Procedure of digit level embedding of simulated reconstructable Λ^0 decay products into the BM@N inner tracker experimental data

Ilnur Gabdrakhmanov

VBLHEP, JINR

Dubna 2020

5th Collaboration Meeting of the BM@N Experiment at the NICA Facility







Tune tracking algorithm to reconstruct Λ^0 (& other hyperons) decays

- \triangleright For each valid experimental event embed a simulated Λ^0 decay
- $\rhd\,$ Reconstruct the event and evaluate whether it is possible to restore the original decay
- $\,\triangleright\,$ Tune tracking algorithm accordingly



- \blacksquare Create Λ^0 ROOT storage from DCMQGSM generated data sets
- Apply misalignment and inverse GEM Lorentz shift for MC digitizers.
- Generate decay events with the storage lambdas put to the primary vertices's positions from an exp file:
 - \circlearrowright Iterate until the reconstructable decay is found.
 - ♦ Reconstructable: each decay product has at least 4 hits in the inner tracker
 - ♦ Inner Tracker: only GEM and Silicon planes
- Embed into real events
- Measure the efficiency of the each reconstruction stage









BM@N







Full Reconstruction efficiency:

- ▷ Hit Maker Efficiency
- ▷ Track Finder Efficiency
- \triangleright Vertex Finder Efficiency



GEM HitMaker Efficiency by modules			
	BigZone	HotZone	
Station = $0 \text{ iMod} = 0$	0.975684	0.989612	
iMod = 1	0.884250	0.983110	
Station = $1 \text{ iMod} = 0$	0.966203	0.988338	
iMod = 1	0.796322	0.939690	
Station = $2 \text{ iMod} = 0$	0.954382	0.981046	
iMod = 1	0.765758	0.951376	
Station = $3 \text{ iMod} = 0$	0.983941	0.970588	
iMod = 1	0.956071	0.981878	
Station = $4 \text{ iMod} = 0$	0.948309	0.958115	
iMod = 1	0.799820	0.947141	
Station = $5 \text{ iMod} = 0$	0.965322	0.972973	
iMod = 1	0.942036	0.966245	



2D stations **XY** efficiency for single protons







2D stations tan efficiency for single protons









3 Regions:

- \triangleright (Tan < 0.6): single cluster
- \triangleright (0.6 < Tan < 0.8): cluster stretches
- \triangleright (0.8 < Tan): cluster tears apart



Solution $\rightarrow~$ Interpolate X Y to the center of the drift area

if(mod-> GetElectronDriftDirection() == ForwardZAxisEDrift)
 driftCenterShift = 0.15;
else
 driftCenterShift = 0.75;
x =((CbmStsPoint*)pt)-> GetX(z + driftCenterShift);
y =((CbmStsPoint*)pt)-> GetY(z + driftCenterShift);



2D stations tan efficiency for single protons corrected







HotZone

0.991044

0.992347

0.995021

0.994269

0.994784

0.993042

0.995150

0.998661

0.992465

1.000000

BigZone

0.993377

0.995249

0.995976

0.997108

0.991839

0.980684

0.999371

0.992662

0.995477

0.998552

Old approach

			•
	BigZone	HotZone	
Station = 0 $iMod = 0$	0.975684	0.989612	Station = $0 \text{ iMod} = 0$
iMod = 1	0.884250	0.983110	iMod = 1
Station = $1 \text{ iMod} = 0$	0.966203	0.988338	Station = $1 \text{ iMod} = 0$
iMod = 1	0.796322	0.939690	iMod = 1
Station = $2 \text{ iMod} = 0$	0.954382	0.981046	Station = $2 \text{ iMod} = 0$
iMod = 1	0.765758	0.951376	iMod = 1
Station = $3 \text{ iMod} = 0$	0.983941	0.970588	Station = $3 \text{ iMod} = 0$
iMod = 1	0.956071	0.981878	iMod = 1
Station = $4 \text{ iMod} = 0$	0.948309	0.958115	Station = $4 \text{ iMod} = 0$
iMod = 1	0.799820	0.947141	iMod = 1
Station = $5 \text{ iMod} = 0$	0.965322	0.972973	Station = $5 \text{ iMod} = 0$
iMod = 1	0.942036	0.966245	iMod = 1

Interpolated drift center

- ✓ Hit Maker Efficiency
- ▷ Track Finder Efficiency
- \triangleright Vertex Finder Efficiency



Further work & possible ways for efficiency improvement:

- \triangleright Normalize Lambda digit amplitudes accordingly experimental ones
- \triangleright Tune tracking for specific tasks
- \vartriangleright Explore tracking efficiency for low $|\vec{p}|$ particles (see the talk by S. Merts)
- \triangleright Apply embedding on the raw ROOT data level (see the talk by P. Batyuk)

Thank you!

Backup Slides







All





TQDC_BC1.GetPeak():BmnEventHeader.fEventId {BmnEventHeader.fEventId<40000}









DstEventHeader.fZ2in*324/46.0 {DstEventHeader.fZ2in>0}



Run 4649 Vertex Z vs Beam Counters



BM@N



Figure: Min 4 hits



Figure: Min 5 hits





Figure: Min 4 hits



Figure: Min 5 hits