Review of Cuts we have studied so far:

- Delta T for each particle species and sub detector
- Kinematic Fitter Confidence Level
- Beam Energy Cut
- Beam Bunch Cut (RF Time)
- Vertex Cuts
- P vs Theta Cut for Photons (Reduces Secondaries)
- Number of photons reconstructed in the event

- All of these have been discussed in detail in my Analysis Note

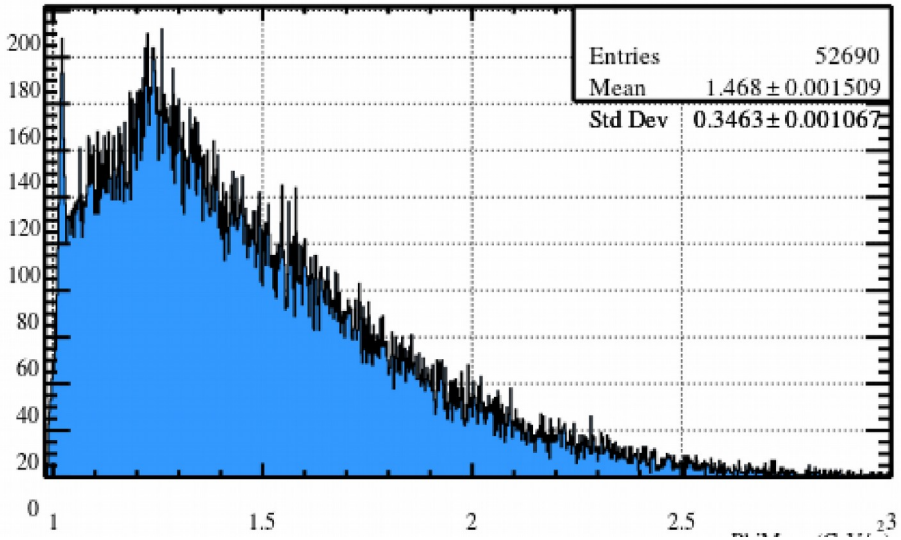
Review of Cuts we will discuss:

- How does the Barnes Cut perform in my analysis?
  - Background Confidence Level < 0.1
  - Signal Confidence Level > 10^-4
  - Signal Confidence Level > 10^-2
  - Confidence Level Ratio 1
  - Confidence Level Ratio 10

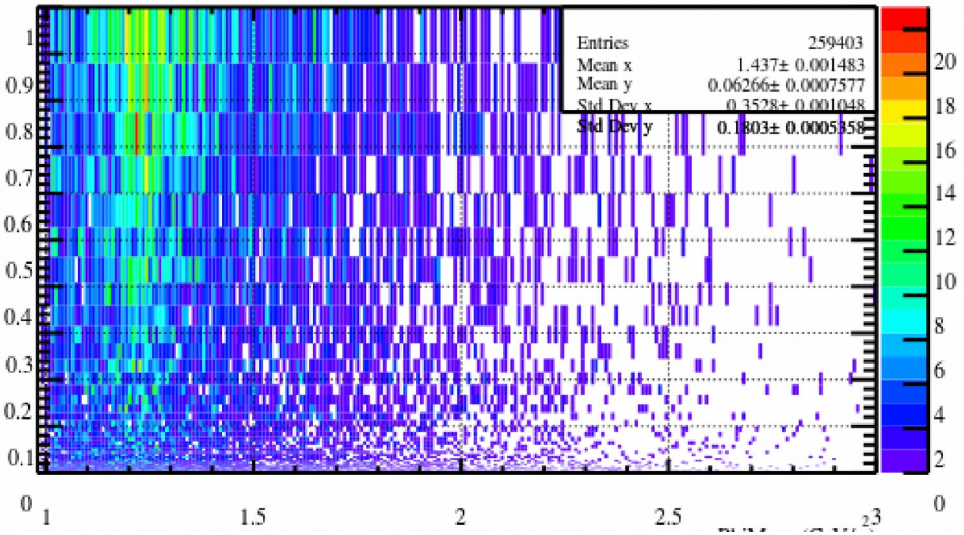
- Special Kaon cut for TOF to reduce rho background
  - Time of Flight Function shift 2 sigma
  - Time of Flight Function shift 3 sigma
  - Only Tight K+ Cut (strangeness conservation)
  - Only Tight K- Cut (strangeness conservation)
  - K+/K- Momentum < 3.0

Phi Meson; “No Cut”

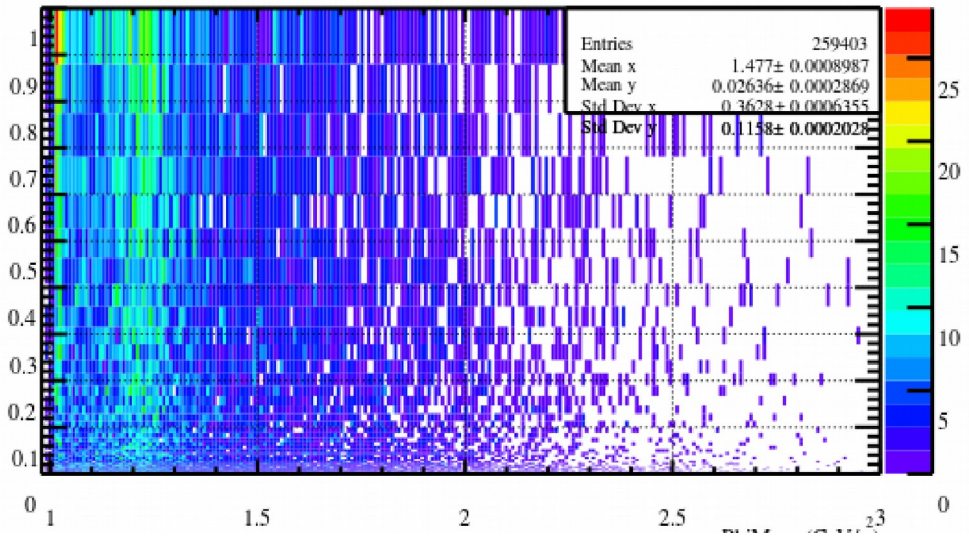
K+K- Mass



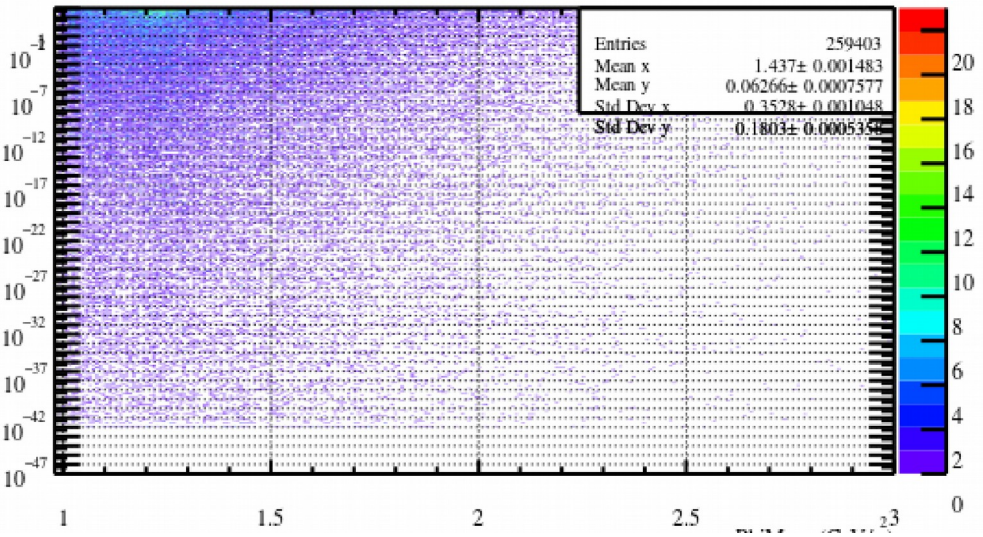
K+K- Mass Vs BG CL



K+K- Mass Vs Signal CL

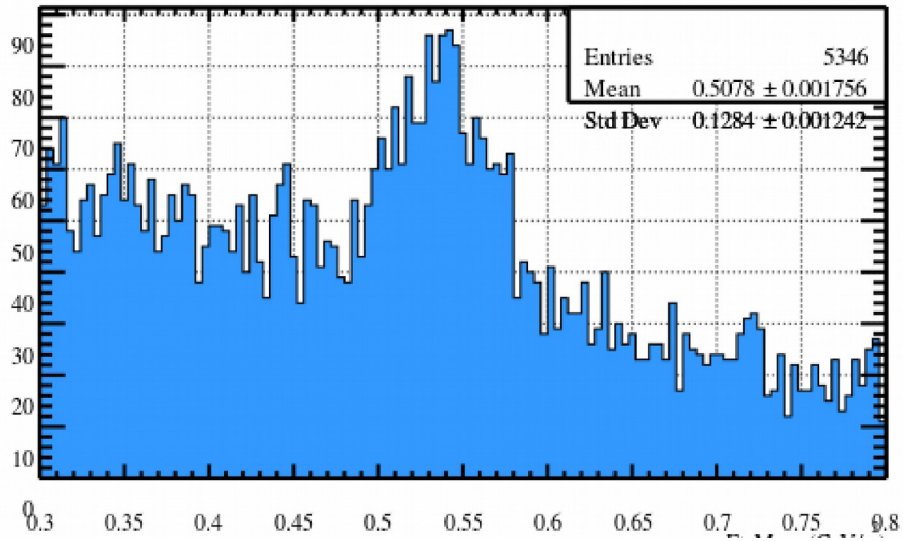


K+K- Mass Vs BG CL logY

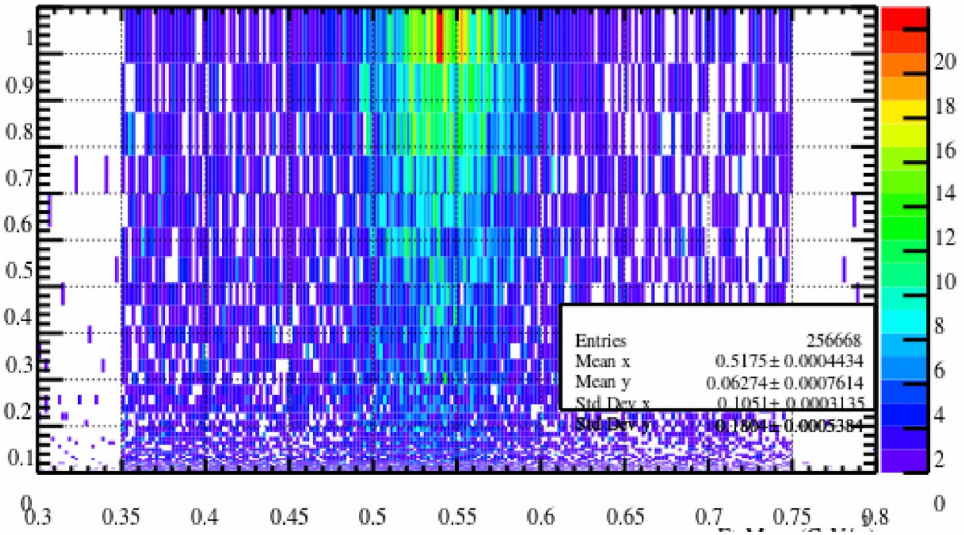


Eta Meson; “No Cut”

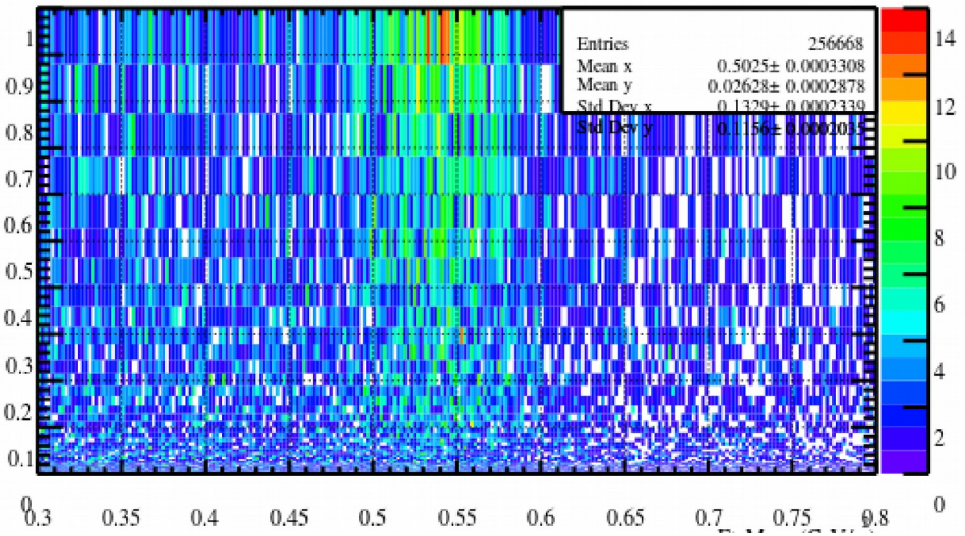
g1g2 Mass



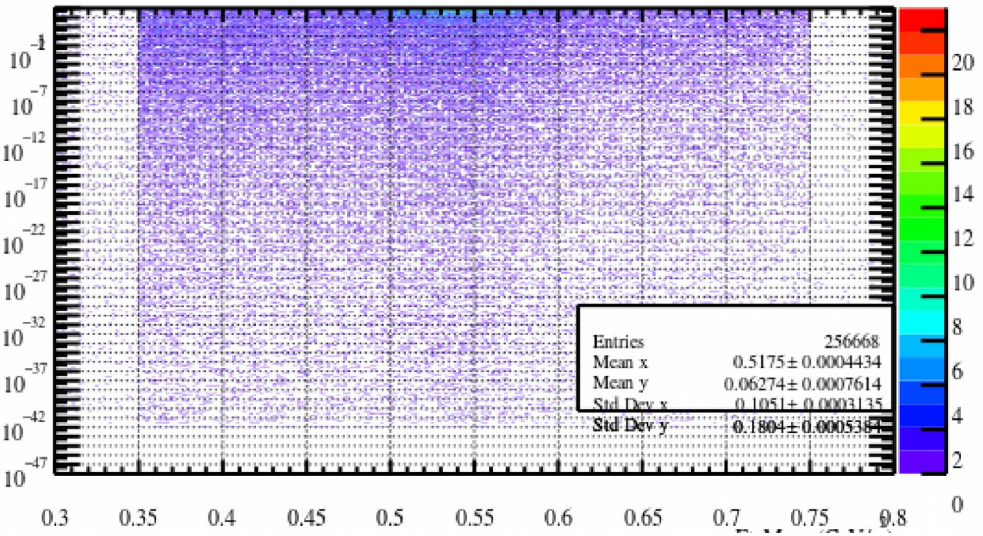
g1g2 Mass Vs BG CL



g1g2 Mass Vs Signal CL

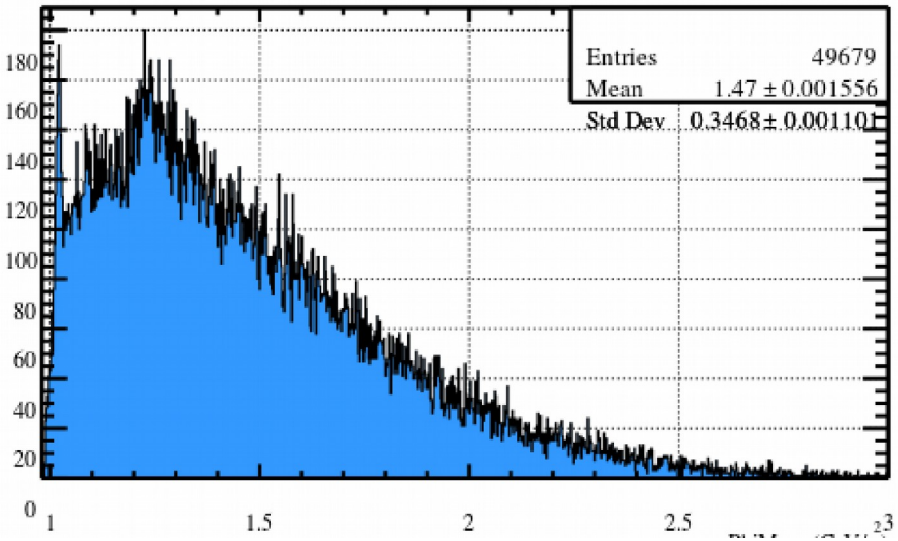


g1g2 Mass Vs BG CL logY

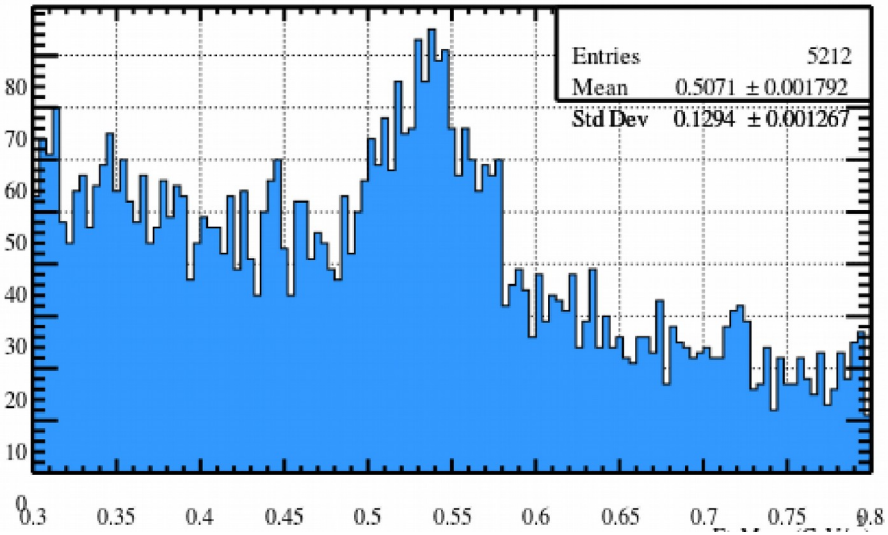


Phi & Eta Meson; Background Confidence Level < 0.1

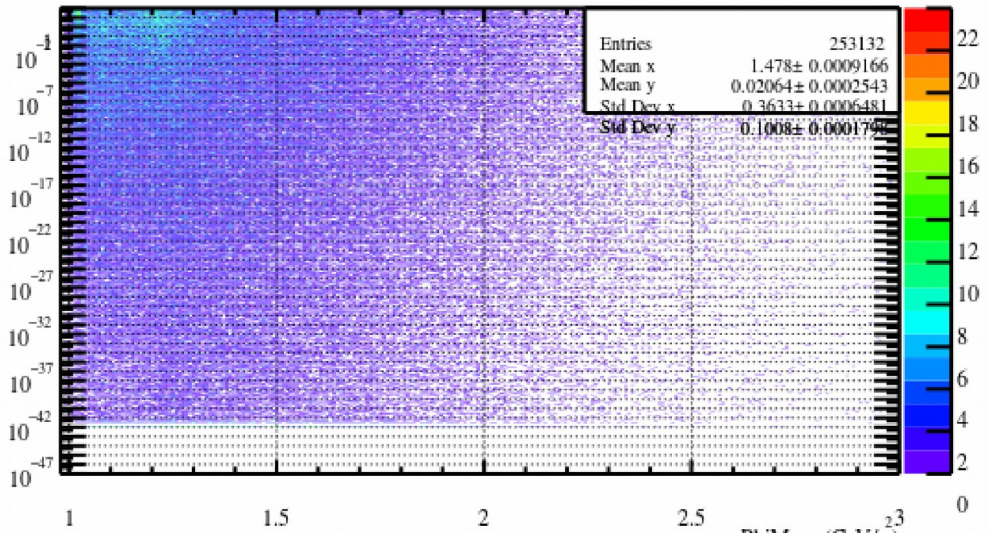
K+K- Mass



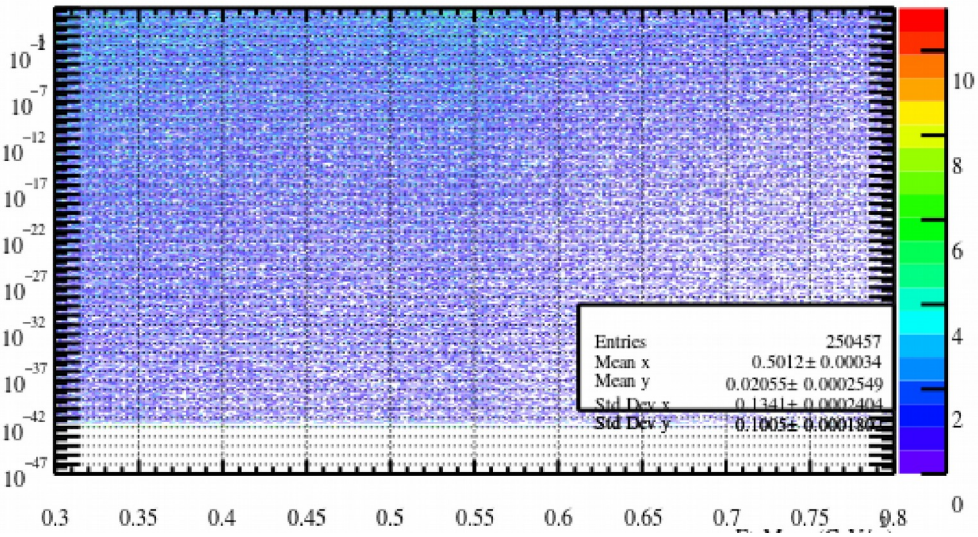
g1g2 Mass



K+K- Mass Vs Signal CL

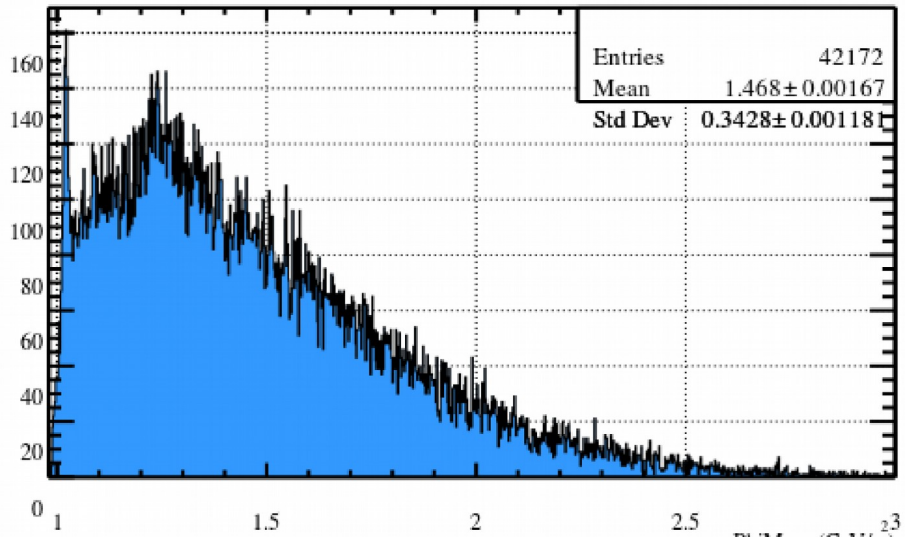


g1g2 Mass Vs Signal CL

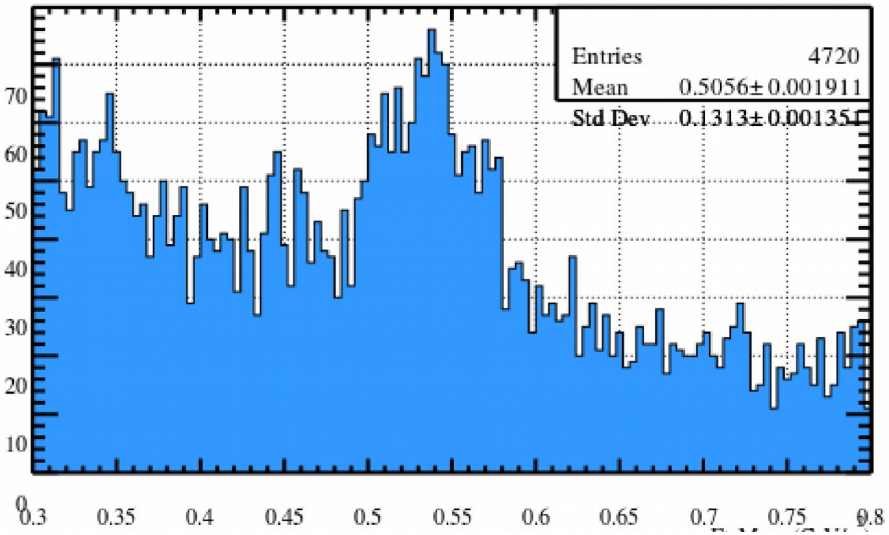


Phi & Eta Meson; Confidence Ratio = 1

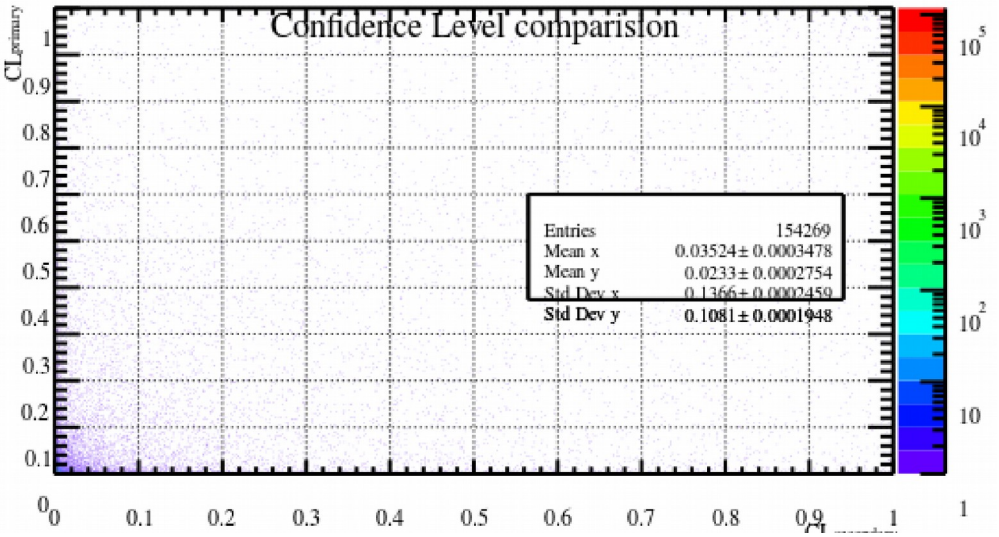
K+K- Mass



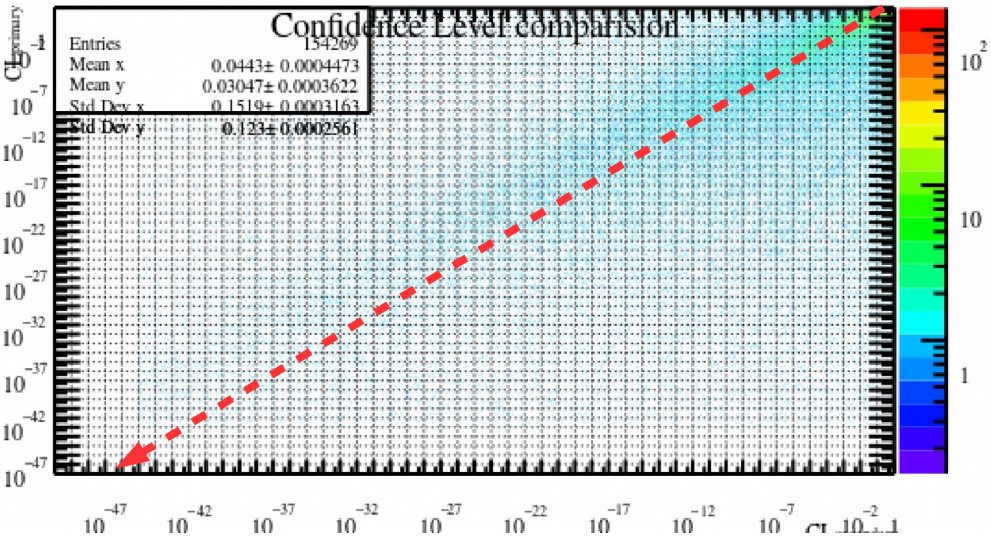
g1g2 Mass



Signal CL Vs BG CL

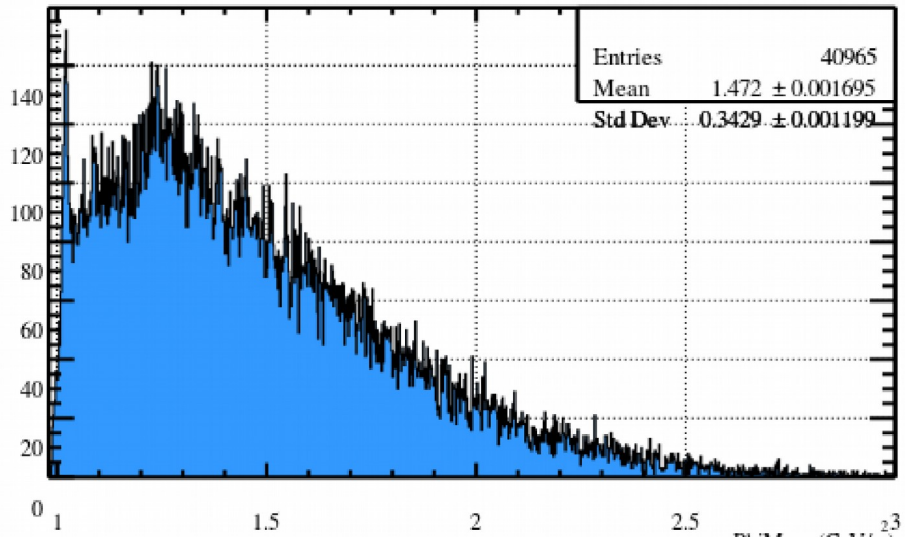


Signal CL Vs BG CL log XY

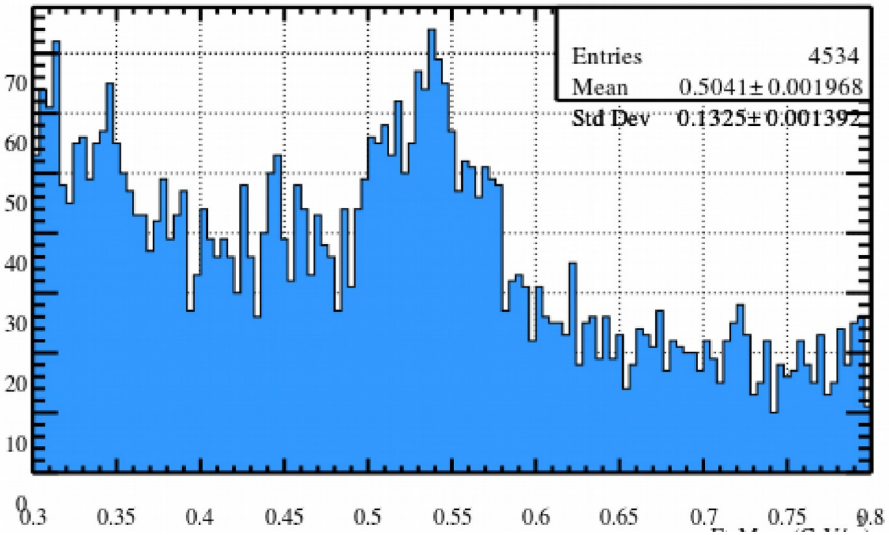


Phi & Eta Meson; Confidence Ratio = 10

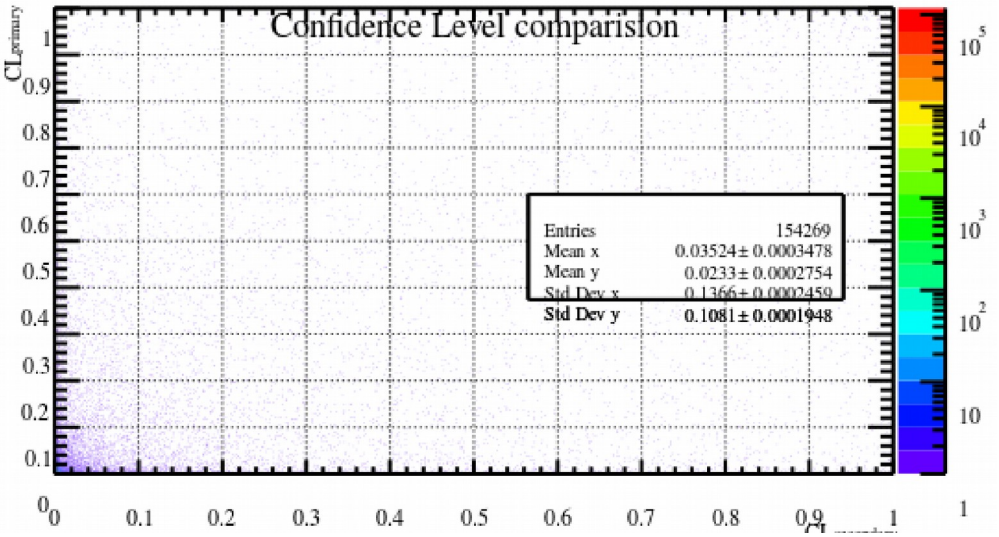
K+K- Mass



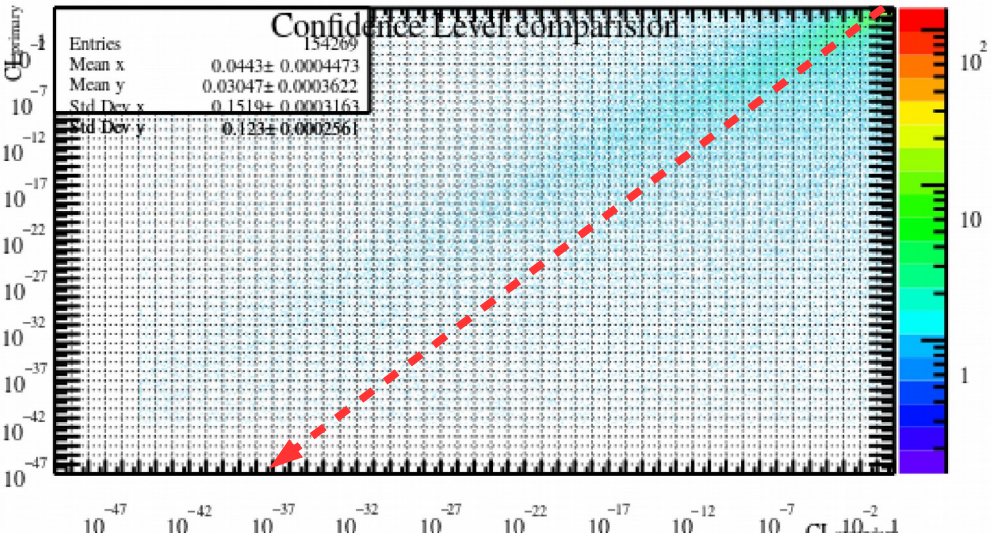
g1g2 Mass



Signal CL Vs BG CL

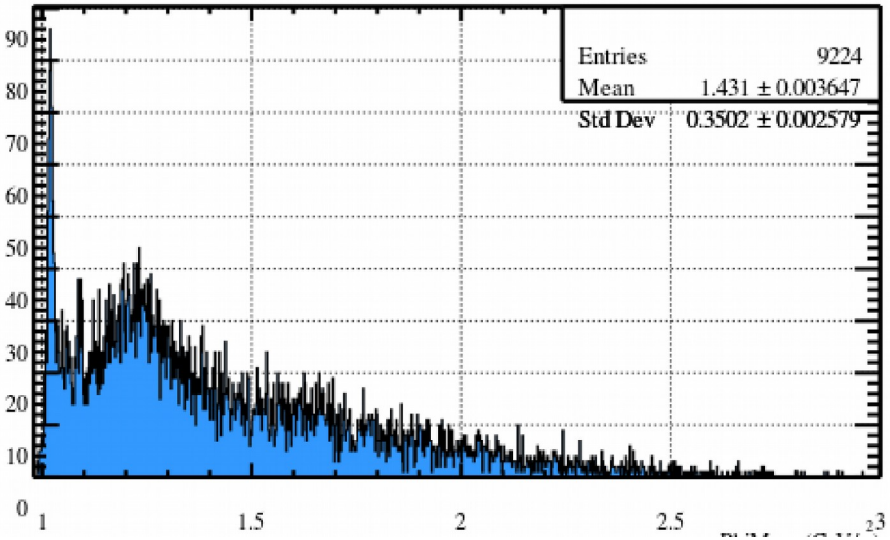


Signal CL Vs BG CL log XY

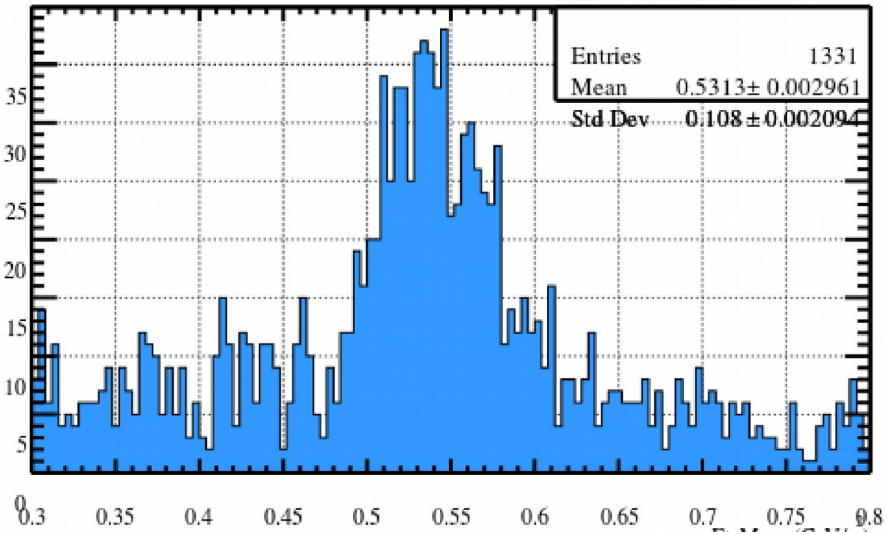


Phi & Eta Meson; Signal CL > 10^-4

K+K- Mass

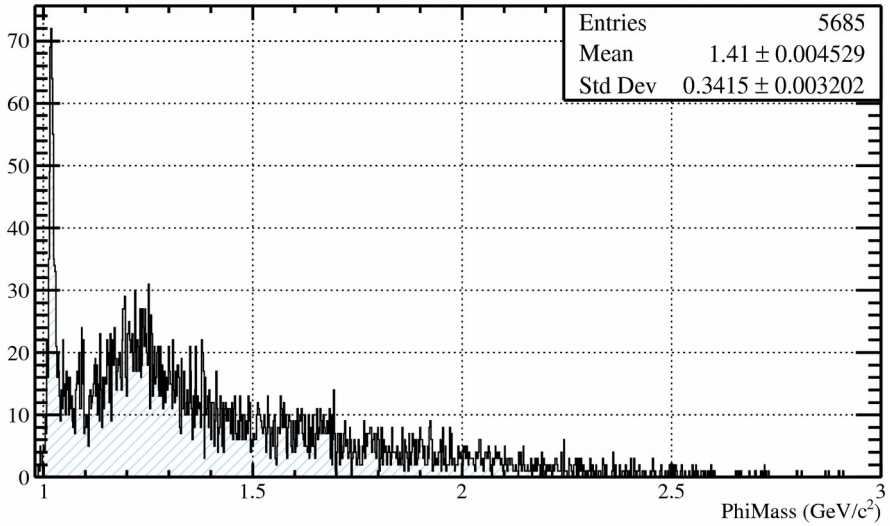


g1g2 Mass

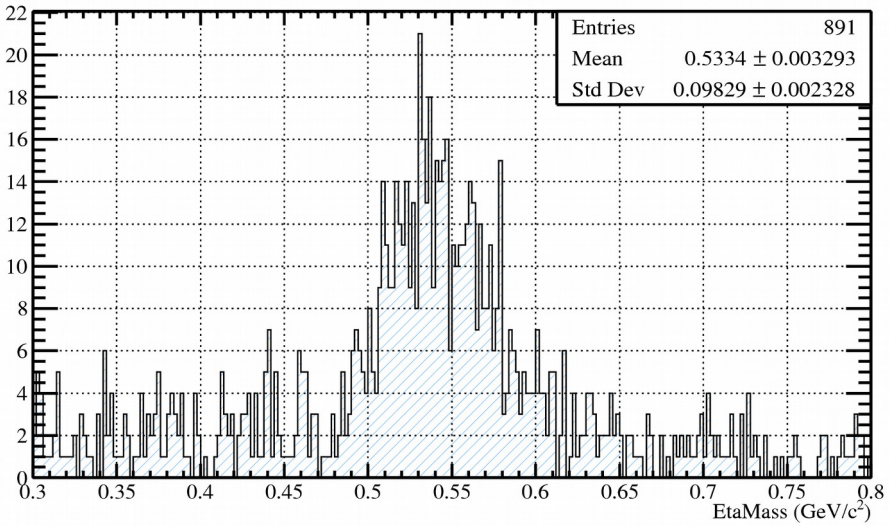


Phi & Eta Meson; Signal CL > 10^-2

K+K- Mass

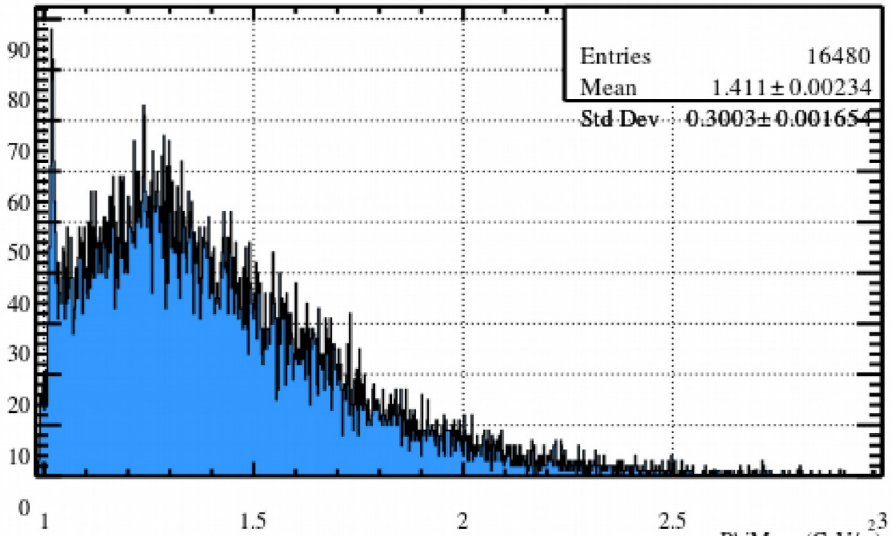


g1g2 Mass

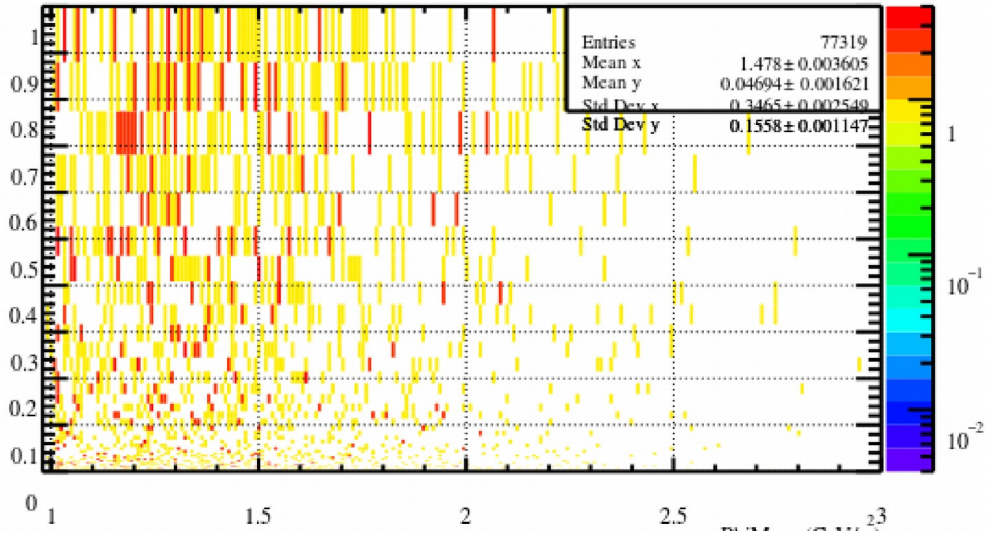


Phi; TOF 2 Sigma Shift

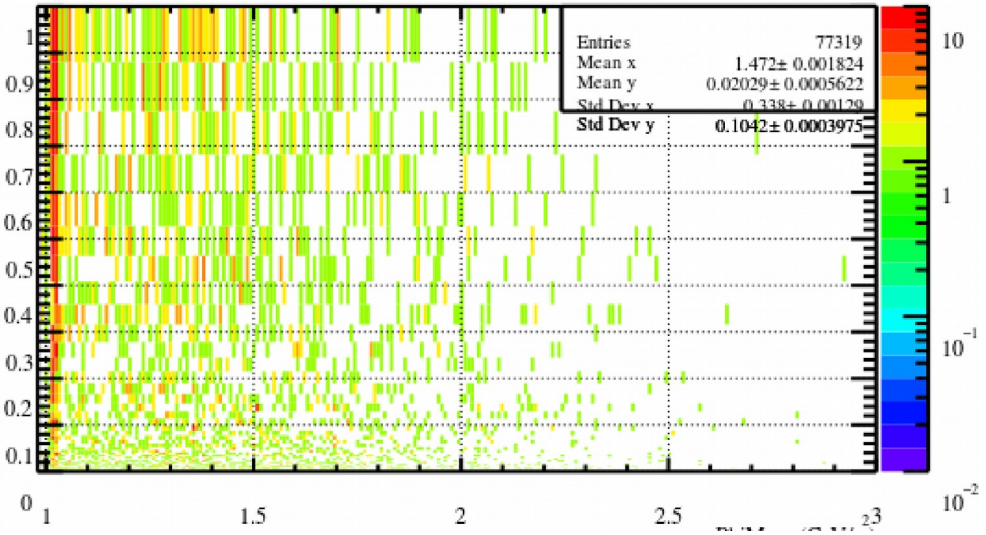
K+K- Mass



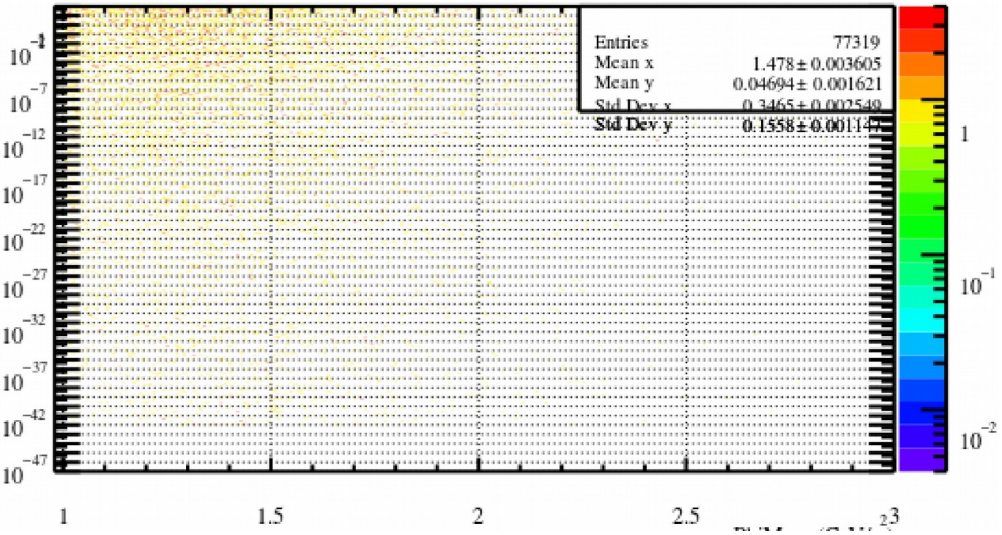
K+K- Mass Vs BG CL



K+K- Mass Vs Signal CL

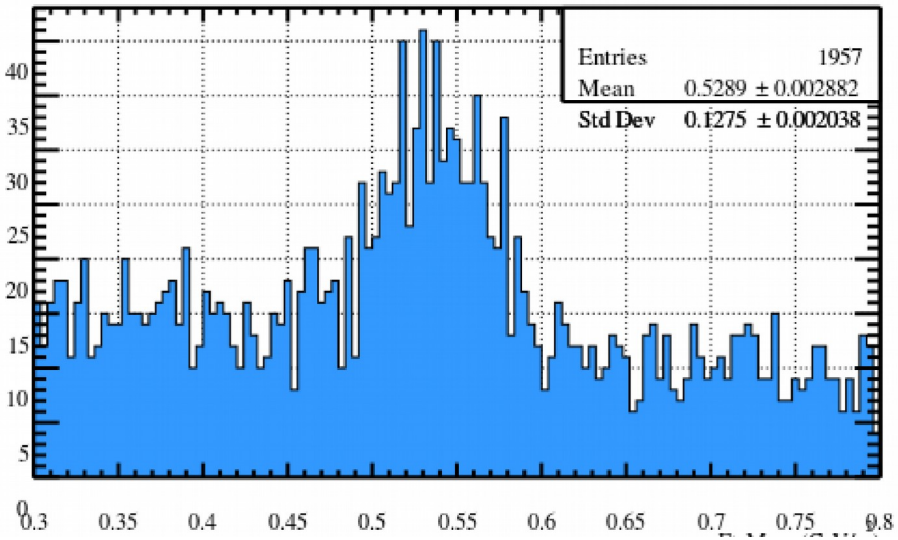


K+K- Mass Vs BG CL log Y

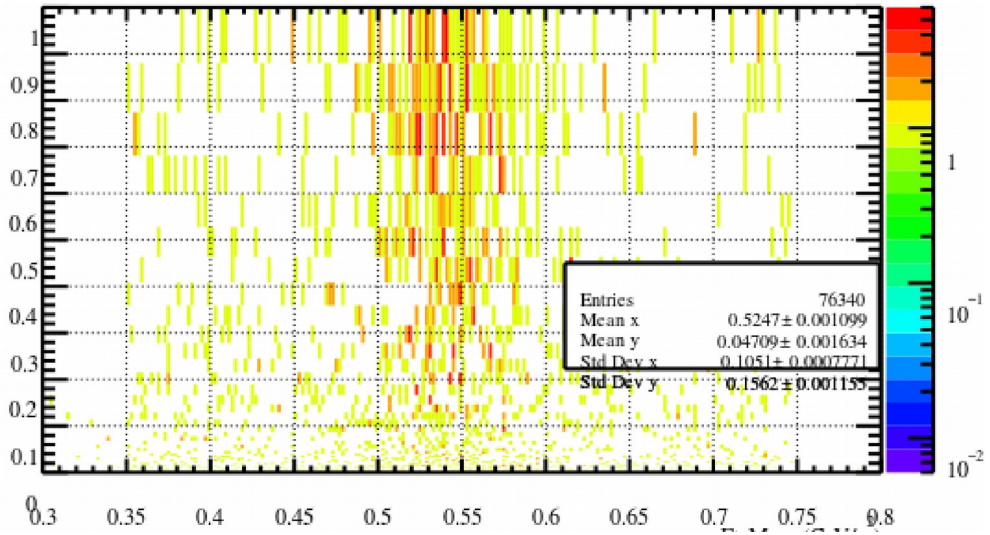


Eta; TOF 2 Sigma Shift

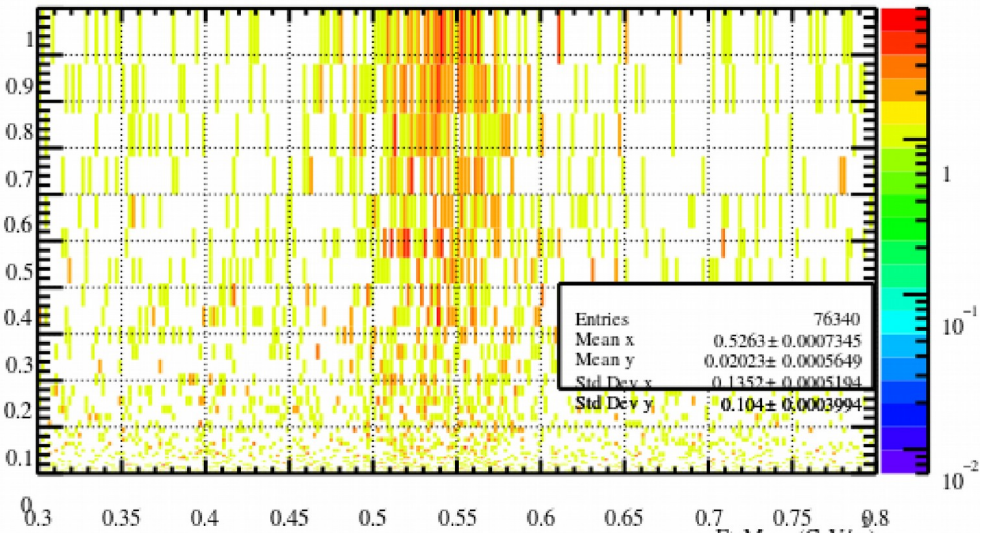
g1g2 Mass



g1g2 Mass Vs BG CL

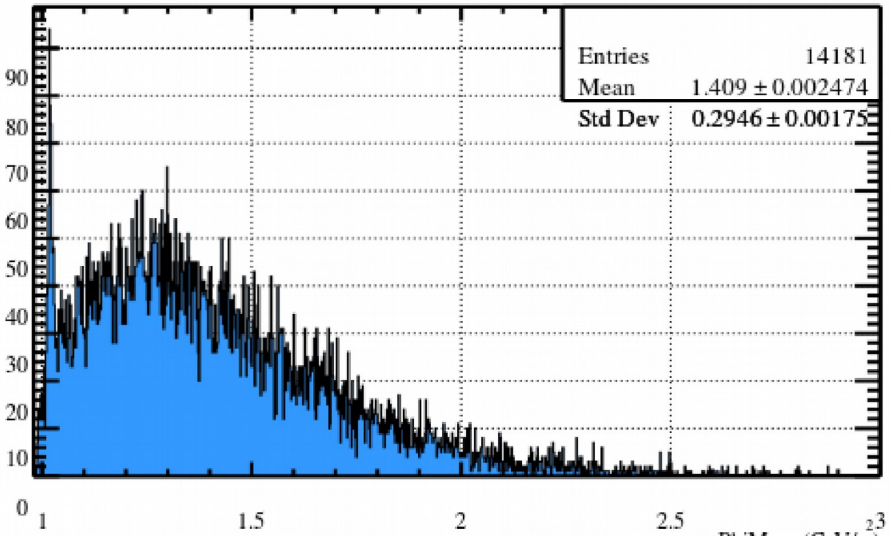


g1g2 Mass Vs Signal CL

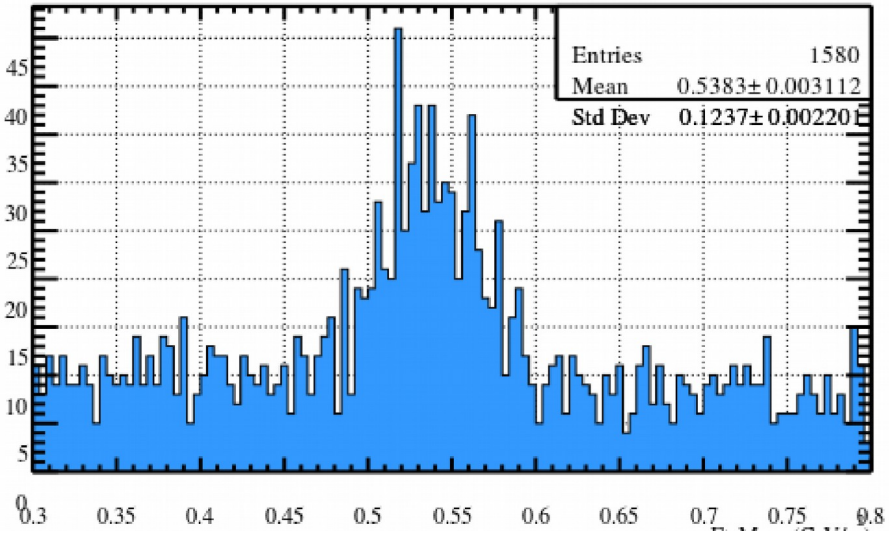


Phi & Eta; TOF 3 Sigma Shift

K+K- Mass

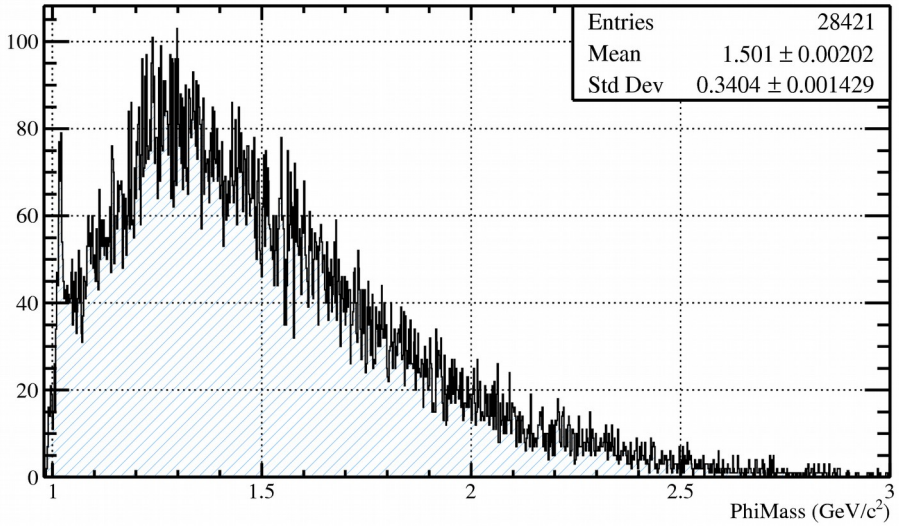


g1g2 Mass

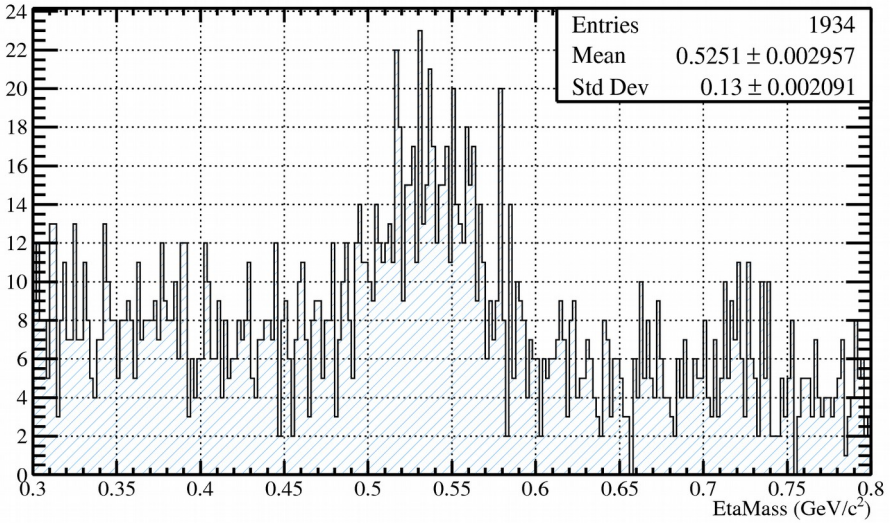


Phi & Eta; Only Tight K+ Cut

K+K- Mass

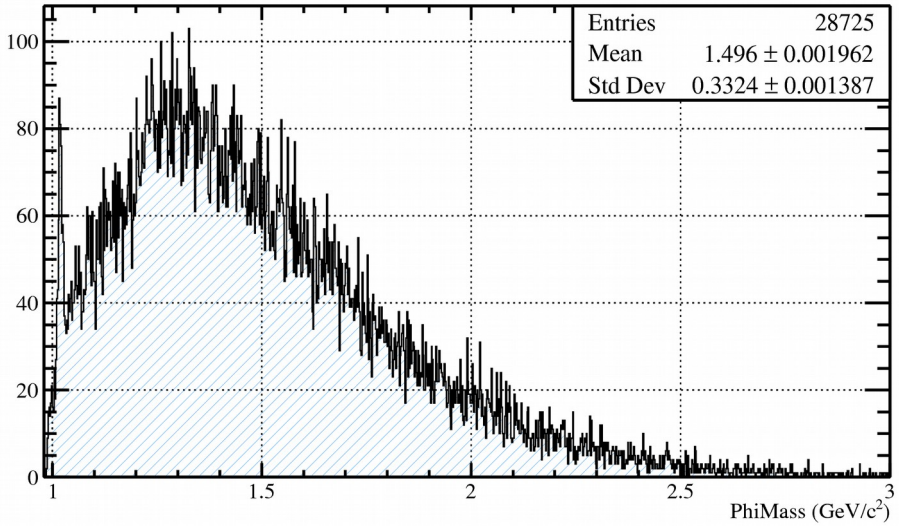


g1g2 Mass

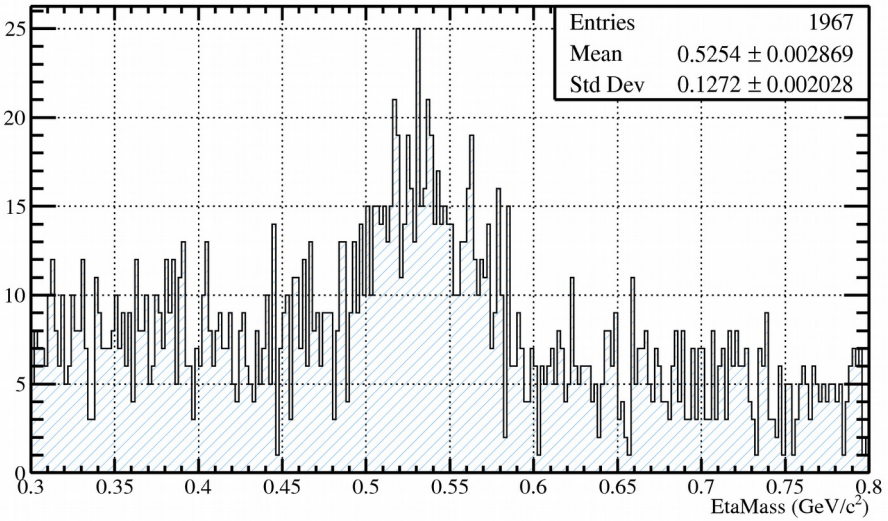


Phi & Eta; Only Tight K- Cut

K+K- Mass

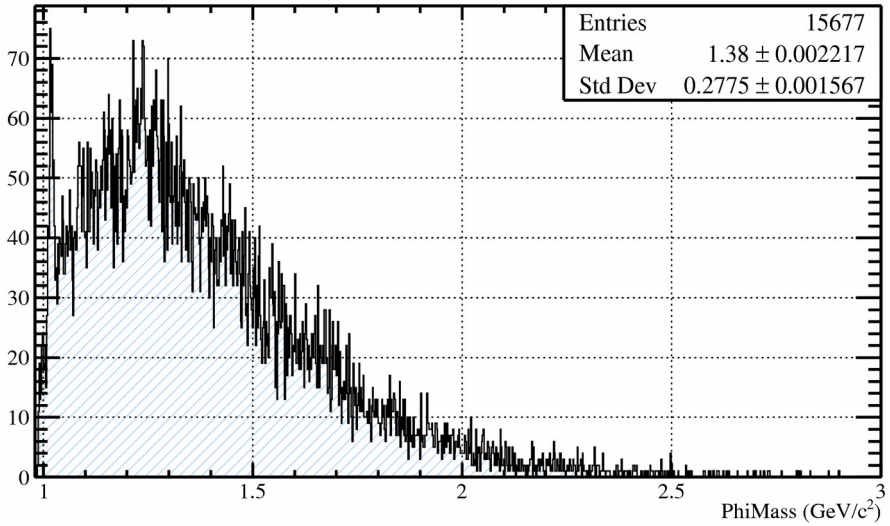


g1g2 Mass

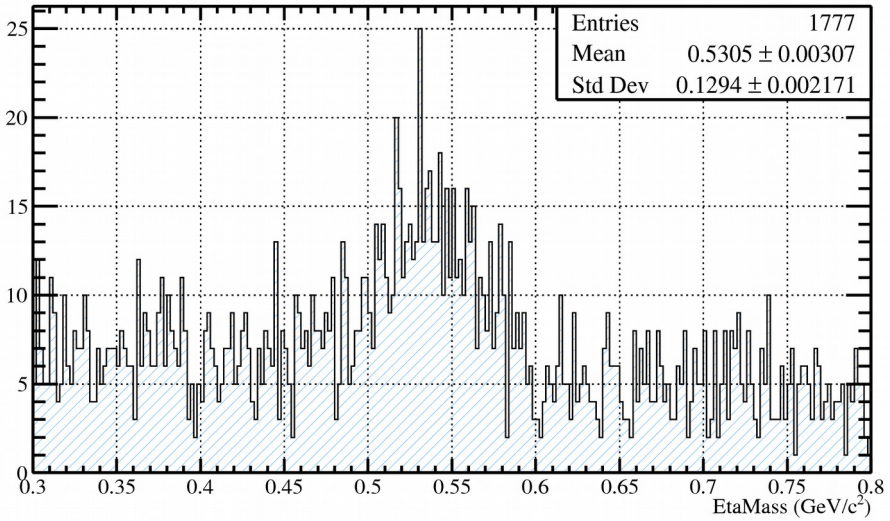


Phi & Eta; K+/K- Momentum < 3.0

K+K- Mass



g1g2 Mass



Phi Fit Results Table

PHI RESULTS:

Cut	Signal	Background	S/BG	TotalBG	TotalBG_Percent	Signal_Percent	Background_Percent	S/BG_Percent
test_BGCL1	574.753	777.582	0.739	14908.669	-6.6	-3.0	-6.1	3.3
test_CL4	411.708	168.472	2.444	2989.044	-81.3	-30.5	-79.7	241.5
test_CLFactor10	513.225	631.998	0.812	11928.227	-25.3	-13.4	-23.7	13.5
test_CLFactor1	558.975	660.694	0.846	12485.907	-21.8	-5.7	-20.2	18.2
test_NOCUT	592.539	828.054	0.716	15957.925	0.0	0.0	0.0	0.0
test_CL2	350.072	101.761	3.440	1807.543	-88.7	-40.9	-87.7	380.7
test_KaonP	212.659	288.713	0.737	5651.831	-64.6	-64.1	-65.1	2.9
test_KMinus	279.879	294.088	0.952	6777.526	-57.5	-52.8	-64.5	33.0
test_KPlus	259.721	290.534	0.894	6762.685	-57.6	-56.2	-64.9	24.9
test_TOF2sig	307.038	279.200	1.100	5304.778	-66.8	-48.2	-66.3	53.7
test_TOF3sig	306.600	228.934	1.339	4428.086	-72.3	-48.3	-72.4	87.2

Eta Fit Results Table

ETA RESULTS:

Cut	Signal	Background	S/BG	TotalBG	TotalBG_Percent	Signal_Percent	Background_Percent	S/BG_Percent
test_BGCL1	573.507	693.519	0.827	4232.565	-1.3	-8.9	-1.3	-7.7
test_CL4	423.579	91.586	4.625	568.145	-86.8	-32.7	-87.0	416.5
test_CLFactor10	461.153	601.110	0.767	3667.086	-14.5	-26.7	-14.5	-14.3
test_CLFactor1	503.557	624.626	0.806	3812.233	-11.1	-20.0	-11.1	-10.0
test_NOCUT	629.479	702.951	0.895	4290.397	0.0	0.0	0.0	0.0
test_CL2	338.648	60.535	5.594	377.231	-91.2	-46.2	-91.4	524.7
test_KaonP	274.026	195.676	1.400	1206.783	-71.9	-56.5	-72.2	56.4
test_KMinus	328.899	204.394	1.609	1256.134	-70.7	-47.8	-70.9	79.7
test_KPlus	287.486	217.910	1.319	1342.065	-68.7	-54.3	-69.0	47.3
test_TOF2sig	331.504	204.422	1.622	1260.133	-70.6	-47.3	-70.9	81.1
test_TOF3sig	324.561	146.935	2.209	911.745	-78.7	-48.4	-79.1	146.7

Phi Fit Results Table; Best in Column

PHI RESULTS:

Cut	Signal	Background	S/BG	TotalBG	TotalBG_Percent	Signal_Percent	Background_Percent	S/BG_Percent
test_BGCL1	574.753	777.582	0.739	14908.669	-6.6	-3.0	-6.1	3.3
test_CL4	411.708	168.472	2.444	2989.044	-81.3	-30.5	-79.7	241.5
test_CLFactor10	513.225	631.998	0.812	11928.227	-25.3	-13.4	-23.7	13.5
test_CLFactor1	558.975	660.694	0.846	12485.907	-21.8	-5.7	-20.2	18.2
test_NOCUT	592.539	828.054	0.716	15957.925	0.0	0.0	0.0	0.0
test_CL2	350.072	101.761	3.440	1807.543	-88.7	-40.9	-87.7	380.7
test_KaonP	212.659	288.713	0.737	5651.831	-64.6	-64.1	-65.1	2.9
test_KMinus	279.879	294.088	0.952	6777.526	-57.5	-52.8	-64.5	33.0
test_KPlus	259.721	290.534	0.894	6762.685	-57.6	-56.2	-64.9	24.9
test_TOF2sig	307.038	279.200	1.100	5304.778	-66.8	-48.2	-66.3	53.7
test_TOF3sig	306.600	228.934	1.339	4428.086	-72.3	-48.3	-72.4	87.2

Eta Fit Results Table; Best in Column

ETA RESULTS:

Cut	Signal	Background	S/BG	TotalBG	TotalBG_Percent	Signal_Percent	Background_Percent	S/BG_Percent
test_BGCL1	573.507	693.519	0.827	4232.565	-1.3	-8.9	-1.3	-7.7
test_CL4	423.579	91.586	4.625	568.145	-86.8	-32.7	-87.0	416.5
test_CLFactor10	461.153	601.110	0.767	3667.086	-14.5	-26.7	-14.5	-14.3
test_CLFactor1	503.557	624.626	0.806	3812.233	-11.1	-20.0	-11.1	-10.0
test_NOCUT	629.479	702.951	0.895	4290.397	0.0	0.0	0.0	0.0
test_CL2	338.648	60.535	5.594	377.231	-91.2	-46.2	-91.4	524.7
test_KaonP	274.026	195.676	1.400	1206.783	-71.9	-56.5	-72.2	56.4
test_KMinus	328.899	204.394	1.609	1256.134	-70.7	-47.8	-70.9	79.7
test_KPlus	287.486	217.910	1.319	1342.065	-68.7	-54.3	-69.0	47.3
test_TOF2sig	331.504	204.422	1.622	1260.133	-70.6	-47.3	-70.9	81.1
test_TOF3sig	324.561	146.935	2.209	911.745	-78.7	-48.4	-79.1	146.7

Initial Conclusion:

- Cutting on the Background Confidence Level preserves the most signal events but its kind of pointless since it only cuts out 1% of background events
- Signal Confidence Level Cut does the best job reducing background and increasing signal to background ratio.
- However, it still cuts a lot of signal events out.
- It still leaves a rho bump in K+K-
- Let’s eliminate this cut for now and see how the other cuts perform against each other; assuming we will use the Confidence Level cut in conjunction with the other ‘best’ cut.

Phi Fit Results Table; Best in Column

PHI RESULTS:

Cut	Signal	Background	S/BG	TotalBG	TotalBG Percent	Signal Percent	Background Percent	S/BG Percent
test_CLFactor10	513.225	631.998	0.812	11928.227	-25.3	-13.4	-23.7	13.5
test_CLFactor1	558.975	660.694	0.846	12485.907	-21.8	-5.7	-20.2	18.2
test_NOCUT	592.539	828.054	0.716	15957.925	0.0	0.0	0.0	0.0
test_KaonP	212.659	288.713	0.737	5651.831	-64.6	-64.1	-65.1	2.9
test_KMinus	279.879	294.088	0.952	6777.526	-57.5	-52.8	-64.5	33.0
test_KPlus	259.721	290.534	0.894	6762.685	-57.6	-56.2	-64.9	24.9
test_TOF2sig	307.038	279.200	1.100	5304.778	-66.8	-48.2	-66.3	53.7
test_TOF3sig	306.600	228.934	1.339	4428.086	-72.3	-48.3	-72.4	87.2

Eta Fit Results Table; Best in Column

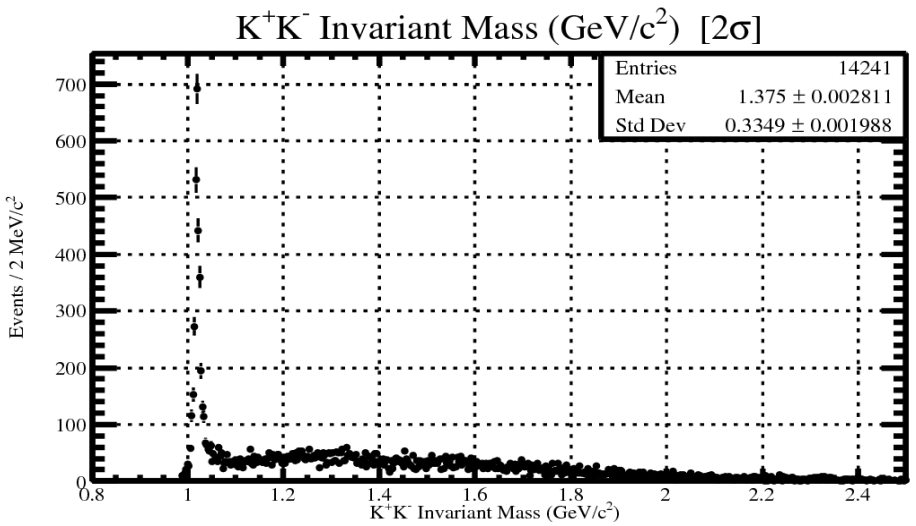
ETA RESULTS:

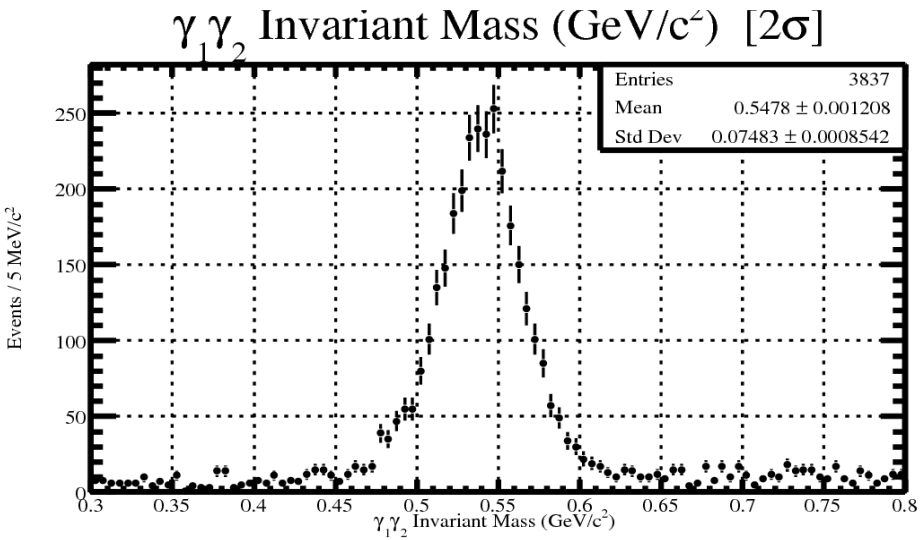
Cut	Signal	Background	S/BG	TotalBG	TotalBG_Percent	Signal_Percent	Background_Percent	S/BG_Percent
test_CLFactor10	461.153	601.110	0.767	3667.086	-14.5	-26.7	-14.5	-14.3
test_CLFactor1	503.557	624.626	0.806	3812.233	-11.1	-20.0	-11.1	-10.0
test_NOCUT	629.479	702.951	0.895	4290.397	0.0	0.0	0.0	0.0
test_KaonP	274.026	195.676	1.400	1206.783	-71.9	-56.5	-72.2	56.4
test_KMinus	328.899	204.394	1.609	1256.134	-70.7	-47.8	-70.9	79.7
test_KPlus	287.486	217.910	1.319	1342.065	-68.7	-54.3	-69.0	47.3
test_TOF2sig	331.504	204.422	1.622	1260.133	-70.6	-47.3	-70.9	81.1
test_TOF3sig	324.561	146.935	2.209	911.745	-78.7	-48.4	-79.1	146.7

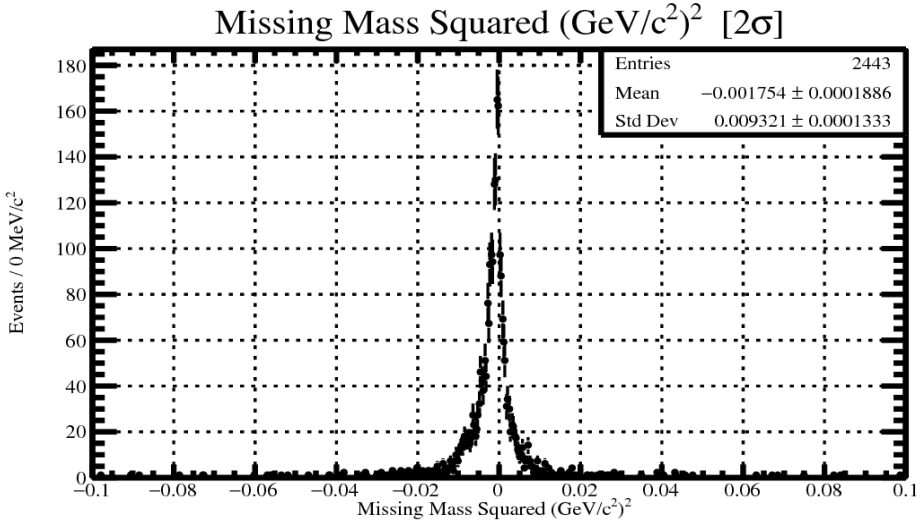
Conclusion:

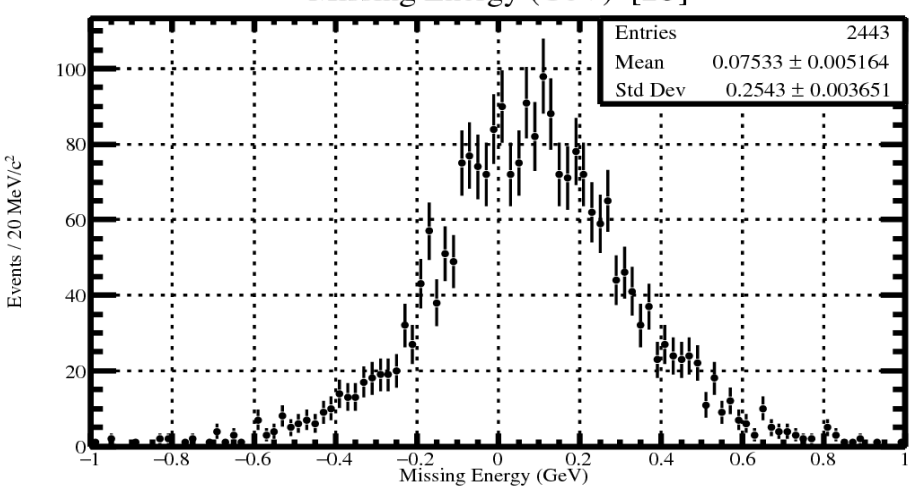
- Both Confidence Level Factor cuts preserve the most events, however:
  - They only cut out 21% of phi background events on average
  - They make the signal to background ratio get worse for the eta
  - They have roughly a factor of 2 or more of Total background in comparison to the other cuts
- Once you remove the Confidence Level Factor cuts, the best cut is the 3 sigma TOF cut. It removes the most background and produces the best signal to background ratio in comparison to the other cuts.
- Other cuts may yield slightly more signal events but the effect is minimal.
- THE BEST CUTS: TOF 3 sigma + Signal Confidence Level

Overall Results

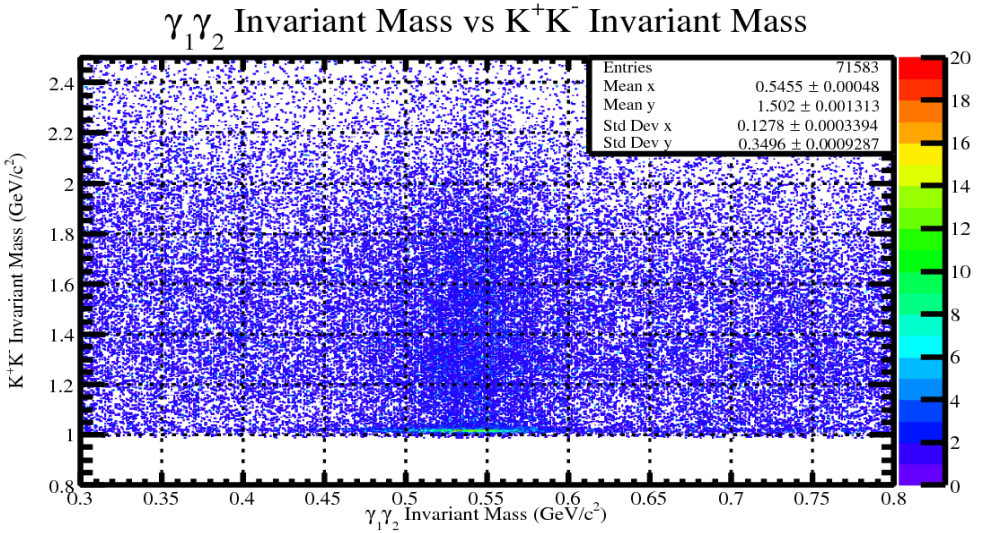


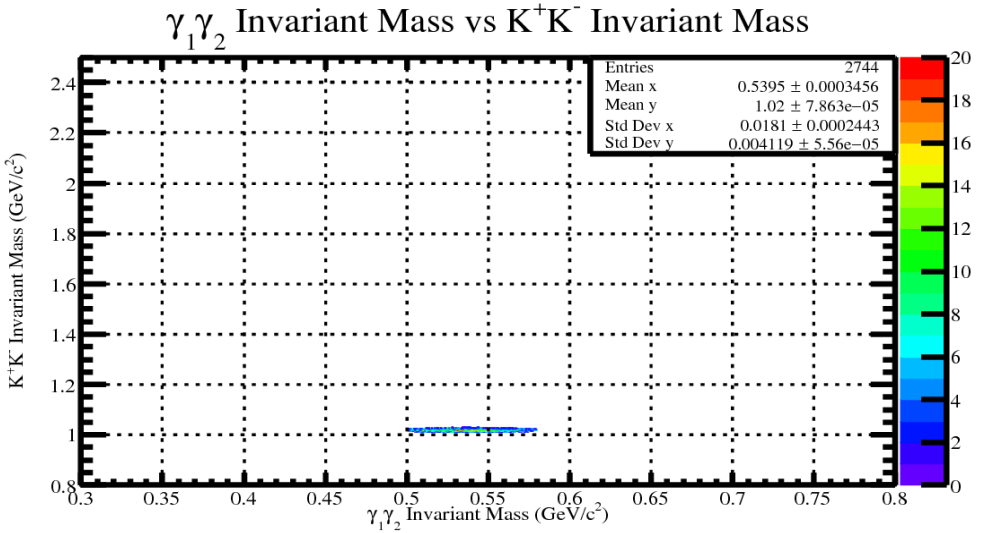


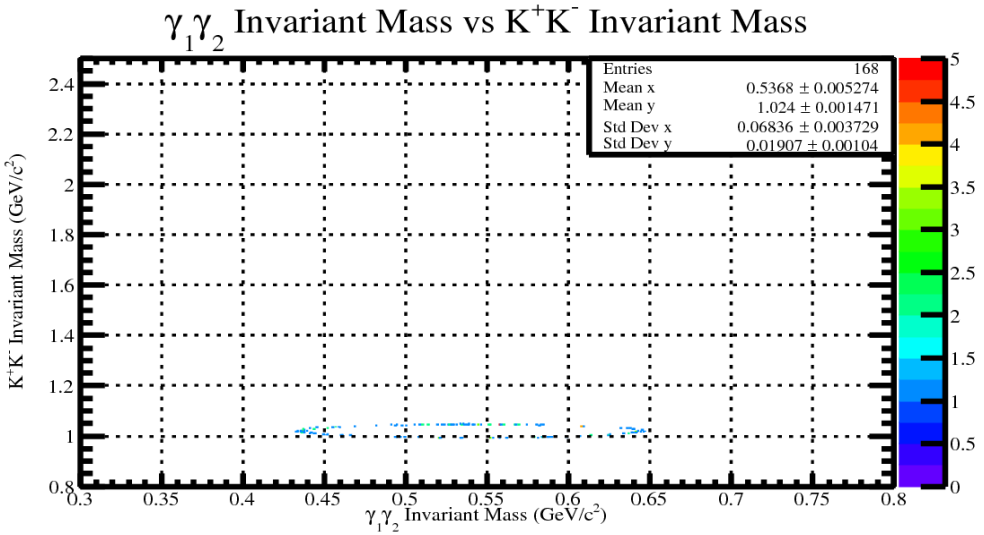


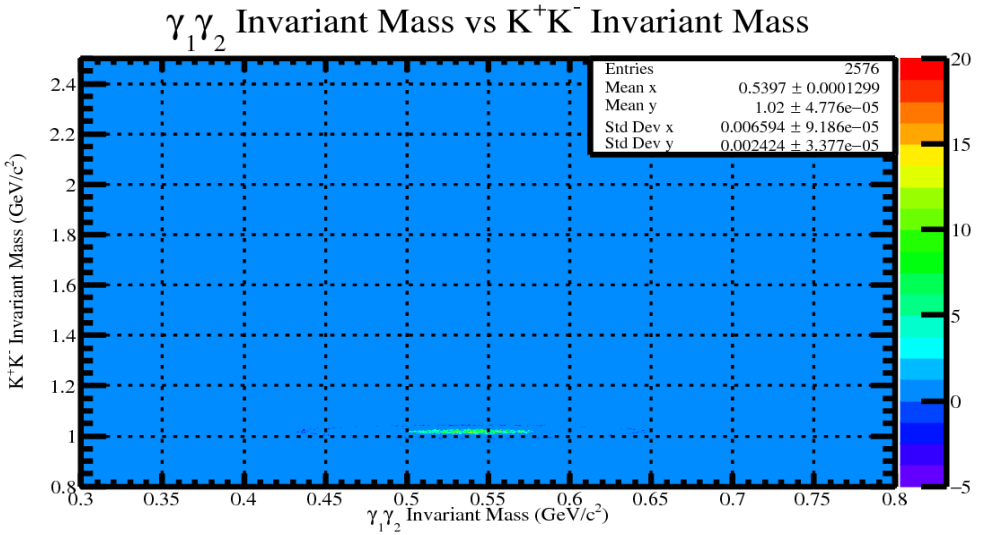


Example Elliptical Mass Cuts

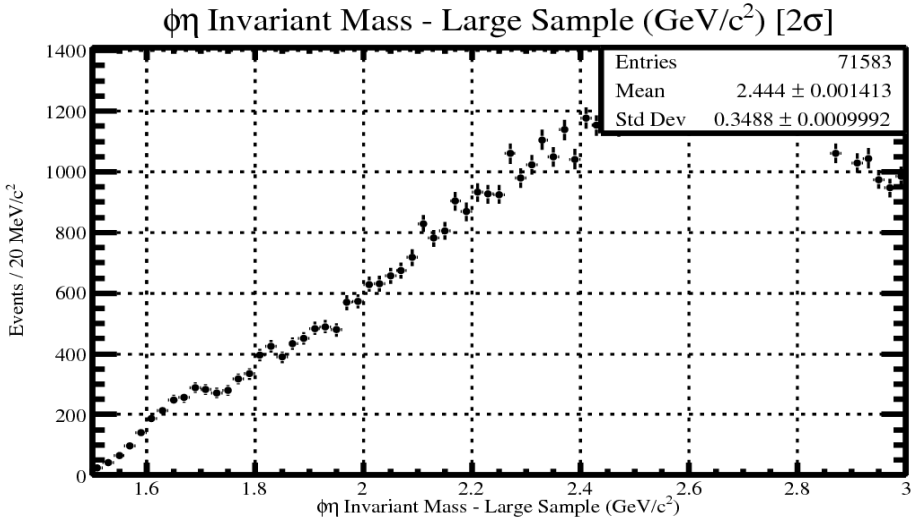


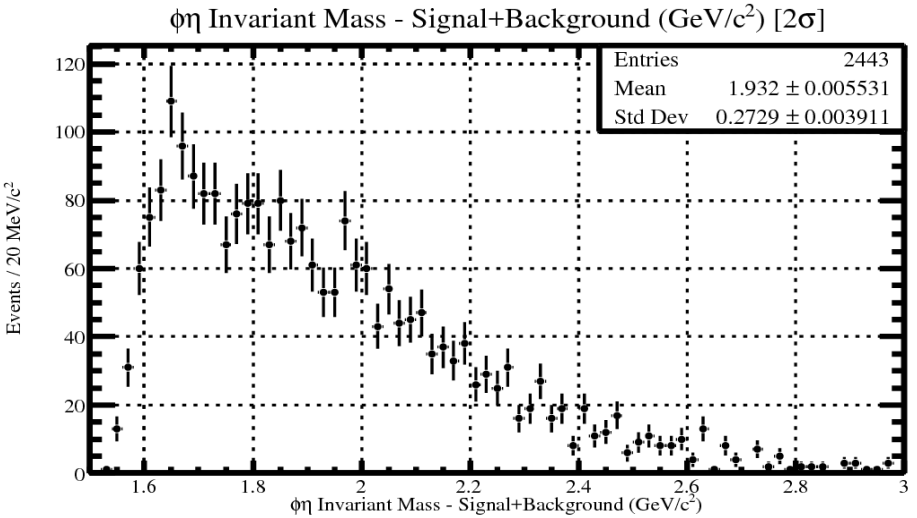


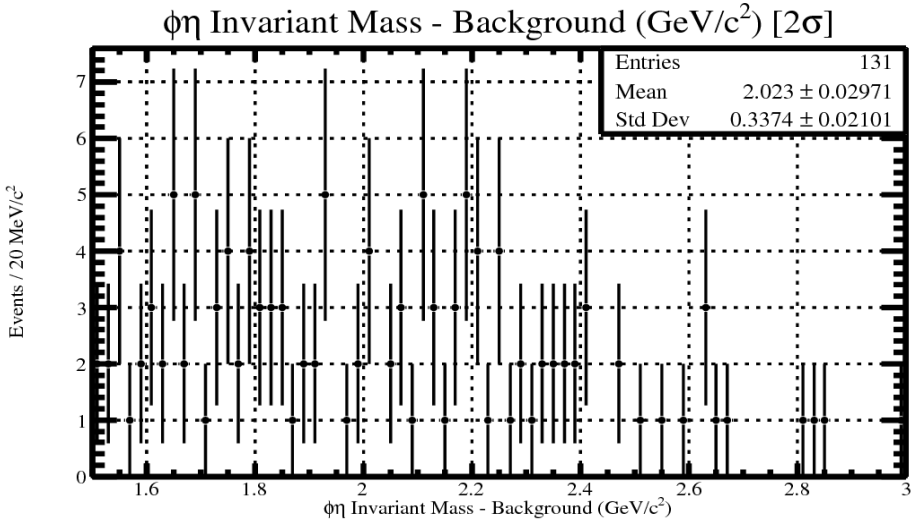


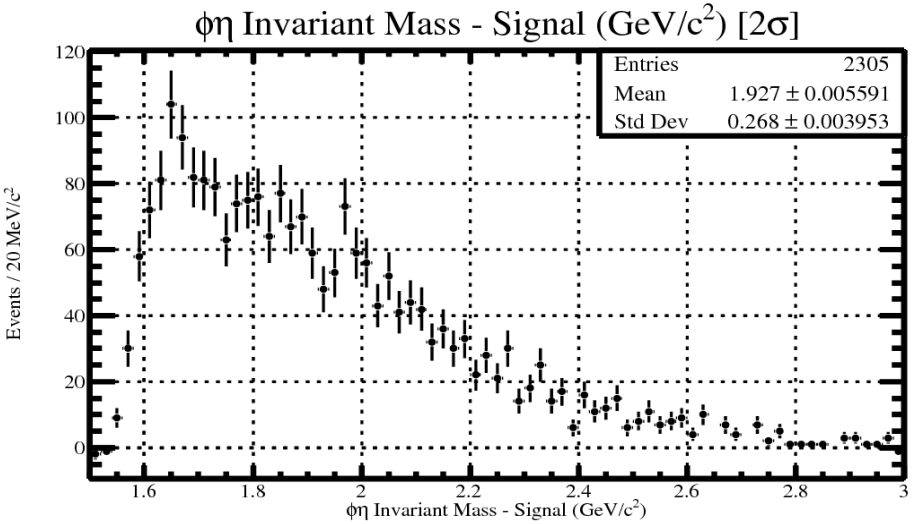


PhiEta

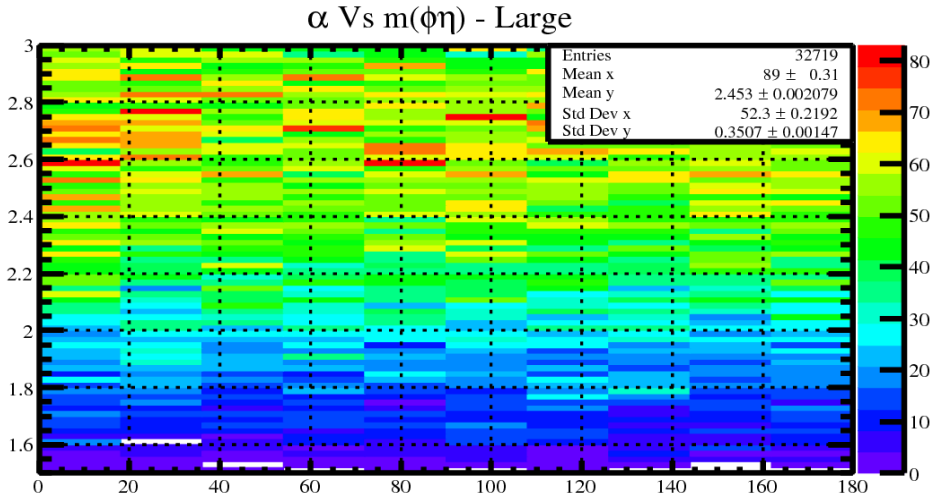

ϕη Invariant Mass - Large Sample (GeV/c²) [2σ]
Entries 71583
Mean 2.444 ± 0.001413
Std Dev 0.3488 ± 0.0009992
Events / 20 MeV/c²
ϕη Invariant Mass - Large Sample (GeV/c²)

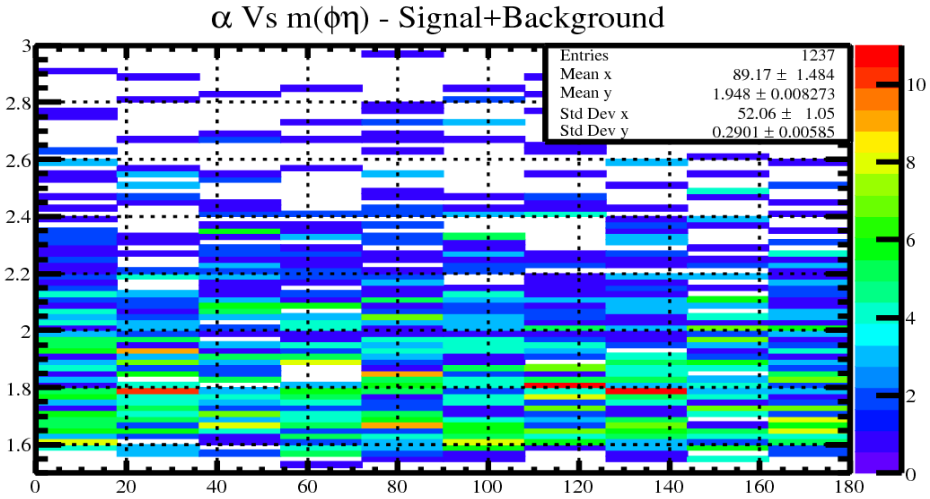

ϕη Invariant Mass - Signal+Background (GeV/c²) [2σ]
Entries 2443
Mean 1.932 ± 0.005531
Std Dev 0.2729 ± 0.003911
Events / 20 MeV/c²
ϕη Invariant Mass - Signal+Background (GeV/c²)

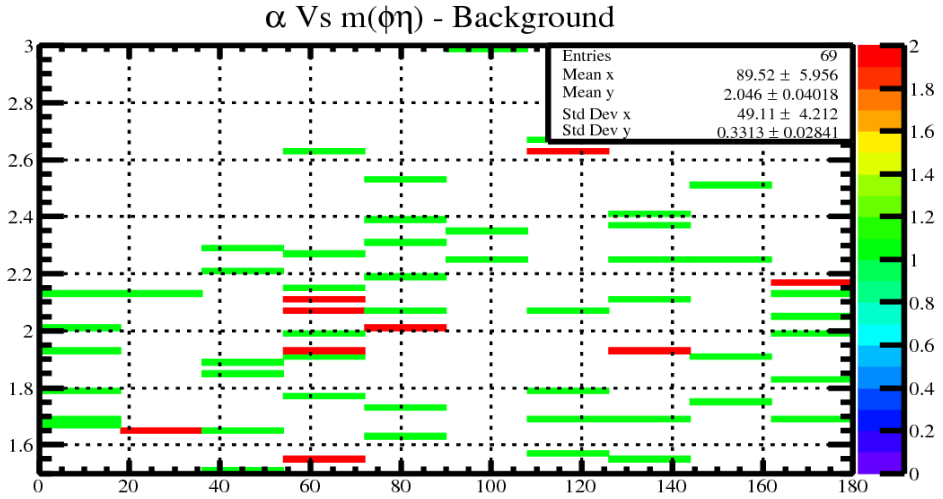

ϕη Invariant Mass - Background (GeV/c²) [2σ]
Entries 131
Mean 2.023 ± 0.02971
Std Dev 0.3374 ± 0.02101
Events / 20 MeV/c²
ϕη Invariant Mass - Background (GeV/c²)

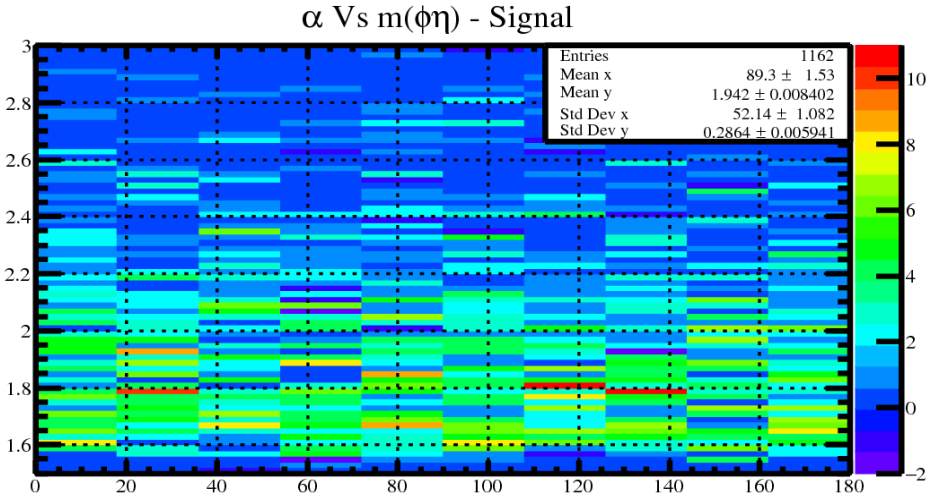

ϕη Invariant Mass - Signal (GeV/c²) [2σ]
Entries 2305
Mean 1.927 ± 0.005591
Std Dev 0.268 ± 0.003953
Events / 20 MeV/c²
ϕη Invariant Mass - Signal (GeV/c²)

Alpha Vs PhiEta

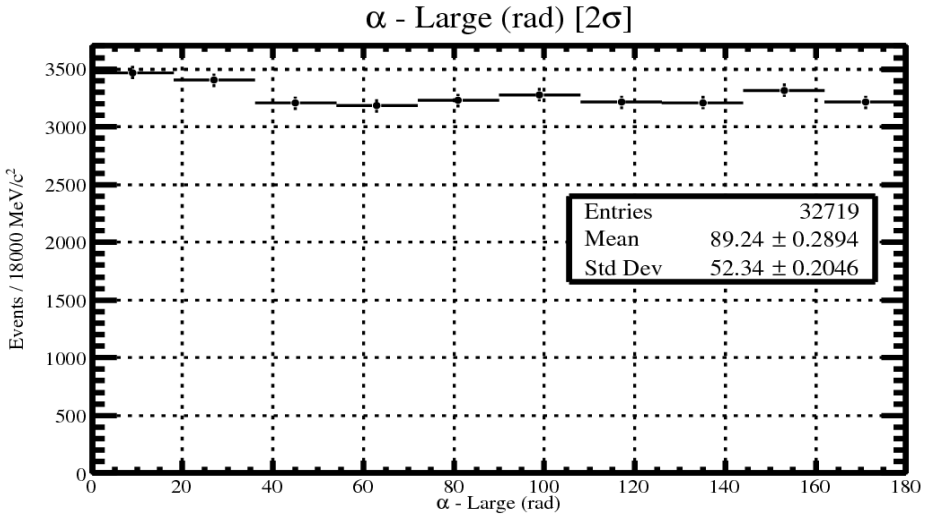


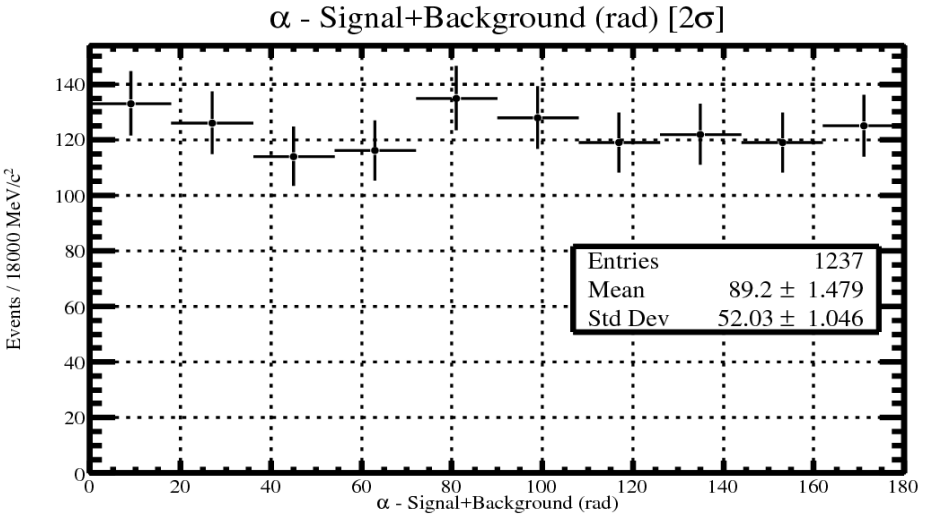


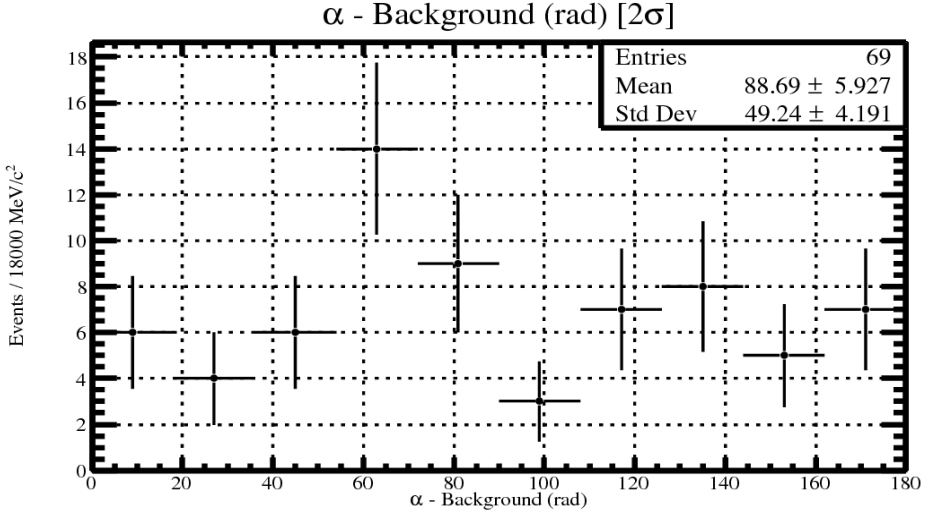


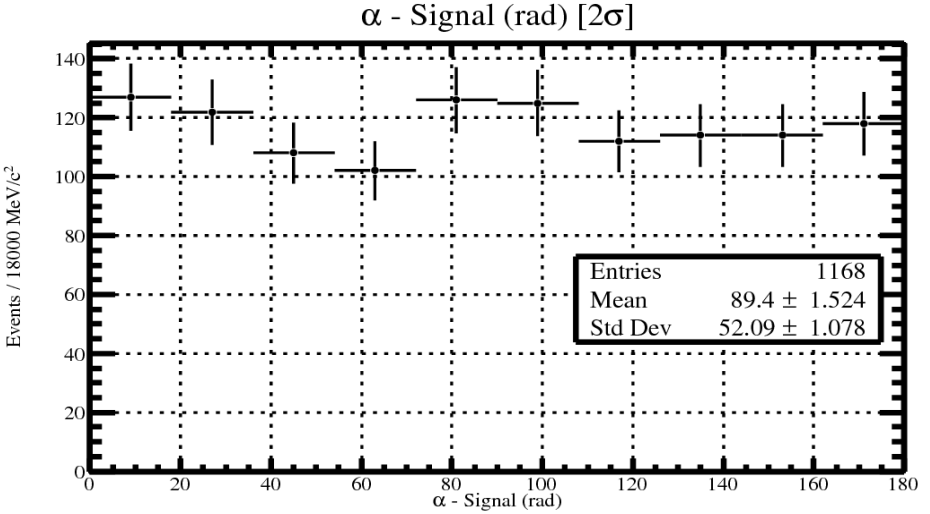


alpha

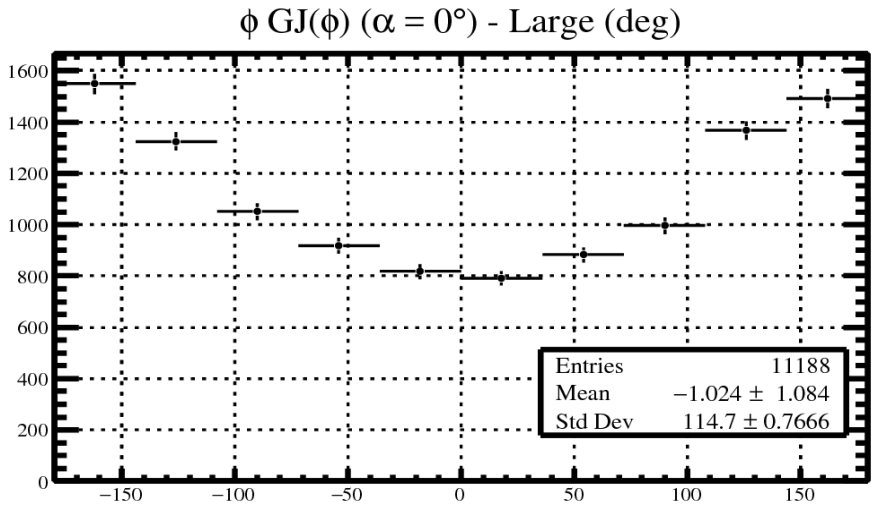

α - Large (rad) [2σ]
Entries 32719
Mean 89.24 ± 0.2894
Std Dev 52.34 ± 0.2046
Events / 18000 MeV/c²
α - Large (rad)

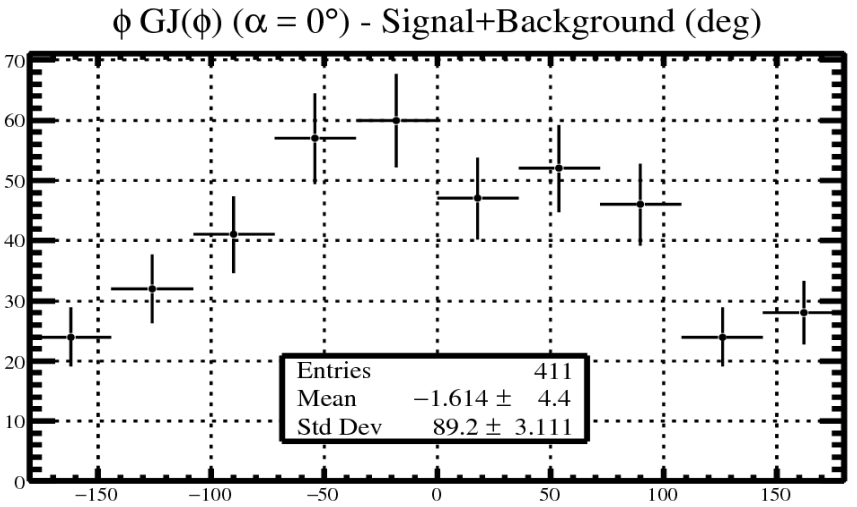

α - Signal+Background (rad) [2σ]
Entries 1237
Mean 89.2 ± 1.479
Std Dev 52.03 ± 1.046
Events / 18000 MeV/c²
α - Signal+Background (rad)

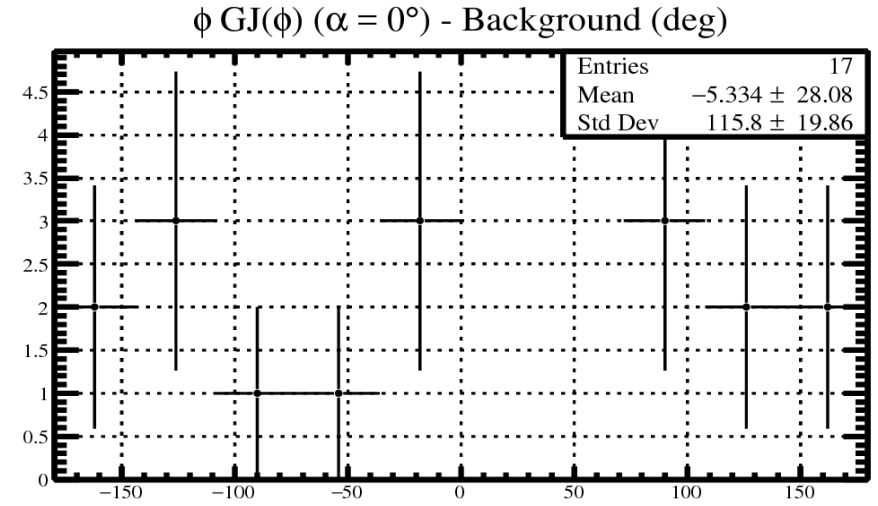

α - Background (rad) [2σ]
Entries 69
Mean 88.69 ± 5.927
Std Dev 49.24 ± 4.191
Events / 18000 MeV/c²
α - Background (rad)

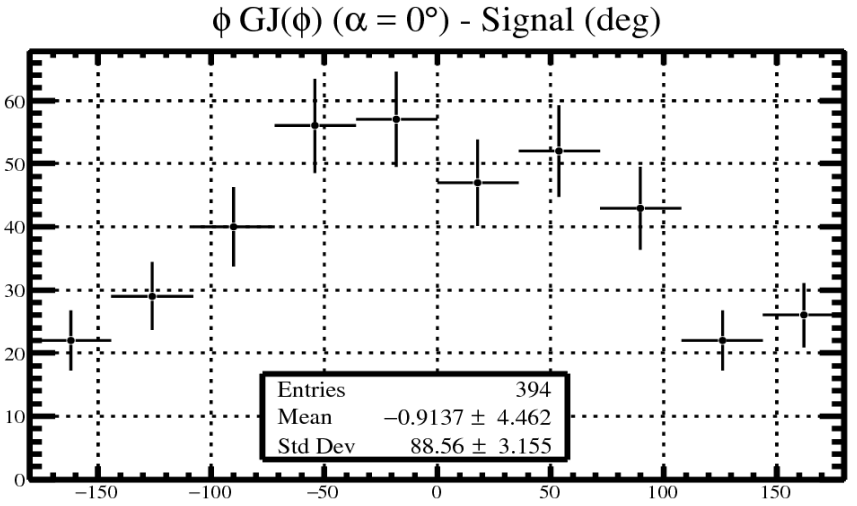

α - Signal (rad) [2σ]
Entries 1168
Mean 89.4 ± 1.524
Std Dev 52.09 ± 1.078
Events / 18000 MeV/c²
α - Signal (rad)

Phi GJ(phi); Alpha 0









Phi GJ(phi); Alpha 90