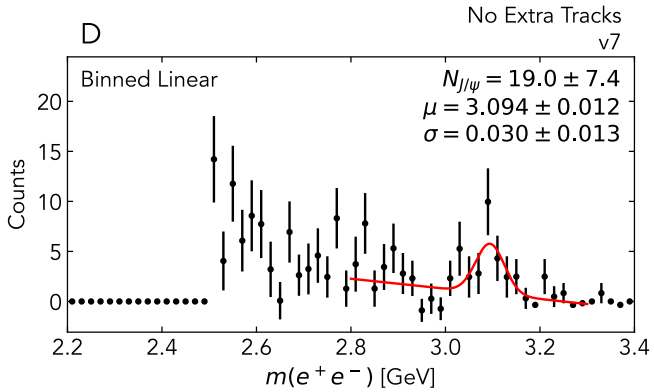
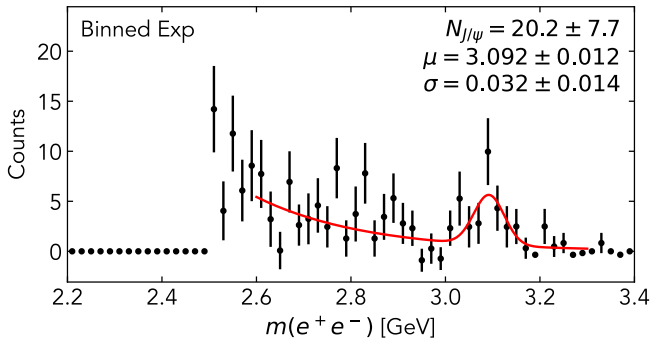
SRC-CT J/Psi Update: 10/16/23

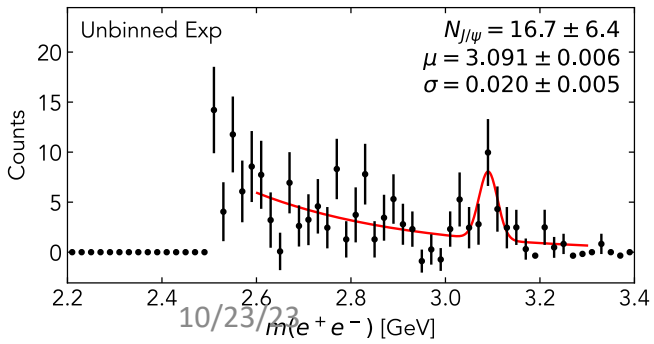
Overview

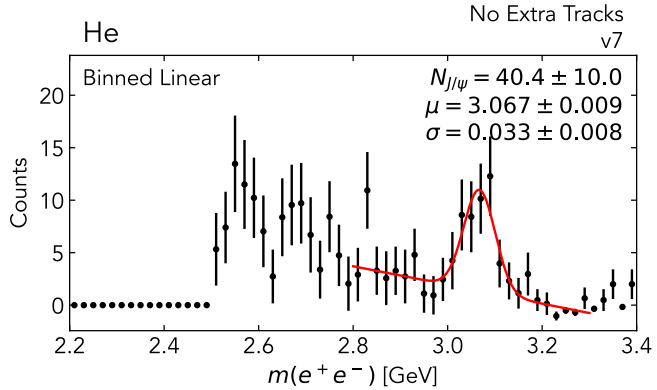
- Unbinned log-Likelihood fitting
- Loosening Cuts
- Understanding Kinematics
  - Alpha, pT, t

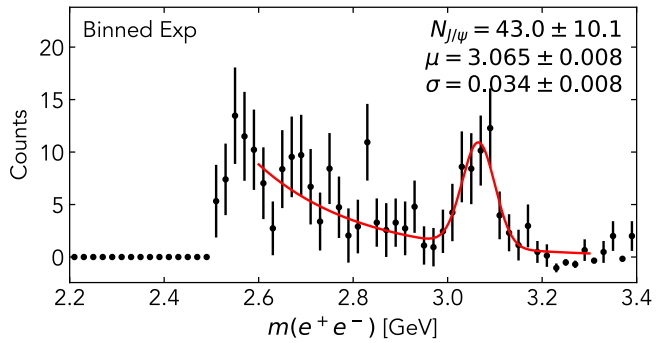
Unbinned Log-likelihood Fitting

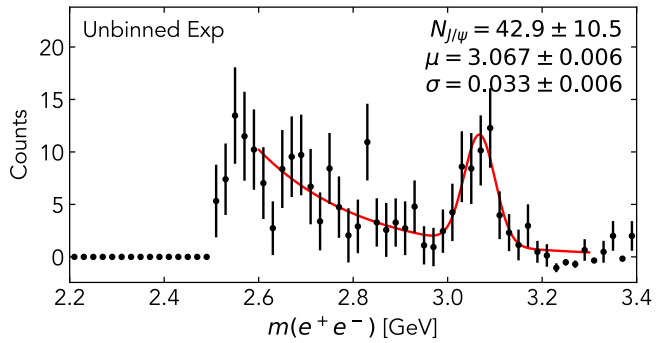


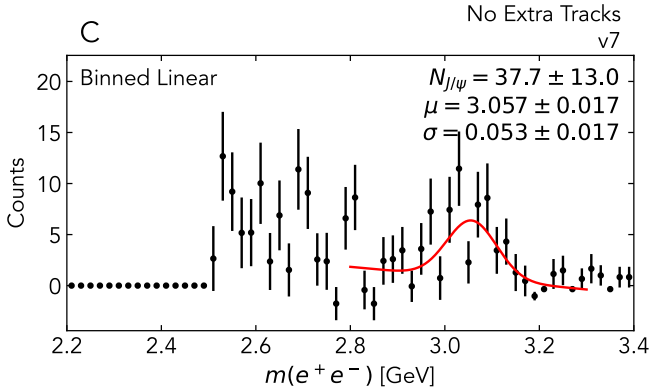


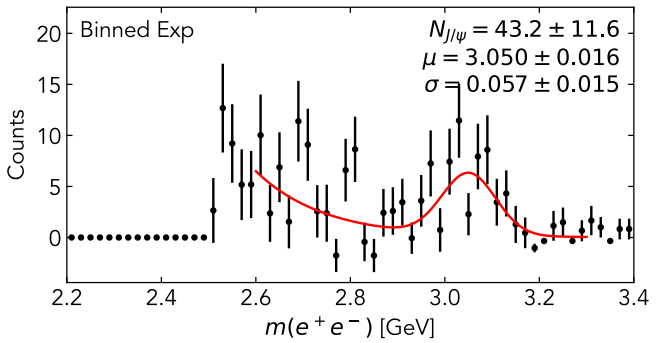


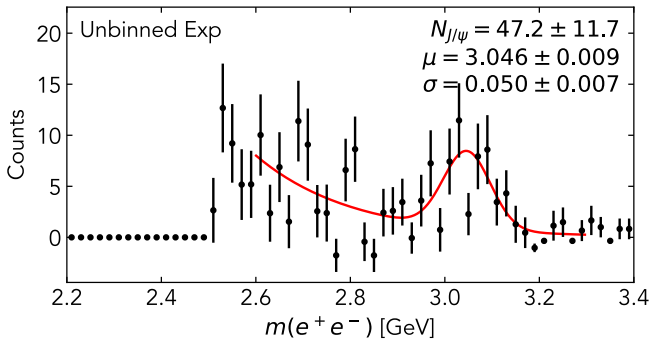






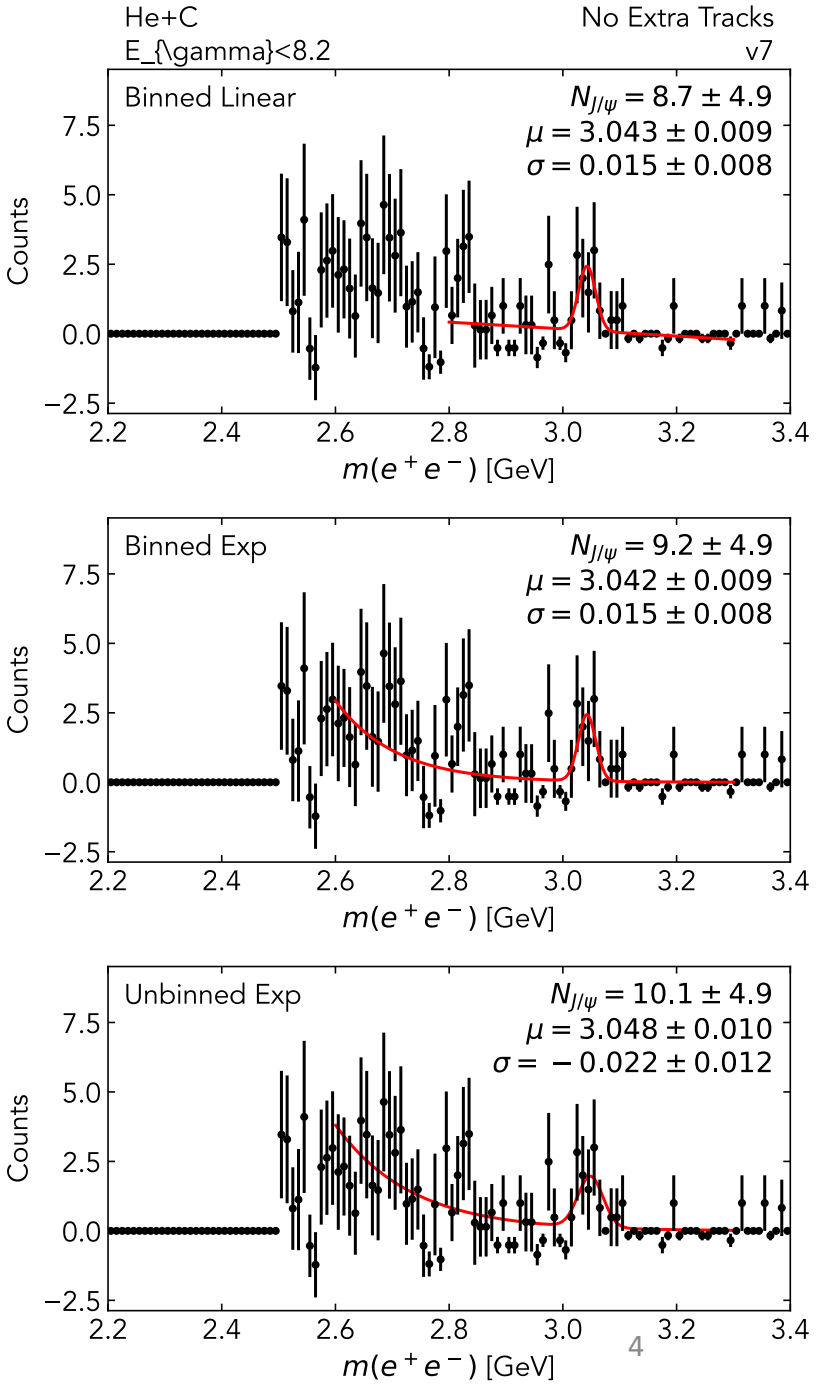






Unbinned Log-likelihood Fitting

- Previously, saw ~10% fluctuations dependent on binning
- LL fits within 1sigma of least-squares

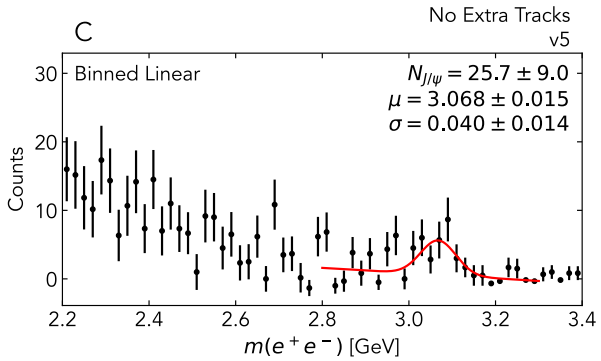


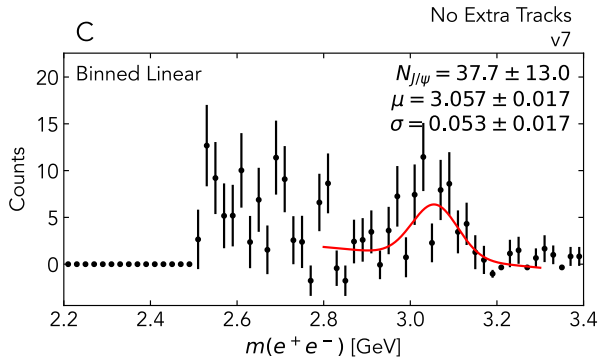
Loosening Cuts

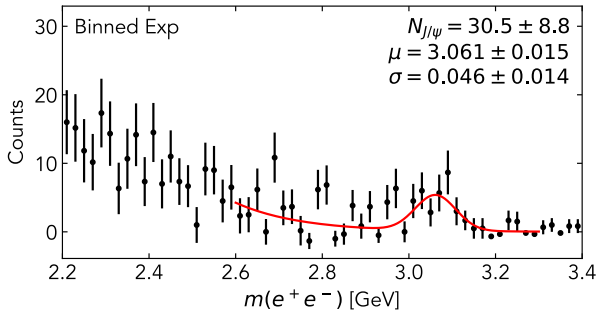
- Attempt to improve efficiency (Jackson update on efficiency)
- v5: Tightest Cuts
- v7: Loosened Cuts
- In progress: even looser cuts (Bo)

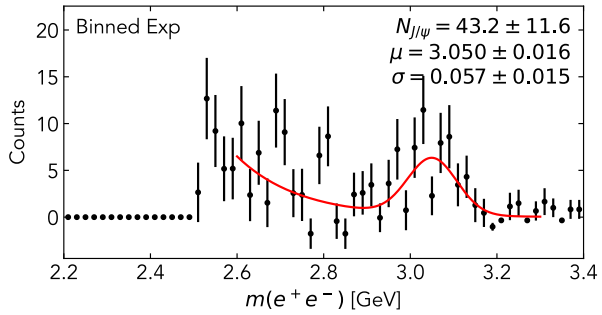
Target	v05 No Track	v07 No Track	Increase
D	14.5	16.7	15%
He	34.9	42.9	23%
C	31	47.2	52%
He + C Subthreshold	8.5	10.1	19%

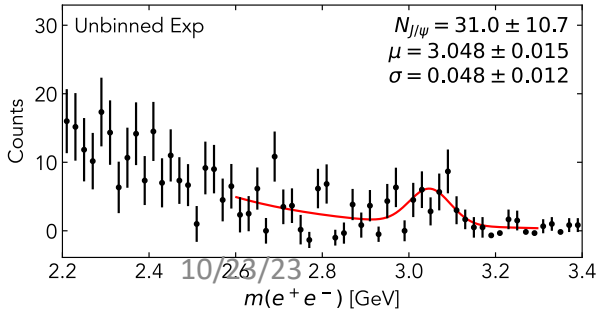
Fine Binning

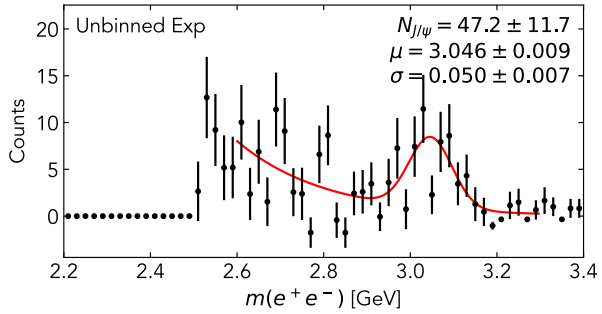




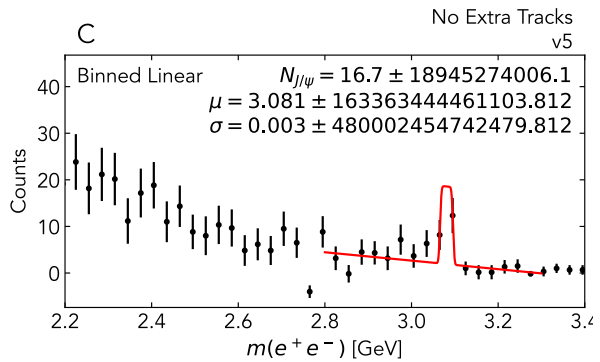


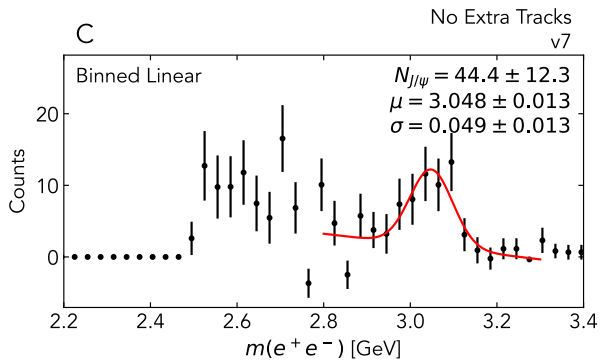


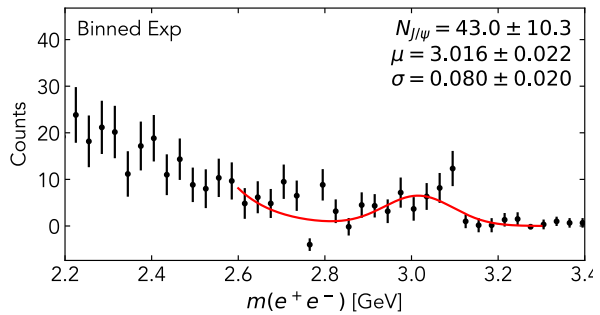


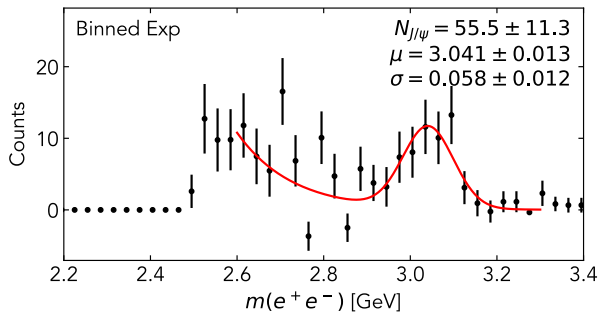


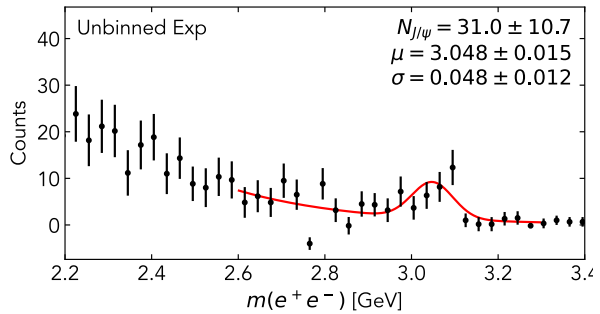
Course Binning

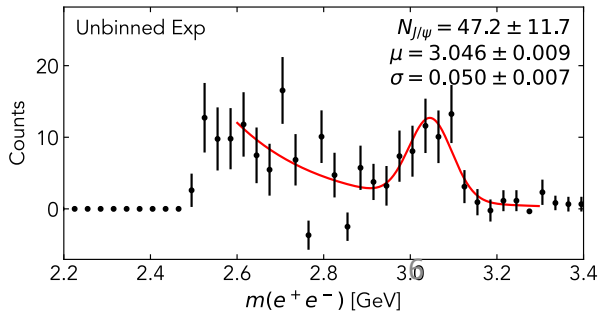






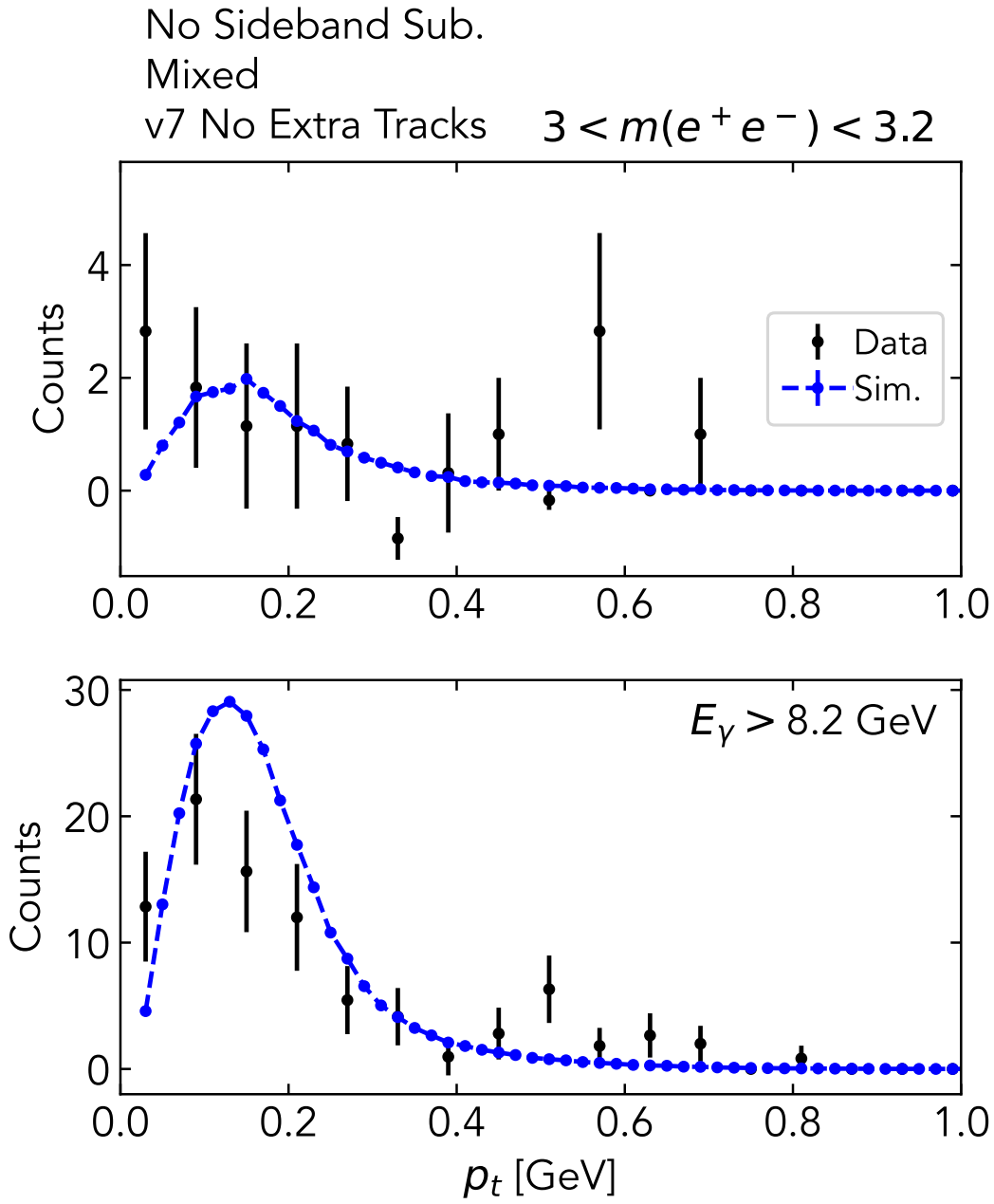




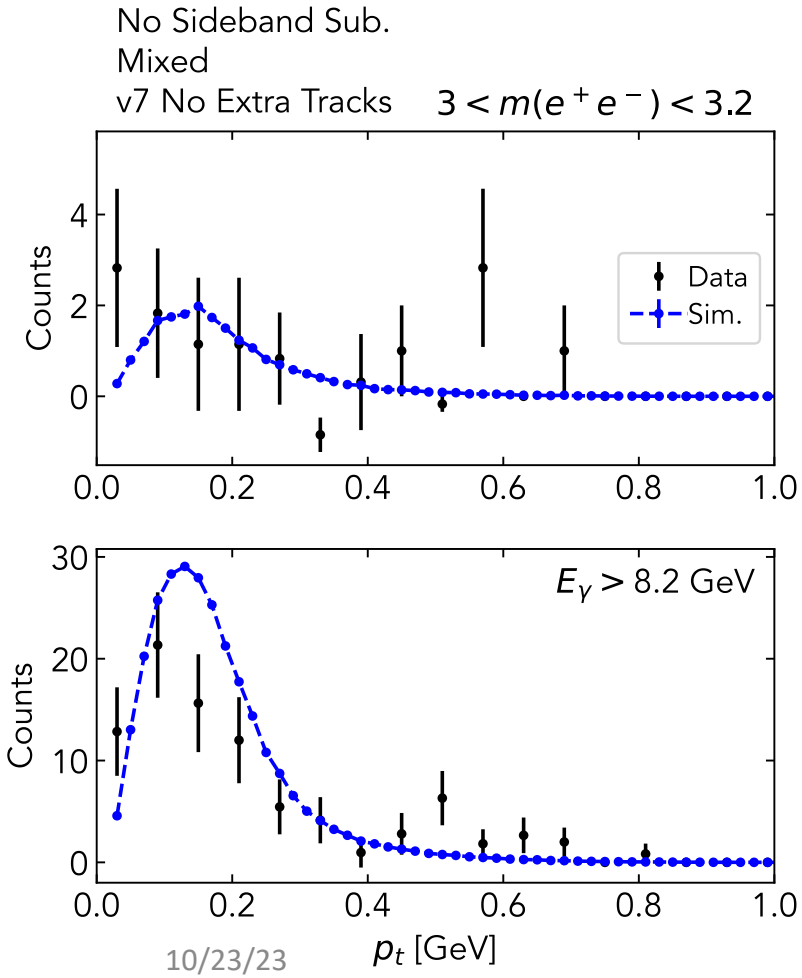


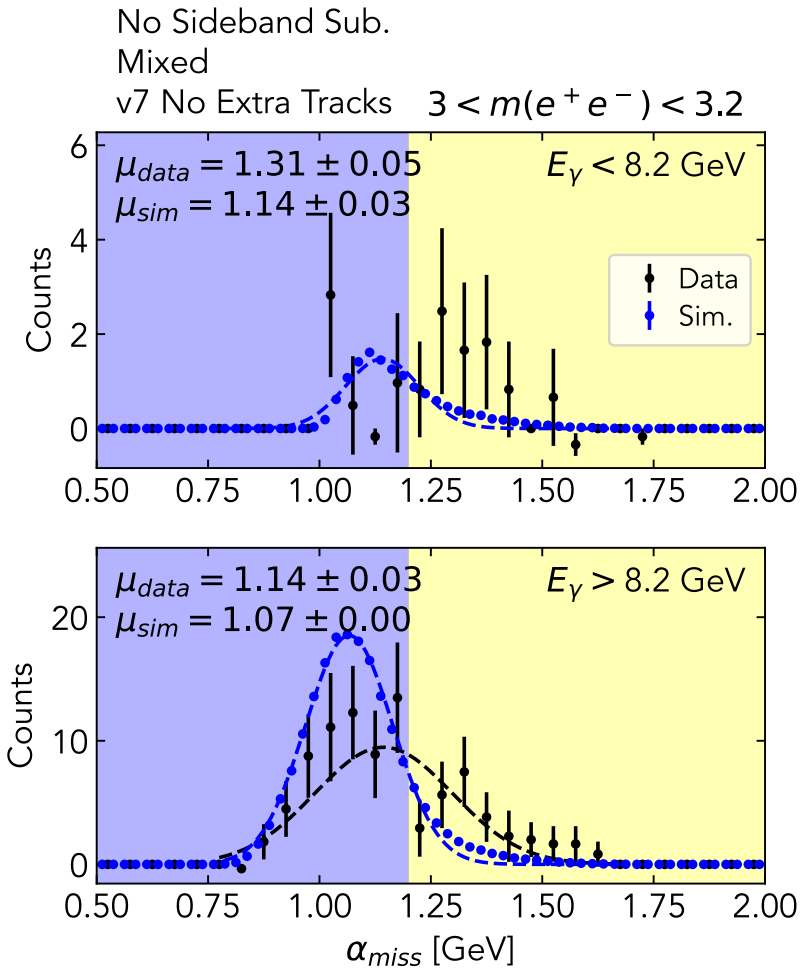
Kinematics

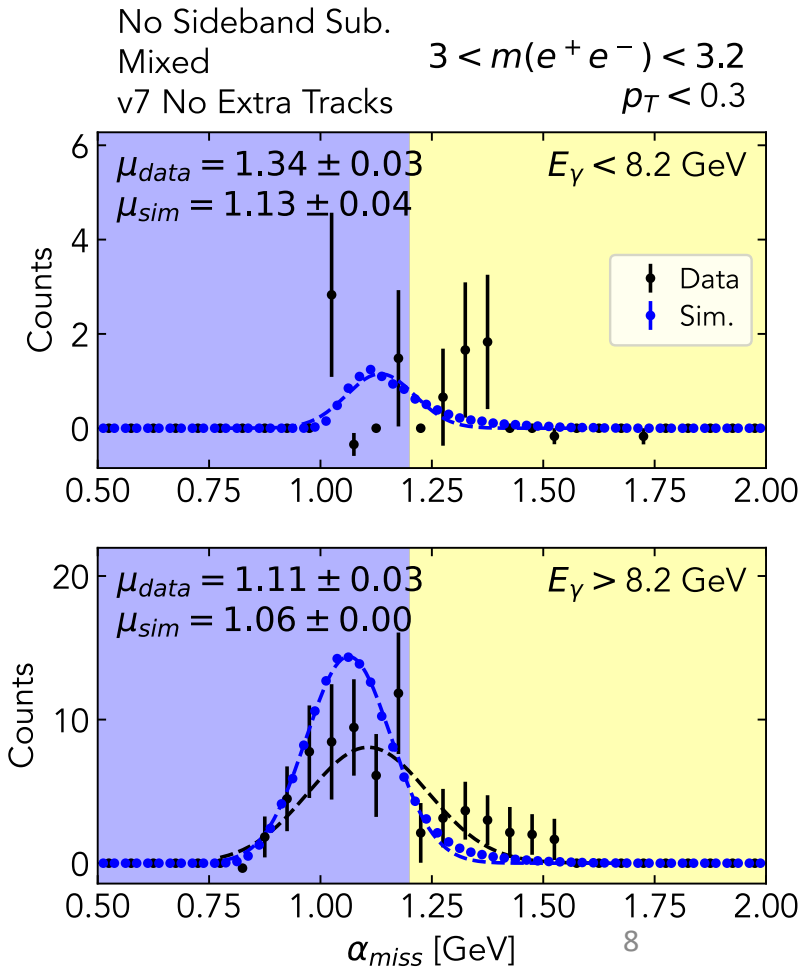
- Clear evidence of re-scattering
- Does this explain discrepancies in alpha_miss?
  - Apply pT cuts at 0.3GeV



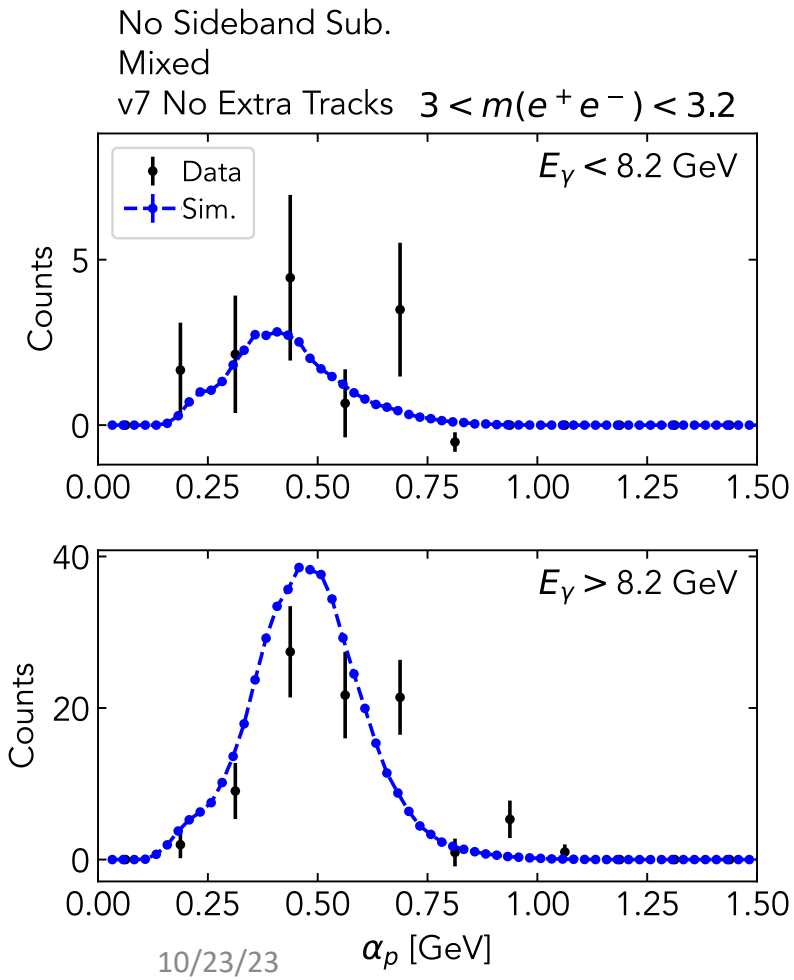
Alpha_miss

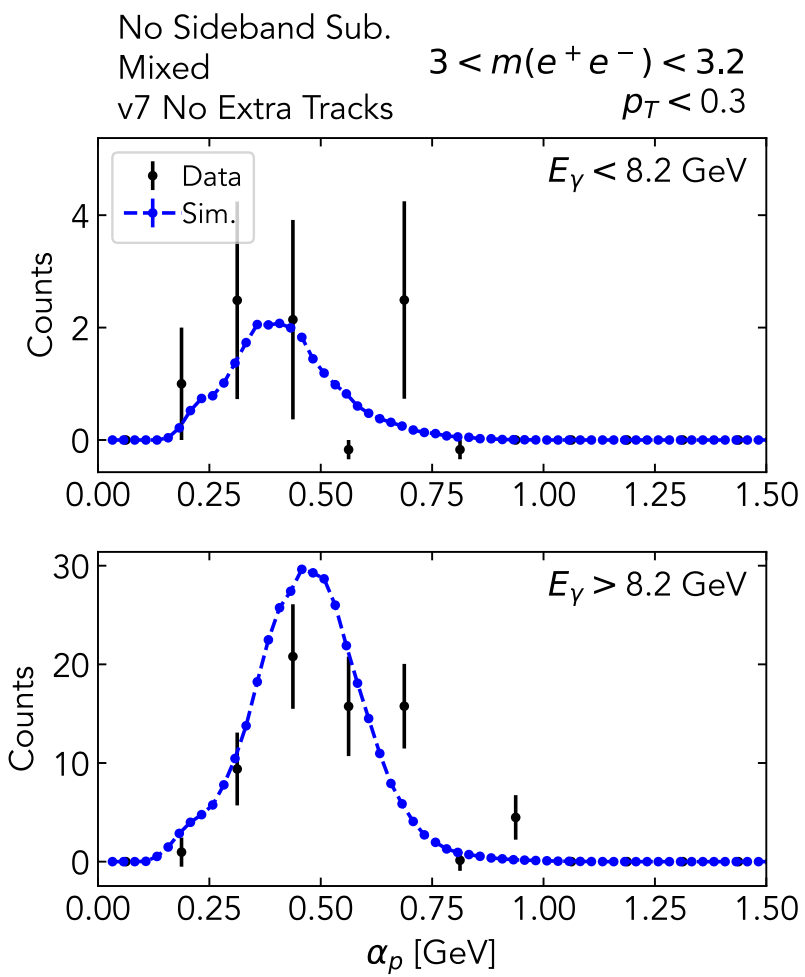

No Sideband Sub.
Mixed
v7 No Extra Tracks
$3 < m(e^+e^-) < 3.2$
Counts
Data
Sim.
$E_\gamma > 8.2$ GeV
p_t [GeV]

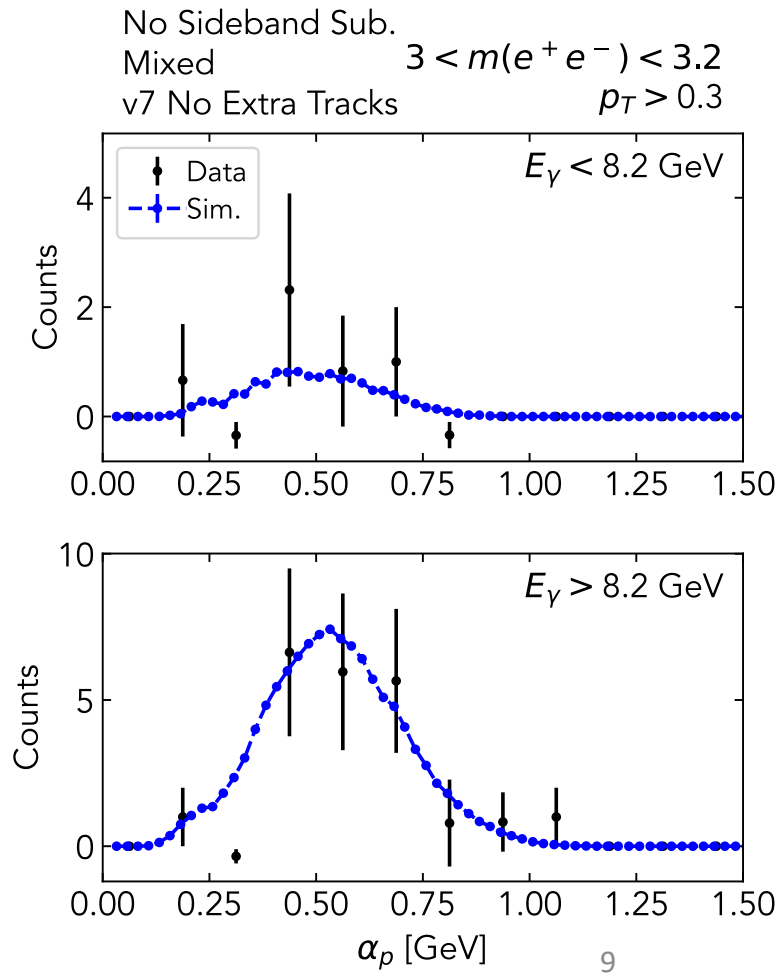

No Sideband Sub.
Mixed
v7 No Extra Tracks
$3 < m(e^+e^-) < 3.2$
$\mu_{data} = 1.31 \pm 0.05$
$\mu_{sim} = 1.14 \pm 0.03$
$E_\gamma < 8.2$ GeV
$\mu_{data} = 1.14 \pm 0.03$
$\mu_{sim} = 1.07 \pm 0.00$
$E_\gamma > 8.2$ GeV
Counts
Data
Sim.
α_{miss} [GeV]


No Sideband Sub.
Mixed
v7 No Extra Tracks
$3 < m(e^+e^-) < 3.2$
$p_T < 0.3$
$\mu_{data} = 1.34 \pm 0.03$
$\mu_{sim} = 1.13 \pm 0.04$
$E_\gamma < 8.2$ GeV
$\mu_{data} = 1.11 \pm 0.03$
$\mu_{sim} = 1.06 \pm 0.00$
$E_\gamma > 8.2$ GeV
Counts
Data
Sim.
α_{miss} [GeV]

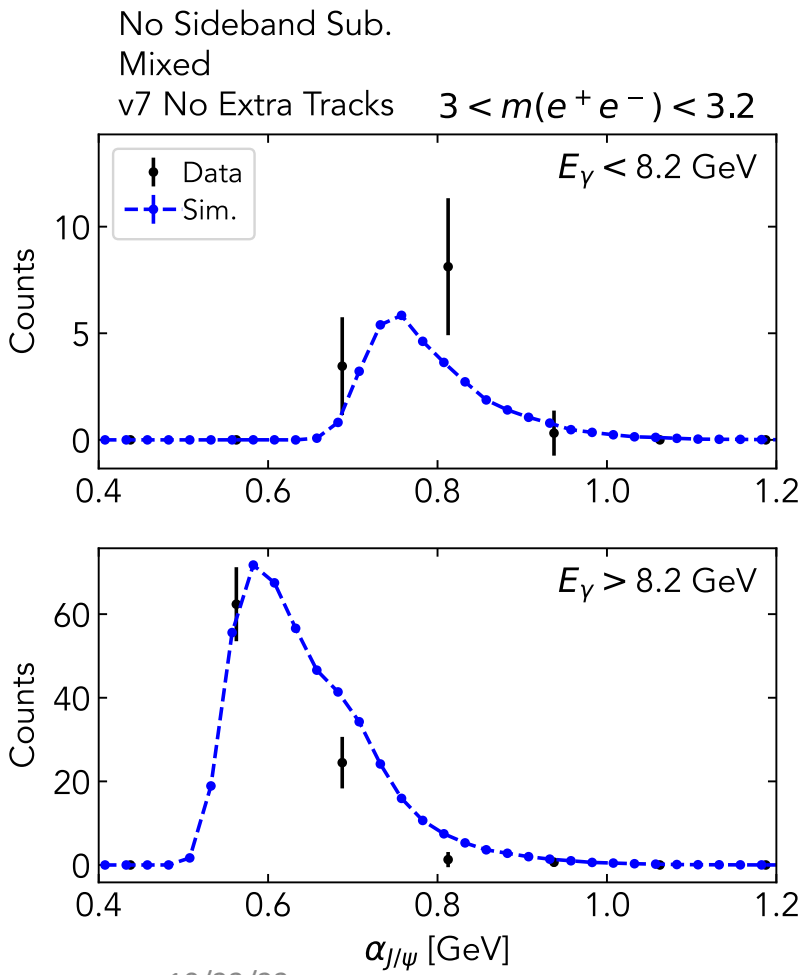
Proton

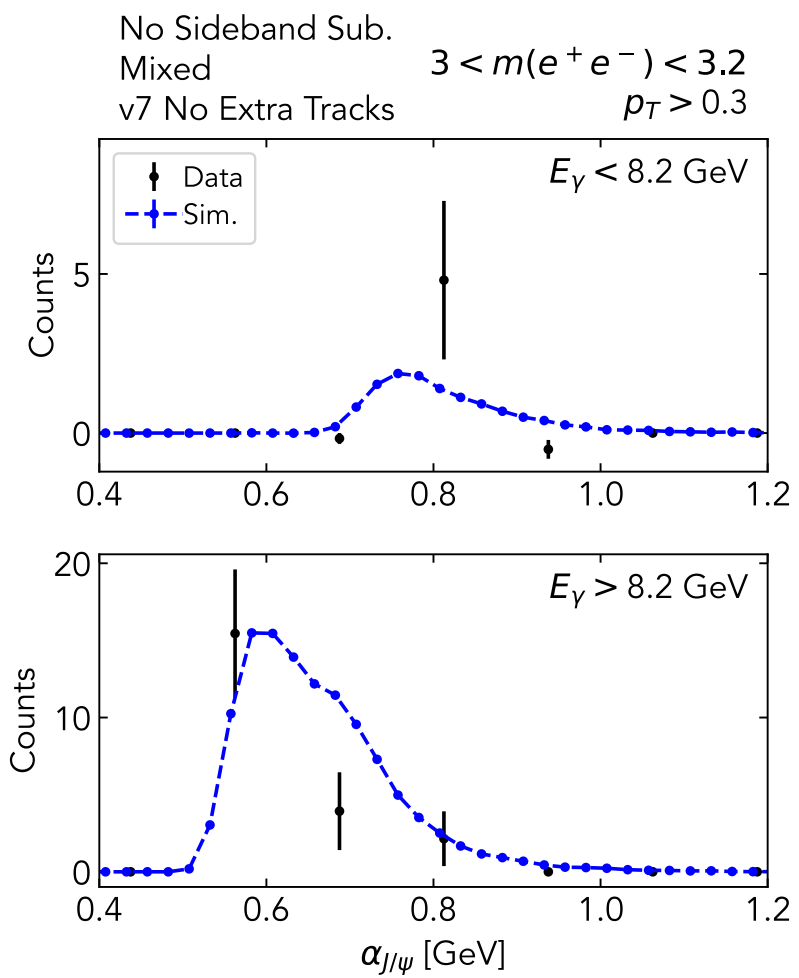

No Sideband Sub.
Mixed
v7 No Extra Tracks
$3 < m(e^+e^-) < 3.2$
Data
Sim.
$E_\gamma < 8.2$ GeV
$E_\gamma > 8.2$ GeV
Counts
α_p [GeV]

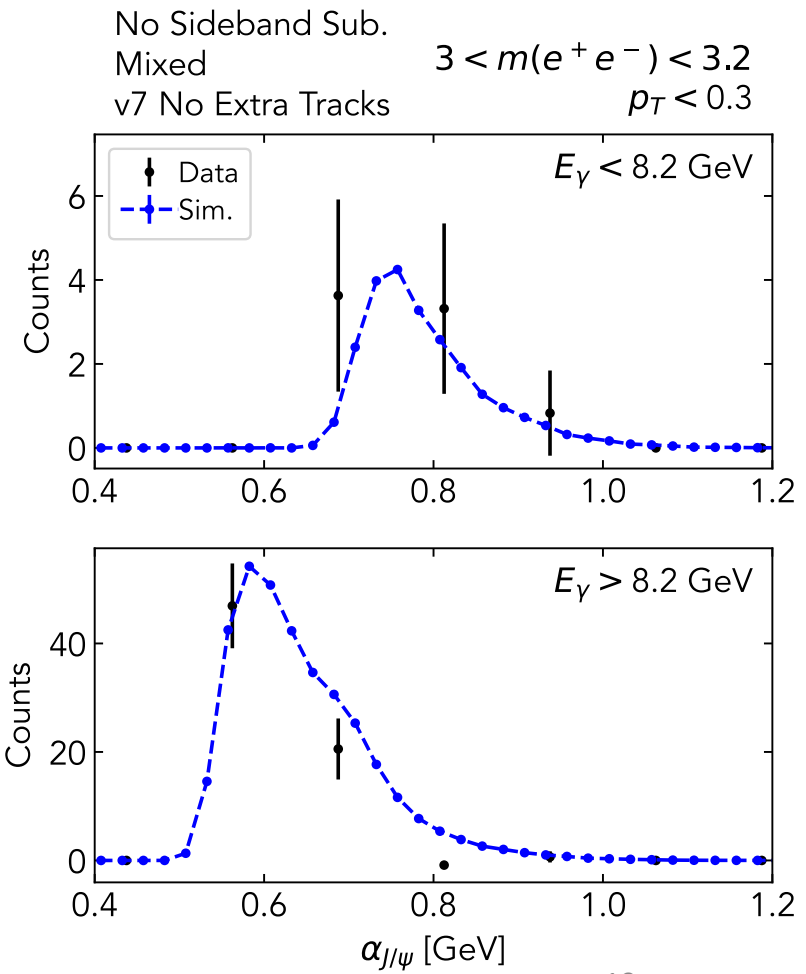

No Sideband Sub.
Mixed
v7 No Extra Tracks
$3 < m(e^+e^-) < 3.2$
$p_T < 0.3$
Data
Sim.
$E_\gamma < 8.2$ GeV
$E_\gamma > 8.2$ GeV
Counts
α_p [GeV]


No Sideband Sub.
Mixed
v7 No Extra Tracks
$3 < m(e^+e^-) < 3.2$
$p_T > 0.3$
Data
Sim.
$E_\gamma < 8.2$ GeV
$E_\gamma > 8.2$ GeV
Counts
α_p [GeV]

J/Psi


No Sideband Sub.
Mixed
v7 No Extra Tracks
$3 < m(e^+e^-) < 3.2$
Data
Sim.
$E_\gamma < 8.2$ GeV
$E_\gamma > 8.2$ GeV
Counts
$\alpha_{J/\psi}$ [GeV]

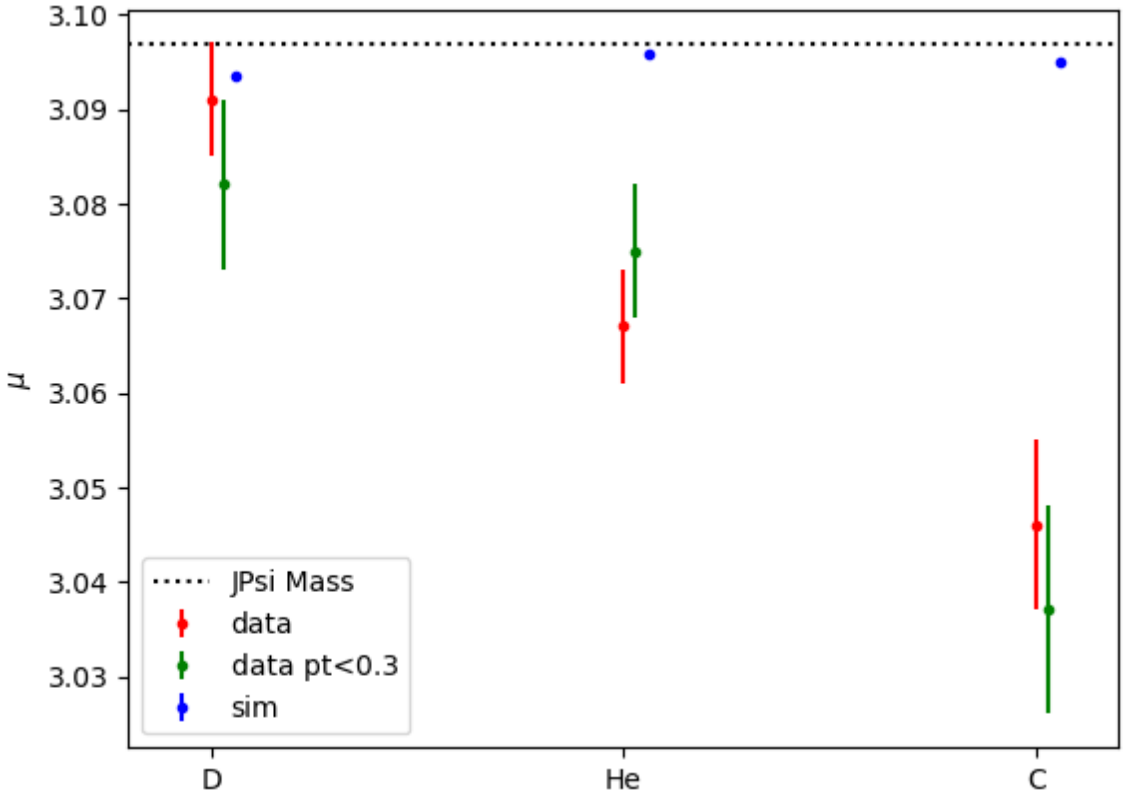

No Sideband Sub.
Mixed
v7 No Extra Tracks
$3 < m(e^+e^-) < 3.2$
$p_T > 0.3$
Data
Sim.
$E_\gamma < 8.2$ GeV
$E_\gamma > 8.2$ GeV
Counts
$\alpha_{J/\psi}$ [GeV]

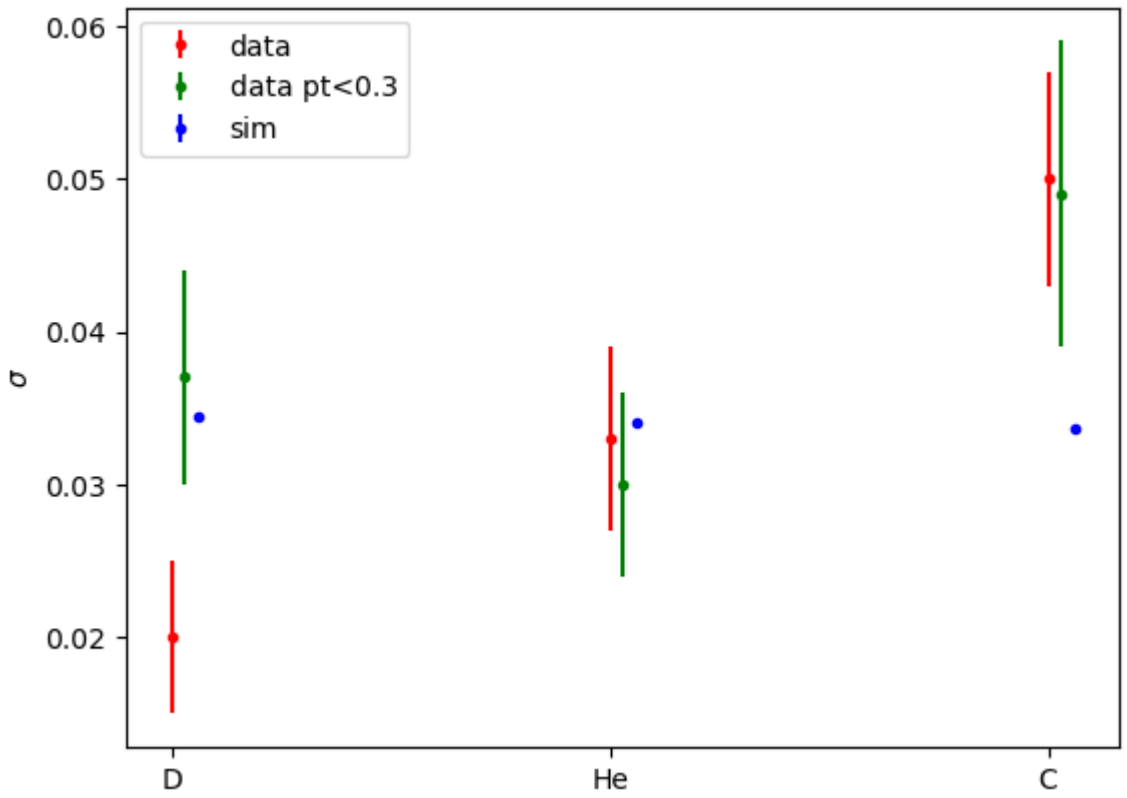

No Sideband Sub.
Mixed
v7 No Extra Tracks
$3 < m(e^+e^-) < 3.2$
$p_T < 0.3$
Data
Sim.
$E_\gamma < 8.2$ GeV
$E_\gamma > 8.2$ GeV
Counts
$\alpha_{J/\psi}$ [GeV]

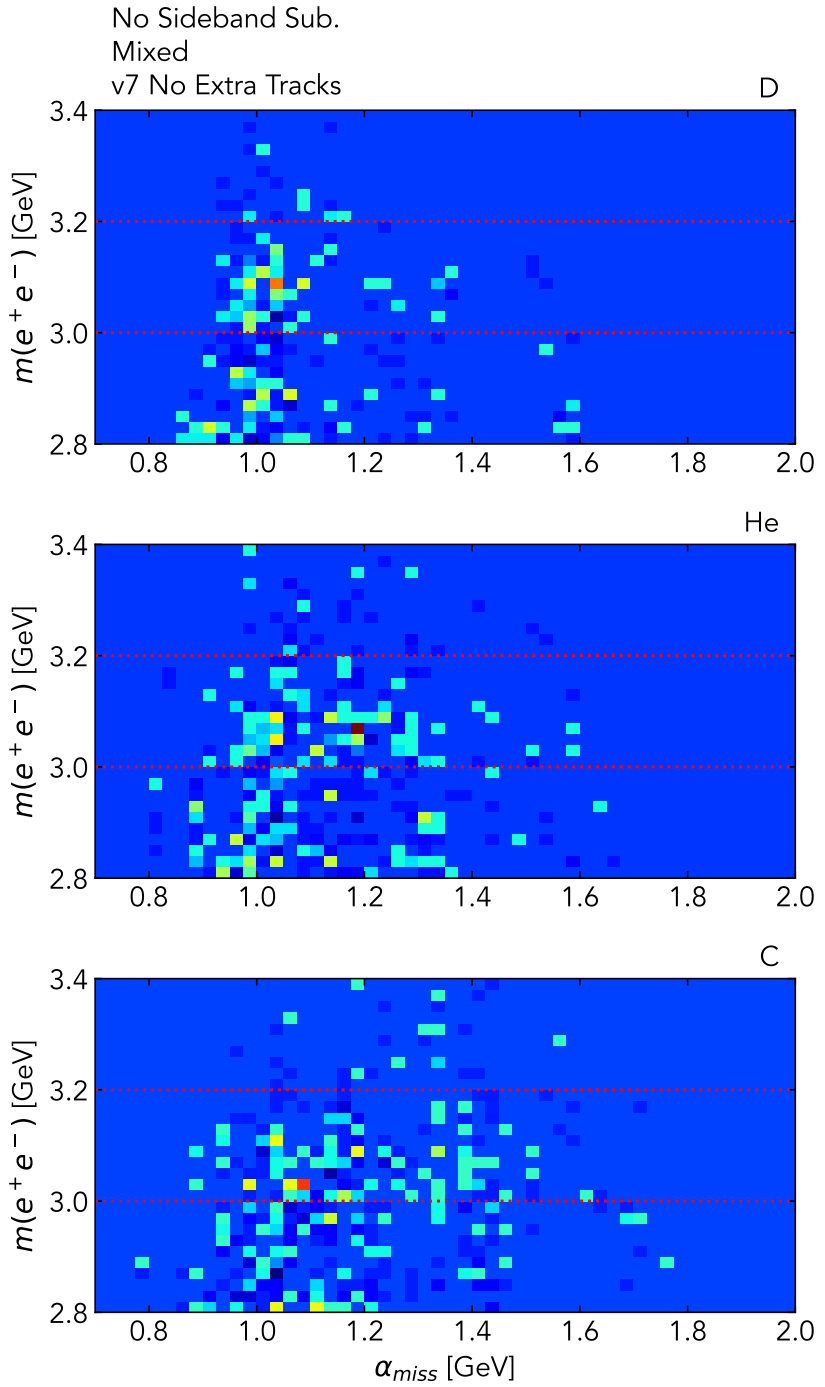
Conclusions & Next Steps

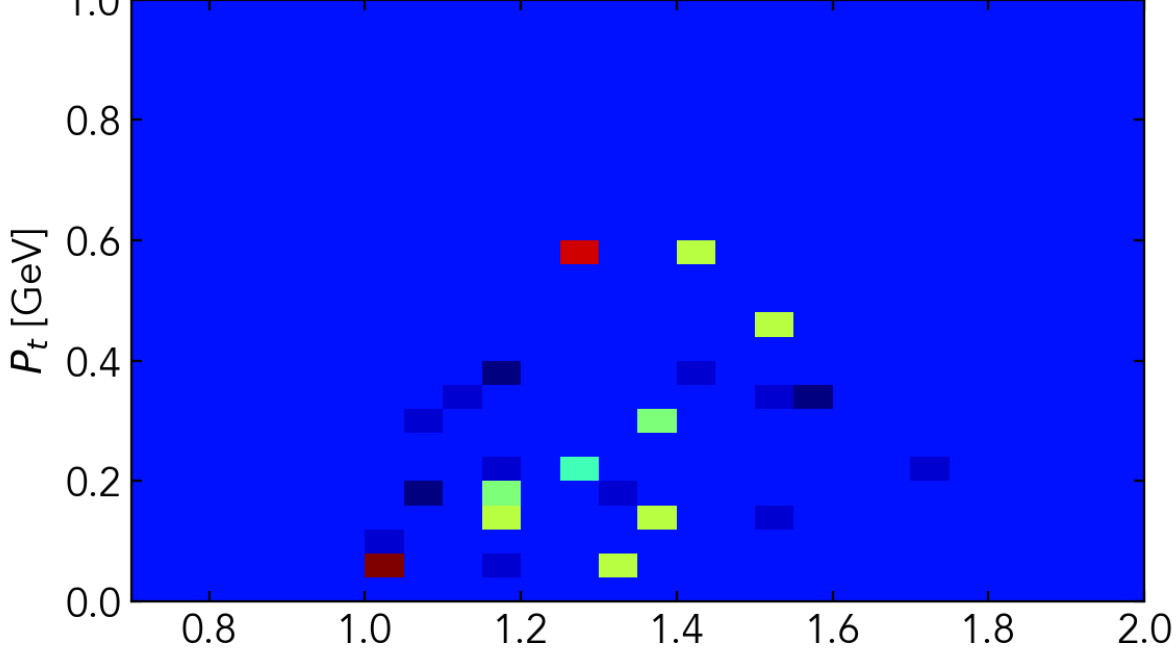
- Kinematic discrepancies not fully described by FSI
  - Low statistics
  - Something else? (Jackson: Hidden color)

- Next:
  - Run final set of loosened cuts
    - ~1-2 weeks
  - Start finalizing paper?

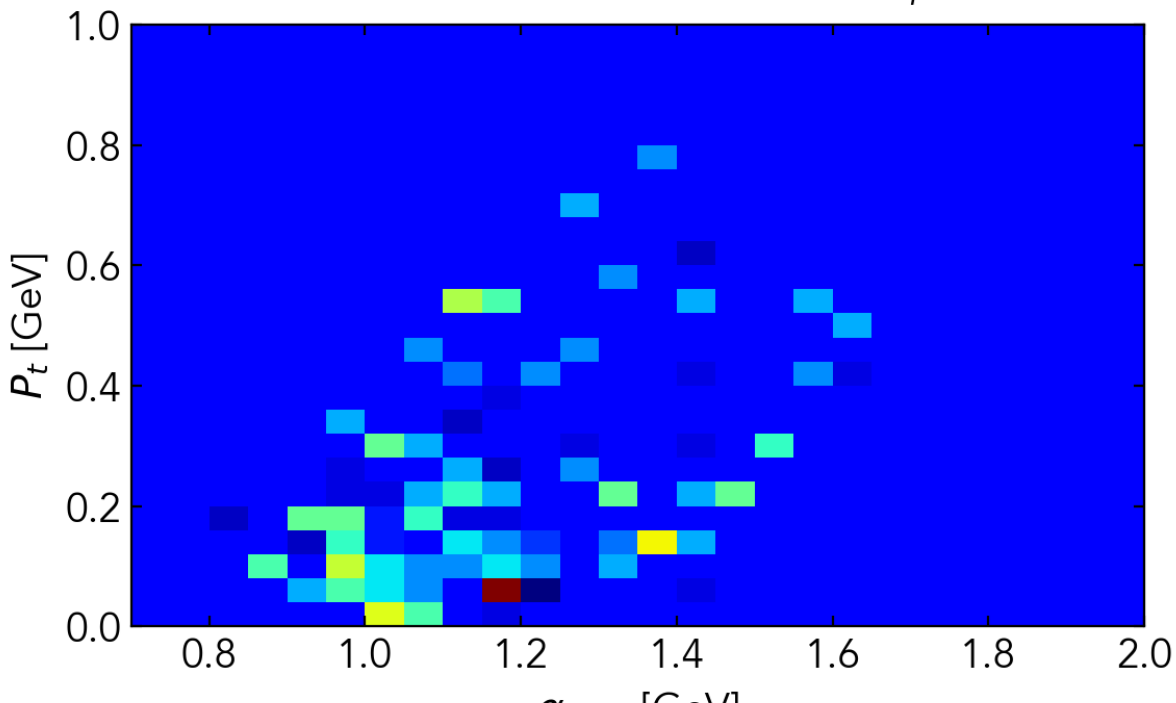

3.10
3.09
3.08
3.07
3.06
3.05
3.04
3.03
μ
JPsi Mass
data
data pt<0.3
sim
D
He
C

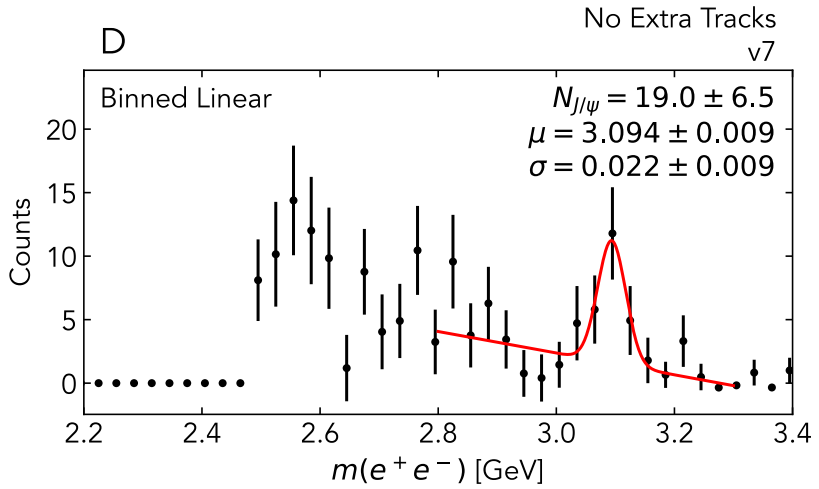

0.06
0.05
0.04
0.03
0.02
σ
data
data pt<0.3
sim
D
He
C

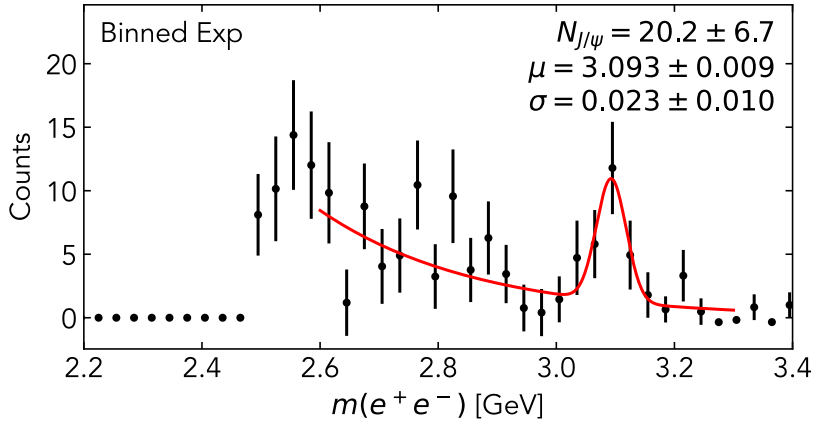

No Sideband Sub.
Mixed
v7 No Extra Tracks
D
He
C
$m(e^+e^-)$ [GeV]
3.4
3.2
3.0
2.8
0.8
1.0
1.2
1.4
1.6
1.8
2.0
α_{miss} [GeV]

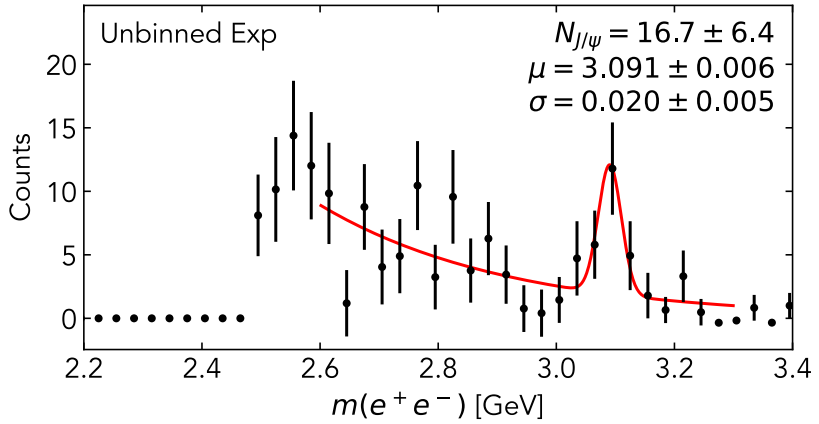

1.0
0.8
0.6
0.4
0.2
0.0
P_t [GeV]
0.8
1.0
1.2
1.4
1.6
1.8
2.0

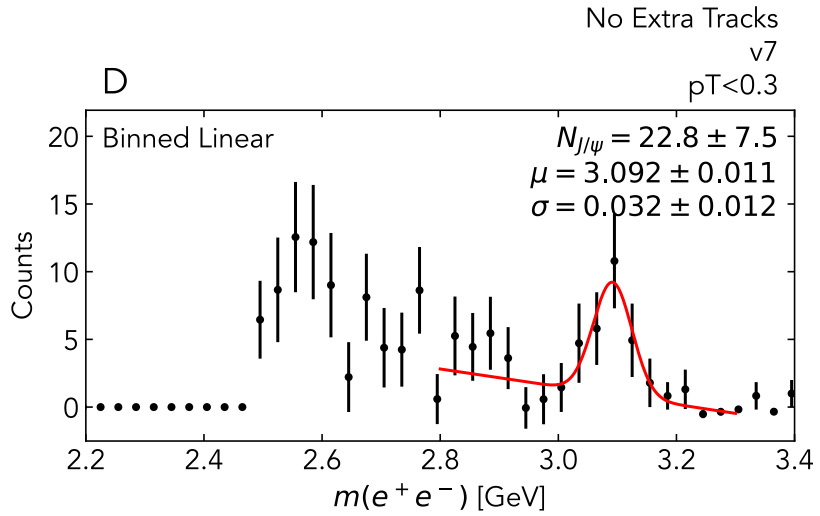
myplot.png

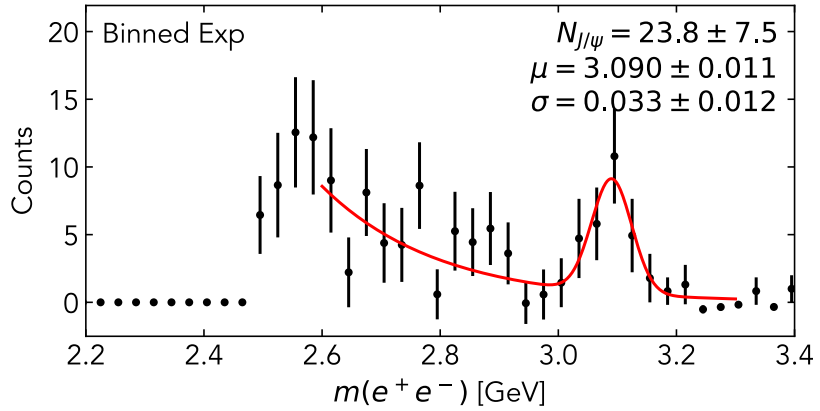

$E_\gamma > 8.2$ GeV
1.0
0.8
0.6
0.4
0.2
0.0
P_t [GeV]
0.8
1.0
1.2
1.4
1.6
1.8
2.0

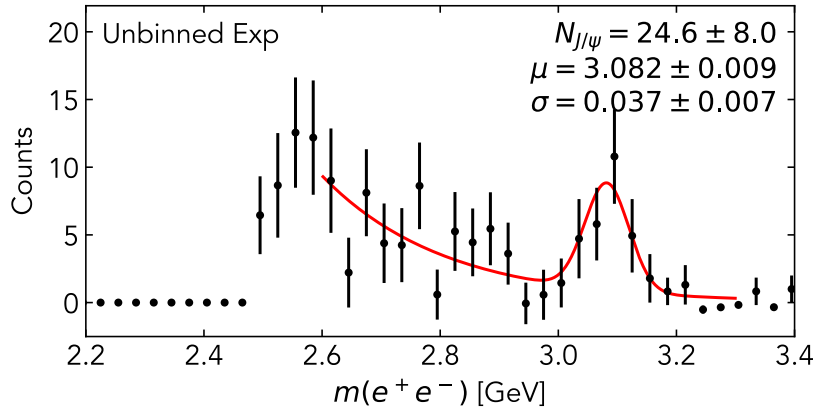

D
No Extra Tracks
v7
Binned Linear
$N_{J/\psi} = 19.0 \pm 6.5$
$\mu = 3.094 \pm 0.009$
$\sigma = 0.022 \pm 0.009$
Counts
$m(e^+e^-)$ [GeV]

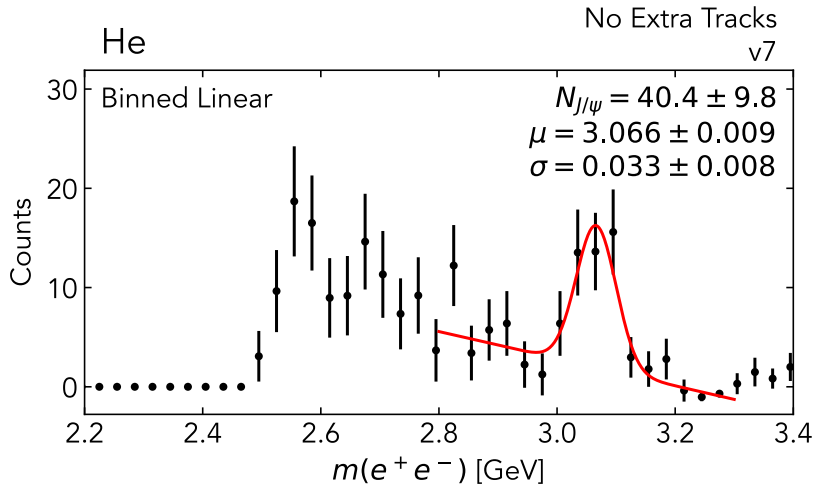

Binned Exp
$N_{J/\psi} = 20.2 \pm 6.7$
$\mu = 3.093 \pm 0.009$
$\sigma = 0.023 \pm 0.010$
Counts
$m(e^+e^-)$ [GeV]

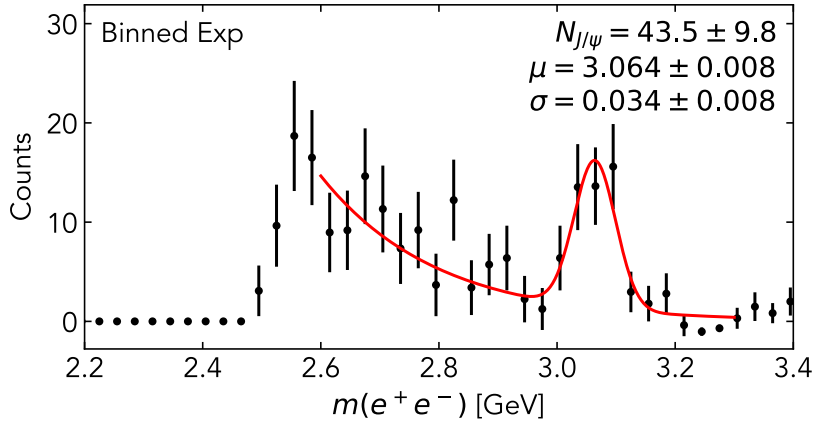

Unbinned Exp
$N_{J/\psi} = 16.7 \pm 6.4$
$\mu = 3.091 \pm 0.006$
$\sigma = 0.020 \pm 0.005$
Counts
$m(e^+e^-)$ [GeV]

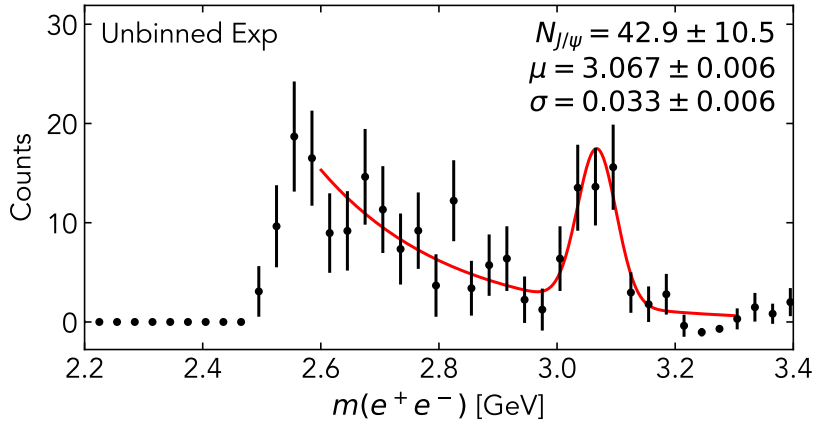

D
No Extra Tracks
v7
pT<0.3
Binned Linear
$N_{J/\psi} = 22.8 \pm 7.5$
$\mu = 3.092 \pm 0.011$
$\sigma = 0.032 \pm 0.012$
Counts
$m(e^+e^-)$ [GeV]

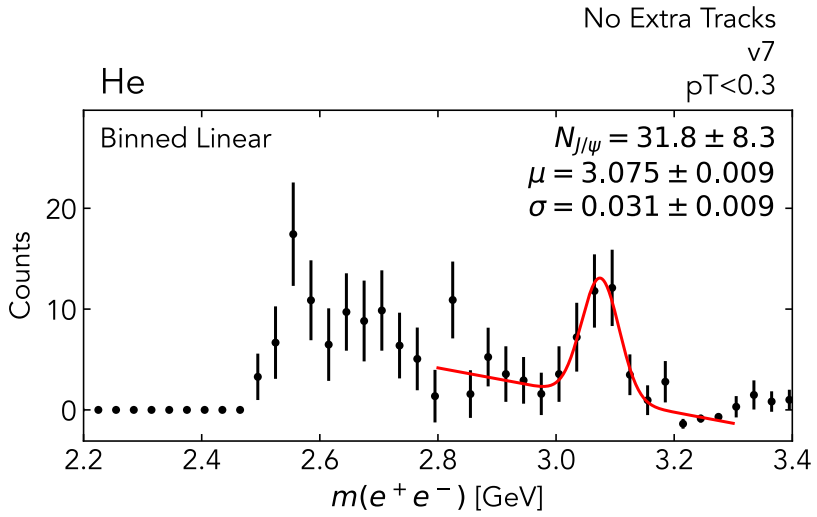

Binned Exp
$N_{J/\psi} = 23.8 \pm 7.5$
$\mu = 3.090 \pm 0.011$
$\sigma = 0.033 \pm 0.012$
Counts
$m(e^+e^-)$ [GeV]

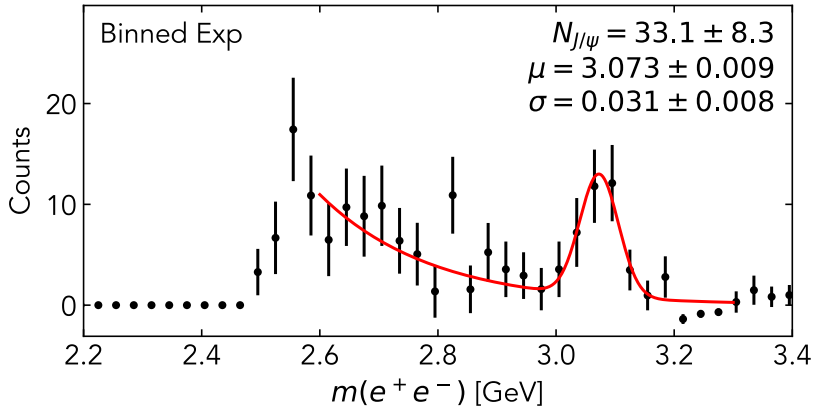

Unbinned Exp
$N_{J/\psi} = 24.6 \pm 8.0$
$\mu = 3.082 \pm 0.009$
$\sigma = 0.037 \pm 0.007$
Counts
$m(e^+e^-)$ [GeV]

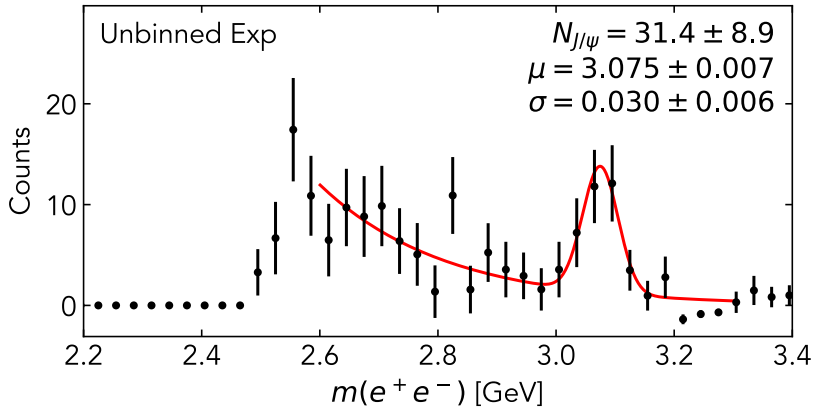

He
No Extra Tracks
v7
Binned Linear
$N_{J/\psi} = 40.4 \pm 9.8$
$\mu = 3.066 \pm 0.009$
$\sigma = 0.033 \pm 0.008$
Counts
$m(e^+e^-)$ [GeV]

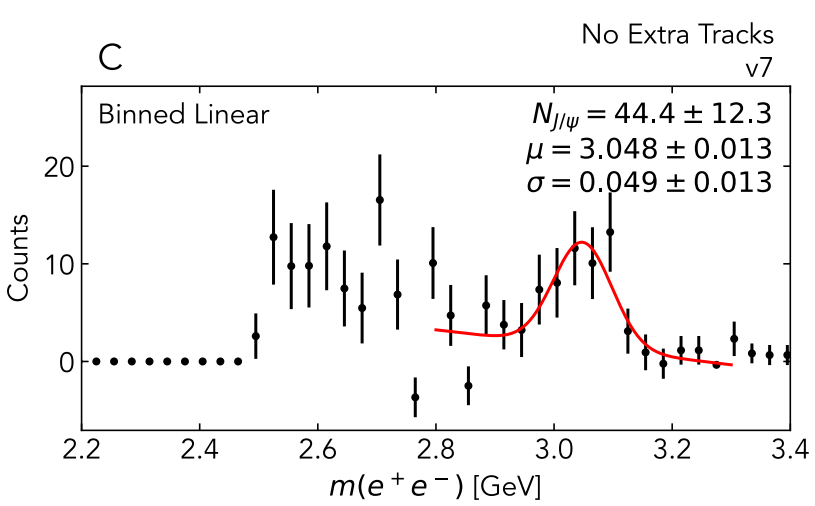

Binned Exp
$N_{J/\psi} = 43.5 \pm 9.8$
$\mu = 3.064 \pm 0.008$
$\sigma = 0.034 \pm 0.008$
Counts
$m(e^+e^-)$ [GeV]

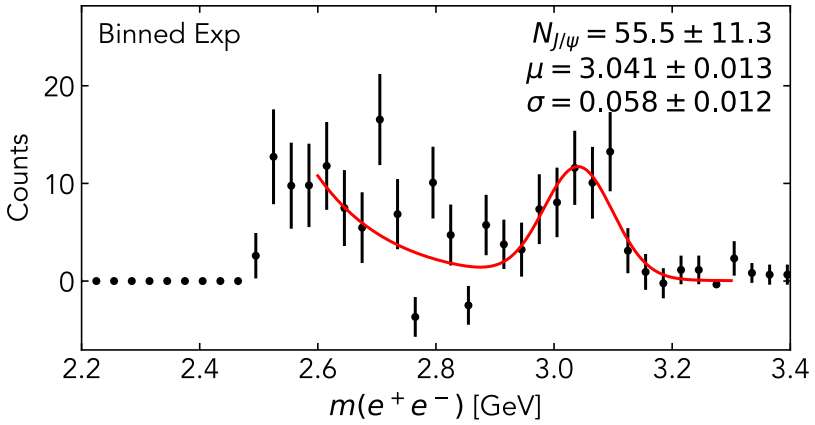

Unbinned Exp
$N_{J/\psi} = 42.9 \pm 10.5$
$\mu = 3.067 \pm 0.006$
$\sigma = 0.033 \pm 0.006$
Counts
$m(e^+e^-)$ [GeV]

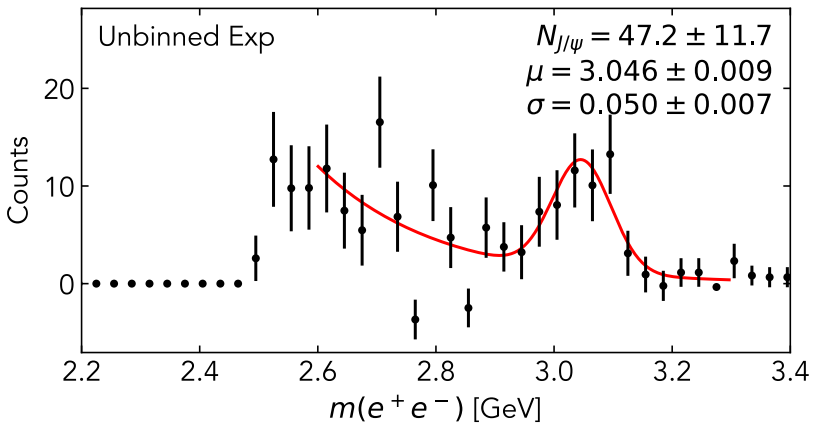

He
No Extra Tracks
v7
pT<0.3
Binned Linear
$N_{J/\psi} = 31.8 \pm 8.3$
$\mu = 3.075 \pm 0.009$
$\sigma = 0.031 \pm 0.009$
Counts
$m(e^+e^-)$ [GeV]

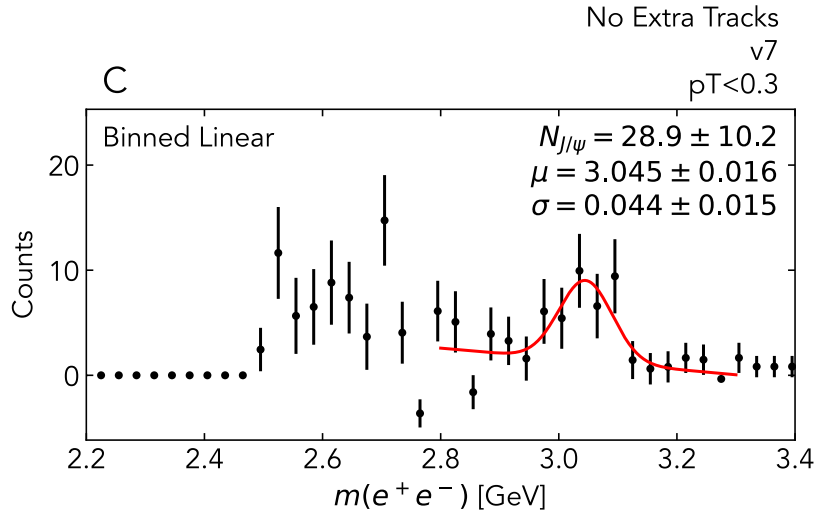

Binned Exp
$N_{J/\psi} = 33.1 \pm 8.3$
$\mu = 3.073 \pm 0.009$
$\sigma = 0.031 \pm 0.008$
Counts
$m(e^+e^-)$ [GeV]

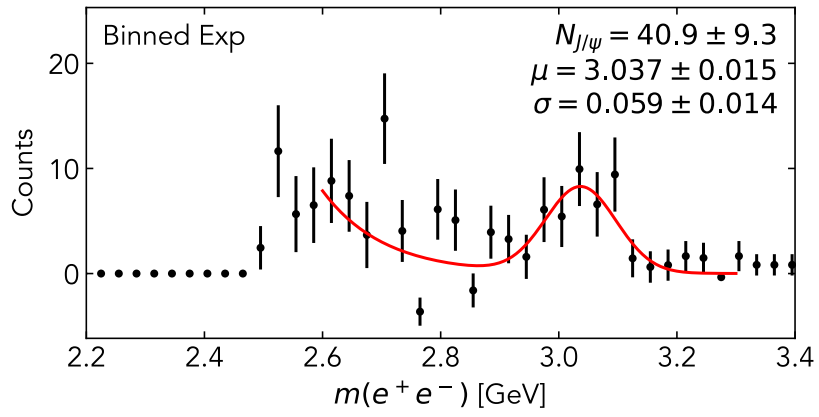

Unbinned Exp
$N_{J/\psi} = 31.4 \pm 8.9$
$\mu = 3.075 \pm 0.007$
$\sigma = 0.030 \pm 0.006$
Counts
$m(e^+e^-)$ [GeV]

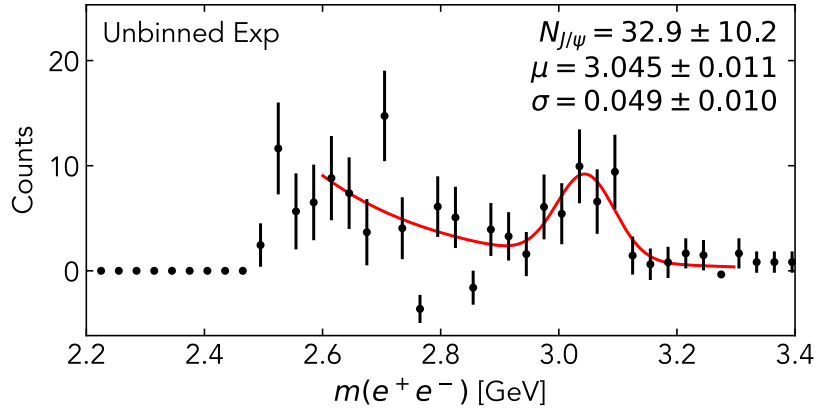

C
No Extra Tracks
v7
Binned Linear
$N_{J/\psi} = 44.4 \pm 12.3$
$\mu = 3.048 \pm 0.013$
$\sigma = 0.049 \pm 0.013$
Counts
$m(e^+e^-)$ [GeV]


Binned Exp
$N_{J/\psi} = 55.5 \pm 11.3$
$\mu = 3.041 \pm 0.013$
$\sigma = 0.058 \pm 0.012$
Counts
$m(e^+e^-)$ [GeV]


Unbinned Exp
$N_{J/\psi} = 47.2 \pm 11.7$
$\mu = 3.046 \pm 0.009$
$\sigma = 0.050 \pm 0.007$
Counts
$m(e^+e^-)$ [GeV]


C
No Extra Tracks
v7
pT<0.3
Binned Linear
$N_{J/\psi} = 28.9 \pm 10.2$
$\mu = 3.045 \pm 0.016$
$\sigma = 0.044 \pm 0.015$
Counts
$m(e^+e^-)$ [GeV]


Binned Exp
$N_{J/\psi} = 40.9 \pm 9.3$
$\mu = 3.037 \pm 0.015$
$\sigma = 0.059 \pm 0.014$
Counts
$m(e^+e^-)$ [GeV]

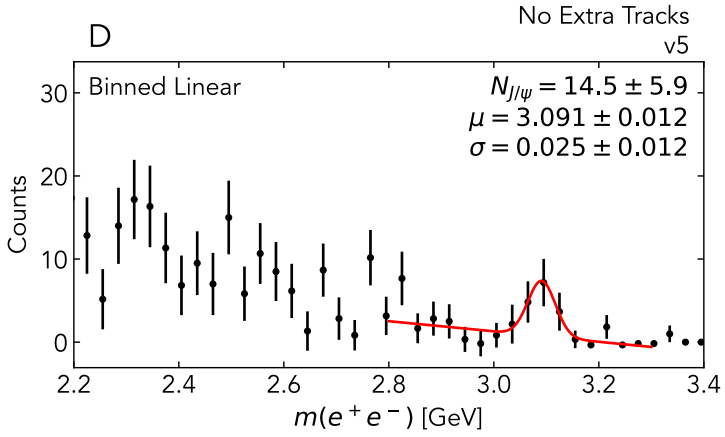

Unbinned Exp
$N_{J/\psi} = 32.9 \pm 10.2$
$\mu = 3.045 \pm 0.011$
$\sigma = 0.049 \pm 0.010$
Counts
$m(e^+e^-)$ [GeV]

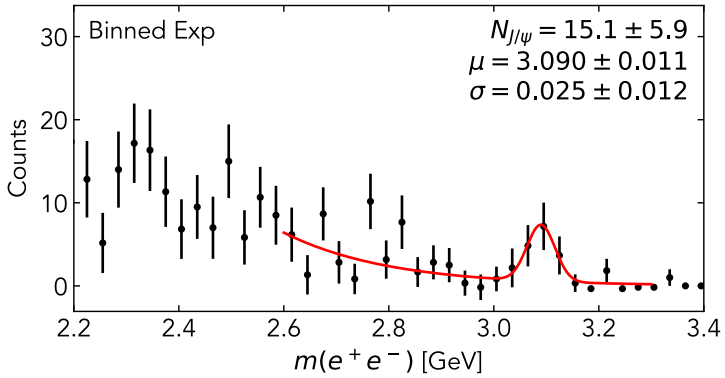
SRC-CT J/Psi Update: 10/23/23

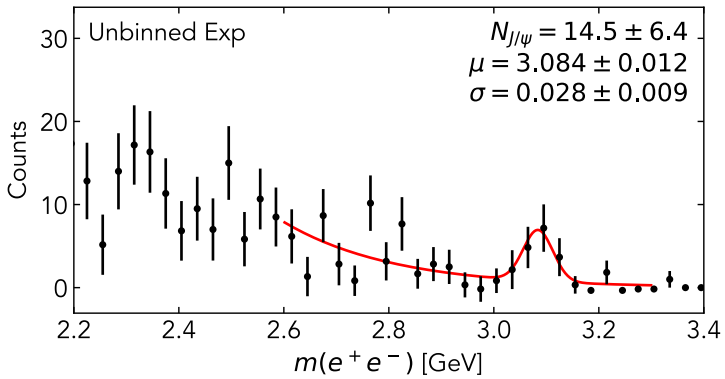
Loosening Cuts

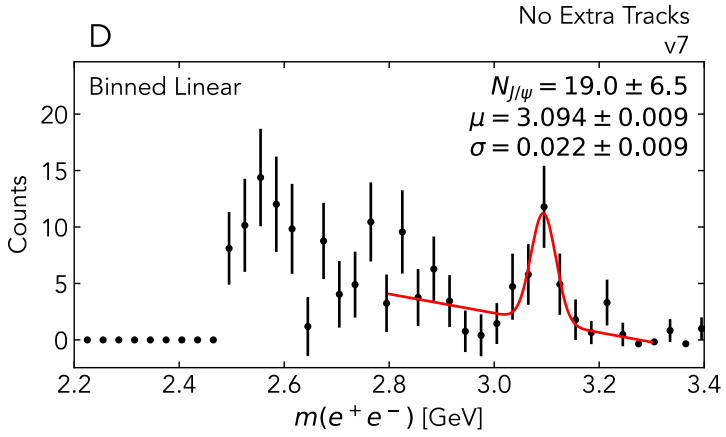
- v5: Tightest Cuts
- v7: Loosened PID Cuts
- v8: Loosened PID & Timing Cuts

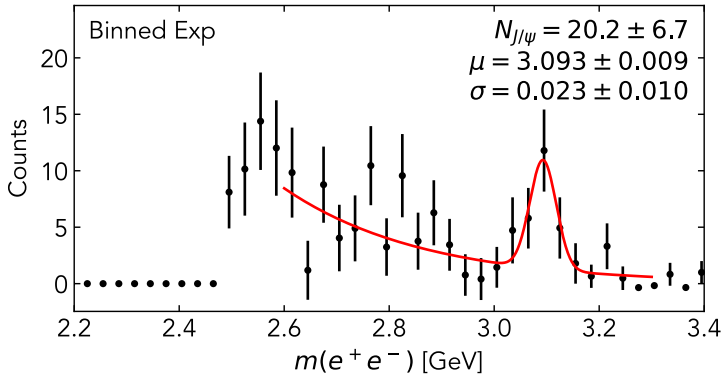
Target	v05 No Track	v07 No Track	Increase (from v05)	v08 No Track	Increase (from v05)
D	14.5	16.7	15%	20.2	39%
He	34.9	42.9	23%	-	-
C	31	47.2	52%	-	-
He + C Subthreshold	8.5	10.1	19%	-	-

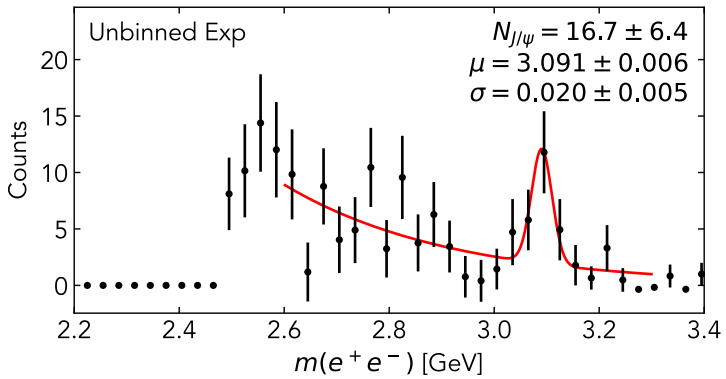

D
No Extra Tracks
v5
Binned Linear
$N_{J/\psi} = 14.5 \pm 5.9$
$\mu = 3.091 \pm 0.012$
$\sigma = 0.025 \pm 0.012$
Counts
$m(e^+e^-)$ [GeV]

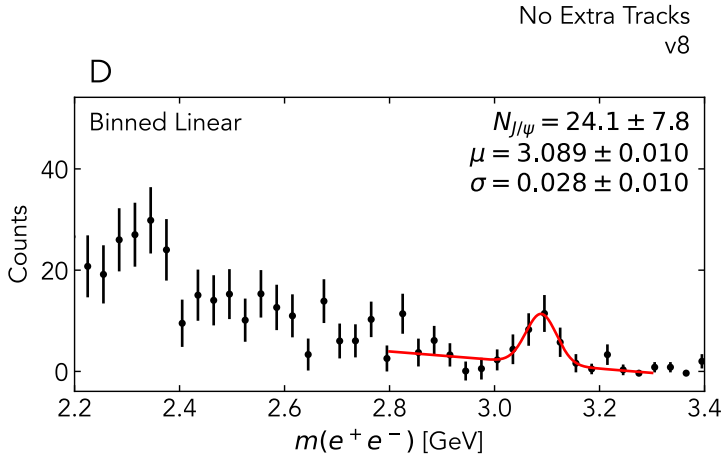

Binned Exp
$N_{J/\psi} = 15.1 \pm 5.9$
$\mu = 3.090 \pm 0.011$
$\sigma = 0.025 \pm 0.012$
Counts
$m(e^+e^-)$ [GeV]

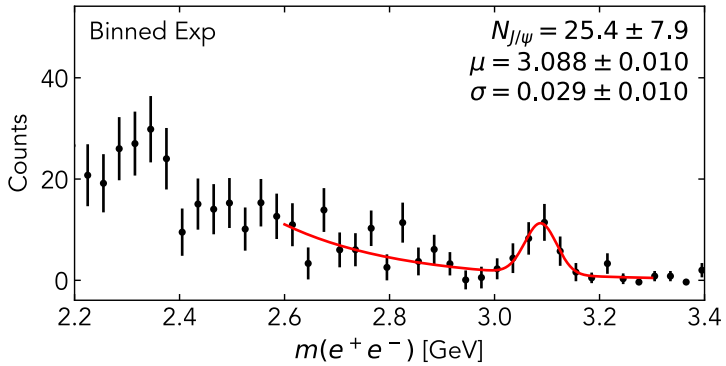

Unbinned Exp
$N_{J/\psi} = 14.5 \pm 6.4$
$\mu = 3.084 \pm 0.012$
$\sigma = 0.028 \pm 0.009$
Counts
$m(e^+e^-)$ [GeV]

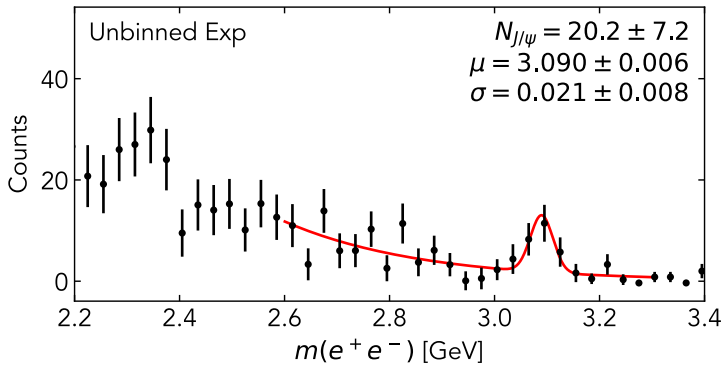

D
No Extra Tracks
v7
Binned Linear
$N_{J/\psi} = 19.0 \pm 6.5$
$\mu = 3.094 \pm 0.009$
$\sigma = 0.022 \pm 0.009$
Counts
$m(e^+e^-)$ [GeV]


Binned Exp
$N_{J/\psi} = 20.2 \pm 6.7$
$\mu = 3.093 \pm 0.009$
$\sigma = 0.023 \pm 0.010$
Counts
$m(e^+e^-)$ [GeV]


Unbinned Exp
$N_{J/\psi} = 16.7 \pm 6.4$
$\mu = 3.091 \pm 0.006$
$\sigma = 0.020 \pm 0.005$
Counts
$m(e^+e^-)$ [GeV]


No Extra Tracks
v8
D
Binned Linear
$N_{J/\psi} = 24.1 \pm 7.8$
$\mu = 3.089 \pm 0.010$
$\sigma = 0.028 \pm 0.010$
Counts
$m(e^+e^-)$ [GeV]


Binned Exp
$N_{J/\psi} = 25.4 \pm 7.9$
$\mu = 3.088 \pm 0.010$
$\sigma = 0.029 \pm 0.010$
Counts
$m(e^+e^-)$ [GeV]


Unbinned Exp
$N_{J/\psi} = 20.2 \pm 7.2$
$\mu = 3.090 \pm 0.006$
$\sigma = 0.021 \pm 0.008$
Counts
$m(e^+e^-)$ [GeV]