Study of $e^+e^- \to \pi^+\pi^-\psi(3686)$, $\psi(3686) \longrightarrow \pi^+\pi^- J/\psi$

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Data Sets

- Boss Version 702.p01;
- 2017 new data samples

Event selection

- **Good Charged Tracks Selection**

  $|V_r| < 1.0$, $|V_z| < 10.0$,$|\mathrm{Cos}\theta|<0.93$;

  $N_{good} = 6$ or 5 ; $N(l^-)=N(l^+)=1$, $l = e(\mu)$;

- **PID**

  lepton: $p > 1.0\ GeV/c$,

  e^+e^-: $\frac{E}{p} > 0.7$,

  $\mu^+\mu^-$: $E < 0.45\ GeV$;

  Pion: $p < 0.65\ GeV/c$;

- **4C and 5C Kinematic fit for 6 tracks**

  χ^2_{4C}<100, no χ^2_{5C} cut

  l^+l^- mass range: [3.05, 3.15] GeV

- **1C and 2C Kinematic fit for 5 tracks**

  χ^2_{1C}<20, no χ^2_{2C} cut

  l^+l^- mass range: [3.05, 3.15] GeV

Event selection

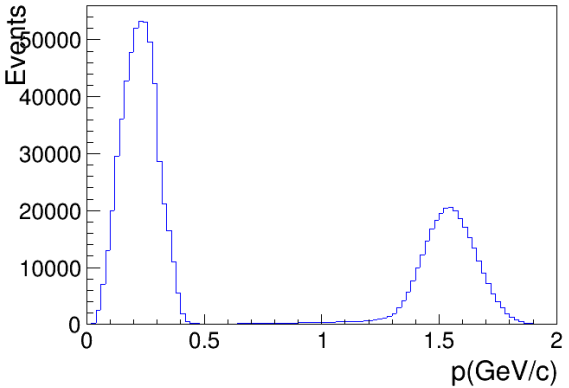
- **PID**

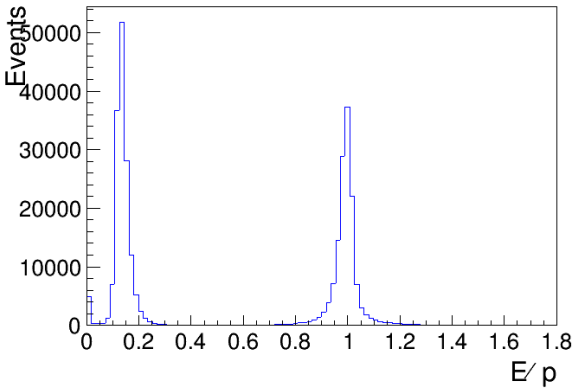
lepton: $p > 1.0\ GeV/c$,

e^+e^-: $\frac{E}{p} > 0.7$,

$\mu^+\mu^-$: E $< 0.45\ GeV$;

Pion: $p < 0.65\ GeV/c$;

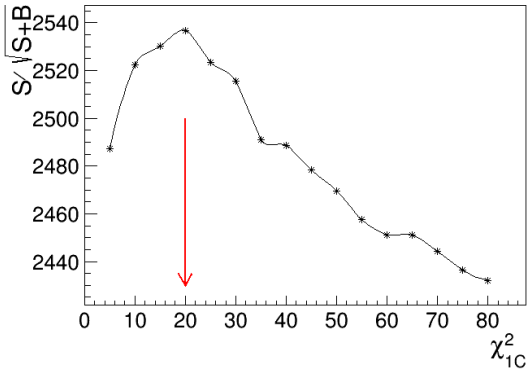


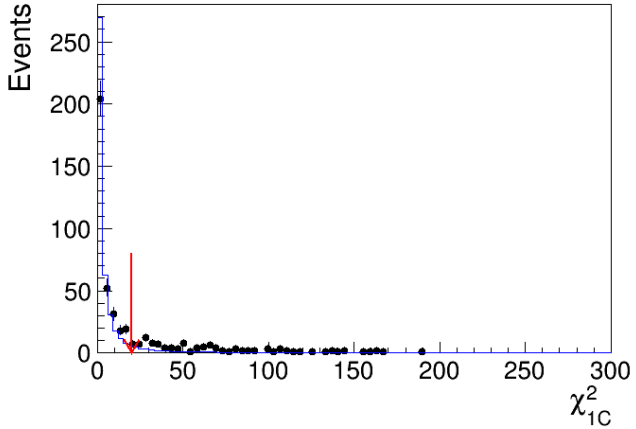


Chisq of kinematic fit(4180)

- For 5 tracks case:

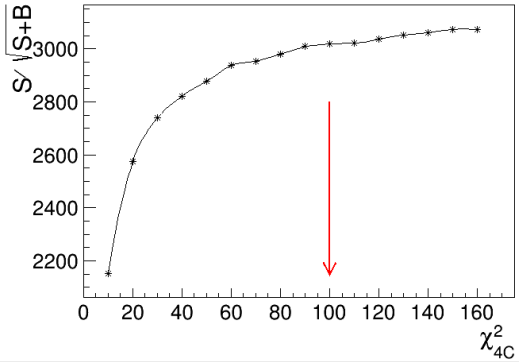
  χ^2_{1C}<20

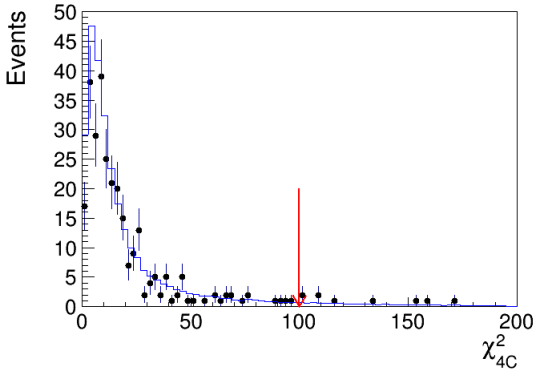




- For 6 tracks case:

  χ^2_{4C}<100

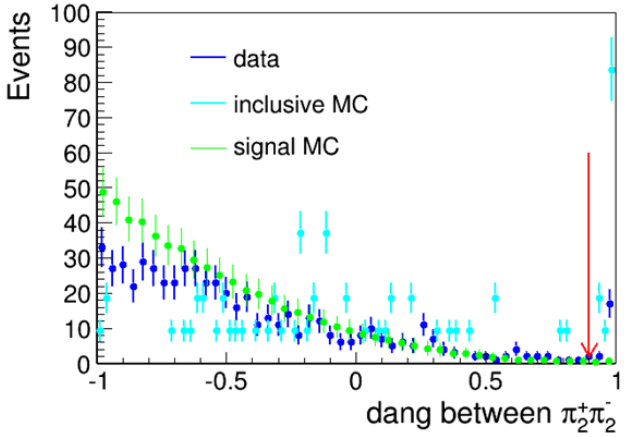




Event selection

- Angle cut for $\pi_2^+\pi_2^-$(comes from $\psi(3686)$):

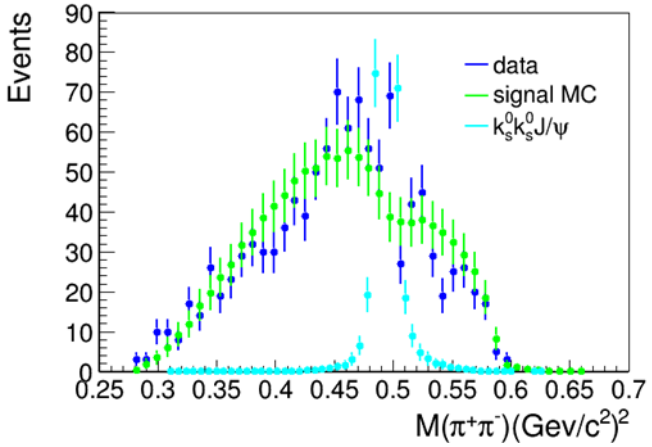
$\cos(\Delta_{angle})<0.9$



- K_s^0 candidates:

$\Sigma(\mathrm{M}(\pi_i^+\pi_j^-)-\mathrm{M}(K_s^0))^2$ has smallest value

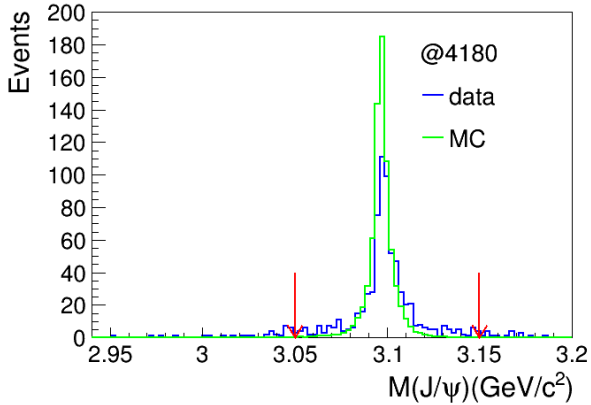
Background: a pair K_s^0 with mass [0.48, 0.505]



Mass window

- After 1C or 4C:

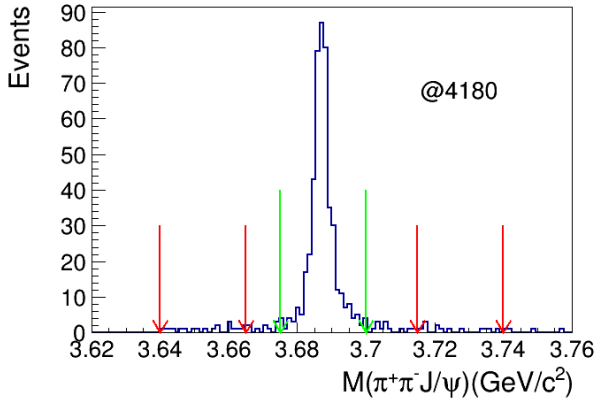
  l^+l^- mass range: [3.05, 3.15] GeV



- For study of intermediate states:

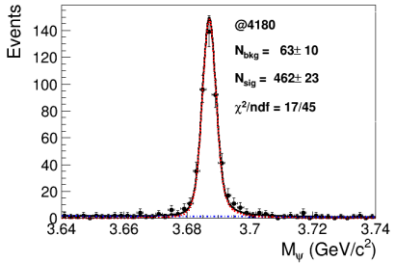
  $\psi(3686)$mass range: [3.675, 3.70] GeV

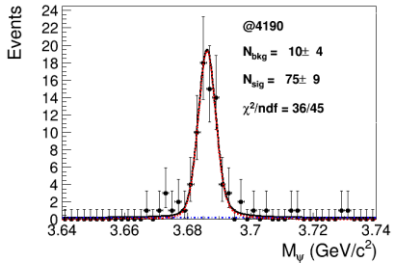
  Sideband range:[3.64,3.665] GeV,[3.715,3.74] GeV

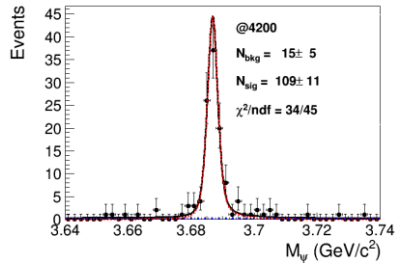


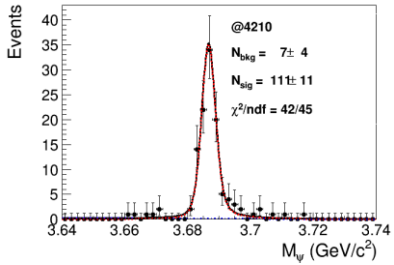
Fit result

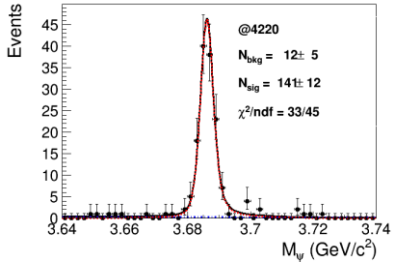
Fit method: MC⊗Gaussian

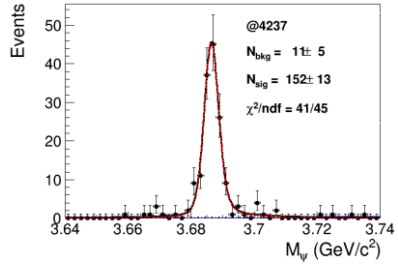


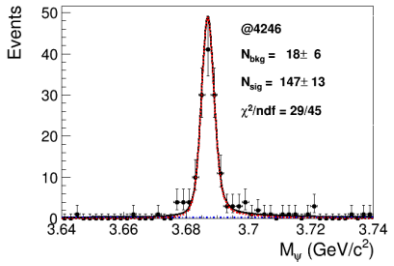


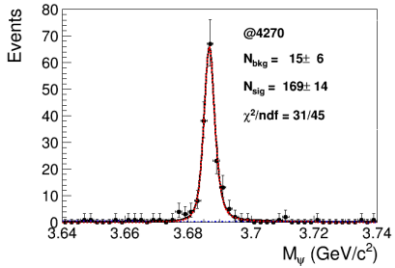


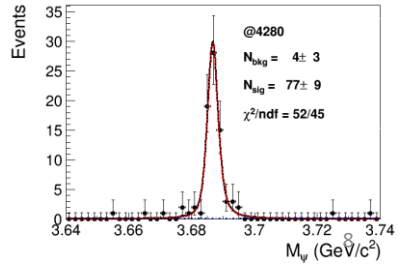




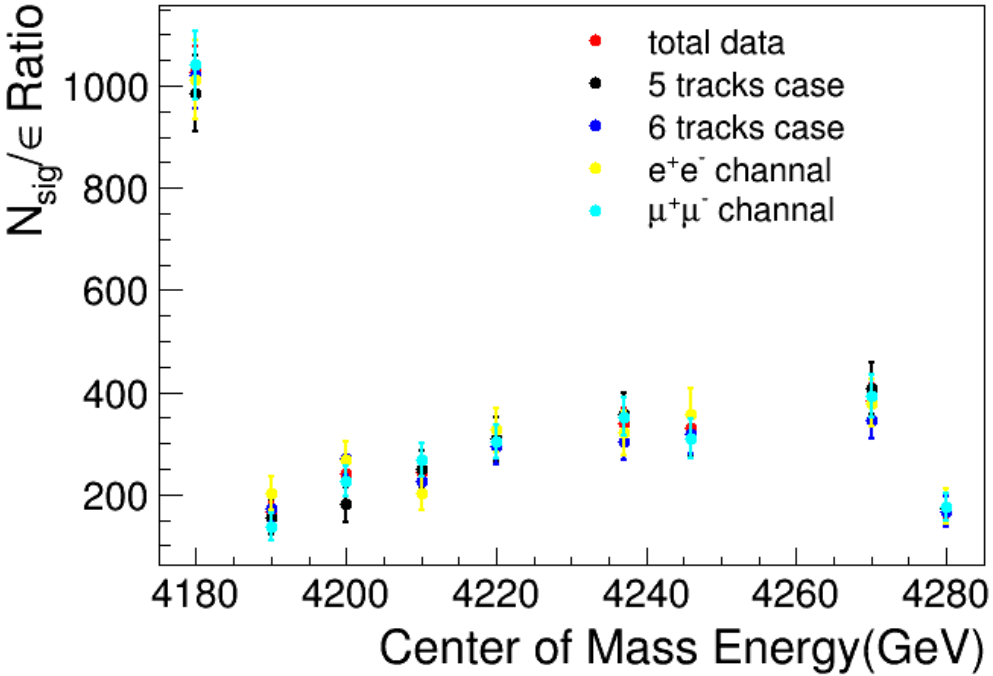






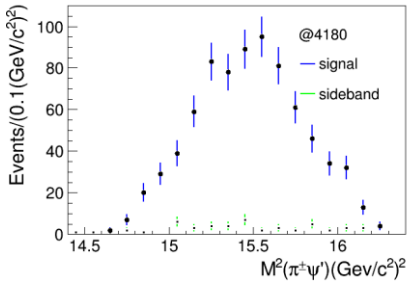


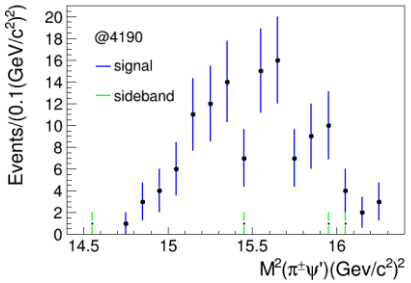
Fit result

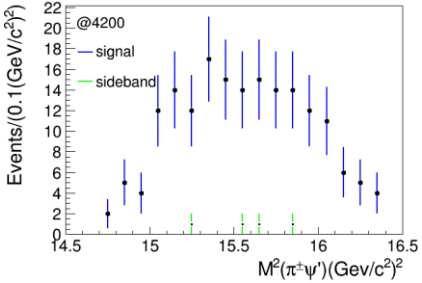


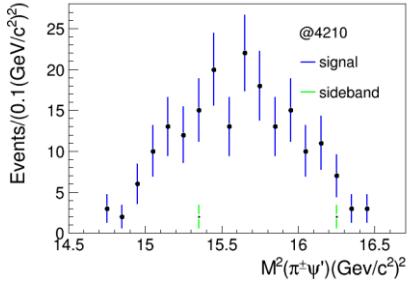
The ratio of signal number and efficiency at different energy are consistent

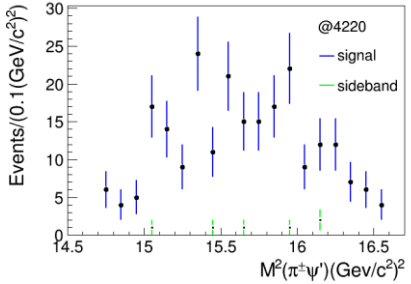
Study of intermediate states

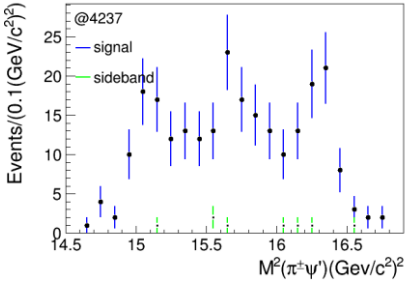


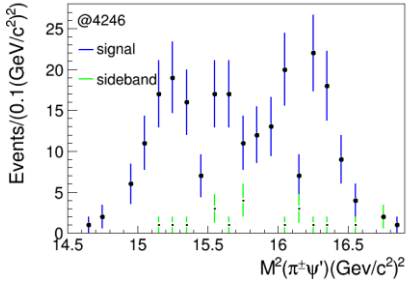


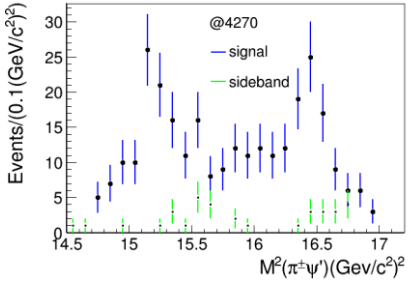


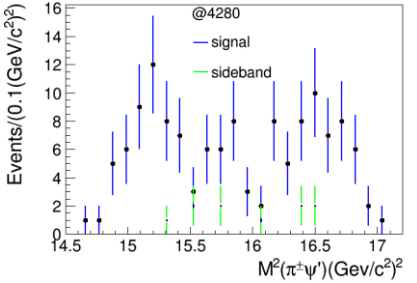




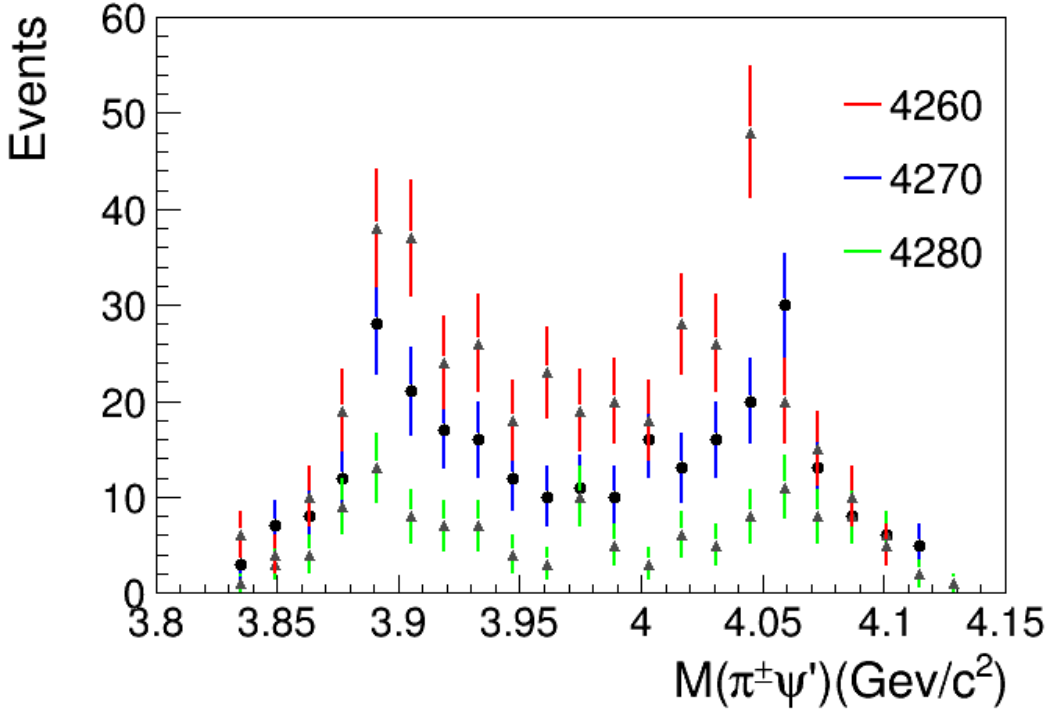






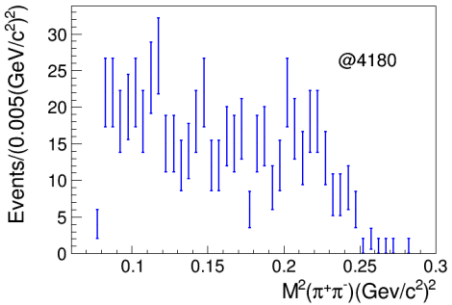


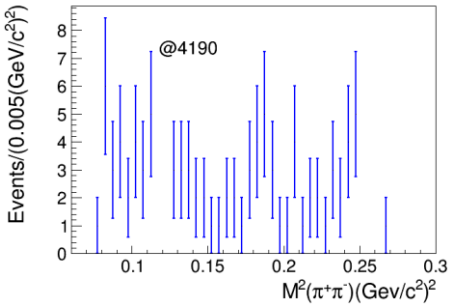
Study of intermediate states

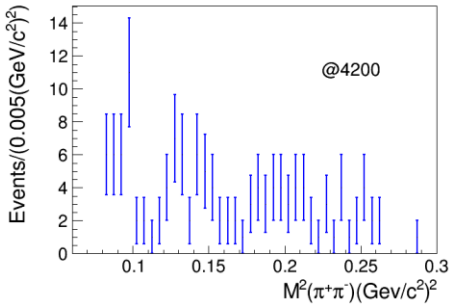


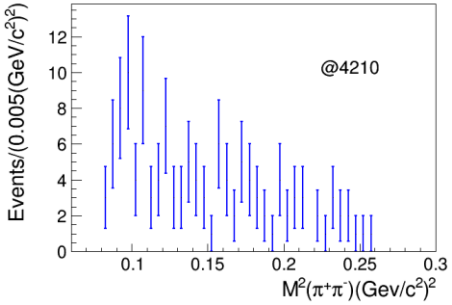
The peaks are at the same area

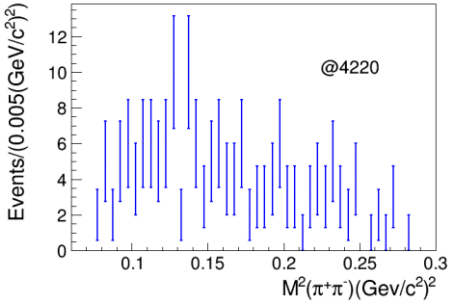
Study of intermediate states

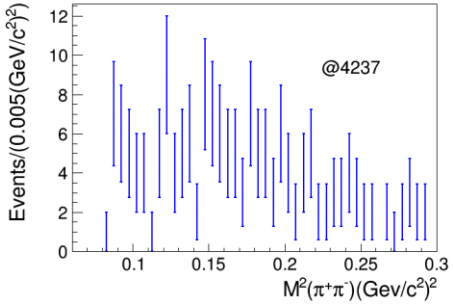


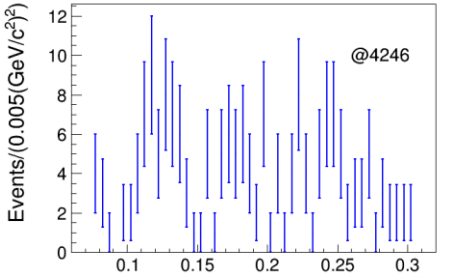


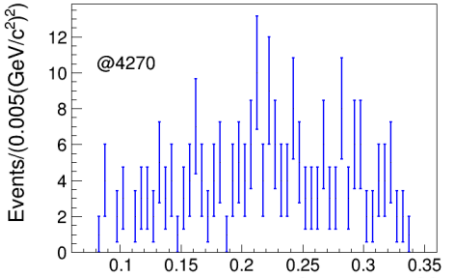


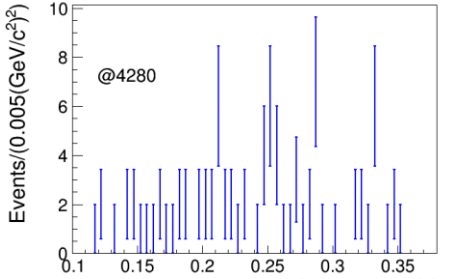










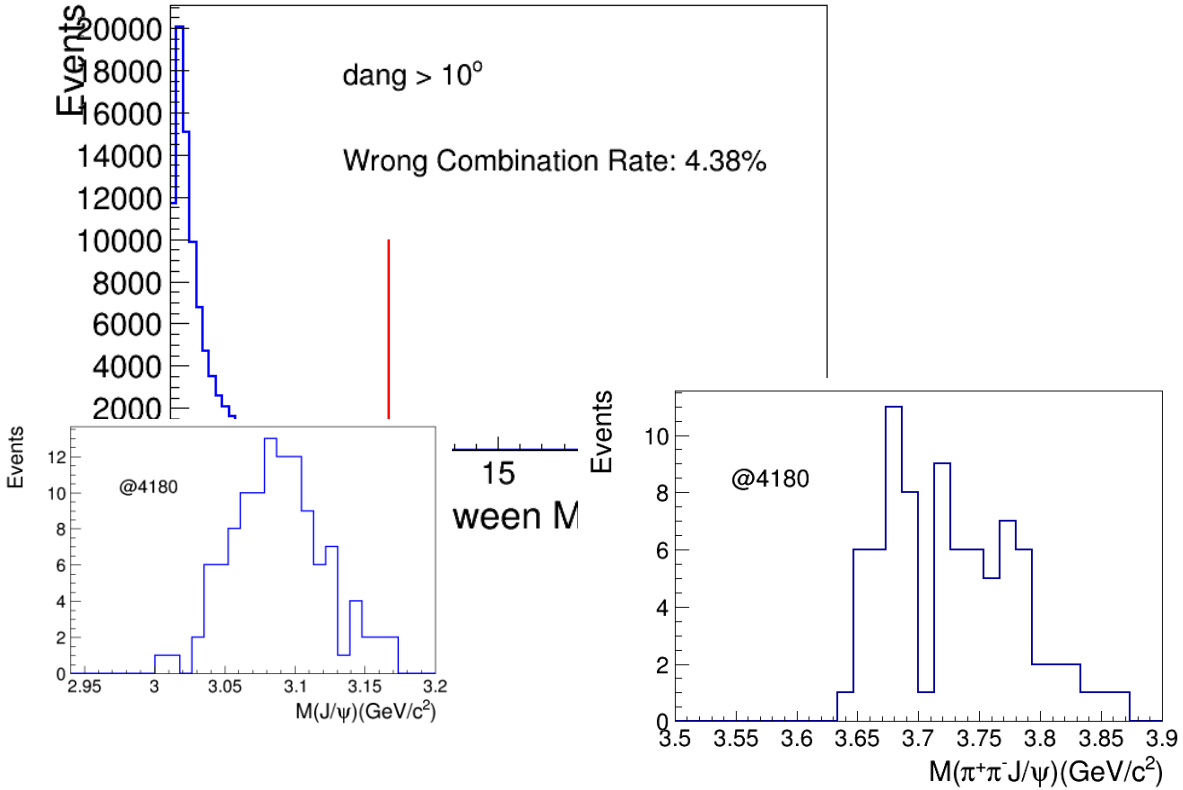


Next to do

- Generate MC decay from Z_C
- Study intermediate structure carefully

backup

Wrong Combination



Signal number and efficiency

energy	$\mu^+\mu^-$		e^+e^-		5 tracks		6 tracks		total	
	N_{sig}	ϵ	N_{sig}	ϵ	N_{sig}	ϵ	N_{sig}	ϵ	N_{sig}	ϵ
4180	288 ±18	27.70%	198±15	19.23%	220±16	21.84%	254 ±16	25.08%	485 ±23	46.93%
4190	39±7	27.83%	43 ± 7	19.42%	37 ±7	21.78%	47±7	25.48%	81 ± 10	47.25%
4200	66±	28.02%	50 ±7	19.43%	41 ±7	21.70%	69±8	25.75%	115 ±11	47.45%
4210	75 ±9	28.04%	40 ±7	19.44%	53±8	21.53%	55 ± 7	25.96%	114 ±11	47.49%
4220	85 ±10	27.98%	62±8	19.49%	65 ±9	21.40%	78±9	26.07%	147±13	47.47%
4237	99 ±11	27.62%	62 ±8	19.23%	79±9	21.14%	76 ± 9	25.70%	161 ±13	46.84%
4246	86±10	27.36%	66±9	19.03%	68±9	20.80%	80 ±9	25.60%	152±13	46.40%
4270	105±11	27.06%	73 ±9	18.71%	87±10	20.46%	86±9	25.31%	178 ±14	45.78%
4280	48±7	27.06%	33±6	18.69%	35±6	20.35%	45±7	25.40%	82 ±9	45.75%

Energy	Mean (10^{-4})	Sigma (10^{-3})	χ^2/ndf
4180	9.15±1.29	1.361±0.193	17/45
4190	0.37±3.95	2.088±0.439	35/45
4200	6.63±2.17	0.0293±1.98	34/45
4210	5.09±2.63	1.348±0.353	41/45
4220	-0.84±2.22	1.110±0.347	32/45
4237	3.21±2.37	1.455±0.325	41/45
4246	7.55±2.32	1.008±0.404	29/45
4270	6.09±1.74	0.211±2.94	30/45
4280	6.23±2.53	0.255±3.584	51/45