Explicit τ Decay Reconstruction at FCC-ee

Lars Bogner
KIT - Institute of Experimental Particle Physics

July 11, 2024

Overview

Introduction

Generator Matching

Performance Evaluation

Conclusion and Outlook

All code can be found on GitLab. The dataset is at
`/ceph/xzuo/FCC_ntuples/tau_reco/ntuples_20240624/`

Introduction

Explicit τ Decay Reconstruction

- assigning decay mode to τ jets based on known decay modes
- reconstruction of intermediate particles (e.g. π^0)
- counting of particles in the decay (with some restrictions, i.e. FSR photons)

Generator Matching

Generator Matching

- produced $\tau^+\tau^-$ with respective decay are part of the dataset
- calculating angle between all jets and the generated τ
- matching the jet with the smallest angle to the τ

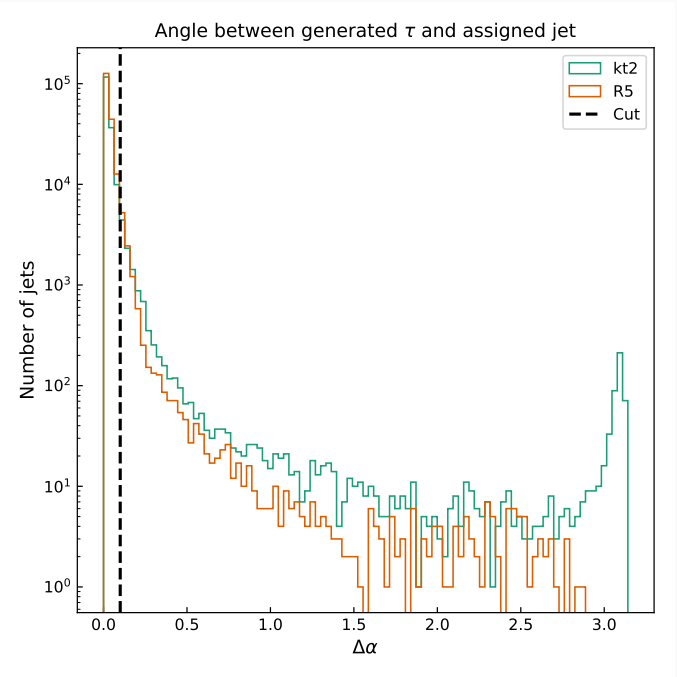


Figure 1: Angle between assigned jets and generated τ

Generator Matching

- produced $\tau^+\tau^-$ with respective decay are part of the dataset
- calculating angle between all jets and the generated τ
- matching the jet with the smallest angle to the τ

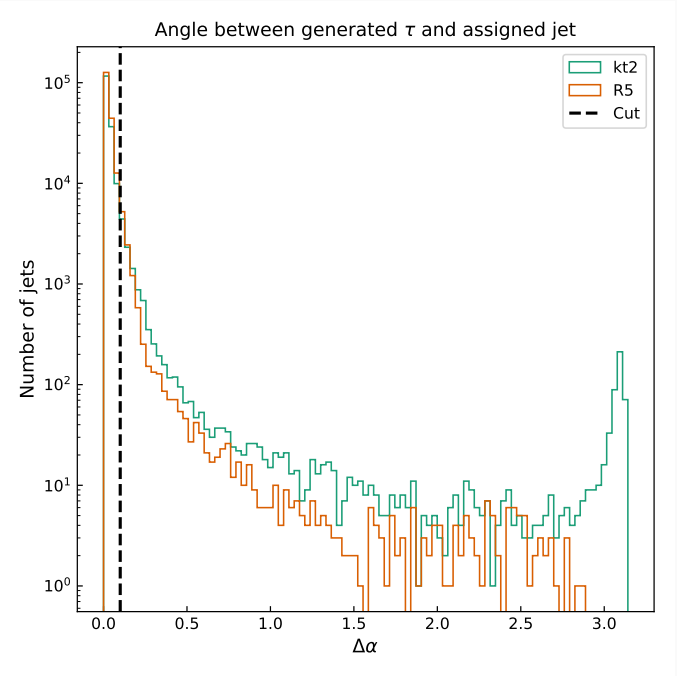


Figure 1: Angle between assigned jets and generated τ

Problem

- no generator information in real data
  $\Rightarrow$ multiple cases which need to be separated

Jet exclusion

Parallel Jets

- two jets with small angle between them
- one generated τ not contained in the jets

Wide Jets

- jet contains products of both τ decays
- angle cone is wide

Cuts for exclusion

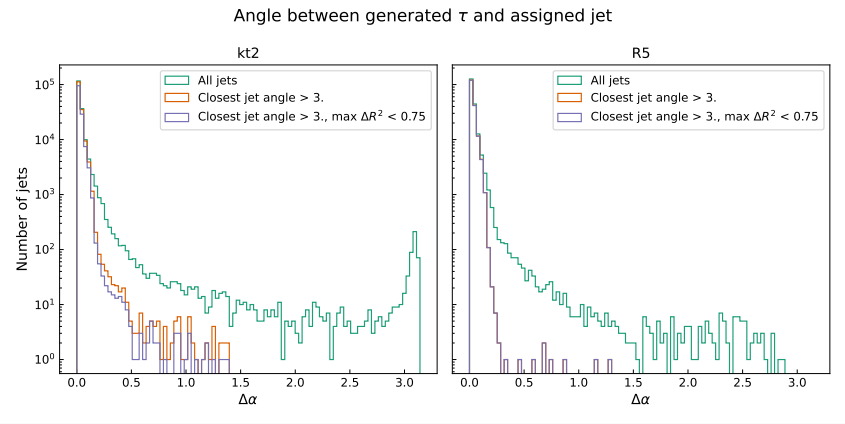
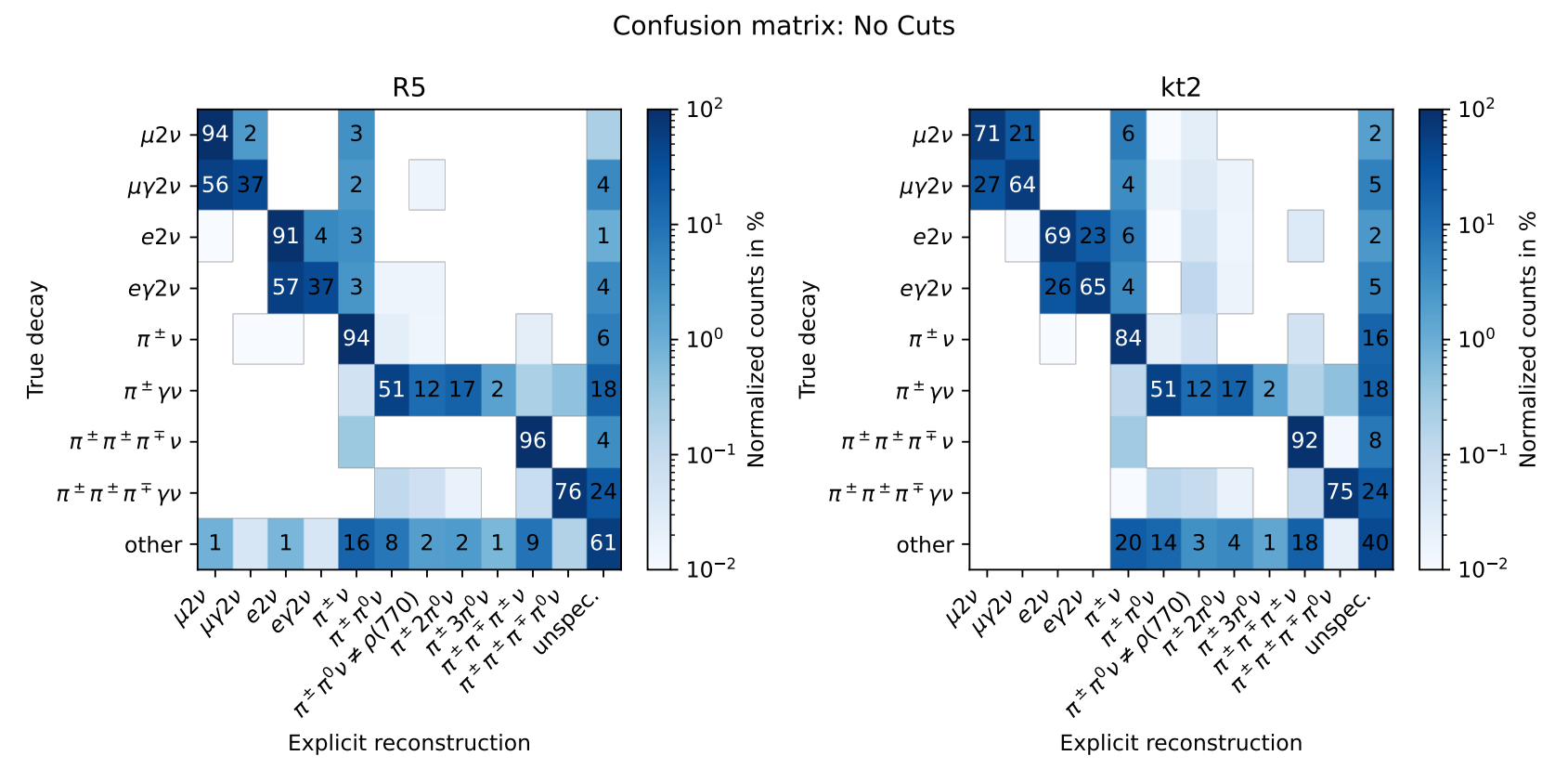


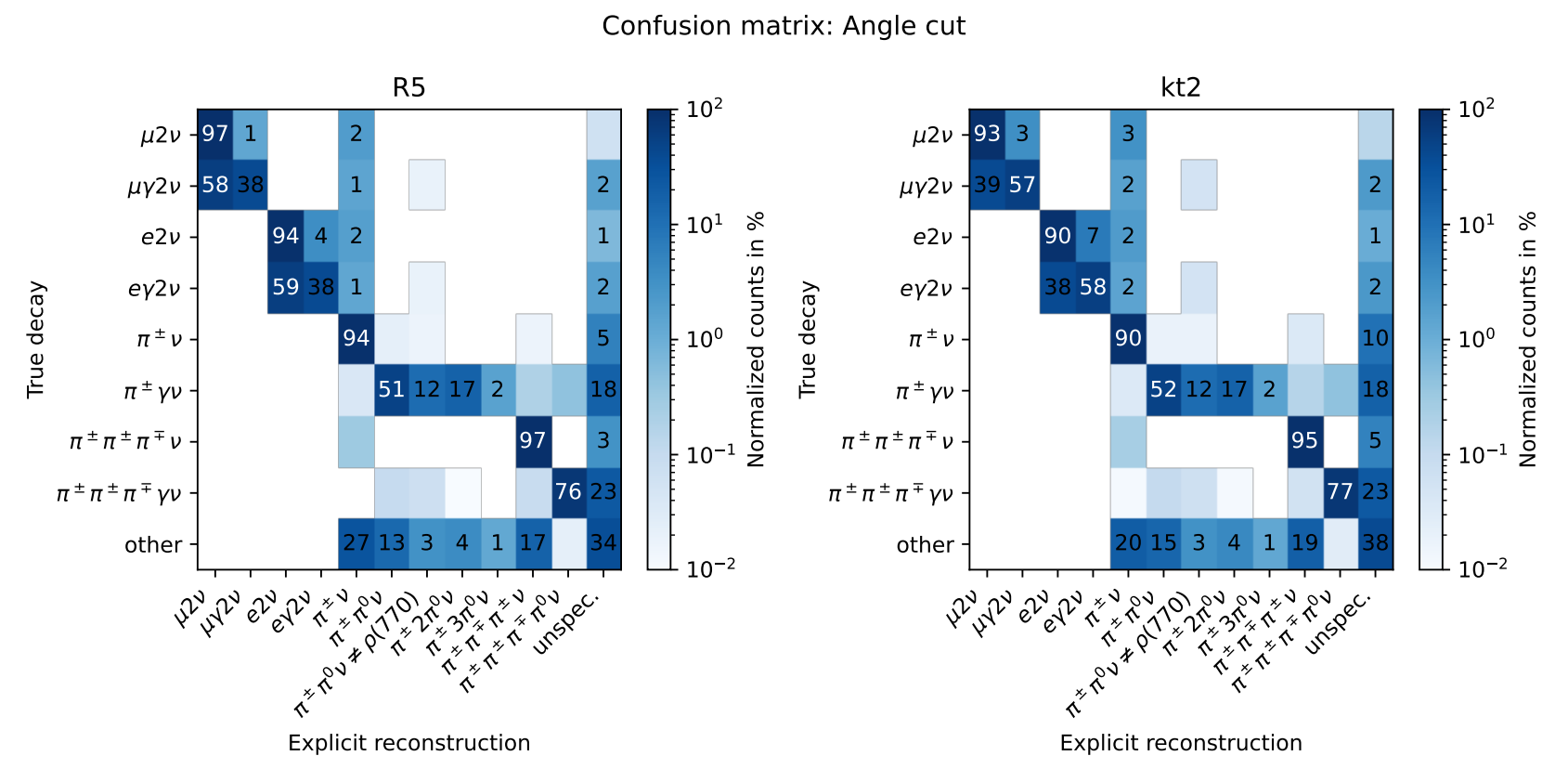
Figure 2: Angle between assigned jets and generated τ with cuts on jet properties

Performance Evaluation

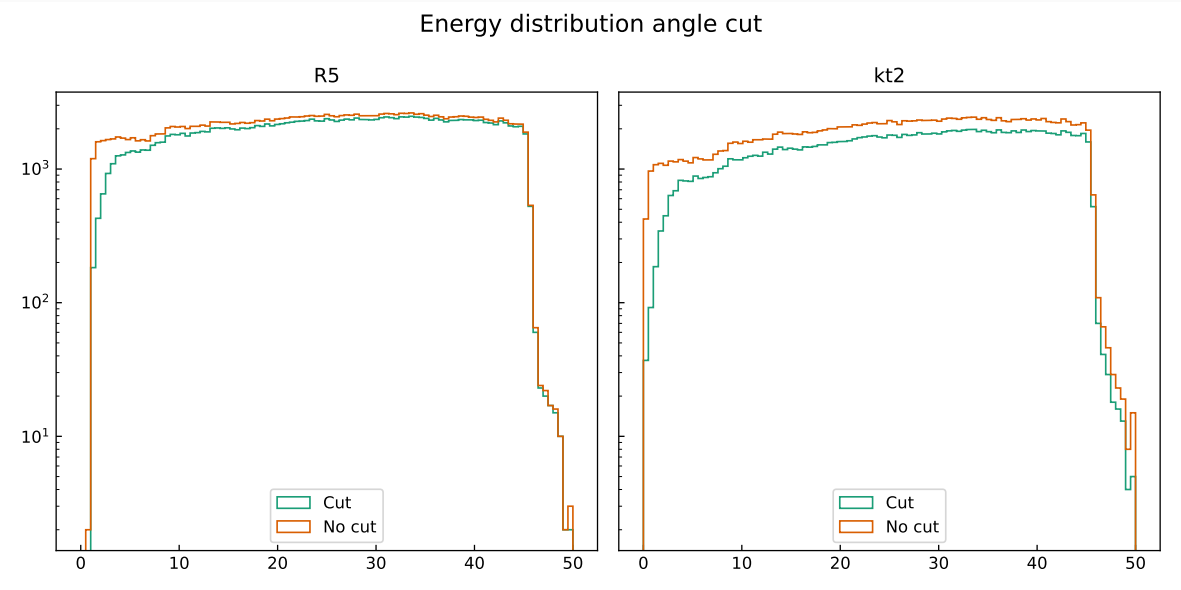
Bare Performance

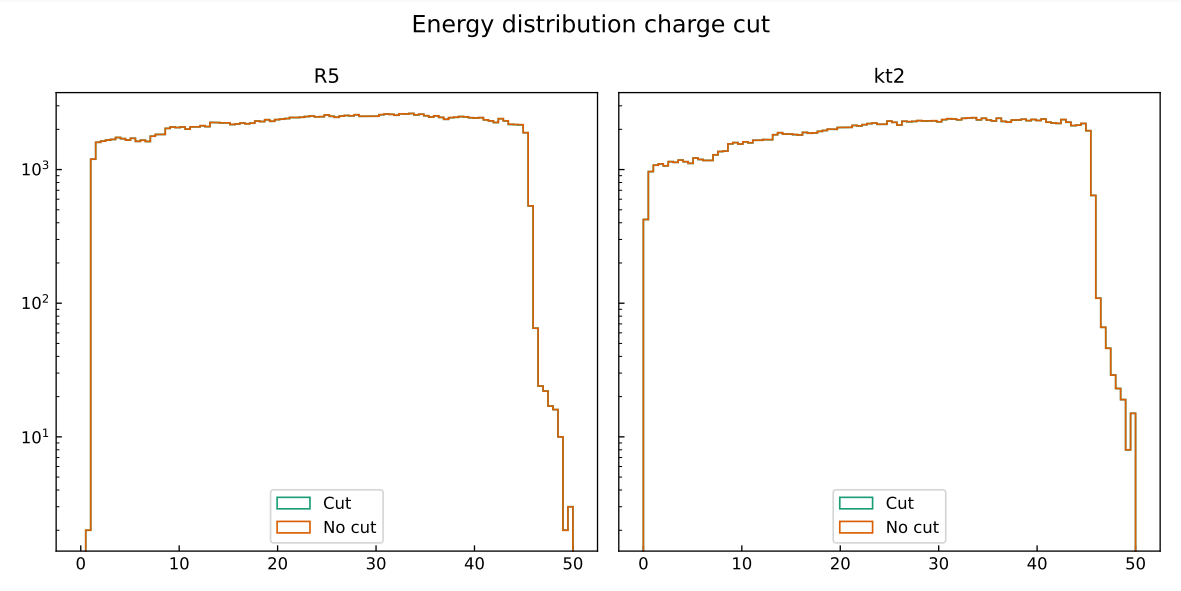


Generator Angle Cut

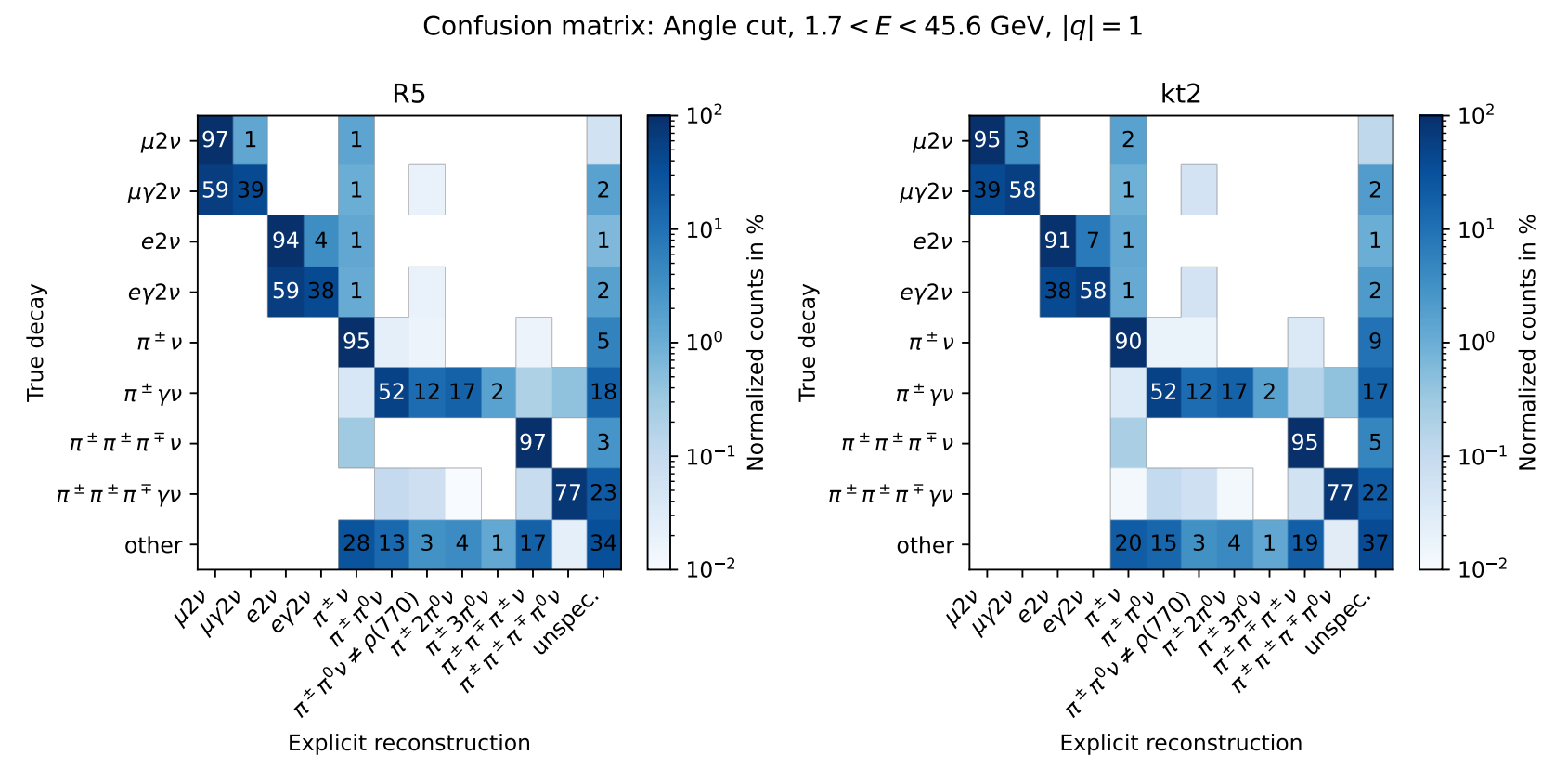


Further Improvements

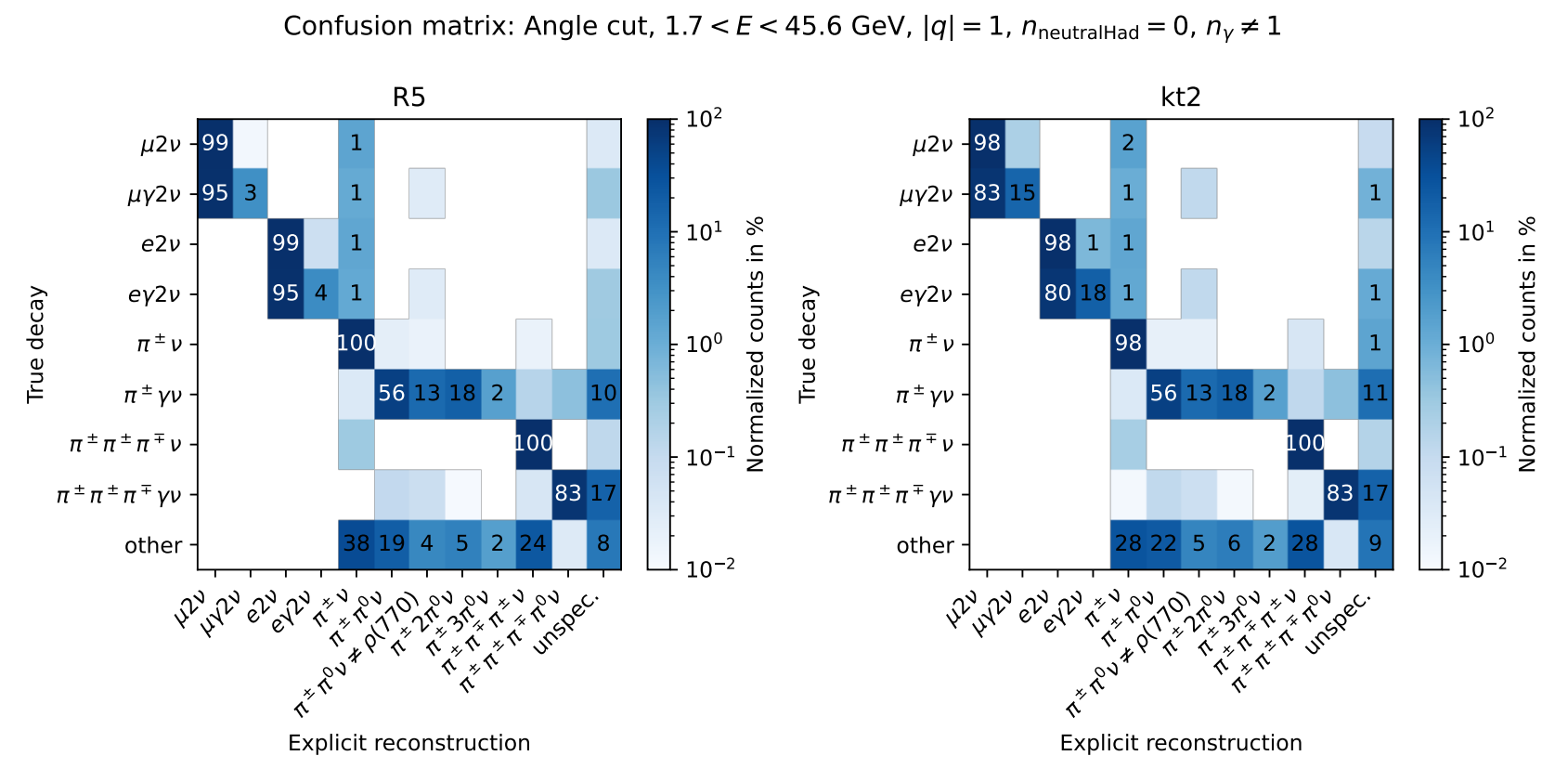




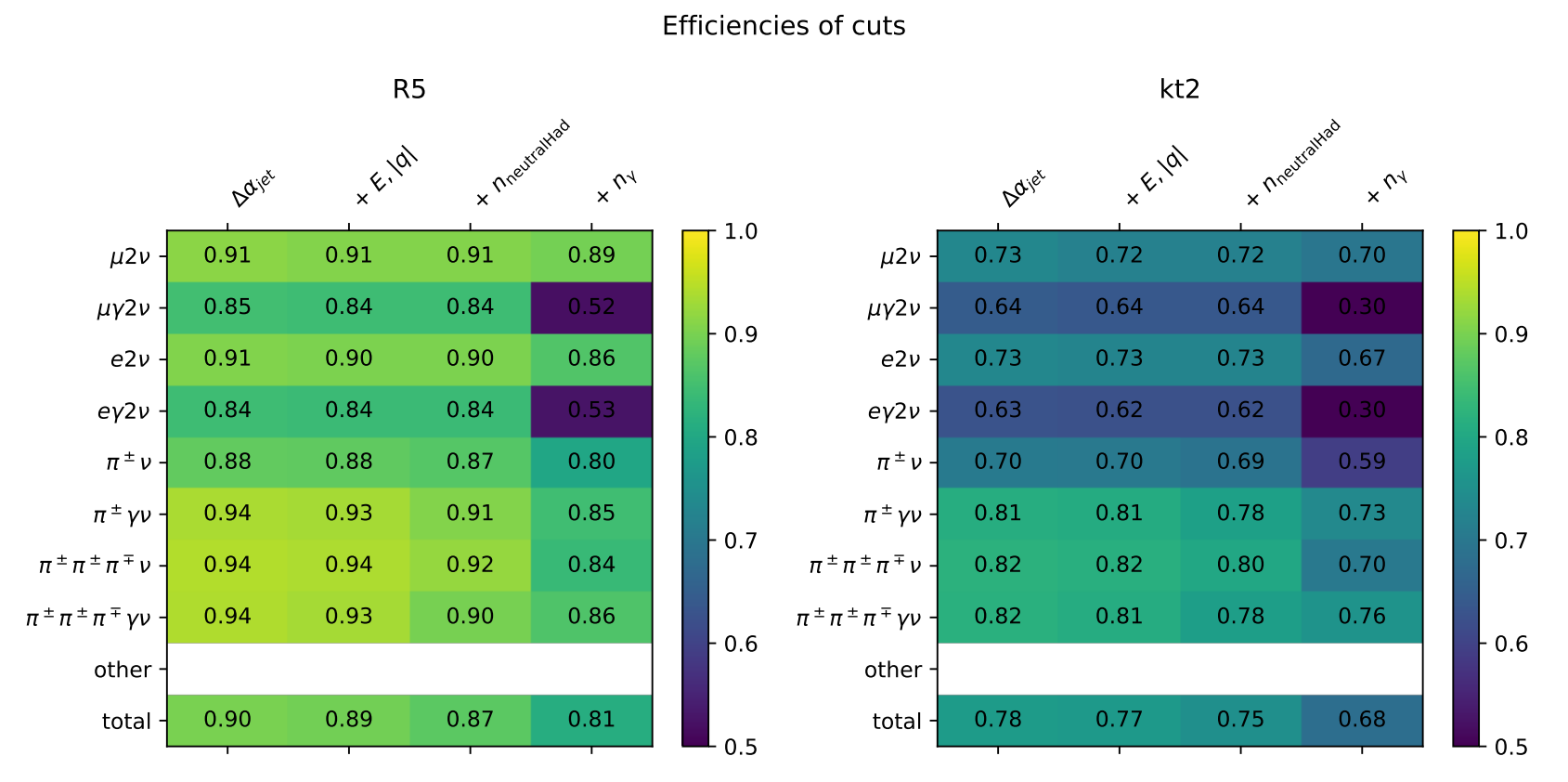
Energy and Charge Limitation



Restrictive Cuts



Efficiencies



Conclusion and Outlook

Conclusion

- explicit τ decay reconstruction allows for very good performance at FCC-ee
- multiple improvements possible

Outlook / Future Work

- better FSR photon exclusion ($\Rightarrow 2\gamma \rightarrow \pi^0$)
- implementation of further decay modes
- usage of more particle properties ($\Rightarrow$ Kaon identification)
- ML approach