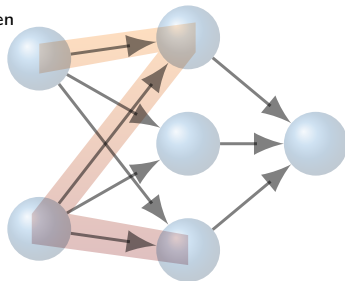# The Neural Network z-Vertex Trigger

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F2F tracking meeting
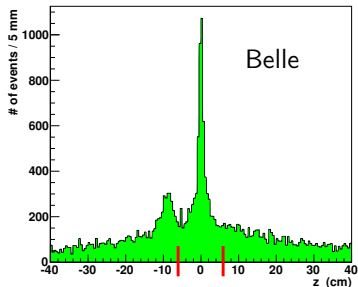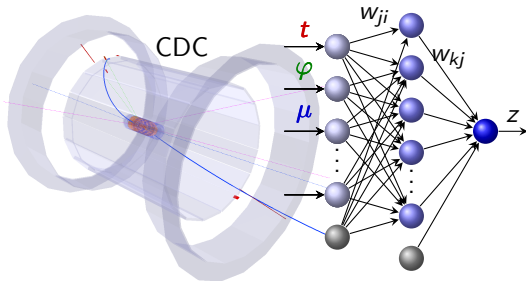Munich

Introduction

Motivation

- many background events outside IP
- more severe at Belle II (increased machine background)
- need $O(2\,\text{cm})$ z-resolution
- build z-vertex trigger at level 1 (Belle had no z-trigger)

Z distribution

Belle

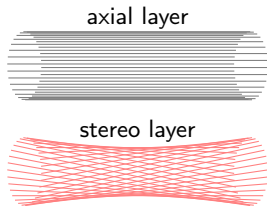offline z-vertex distribution

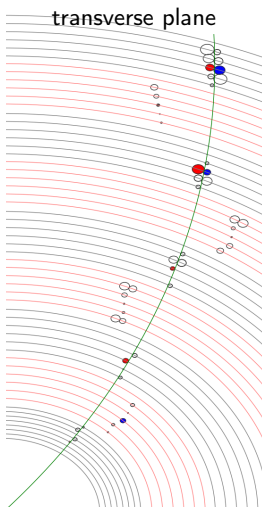CDC

t
φ
μ

w_{ji}

w_{kj}

z

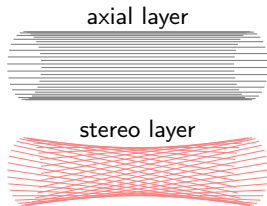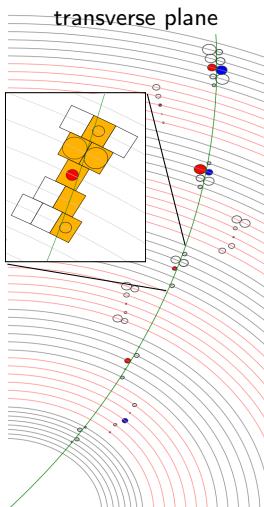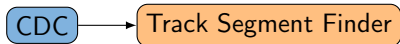## Neural Network

- robust deterministic pattern recognition

input CDC hit positions (φ, μ) and drift times (t)

output z estimate

CDC

transverse plane

axial layer

stereo layer

CDC → Track Segment Finder
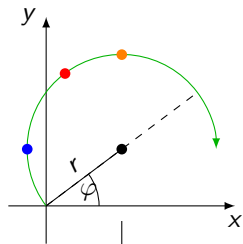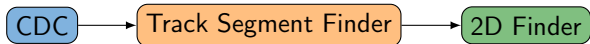

transverse plane

axial layer

stereo layer

transverse plane

axial layer

Hough

track

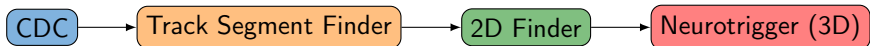# Track reconstruction at CDC Trigger

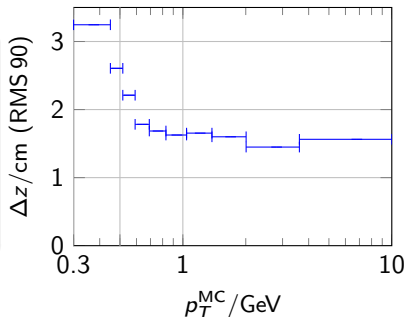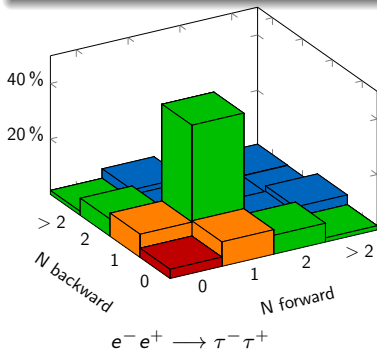# Neurotrigger results
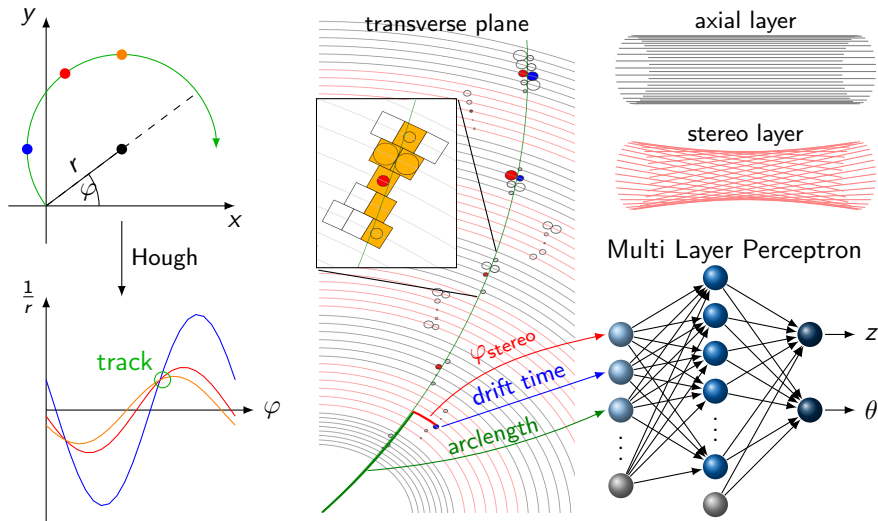
z-Vertex Resolution

- single track z-resolution estimate: RMS 90
- presently: only 2 networks for the full CDC (for + and - charged tracks)
- resolution O(2 cm)
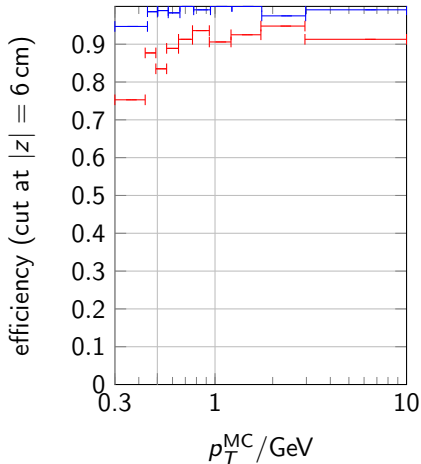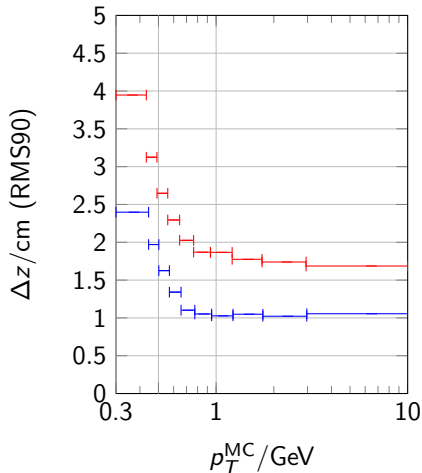

Benefit

- rescue low multiplicity events, e.g. $e^+e^- \to \tau^+\tau^-$
- without z trigger: 3 tracks required (≥ 1 in each hemisphere)
- with z trigger: only 2 tracks required
- potential efficiency increase by factor 3.9

$e^-e^+ \longrightarrow \tau^-\tau^+$

24 experts for different combination of charge and missing hits

− without BeamBkgMixer − with BeamBkgMixer

Summary

Status

- basf2 modules to train and run the neurotrigger
- training uses MCParticles as target
- good performance, but losses with background mixer

Work in progress

- alternatives to standard 2D Finder
- stereo hit selection (at the moment: per hit criterion based on distance to 2D track and drift time)
- general optimization of free parameters
- training on reconstructed tracks