

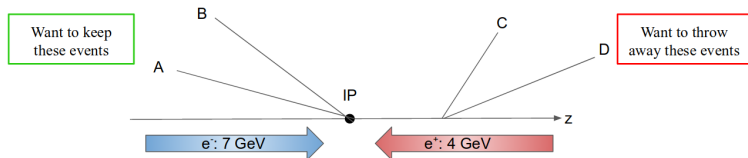
Optimizing the z-Vertex Neural Network Trigger for the Belle II Experiment

Sara McCarney - Young Scientist Workshop, Ringberg Castle

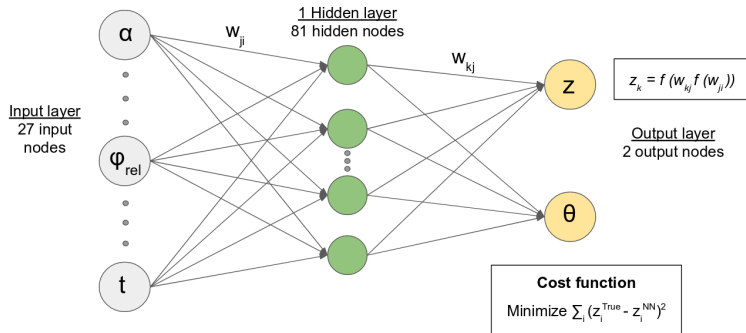
23/07/2019

z-Vertex Trigger

- Physically interesting reactions come from IP
- High rate of background displaced along z-axis
- Reconstruct 'z-vertex' to throw away these events



z-Vertex Neural Network



Software simulation studies

1. Train Neural Networks with Monte Carlo Particles
2. Neural Network trigger can be simulated in SW
3. The output of the trigger can be compared to their true values to obtain resolutions

Software simulation studies

3 studies:

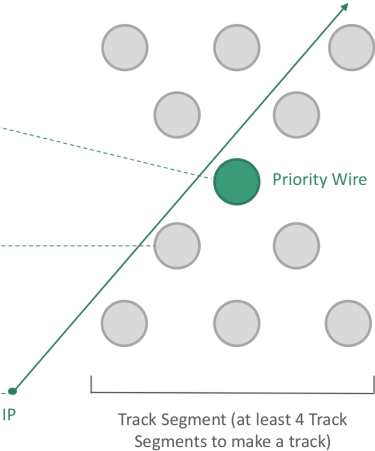
1. Event time option
2. Training in enlarged region
3. Training with more data

Event time selection

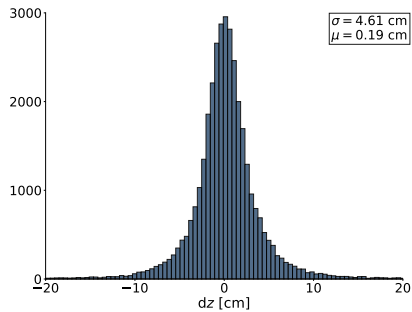
Fastest Priority Time
The timing of the fastest
Priority Wire in a track

Event Time Finder (ETF)
The timing of the fastest wire
hit in a track (not necessarily
the priority wire)

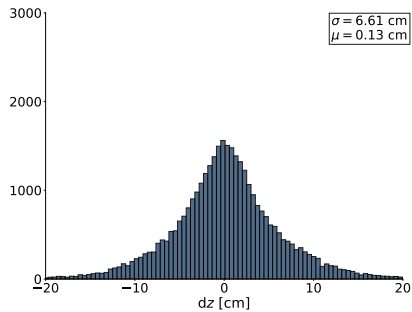
True Event Time
The true Monte Carlo time ($t=0$)



Event time selection

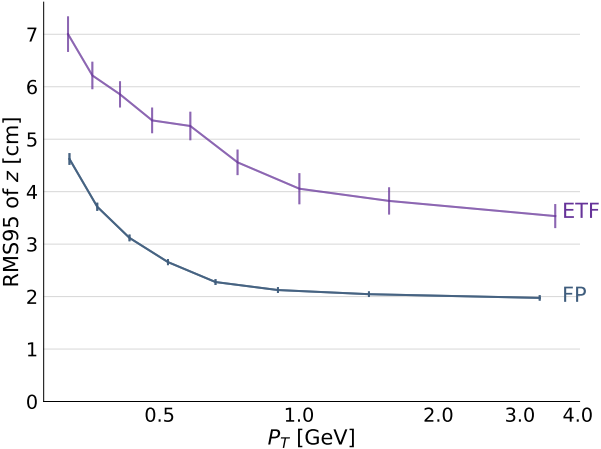


FP time



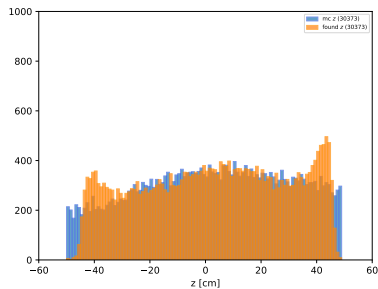
ETF time

Event time selection

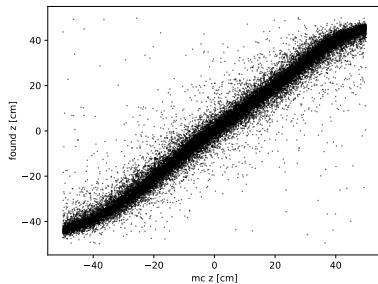


FP trained with events generated in $z=[-50, 50]$

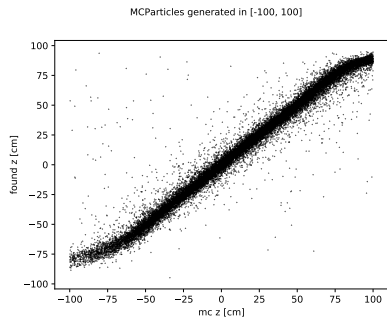
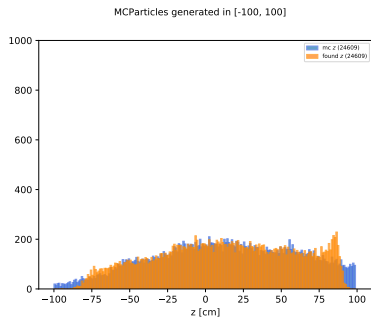
MCParticles generated in $[-50, 50]$



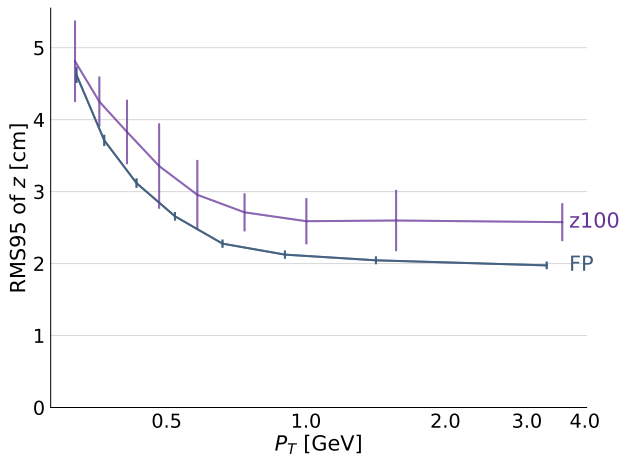
MCParticles generated in $[-50, 50]$



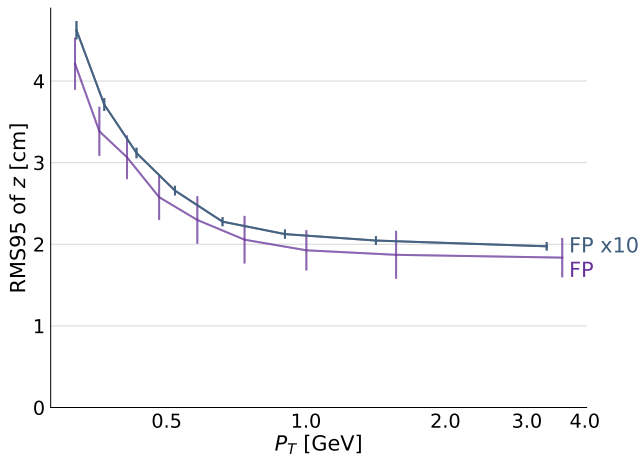
FP trained with events generated in $z=[-100, 100]$



FP trained with events generated in $z=[-100, 100]$

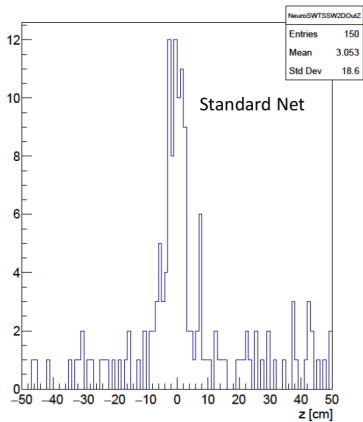


×10 more training events

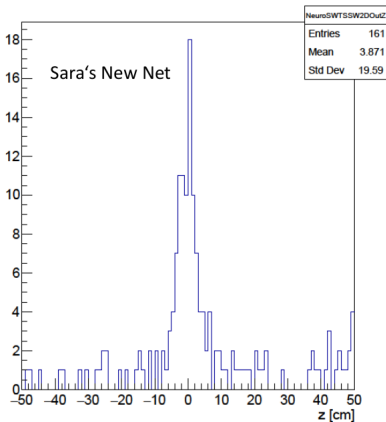


Test with real data

z distribution from simulation, sw TS sw 2D



z distribution from simulation, sw TS sw 2D



Summary

1. The Event Time Finder algorithm should be improved; fastest priority time will be used in meantime
2. Training in enlarged region $z=[-100,100]$ avoids the non-linear structures in the $z=[-50, 50]$ which are too close to a z -cut of ± 40 cm
3. Any deterioration in resolution could be compensated by training with more data

Outlook

- Training in this enlarged region $z=[-100,100]$ with $\times 10$ data underway
- Training with reconstructed tracks and real data expected to provide yet better resolution