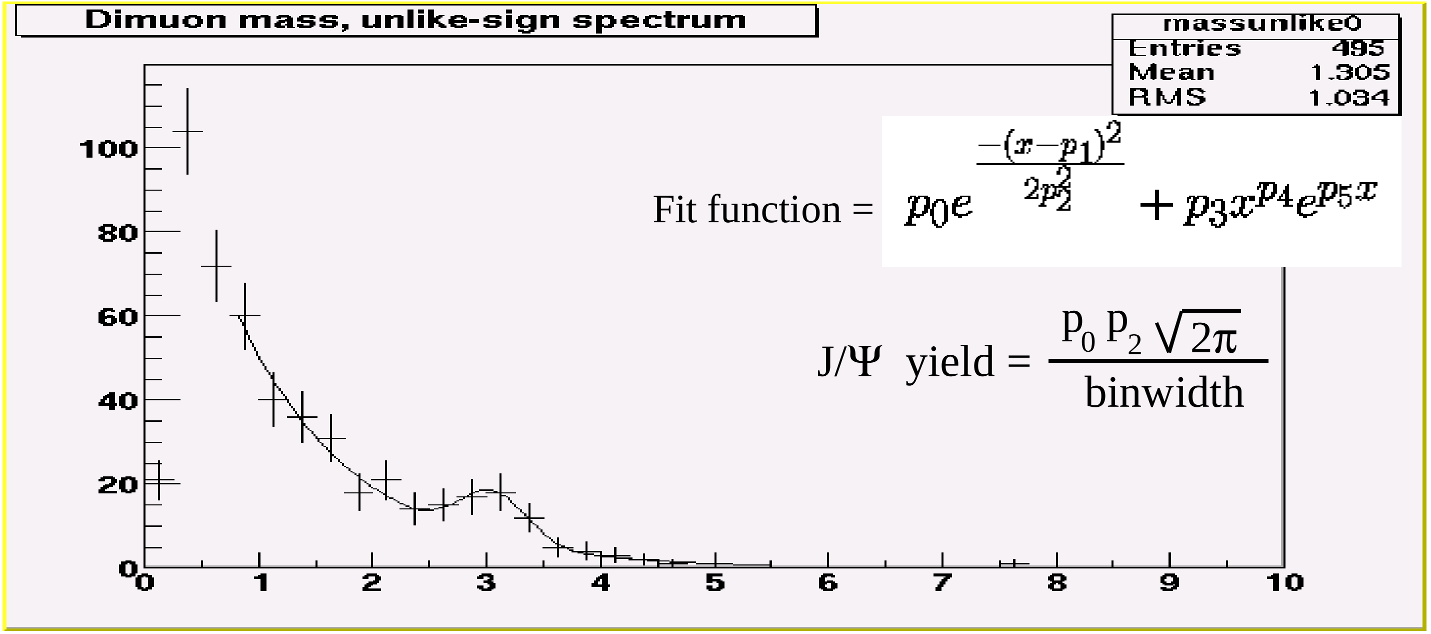
J/Ψ yield dependence on background subtraction methods and track quality cuts.

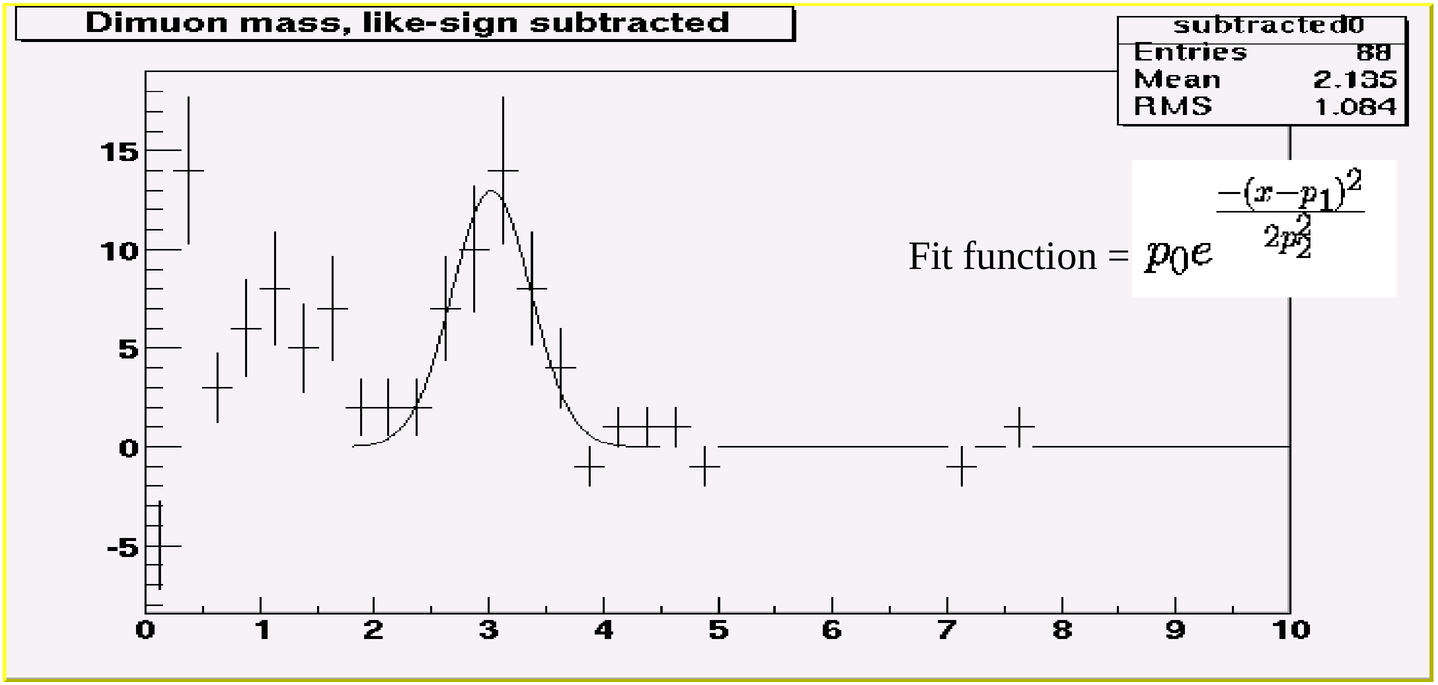
Goal: to understand how various background subtraction methods and track quality cuts affect the J/Ψ yield.

Approach: 3 techniques for extracting the J/Ψ yield are studied.

- Fit the +- dimuon mass spectrum with a background + signal function.
- Subtract the like sign spectrum from the unlike sign spectrum and fit the result with a gaussian.
- Subtract the like sign spectrum from the unlike sign spectrum and sum the bin entries from 2-4 GeV.

For these three techniques, several cuts are studied using both the VtxOut vertex and the BBC vertex.


Dimuon mass, unlike-sign spectrum
massunlike0
Entries 495
Mean 1.305
RMS 1.034
Fit function = $p_0 e^{\frac{-(x-p_1)^2}{2p_2^2}} + p_3 x^{p_4} e^{p_5 x}$
J/Ψ yield = $\frac{p_0 \, p_2 \sqrt{2\pi}}{\text{binwidth}}$
0
20
40
60
80
100
0 1 2 3 4 5 6 7 8 9 10


Dimuon mass, like-sign subtracted
subtracted0
Entries 88
Mean 2.135
RMS 1.084
Fit function = $p_0 e^{\frac{-(x-p_1)^2}{2p_2^2}}$
-5
0
5
10
15
0 1 2 3 4 5 6 7 8 9 10

Some basic cuts are always applied to get rid of insane tracks:

- $x_F < 1$
- $p_T < 15$ GeV
- ghostflag = 0
- |vertex| < 38 cm
- chi2 < 500
- #tracks < 50
- prob = 1

The cuts which are studied are:

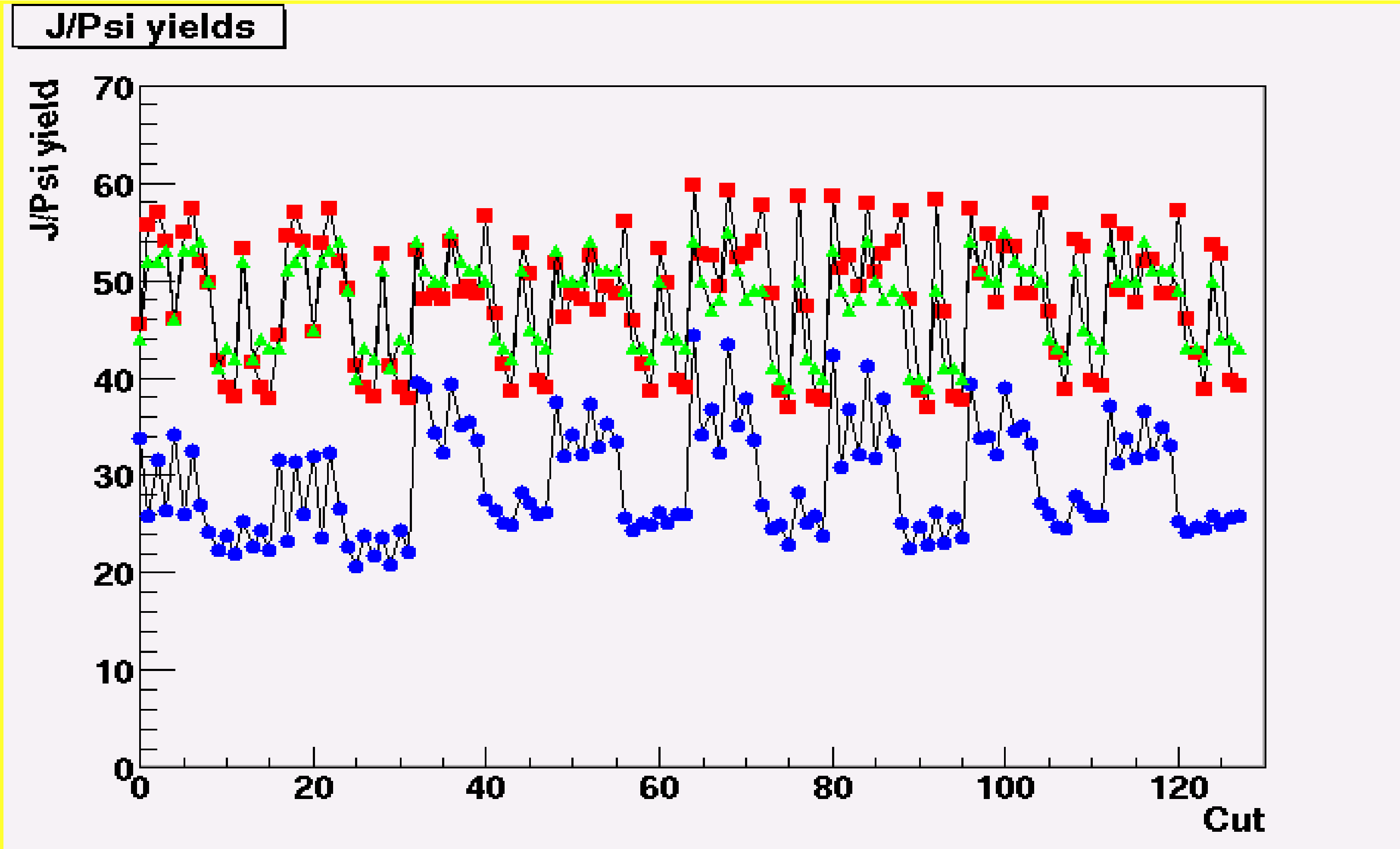
- Match angle < 15^o
- Match position < 40 cm
- lastplane1 + lastplane2 >= 6
- chi2 < 100
- opening angle > 10^o
- event vtx - muon vtx < 50 cm
- muvert1 - muvert2 < 50cm

→ 7 cuts means 128 possible combinations

Monte Carlo events were used to determine values for the cuts that would affect only background, and not the J/Ψ signal.

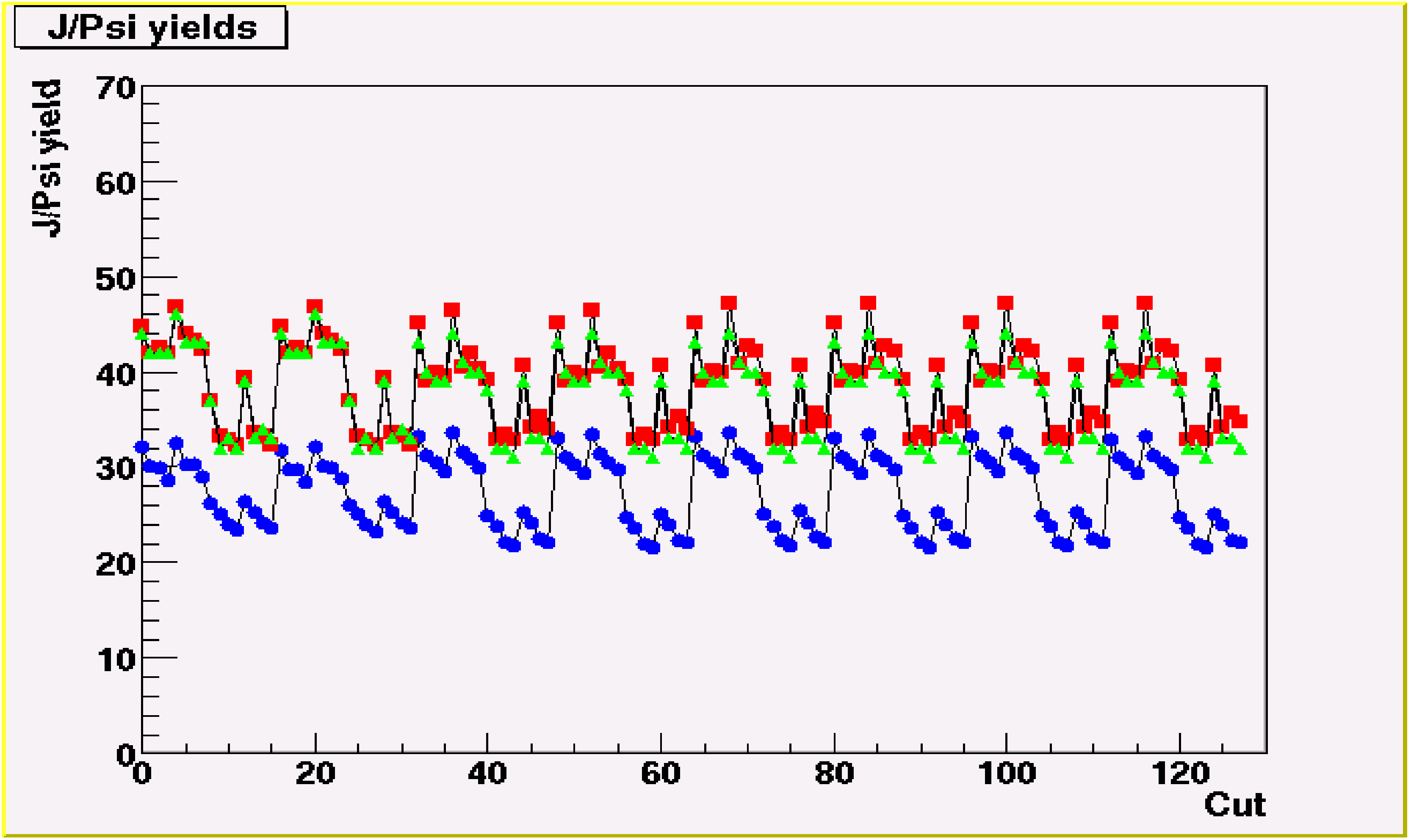
Raw J/Ψ yield for all possible 128 cuts if using the VtxOut vertex:

circle = fit +- mass spectrum w/gaussian + background func.
square = do like-sign subtraction & fit w/gaussian
triangle = do like-sign subtraction & add bins



Raw J/Ψ yield for all possible 128 cuts if using the BBC vertex:

circle = fit +- mass spectrum w/gaussian + background func.
square = do like-sign subtraction & fit w/gaussian
triangle = do like-sign subtraction & add bins



Observations:

Subtracting the like-sign spectrum from the unlike-sign spectrum leaves a significant number of hits in the low mass region.

The J/Ψ yield can vary significantly depending on what background subtraction technique is used and which cuts are applied.

Attempting to fit the unlike sign mass spectrum with a background function + gaussian generally produces a lower yield than if one performs a like-sign spectrum subtraction.

Sensitivity to the various cuts is roughly the same for all techniques (the graphs of yield vs. cut have the same shape).

The yield appears to be quite sensitive to a cut on chisquared of the track.

The sigma of the gaussian peak is larger (~450 MeV) when fitting the background then it is when fitting the like-sign subtracted spectrum (~290 MeV).

More details:

http://www.phenix.bnl.gov/phenix/WWW/publish/ahoover/cutstudy/

cuts_vtxout.txt: returned fit parameters, parameter errors, chi2 values, and definitions of the 128 cuts that were used when using the VtxOut vertex.

yield_vtxout.txt : yields with errors for all cuts and all background subtraction methods using the VtxOut vertex.

cutstudy_vtxout.root: ROOT file with all mass histograms, fitted functions and an ntuple called “yieldntuple” which contains the yields and errors for all the cuts and background subtraction techniques.

cuts_bbcver.txt
yield_bbcver.txt
cutstudy_bbcver.txt: same things but for the BBC vertex.