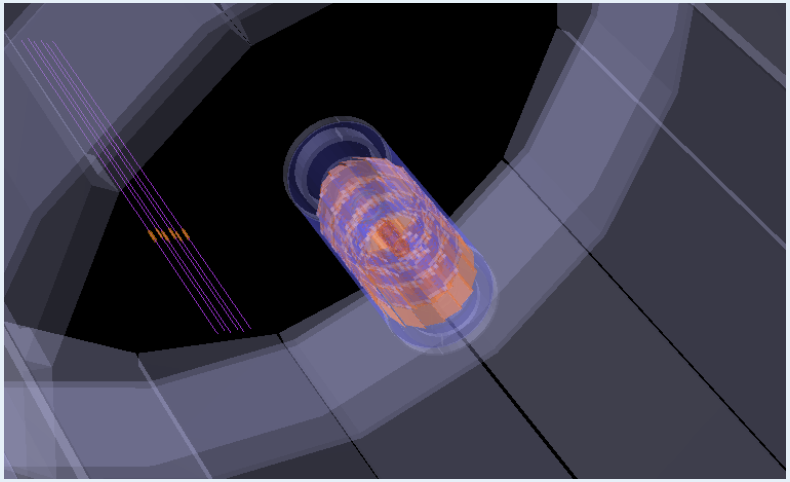
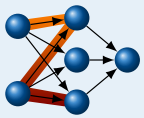


Cosmic Ray Test of the Belle II z-Vertex Trigger

DPG-Frühjahrstagung
Hamburg

2.3.2016

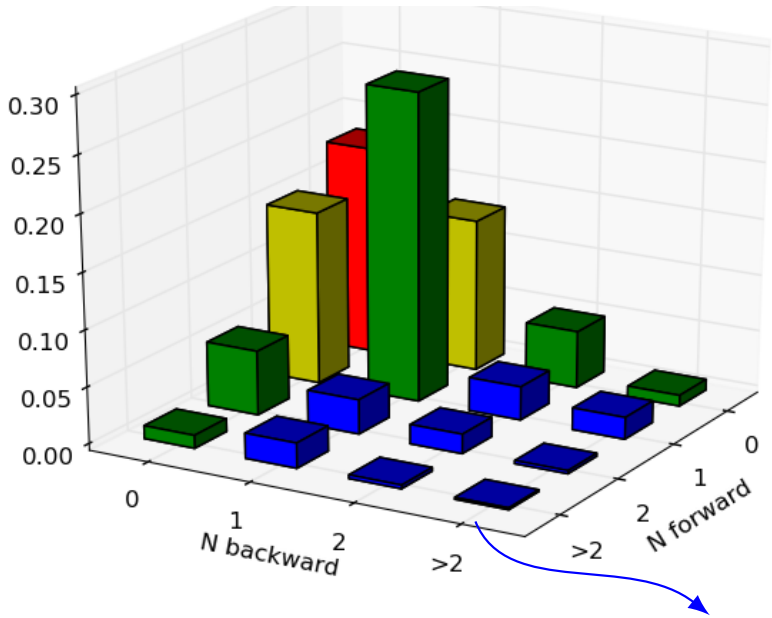


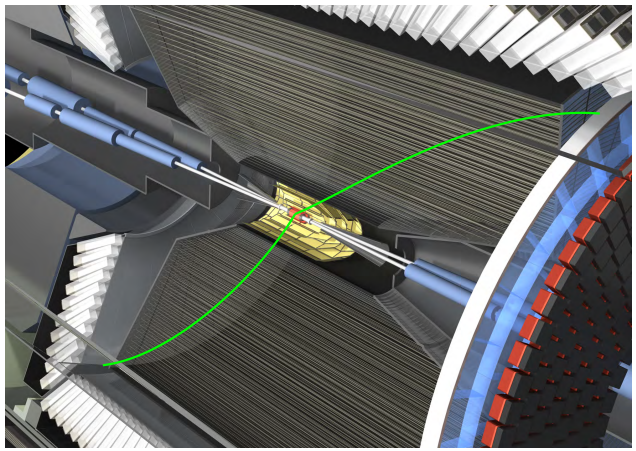
Neuro team
Y. Chen, C. Kiesling, **S. Neuhaus**, S. Skambraks

Trigger for low track multiplicity

- SuperKEKB: increased luminosity and background compared to KEKB
- standard CDC trigger: minimum track multiplicity, match to ECL

$$e^- e^+ \to \tau^- \tau^+$$



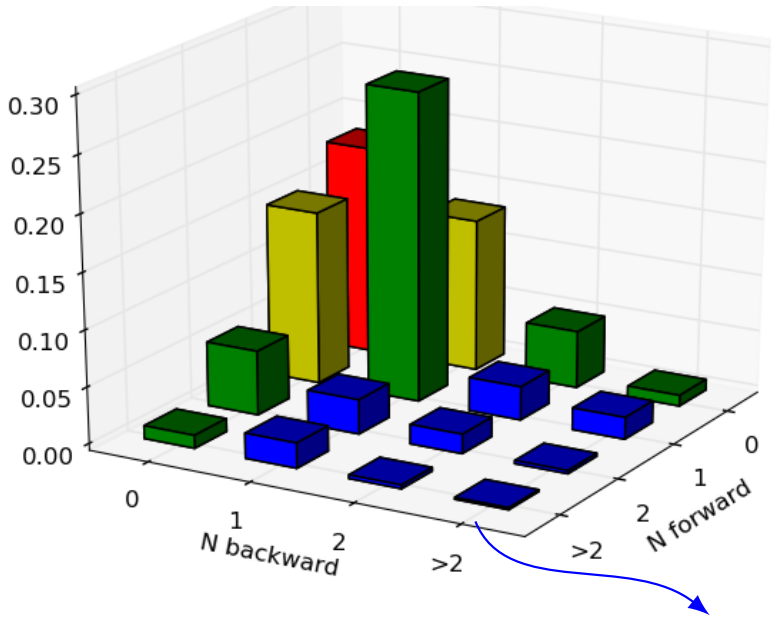


$\geq$ 3 tracks, forward/backward: only 13 %

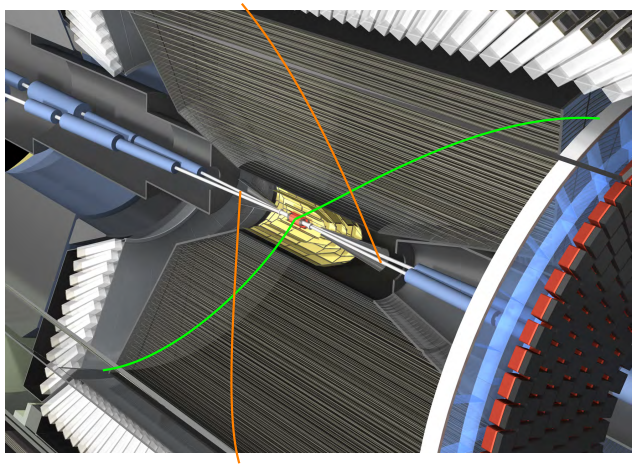
Trigger for low track multiplicity

- SuperKEKB: increased luminosity and background compared to KEKB
- standard CDC trigger: minimum track multiplicity, match to ECL

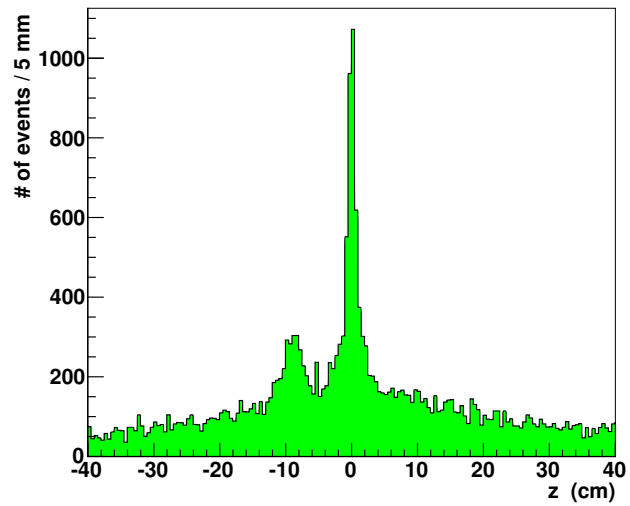
$$e^- e^+ \rightarrow \tau^- \tau^+$$



$\geq$ 3 tracks, forward/backward: only 13 %



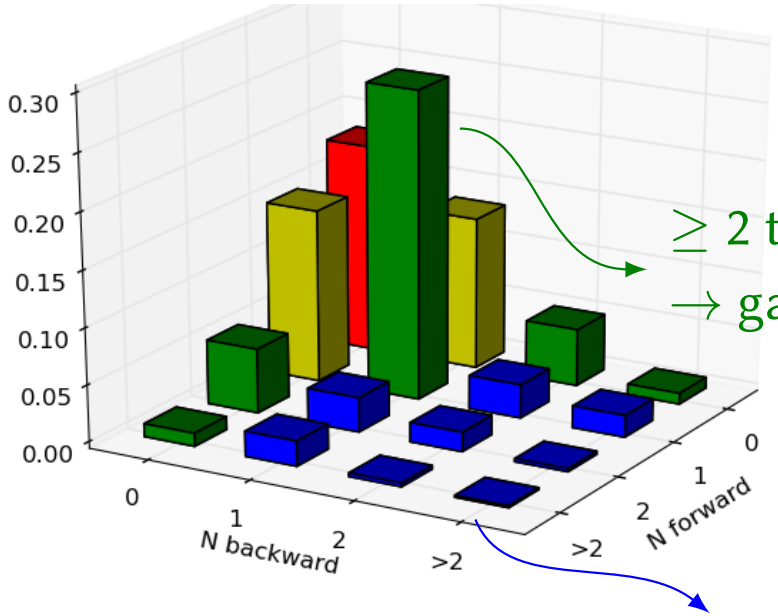
Z distribution recorded in Belle



Trigger for low track multiplicity

- SuperKEKB: increased luminosity and background compared to KEKB
- standard CDC trigger: minimum track multiplicity, match to ECL

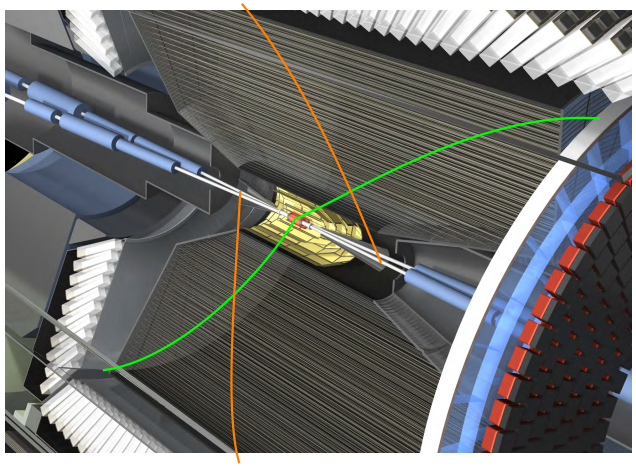
$e^- e^+ \to \tau^- \tau^+$



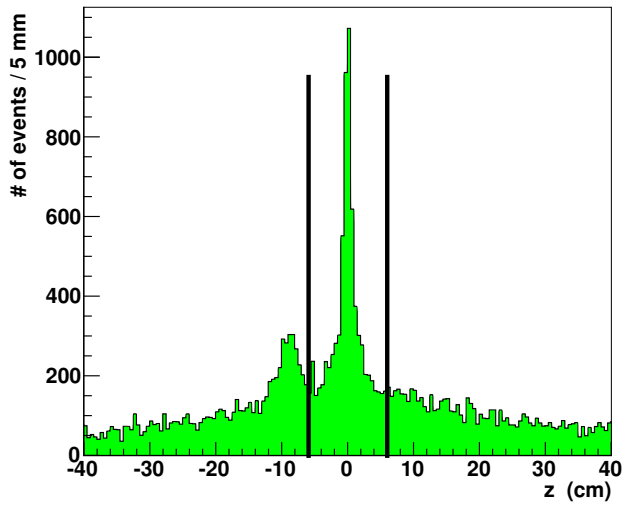
$\geq$ 2 tracks: 53 %

$\to$ gain factor 4

$\geq$ 3 tracks, forward/backward: only 13 %



Z distribution recorded in Belle

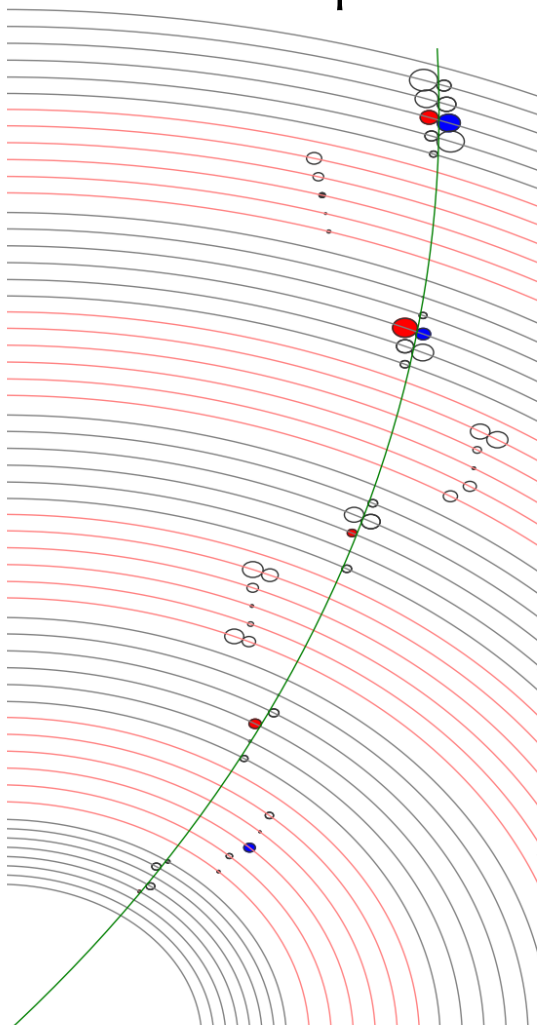


- z-vertex resolution 2 cm $\to$ cut at $\pm$6 cm
- pure 2 track trigger possible

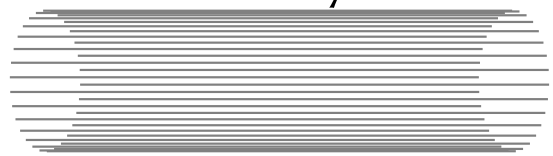
Track reconstruction at CDC Trigger

CDC

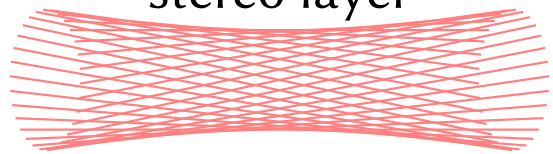
transverse plane



axial layer



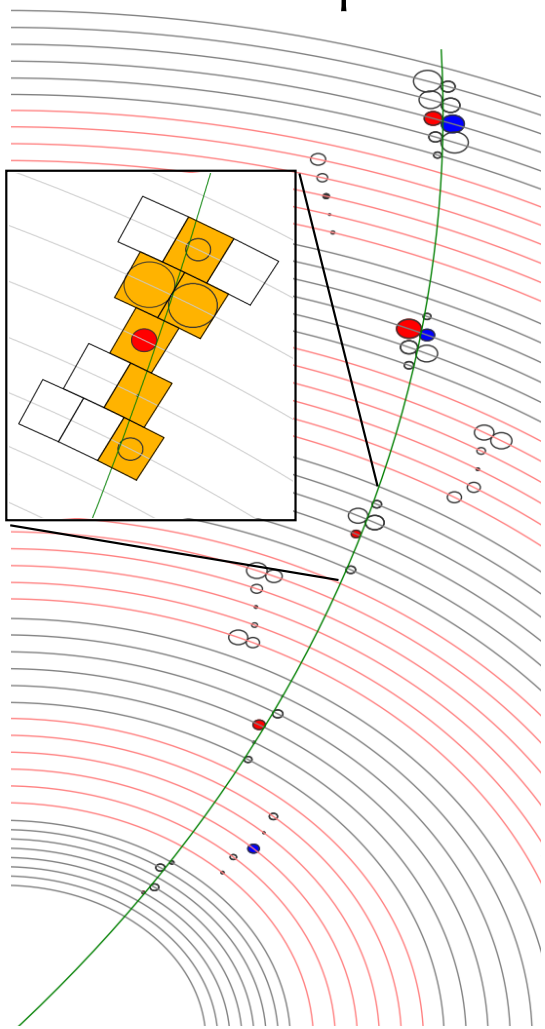
stereo layer



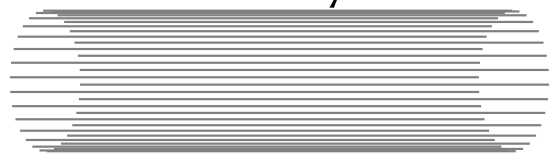
Track reconstruction at CDC Trigger

CDC → Track Segment Finder

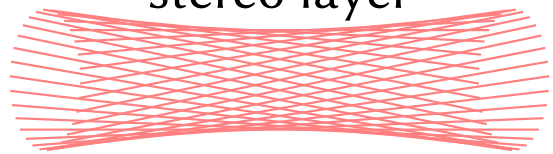
transverse plane



axial layer

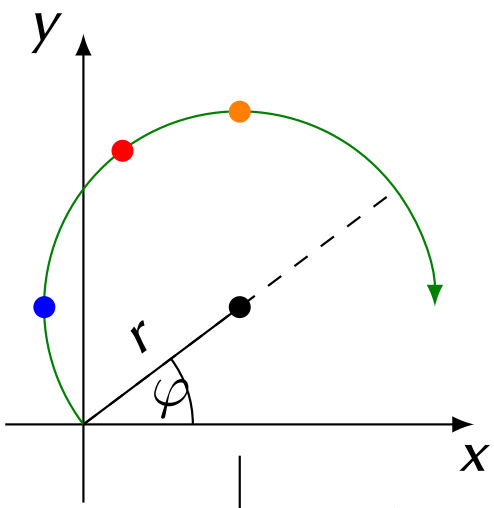


stereo layer

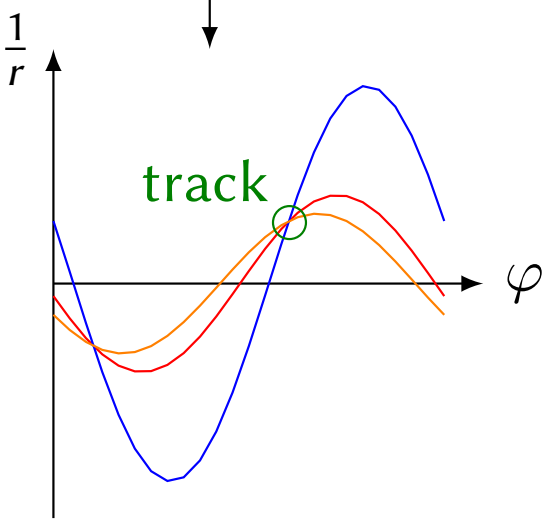


Track reconstruction at CDC Trigger

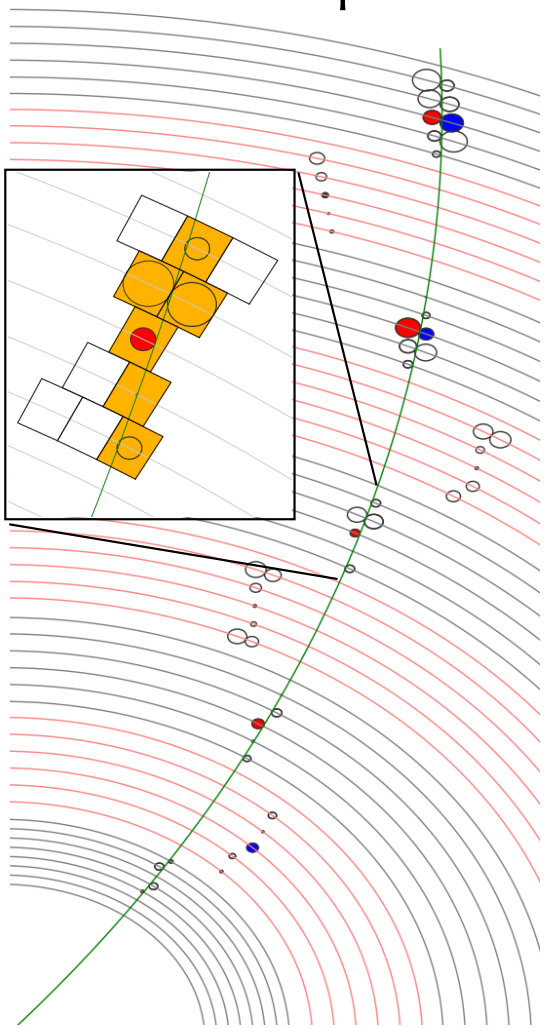
CDC → Track Segment Finder → 2D Finder



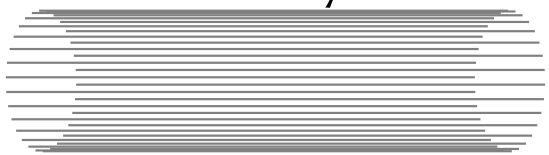
Hough



transverse plane

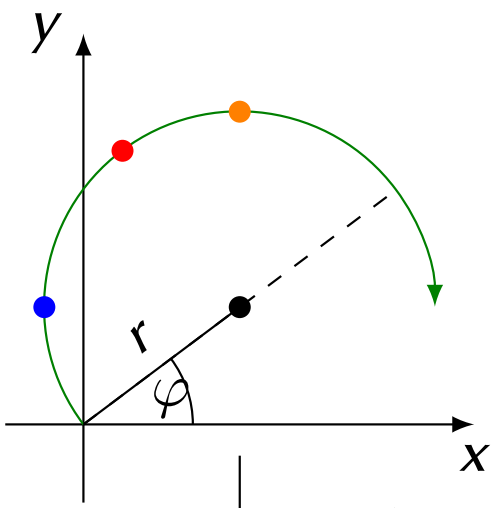


axial layer

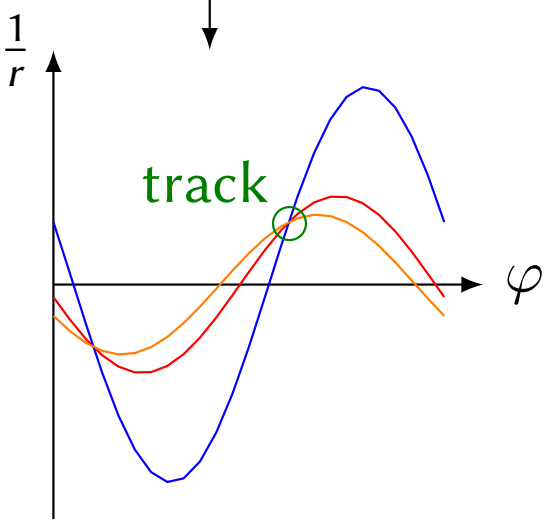


Track reconstruction at CDC Trigger

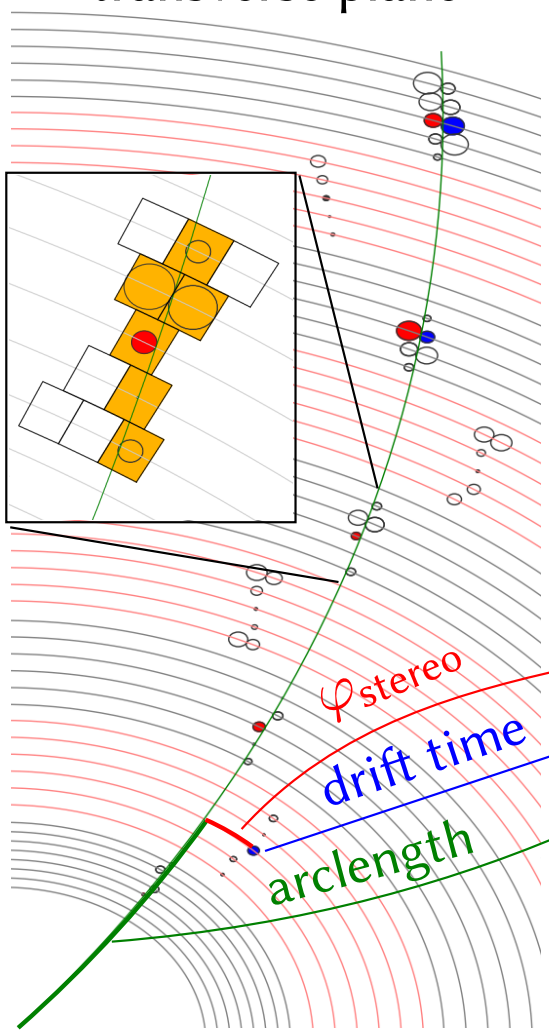
CDC → Track Segment Finder → 2D Finder → Neurotrigger (3D)



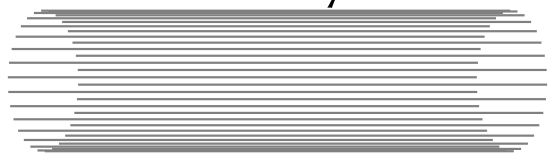
Hough



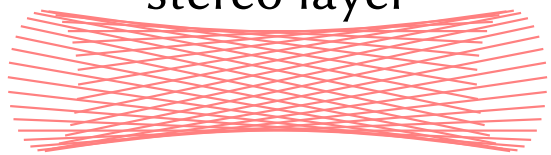
transverse plane



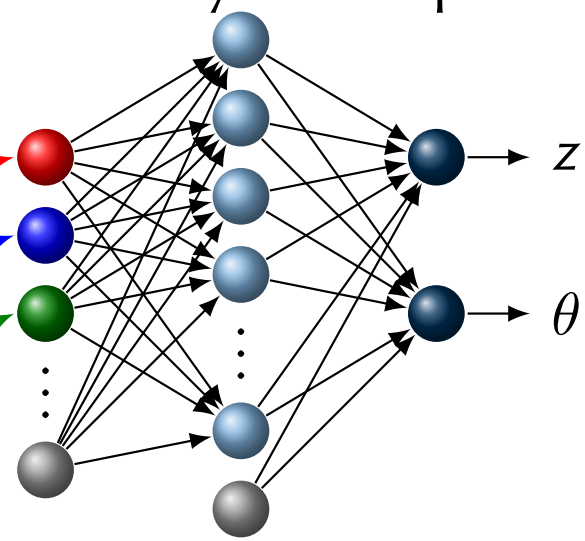
axial layer



stereo layer

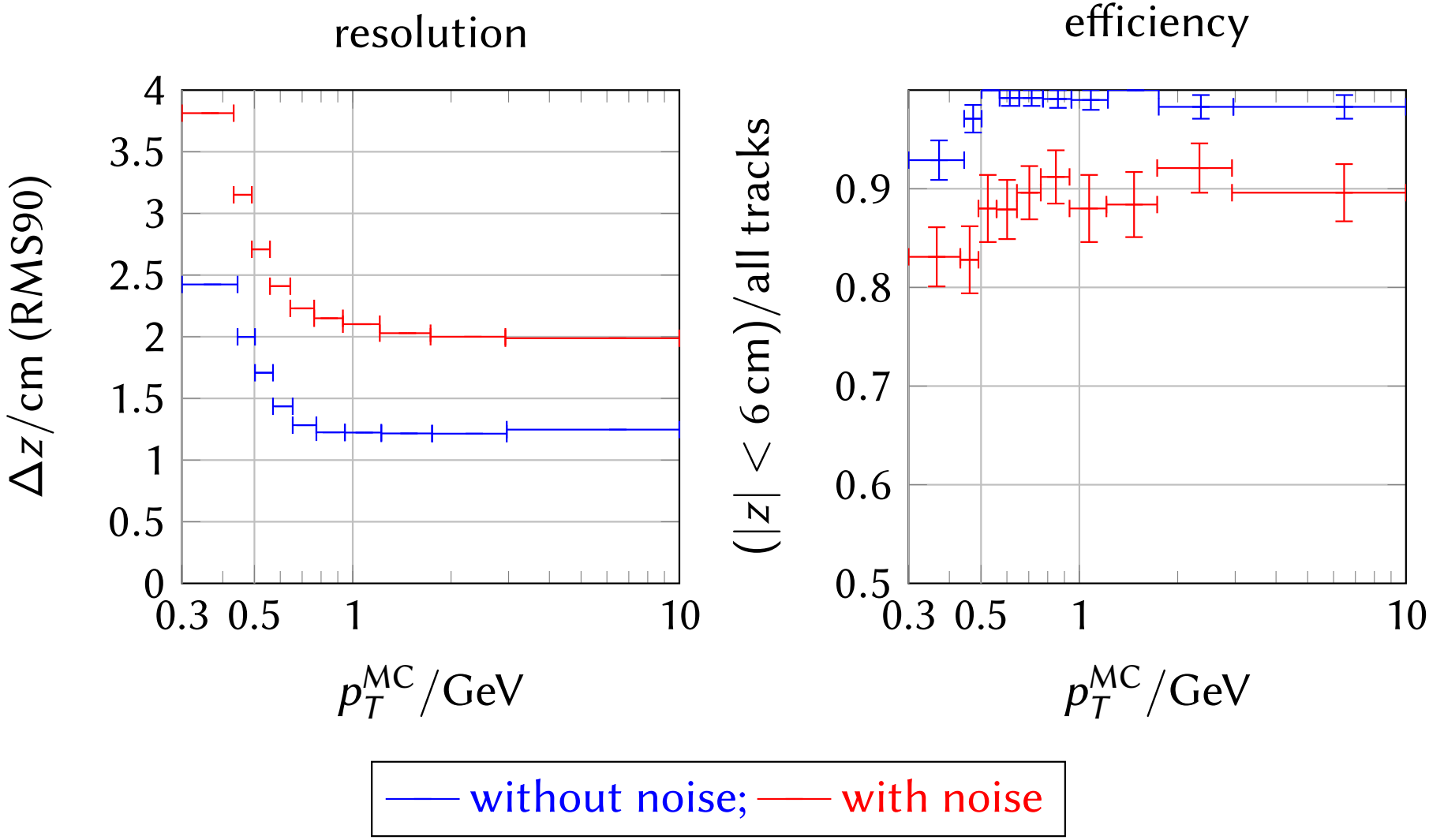


Multi Layer Perceptron



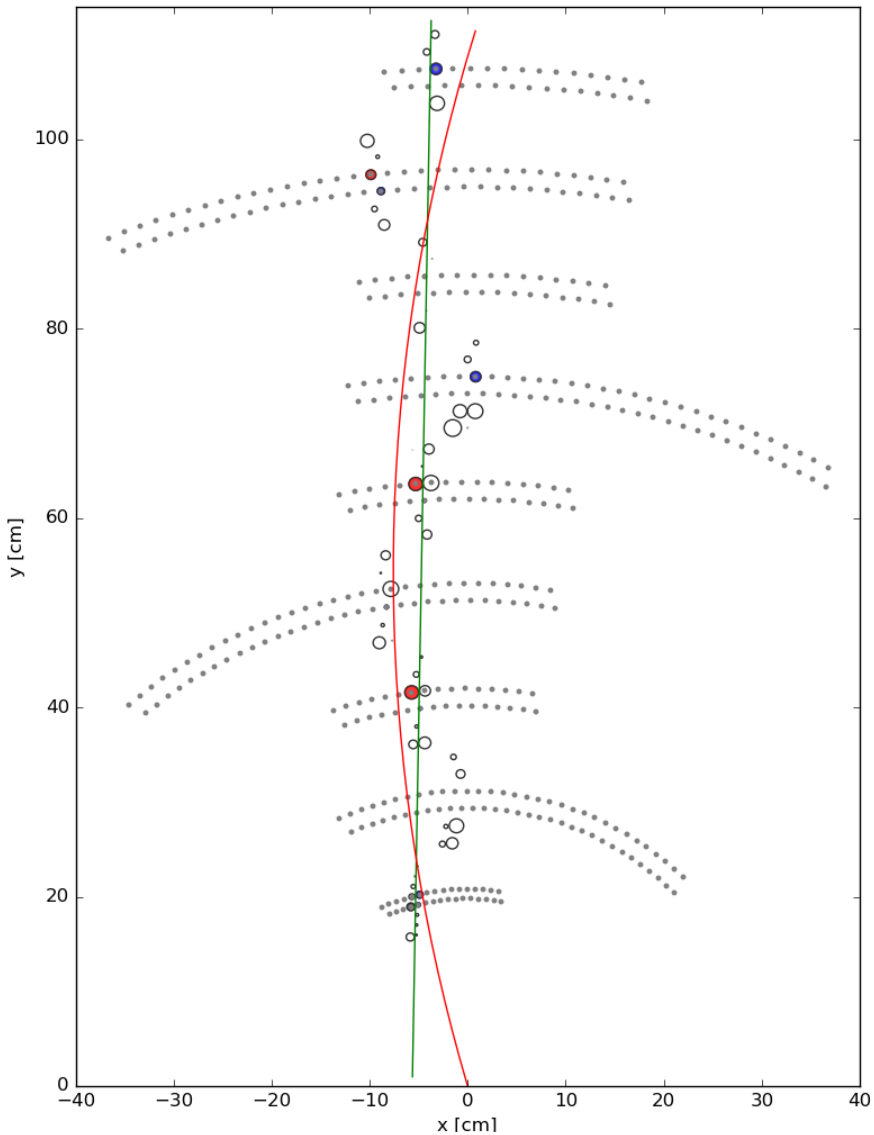
Neurotrigger results

charge dependent expert MLPs → select weights based on 2D track



Cosmic ray test setup

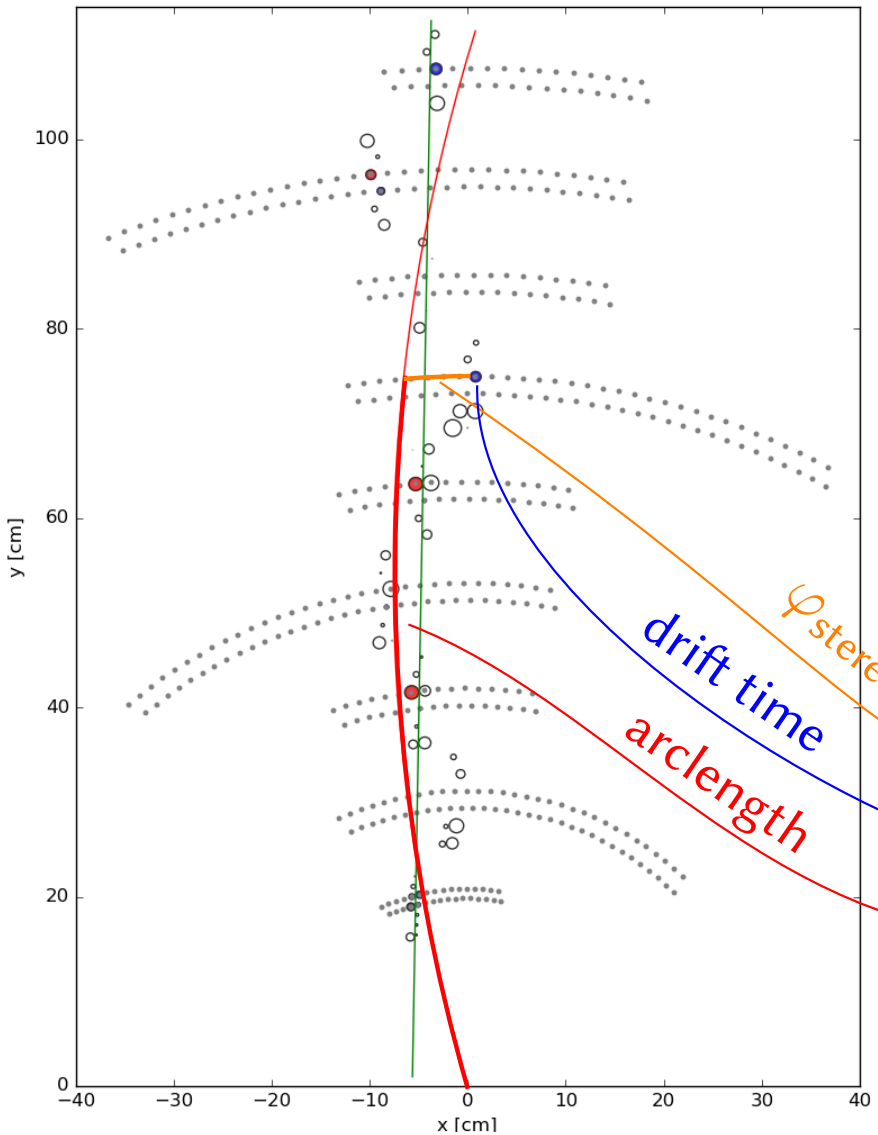
upper sector



- 18 % of CDC wires connected (2 vertical sectors)
- no magnetic field → straight tracks
- 2D Finder: origin constraint
- transverse offset → curvature

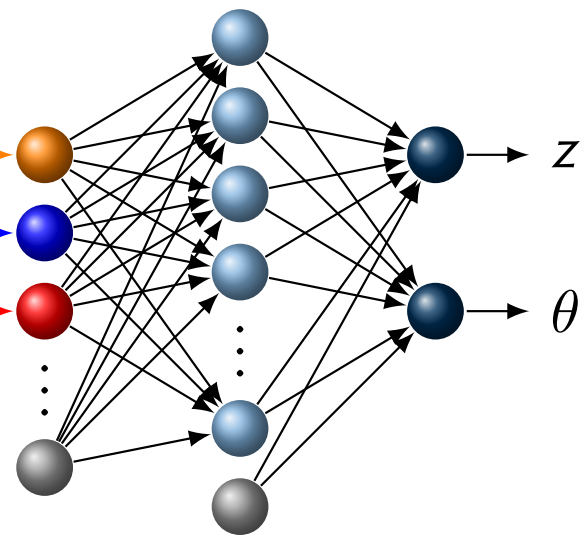
Cosmic ray test setup

upper sector



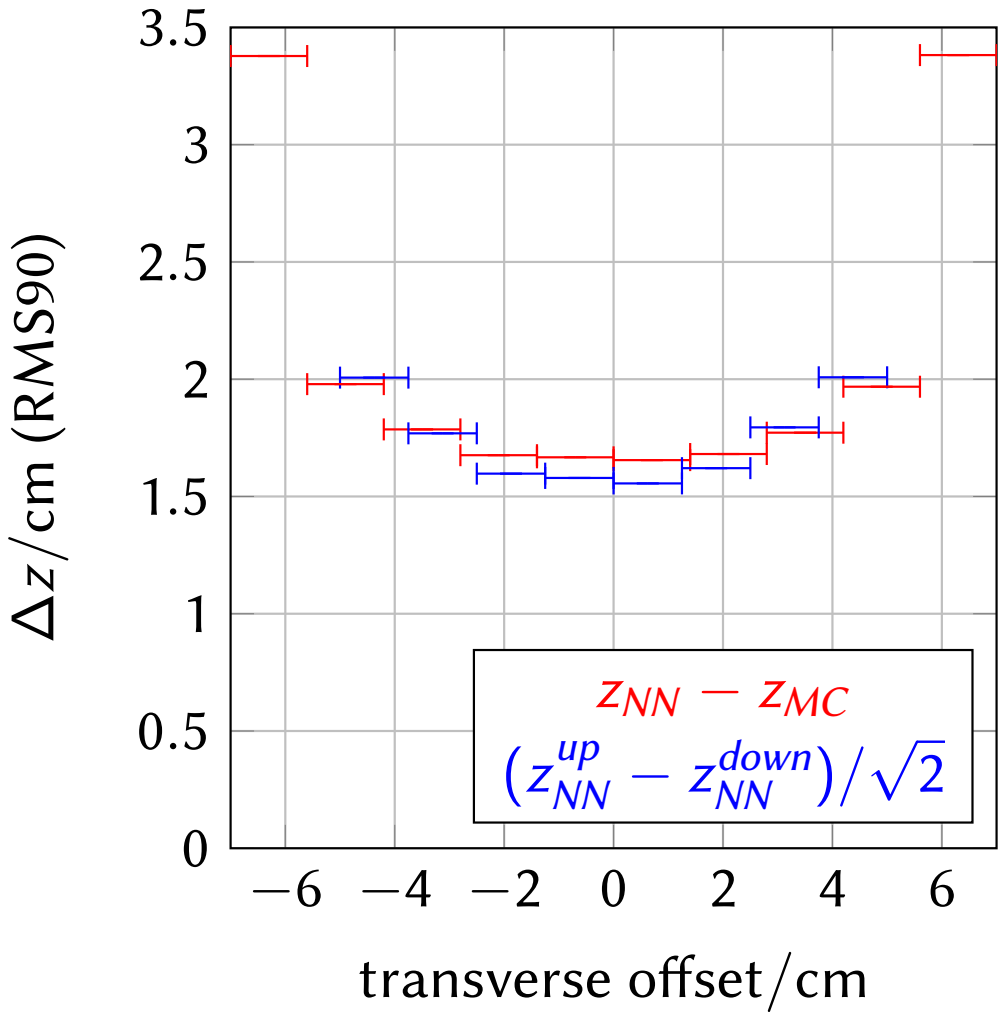
- 18 % of CDC wires connected (2 vertical sectors)
- no magnetic field → straight tracks
- 2D Finder: origin constraint
- transverse offset → curvature

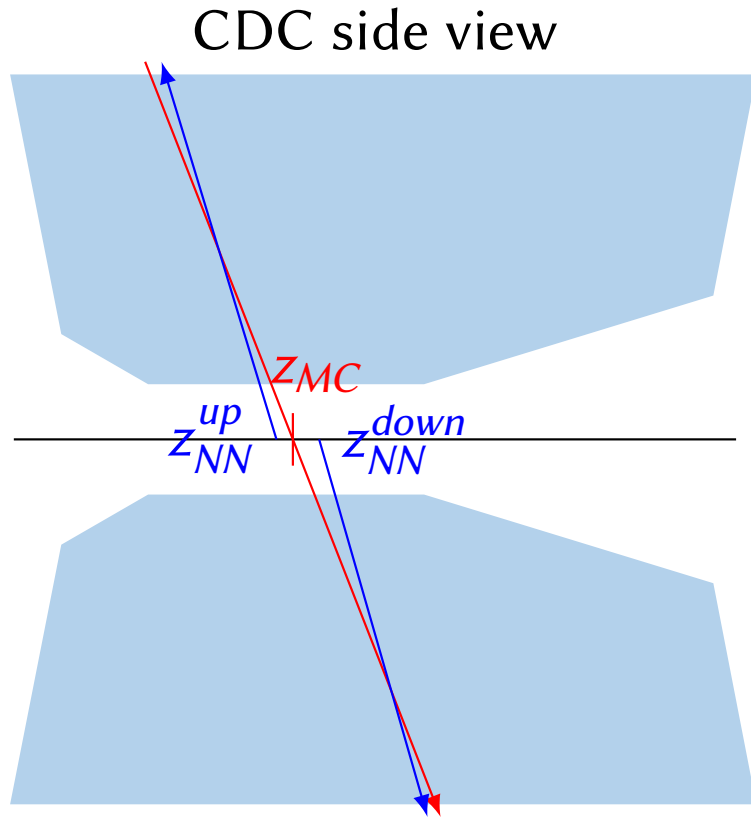
Neurotrigger:
retrain without change of model

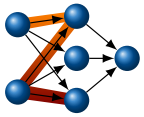


Simulation results

"back to back" tracks → MC free z resolution







Summary

- L1 z-vertex trigger for Belle II with $\mathcal{O}(\mathrm{cm})$ resolution
- MLP with 2D track parameters as input and z as output
- training on examples $\rightarrow$ easy adaptation to different geometry
- work on preprocessing to suppress noise
- first results from cosmic rays with full trigger expected end of April

Thank you for your attention!