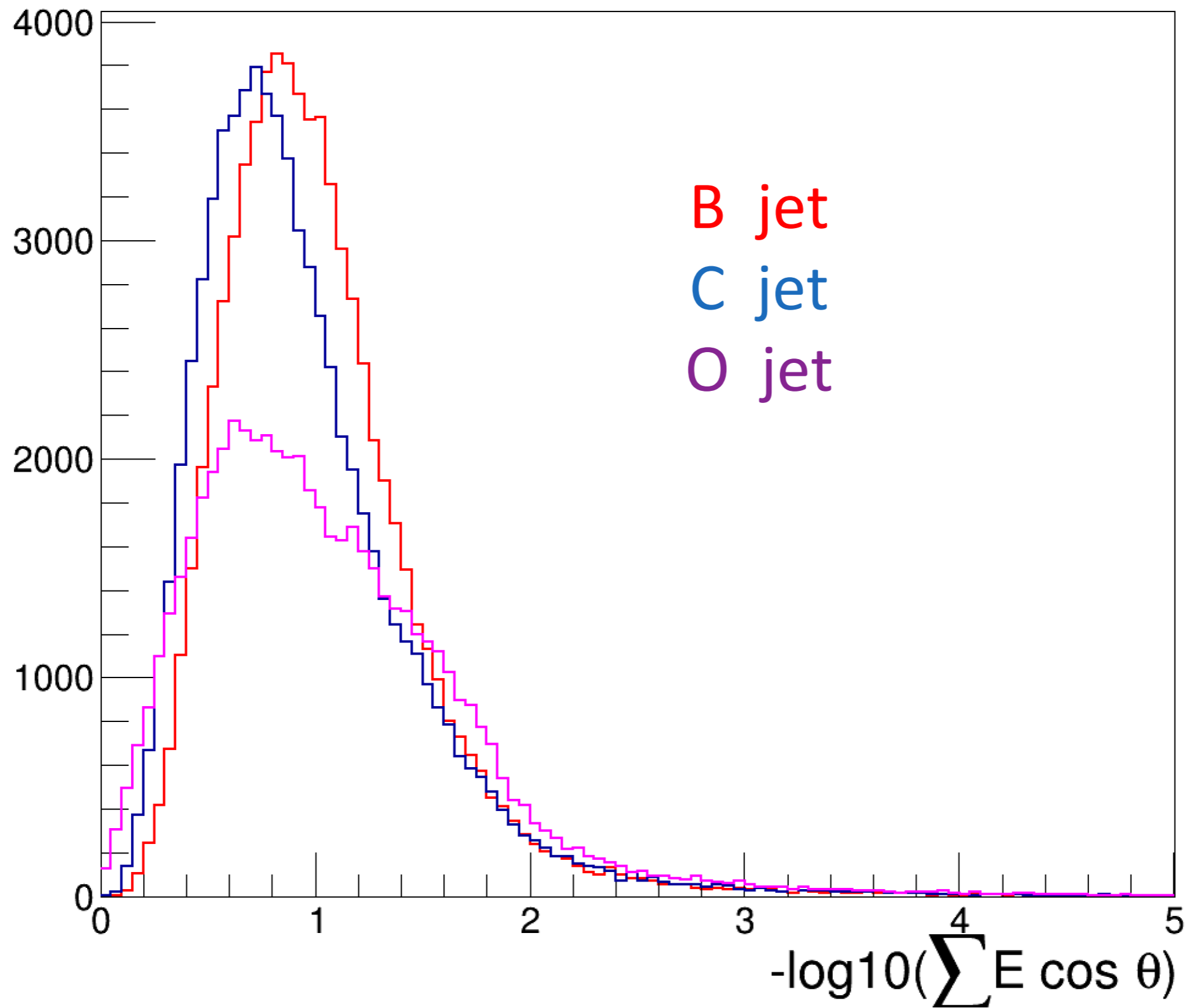
■ EW physics: PID on jet reconstruction and tagging

■ Flavor physics: PID on narrow resonances

Final states of ZH process

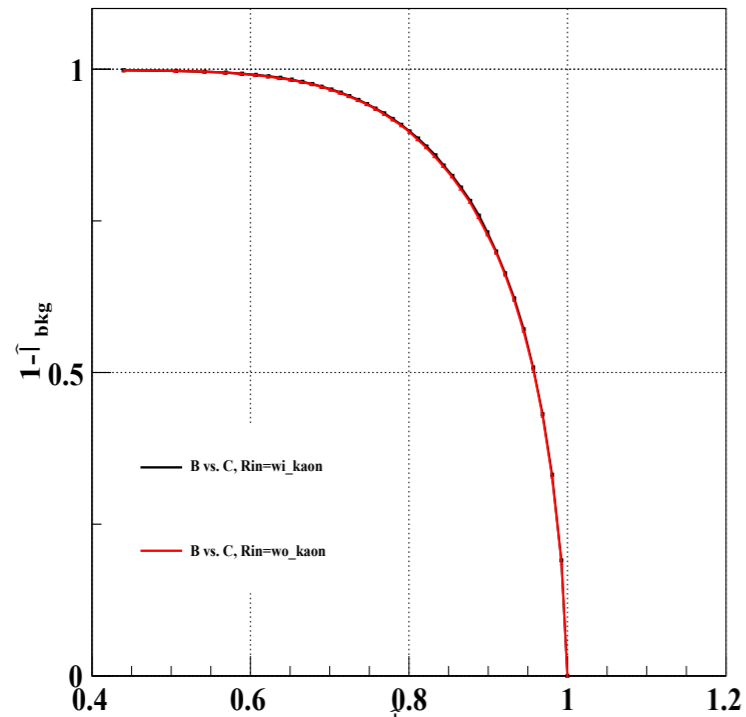


K PID helps Jet flavor tagging

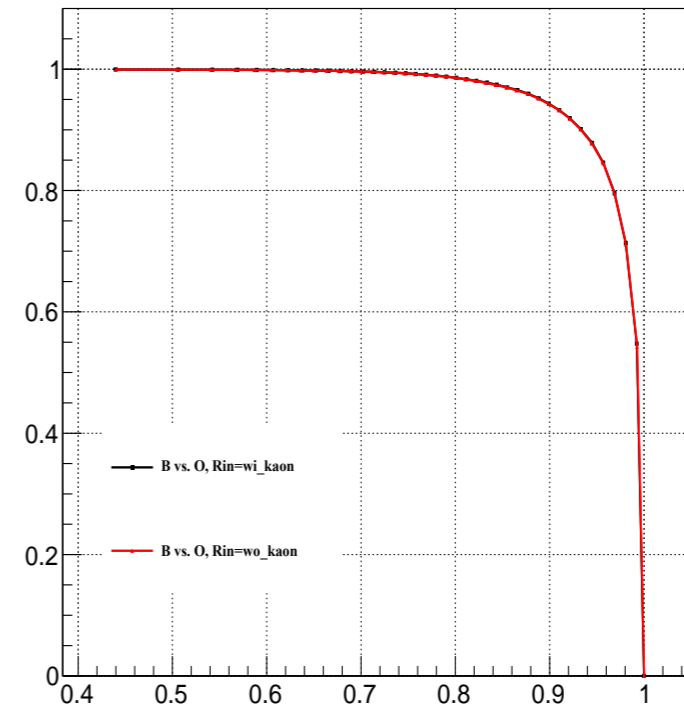


Jet flavor tagging

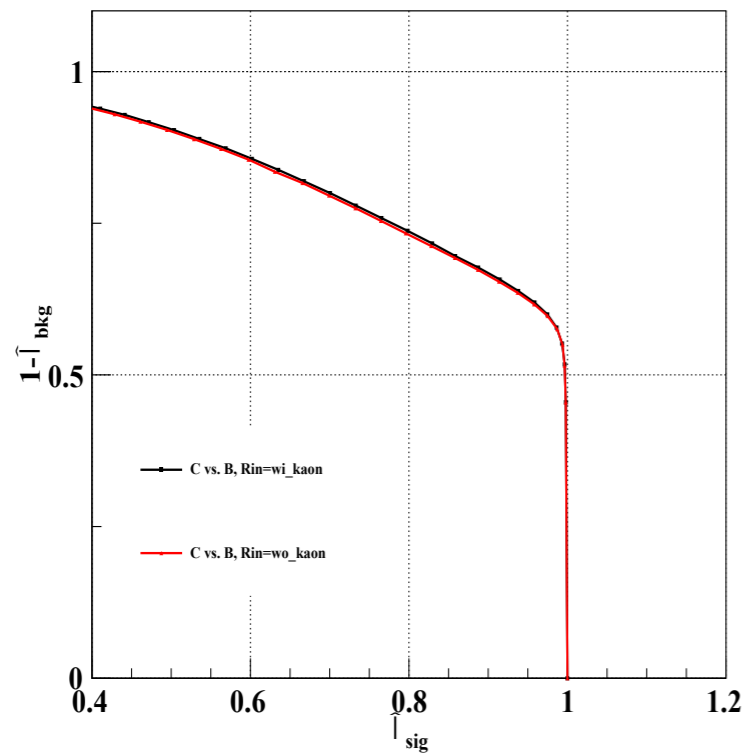
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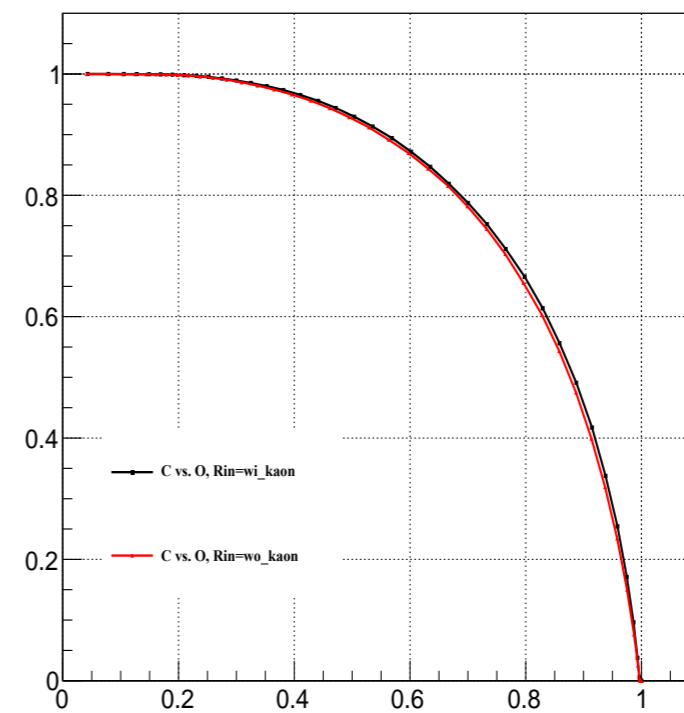
B tagging
C background



B tagging
uds background



C tagging
B background



C tagging
uds background

Summary

- PID is useful for jet objects: energy resolution, flavor tagging, jet charge, etc.
- And also important for flavor study:
 1. Improving the mass resolution
 2. Reducing combinatorial background
 3. Ultimately enhancing the S/B ratio
- All these possible improvements will be carefully investigated to demonstrate the added-value of PID

- BACK UP

PID helps jet energy resolution

**K PID helps to jet charge
determination (put it in plan)**