

Hard exclusive production of vectormesons with CORE

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JLU Giessen and UCONN

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Motivation: Accessing gluon and sea-quark GPDs

Investigated channels:

$$\left. \begin{array}{l} \rho^0 \rightarrow \pi^+ \pi^- \\ \omega \rightarrow \pi^+ \pi^- \end{array} \right\} \text{u, d quarks}$$

$$\left. \begin{array}{l} \phi \rightarrow K^+ K^- \end{array} \right\} \text{s quarks, gluons}$$

$$\left. \begin{array}{l} J/\psi \rightarrow e^+ e^- \\ J/\psi \rightarrow \mu^+ \mu^- \end{array} \right\} \text{c quarks, gluons}$$

$$\left. \begin{array}{l} \Upsilon \rightarrow e^+ e^- \\ \Upsilon \rightarrow \mu^+ \mu^- \end{array} \right\} \text{b quarks, gluons}$$

generator: estarlight (hepmc3 output)

$Q^2 > 4.0 \text{ GeV}^2$ 1.000.000 events

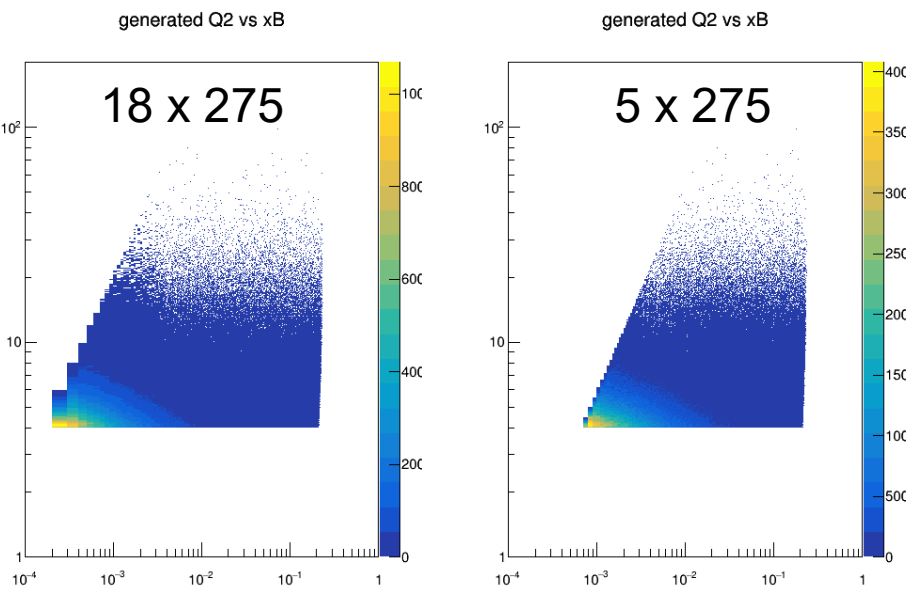
electrons x protons

18 x 275 (max energy, low luminosity)

10 x 275 (max luminosity)

5 x 275 (max luminosity, best PID)

5 x 100 (medium luminosity)



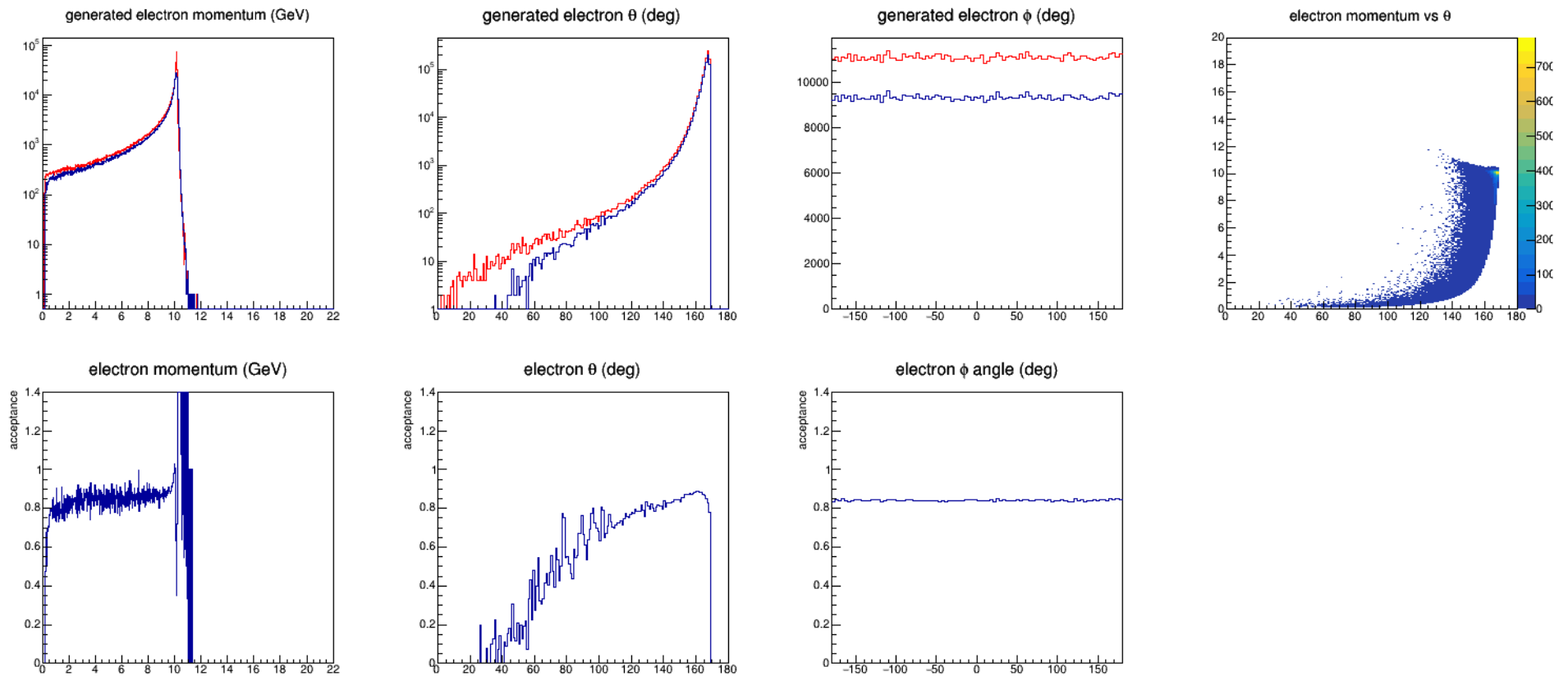
σ in pb:		$\pi^+ \pi^-$ $\uparrow$ ρ^0	$\pi^+ \pi^-$ $\uparrow$ 3	$K^+ K^-$ $\uparrow$ ϕ	$J/\psi \rightarrow e^+ e^-$	$J/\psi \rightarrow \mu^+ \mu^-$	$Y \rightarrow e^+ e^-$ $Q^2 > 1 \text{ GeV}^2$	$Q^2 > 0 \text{ GeV}^2$	$Y \rightarrow \mu^+ \mu^-$ $Q^2 > 1 \text{ GeV}^2$	$Q^2 > 0 \text{ GeV}^2$
e^-	p^+									
18	275	929,8	1,72	72,12	10,16	10,43	0,0571	0.385	0,0595	0.401
10	275	817,0	1,518	62,61	7,88	8,08	0,0403	0.267	0,0420	0.278
5	275	691,3	1,293	52,08	5,69	5,84				
5	100	515,7	0,979	37,57	3,21	3,29				

reconstruction: Delphes (Delphes_EIC_CORE_3T_v5.tcl)

$$\rho^0 \rightarrow \pi^+ \pi^-$$

10 x 275

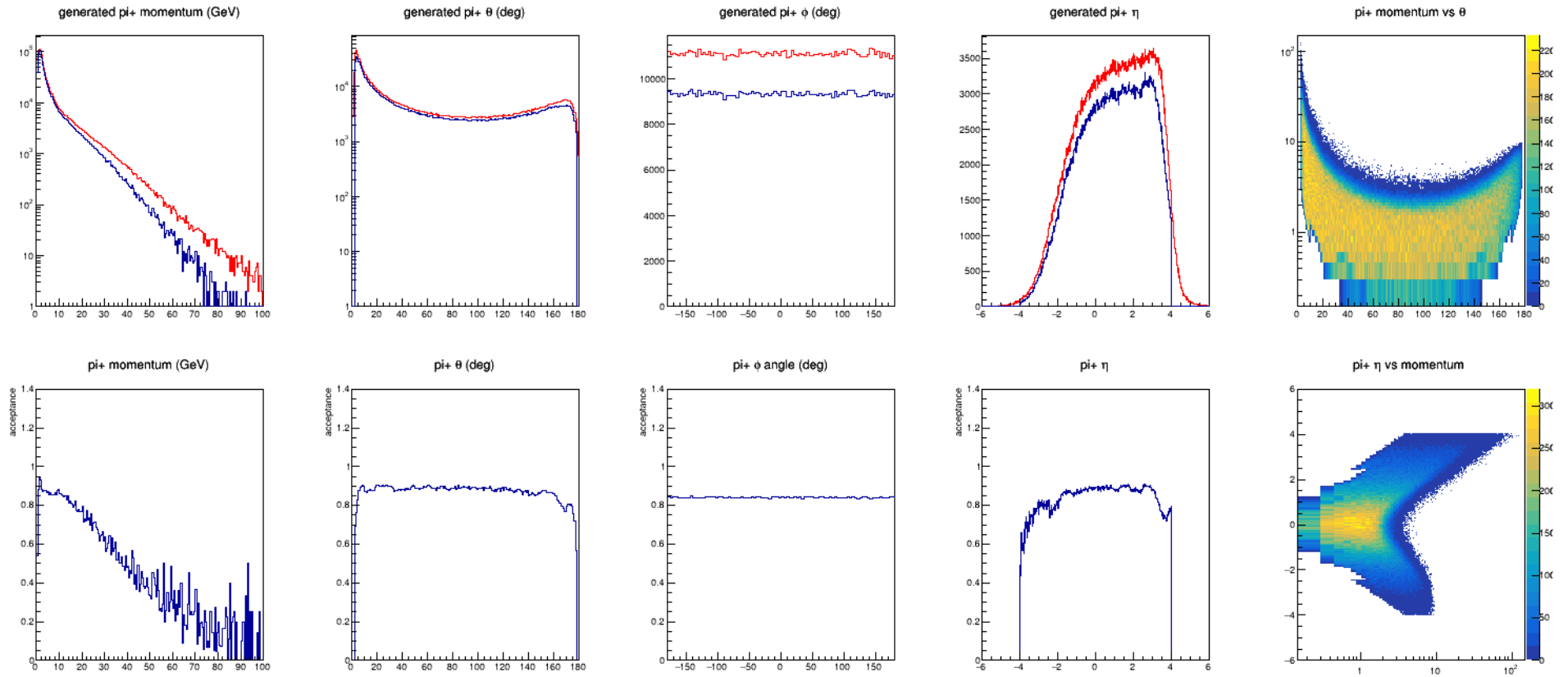
electrons:



$$\rho^0 \rightarrow \pi^+ \pi^-$$

10 x 275

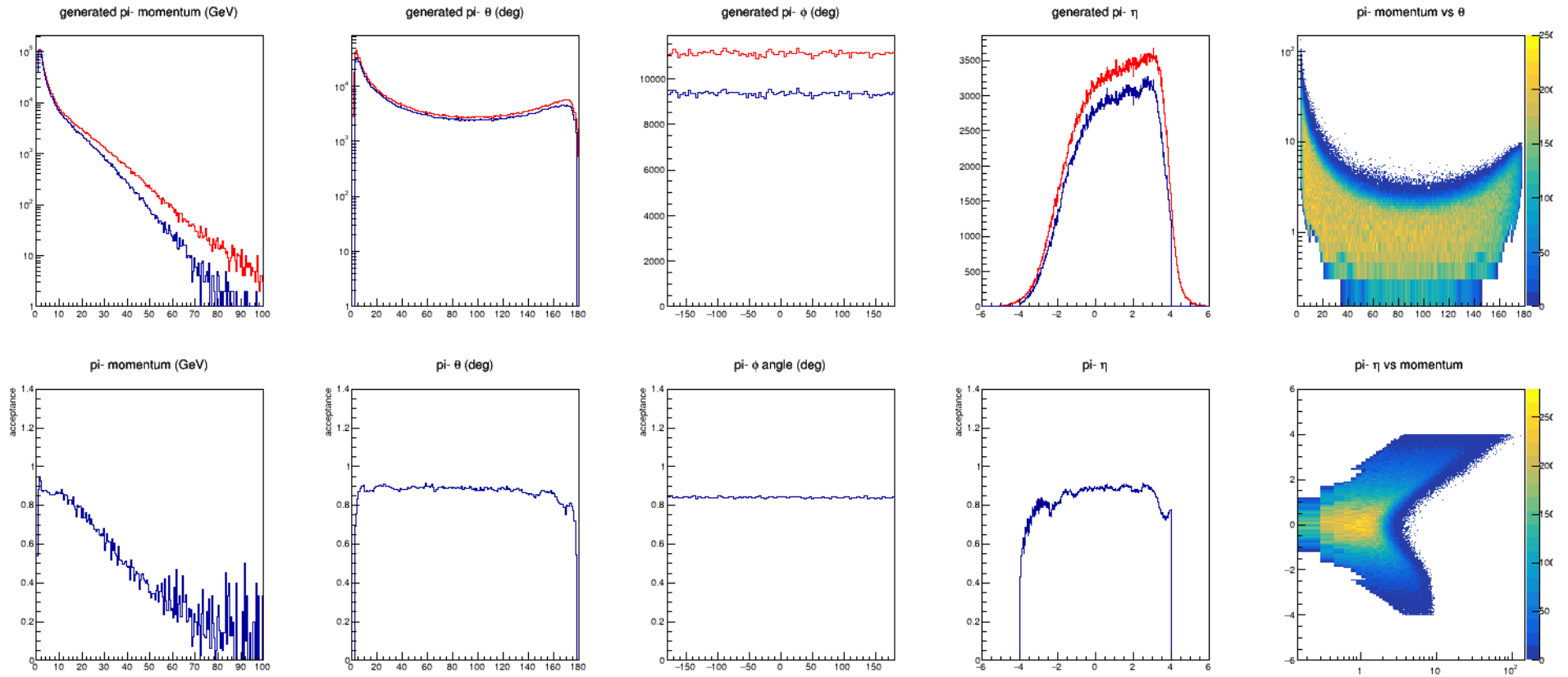
π^+ :



$$\rho^0 \rightarrow \pi^+ \pi^-$$

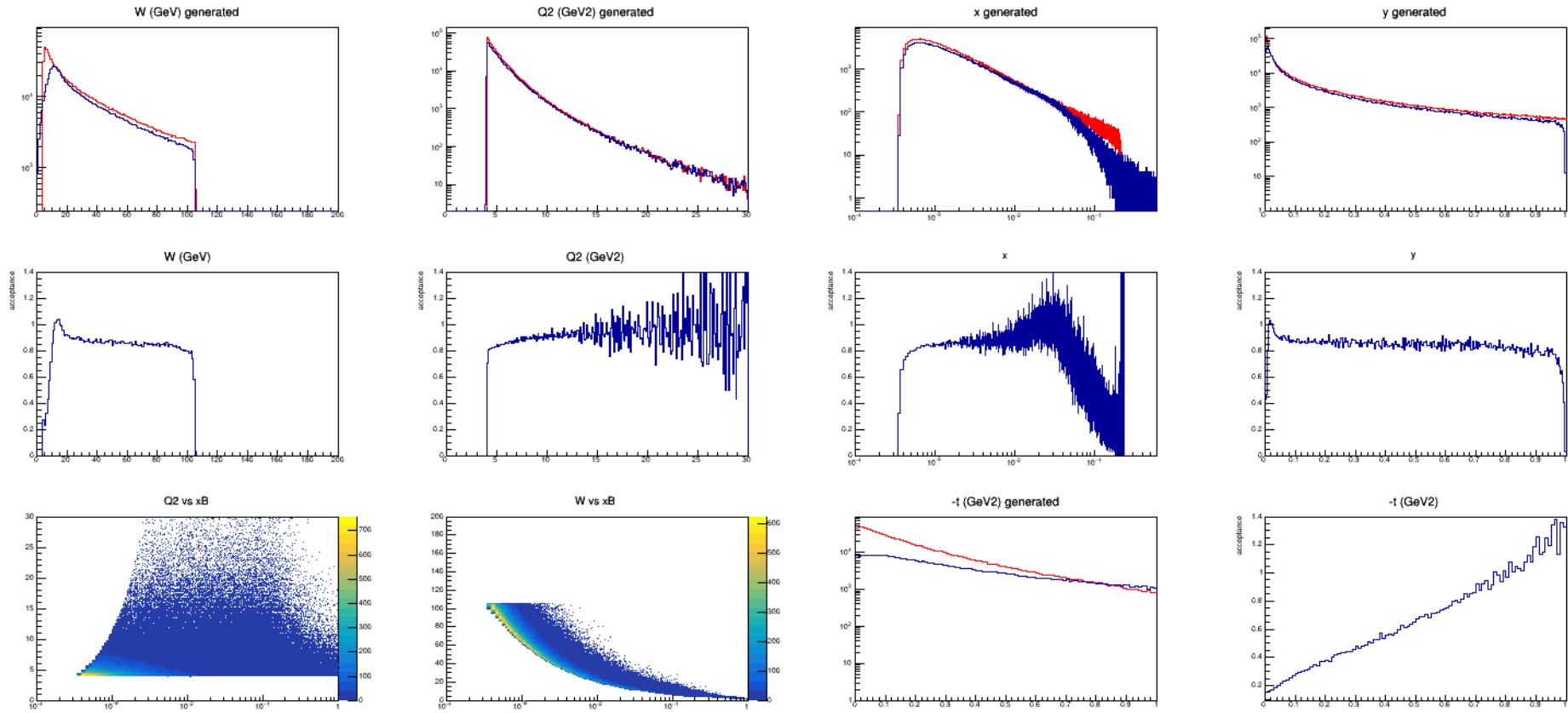
10 x 275

π^- :



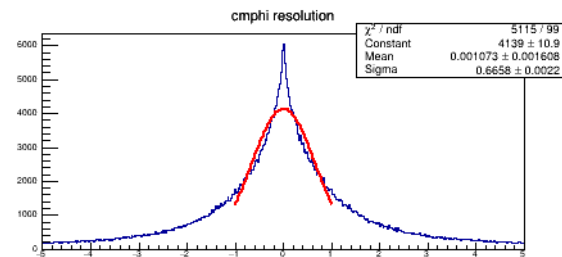
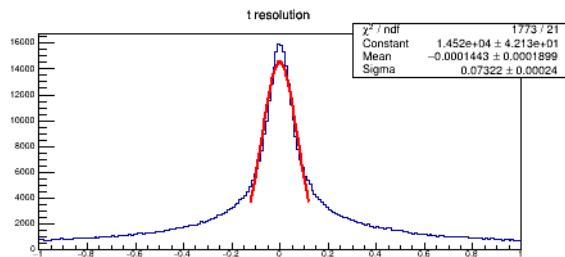
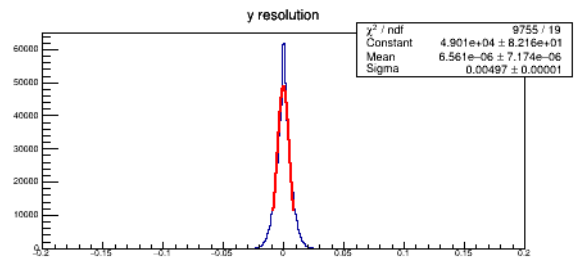
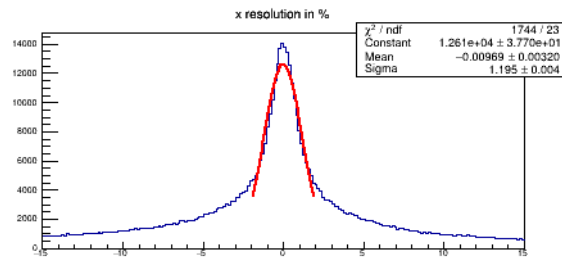
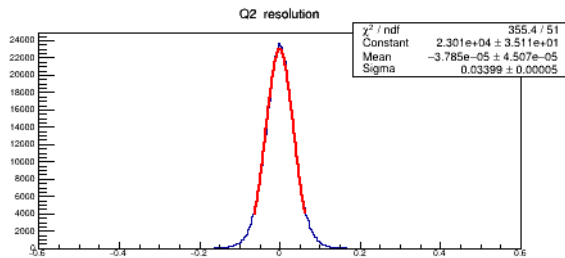
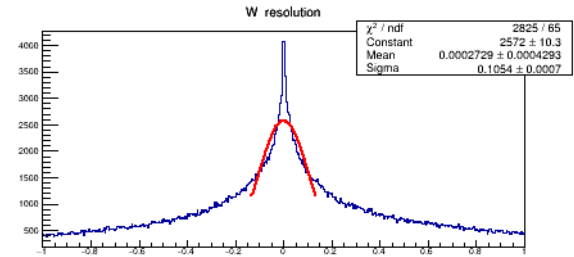
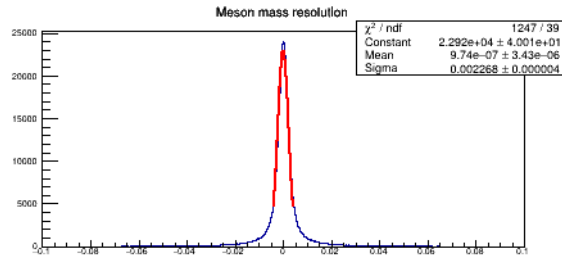
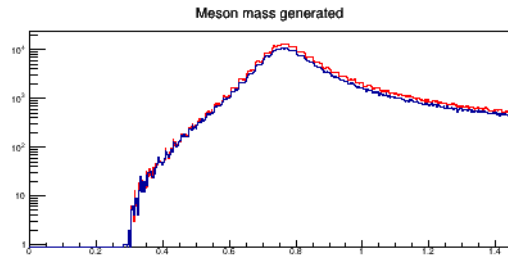
$$\rho^0 \rightarrow \pi^+ \pi^-$$

10 x 275



$$\rho^0 \rightarrow \pi^+ \pi^-$$

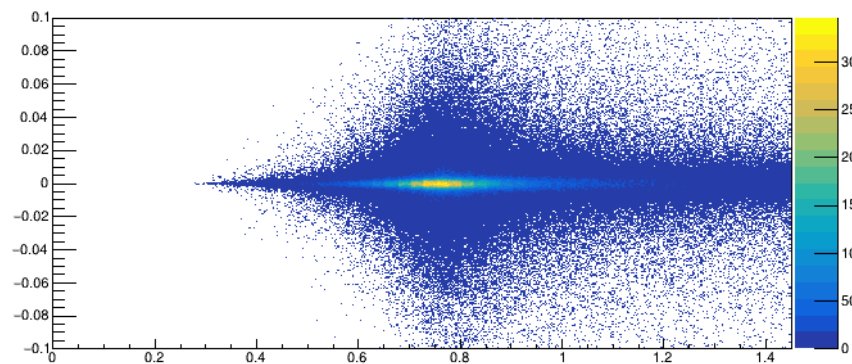
10 x 275



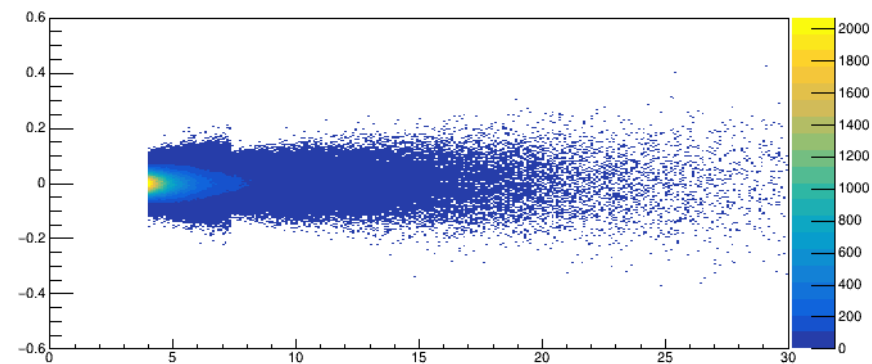
$$\rho^0 \rightarrow \pi^+ \pi^-$$

10 x 275

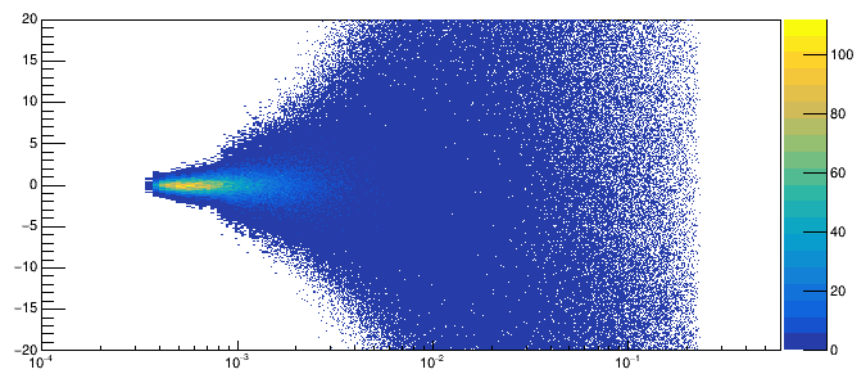
Meson mass resolution vs meson mass



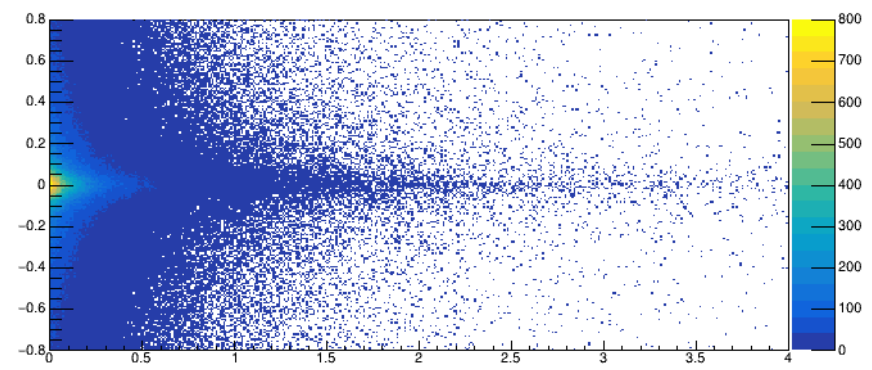
Q2 resolution vs Q2



x resolution in % vs x

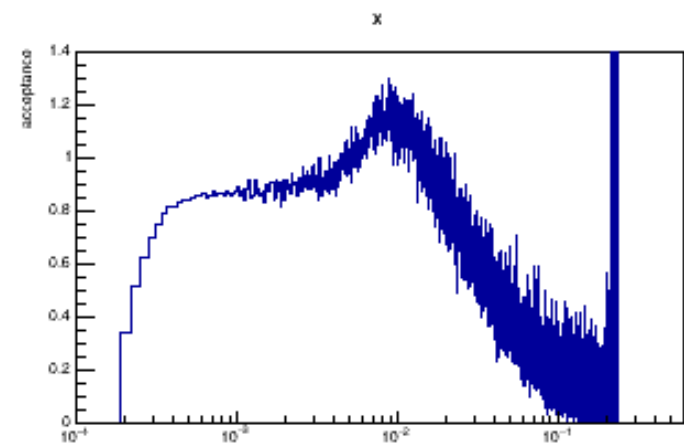
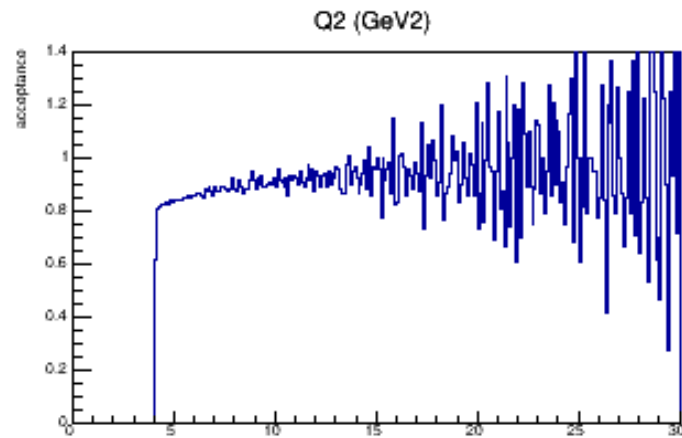


t resolution vs t

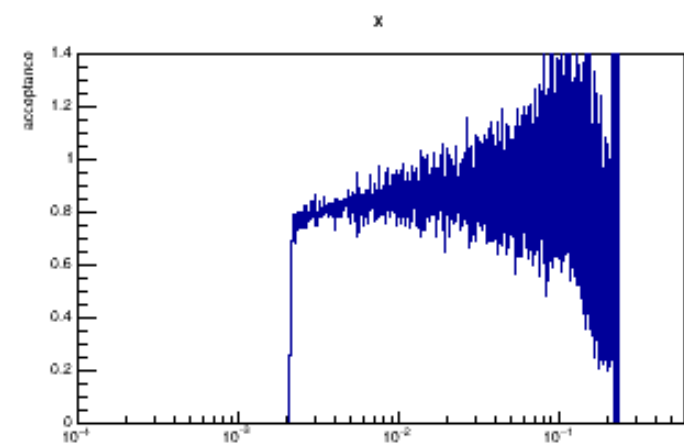
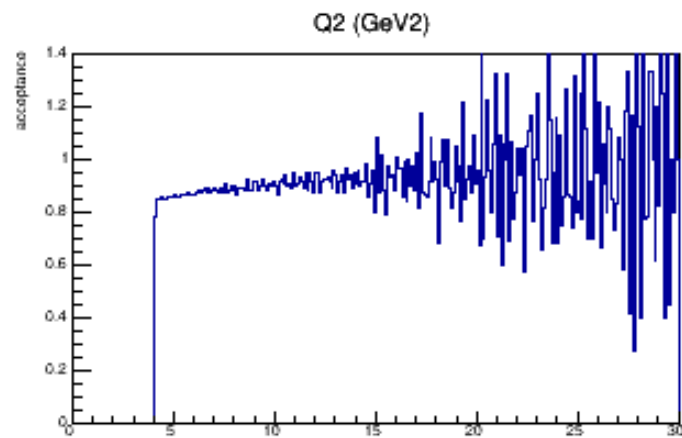


$$\rho^0 \rightarrow \pi^+ \pi^-$$

18 x 275

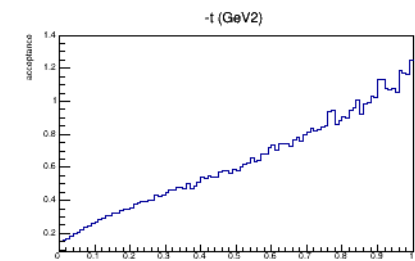
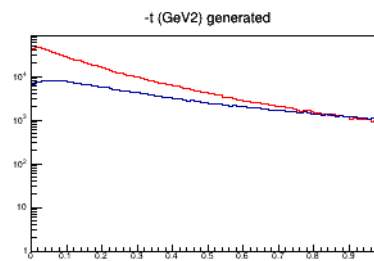
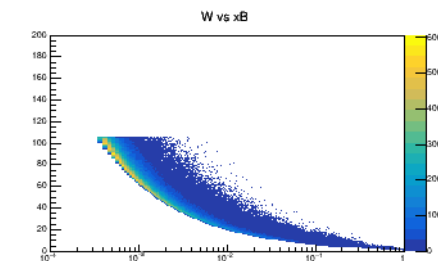
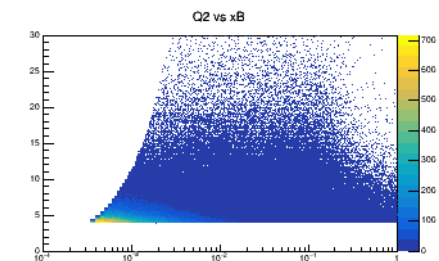
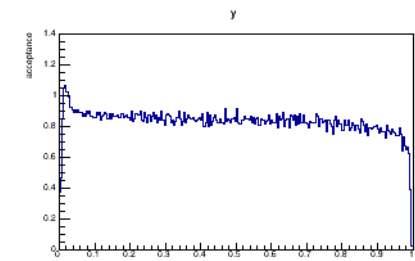
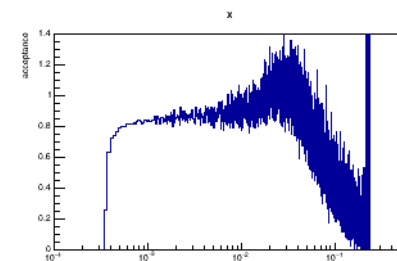
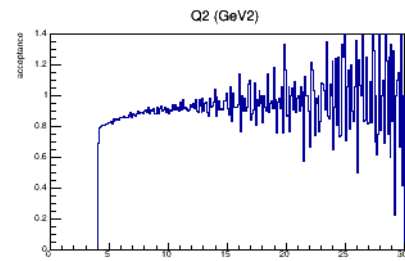
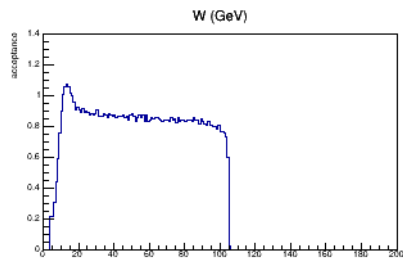
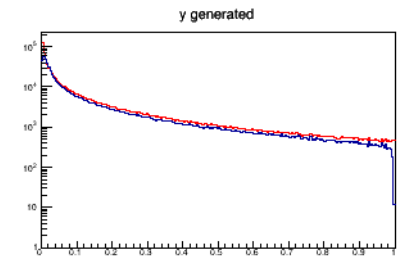
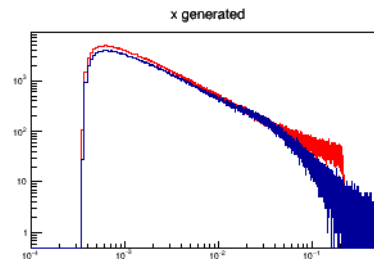
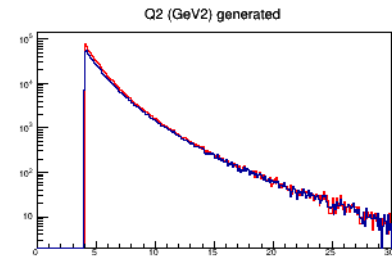
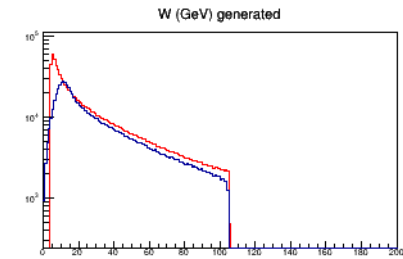


5 x 275



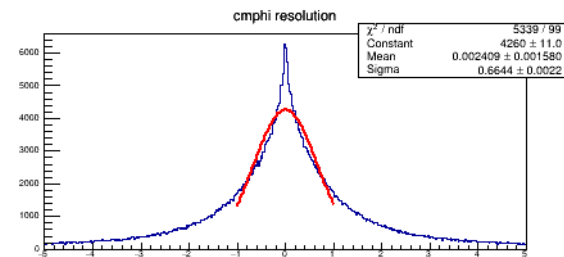
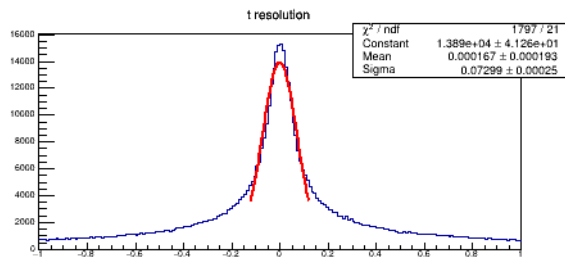
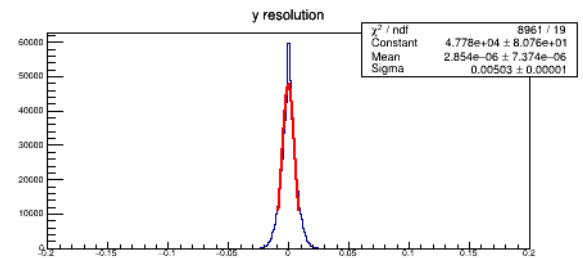
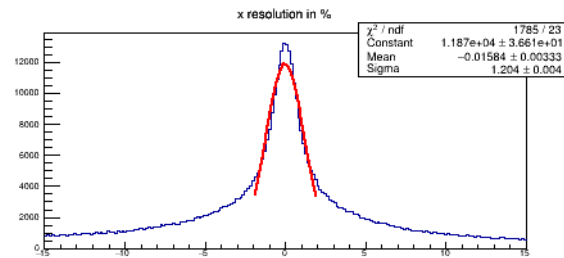
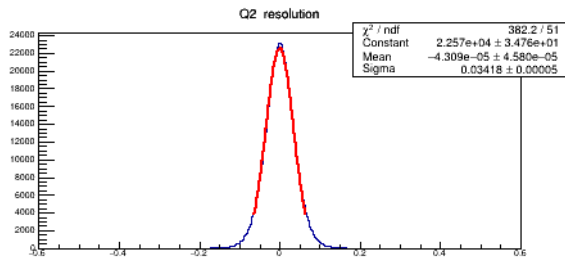
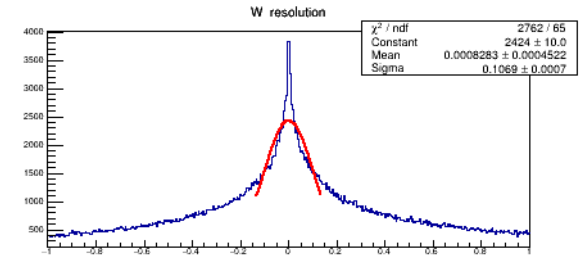
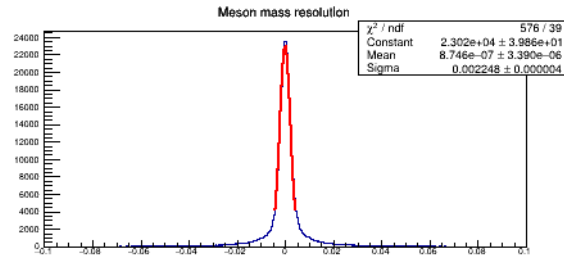
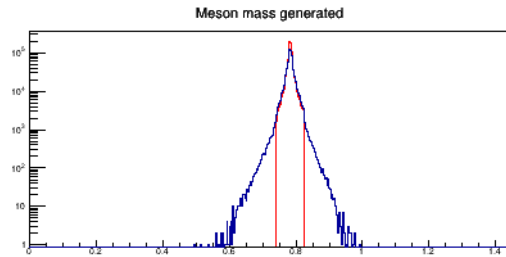
$$\omega \rightarrow \pi^+ \pi^-$$

10 x 275



$$\omega \rightarrow \pi^+ \pi^-$$

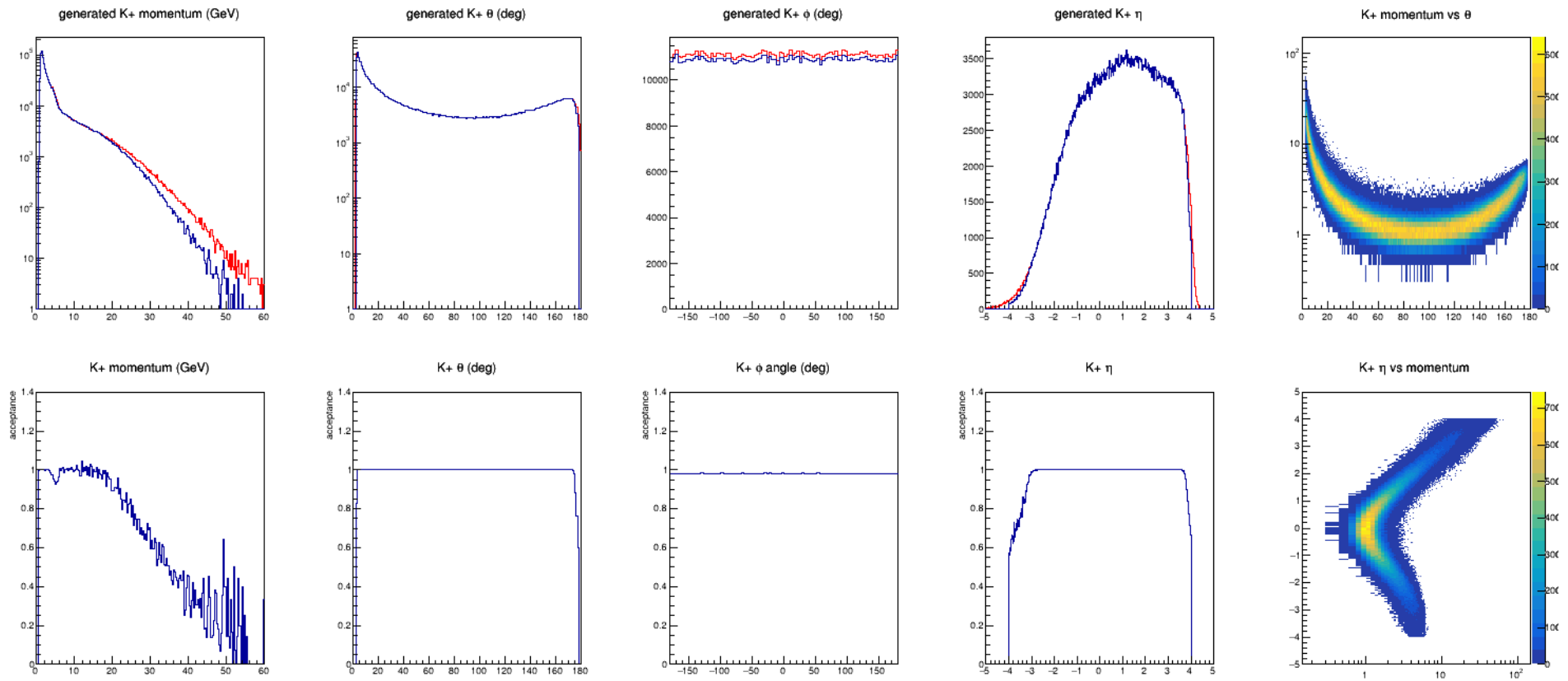
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$$\phi \rightarrow K^+ K^-$$

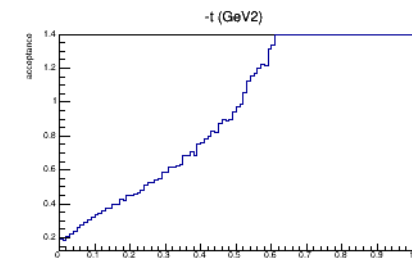
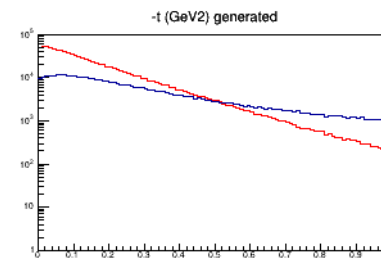
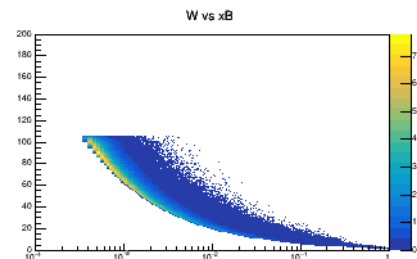
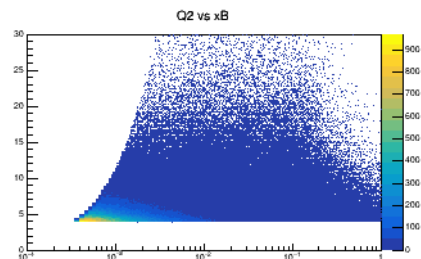
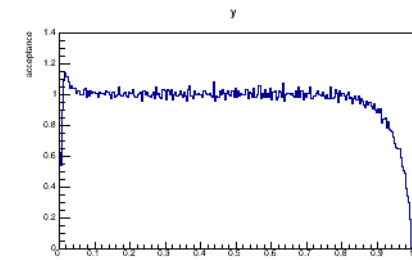
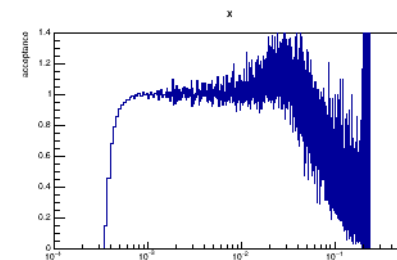
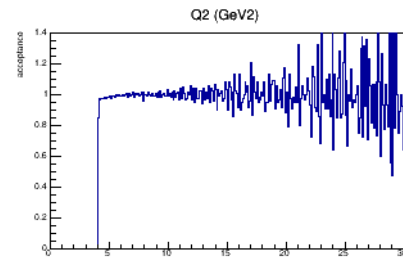
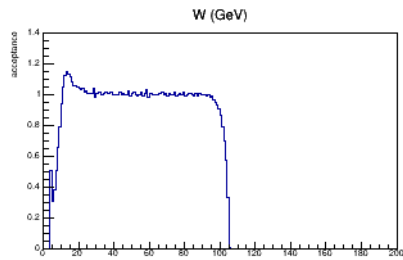
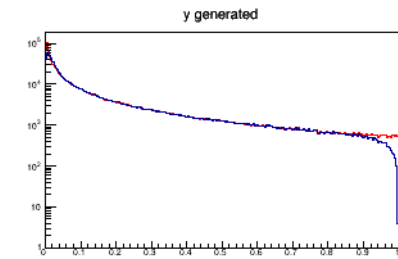
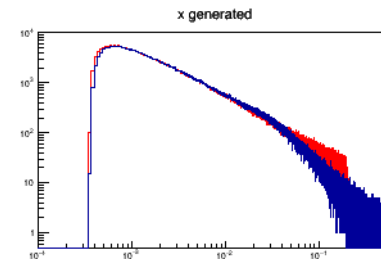
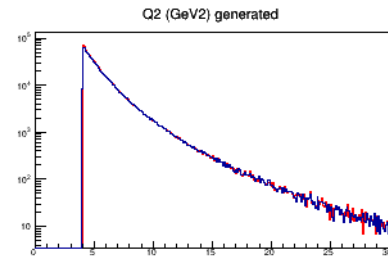
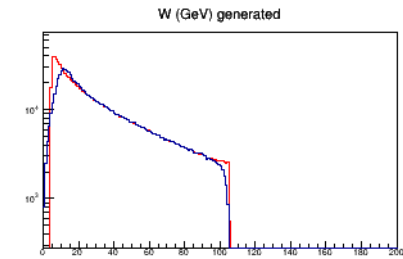
10 x 275

K^+ (similar for K^-):



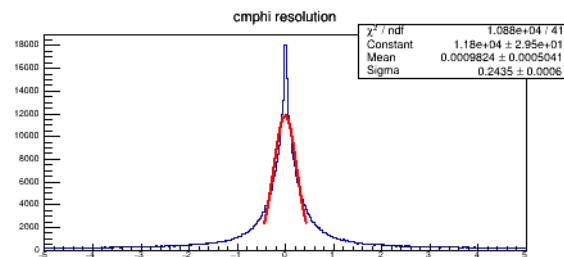
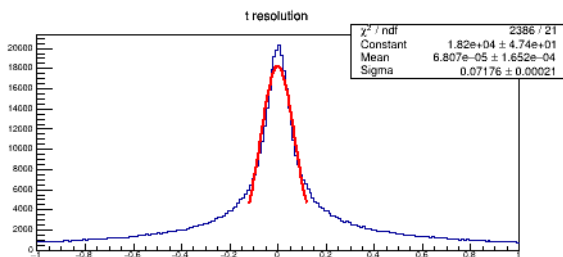
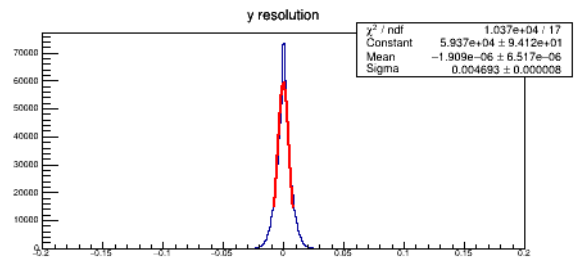
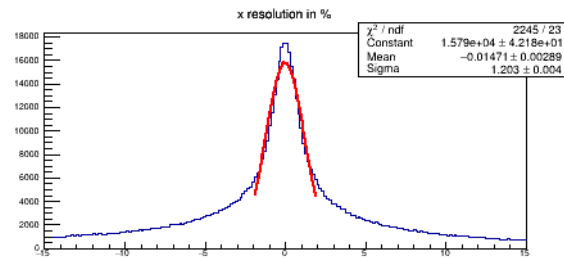
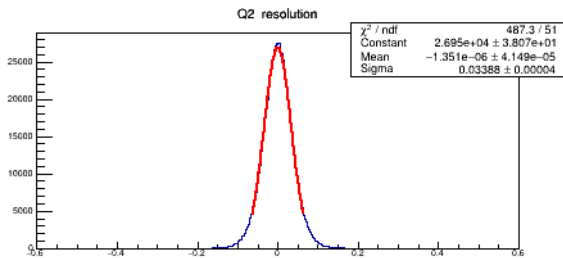
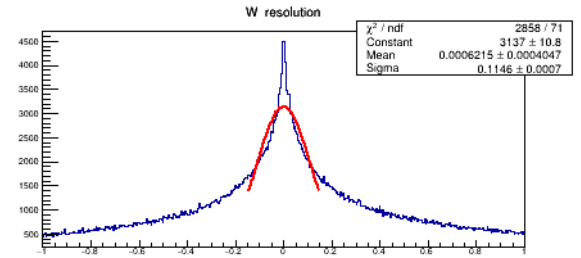
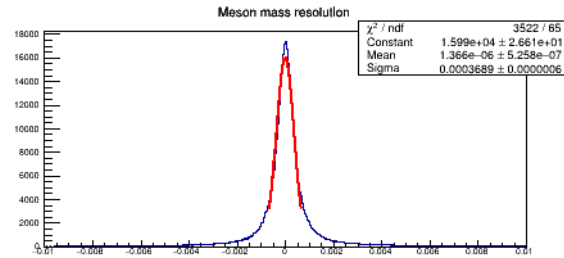
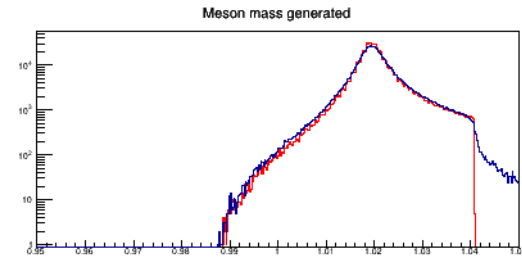
$$\phi \rightarrow K^+ K^-$$

10 x 275



$$\phi \rightarrow K^+ K^-$$

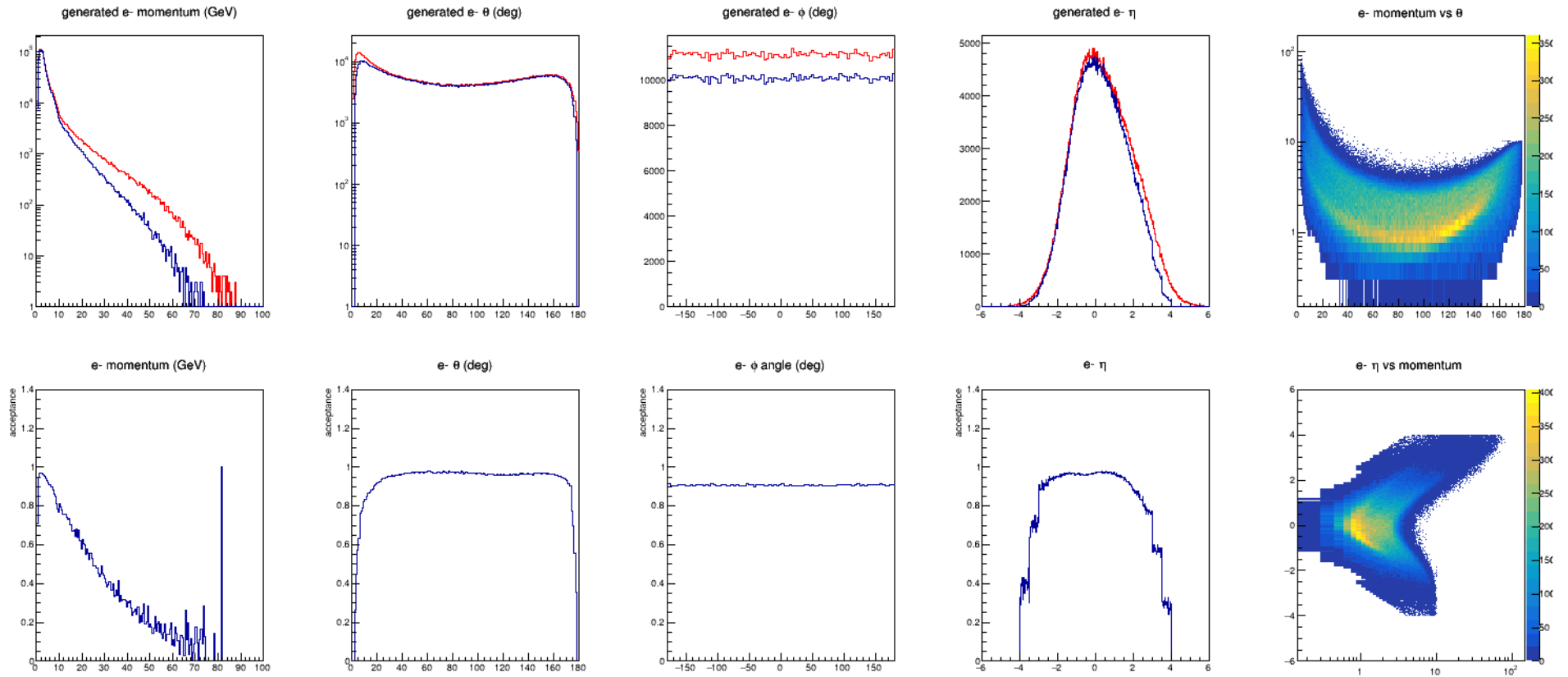
10 x 275



$$J/\Psi \rightarrow e^+e^-$$

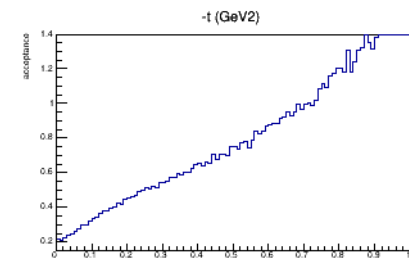
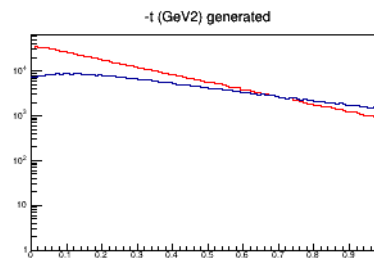
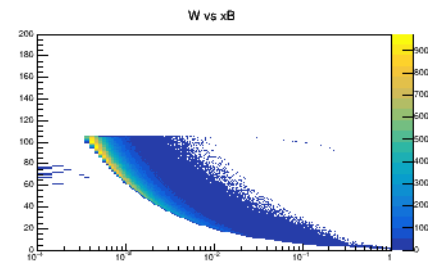
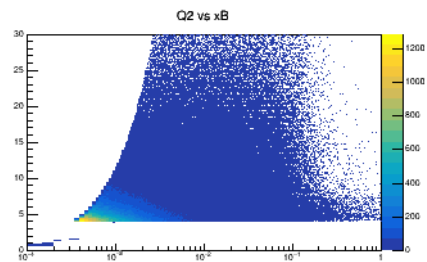
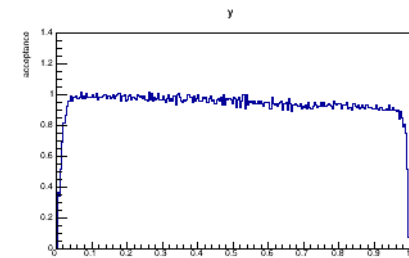
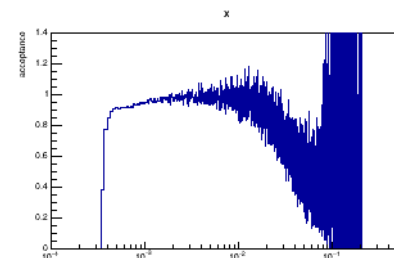
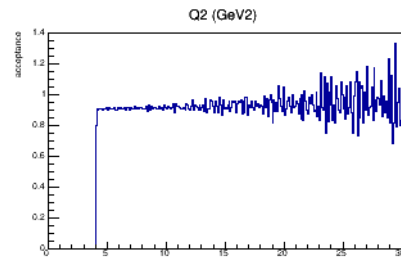
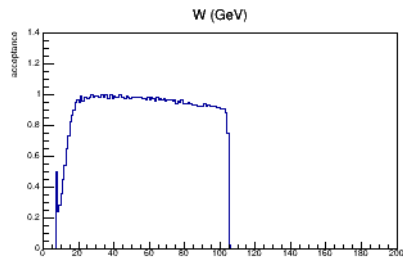
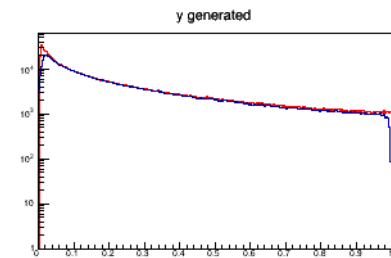
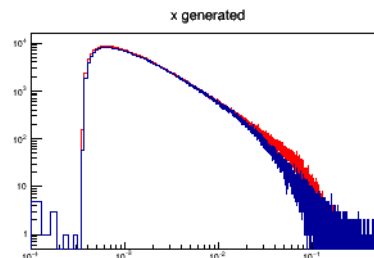
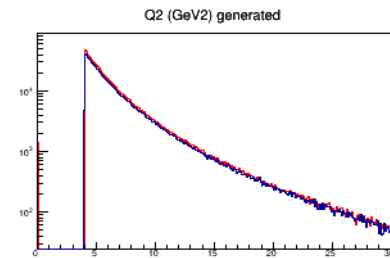
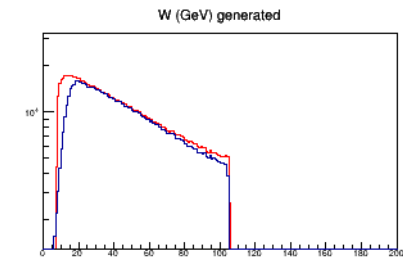
10 x 275

e^- (similar for e^+):



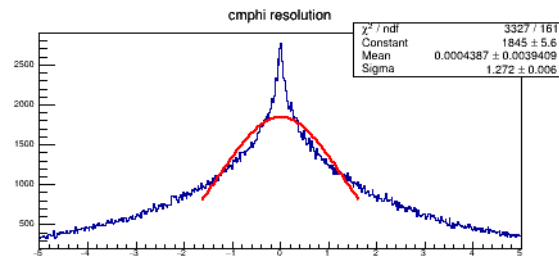
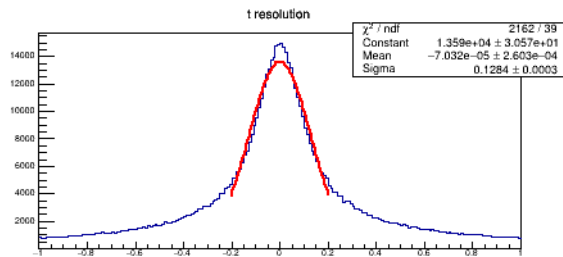
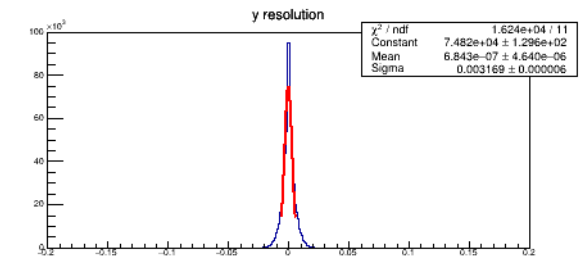
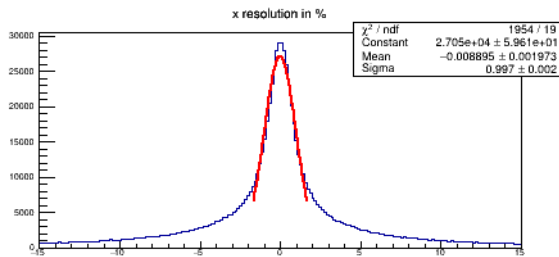
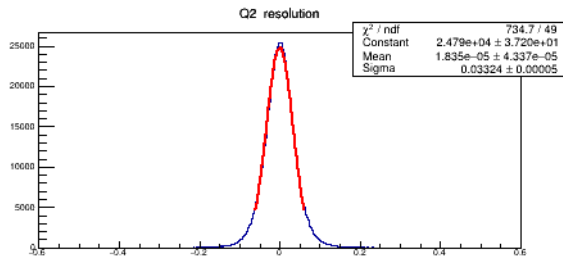
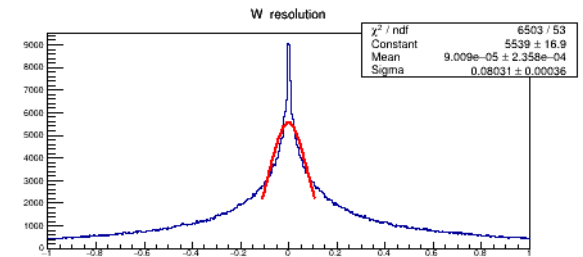
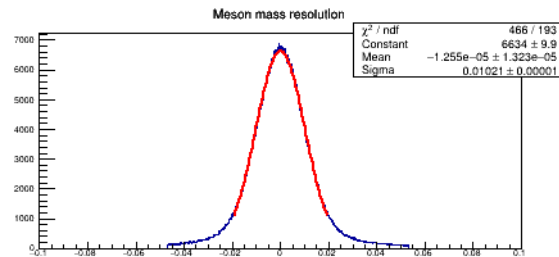
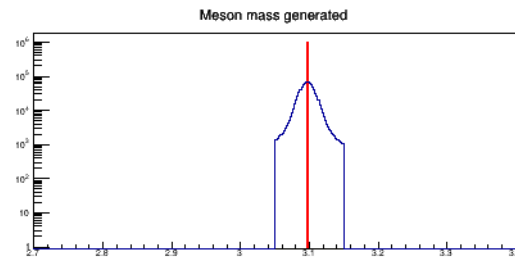
$$J/\Psi \rightarrow e^+e^-$$

10 x 275



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

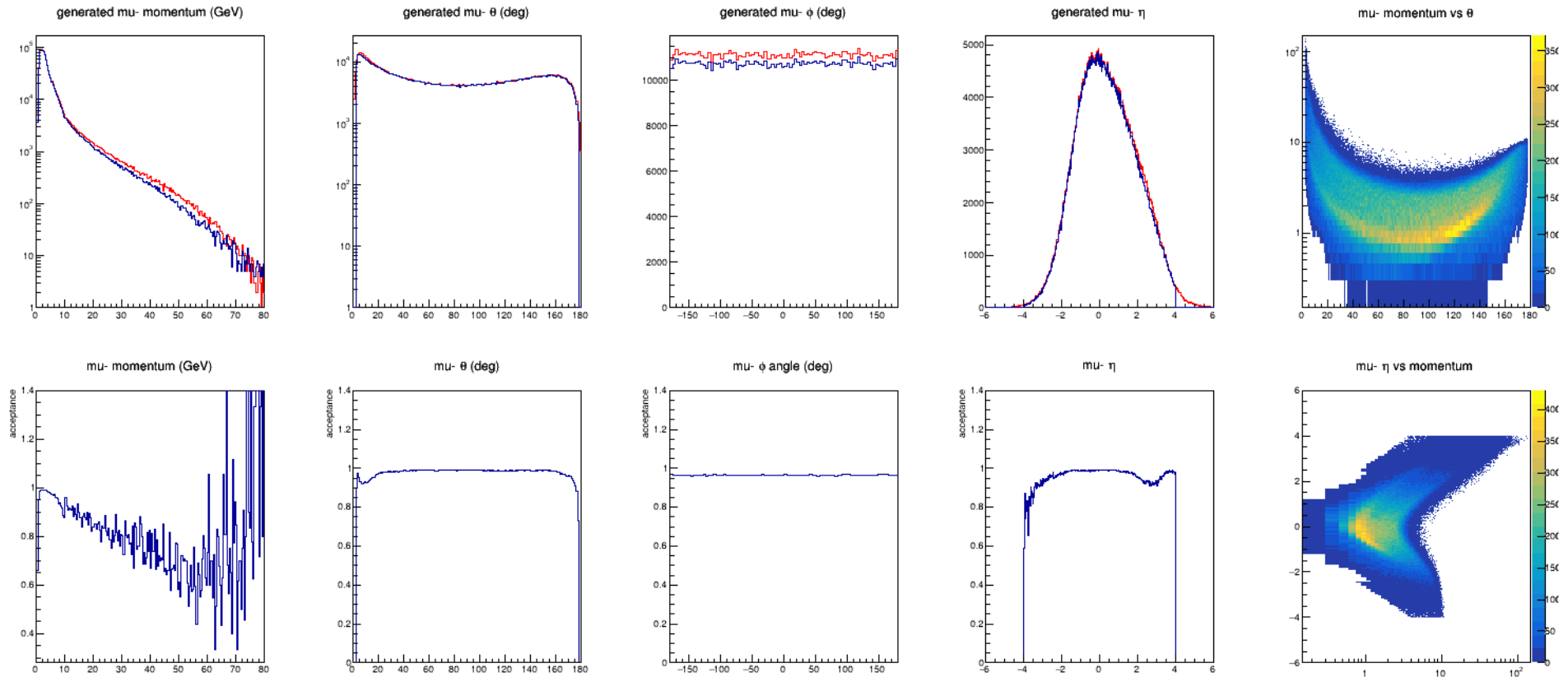
10 x 275



$$J/\Psi \rightarrow \mu^+\mu^-$$

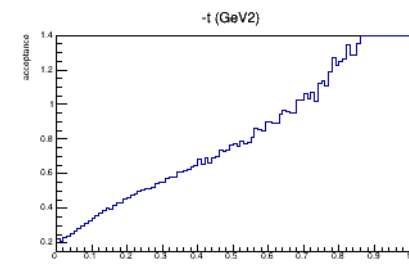
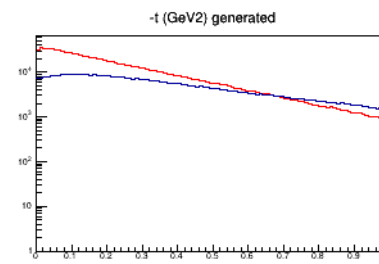
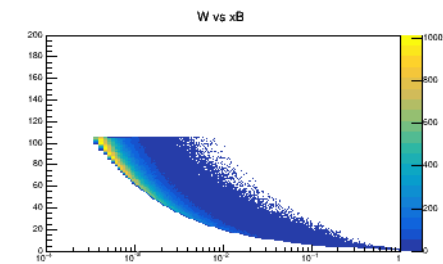
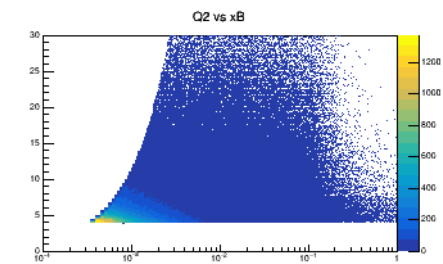
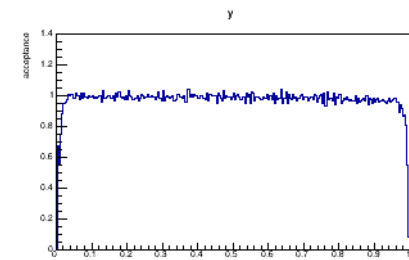
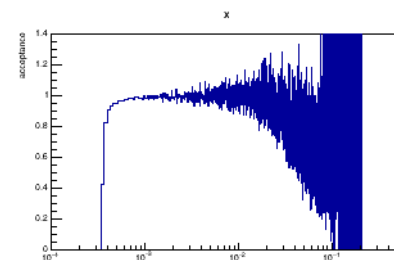
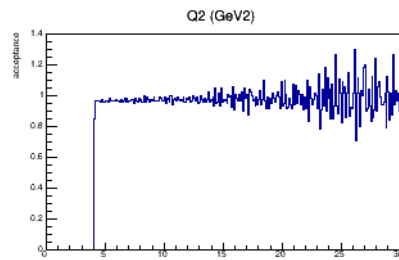
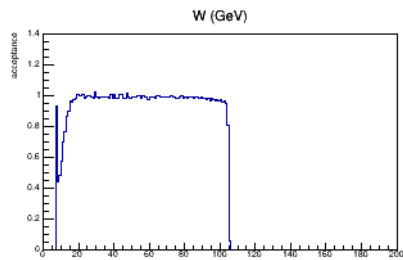
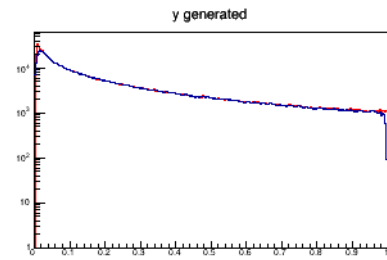
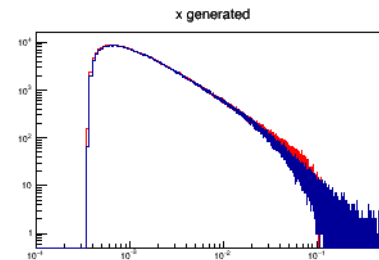
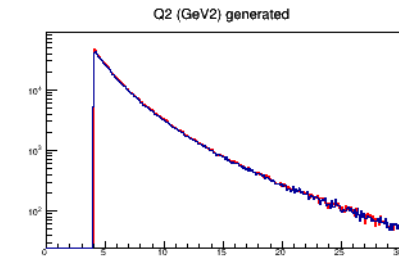
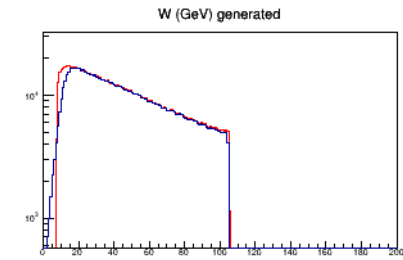
10 x 275

μ^- (similar for μ^+):



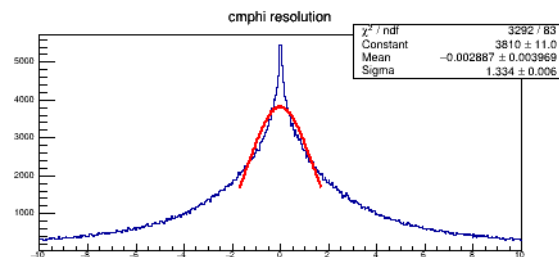
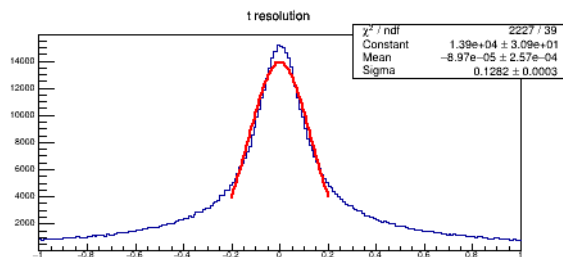
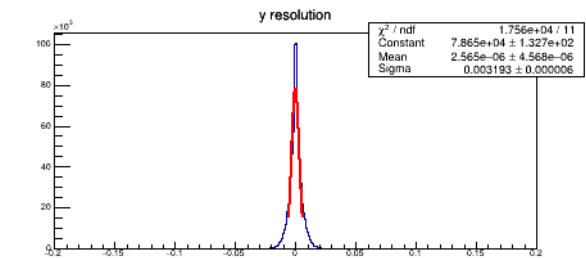
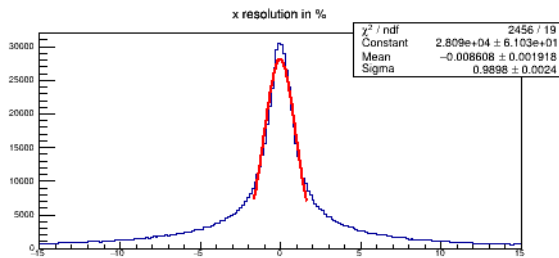
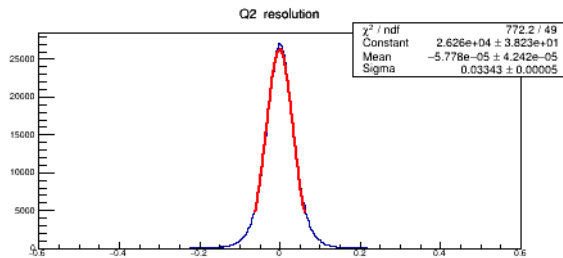
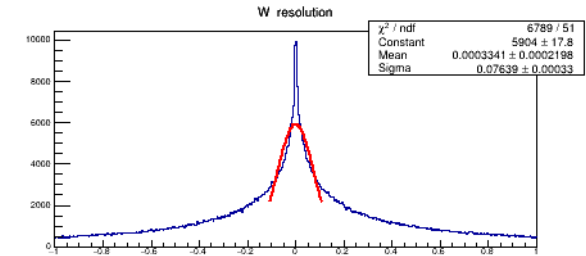
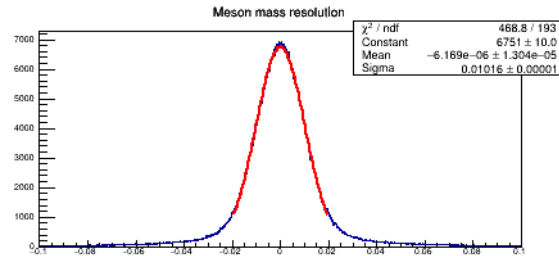
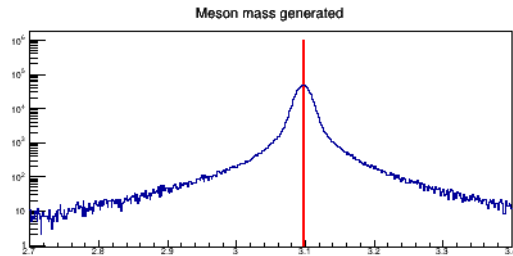
$$J/\Psi \rightarrow \mu^+\mu^-$$

10 x 275



$J/\Psi \rightarrow \mu^+\mu^-$

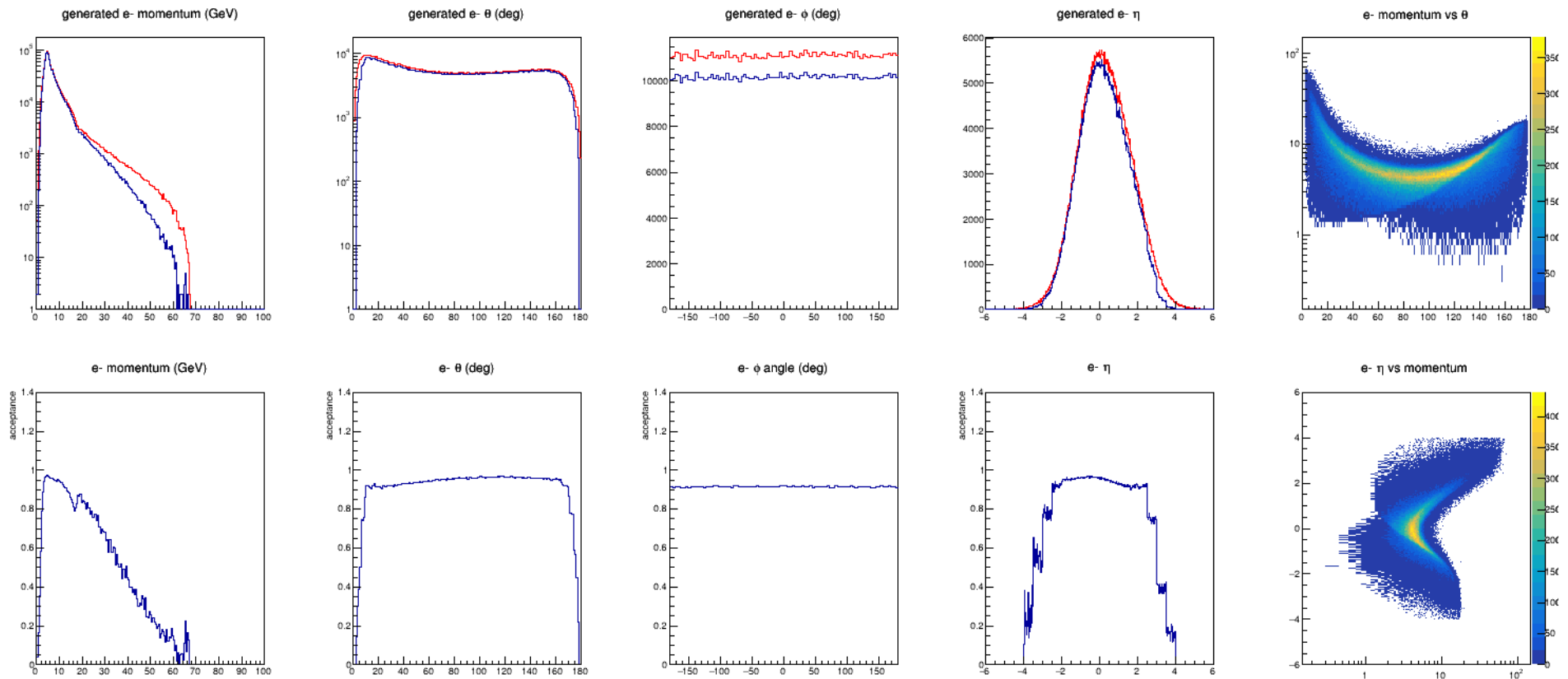
10 x 275



$$\Upsilon \rightarrow e^+e^-$$

18 x 275 $Q^2 > 1 \text{ GeV}^2$

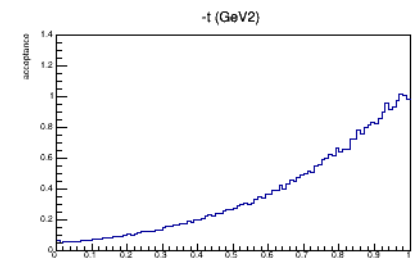
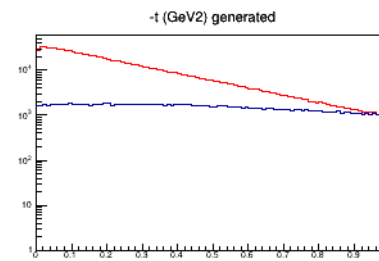
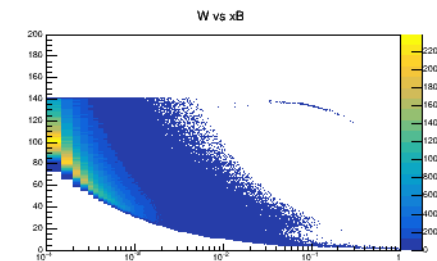
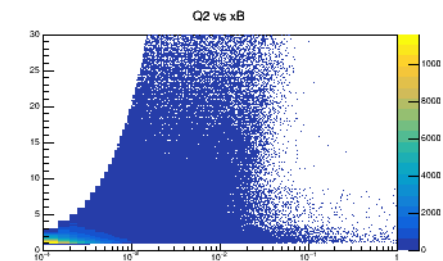
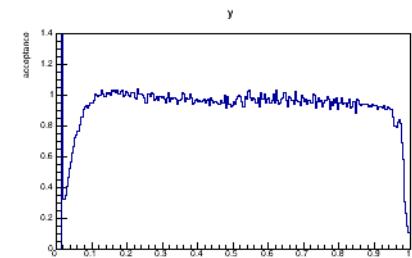
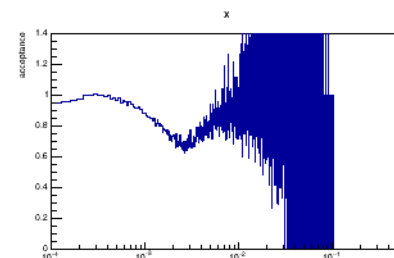
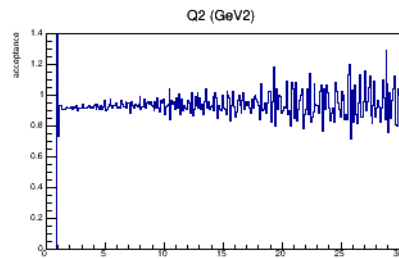
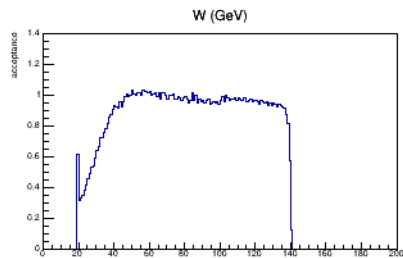
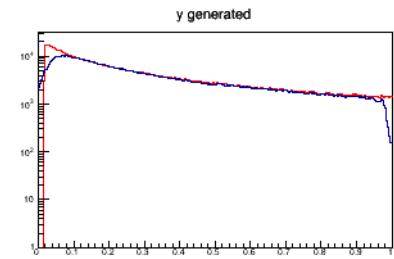
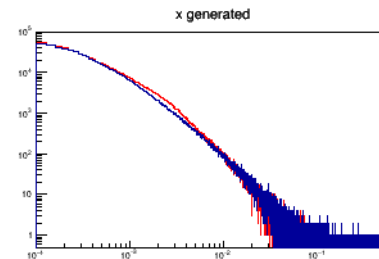
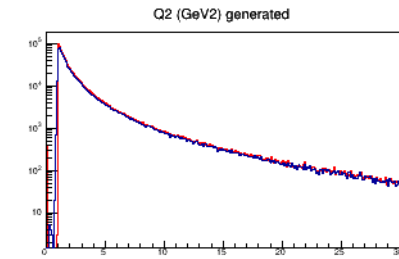
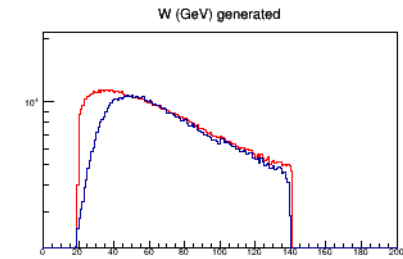
e^- from Υ decay (similar for e^+):



$$\Upsilon \rightarrow e^+e^-$$

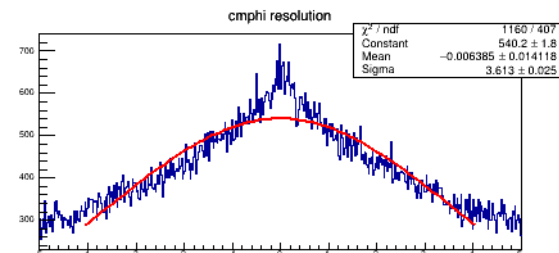
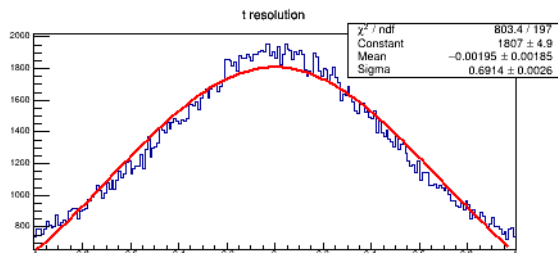
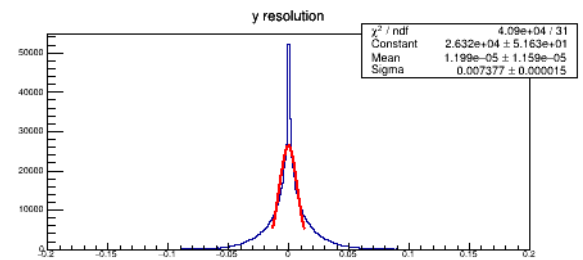
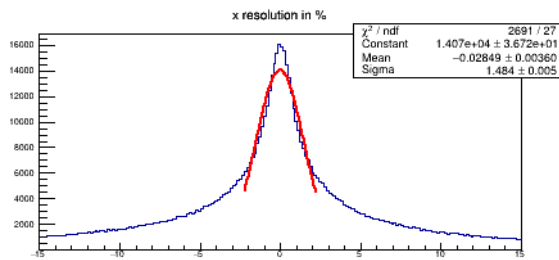
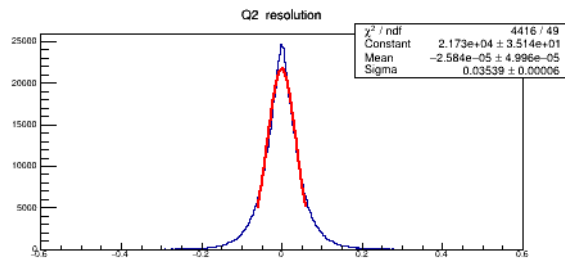
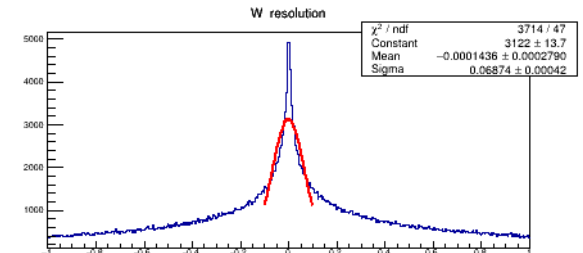
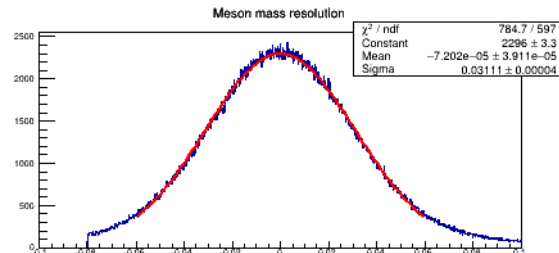
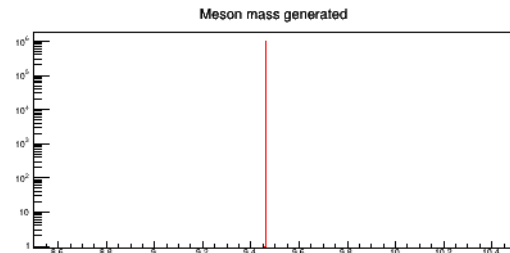
18 x 275

$Q^2 > 1 \text{ GeV}^2$



$$\Upsilon \rightarrow e^+e^-$$

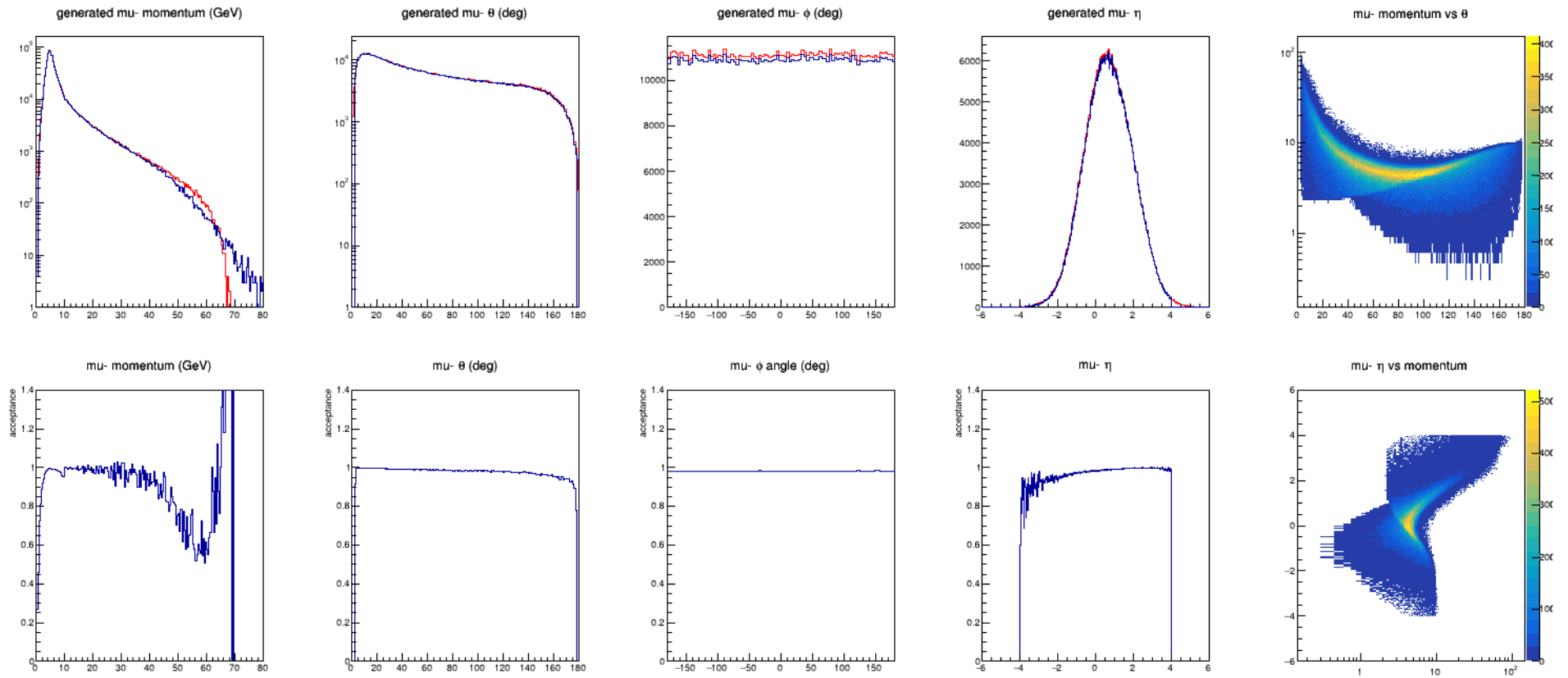
18 x 275 $Q^2 > 1 \text{ GeV}^2$



$$\Upsilon \rightarrow \mu^+ \mu^-$$

18 x 275 $Q^2 > 1 \text{ GeV}^2$

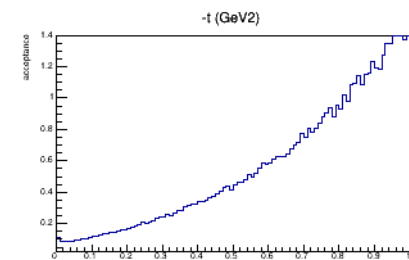
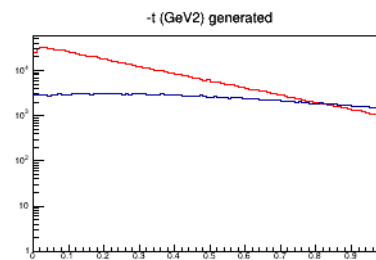
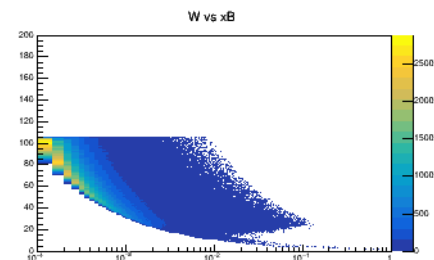
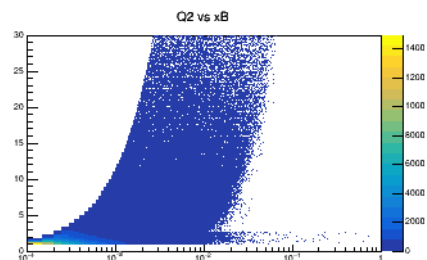
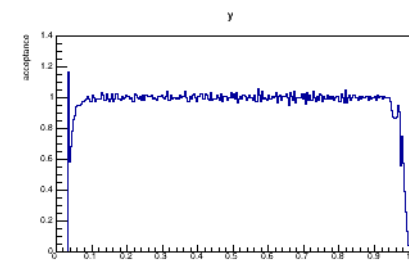
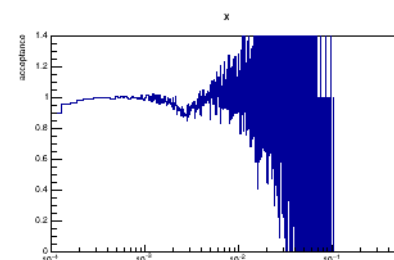
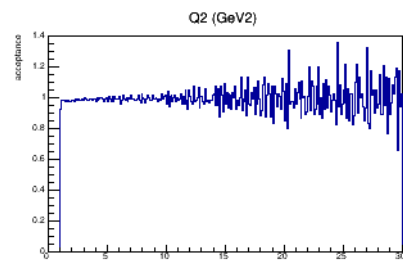
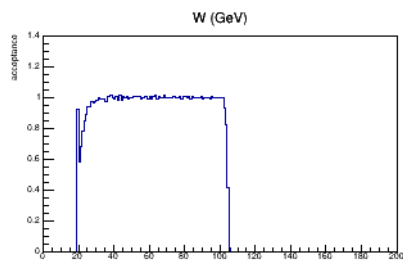
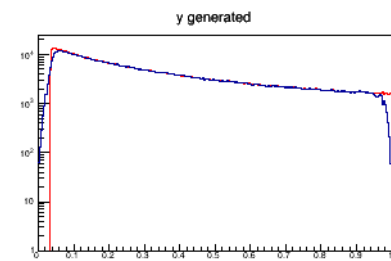
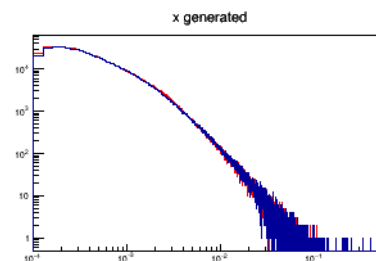
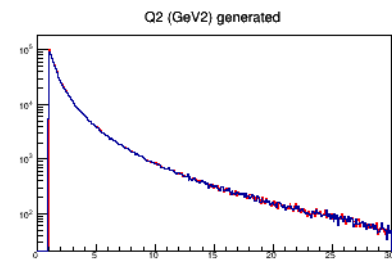
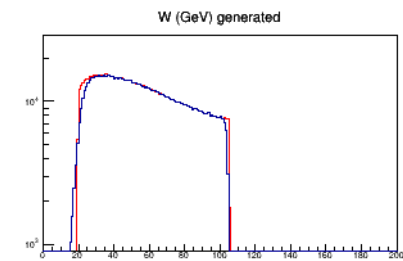
μ^- (similar for μ^+):



$$\Upsilon \rightarrow \mu^+ \mu^-$$

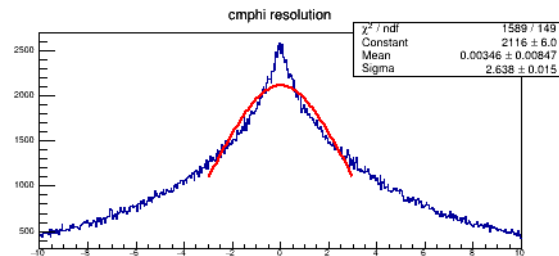
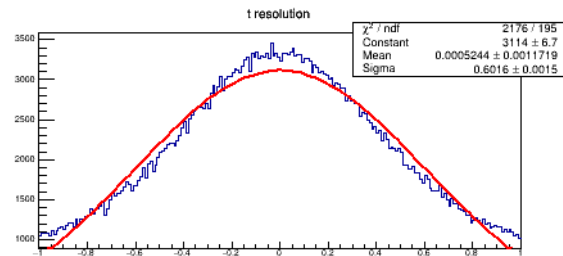
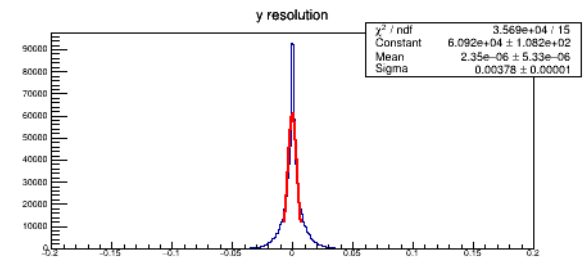
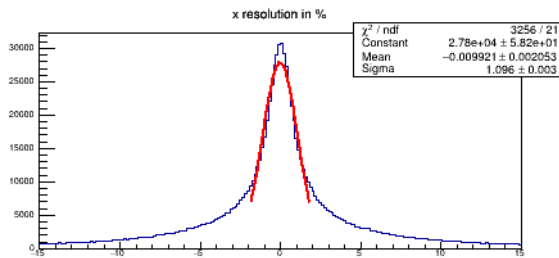
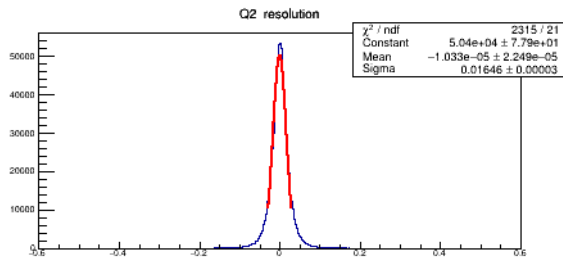
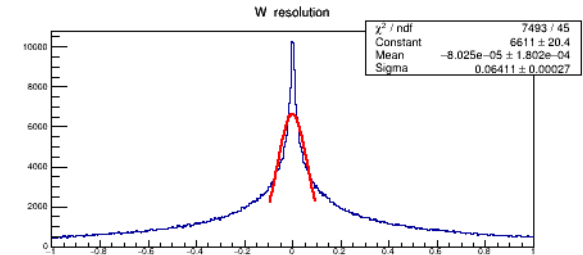
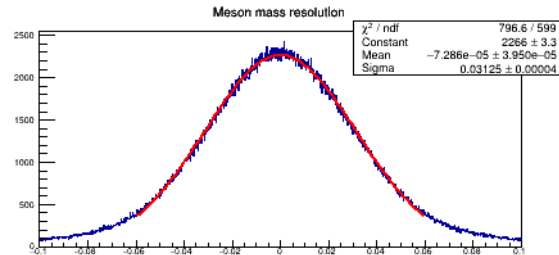
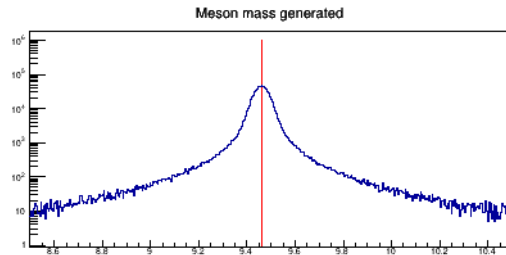
18 x 275

$Q^2 > 1 \text{ GeV}^2$



$$\Upsilon \rightarrow \mu^+\mu^-$$

18 x 275 $Q^2 > 1 \text{ GeV}^2$



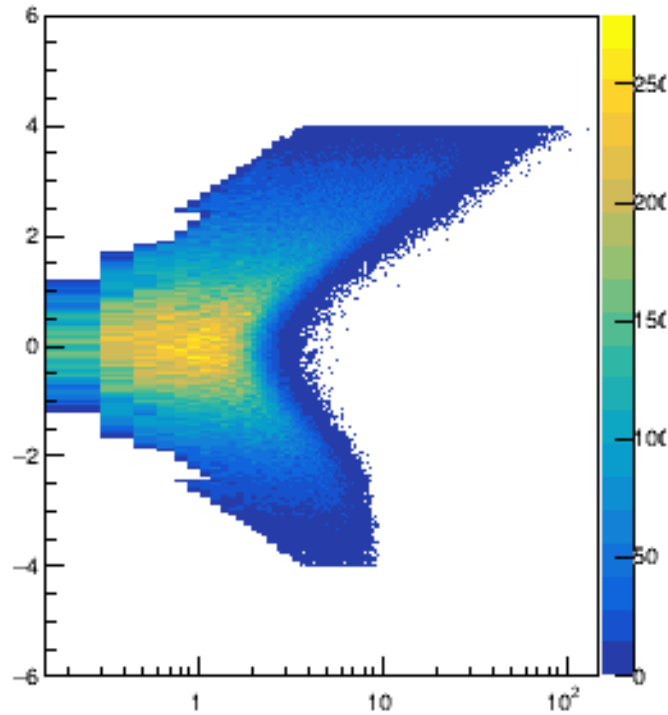
	M_res	W_res	q2_res	x_res [%]	y_res	t_res	cmphi _res
$\rho^0 \rightarrow \pi^+ \pi^-$							
rho_18_275	0,00228	0,12	0,07	1,60	0,01	0,13	0,80
rho_10_275	0,00227	0,11	0,03	1,19	0,00	0,07	0,67
rho_5_275	0,00229	0,11	0,02	1,21	0,00	0,06	0,59
rho_5_100	0,00220	0,08	0,02	1,20	0,00	0,06	0,60
$\omega \rightarrow \pi^+ \pi^-$							
omega_18_275	0,00225	0,13	0,07	1,61	0,01	0,13	0,80
omega_10_275	0,00225	0,11	0,03	1,20	0,01	0,07	0,66
omega_5_275	0,00226	0,11	0,02	1,21	0,00	0,05	0,59
omega_5_100	0,00222	0,09	0,02	1,23	0,00	0,06	0,59
$\phi \rightarrow K^+ K^-$							
phi_18_275	0,00037	0,15	0,07	1,67	0,01	0,13	0,33
phi_10_275	0,00037	0,11	0,03	1,20	0,00	0,07	0,24
phi_5_275	0,00036	0,10	0,02	1,19	0,00	0,05	0,21
phi_5_100	0,00034	0,08	0,02	1,18	0,00	0,05	0,23

	M_res	W_res	q2_res	x_res [%]	y_res	t_res	cmphi _res
jpsi_ee_18_275	0,0105	0,080	0,062	1,257	0,0062	0,20	1,57
jpsi_ee_10_275	0,0102	0,080	0,033	0,997	0,0032	0,13	1,27
jpsi_ee_5_275	0,0102	0,069	0,024	0,967	0,0024	0,10	1,13
jpsi_ee_5_100	0,0098	0,050	0,024	0,947	0,0023	0,10	1,19
jpsi_mumu_18_275	0,0105	0,069	0,062	1,222	0,0062	0,20	1,67
jpsi_mumu_10_275	0,0102	0,076	0,033	0,990	0,0032	0,13	1,33
jpsi_mumu_5_275	0,0101	0,069	0,024	0,968	0,0024	0,11	1,13
jpsi_mumu_5_100	0,0098	0,050	0,024	0,943	0,0023	0,10	1,23
ups_ee_q2>1_18_275	0,0311	0,069	0,035	1,484	0,0074	0,69	3,61
ups_ee_q2>1_10_275	0,0311	0,064	0,016	1,085	0,0037	0,59	2,46
ups_mumu_q2>1_18_275	0,0311	0,065	0,036	1,479	0,0078	0,70	3,76
ups_mumu_q2>1_10_275	0,0313	0,064	0,016	1,096	0,0038	0,60	2,64

10 x 275

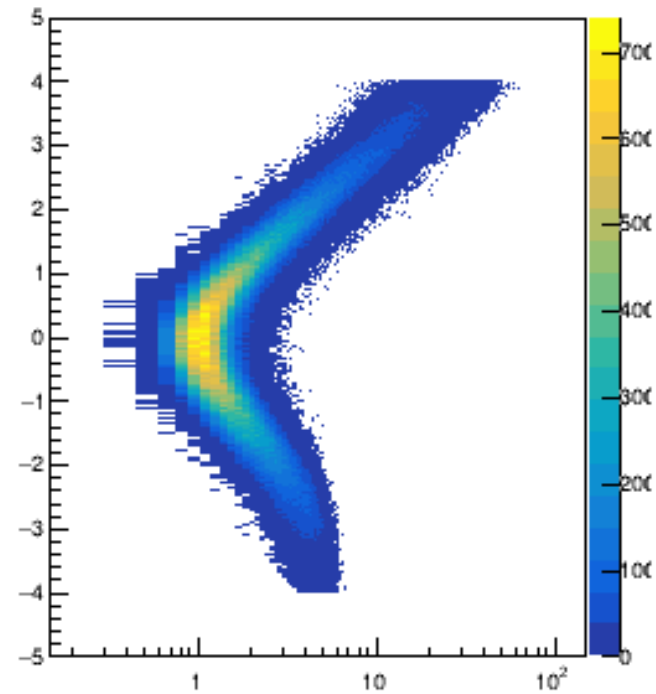
$$\rho^0 \rightarrow \pi^+ \pi^-$$

π - η vs momentum



$$\phi \rightarrow K^+ K^-$$

K - η vs momentum



-3.5 < η < -1.7 K/π separation up to $p = 2.0$ GeV/c
-1.56 < η < 1.56 K/π separation up to $p = 6.0$ GeV/c
1.56 < η < 3.5 K/π separation up to $p = 50$ GeV/c

10 x 275

$$J/\Psi \rightarrow e^+e^-$$

$$\Upsilon \rightarrow e^+e^-$$

$$J/\Psi \rightarrow \mu^+\mu^-$$

$$\Upsilon \rightarrow \mu^+\mu^-$$

e- η vs momentum

