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

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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:

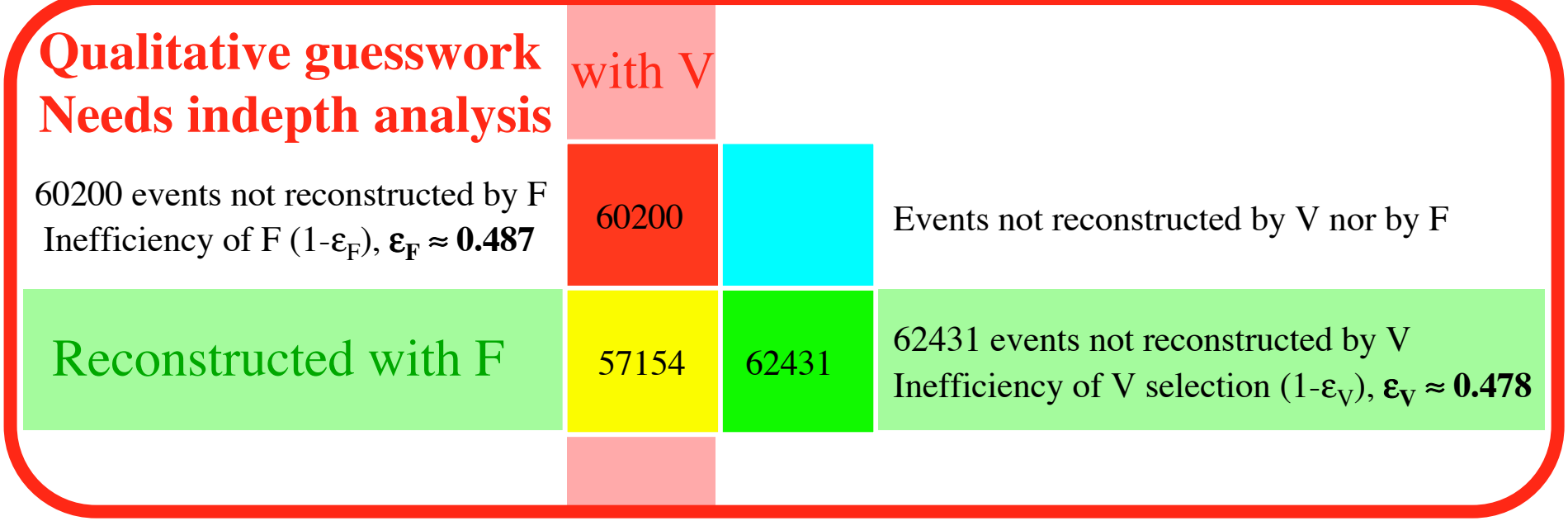
Prompt data: Ni 2001, runs 3447-3635 (ca. 120 runs)
Cuts: prompt, $Q_T \leq 4$ MeV/c, $Q_l \leq 15$ MeV/c
Reconstructed:
V-tracking: 117354
F-tracking: 119585
Common events (overlap): 57154

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

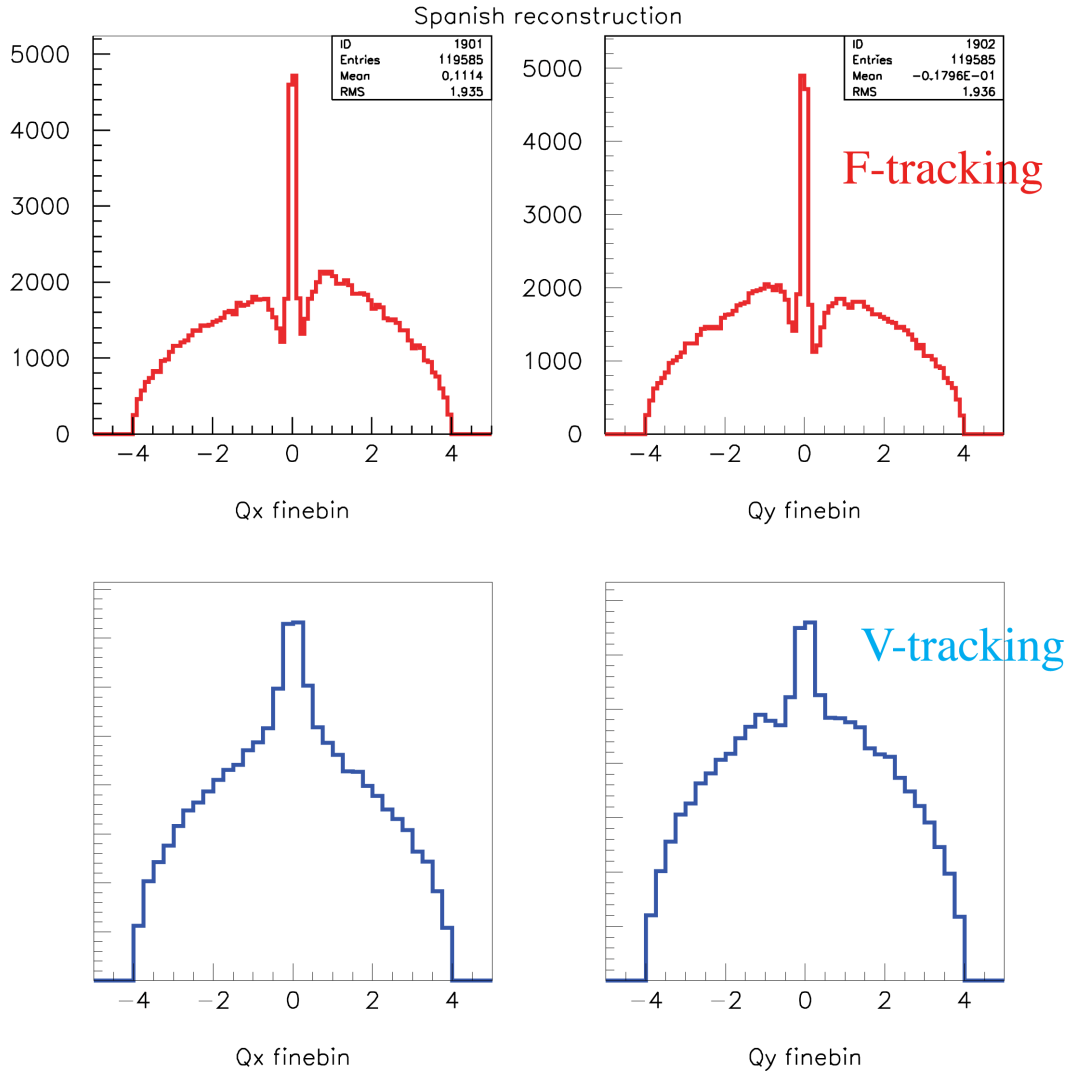
Qualitative guesswork
Needs indepth analysis



No of active detector planes for both tracks

(4 out of 6) : (5 out of 6) : (6 out of 6) ÷ 3514:17755:19639

Qx, Qy distributions, all reconstructed events



Observations F and V-tracking

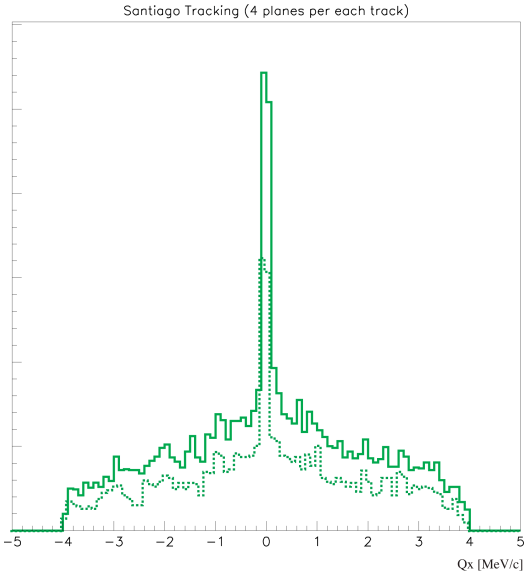
1. Peak at $Q_{x,y} = 0$ probably due to unresolved double tracks
2. Strong peak for F-tracking probably due to loose cuts on IH

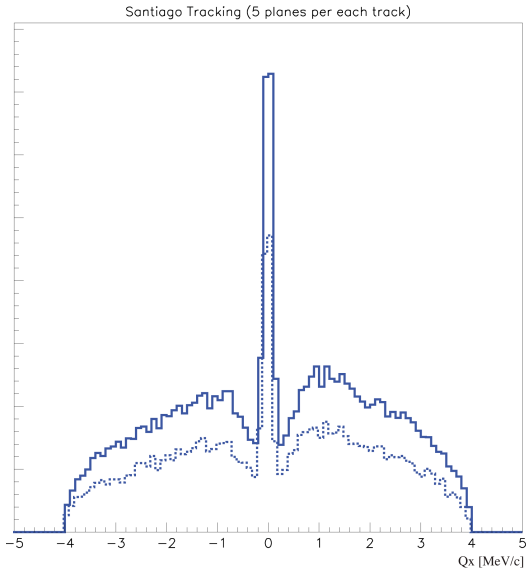
Observations F-tracking

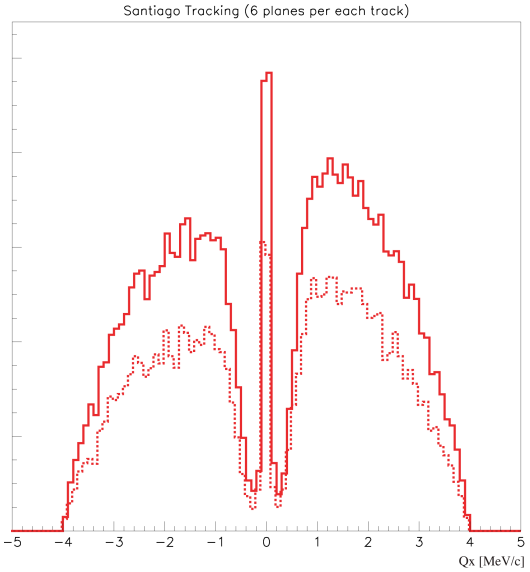
1. Strong dips left and right of central peak
2. Strong asymmetry positive vs negative Qx, Qy
   - Negative Qx less likely than positive Qx
   - Negative Qy more likely than positive Qy

Qx as function of number of active planes,

F-tracking, all reconstructed events, $Q_T \leq 4$ MeV/c







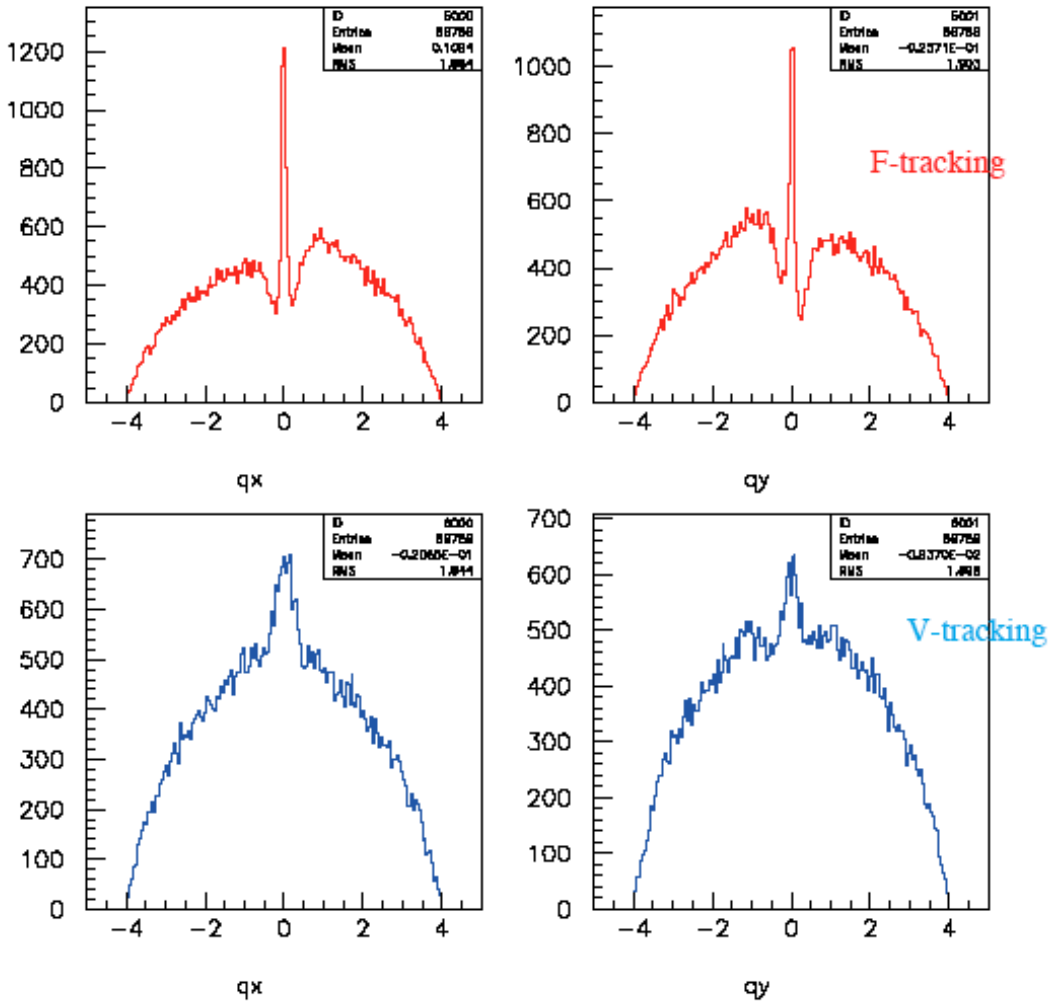
Not on scale

Solid lines: including accidentals Dashed lines: only prompt

Observations:

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

Qx, Qy distributions, overlap events



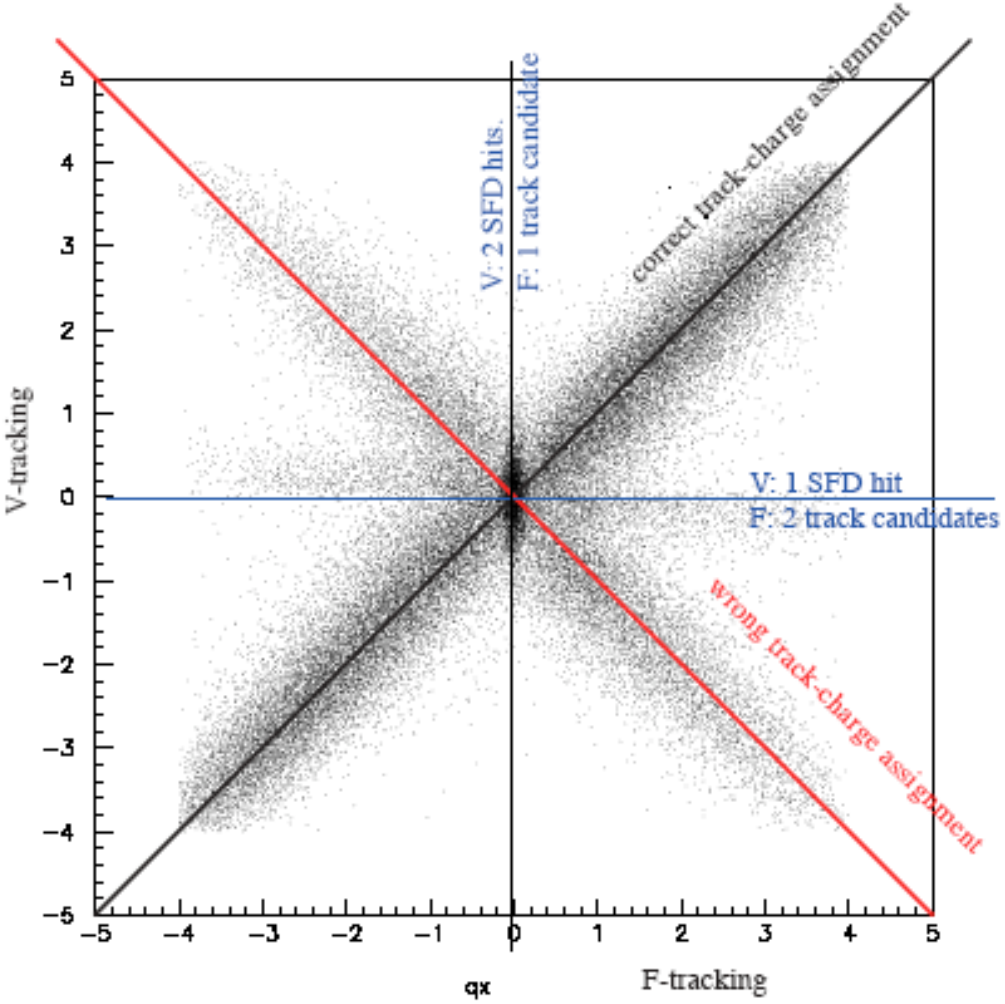
Observations F and V-tracking

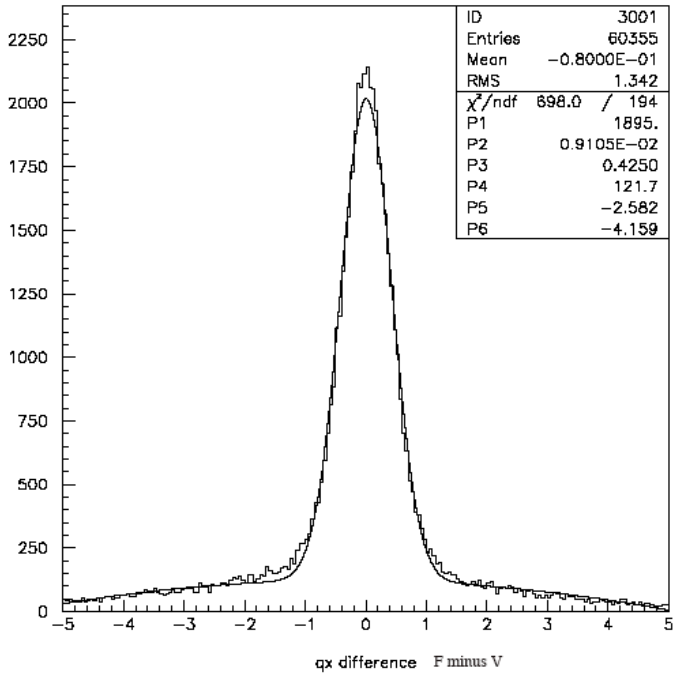
1. Peak at $Q_{x,y} = 0$ probably due to unresolved double tracks

Observations F-tracking

1. Strong dips left and right of central peak
2. Strong asymmetry Qx, Qy

Qx, F vs V tracking



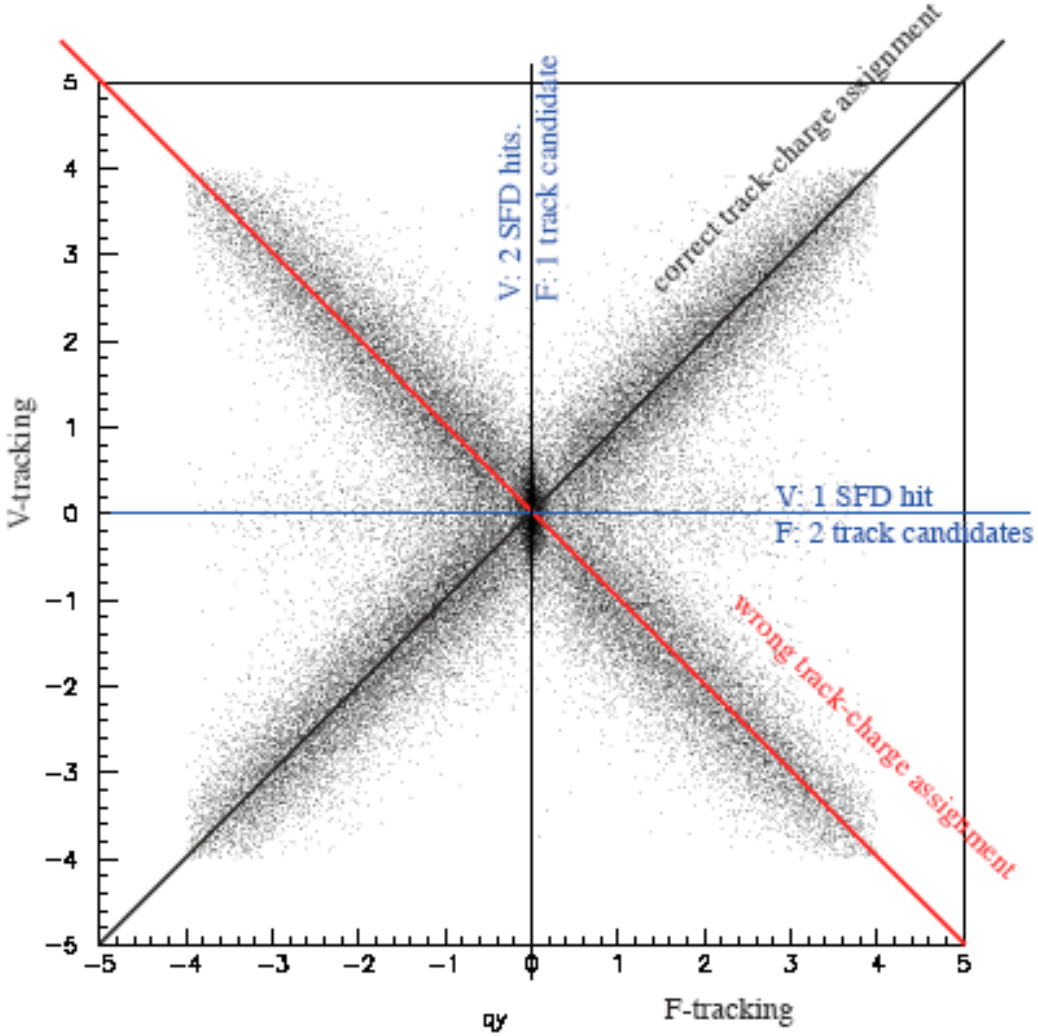


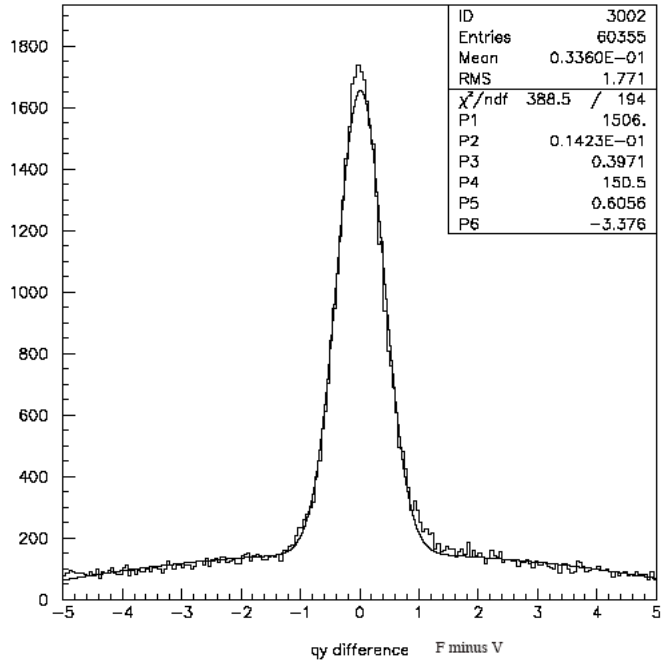
Projection

F = V + 0.009 MeV/c

σ = 0.425 MeV/c

Qy, F vs V tracking



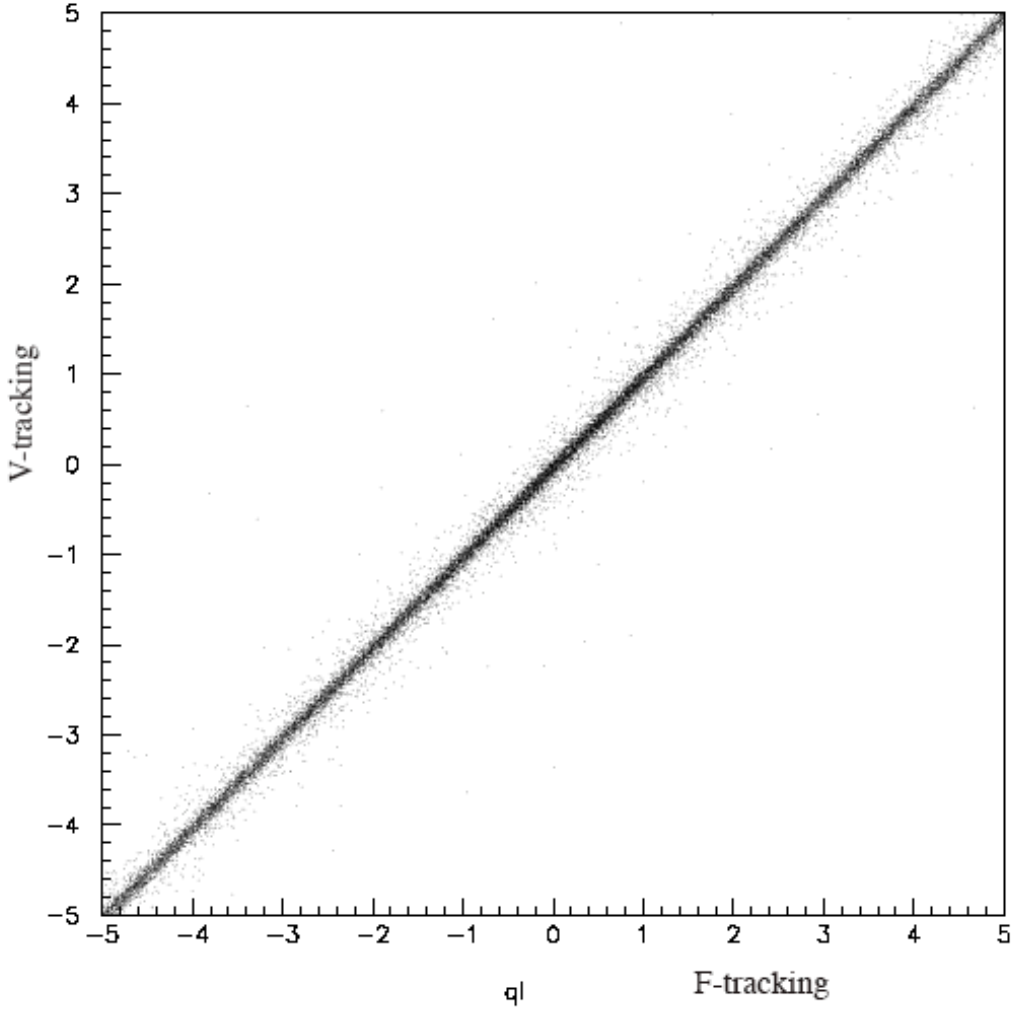


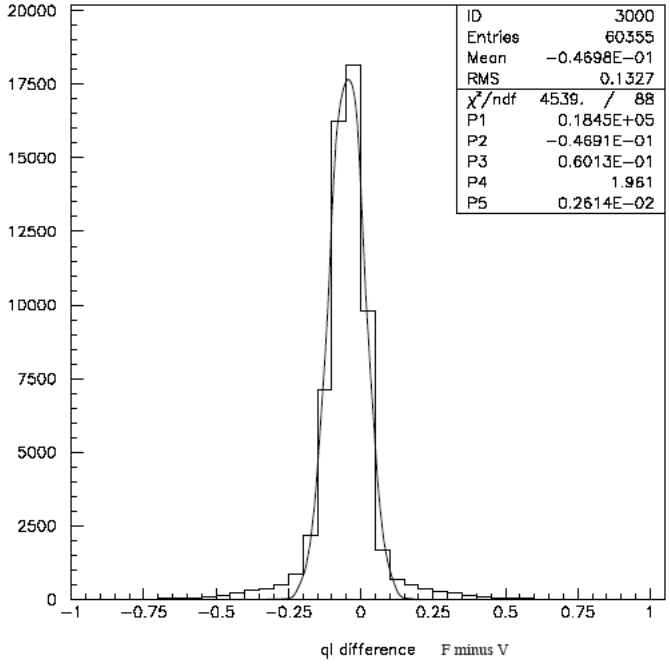
Projection

F = V + 0.014 MeV/c

σ = 0.40 MeV/c

Q_l, F vs V tracking





Projection

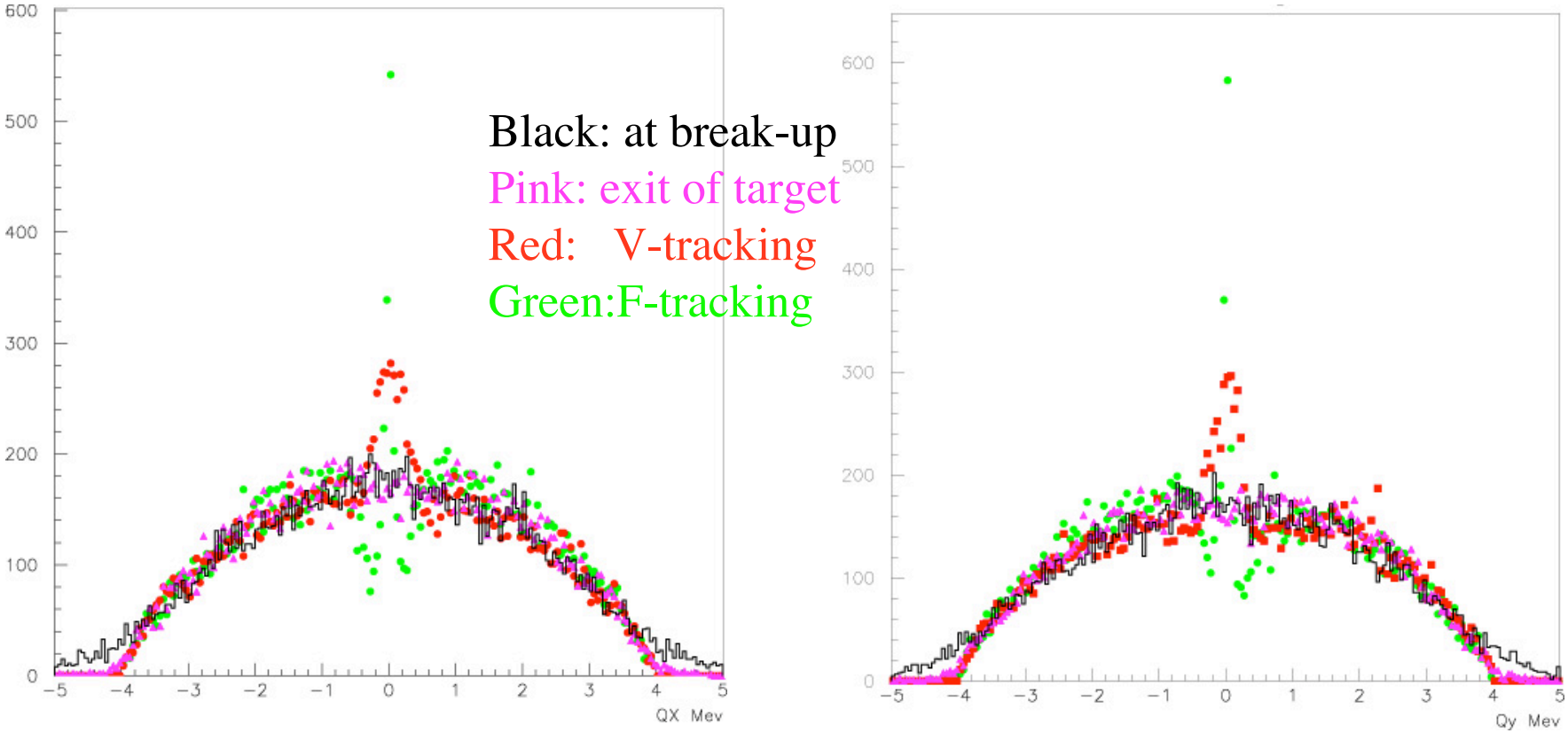
F = V - 0.047 MeV/c

σ = 0.06 MeV/c

Monte Carlo

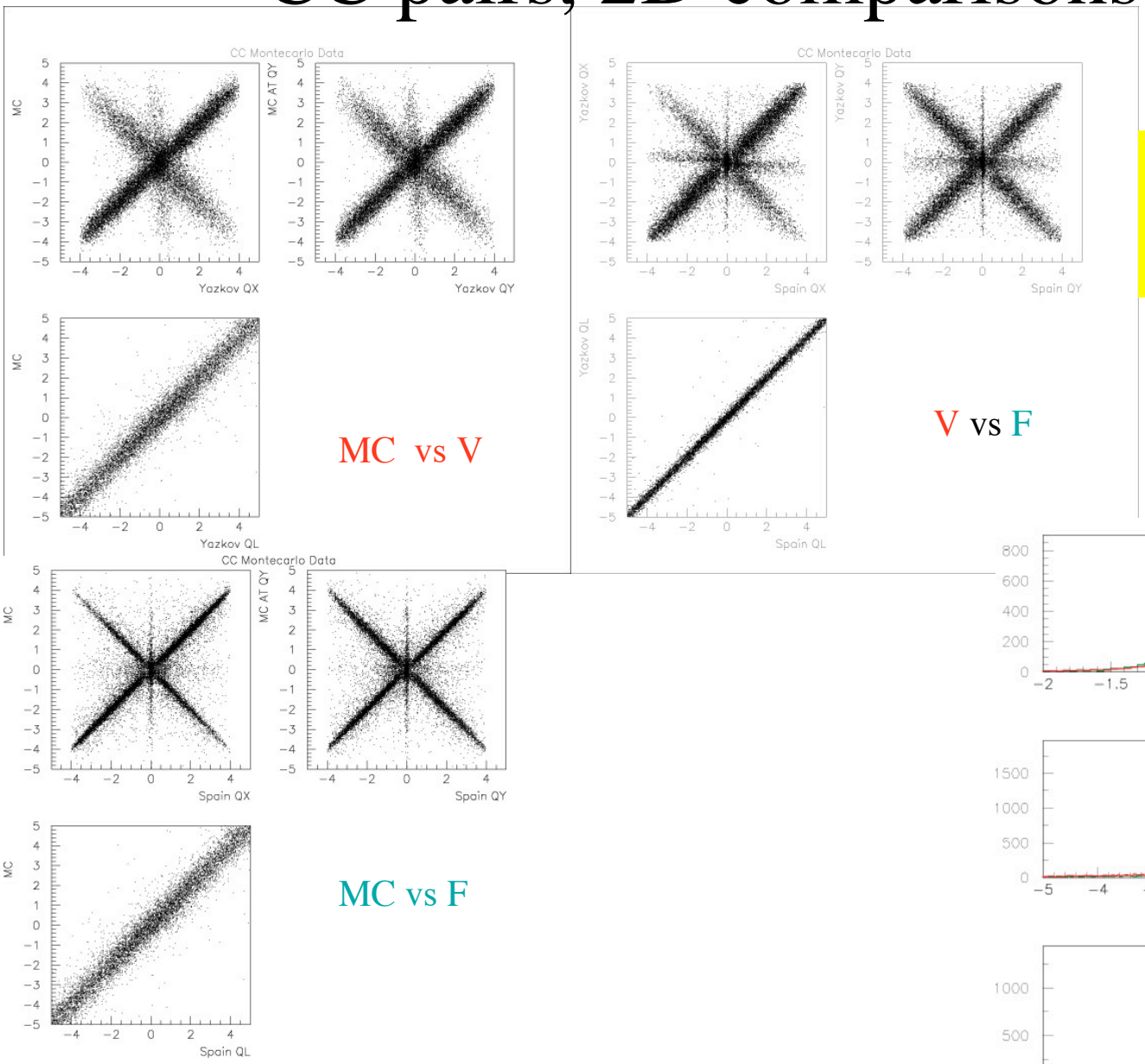
compare events that are reconstructed by V and F tracking

MC, CC pairs, reconstructed $Q_{x,y}$



Features from data are confirmed

CC pairs, 2D comparisons $Q_{x,y,l}$

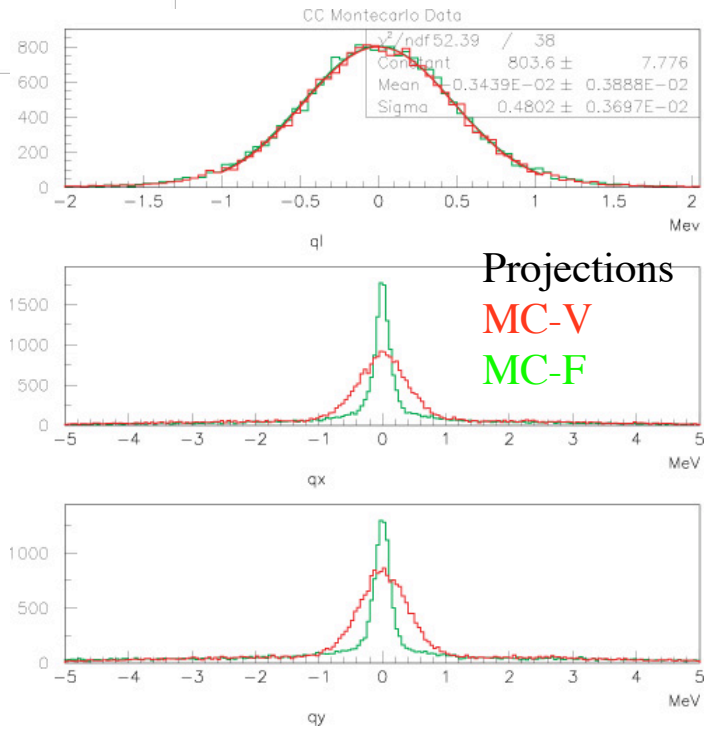


MC vs V

V vs F

MC vs F

Features similar to data
F and V equivalent for Q_l
F superior to V for $Q_{x,y}$



Projections
MC-V
MC-F

revised 20.04.05

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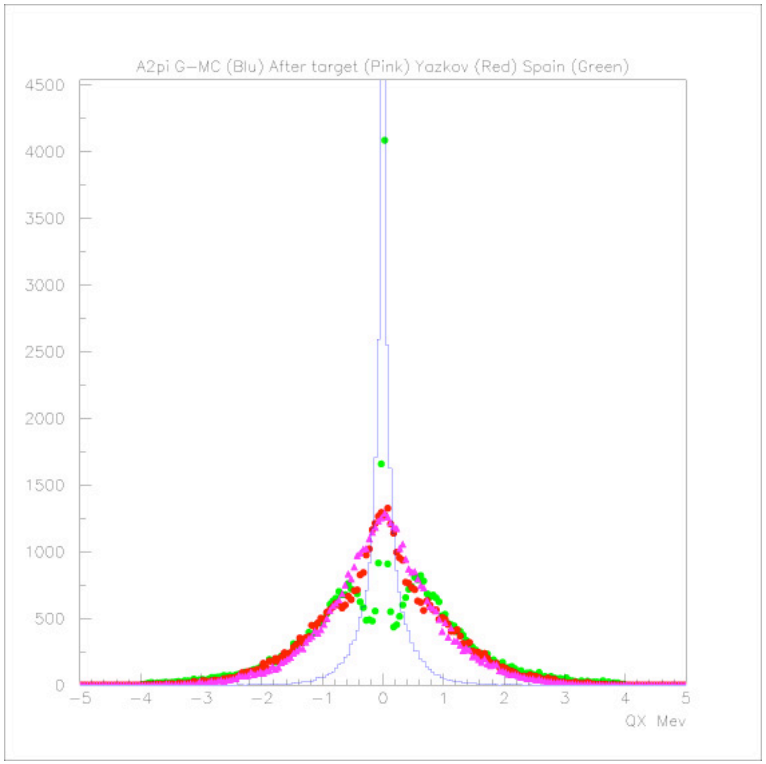
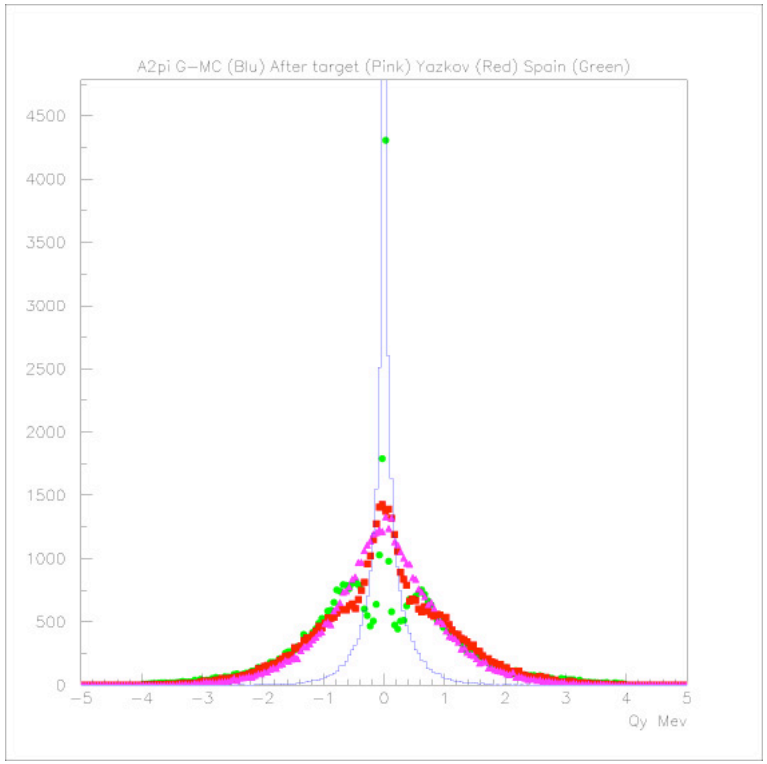
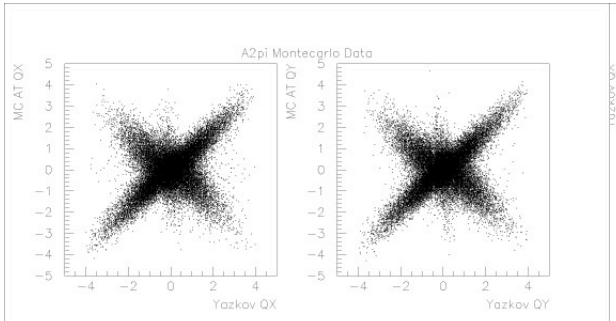
atomic pairs, reconstructed $Q_{x,y}$



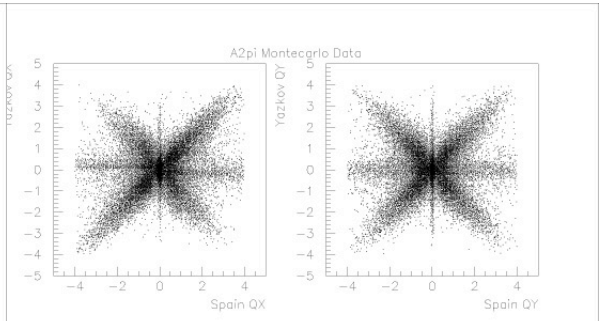


Blue: at break-up
Pink: GEANT, at exit of target
Red: V-tracking
Green: F-tracking

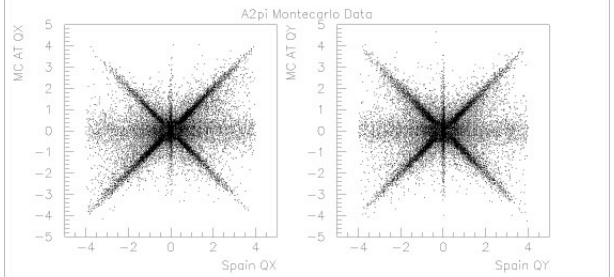
atomic pairs, 2D comparisons $Q_{x,y,l}$



MC vs V

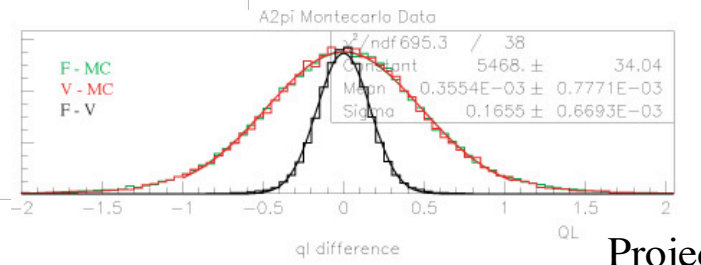


V vs F



MC vs F

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

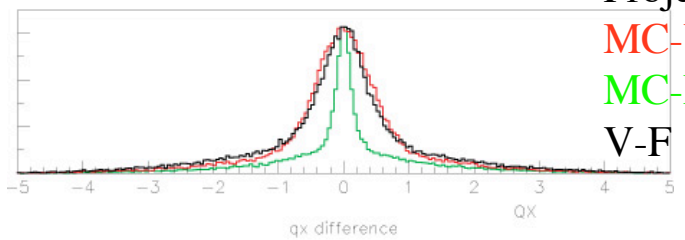


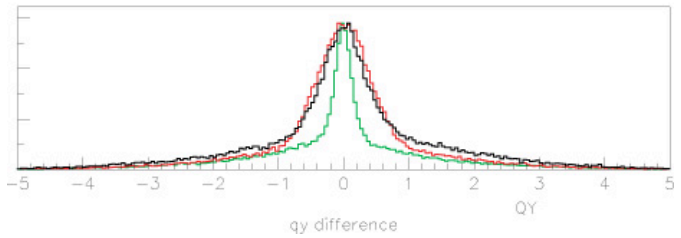
Projections

MC-V

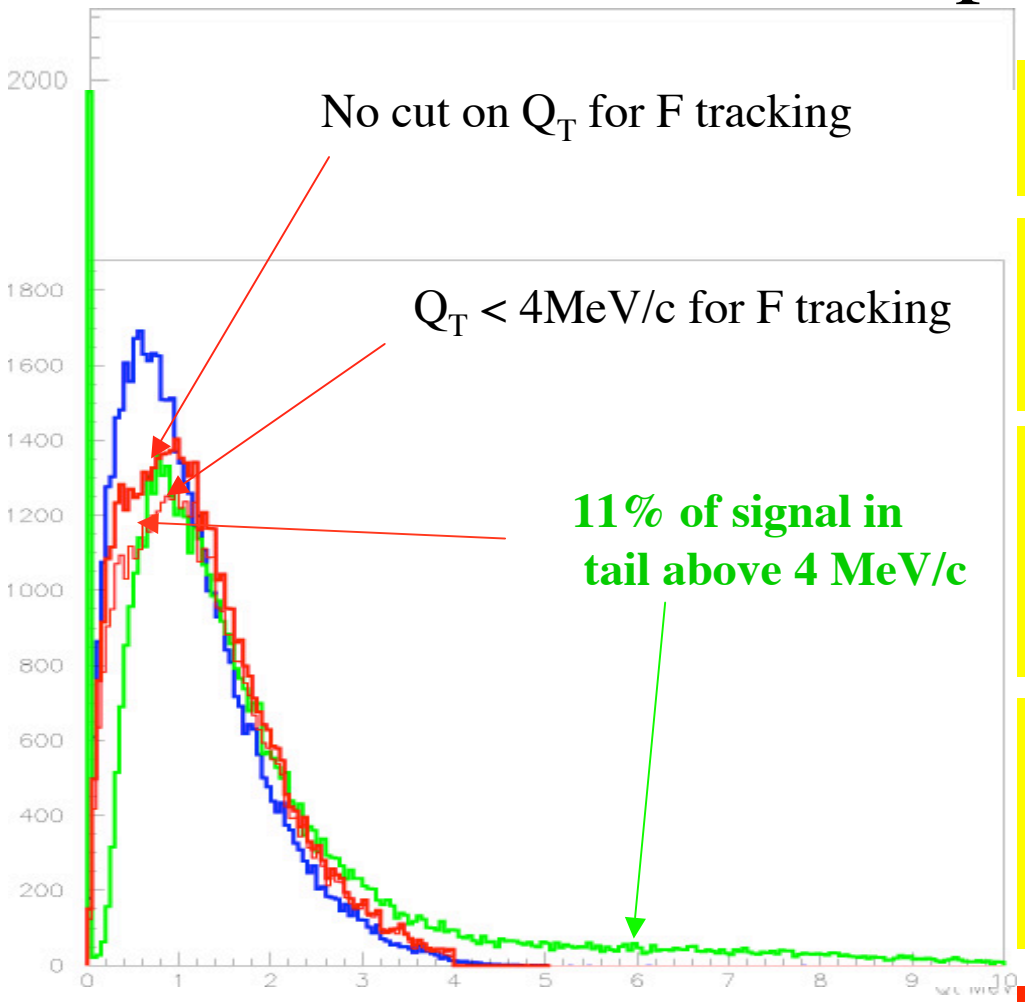
MC-F

V-F





atomic pairs, Q_T



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

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

V-tracking
- reproduces Q_T well, some difficulties around 0.5 MeV

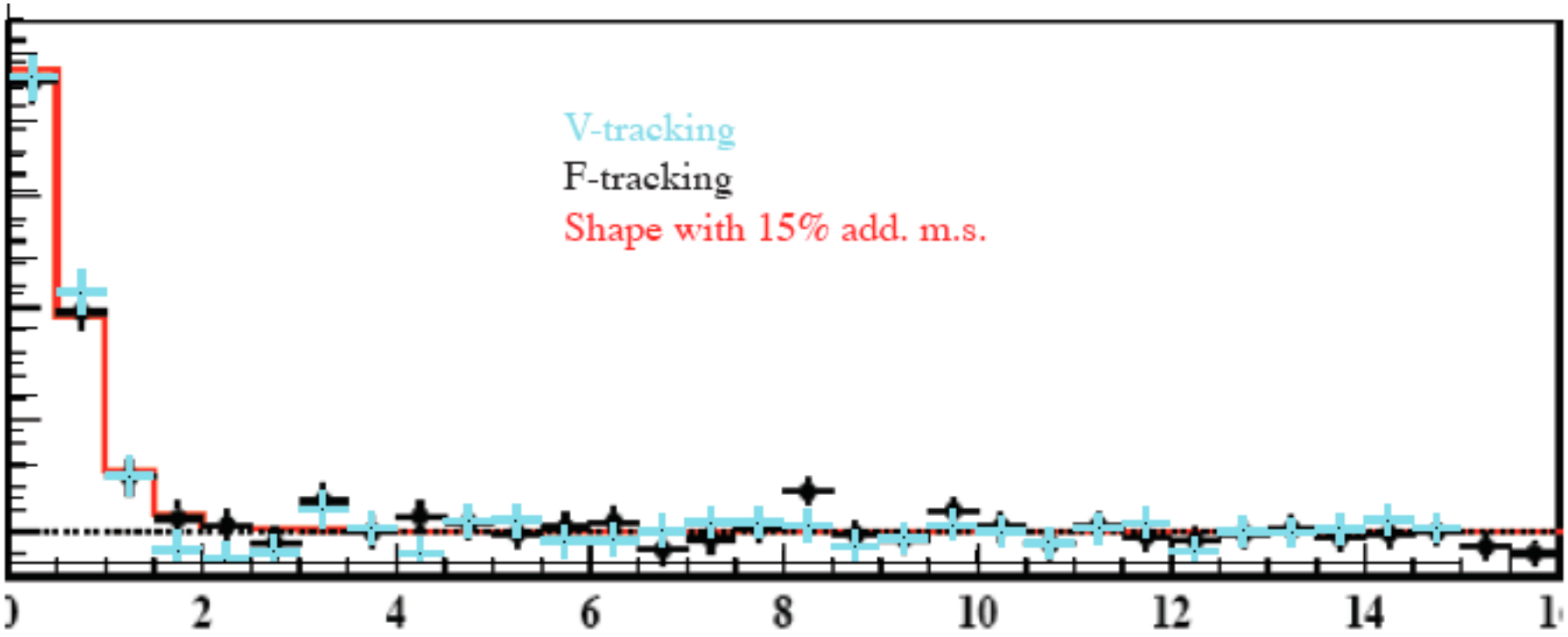
F-tracking
- produces strong spike at $Q_T = 0$
- produces strong depletion at low Q_T
- produces a long tail towards large Q_T

V-tracking
- 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

Comparison of experimental Q_l distributions

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



V-tracking and F tracking are equivalent

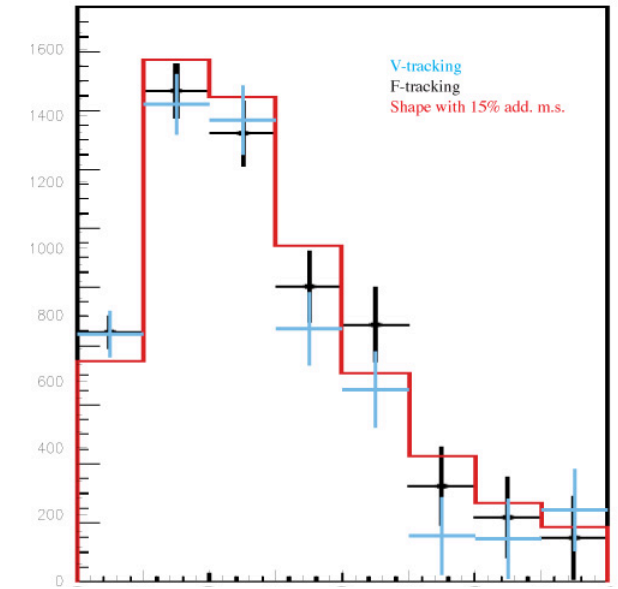
Comparison of experimental Q_T distributions

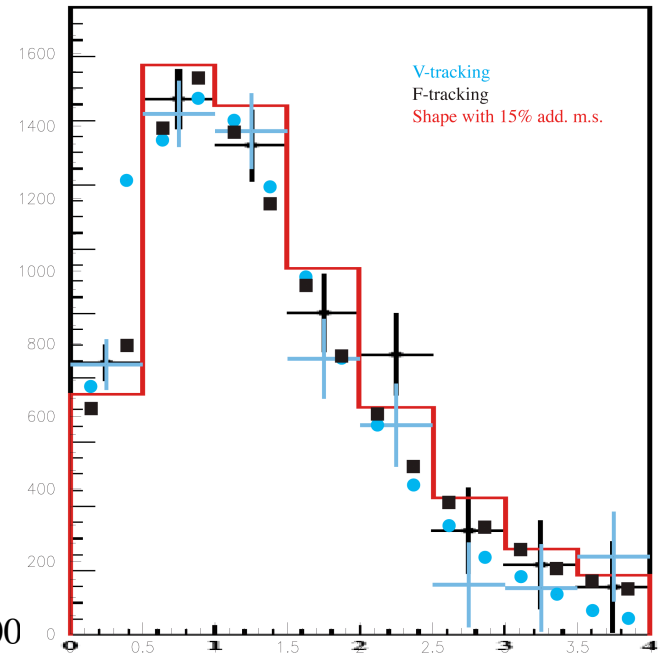
http://www.usc.es/gaes/breakup_prob.ps and V-tracking, Ni2001-94µm

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

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

V-tracking:
- Good agreemment with MC





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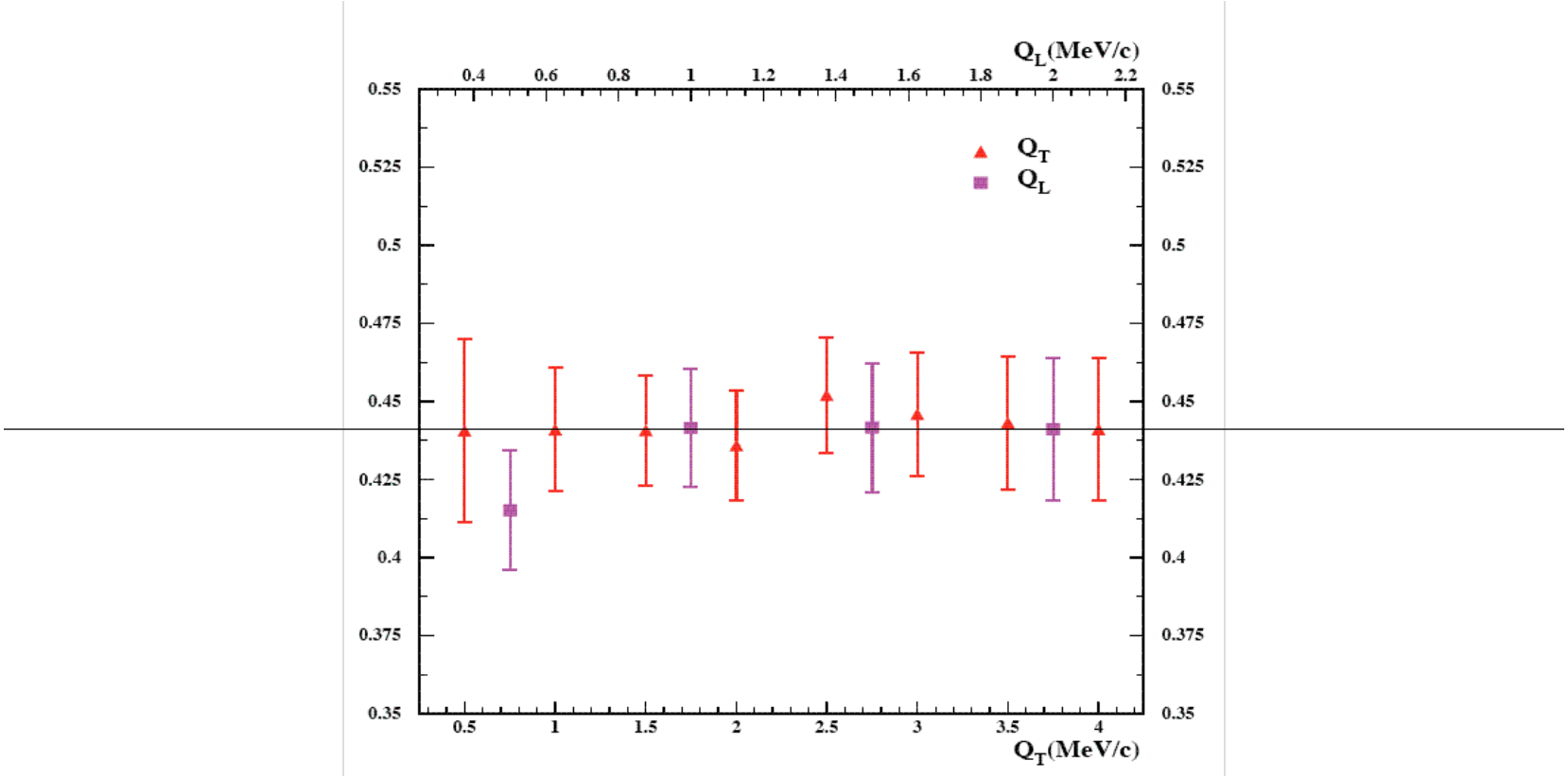
Pbr as function of cuts in Q_l, Q_T

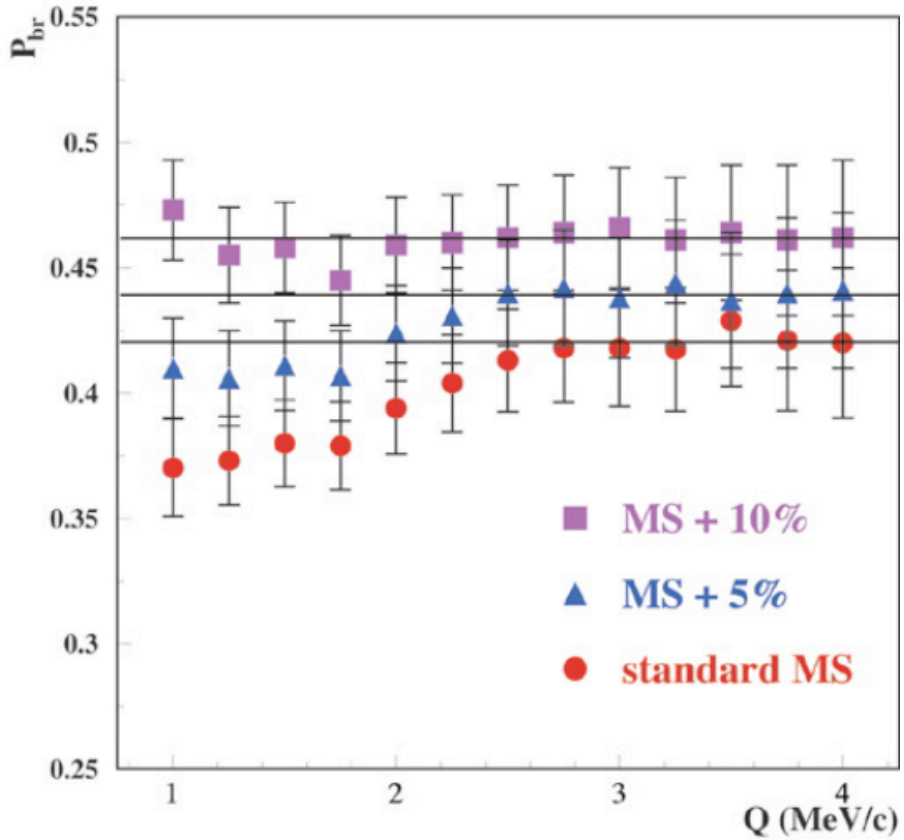
http://www.usc.es/gaes/breakup_prob.ps



Independence of Pbr 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_l, Q

Schuetz Thesis



Independence of cut is artefact, due to large multiple scattering

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 $\pi\pi$ pairs with its present algorithms**