3D Fitter (CDCTRG)

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Motivation



 3D fitter is just monitored because dz0 resolution of fitter is worse than neurotrigger.

• Some knowledge can be shared to neurotrigger.

Algorithm

• As a property of a helix, $z(s) = \cot\theta \cdot s + z_0$

• Determine z_0 and $\cot\theta$ by minimizing χ^2 . $\chi^2 = \sum_{i=1}^{4} \frac{(z_i - z(s_i))^2}{\sigma_i^2}$

$$z_i$$
: z position

 s_i : arc length of 2D track

 σ_i : constant. standard deviation of $\Delta z_i (= z_{i,\text{fitter}} - z_{i,\text{offline}})$



Good example



Bad example



Outline

- 1. Drift correction is not working
- 2. Background filtering by ADC value

3. Fitter choose wrong hit



Drift correction: Problem



• There are many undetermined hits with large drift time.

 \times TS hits used by fitter track were counted.

Drift correction: Trial & Result

Determine Left/Right based on ...

Pattern matching





z0 resolution didn't improved.



Outline

- 1. Drift correction is not working
 - z0 resolution didn't improved.
- 2. Background filtering by ADC value

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ADC: Event display & Distribution



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ADC: Result

I set thresholds for ADC before Track Segment finding.

- Loss of efficiency is large.
- I will try using ADC for hit choice in 3D fitter.

exp26 run1968

		Low ADC threshold				Hig	Uncertainty			
		5	10	15	20	300	400	500	600	
Efficiency (%)	62.6	-12.7	-17.1	-22.0	-29.0	-12.9	-8.9	-7.0	-5.5	~±1.2
Fake track rate (%)	18.0	-5.3	-6.6	-7.2	-6.7	-5.1	-4.3	-3.4	-2.7	~±0.8
z0 resolution (cm)	2.7	-0.2	-0.9	-1.4	-1.6	-1.1	-1.1	-0.9	-0.2	~±0.2

Outline

- 1. Drift correction is not working
 - z0 resolution didn't improved.
- 2. Background filtering by ADC value
 - Loss of efficiency is large.
- 3. Fitter choose wrong hit

Hit choice: Current method



Hit choice: Ideas

- 1. Try all combinations
- 2. Add origin as a candidate
- 3. Pre-fit using all candidates



Hit choice: Result



Summary & Plans

- 1. Drift correction is not working
 - z0 resolution didn't improved.
- 2. Background filtering by ADC value
 - Loss of efficiency is large.
- 3. Fitter choose wrong hit
 - Add origin method looks good, but need more investigation.

Plans

• use ADC for choosing hit

Iook correlation between dz0 and some factors

Backup



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Performance of firmware

• Δz_0 resolution of 3D Fitter is worse than that of Neurotrigger.



How to get z position

Stereo wire is tilted with respect to z axis.



Matching algorithm

For trigger track j: offline track i is matched if
 i is the nearest offline track

 $\circ |\varphi_i - \varphi_j| < 10^\circ$

For offline track i: trigger track j is matched if
j is the nearest among matched tracks to i



%"nearest" means that the difference of 2D track angle $|\varphi_i - \varphi_j|$ is the smallest.

Drift correction: Δz_0 distribution



ADC: Crosstalk filter



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ADC: Signal/BG discrimination







ADC: distribution



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ADC: Trigger performance with ADC threshold



selected only long track

 offlineTrack.getHitPatternCDC().getLastLayer() > 50 and offlineTrack.getHitPatternCDC().getFirstLayer() < 5 and offlineTrack.getTransverseMomentum()>0.4







ADC: Trigger performance with ADC threshold

I evaluated

Efficiency := #(selected offline tracks matched to trigger track) #(selected offline tracks)

Fake track rate := #(trigger tracks not matched to any offline tracks) #(trigger tracks)

• z0 resolution := standard deviation σ of gaussian when dz0 distribution is fitted by double gaussian





ADC: Trigger performance with ADC threshold

exp24 run2004

		Lower ADC threshold				Higher ADC threshold				Uncertainty
		5	10	15	20	300	400	500	600	
Efficiency (%)	78.7	-3.5	-4.4	-5.9	-9.6	-8.2	-4.8	-3.3	-2.3	~±0.7
Fake track rate (%)	6.2	-0.7	-1.0	-1.1	-1.4	-1.2	-0.9	-0.7	-0.5	~±0.4
z0 resolution (cm)	1.7	-0.02	-0.17	-0.21	+0.02	-0.08	-0.14	-0.14	-0.18	~±0.08





Hit choice: Candidates



Hit choice: Data and Method



This event is HLT Mode = beam_reco_monitor. (i.e. no event selection like |z0| < 1 by High Level Trigger)</p>

No event selection



Hit choice: Idea1 Try all combination



If all Super Layers have 3 candidates, possible combinations would be 3⁴ = 81.
 So this is not practical.

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Hit choice: Idea2 Pre-fitting



Hit choice: Idea3 Add origin

Add origin as a candidate because most z0_offline ~ 0.



Hit choice: Idea3 Add origin

