

Di-electron analysis: Current status

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MPD Cross-PWG Meeting

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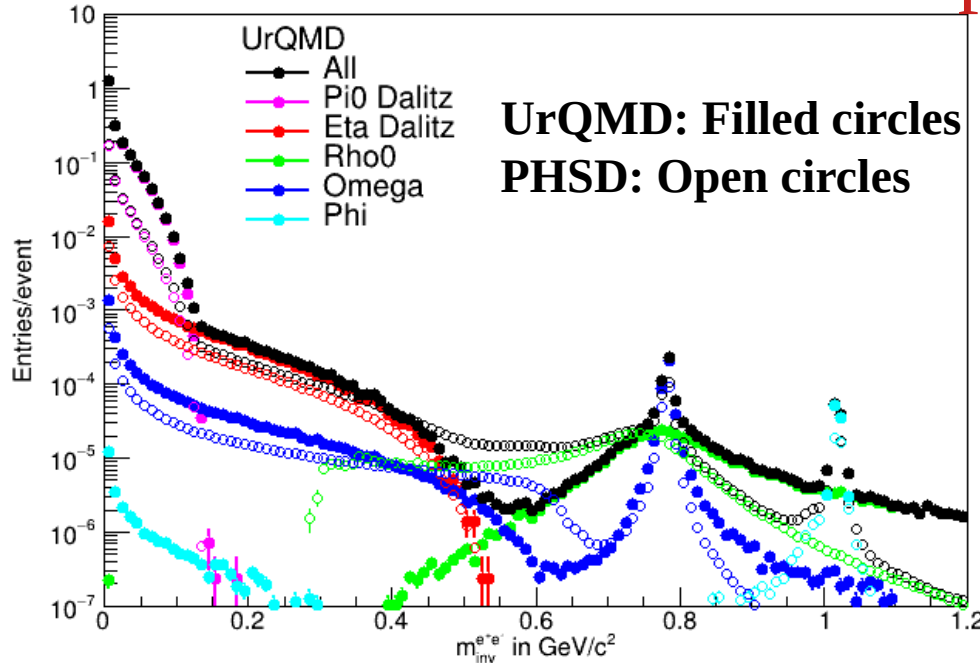
1 JOINT INSTITUTE
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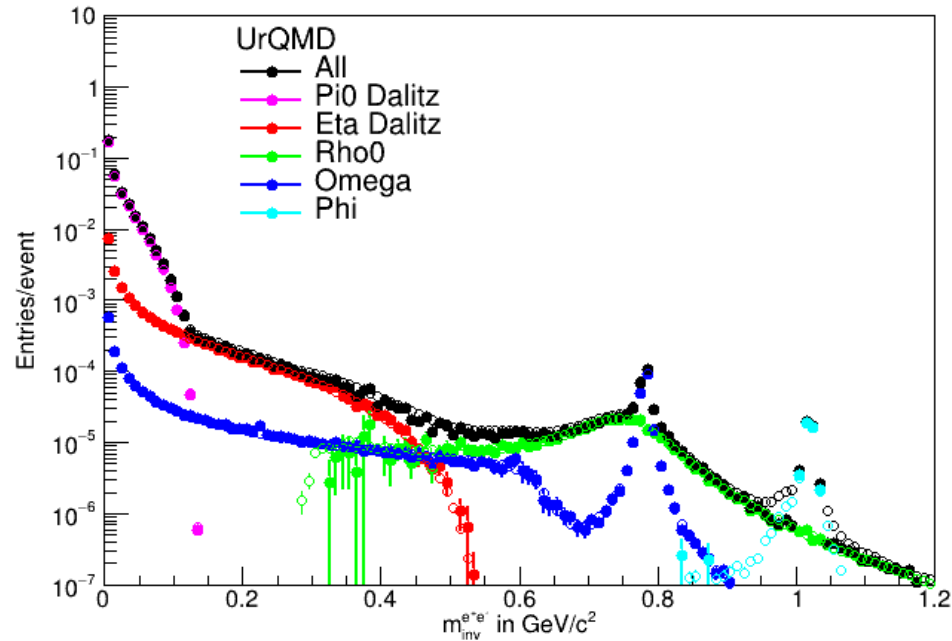
Outline

- 1) Current status with Request 11 and 25 productions.
- 2) Next steps

Di-electron continuum shape:



- Shapes and Multiplicities are different in PHSD and UrQMD.
- Need to scaled down to PHSD.



Selection Cuts

Request 11 → 10M events

- 1) $|V_z| < 50$ cm.
- 2) DCA x,y,z $< 2\sigma$ (3σ).
- 3) Nhits > 39
- 4) TPC nSigma -2 to 2 sigma at $p = 0$ and -1 to 2 sigma for $p > 800$ MeV/c
- 5) TOF nSigma -2 to 2 sigma
- 6) TOF matching -2 to 2 sigma
- 7) TPC nSigma pi veto
- 8) Limiting the eta acceptance of the reconstructed track to 0.3

1) Tight cuts on Partner: Same as above

2) Loose Cuts on Partner

1) $|\text{Eta}| < 2.5$, Nhits > 10 , $p_T > 50$ MeV/c

2) DCA > 3.5 sigma (only Dalitz rejection)

3) $|\text{TPC nSigma}| < 2$ sigma, TOF nSigma < 2 Sigma with matching 2 Sigma

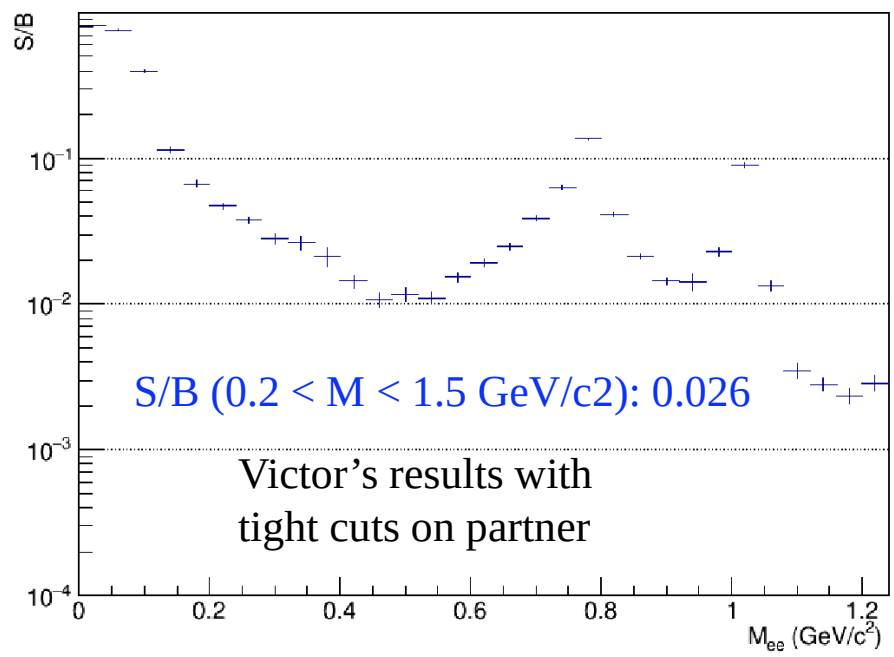
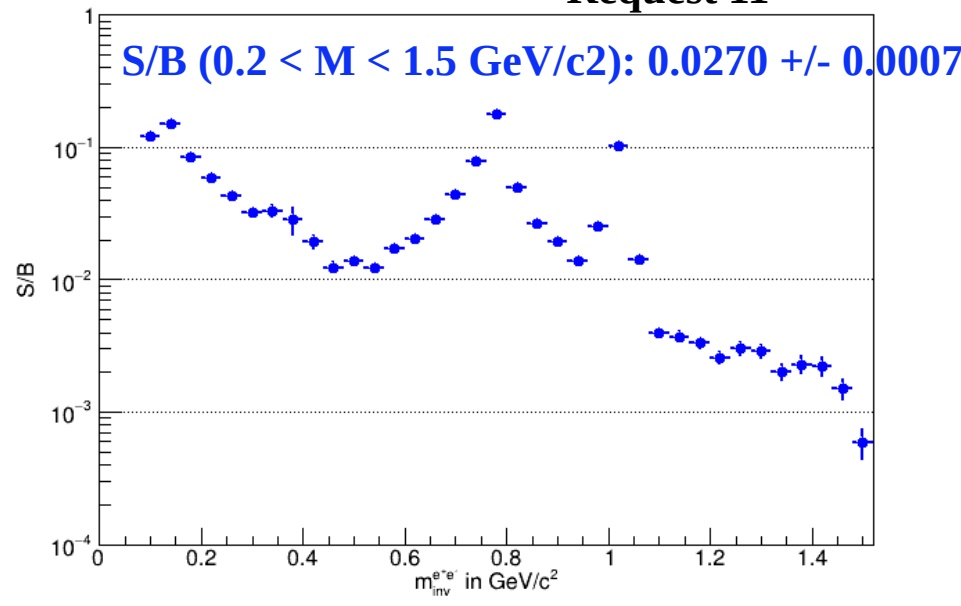
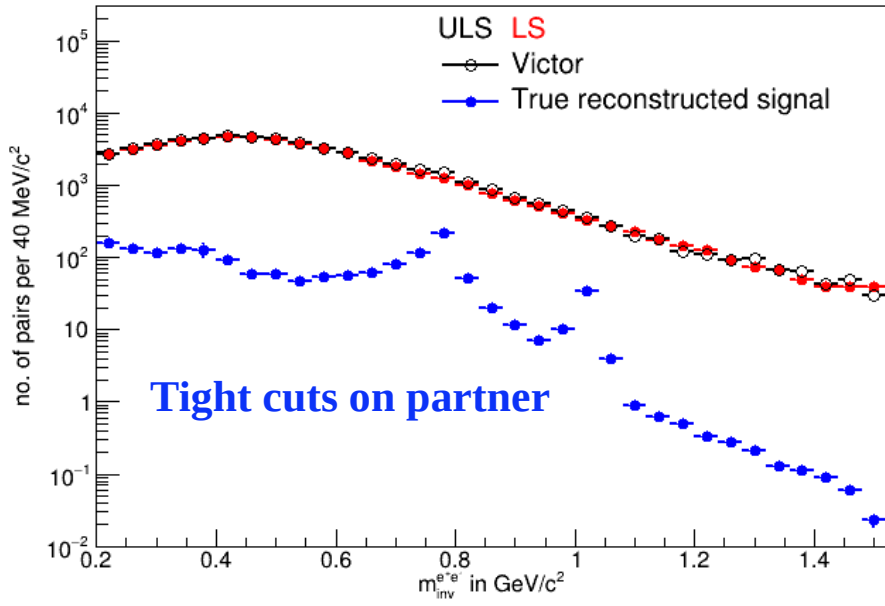
1) Conversion Rejection: Chi2 for the secondary vertex, pointing angle, DCA for e, distance to PV.

2) Dalitz rejection: No further pairing of pairs with $M < 100$ (120) MeV/c²

3) Pairing: $p_T > 100$ MeV/c for Victor like analysis, $p_T > 200$ MeV/c for Sudhir analysis

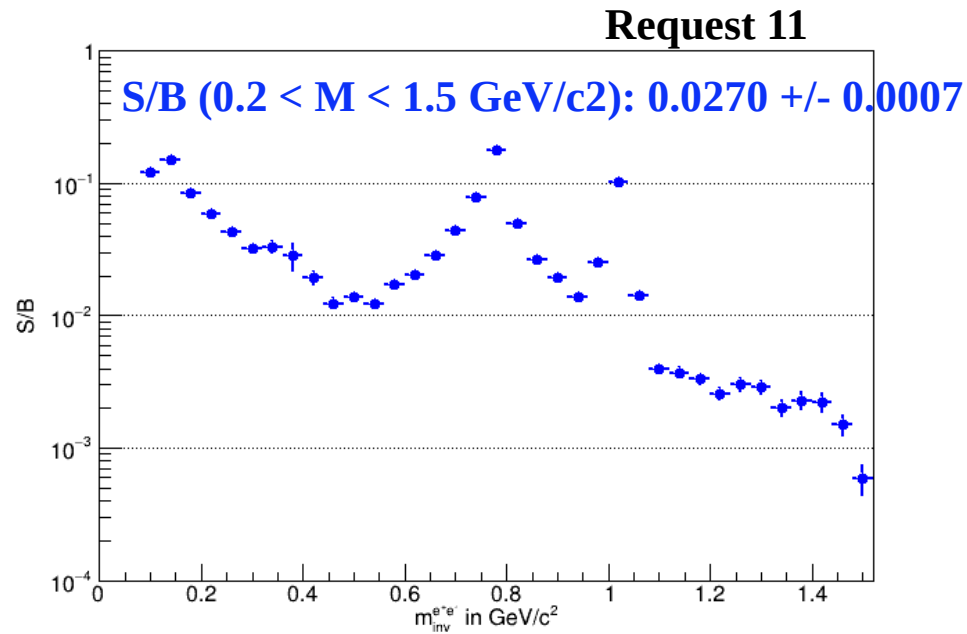
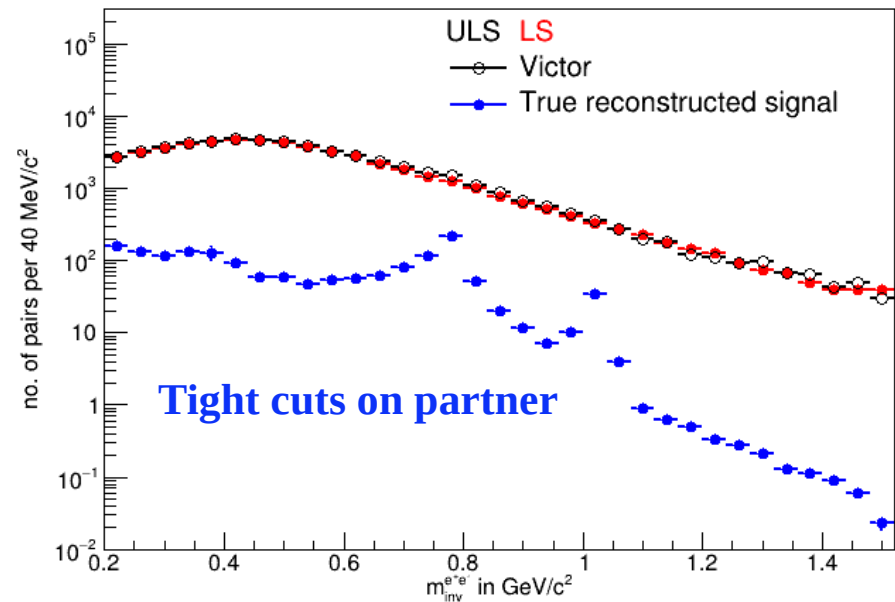
$\rho^0 \rightarrow e^+e^-$ (x20)
$\omega \rightarrow e^+e^-$ (x20)
$\omega \rightarrow \pi^0 e^+e^-$ (x20)
$\phi \rightarrow e^+e^-$ (x20)
$\phi \rightarrow \eta e^+e^-$ (x20)

Request 11

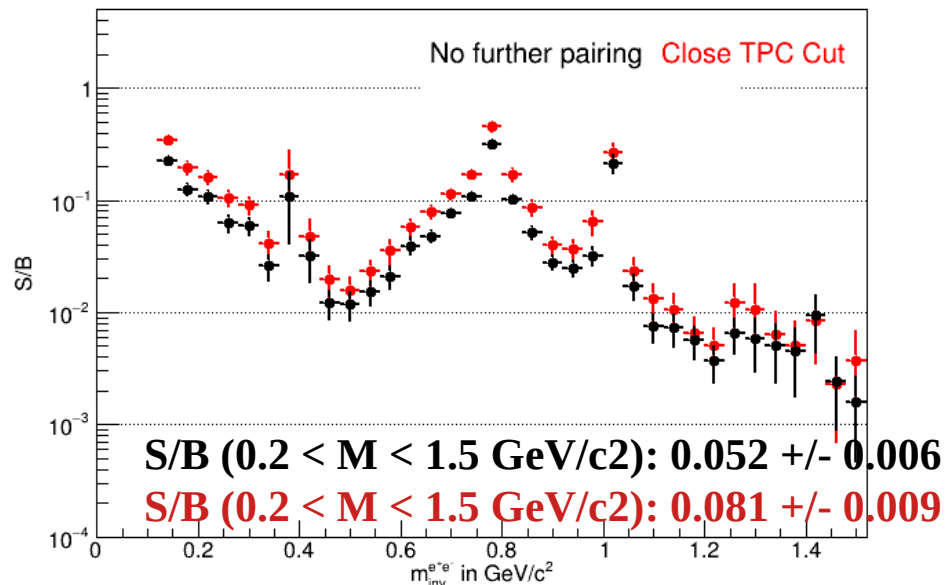
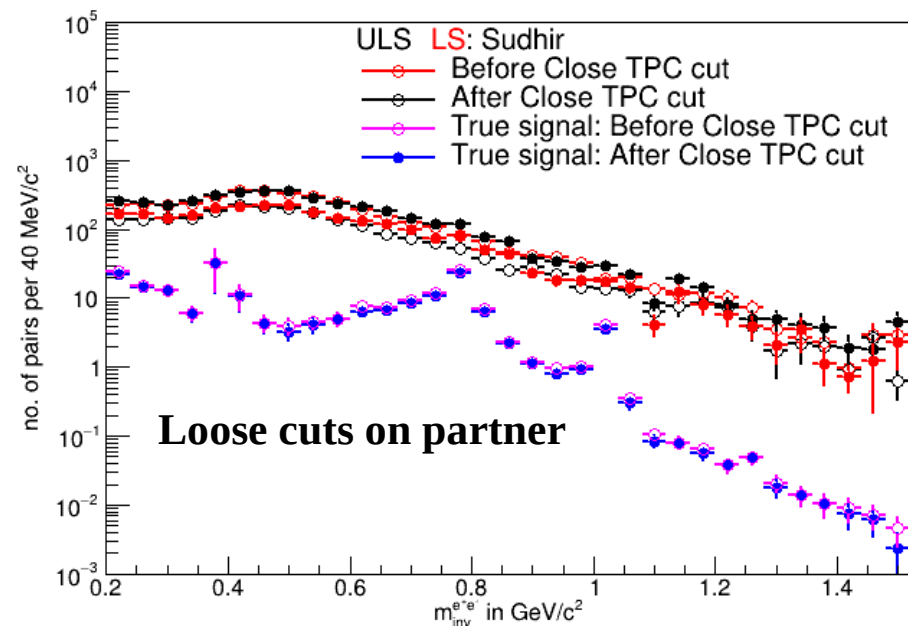


Strategy: Pair Analysis

- Three electron pools:
 - Pool-1 for fully reconstructed tracks in fiducial area ($|\eta| < 0.3$)
 - Pool-2 for fully reconstructed tracks in whole rapidity acceptance.
 - Pool-3 with TPC only tracks.
- **No further pairing:** Tracks belonging to fully reconstructed π^0 Dalitz are tagged and not used for further pairing.
- **Close TPC cut:** Track from Pool-1 is paired with tracks from Pool-3 and both tracks are removed as a potential Dalitz pair if they have $M_{\text{inv}} < 120$ MeV/c² and opening angle < 10 degrees.
- Rest of the tracks with $p_t > 200$ MeV from Pool-1 are paired among themselves to build ULS and LS pair spectra.



S/B for loose cuts on partner: 0.0310 +/- 0.0008



Selection Cuts

Request 25 → 38M events: More realistic: Some changes w.r.t. Request 11.

- **Realistic dEdX simulations**
- **B = 0-16 fm etc**

- 1) $|V_z| < 100$ cm.
- 2) DCA $x,y,z < 2\sigma$ (3σ).
- 3) Nhits > 39
- 4) TPC nSigma -2 to 2 sigma at $p = 0$ and -1 to 2 sigma for $p > 800$ MeV/c
- 5) TOF nSigma -2 to 2 sigma
- 6) TOF matching -2 to 2 sigma
- 7) **Limiting the eta acceptance of the reconstructed track to 0.3**

1) Tight cuts on Partner: Same as above

2) Loose Cuts on Partner

1) $|\text{Eta}| < 2.5$, Nhits > 10 , $p_T > 50$ MeV/c

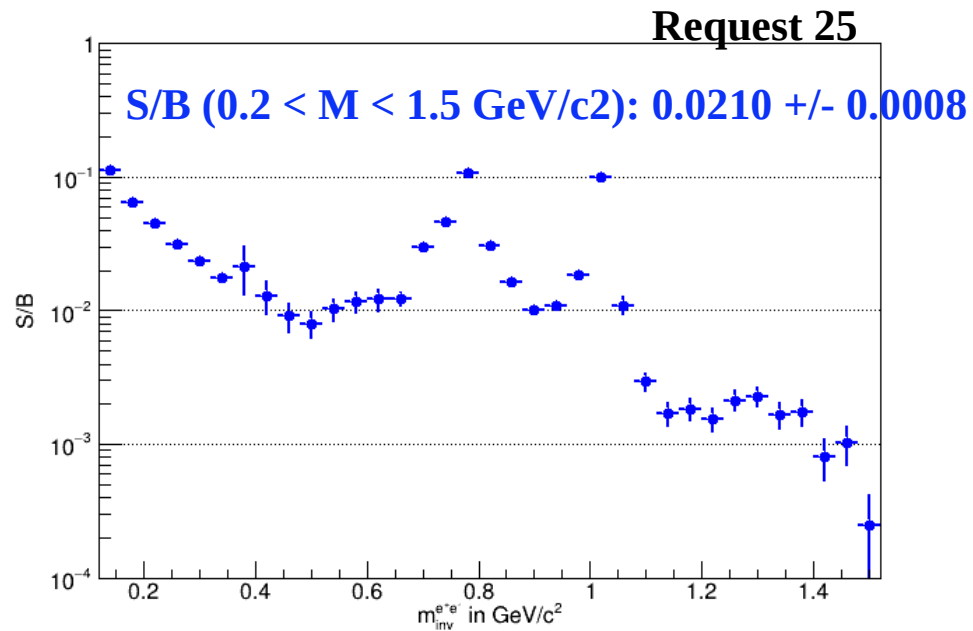
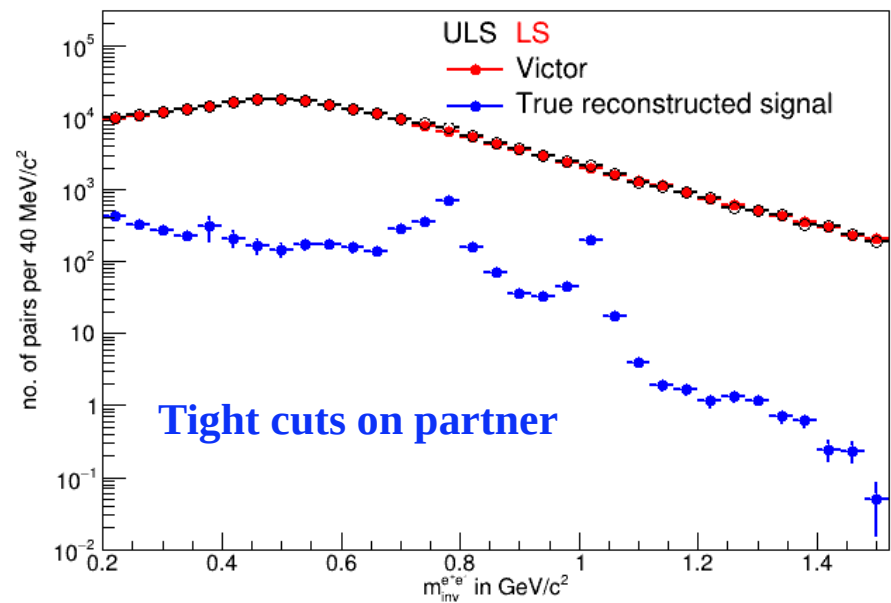
2) DCA > 3.5 sigma (only Dalitz rejection)

3) $|\text{TPC nSigma}| < 2$ sigma, TOF nSigma < 2 Sigma with matching 2 Sigma

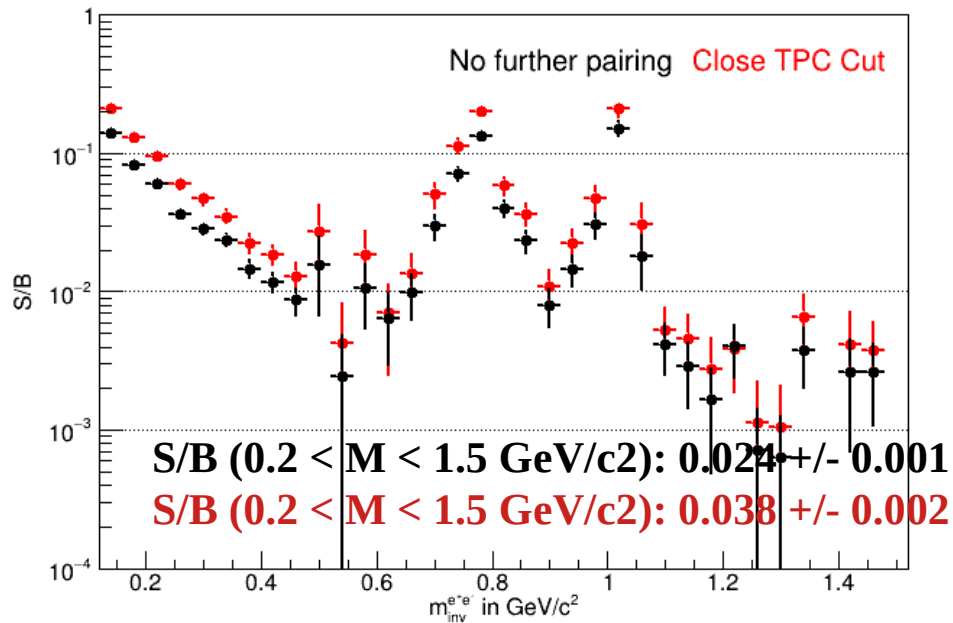
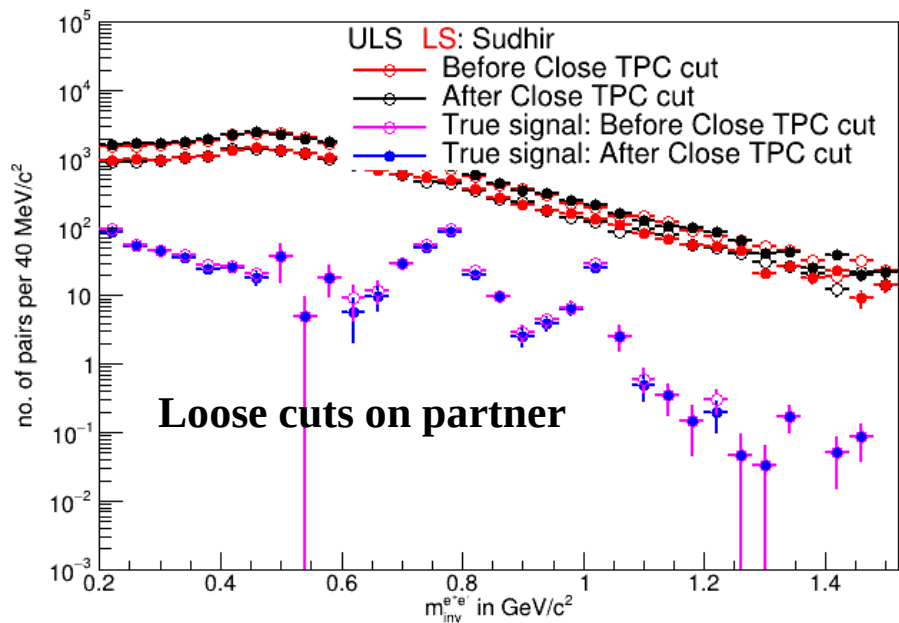
1) Conversion Rejection: Chi2 for the secondary vertex, pointing angle, DCA for e, distance to PV → **Same as Request 11 (needs to be updated, if necessary).**

2) Dalitz rejection: No further pairing of pairs with $M < 100$ (120) MeV/c²

3) Pairing: **$p_T > 200$ MeV/c**



S/B for loose cuts on partner: 0.0228 +/- 0.0008



Next Steps

=====
Total reconstructed tracks after close TPC cut: ===== 126939
=====

Below: Only Conversion, pi0 and eta Dalitz sources are considered --

Track has Partner Inside TPC i.e. between $35 \text{ MeV} < p_T < 100 \text{ MeV}$: ===== 40918

hTrackIsNotElectron (Hadron): ===== 9688

Track has Partner with $p_T < 35 \text{ MeV}$: ===== 30487

Track has Partner with $p_T > 100 \text{ MeV}$: ===== 29903

Rest: ===== 15943
=====

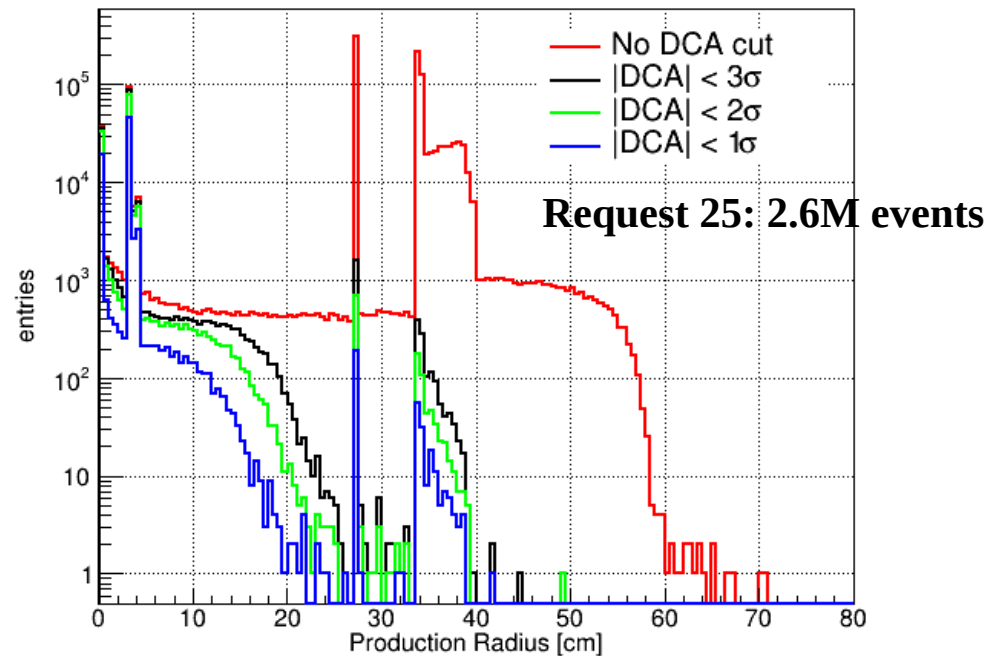
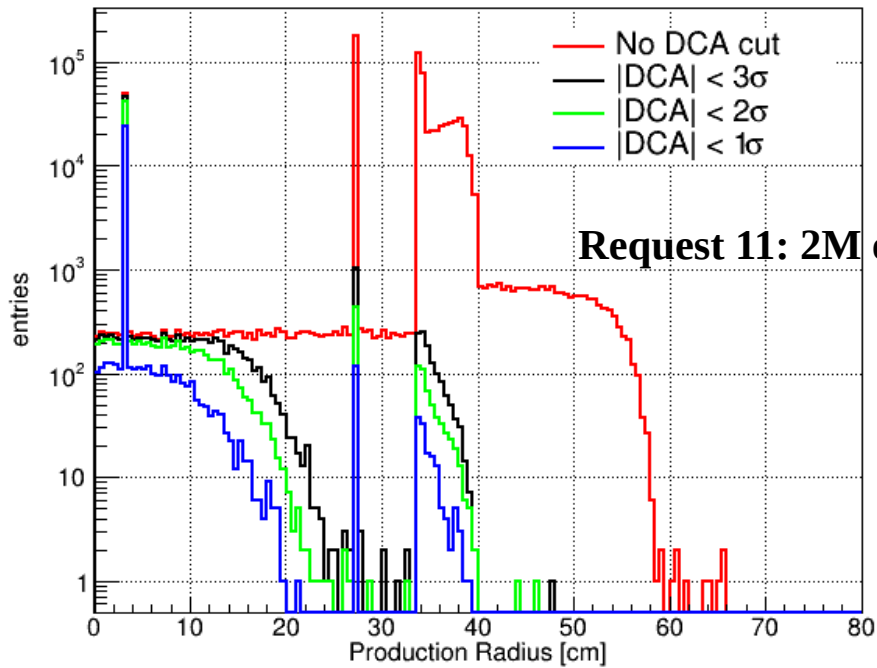
- Trying to understand the origin of remaining background after close TPC cut.
- Time of flight information from ECal for high p_T tracks in case of TOF inefficiency?
- More detailed and differential classification of these contributions.

Next Steps

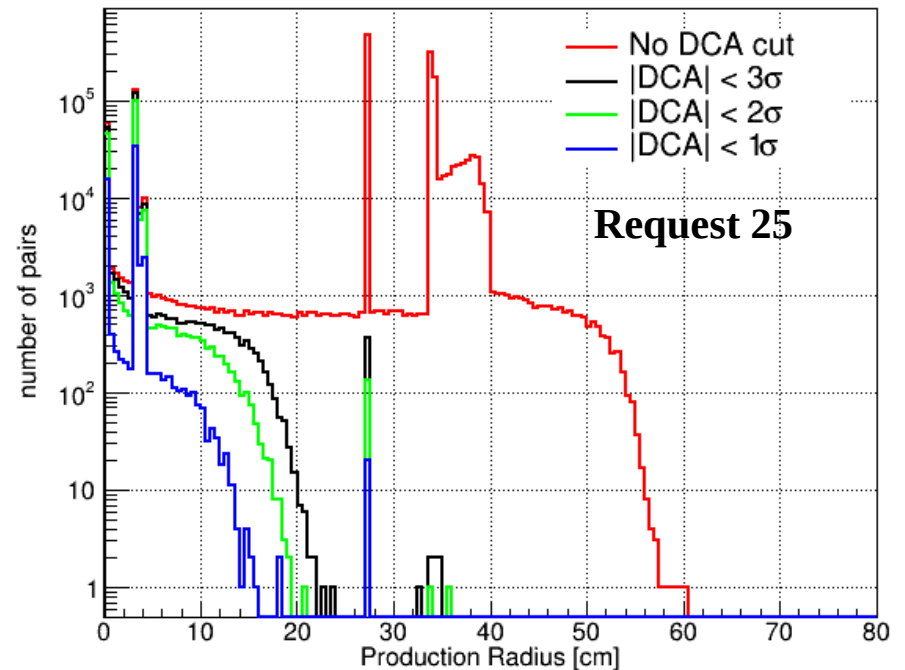
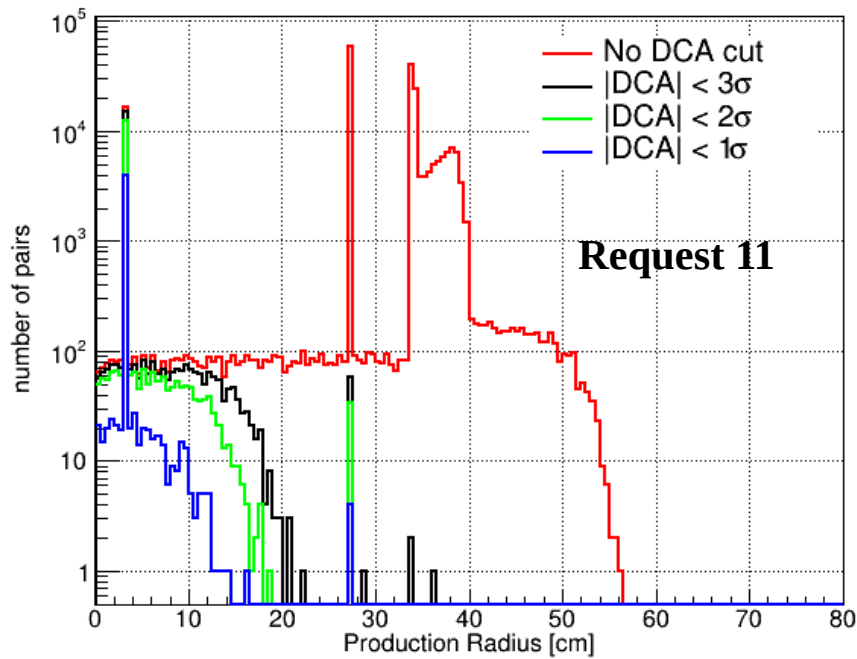
- 1) Use of photon information in ECal to reject electrons from Dalitz decays:
 - 1) Invariant mass between the Dalitz electrons and photon in corresponding decay channel should be less than $< 0.14 \text{ GeV}/c$.
 - 2) Opening angle distribution.
 - 3) Other kinematical variables?
- 2) For Photon Identification (following Pi0Analysis.C tutorial macro)
 - 1) $\text{EMCCluster} \rightarrow \text{GetChi2}() < 4$
 - 2) $\text{Tcl} < 2 \text{ ns}$.
 - 3) Charge Particle veto.
 - 4) $\text{EMCCluster} \rightarrow \text{GetE}() > 50 \text{ MeV}$.
 - 5) Minimum number of towers in the cluster > 2

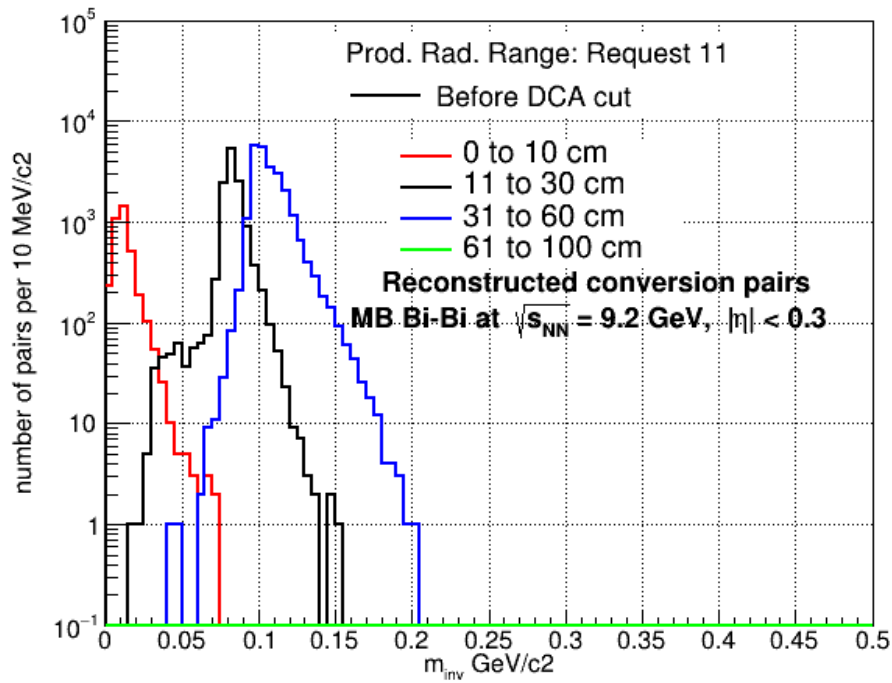
BACK-UP

Production radius distribution of reconstructed conversion electrons for different DCA selection.

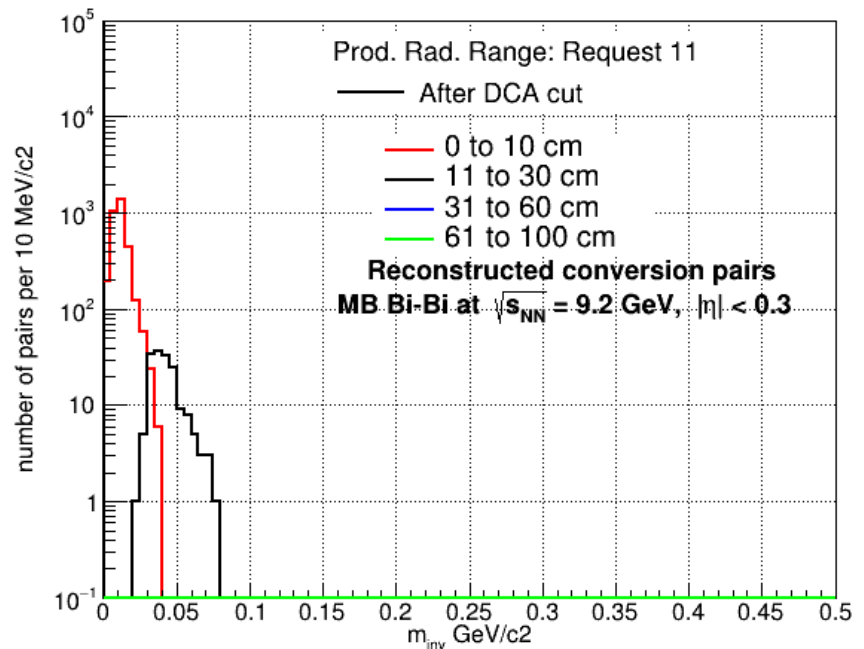


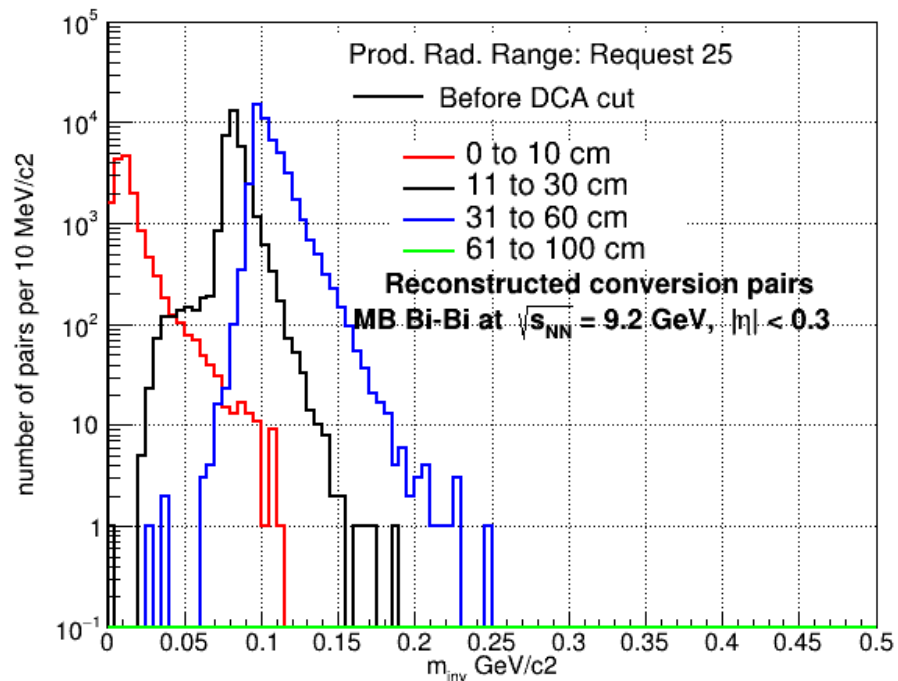
Production radius distribution of reconstructed conversion pairs for different DCA selection.



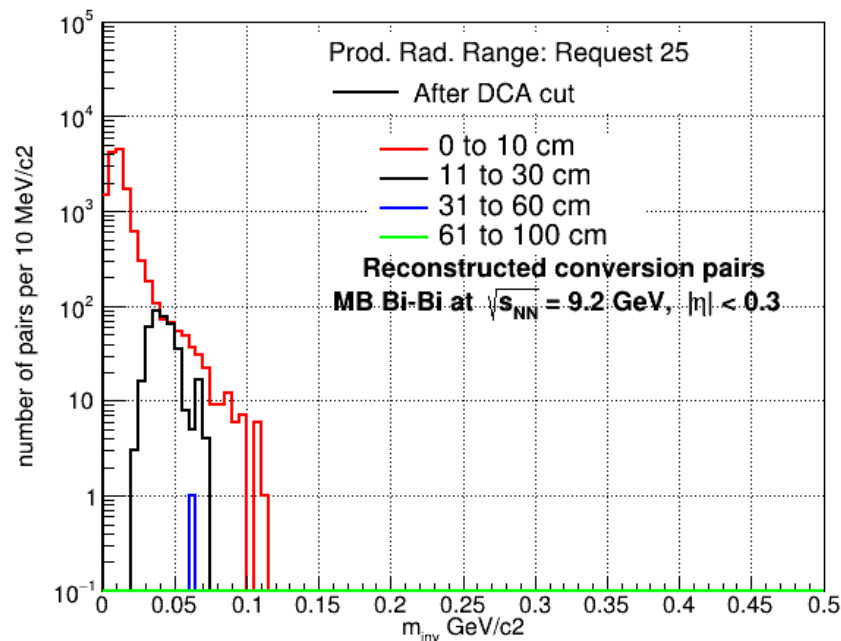


Invariant mass spectra of reconstructed conversion pairs in different production radius regions, before and after applying DCA selection.

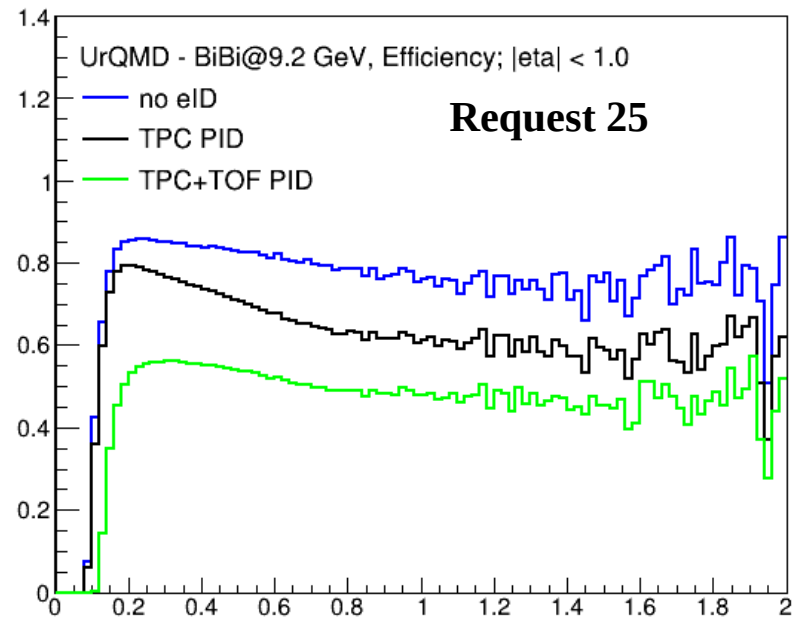
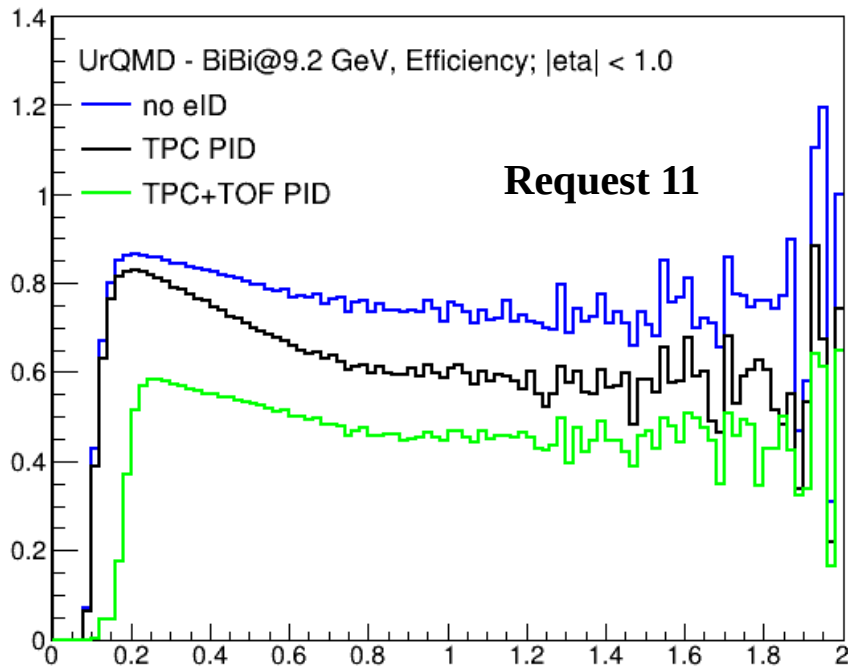




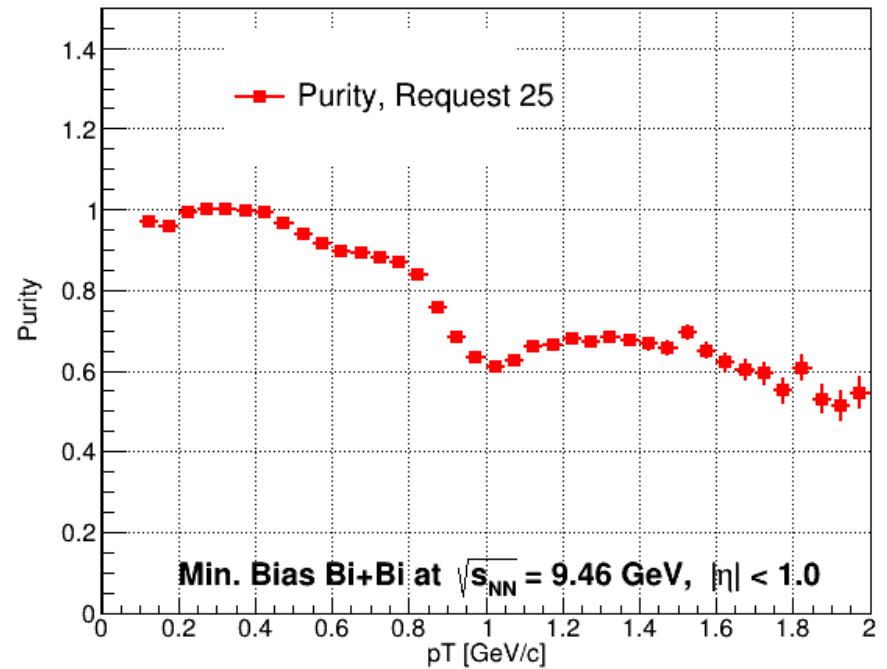
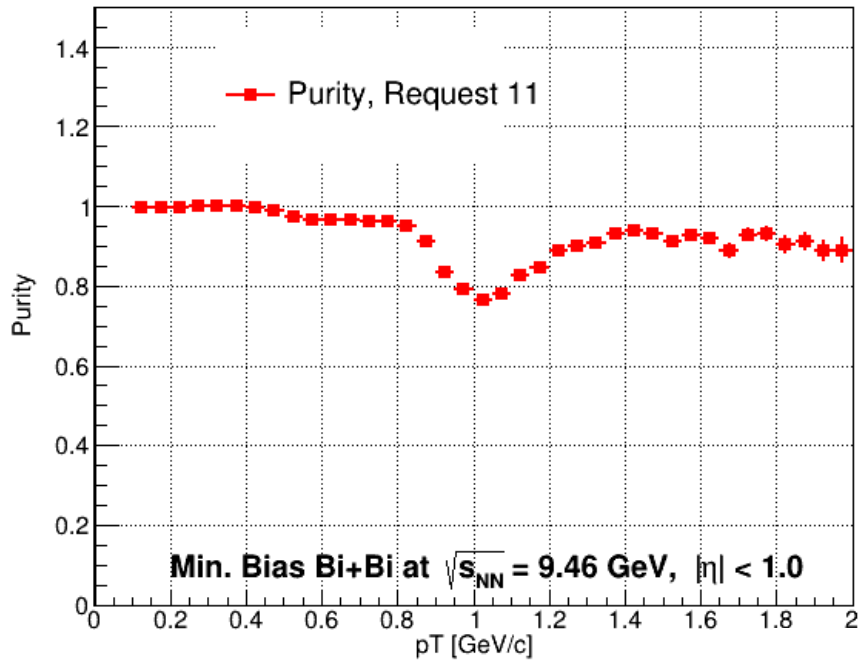
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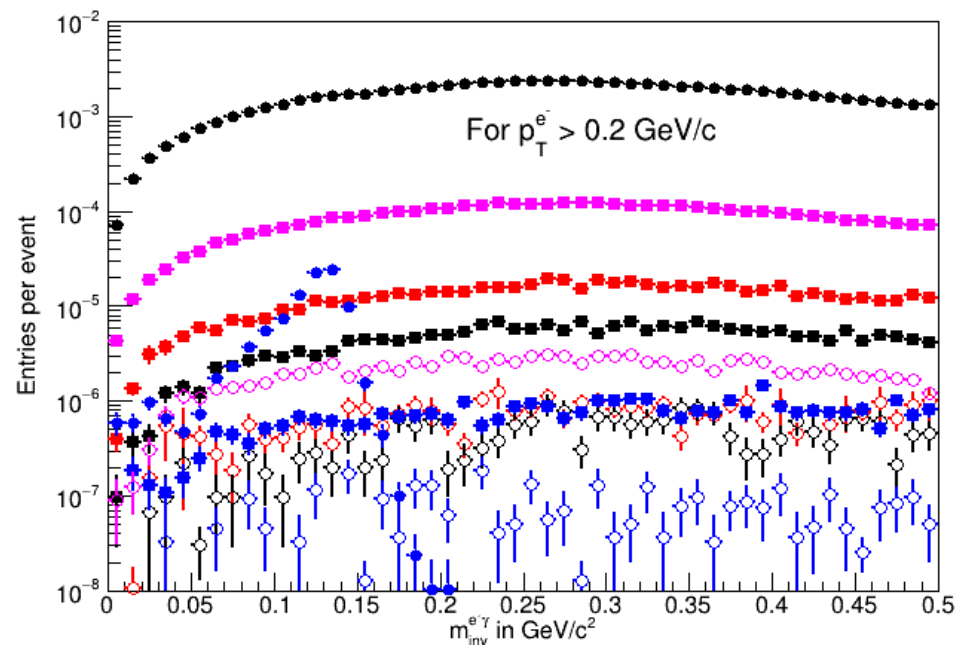


Efficiency



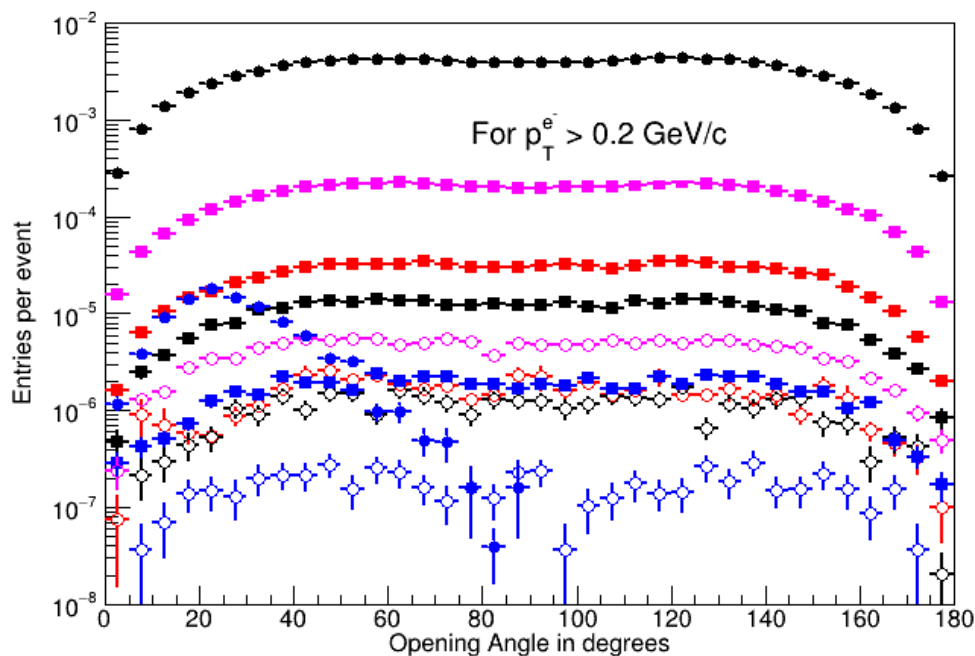
Purity





Post Close TPC cut, Invariant Mass of:

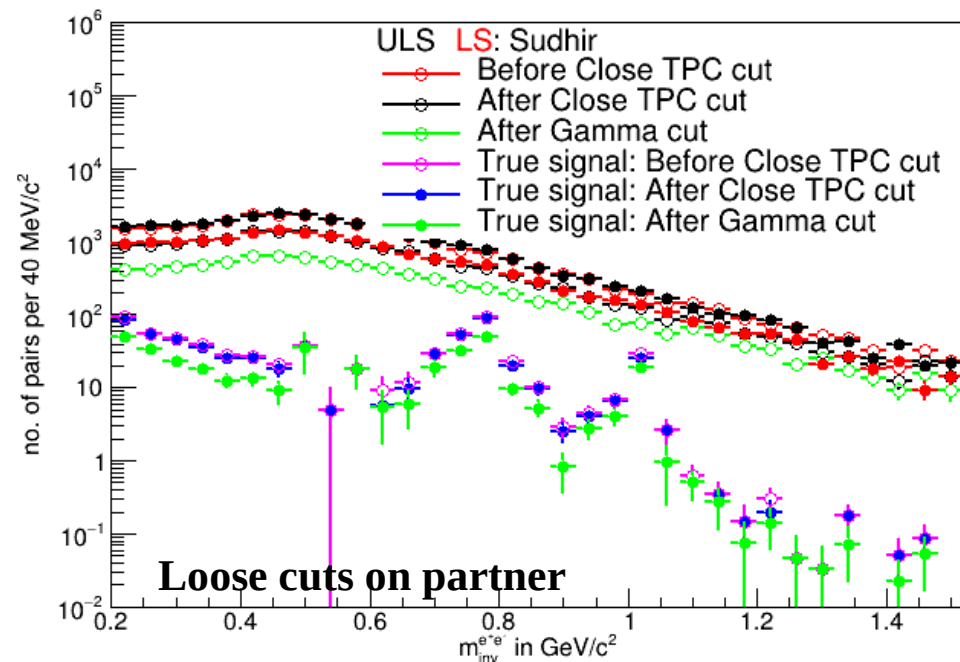
- All e^- and all γ
- Eta Dalitz e^- w/ partner and all γ
- Eta Dalitz e^- w/o partner and all γ
- Omega e^- w/ partner and all γ
- Omega e^- w/o partner and all γ
- Rho0 e^- w/ partner and all γ
- Rho0 e^- w/o partner and all γ
- Phi e^- w/ partner and all γ
- Phi e^- w/o partner and all γ



Post Close TPC cut, Opening Angle between:

- All e^- and all γ
- Eta Dalitz e^- w/ partner and all γ
- Eta Dalitz e^- w/o partner and all γ
- Omega e^- w/ partner and all γ
- Omega e^- w/o partner and all γ
- Rho0 e^- w/ partner and all γ
- Rho0 e^- w/o partner and all γ
- Phi e^- w/ partner and all γ
- Phi e^- w/o partner and all γ
- Dalitz e^- and γ

Pi0 – Eta yield (for gamma as well) and di-electron continuum shape is corrected to PHSD

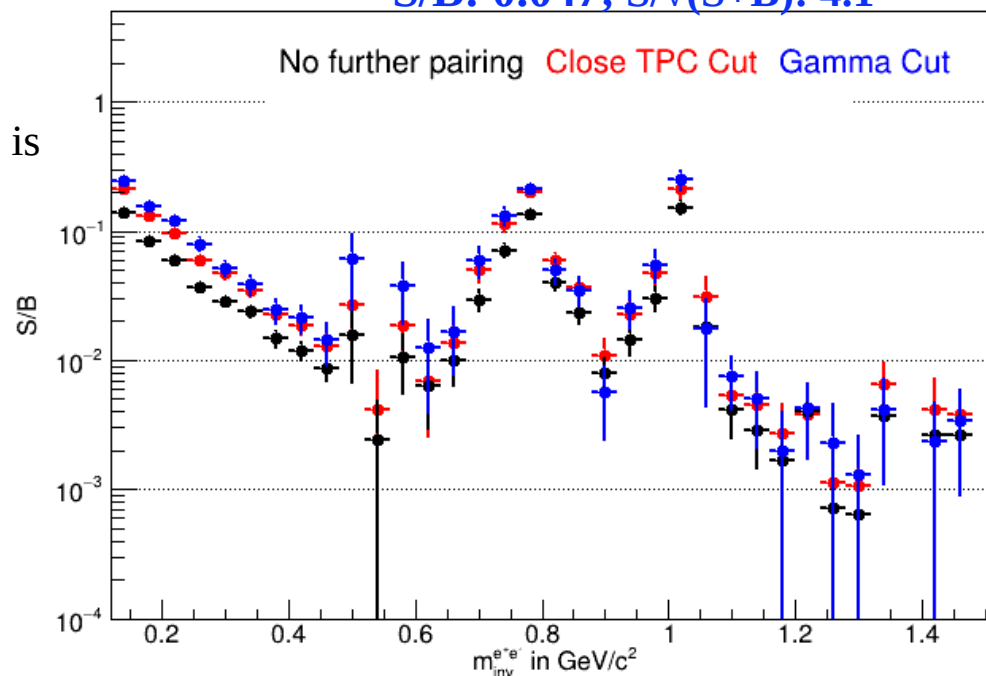


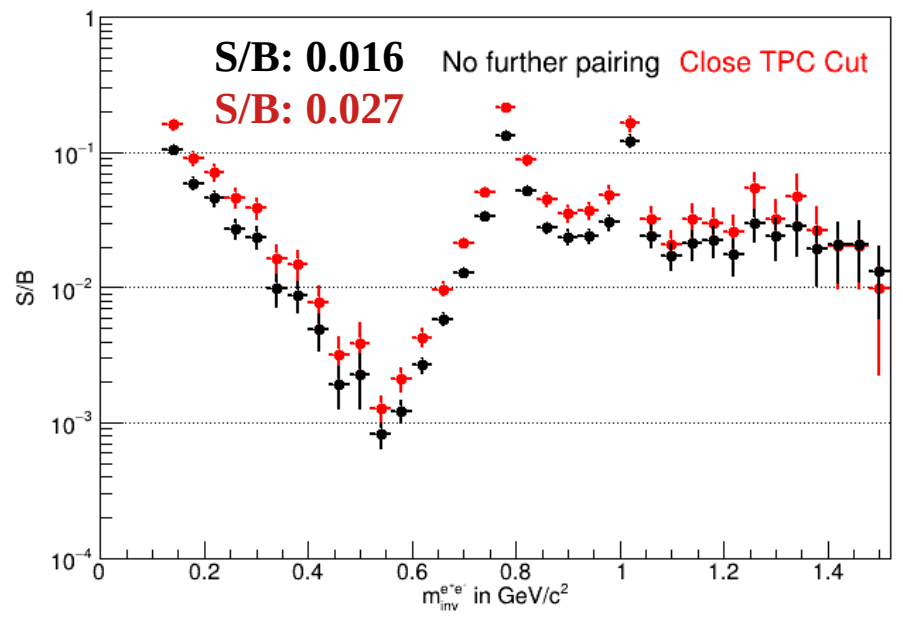
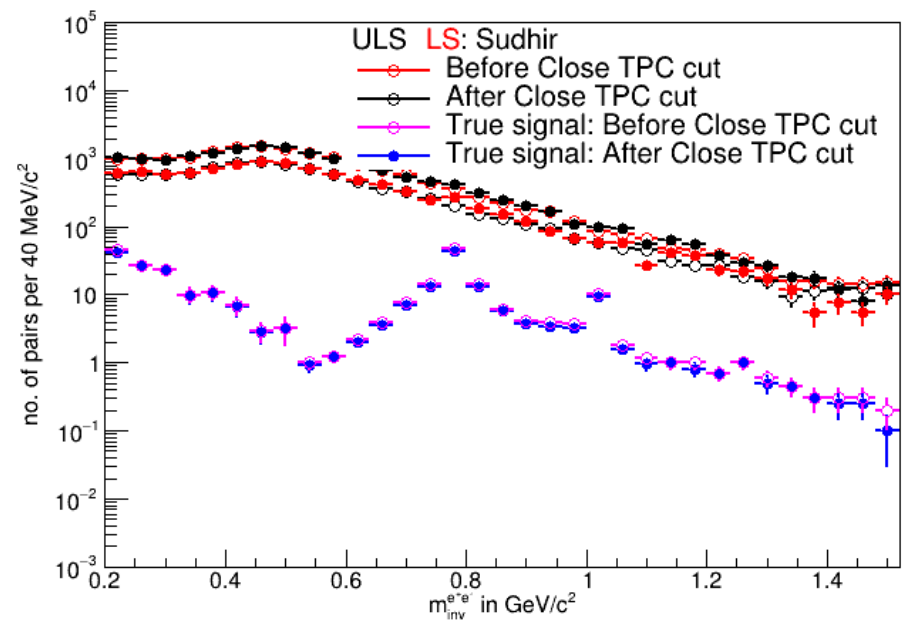
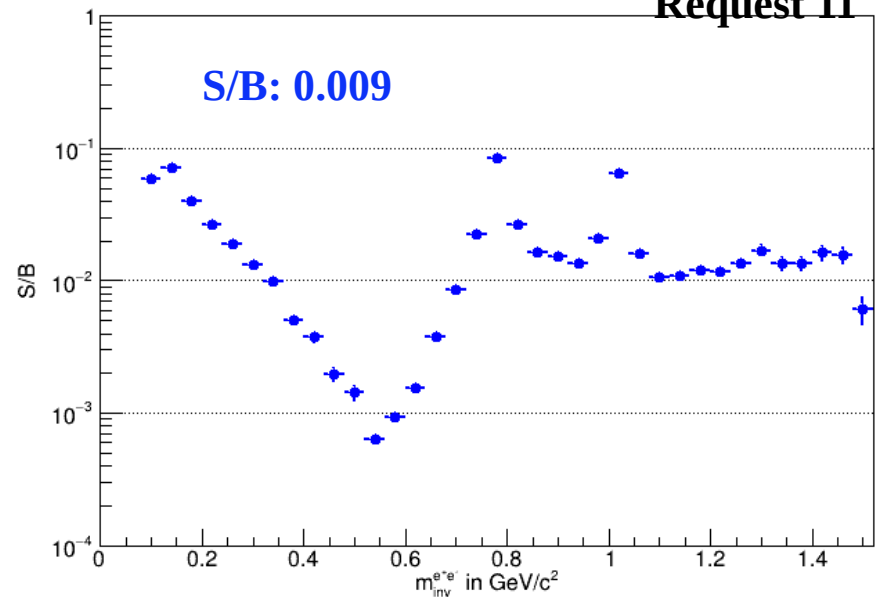
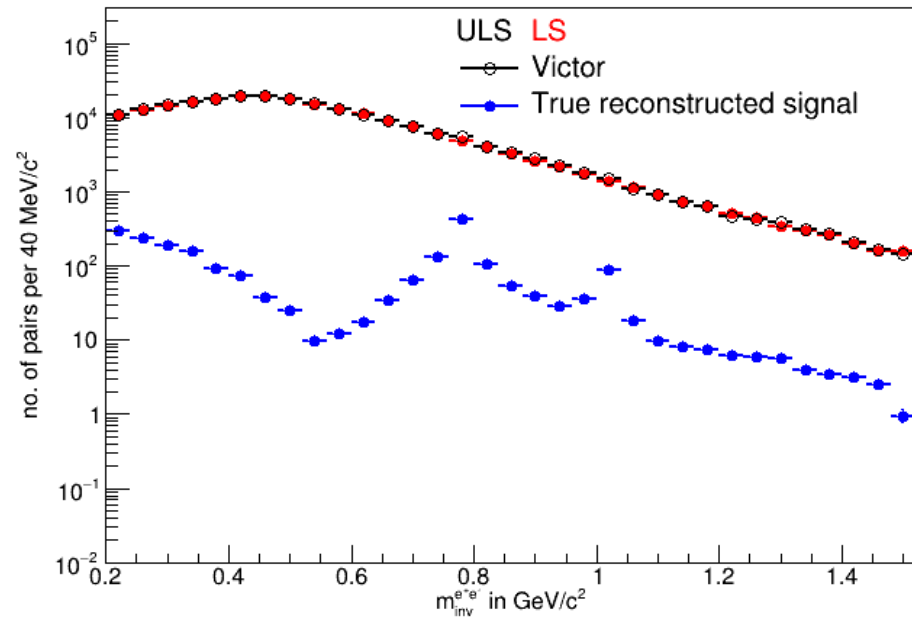
S/B: 0.024; $S/\sqrt{(S+B)}$: 3.9

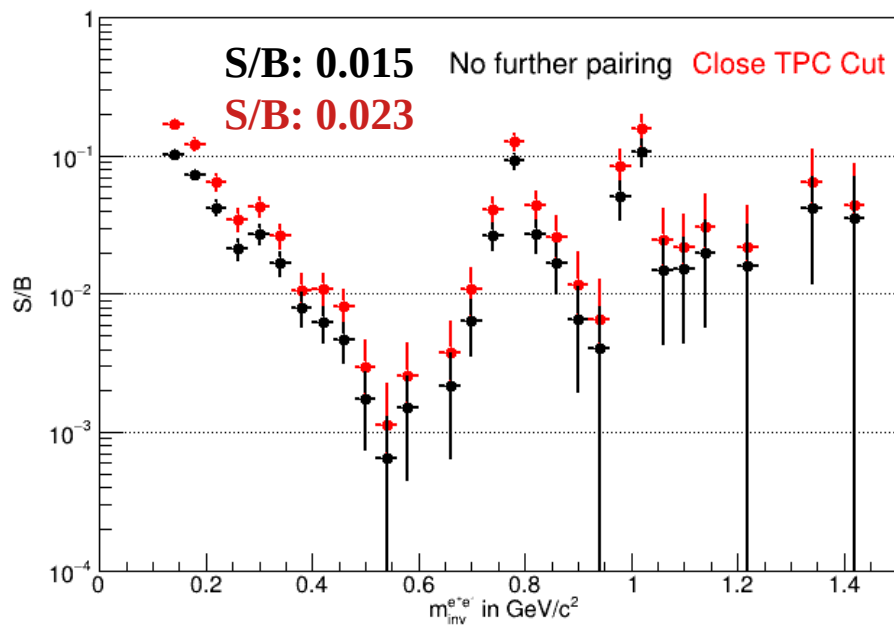
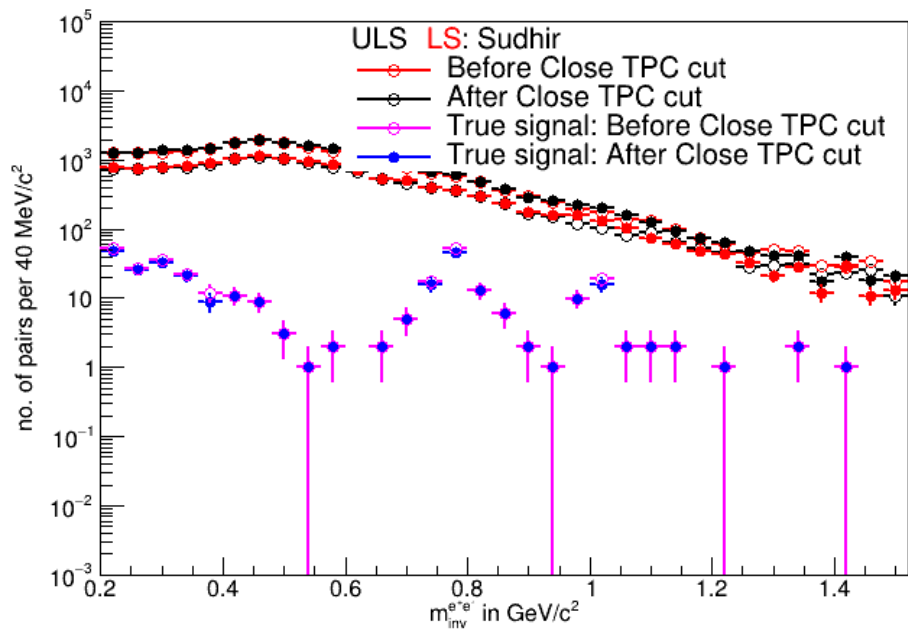
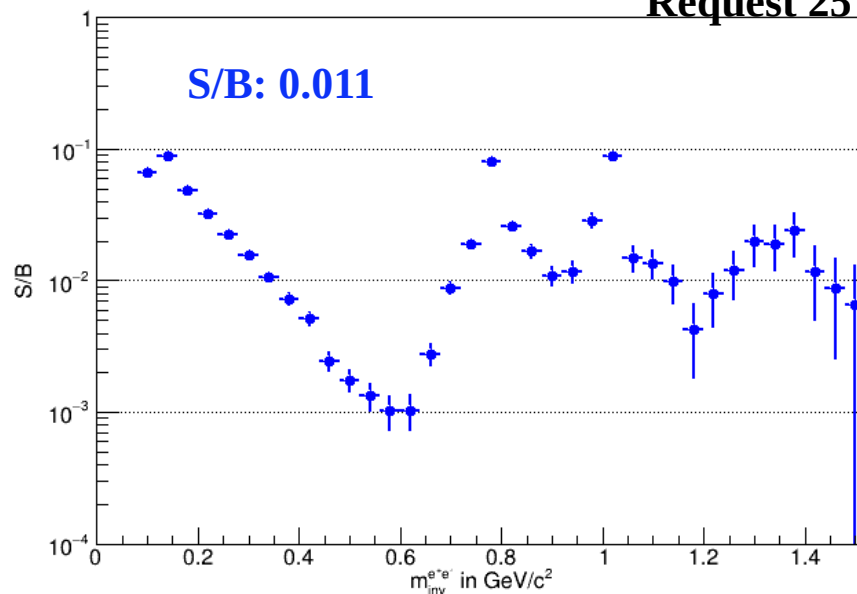
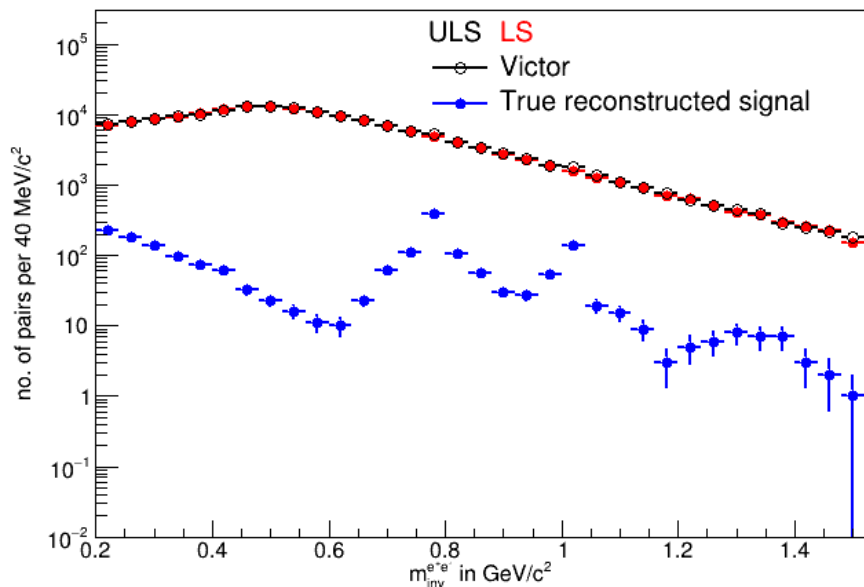
S/B: 0.038; $S/\sqrt{(S+B)}$: 4.7

S/B: 0.047; $S/\sqrt{(S+B)}$: 4.1

Gamma cut: No further pairing of the electrons whose invariant mass with photon is between 0.1 and 0.14 GeV/c²







Next Steps

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Track has Partner with pT < 35 MeV: ===== 30487

Track has Partner with pT > 100 MeV: ===== 29903

Rest: ===== 15943

-321 K^{-} ===== 178

-13 mu ===== 2

-11 e^{+} ===== 148

11 e^{-} ===== 2

22 photon ===== 7360

111 #pi^{0} - partner is outside TPC acceptance ===== 5029

113 SIGNAL: #rho^{0} ===== 411

130 K_{L}^{0} ===== 521

221 #eta - partner is outside TPC acceptance ===== 430

223 SIGNAL: omega ===== 1360

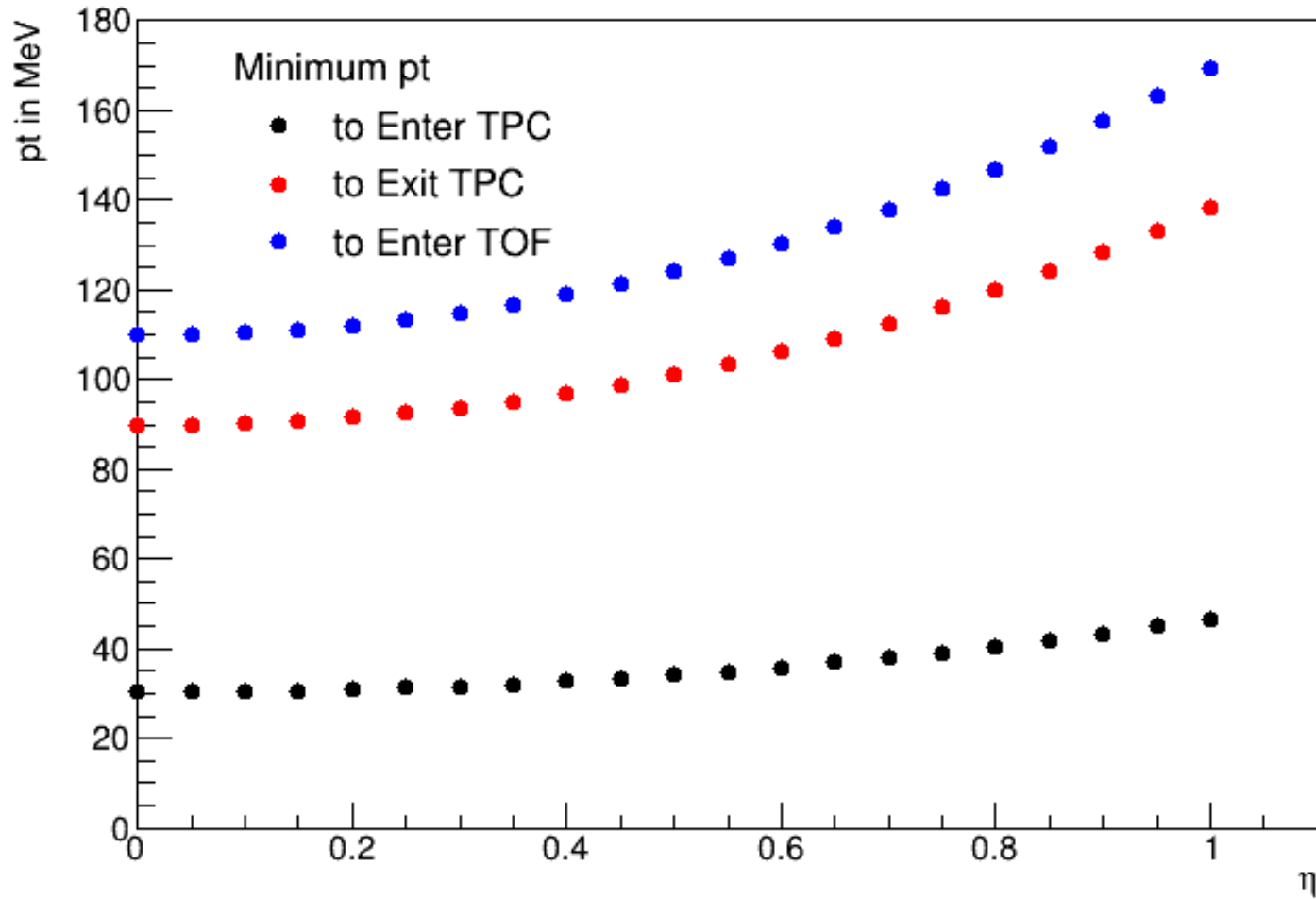
321 K^{+} ===== 320

331 eta^{'} ===== 26

333 SIGNAL: #phi ===== 160
=====

- Trying to understand the origin of remaining background after close TPC cut.

Minimum pt required to enter or exit TPC and TOF



Assuming the TPC Inner radius to be 40.3 cm and outer radius to be 119.5 cm as well as TOF inner radius is 146.5 cm which is taken from its TDR.

Minimum pt (in MeV) to enter TPC and TOF and exit TPC in various eta regions

Eta	theta	Min. Rad. of curv at TPC entrance	Min. pt to enter TPC	Min. Rad. of curv. at TPC exit	Min. pt to exit TPC	Min. Rad. at TOF entrance	Min. pt to enter TOF
0.000	90.00	20.15	30.22	59.75	89.62	73.25	109.88
0.050	87.14	20.18	30.26	59.82	89.74	73.34	110.01
0.100	84.28	20.25	30.38	60.05	90.07	73.62	110.42
0.150	81.44	20.38	30.57	60.42	90.64	74.08	111.11
0.200	78.62	20.55	30.83	60.95	91.42	74.72	112.08
0.250	75.82	20.78	31.17	61.63	92.44	75.55	113.33
0.300	73.06	21.06	31.60	62.46	93.69	76.57	114.86
0.350	70.34	21.40	32.10	63.45	95.17	77.78	116.67
0.400	67.67	21.78	32.68	64.59	96.89	79.19	118.78
0.450	65.05	22.22	33.34	65.90	98.85	80.79	121.19
0.500	62.48	22.72	34.08	67.38	101.06	82.60	123.90
0.550	59.97	23.28	34.91	69.02	103.53	84.61	126.92
0.600	57.52	23.89	35.83	70.83	106.25	86.84	130.25
0.650	55.13	24.56	36.84	72.82	109.23	89.28	133.91
0.700	52.82	25.29	37.94	75.00	112.49	91.94	137.91
0.750	50.57	26.09	39.13	77.36	116.04	94.84	142.25
0.800	48.39	26.95	40.42	79.91	119.87	97.97	146.95
0.850	46.29	27.88	41.82	82.67	124.00	101.34	152.02
0.900	44.25	28.88	43.32	85.63	128.44	104.97	157.46
0.950	42.29	29.95	44.92	88.80	133.20	108.87	163.30
1.000	40.40	31.09	46.64	92.20	138.30	113.03	169.55
1.050	38.57	32.32	48.47	95.83	143.74	117.48	176.22
1.100	36.82	33.62	50.43	99.69	149.54	122.22	183.33
1.150	35.14	35.01	52.51	103.8	155.72	127.27	190.90
1.200	33.52	36.48	54.73	108.2	162.28	132.63	198.95

NOTE: TPC Inner (40.3 cm) and outer radius (119.5 cm) values are taken from the analysis code and TOF inner radius (146.5 cm) value is taken from its TDR.