Study on Pythia Events in Different Magnetic Fields Using BDTs

$$\gamma\, p \rightarrow p\, \eta\, \pi^{+}\, \pi^{-}$$

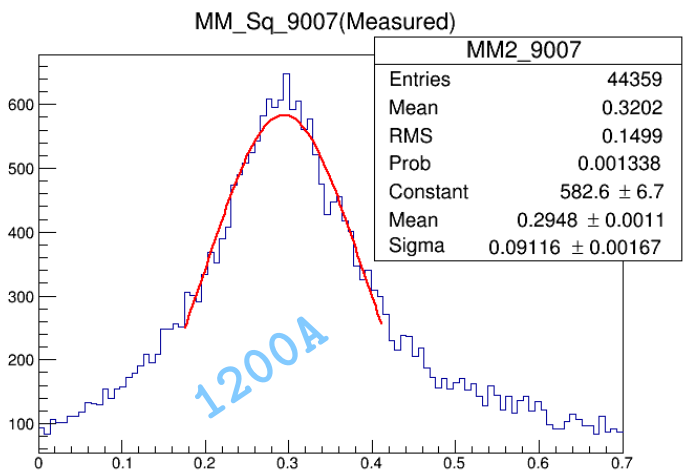
(08/10/2014)

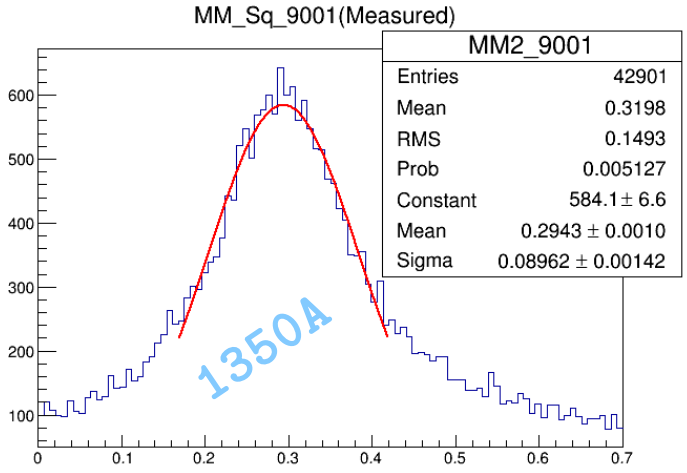
Overview

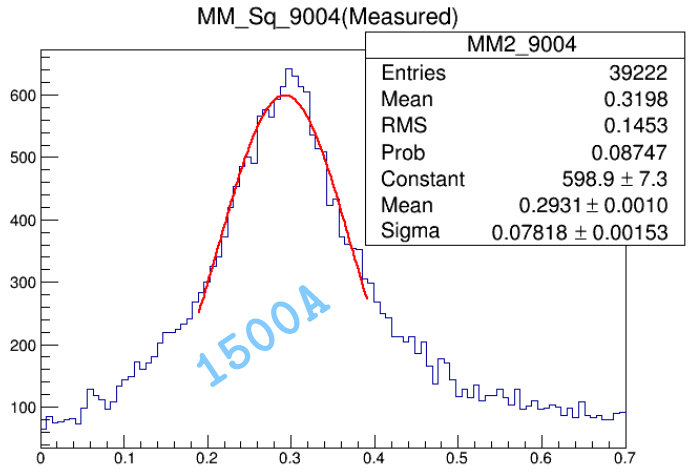
- Selection of $\gamma\, p \rightarrow p\, \pi^{+}\, \pi^{-} [\eta]$ over 10M pythia events for the three different currents.

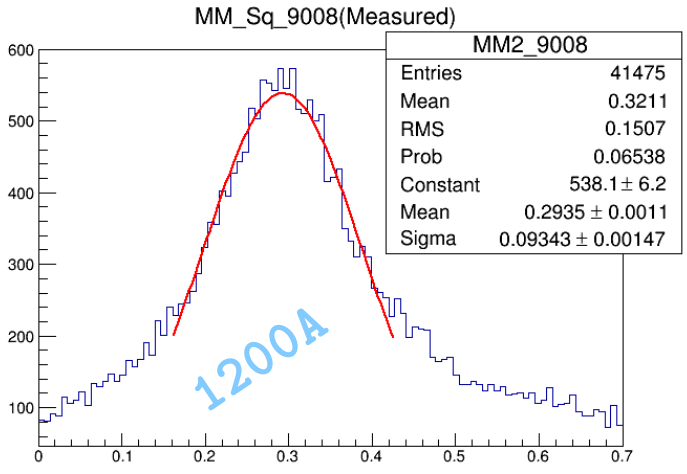
- Exclusive reaction of $\gamma\, p \rightarrow p\, \eta\, \pi^{+}\, \pi^{-}$ with $\eta \rightarrow \gamma\, \gamma$

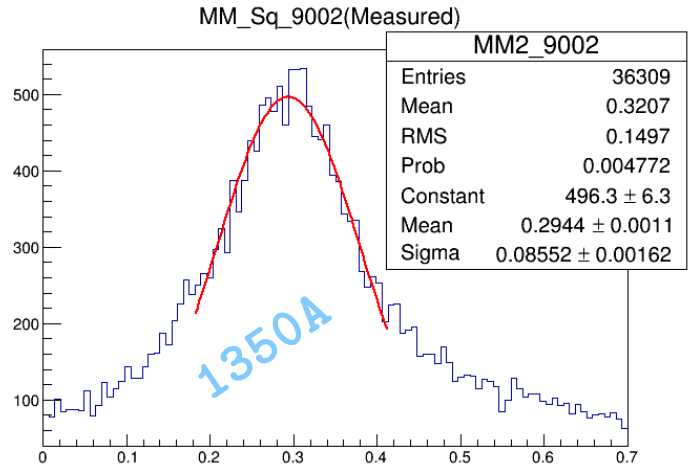
Inclusive reaction where we are missing an Eta

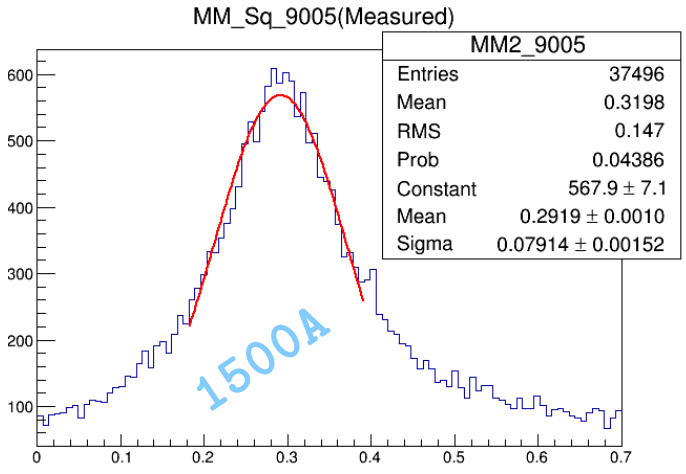






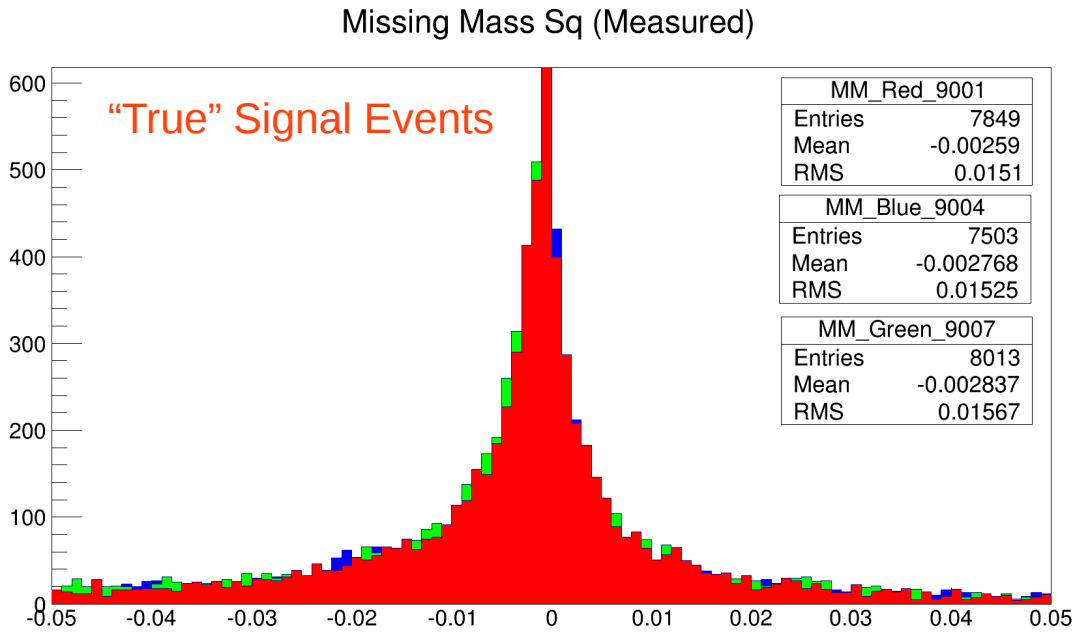




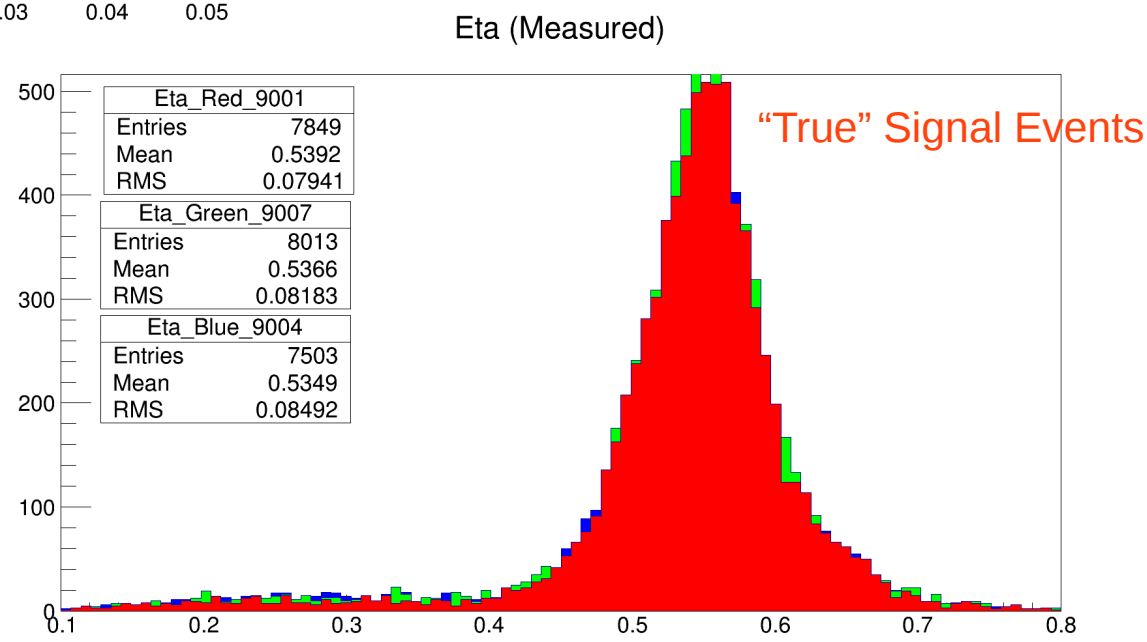


Mass distribution for the three different currents

Exclusive

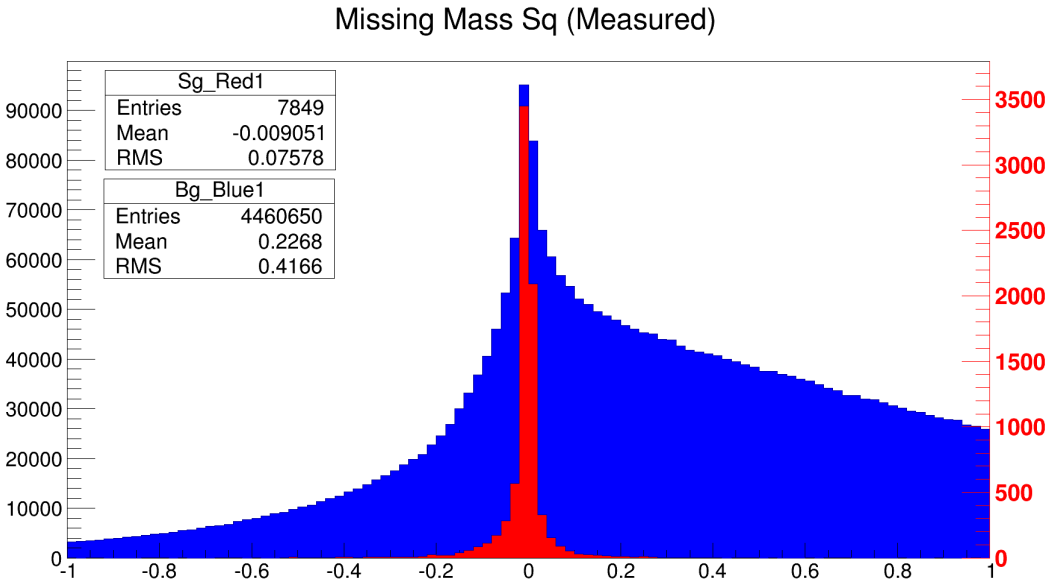


$\eta \rightarrow \gamma\,\gamma$

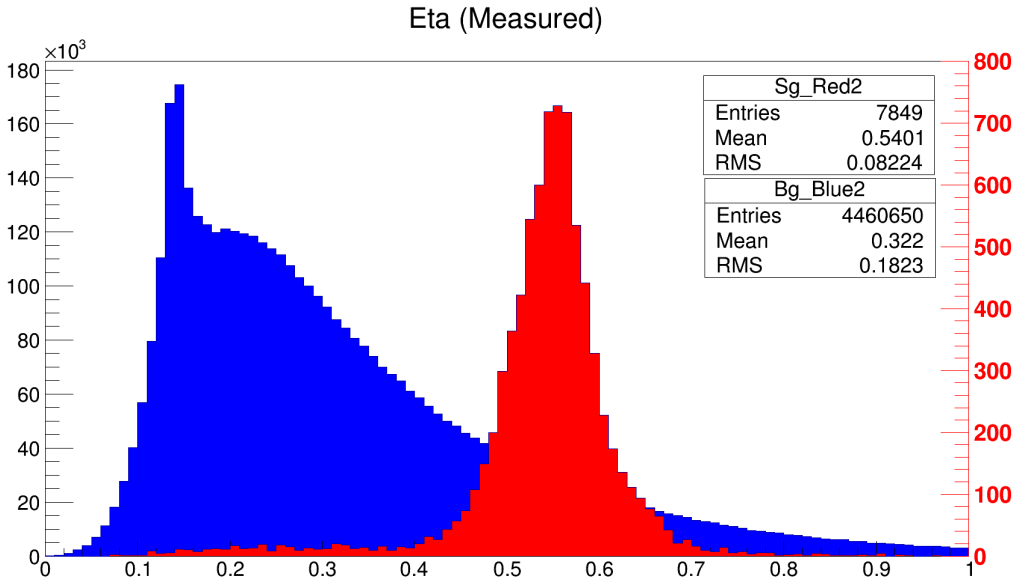


Signal Vs Background for the BDT for 9001 (1350A)

Exclusive



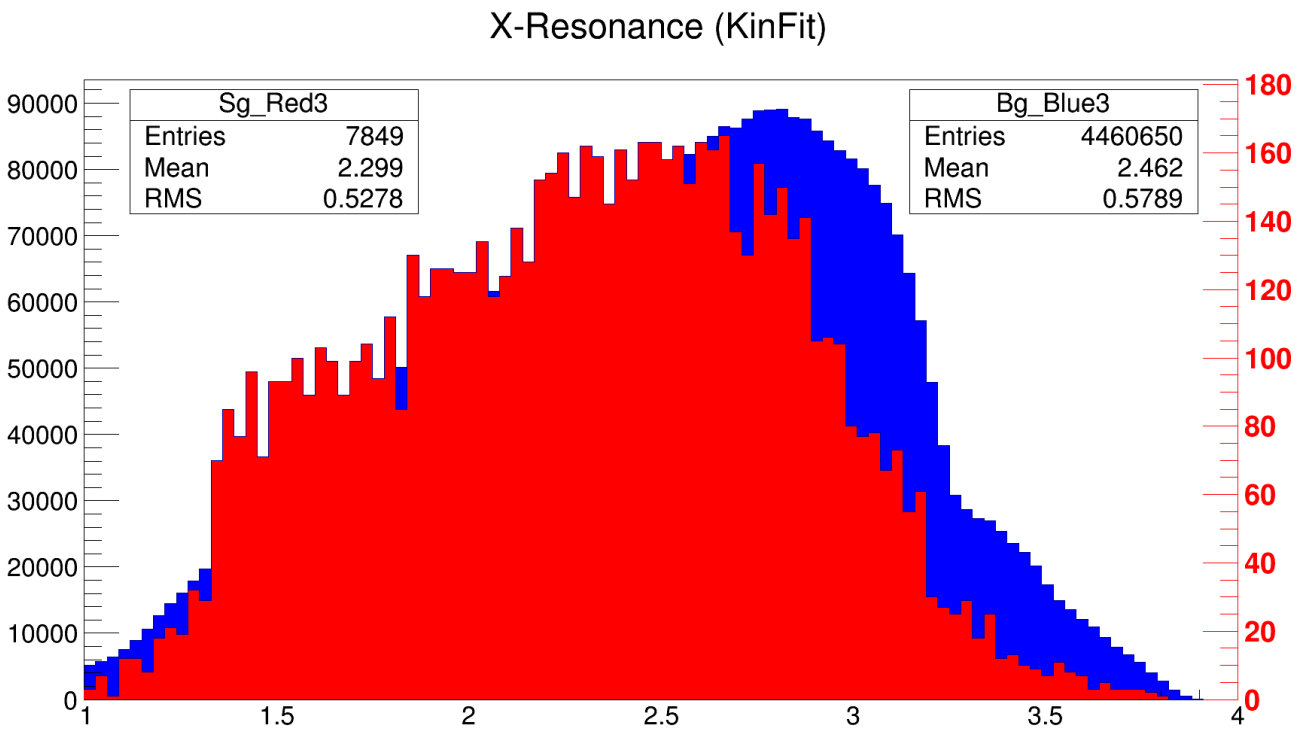
$\eta \rightarrow \gamma\,\gamma$



Signal Vs Background for the BDT for 9001 (1350A)

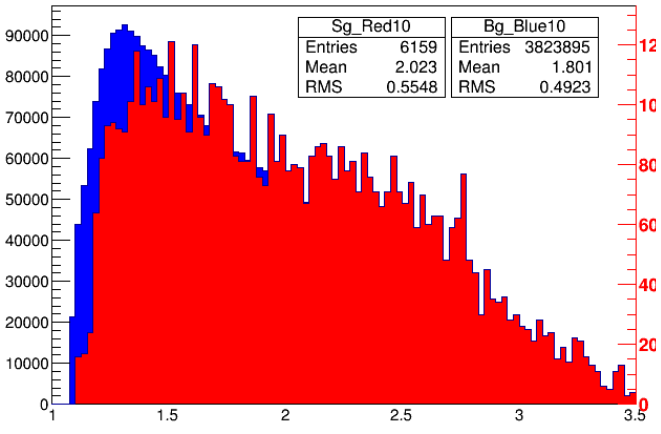
Exclusive

$$X \rightarrow \pi^{+} \pi^{-} \eta$$

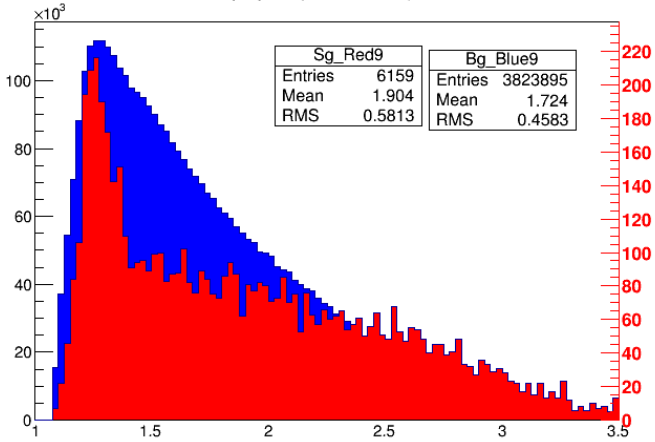


Background Vs Signal for 9002 (EM 5.5E7; Measured)

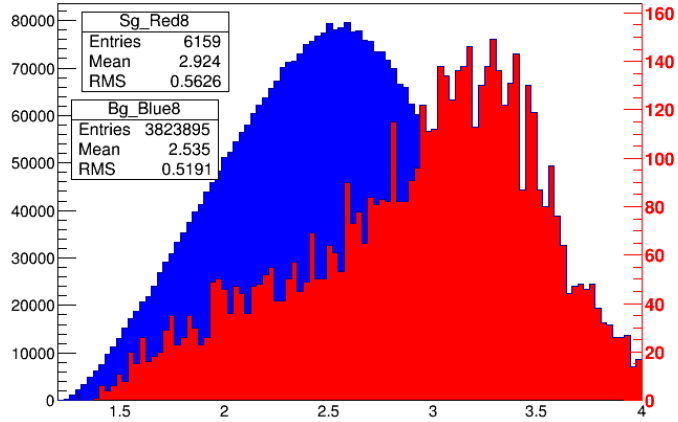
p_piM (Measured)



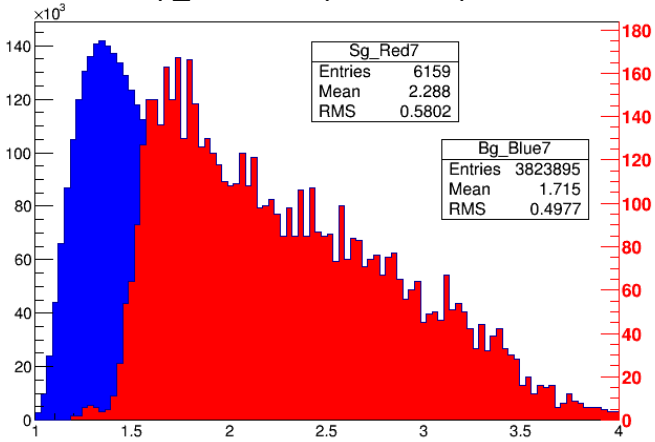
p_piP (Measured)



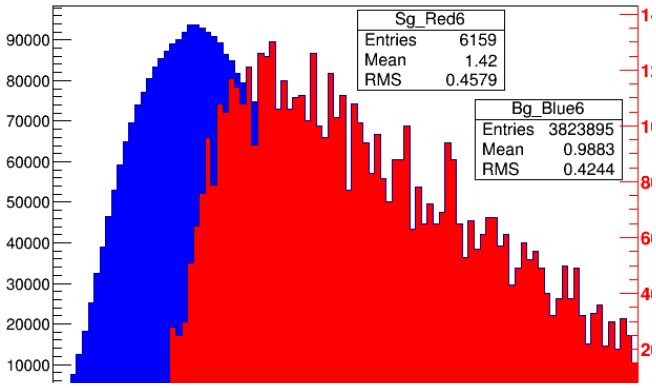
p_piPpiM (Measured)



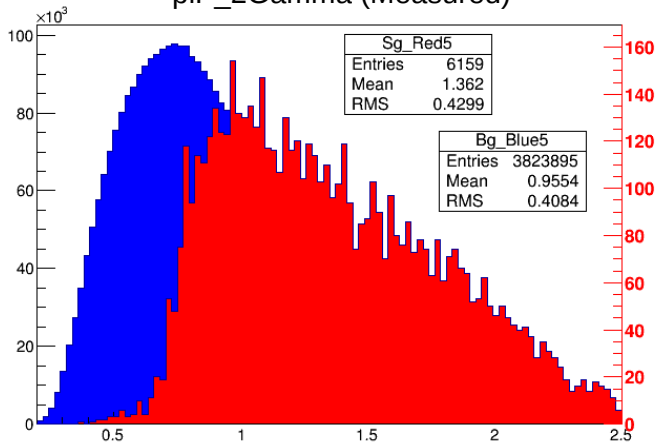
p_2Gamma (Measured)



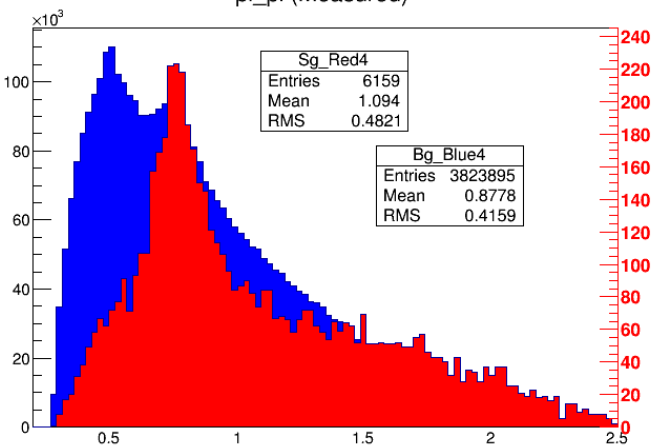
piM_2Gamma (Measured)



piP_2Gamma (Measured)



pi_pi (Measured)



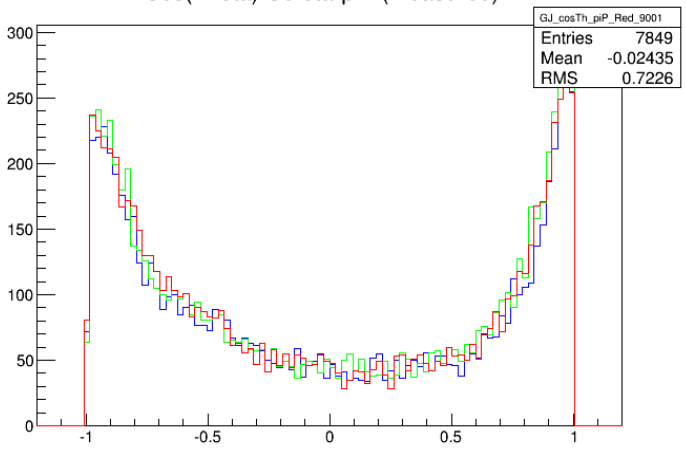
Exclusive

Angles for the three different Currents (Signal with EM 1.1E7)

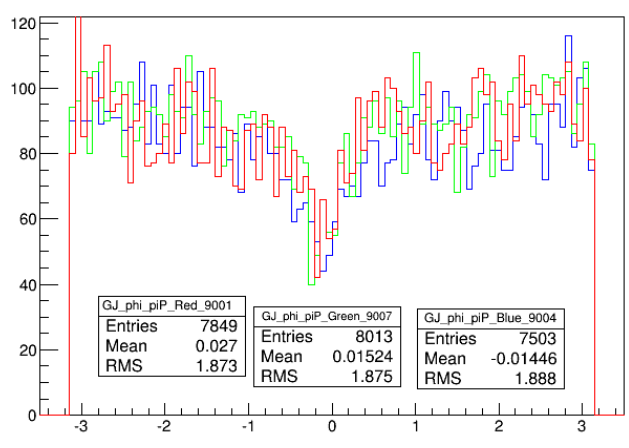
Green: 1200A ; Red: 1300A ; Blue: 1500A

Exclusive

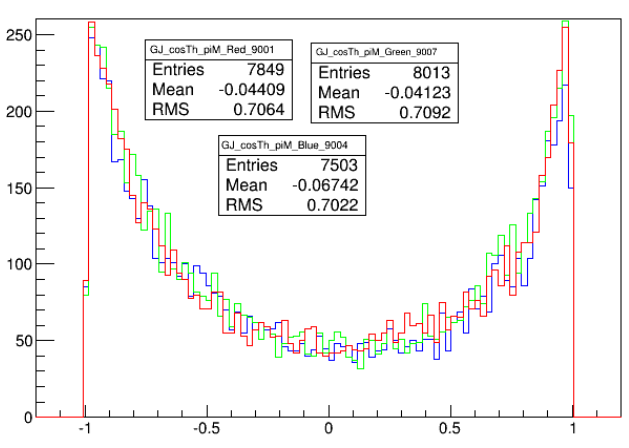
Cos(Theta) GJ eta-piP (Measured)



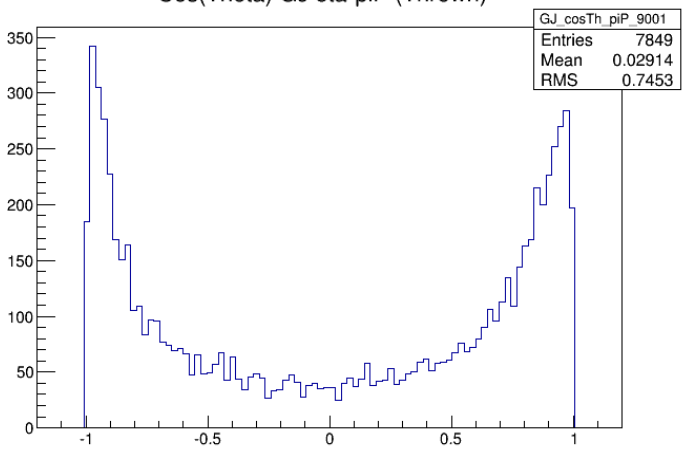
phi GJ eta-piP (Measured)



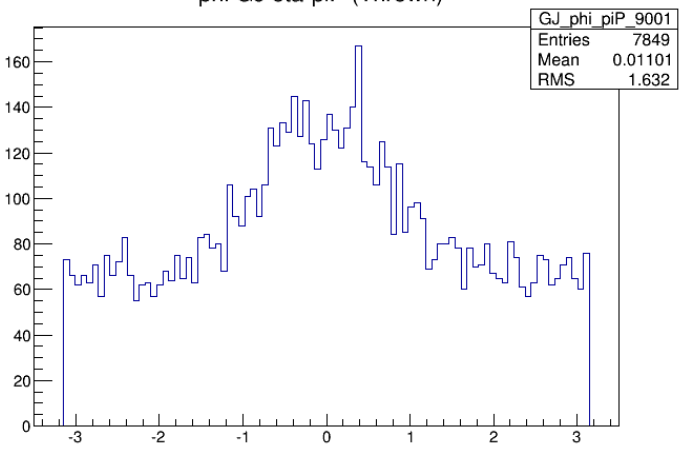
Cos(Theta) GJ eta-piM (Measured)



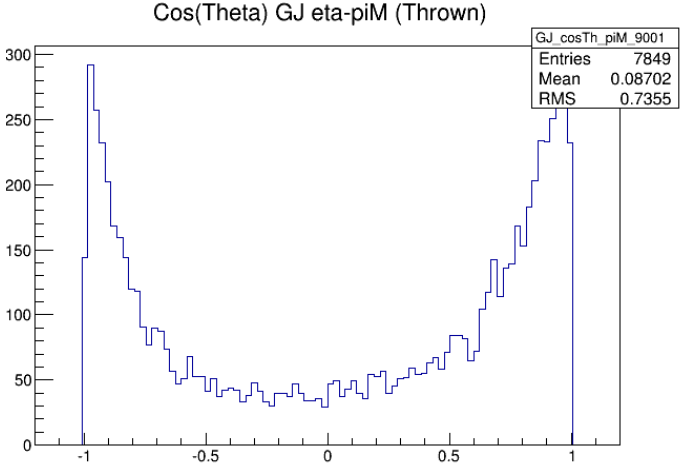
Cos(Theta) GJ eta-piP (Thrown)



phi GJ eta-piP (Thrown)



Cos(Theta) GJ eta-piM (Thrown)

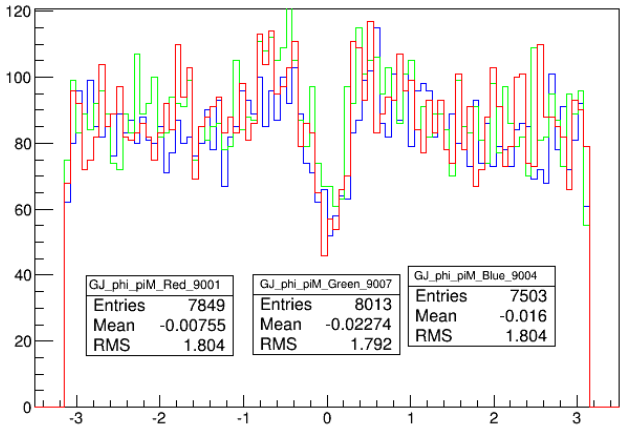


Angles for the three different Currents (Signal with EM 1.1E7)

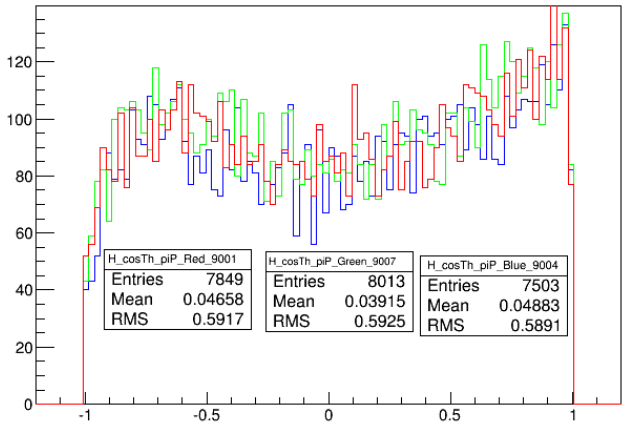
Green: 1200A ; Red: 1300A ; Blue: 1500A

Exclusive

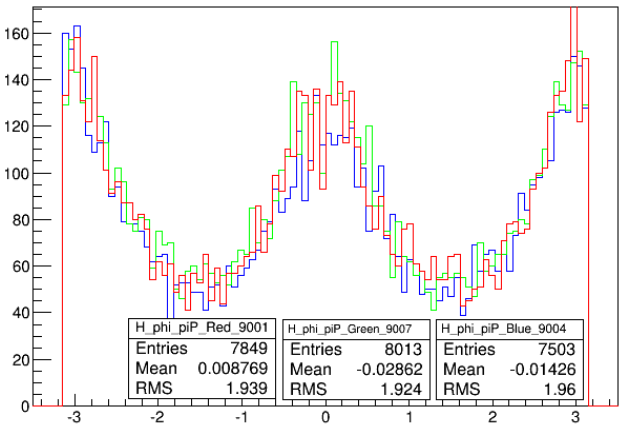
phi GJ eta-piM (Measured)



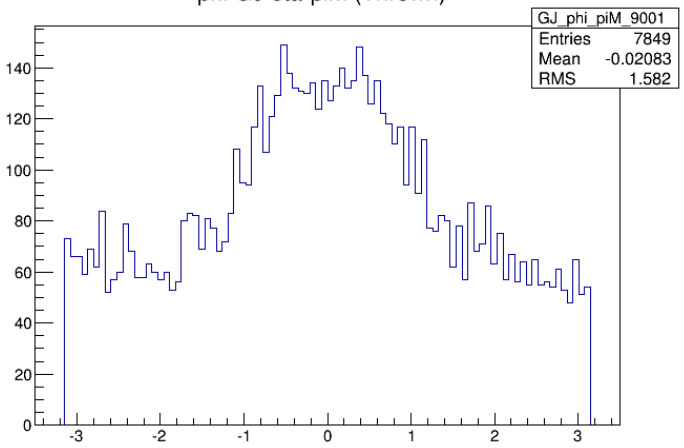
Cos(Theta) H eta-piP (Measured)



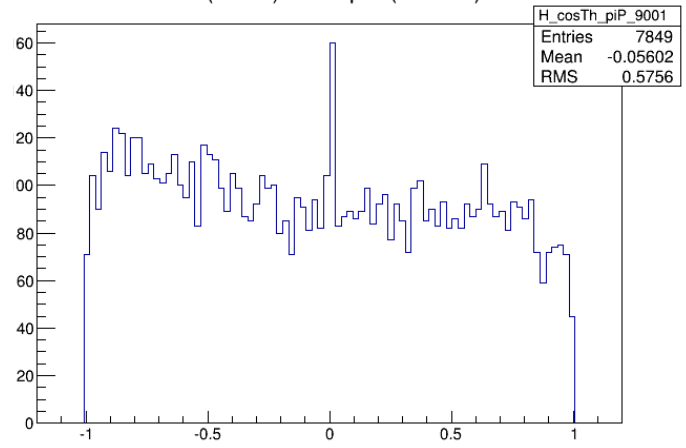
phi H eta-piP (Measured)



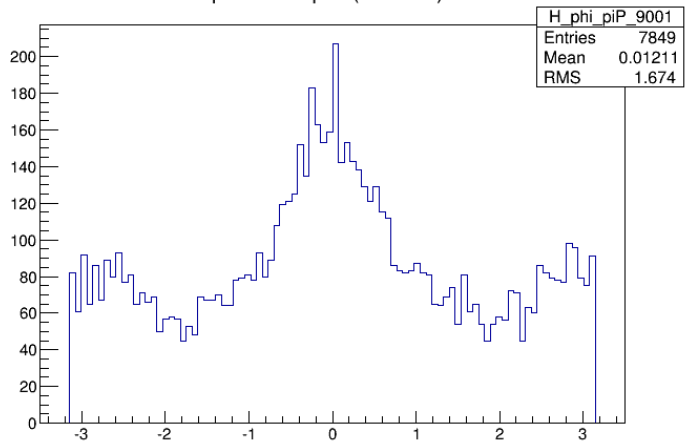
phi GJ eta-piM (Thrown)



Cos(Theta) H eta-piP (Thrown)



phi H eta-piP (Thrown)

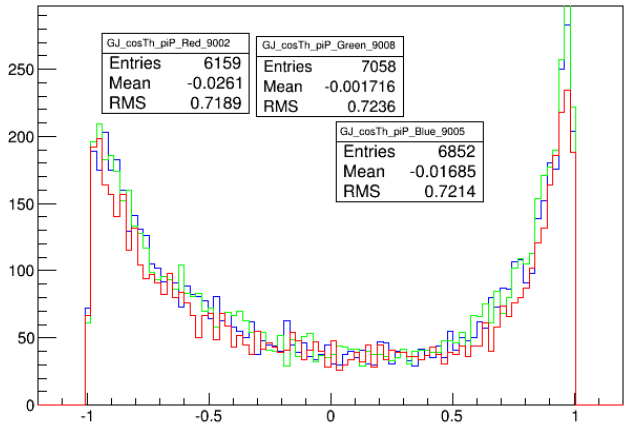


Angles for the three different Currents (Signal with EM 5.5E7)

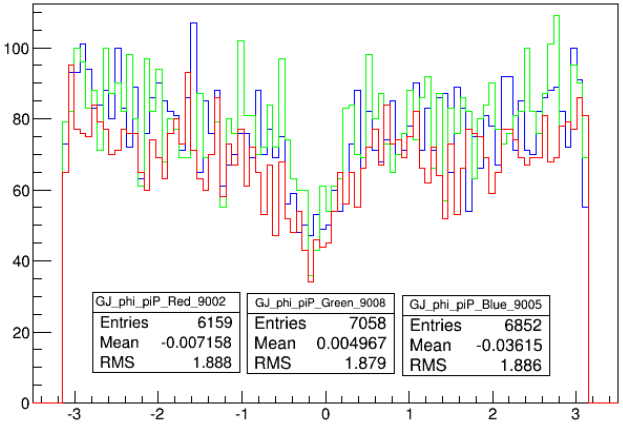
Green: 1200A ; Red: 1300A ; Blue: 1500A

Exclusive

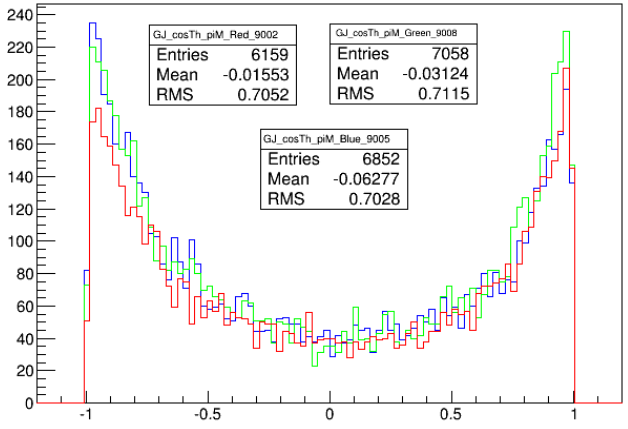
Cos(Theta) GJ eta-piP (Measured)



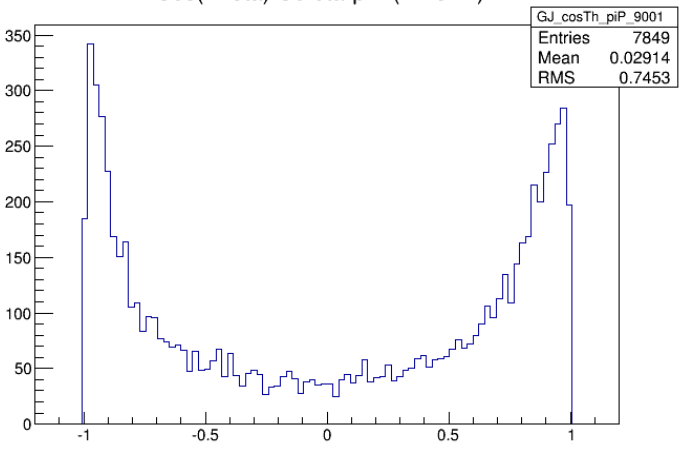
phi GJ eta-piP (Measured)



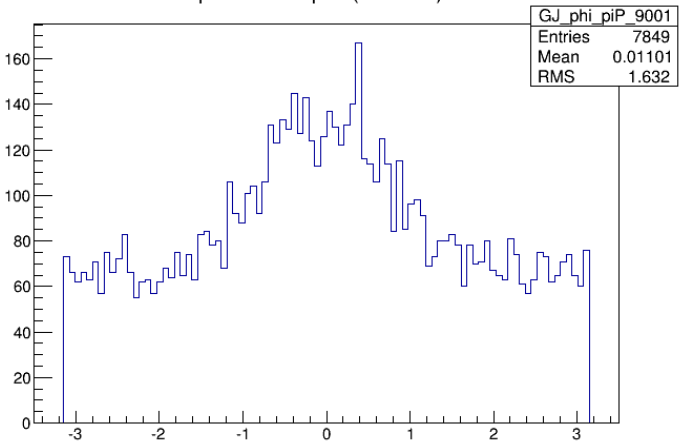
Cos(Theta) GJ eta-piM (Measured)



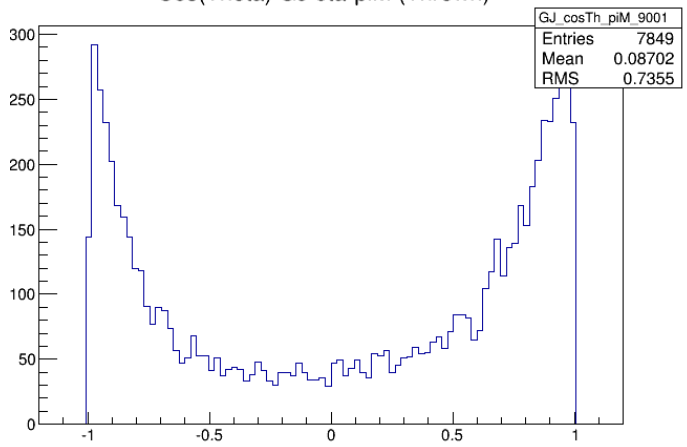
Cos(Theta) GJ eta-piP (Thrown)



phi GJ eta-piP (Thrown)



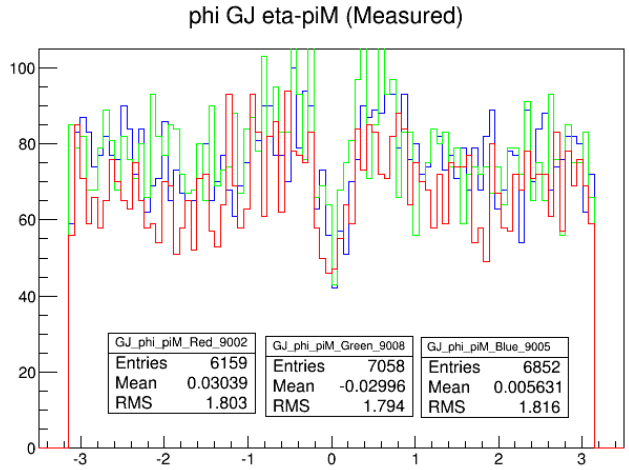
Cos(Theta) GJ eta-piM (Thrown)

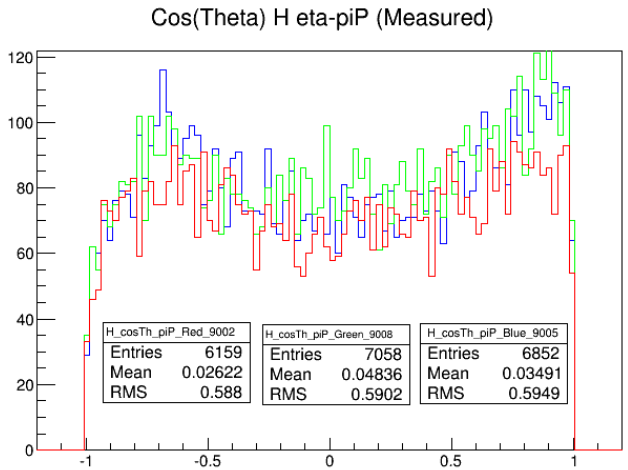


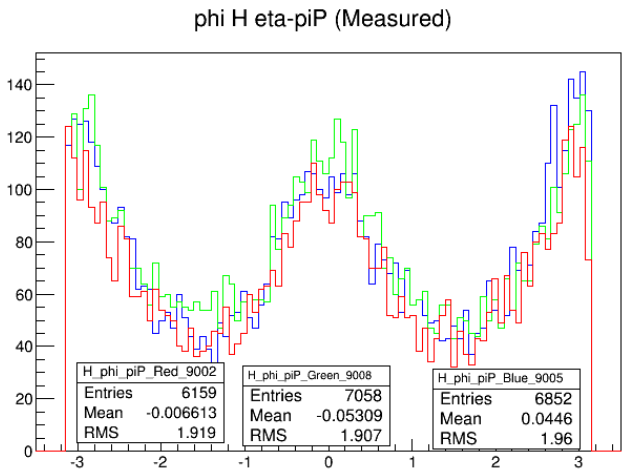
Angles for the three different Currents (Signal with EM 5.5E7)

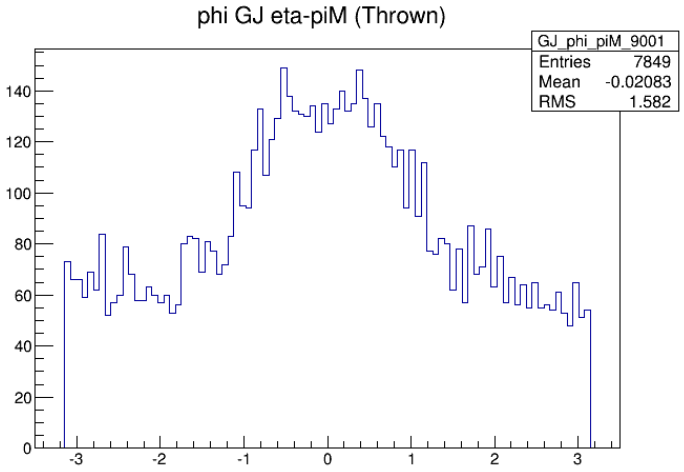
Green: 1200A ; Red: 1300A ; Blue: 1500A

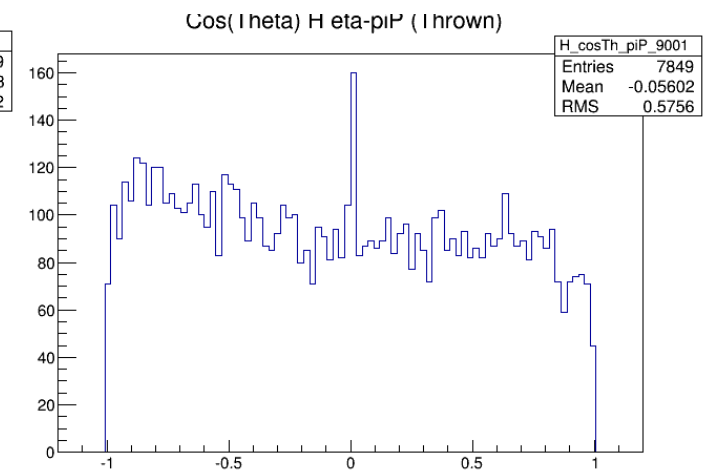
Exclusive

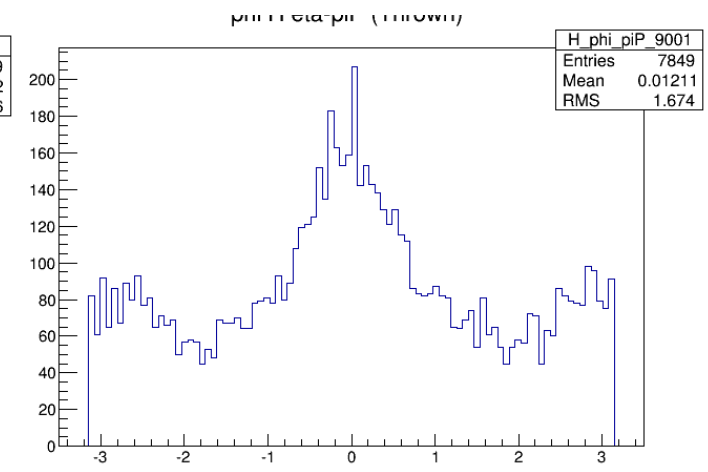












Top Ranking Variables for the three Currents with 1.1E7 EM rate

Exclusive

1350A

Rank	Variable	Variable Importance
1	FOM_KinFit	2.717e-01
2	Unused__Max_Proton_FOM	8.974e-02
3	Photon2__Timing_FOM	8.472e-02
4	Photon1__Timing_FOM	8.337e-02
5	PiPlus__Timing_FOM	7.204e-02
6	Unused__Max_KPlus_FOM	6.825e-02
7	Unused__Max_KMinus_FOM	6.211e-02
8	PiMinus__DCdEdx_FOM	6.181e-02
9	PiMinus__Timing_FOM	5.854e-02
10	PiPlus__DCdEdx_FOM	5.699e-02
11	PiMinus__NDF_Tracking	5.143e-02
12	PiPlus__NDF_Tracking	3.926e-02

1500A

Rank	Variable	Variable Importance
1	FOM_KinFit	3.264e-01
2	Unused__Max_Proton_FOM	1.011e-01
3	Photon1__Timing_FOM	8.263e-02
4	Unused__Max_KPlus_FOM	8.153e-02
5	Photon2__Timing_FOM	7.212e-02
6	PiPlus__Timing_FOM	6.813e-02
7	PiPlus__DCdEdx_FOM	6.747e-02
8	PiMinus__Timing_FOM	5.483e-02
9	PiPlus__NDF_Tracking	4.324e-02
10	PiMinus__DCdEdx_FOM	3.776e-02
11	Unused__Max_KMinus_FOM	3.368e-02
12	PiMinus__NDF_Tracking	3.106e-02

1200A

Rank	Variable	Variable Importance
1	FOM_KinFit	3.047e-01
2	Unused__Max_Proton_FOM	9.342e-02
3	Photon1__Timing_FOM	8.476e-02
4	PiPlus__DCdEdx_FOM	7.755e-02
5	PiPlus__Timing_FOM	6.902e-02
6	PiMinus__DCdEdx_FOM	6.480e-02
7	Photon2__Timing_FOM	6.190e-02
8	Unused__Max_KMinus_FOM	5.385e-02
9	PiPlus__NDF_Tracking	5.341e-02
10	PiMinus__NDF_Tracking	4.940e-02
11	Unused__Max_KPlus_FOM	4.784e-02
12	PiMinus__Timing_FOM	3.939e-02

Top Ranking Variables for the three Currents with 5.5E7 EM rate

Exclusive

1350A

Rank	Variable	Variable Importance
1	FOM_KinFit	2.410e-01
2	Proton__NDF_Tracking	9.068e-02
3	Proton__DCdEdx_FOM	6.570e-02
4	PiPlus__Timing_FOM	6.014e-02
5	Photon1__Timing_FOM	5.859e-02
6	Photon2__Timing_FOM	5.830e-02
7	PiMinus__NDF_Tracking	5.811e-02
8	Unused__Max_Proton_FOM	5.662e-02
9	Proton__Timing_FOM	5.536e-02
10	PiPlus__DCdEdx_FOM	5.381e-02
11	Unused__Max_KPlus_FOM	4.792e-02
12	PiMinus__DCdEdx_FOM	4.669e-02
13	PiMinus__Timing_FOM	3.931e-02
14	Unused__Max_KMinus_FOM	3.857e-02
15	PiPlus__NDF_Tracking	2.923e-02

1500A

Rank	Variable	Variable Importance
1	FOM_KinFit	2.373e-01
2	Unused__Max_Proton_FOM	8.138e-02
3	Proton__DCdEdx_FOM	7.851e-02
4	Proton__NDF_Tracking	7.147e-02
5	Proton__Timing_FOM	7.145e-02
6	Photon2__Timing_FOM	5.687e-02
7	PiPlus__Timing_FOM	5.537e-02
8	Photon1__Timing_FOM	5.160e-02
9	Unused__Max_KPlus_FOM	5.030e-02
10	PiMinus__Timing_FOM	5.017e-02
11	PiMinus__NDF_Tracking	4.186e-02
12	PiPlus__NDF_Tracking	4.168e-02
13	PiPlus__DCdEdx_FOM	3.942e-02
14	Unused__Max_KMinus_FOM	3.770e-02
15	PiMinus__DCdEdx_FOM	3.492e-02

1200A

Rank	Variable	Variable Importance
1	FOM_KinFit	2.281e-01
2	Proton__DCdEdx_FOM	8.580e-02
3	Unused__Max_Proton_FOM	7.404e-02
4	Proton__NDF_Tracking	6.751e-02
5	PiMinus__NDF_Tracking	6.685e-02
6	Photon2__Timing_FOM	6.349e-02
7	Unused__Max_KMinus_FOM	6.128e-02
8	PiMinus__DCdEdx_FOM	5.708e-02
9	PiPlus__Timing_FOM	4.844e-02
10	Photon1__Timing_FOM	4.436e-02
11	PiPlus__NDF_Tracking	4.420e-02
12	PiMinus__Timing_FOM	4.303e-02
13	PiPlus__DCdEdx_FOM	4.262e-02
14	Proton__Timing_FOM	3.898e-02
15	Unused__Max_KPlus_FOM	3.423e-02

Purity- Efficiency for the three Currents

Exclusive

Run #	Field (A)	EM	Efficiency (error)	Purity			# Pythia Events	# Correct Thrown*	# Signal events	Background Combos	Accepted* (%)
				0.99	0.9	0.7					
9007	1200	1.1		0.723(07)	0.817(06)	0.911(04)	10M	83329	8013(90)	6.5M	24.4(0.3)
9008	1200	5.5		0.719(07)	0.854(06)	0.941(04)	10M	82767	8192(91)	6M	25.1(0.3)
9001	1350	1.1		0.747(07)	0.829(06)	0.916(04)	10M	82937	7849(89)	4.5M	24.0(0.3)
9002	1350	5.5		0.730(08)	0.856(06)	0.949(04)	8.5M	74383	7133(85)	3.8M	24.3(0.3)
9004	1500	1.1		0.719(07)	0.807(06)	0.901(05)	10M	83100	7503(87)	5M	22.9(0.3)
9005	1500	5.5		0.712(08)	0.846(06)	0.940(04)	10M	82767	7936(89)	4.8M	24.3(0.3)

(*) The number of correct thrown is for the total $\gamma p \rightarrow p \eta \pi^+ \pi^-$ reaction where the percent accepted is only for the $\eta \rightarrow \gamma\gamma$ mode (which is the one that the report refers to).

% of Thrown events passing BDT cut at a given purity

Exclusive

Run #	Field (A)	EM	% of Thrown events passing BDT cut at given purity		
			0.99	0.9	0.7
9007	1200	1.1	17.7	19.9	22.2
9008	1200	5.5	18.1	21.5	23.6
9001	1350	1.1	17.9	19.9	22.0
9002	1350	5.5	17.8	20.1	23.1
9004	1500	1.1	16.5	18.5	20.6
9005	1500	5.5	17.3	20.6	22.9

Purity- Efficiency for the three Currents

Inclusive reaction: Missing a proton

Run #	Field (A)	EM	Efficiency (error)	Purity			# Pythia Events	# Correct Thrown*	# Signal events	Background Combos	Accepted* (%)
				0.99	0.9	0.7					
9007	1200	1.1		0.789(05)	0.868(04)	0.931(03)	10M	83329	11800(109)	6.9M	35.9
9008	1200	5.5		0.778(05)	0.861(04)	0.924(03)	10M	82767	10592(103)	6.4M	32.5
9001	1350	1.1		0.827(05)	0.890(04)	0.937(03)	10M	82937	11483(107)	5.3M	35.1
9002	1350	5.5		0.814(05)	0.884(04)	0.935(03)	8.5M	74383	9309(97)	4.6M	31.8
9004	1500	1.1		0.800(05)	0.869(04)	0.924(03)	10M	83100	11287(106)	6.1M	34.5
9005	1500	5.5		0.777(05)	0.853(05)	0.919(03)	10M	82767	10579(103)	5.9M	32.4

(*) The number of correct thrown is for the total $\gamma p \rightarrow p \eta \pi^+ \pi^-$ reaction where the percent accepted is only for the $\eta \rightarrow \gamma \gamma$ mode (which is the one that the report refers to).

% of Thrown events passing BDT cut at a given purity

Inclusive reaction: Missing a proton

Run #	Field (A)	EM	% of Thrown events passing BDT cut at given purity		
			0.99	0.9	0.7
9007	1200	1.1	28.4	31.2	33.5
9008	1200	5.5	25.3	28.0	30.0
9001	1350	1.1	29.1	31.3	32.9
9002	1350	5.5	25.9	28.1	29.7
9004	1500	1.1	27.6	30.0	31.9
9005	1500	5.5	25.2	27.7	29.8