Comparison of F and V tracking

A. Benelli and L. Tauscher

The following study is a revised version of what was presented at the analysis meeting of April 16, 2005. Pages that were revised are marked on the bottom, left.

The changes became necessary after we recognized that
1. the time window for F-tracking was set too large. This concerns only events which were no overlap events, as for V-tracking the window was set properly. The page comparing $Q_L$ non-overlapping with overlapping for F-tracking thus has become obsolete.
2. The CC background was compared to Q-values at break-up and not at the exit of the target

Only point #2 above led to a minor change of our conclusions, last page
Comparison of F and V tracking

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Aim of the study: analysis of reconstruction features of the two tracking procedures for the lifetime measurement

Tools: Santiago ARIANE (most recent version, no instructions on selection cuts)

without any change ⇒ F-tracking

ARIANE version 304-35, vertex fit ⇒ V-tracking

Method: Analyse a. real data, b. MC (CC and atomic pairs) and use results from Santiago draft 2 and V-tracking Ni2001-94 μm

Real data:
Prompt data: Ni 2001, runs 3447-3635 (ca. 120 runs)
Cuts: prompt, Q_T ≤ 4 MeV/c, Q_I ≤ 15 MeV/c
Reconstructed:
V-tracking: 117354
F-tracking: 119585
Common events (overlap): 57154
Comparison of prompt data

Efficiency:
- No of events rejected by F but accepted by V: 60200
- No of events rejected by V but accepted by F: 62431
- No of events accepted by V and accepted by F: 57154

<table>
<thead>
<tr>
<th>Qualitative guesswork</th>
<th>with V</th>
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</thead>
<tbody>
<tr>
<td>60200 events not reconstructed by F</td>
<td>60200</td>
</tr>
<tr>
<td>Inefficiency of F (1-\varepsilon_F), (\varepsilon_F \approx 0.487)</td>
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<table>
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<th>Reconstructed with F</th>
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<tr>
<td>57154</td>
</tr>
<tr>
<td>62431 events not reconstructed by V nor by F</td>
</tr>
<tr>
<td>Inefficiency of V selection (1-\varepsilon_V), (\varepsilon_V \approx 0.478)</td>
</tr>
</tbody>
</table>

No of active detector planes for both tracks
(4 out of 6) : (5 out of 6) : (6 out of 6) \(\div\) 3514:17755:19639

revised 26.04.05  A. B. and L. T. 16.4.2005
Qx, Qy distributions, all reconstructed events

Observations F and V-tracking
1. Peak at Q_{x,y} = 0 probably due to unresolved double tracks
2. Strong peak for F-tracking probably due to loose cuts on IH

Observations F-tracking
1. Strong dips left and right of central peak
2. Strong asymmetry positive vs negative Qx, Qy
   - Negative Qx less likely than positive Qx
   - Negative Qy more likely than positive Qy

revised 26.04.05
Qx as function of number of active planes, F-tracking, all reconstructed events, $Q_T \leq 4 \text{ MeV}/c$

Observations:

- “best” upstream tracking shows deepest dips
- Events missing in dips do not show up in central peak

Not on scale

Solid lines: including accidentals  Dashed lines: only prompt

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Qx, Qy distributions, overlap events

Observations F and V-tracking
1. Peak at Q_{x,y} = 0 probably due to unresolved double tracks

Observations F-tracking
1. Strong dips left and right of central peak
2. Strong asymmetry Qx, Qy
Qx, F vs V tracking

Projection
F = V + 0.009 MeV/c
\(\sigma = 0.425\) MeV/c

Qy, F vs V tracking

Projection
\[ F = V + 0.014 \text{ MeV/c} \]
\[ \sigma = 0.40 \text{ MeV/c} \]
Q_l, F vs V tracking

Projection
F = V - 0.047 MeV/c
\( \sigma = 0.06 \text{ MeV/c} \)
Monte Carlo

compare events that are reconstructed by V and F tracking
MC, CC pairs, reconstructed $Q_{x,y}$

- Black: at break-up
- Pink: exit of target
- Red: V-tracking
- Green: F-tracking

Features from data are confirmed
CC pairs, 2D comparisons $Q_{x,y,l}$

Features similar to data $F$ and $V$ equivalent for $Q_l$

$F$ superior to $V$ for $Q_{x,y}$

$MC$ vs $V$

$V$ vs $F$

$MC$ vs $F$

revised 20.04.05


Projections

$MC$-$V$

$MC$-$F$
atomic pairs, reconstructed $Q_{x,y}$

Blue: at break-up
Pink: GEANT, at exit of target
Red: V-tracking
Green: F-tracking
atomic pairs, 2D comparisons $Q_{x,y,l}$

- F and V different in transverse plane
- F and V equivalent in $Q_l$

Mc vs V

Mc vs F

V vs F

Projections

MC-V
MC-F
V-F

atomic pairs, $Q_T$

**Q_T after target** has to be reconstructed
i.e. it is going to be smeared by resolution

**F-tracking**
- produces strong spike at $Q_T = 0$
- produces strong depletion at low $Q_T$
- produces a long tail towards large $Q_T$

**V-tracking**
- reproduces $Q_T$ well, some difficulties around 0.5 MeV
- Some depletion at low $Q_T$ because of condition that events have to be accepted also by F-tracking

F-tracking is NOT suited for atomic pair reconstruction

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Blue: after target
Red: V tracking
Green: F tracking

No cut on $Q_T$ for F tracking

$Q_T < 4 \text{MeV}/c$ for F tracking

11% of signal in tail above 4 MeV/c

$Q_T < 4 \text{MeV}/c$ for F tracking
Comparison of experimental $Q_1$ distributions

(http://www.usc.es/gaes/breakup_prob.ps) and V-tracking, Ni2001-94µm

V-tracking and F tracking are equivalent

Comparison of experimental $Q_T$ distributions

http://www.usc.es/gaes/breakup_prob.ps and V-tracking, Ni2001-94µm

**F-tracking:**
- MC features qualitatively confirmed
- Coarse binning hides details

**F-tracking:**
- MC features quantitatively confirmed (strong low $Q_T$ depletion, long tail), good agreement with MC (argument against large mult. scatt.)

**V-tracking:**
- Good agreement with MC

A. B. and L. T. 16.4.200
Independence of $P_{br}$ from cut was used as argument for correctness of $Q_T$ reconstruction with F-tracking.
Pbr as function of m.s. and cuts in $Q_1, Q$

Independence of cut is artefact, due to large multiple scattering

Schuetz Thesis
CONCLUSIONS

F-tracking allows for different event selection. Only 2/3 of the useful data can be reconstructed by either of the two tracking methods.

1. F-tracking produces large biases
   • Dips in Qx, Qy, events moved where??
   • Asymmetry positive/negative Qx, Qy
   • Spike, depletion, strong (11% of signal) tail in Q_T(>4 MeV/c) for atomic signal
2. F- and V tracking reconstruct only 1/3 of the useful events in common
3. Q_T from F-tracking better than for V-tracking for resolved tracks
4. F and V-tracking equivalent for Q_L
5. Consistency of V-tracking established
6. MSGCs are not necessary for obtaining conclusive results
7. F-tracking can not be used for low-Q ππ pairs with its present algorithms