Performance of the Belle II z-Trigger under Luminosity Conditions: First Experience

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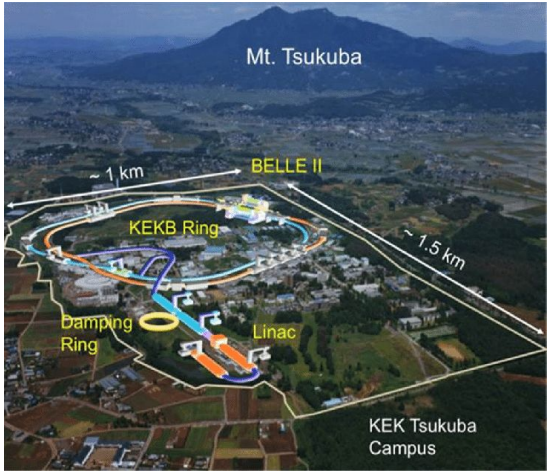
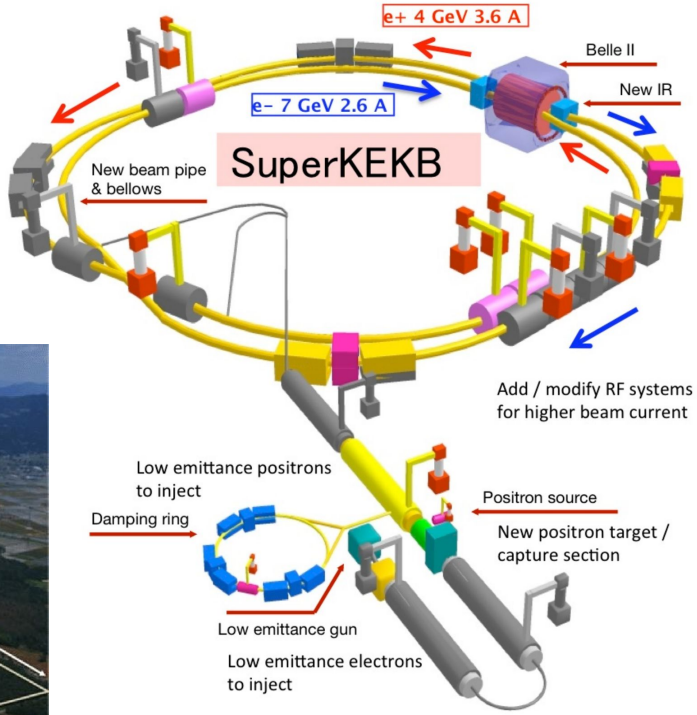
The Belle II Experiment

- Located at the SuperKEKB in Tsukuba, Japan
- asymmetric e+/e- collider operating at 10.58GeV (γ_{4s}-resonance for B-meson pair production)





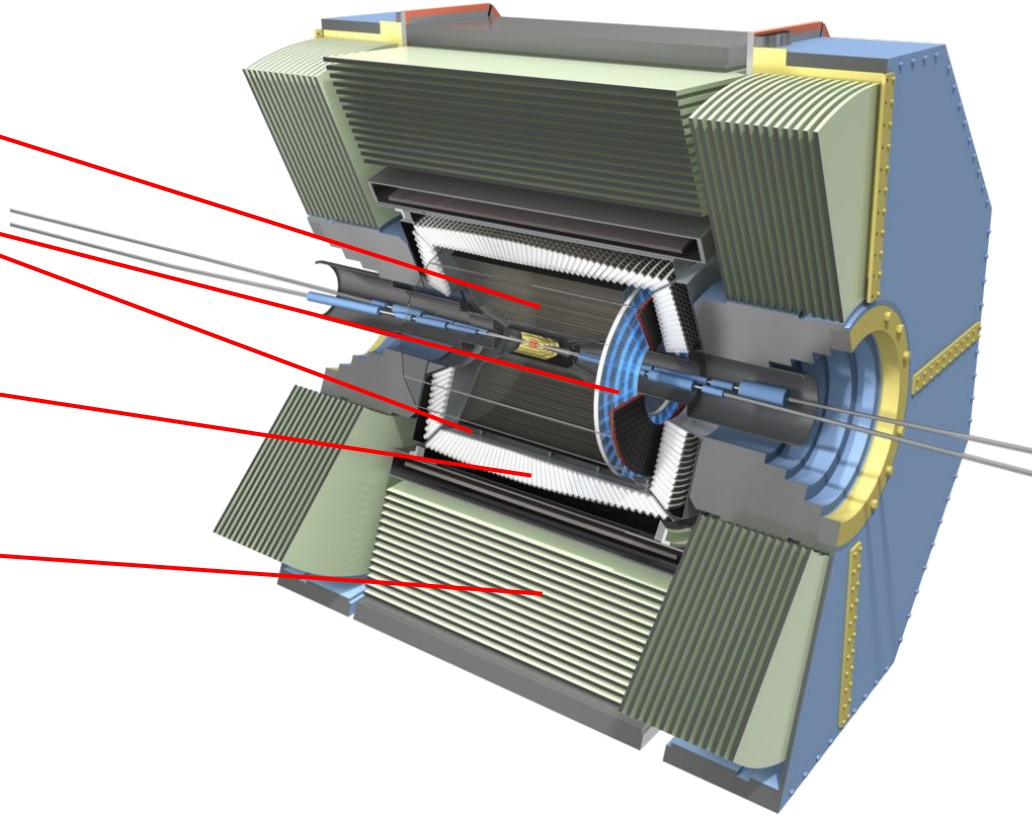
The Belle II L1 Trigger System

Central Drift Chamber (CDC)

Particle Identification (PID) (TOP + ARICH)

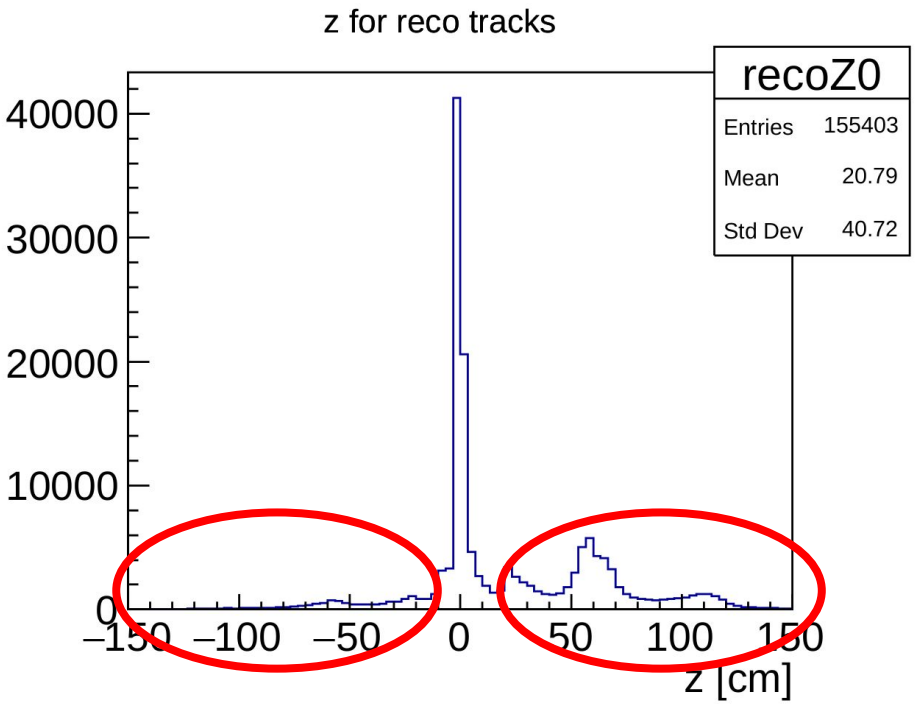
Electromagnetic Calorimeter (ECL)

Scintillator Based KLong and Muon Detector (KLM)

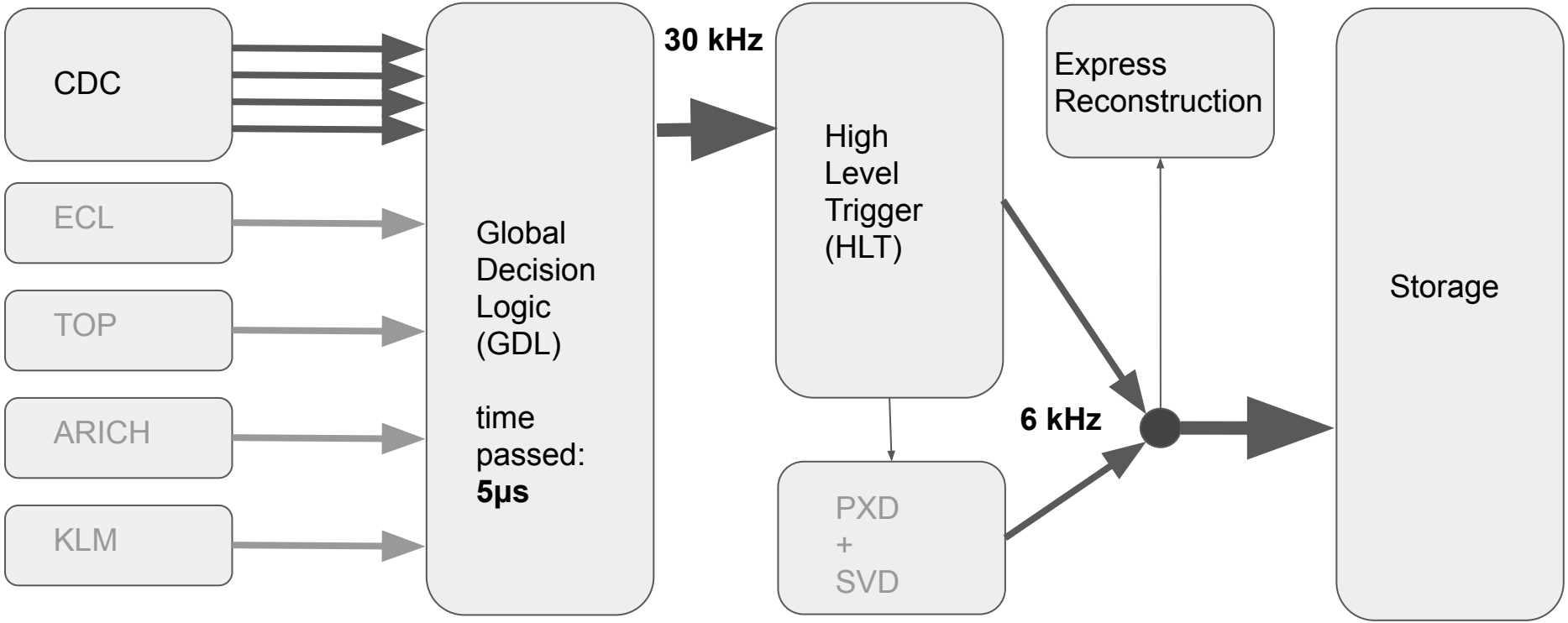


CDC: The Neurotrigger

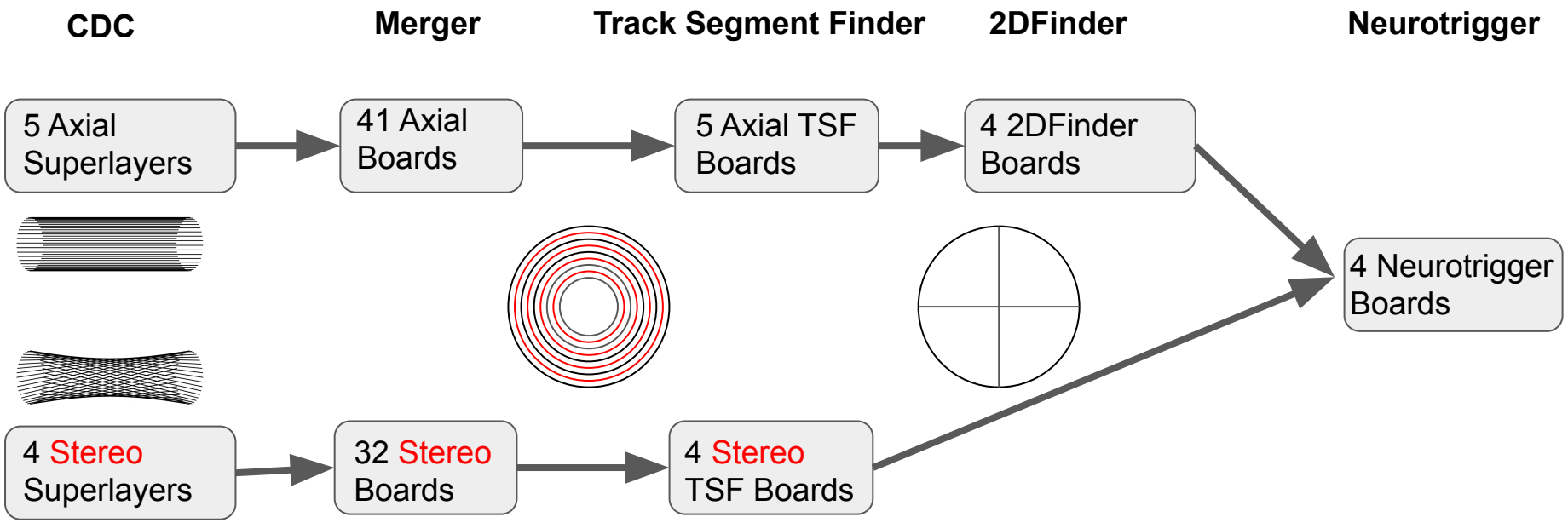
- The Neurotrigger is a first level track trigger
- It is able to filter tracks from outside the interaction region



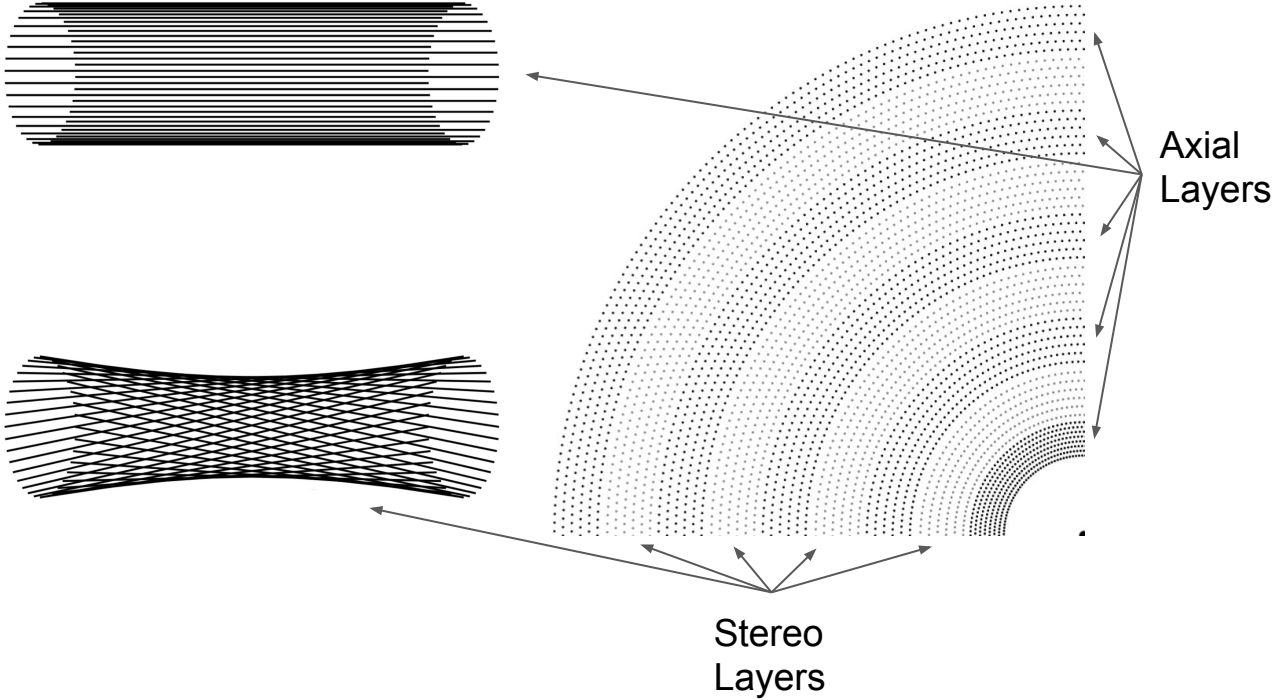
The Trigger System and Data Flow



The CDC Data Flow

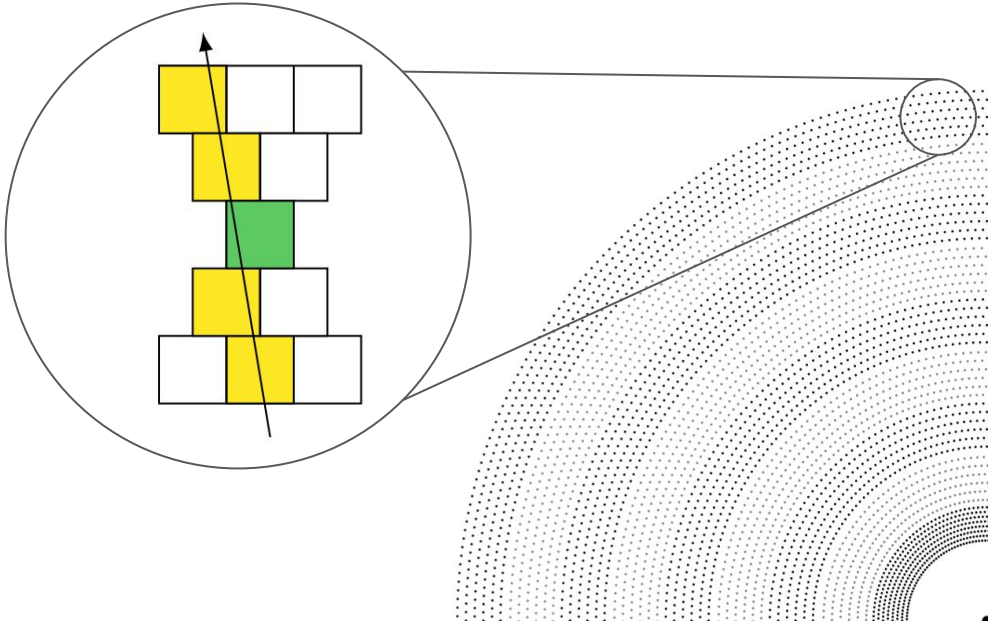


Central Drift Chamber (CDC)



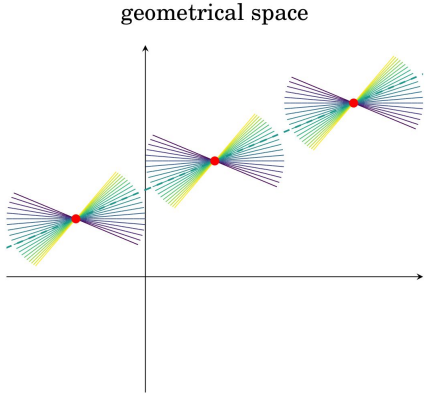
- 56 wire layers, total of 14436 sense wires
- divided into 9 Superlayers (5 Axial, 4 Stereo)

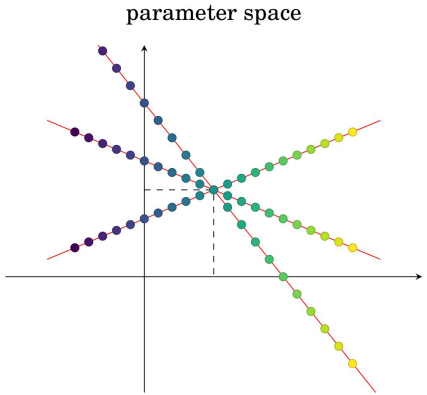
The Track Segment Finder

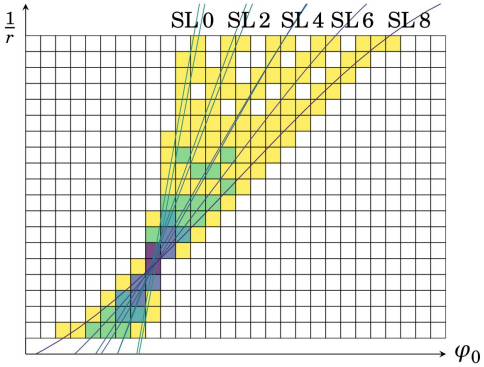


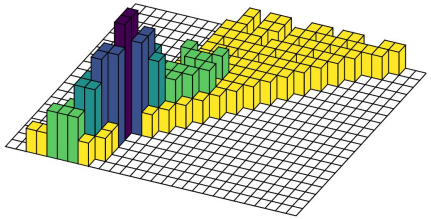
- Used for data reduction / background suppression
- Find hit patterns “Track Segments” within Superlayers (SL)
- 4 out of 5 Wire Layers in a SL need a Hit
- Outputs Track Segment Number, left/right information and the time of the priority wire (green)

The 2D Finder



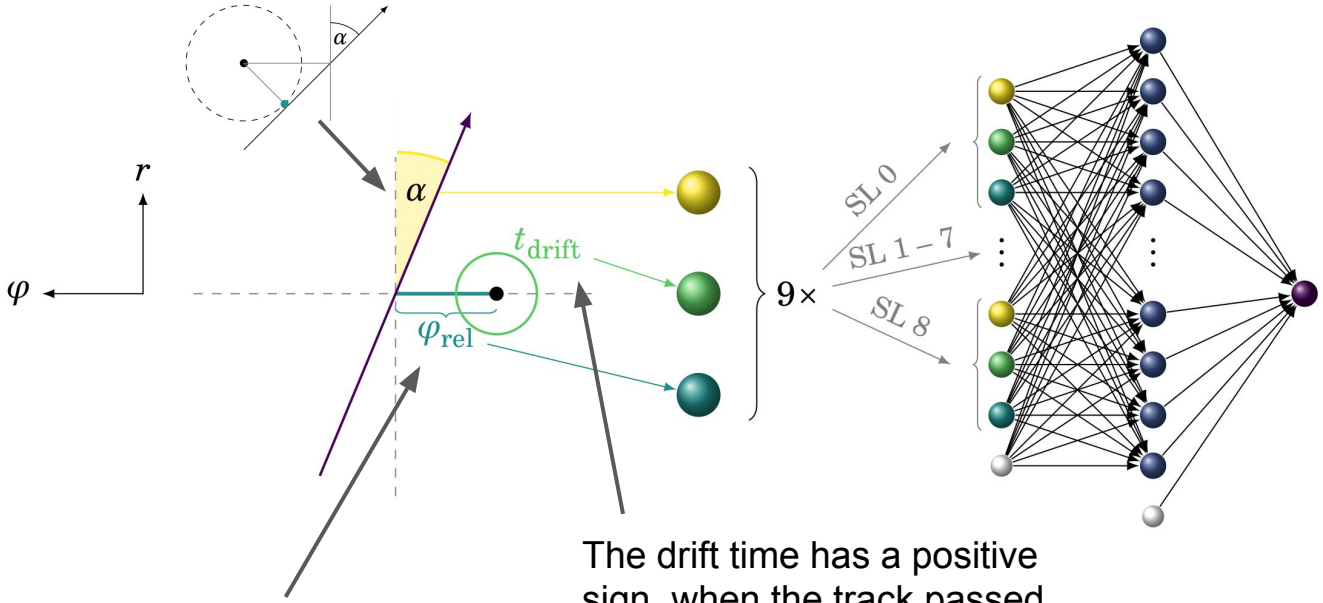






- Finds 2-dimensional Tracks without z-information
- Takes only Axial Track Segments as Input
- Uses the Hough-Transformation: Every Point in the geometrical space corresponds to a line in the parameter space
- **only when a 2D-Track is found, the Neurotrigger starts**

The Neurotrigger



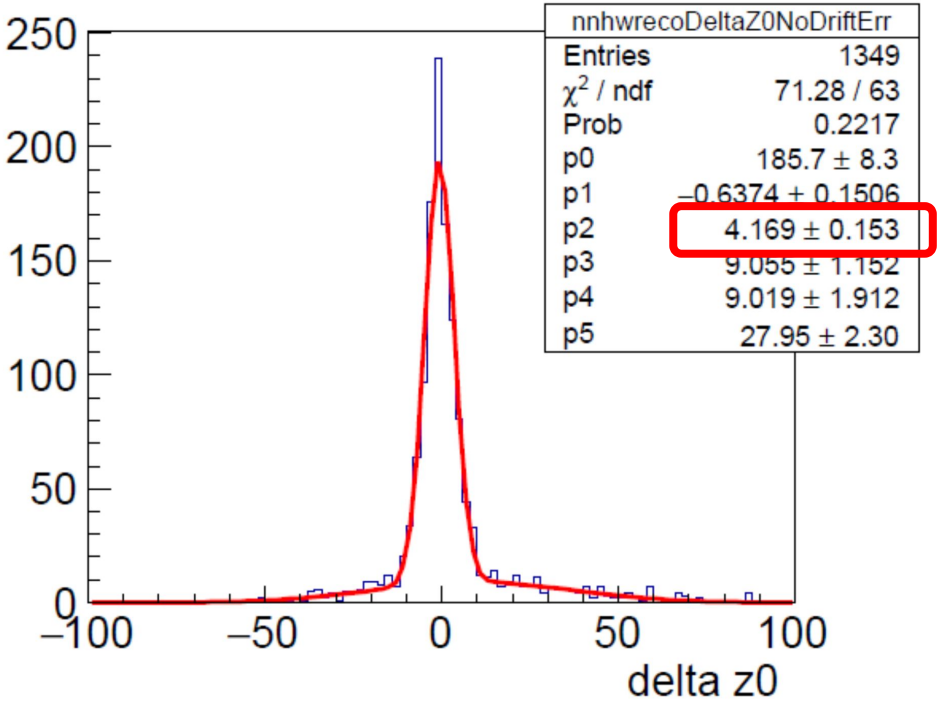
Delta φ relative to the 2DTrack. For Axial TS this is 0.

The drift time has a positive sign, when the track passed on the right side, and a negative sign if it passed on the left.

- Multilayer Perceptron with 1 hidden layer
- Inputs:
  - Crossing angle
  - Drift time
  - φ relative to 2DTrack
- Outputs:
  - z vertex
  - θ angle

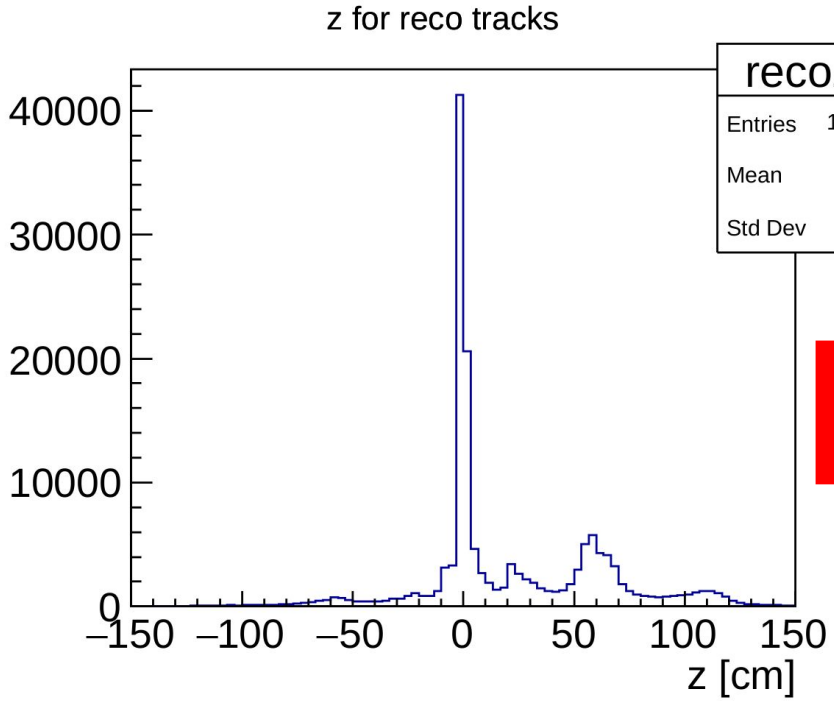
The Neurotrigger - z-Resolution in Hardware

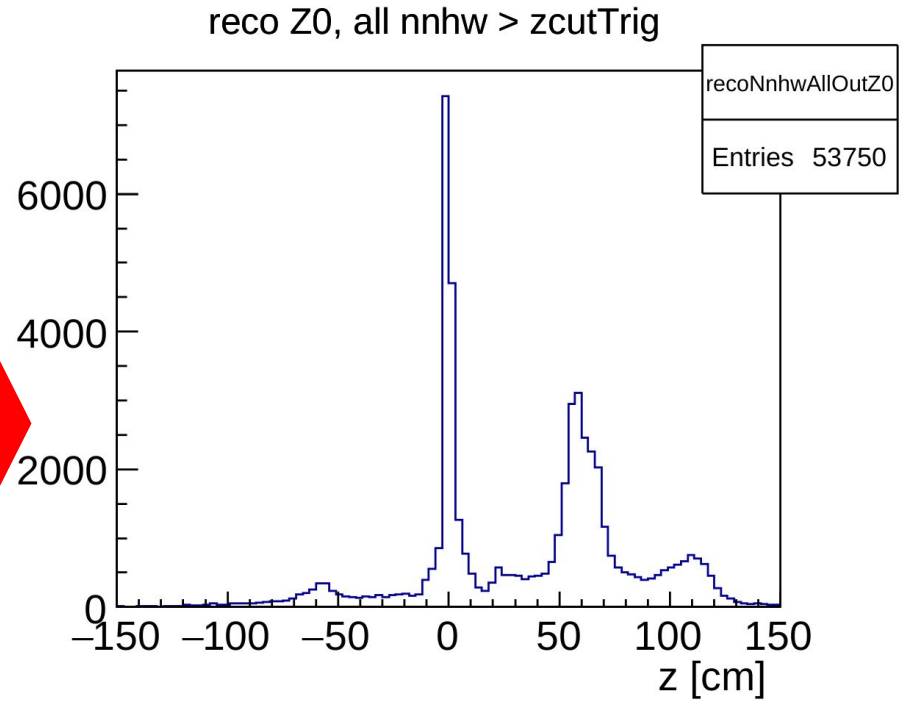
- Delta-z resolution plot for Neurotrigger results and matched reconstructed tracks
- The fitted Gaussian returns a standard deviation of $\sigma = 4.2$cm



Rejection for |z| < 35cm

Simple trigger logic: every track outside 35cm of the interaction point is rejected





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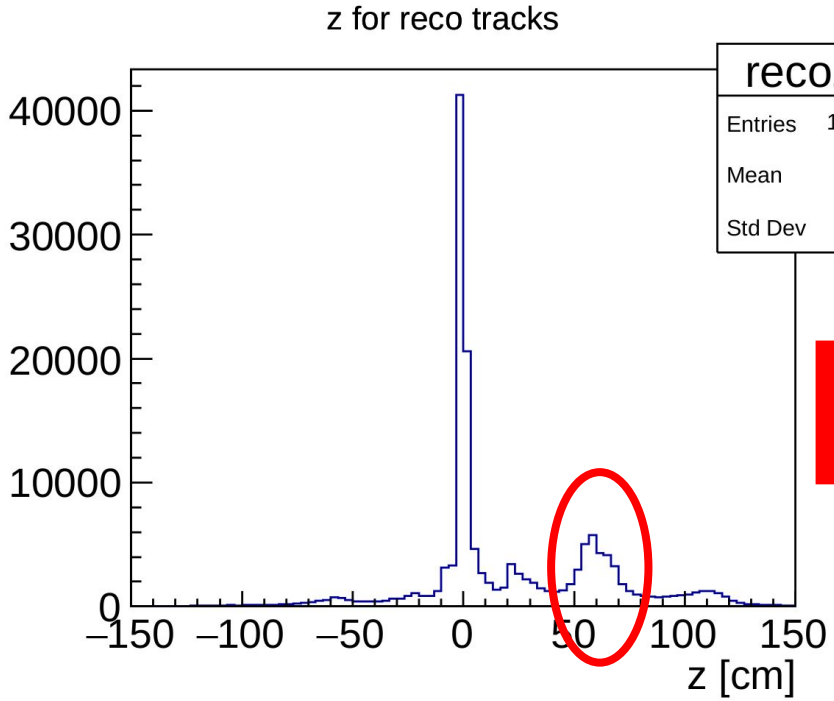

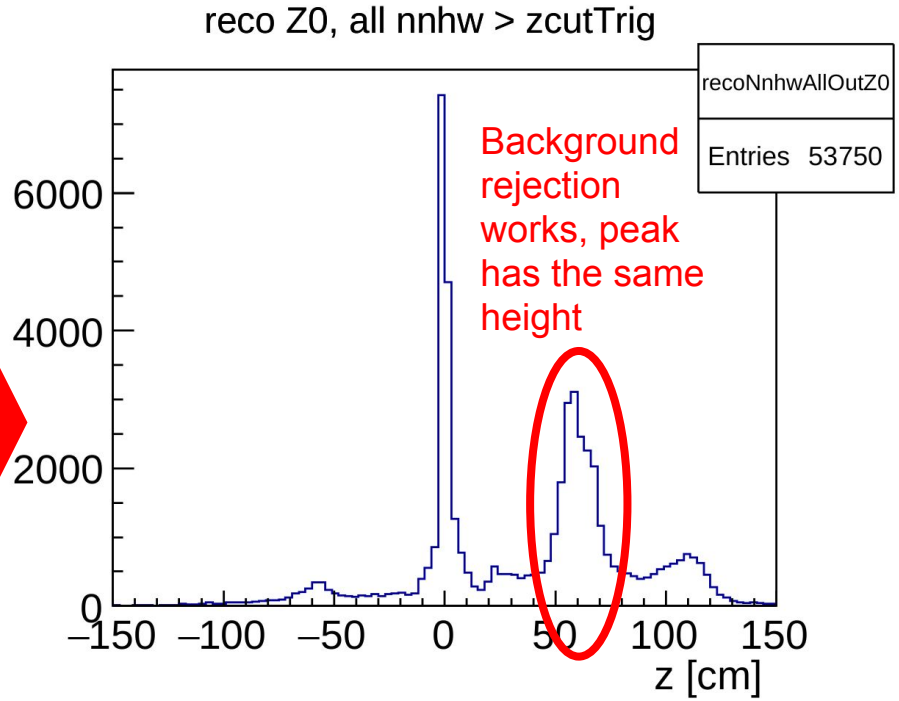

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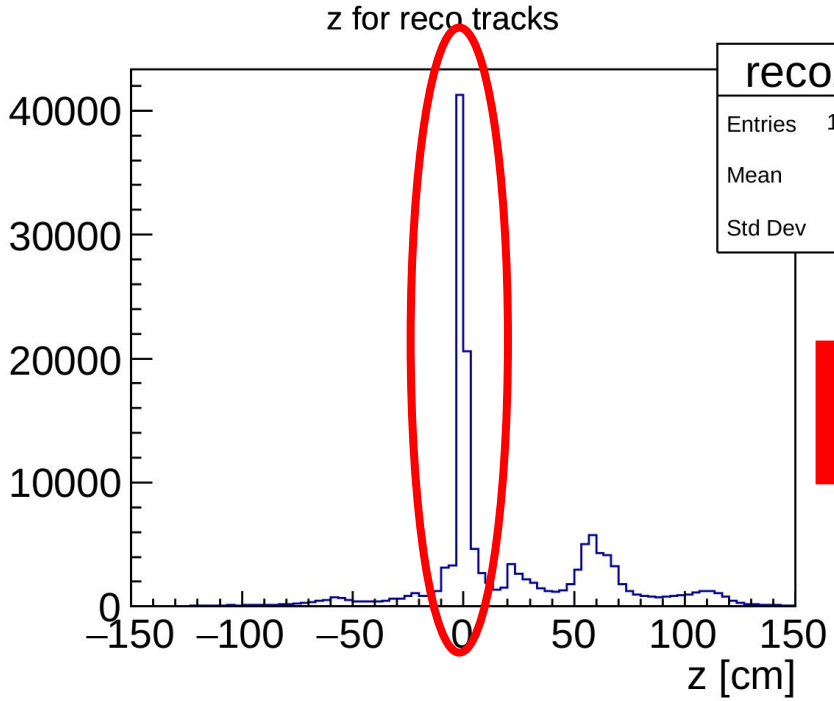

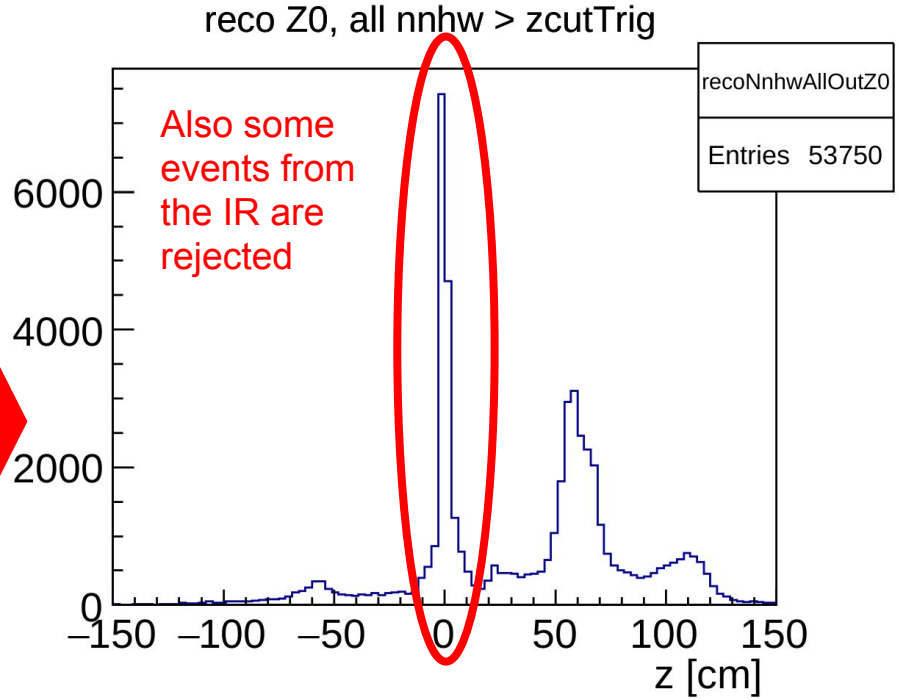

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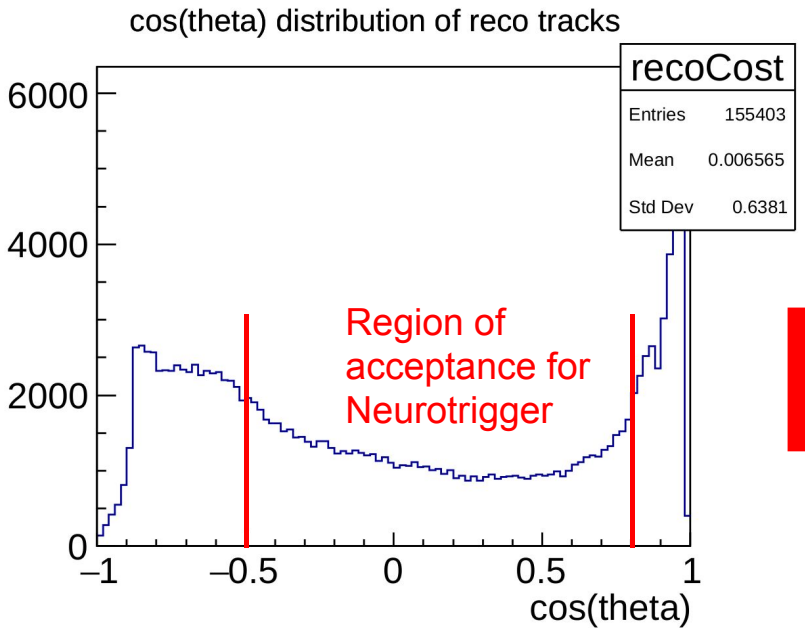

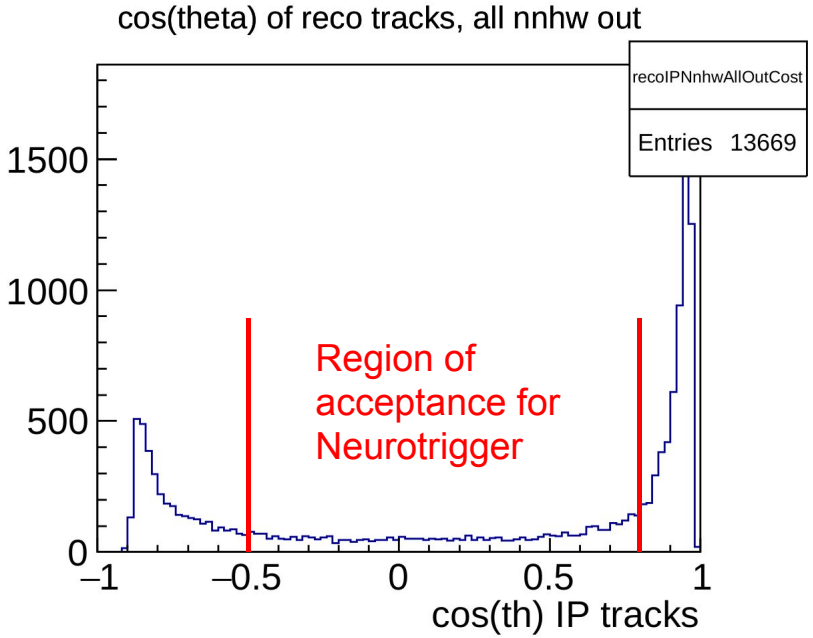

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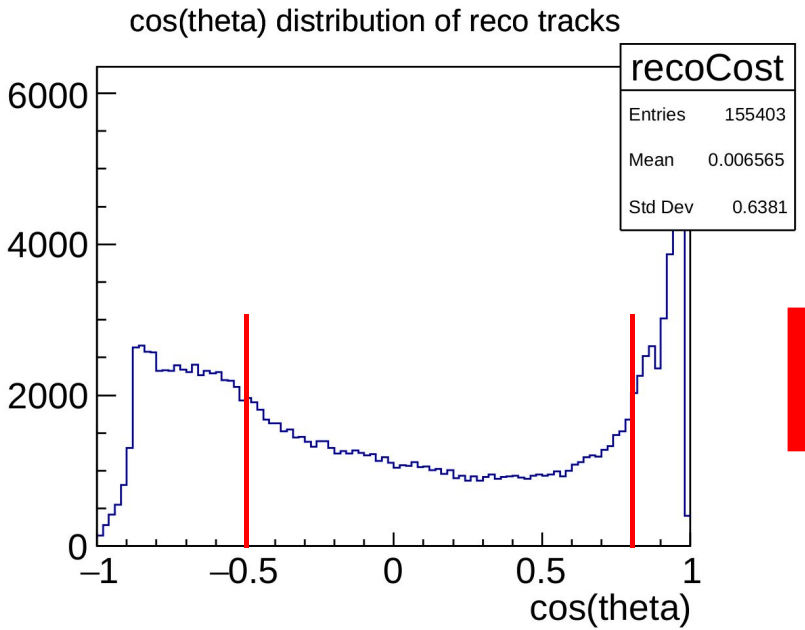

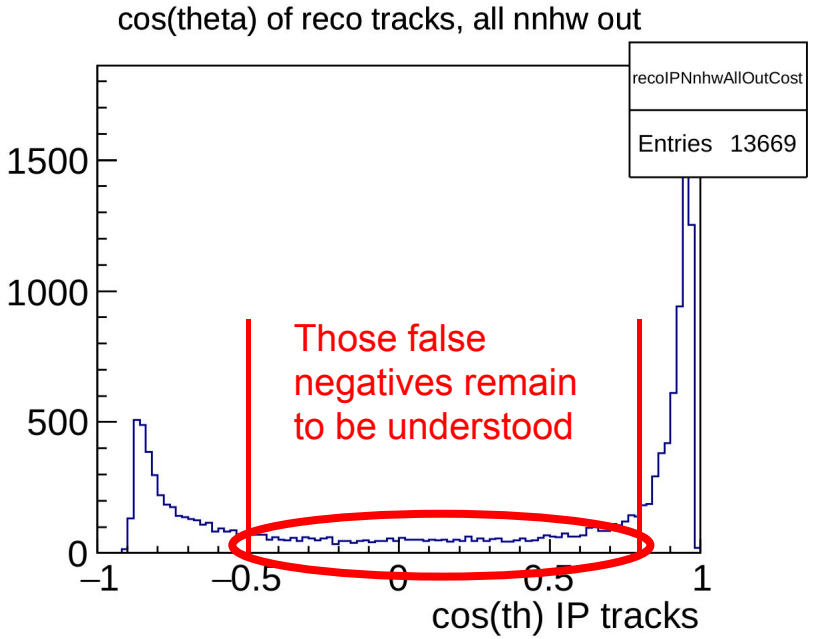

Conclusions and Outlook

- With the Neurotrigger, a great background reduction is possible
- We still need to understand, where the false negatives are coming from
- Next step: Move from track based to event based trigger decisions and implement 2-track trigger algorithms
- Tomorrow there will be a talk from Sebastian Skambraks about improving the 2D-Finder to a 3D-Finder

Thanks for Your Attention!