The comparison of $\eta J/\psi$ program

Mode I: $e^+e^- \to \eta J/\psi$,

$\eta \to \gamma\gamma$

$J/\psi \to l^+l^-$ $(l = e/\mu)$

Initial Event Selection

- **Charge Tracks**
  - $|\mathrm{R}z| \leq 10.0$ cm, $|\mathrm{Rxy}| \leq 1.0$ cm
  - $|\cos\theta| \leq 0.93$
  - $N_{charged} = 2,\ Q_{total} = 0$
  - PID: for $leptons$: $P > 1\ GeV/c$. $\begin{cases} \mu\text{: } E_{EMC} < 0.4 \text{ GeV} \\ e\text{: } E_{EMC}/P > 0.8 \end{cases}$

    $\boldsymbol{N_e = 2 \,||\, N_\mu = 2}$
- **Good Photons**
  - $E \geq 25$ MeV for barrel $(|\cos\theta| < 0.8)$
  - $E \geq 50$ MeV for endcap $(0.86 < |\cos\theta| < 0.92)$
  - $0 \leq t_{TDC} \leq 14$ $(\times 50$ ns$)$
  - $\theta_{\gamma-chrg} \geq 20°$
  - $N_\gamma \geq 2$
- **Kinematic fit 4C**
  - $\boldsymbol{e^+e^- \to \gamma\gamma l^+ l^-}$ $\boldsymbol{(l = e/\mu)}$

ECMS=4180

	$J/\psi \to \mu^+\mu^-$	$J/\psi \to e^+e^-$
Signal efficiency	36.4%	25.1%

CUT	$J/\psi \to \mu^+\mu^-$		$J/\psi \to e^+e^-$	
	Mine	Compare	Mine	Compare
$\chi^2_{4c} < 40$	37.033%	37.033%	25.669%	25.669%
$M(l^+l^- - m_{J/\psi}) < 30MeV$	36.320%	36.320%	24.923%	24.923%
$E_{\gamma low} < 0.08\ GeV$	36.207%	36.207%	24.848%	24.848%

ECMS=4260

	$J/\psi \to \mu^+\mu^-$	$J/\psi \to e^+e^-$
Signal efficiency	30.7%	21.2%

CUT	$J/\psi \to \mu^+\mu^-$		$J/\psi \to e^+e^-$	
	Mine	Compare	Mine	Compare
$\chi^2_{4c} < 40$	32.461%	32.461%	22.723%	22.723%
$M(l^+l^- - m_{J/\psi}) < 30MeV$	30.867%	30.867%	21.412%	21.412%
$E_{\gamma low} < 0.08\ GeV$	30.585%	30.585%	21.216%	21.216%

ECMS=4420

	$J/\psi \to \mu^+\mu^-$	$J/\psi \to e^+e^-$
Signal efficiency	24.8%	16.9%

CUT	$J/\psi \to \mu^+\mu^-$		$J/\psi \to e^+e^-$	
	Mine	Compare	Mine	Compare
$\chi^2_{4c} < 40$	25.529%	25.529%	17.627%	17.627%
$M(l^+l^- - m_{J/\psi}) < 30MeV$	24.849%	24.849%	16.948%	16.948%
$E_{\gamma low} < 0.08\ GeV$	24.195%	24.195%	16.544%	16.544%

ECMS=4600

	$J/\psi \to \mu^+\mu^-$	$J/\psi \to e^+e^-$
Signal efficiency	5.2%	3.5%

CUT	$J/\psi \to \mu^+\mu^-$		$J/\psi \to e^+e^-$	
	Mine	Compare	Mine	Compare
$\chi^2_{4c} < 40$	4.9127%	4.9127%	3.3092%	3.3092%
$M(l^+l^- - m_{J/\psi}) < 30MeV$	4.8215%	4.8215%	3.1994%	3.1994%
$E_{\gamma low} < 0.08\ GeV$	4.6422%	4.6422%	3.0876%	3.0876%

Mode II: $e^+e^- \to \eta J/\psi$,

$\eta \to \pi^0\pi^+\pi^-$

$J/\psi \to l^+l^-$ $(l = e/\mu)$

Initial Event Selection

- **Charge Tracks**
  - $|\mathrm{Rz}| \leq 10.0$ cm, $|\mathrm{Rxy}| \leq 1.0$ cm
  - $|\cos\theta| \leq 0.93$
  - $N_{charged} = 2,\ Q_{total} = 0$
  - PID: for leptons: $P > 1$ GeV/c. P ≤ 1 GeV/c is π

$$\begin{cases} \mu\text{: } E_{EMC} < 0.4 \text{ GeV} \\ e\text{: } E_{EMC}/P > 0.8 \end{cases}$$

$$\boldsymbol{N_e = 2} \ || \ \boldsymbol{N_\mu = 2} \qquad \&\& \qquad \boldsymbol{N_\pi = 2}$$

- **Good Photons**
  - $E \geq 25$ MeV for barrel $(|\cos\theta| < 0.8)$
  - $E \geq 50$ MeV for endcap $(0.86 < |\cos\theta| < 0.92)$
  - $0 \leq t_{TDC} \leq 14$ $(\times 50$ ns$)$
  - $\theta_{\gamma-chrg} \geq 20°$
  - $N_\gamma \geq 2$
- **Kinematic fit 5C**
  - $\boldsymbol{e^+e^- \to \gamma\gamma\pi^+\pi^- l^+l^-}$ $(\boldsymbol{l = e/\mu})$, $\boldsymbol{\pi^0 \to \gamma\gamma}$

ECMS=4180

	$J/\psi \to \mu^+\mu^-$	$J/\psi \to e^+e^-$
Signal efficiency	12.8%	8.9%

CUT	$J/\psi \to \mu^+\mu^-$		$J/\psi \to e^+e^-$	
	Mine	Compare	Mine	Compare
$\chi^2_{5c} < 80$	14.8509%	14.8509%	10.3698%	10.3698%
$M(l^+l^- - m_{J/\psi}) < 30MeV$	14.6523%	14.6523%	10.2421%	10.2421%

ECMS=4260

	$J/\psi \to \mu^+\mu^-$	$J/\psi \to e^+e^-$
Signal efficiency	10.5%	7.4%

CUT	$J/\psi \to \mu^+\mu^-$		$J/\psi \to e^+e^-$	
	Mine	Compare	Mine	Compare
$\chi^2_{5c} < 80$	12.5133%	12.5133%	8.8398%	8.8398%
$M(l^+l^- - m_{J/\psi}) < 30MeV$	11.7462%	11.7462%	8.4254%	8.4254%

ECMS=4420

	$J/\psi \to \mu^+\mu^-$	$J/\psi \to e^+e^-$
Signal efficiency	8.3%	5.8%

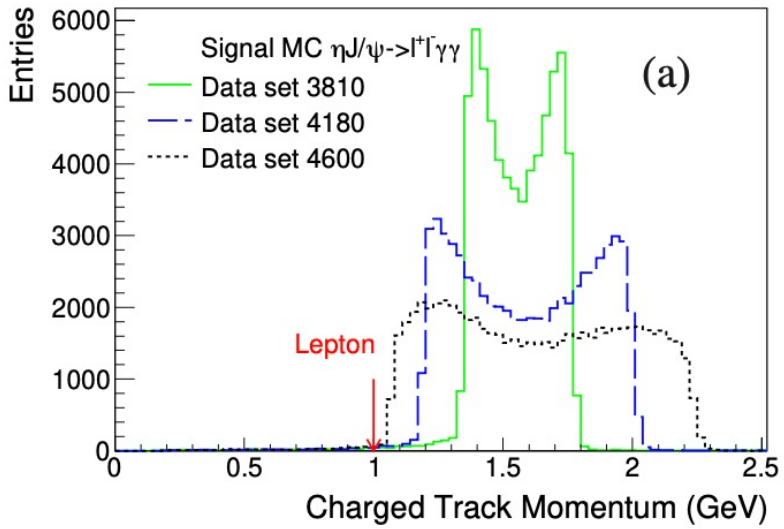
CUT	$J/\psi \to \mu^+\mu^-$		$J/\psi \to e^+e^-$	
	Mine	Compare	Mine	Compare
$\chi^2_{5c} < 80$	9.2040%	9.2040%	6.4069%	6.4069%
$M(l^+l^- - m_{J/\psi}) < 30MeV$	8.9506%	8.9506%	6.2388%	6.2388%

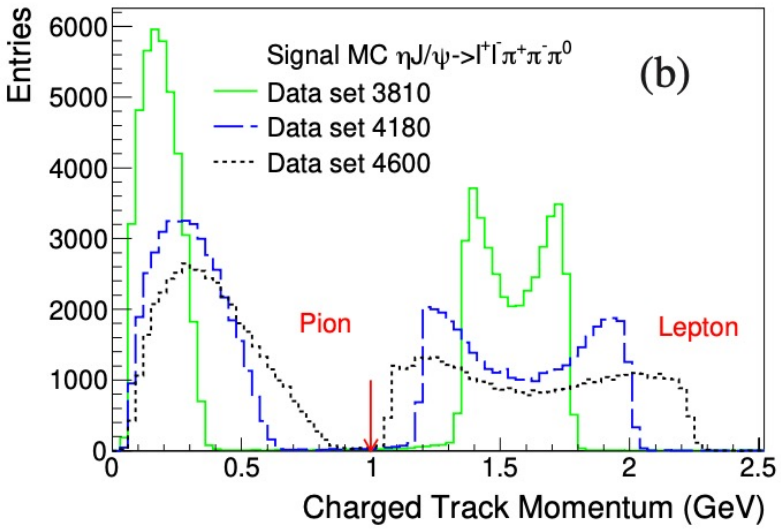
ECMS=4600

	$J/\psi \to \mu^+\mu^-$	$J/\psi \to e^+e^-$
Signal efficiency	1.5%	1.1%

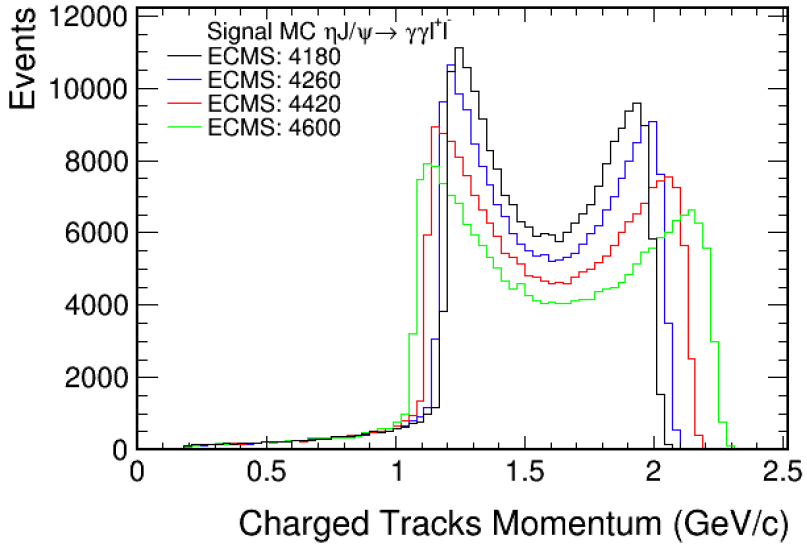
CUT	$J/\psi \to \mu^+\mu^-$		$J/\psi \to e^+e^-$	
	Mine	Compare	Mine	Compare
$\chi^2_{5c} < 80$	1.5189%	1.5189%	1.0506%	1.0506%
$M(l^+l^- - m_{J/\psi}) < 30MeV$	1.4968%	1.4968%	1.0307%	1.0307%

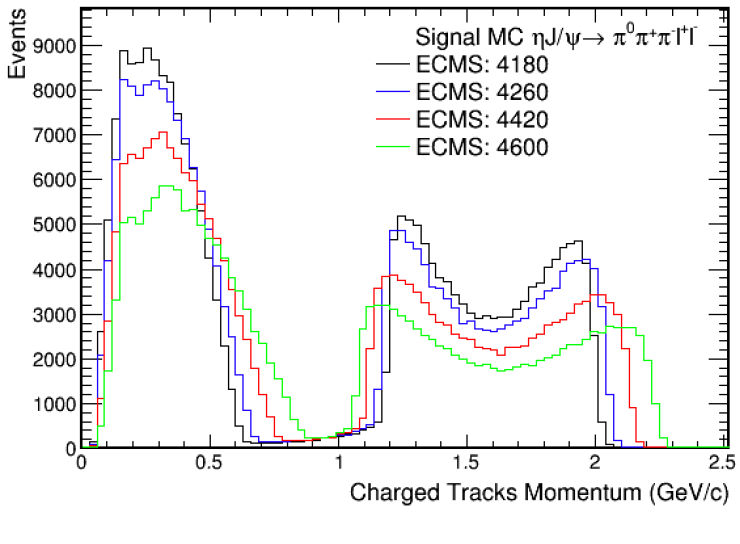
Lepton-Pion separation





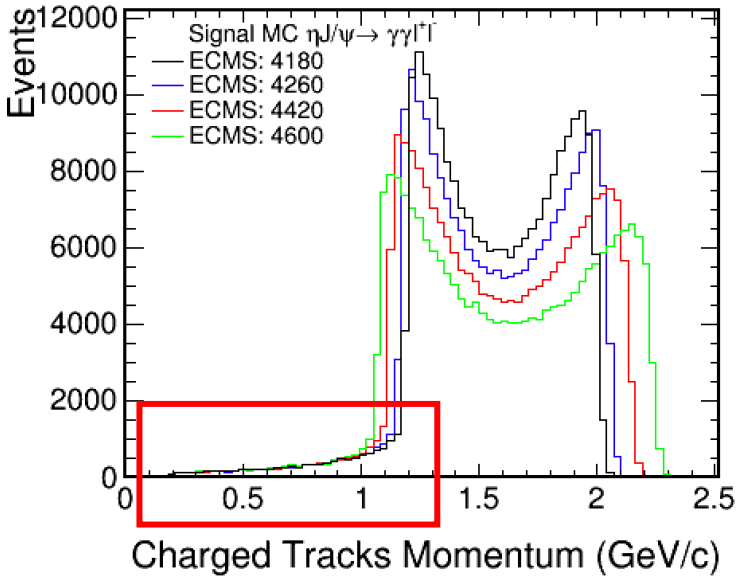
- My repetition by using flat line shape



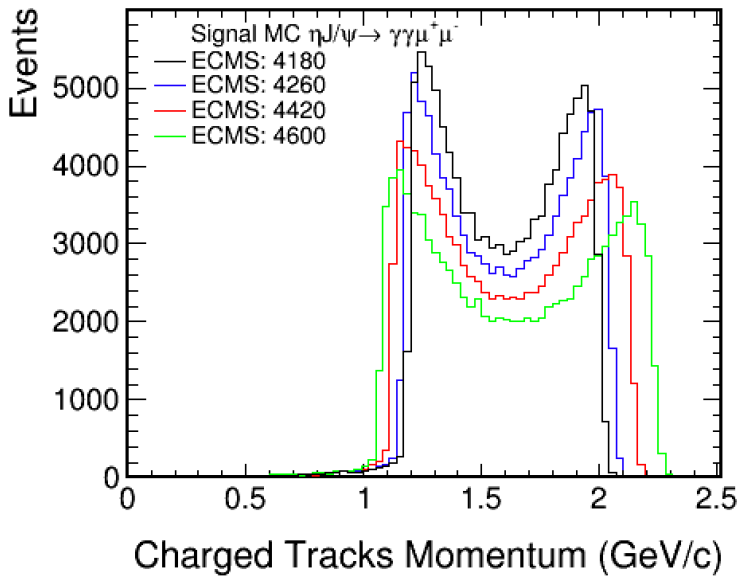


Lepton-Pion separation

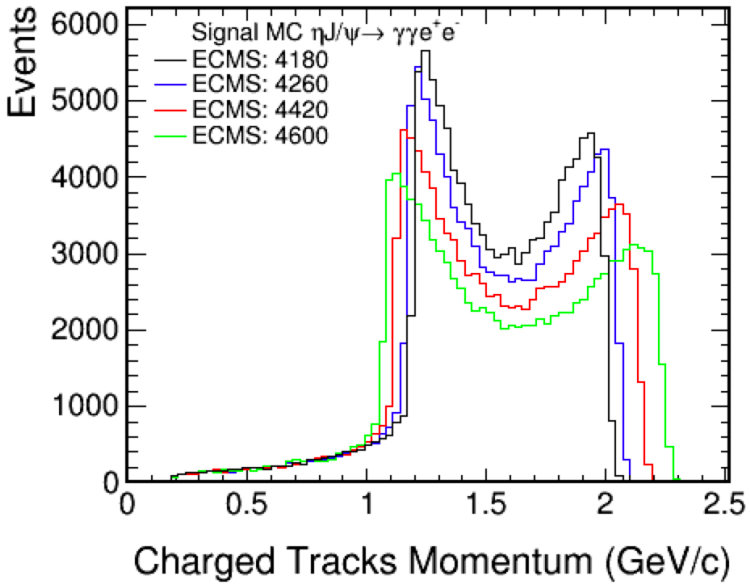
- By using flat line shape



$J/\psi \to \mu^+\mu^-$



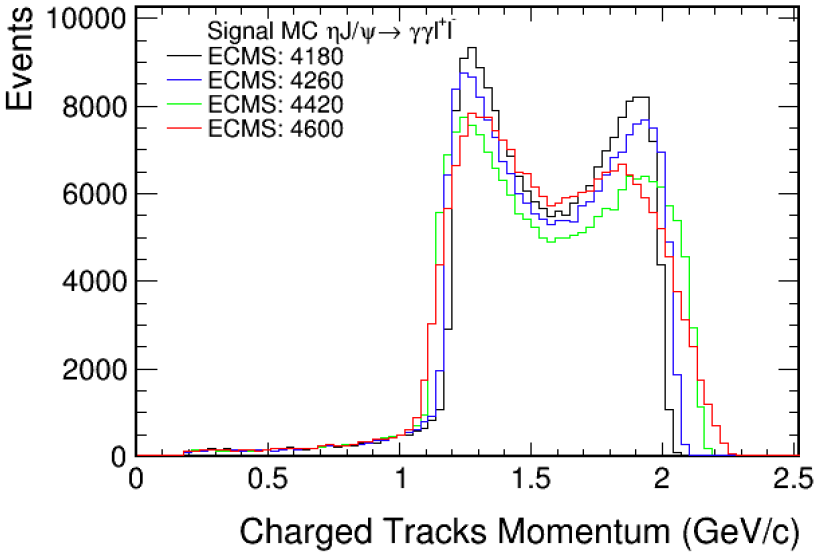
$J/\psi \to e^+e^-$

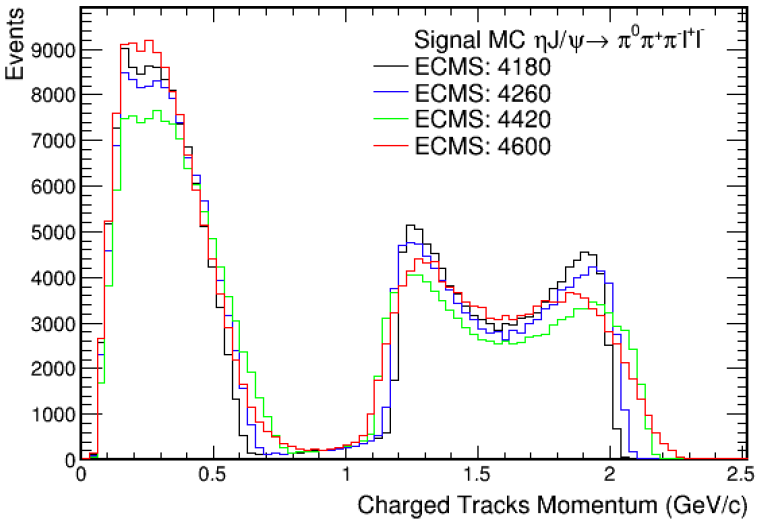


Lepton-Pion Separation

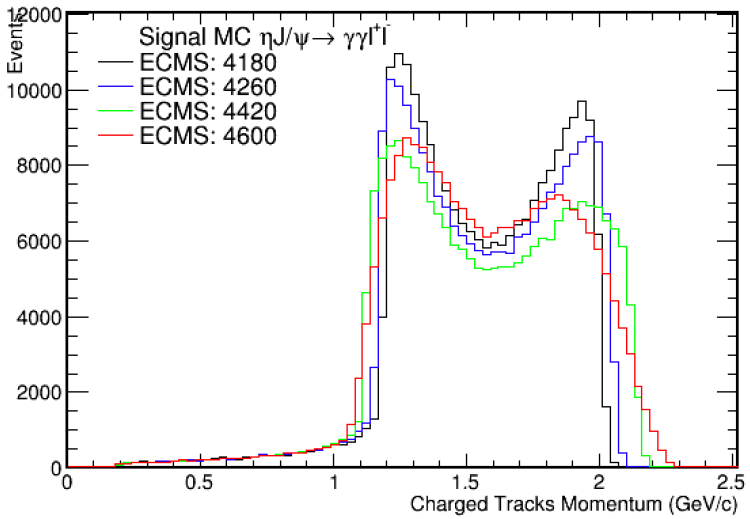
- My repetition by using the same line shape

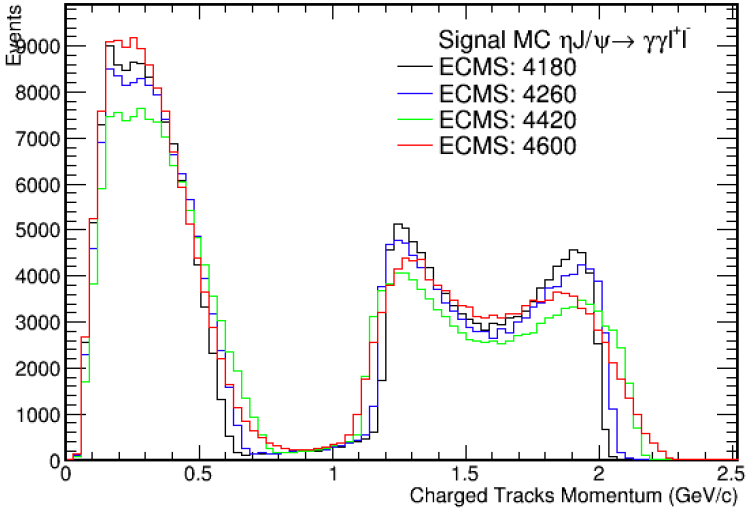
By Yutong



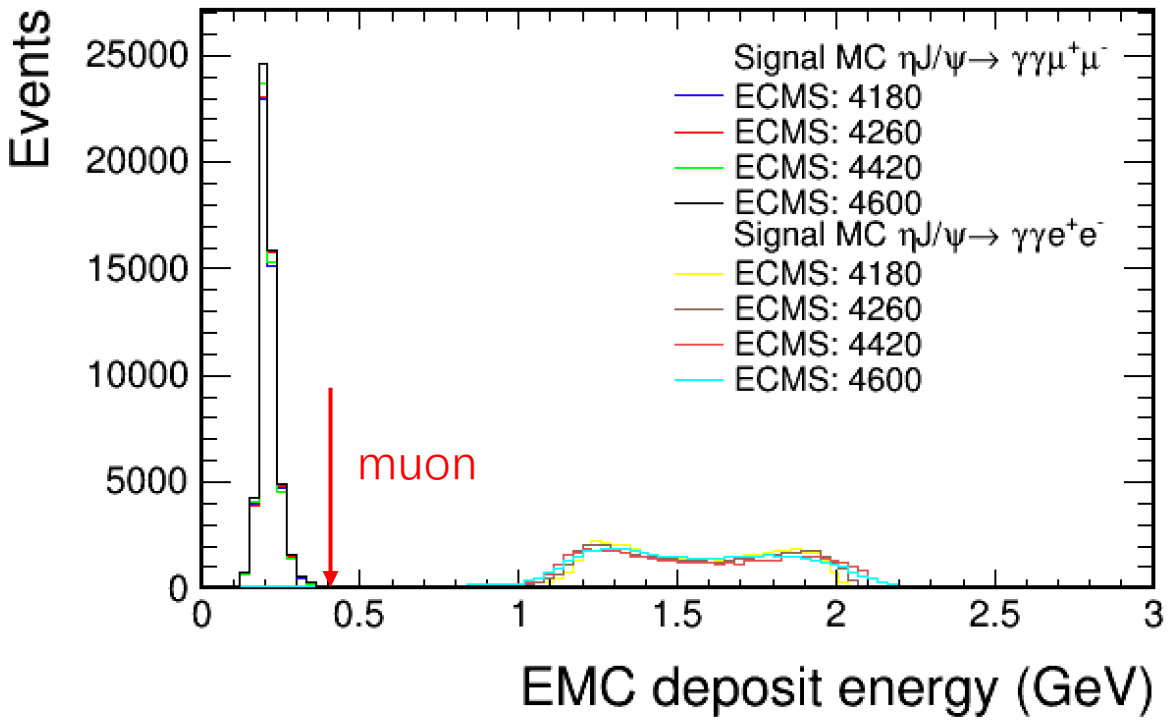


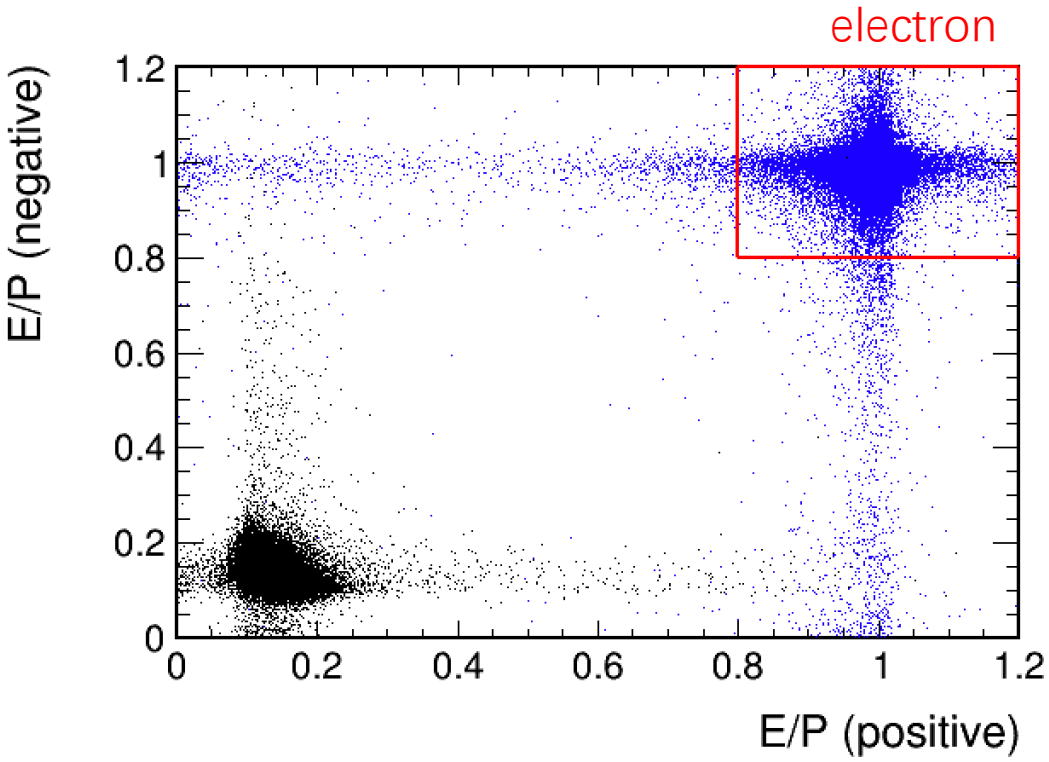
By Yateng

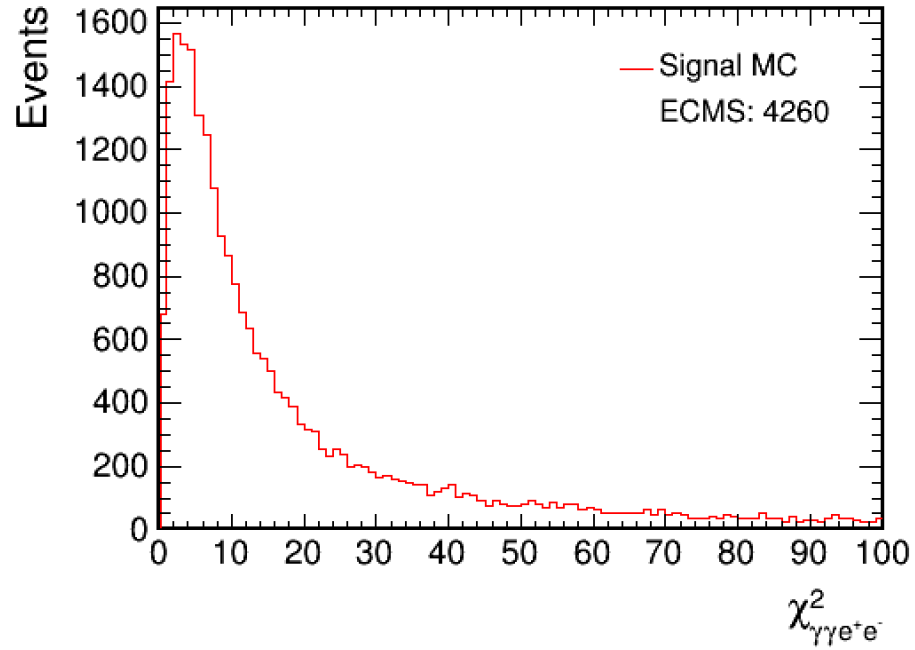


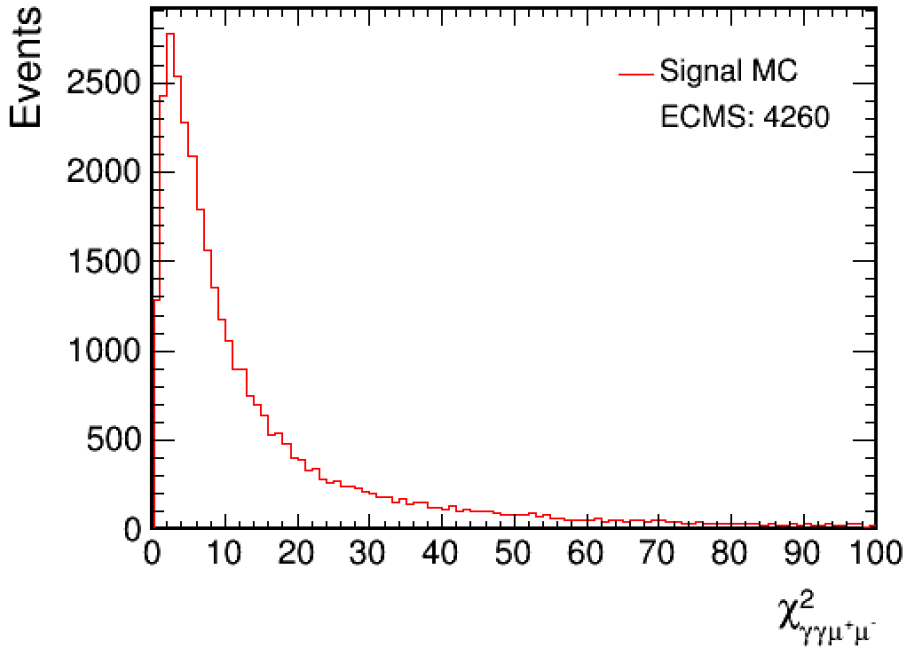


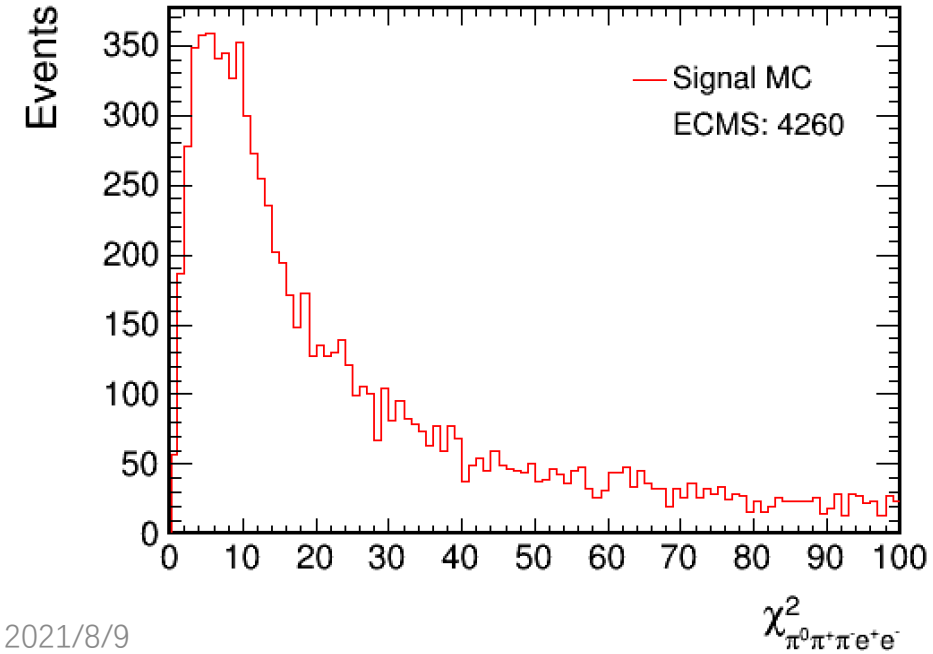
$e - \mu$ Separation

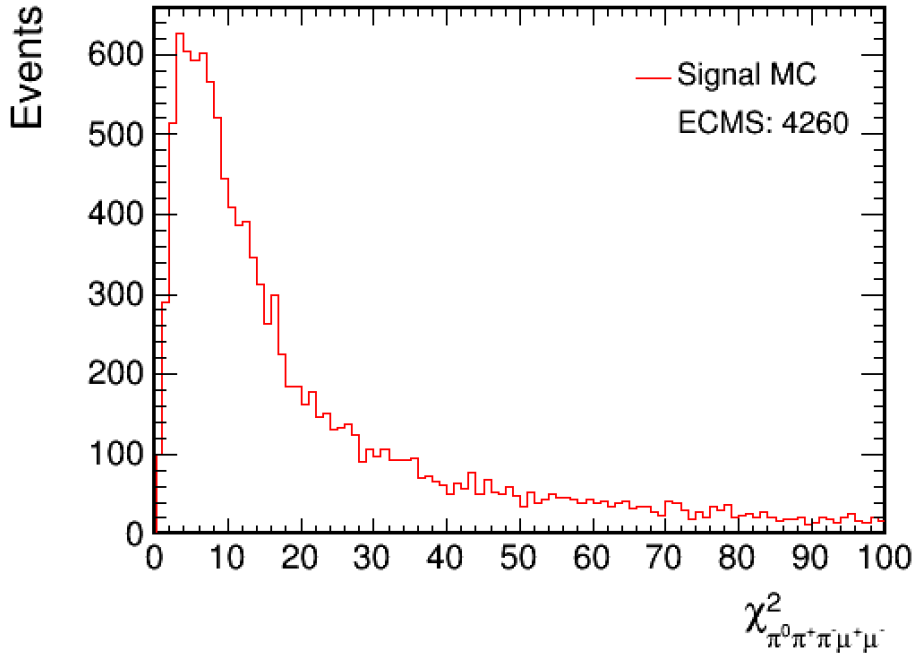





Events
Signal MC
ECMS: 4260
$\chi^2_{\gamma\gamma e^+e^-}$


Events
Signal MC
ECMS: 4260
$\chi^2_{\gamma\gamma\mu^+\mu^-}$


Events
Signal MC
ECMS: 4260
$\chi^2_{\pi^0\pi^+\pi^-e^+e^-}$

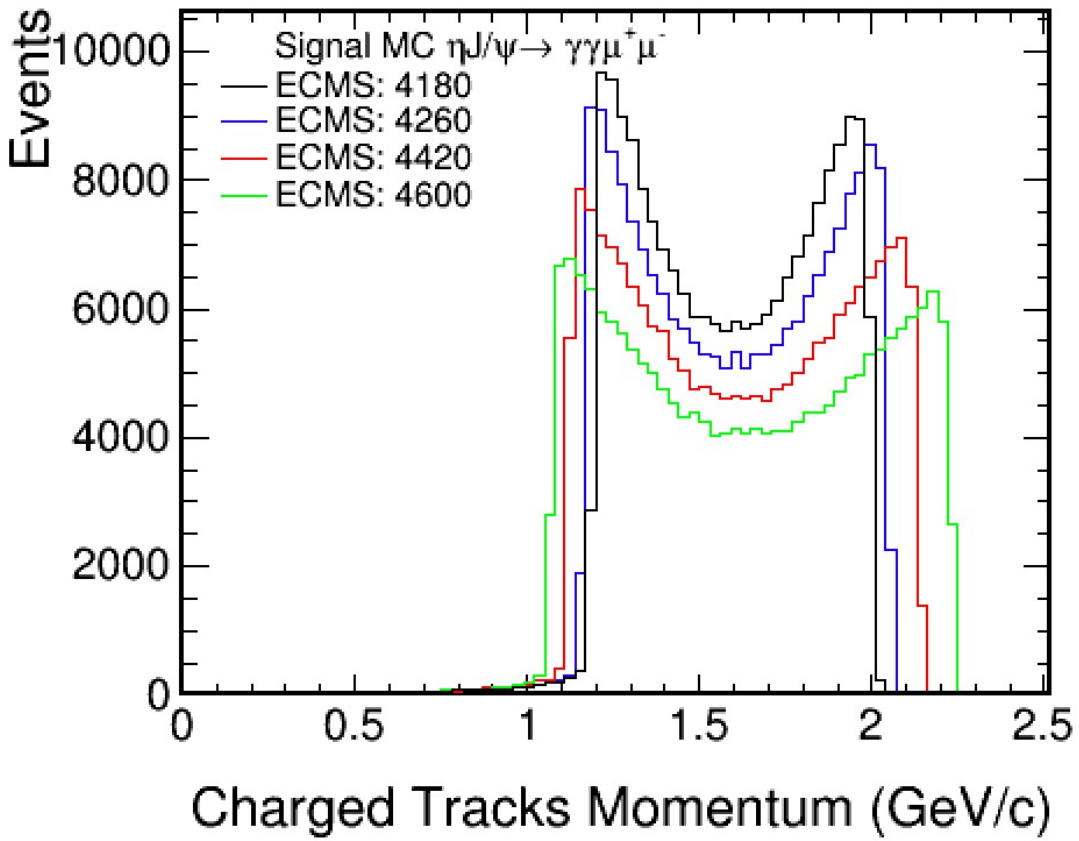

Events
Signal MC
ECMS: 4260
$\chi^2_{\pi^0\pi^+\pi^-\mu^+\mu^-}$

Back up

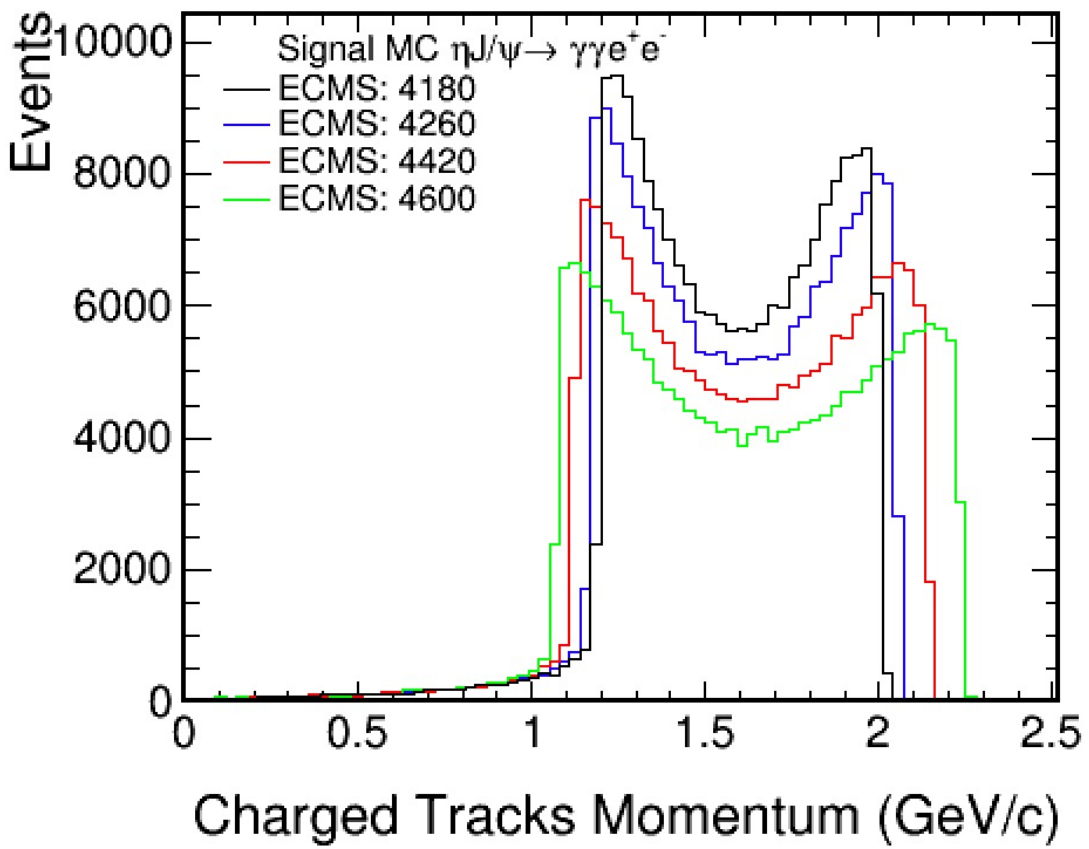
Back up

- MC Truth (by flat line shape)

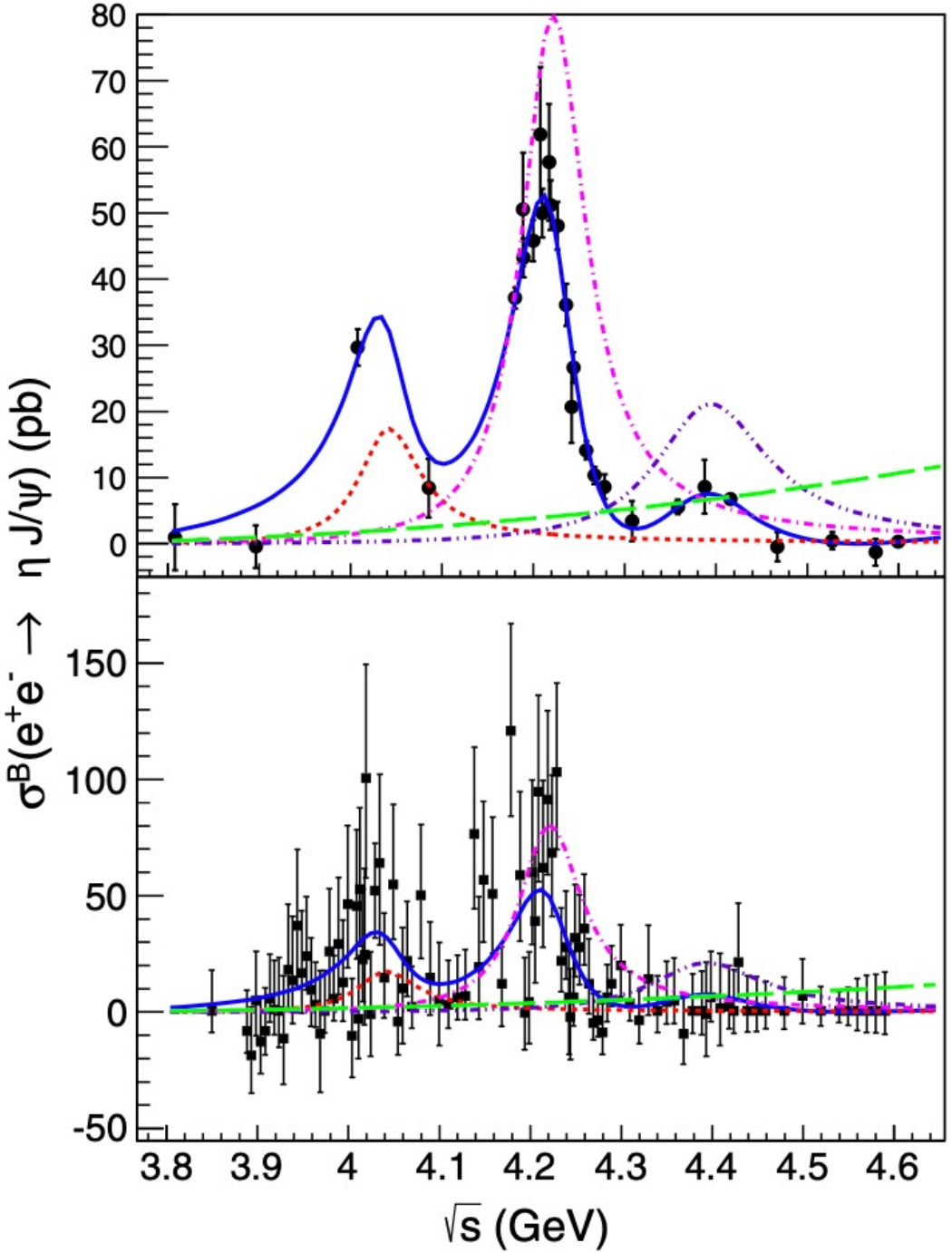
$J/\psi \to \mu^+\mu^-$



$J/\psi \to e^+e^-$



Back up


80
70
60
50
40
30
20
10
0
150
100
50
0
-50
3.8
3.9
4
4.1
4.2
4.3
4.4
4.5
4.6
$\sigma^B(e^+e^- \to \eta J/\psi)$ (pb)
$\sqrt{s}$ (GeV)