Update on Dielectron analysis with MPD

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MPD Cross-PWG meeting

Content

- Optimization of fiducial and veto acceptance
- A look at the Low B sample.
- Conclusions

Analysis Strategy

$\Rightarrow$ Three electron pools:

$\rightarrow$ Pool-1 - fully reconstructed tracks[1] in fiducial area ($|\eta| < \mathbf{0.7}$) - $p_{\mathrm{T}} \gtrapprox 110$ MeV/c

$\rightarrow$ Pool-2 - fully reconstructed tracks in veto area $\mathbf{0.7} < |\eta| < \mathbf{1.0}$ - $p_{\mathrm{T}} \gtrapprox 110$ MeV/c.

$\rightarrow$ Pool-3 with tracks reconstructed in TPC.

- $p_{\mathrm{T}} <= 110$ MeV/c $\rightarrow$ not reaching the TOF.
- $p_{\mathrm{T}} > 110$ MeV/c $\rightarrow$ reaching the TOF.

- Step 1 - No further pairing (NFP): Tagging between Pool 1 and Pool 2.
- Step 2 - Close TPC cut (CTC): Tagging between Pool 1 and 3, and pairs within certain M_{inv} and opening angle are removed.
- Step 3: Rest of the tracks with $p_{\mathrm{T}} > 200$ MeV from Pool-1 are paired among themselves to build ULS and LS pair spectra.

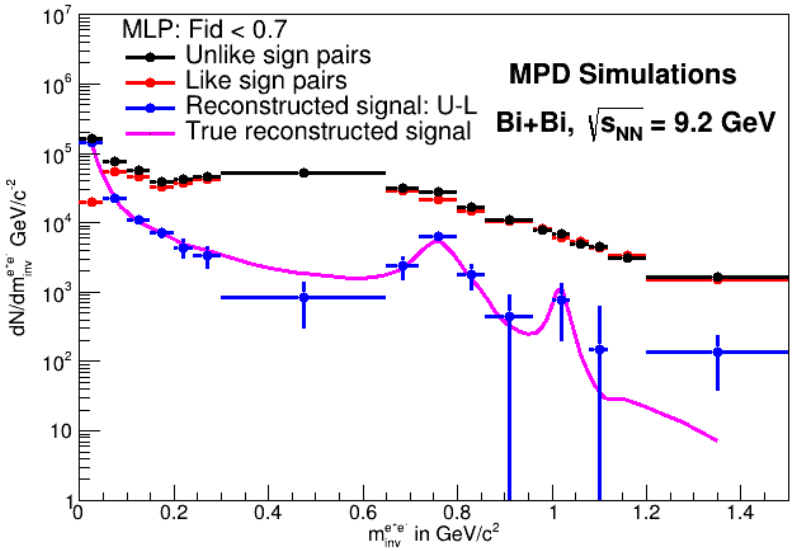
[1] TOF and ECal matched tracks identified in the TPC, TOF and ECal

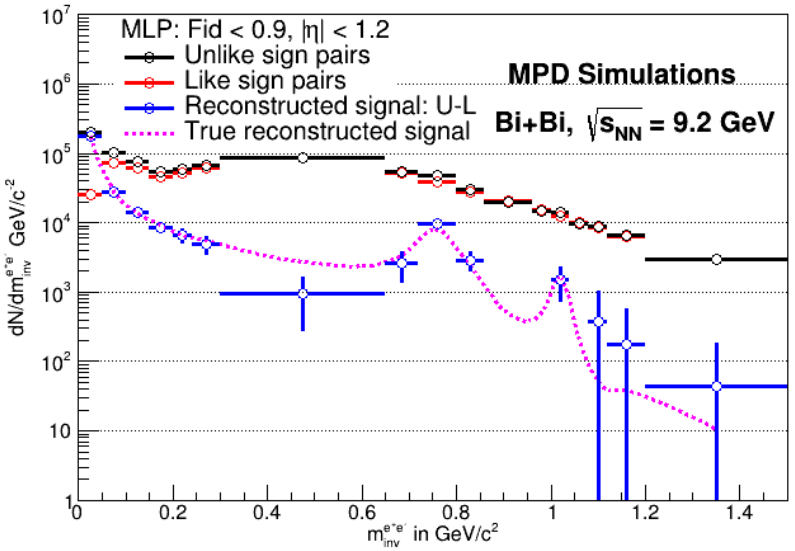
MLP: Req. 34 (12.1M except Fid. < 0.6: 11.6M) Invariant mass: 0.2 to 1.5 GeV

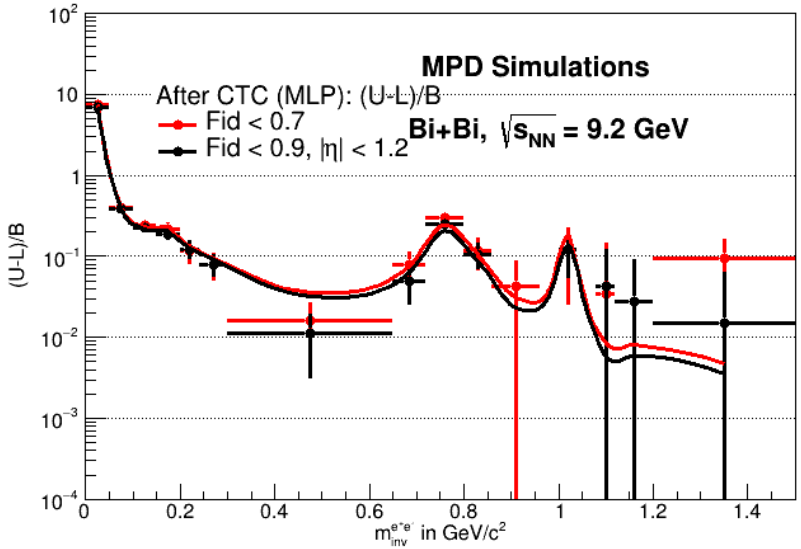
	Fid. $<$ 0.6	Fid. $<$ 0.7	Fid. $<$ 0.75	Fid. $<$ 0.8	Fid. $<$ 0.85	Fid. $<$ 0.9
U	21491±147	30976±176	35688±189	40566±201	45954±214	51297±226
B	20504±143	29455±172	34026±184	38863±197	44052±210	49267±222
U-B	987±205	1521±246	1663±264	1703±282	1902±300	2030±317
(U-B)/B	**4.81±0.05**	**5.16±0.04**	**4.89±0.04**	**4.38±0.03**	**4.32±0.03**	**4.12±0.03**
BFE	23	38	40	37	40	41
S	1359	1860	2071	2314	2534	2724
S/B	**6.63**	**6.31**	**6.09**	**5.95**	**5.75**	**5.53**
BFE	44	57	61	67	71	73

- B - Combinatorial background approximated by like sign pairs.
- Fiducial acceptance was varied from $|\eta| < 0.6$ to 0.9.
- The signal increases with acceptance but the background increases faster and consequently S/B decreases.
- Measured signal is underestimated compared to true reconstructed signal.

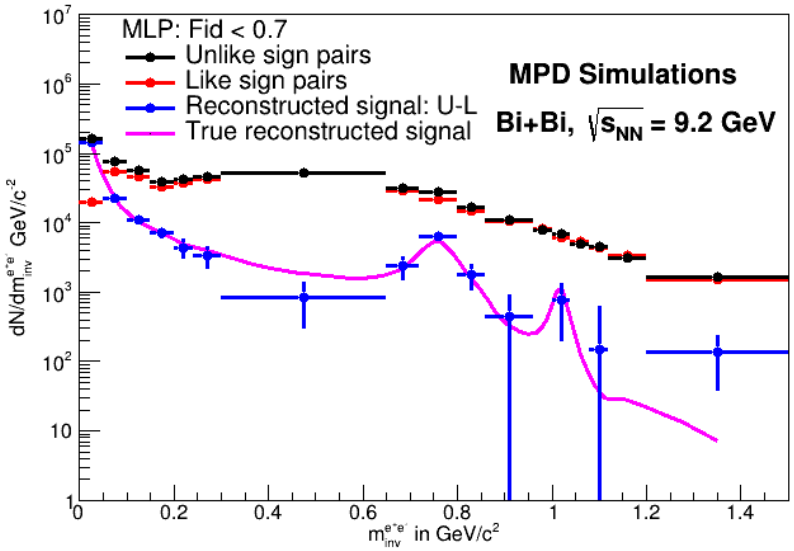
ULS, LS and Signal: MLP (Fid < 0.7) and (Fid < 0.9, $|\eta| < 1.2$)

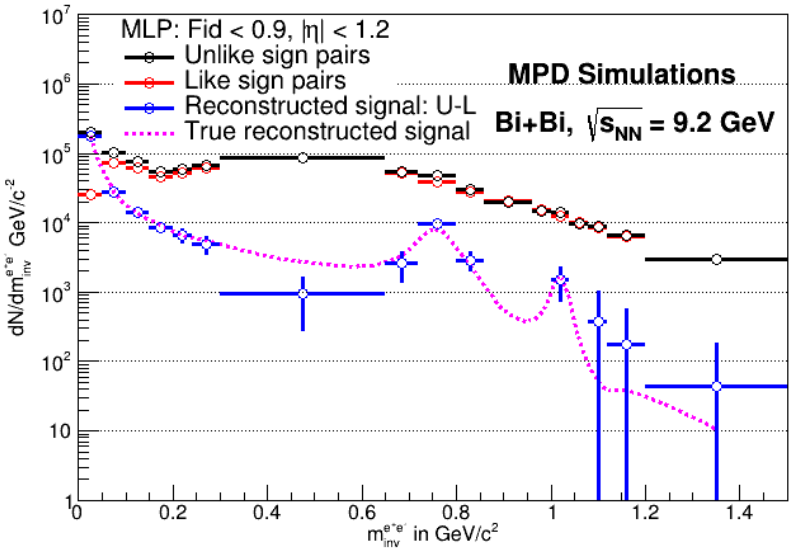


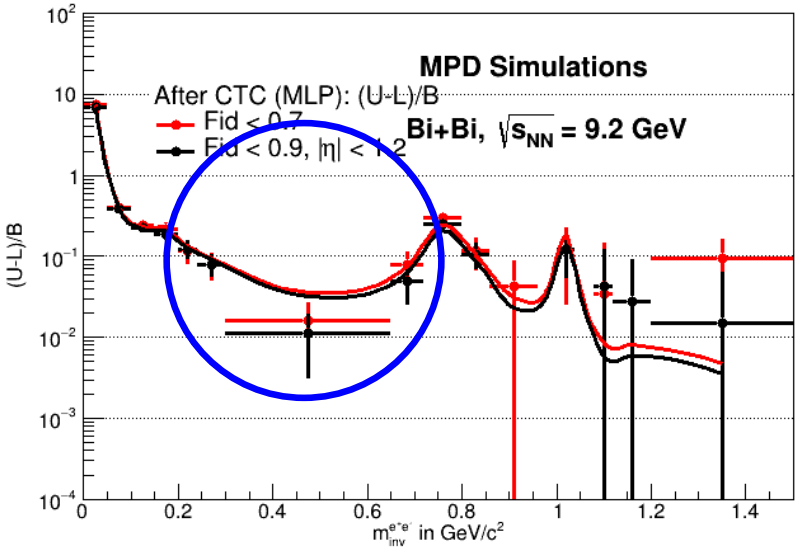




ULS, LS and Signal: MLP







MLP: Req. 34 (12.1M except Fid. $<$ 0.6: 11.6M) Invariant mass: 0.65 to 1.5 GeV

	Fid. $<$ 0.6	Fid. $<$ 0.7	Fid. $<$ 0.75	Fid. $<$ 0.8	Fid. $<$ 0.85	Fid. $<$ 0.9
U	5485±74	8259±91	9724±99	11212±106	12941±114	14874±122
B	4920±70	7406±86	8739±93	10232±101	11917±109	13736±117
U-B	566±102	852±125	985±136	980±146	1025±158	1138±169
(U-B)/B	**11.50±0.23**	**11.51±0.18**	**11.27±0.17**	**9.57±0.13**	**8.60±0.11**	**8.28±0.10**
BFE	31	46	53	45	42	45
S	562	774	876	971	1074	1167
S/B	**11.42**	**10.45**	**10.03**	**9.49**	**9.01**	**8.49**
BFE	30	38	42	44	46	48

- B - Combinatorial background approximated by like sign pairs.
- Same numbers as previous table but for 0.65 GeV $< m_{inv}^{e^+e^-} <$ 1.5 GeV.
- The measured signal and true reconstructed signal are close to each other in this region.

MLP: Req. 34 (12.1M except Fid. < 0.6: 11.6M) Invariant mass: 0.2 to 0.65 GeV

	Fid. $<$ 0.6	Fid. $<$ 0.7	Fid. $<$ 0.75	Fid. $<$ 0.8	Fid. $<$ 0.85	Fid. $<$ 0.9
U	16005±127	22717±151	25965±161	29354±171	33012±182	36423±191
B	15584±125	22048±148	25287±159	28630±169	32135±179	35531±188
U-B	421±178	669±212	678±226	724±241	877±255	892±268
(U-B)/B	**2.70±0.03**	**3.03±0.03**	**2.68±0.02**	**2.53±0.02**	**2.73±0.02**	**2.51±0.02**
BFE	6	10	9	9	12	11
S	796	1086	1195	1343	1460	1557
S/B	**5.11**	**4.93**	**4.73**	**4.69**	**4.54**	**4.38**
BFE	20	26	28	31	32	33

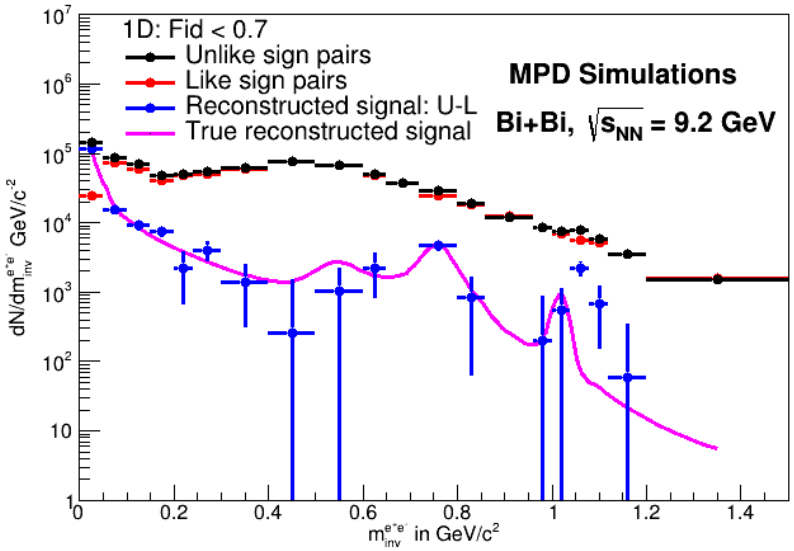
- B - Combinatorial background approximated by like sign pairs.
- Same numbers for 0.2 GeV $< m_{inv}^{e^+e^-} <$ 0.65 GeV.
- Similar underestimation of measured signal.
- Deficit seems to remain intact even in case of two independent samples: e.g. (Fid < 0.7) and (Fid < 0.9 - Fid < 0.7).
- Statistics or systematic?

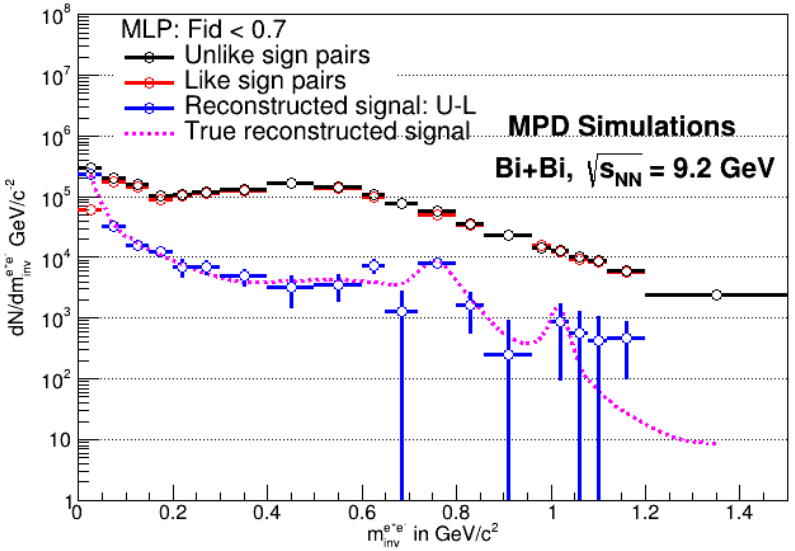
Production Request 25 (31M): Fid. < 0.7

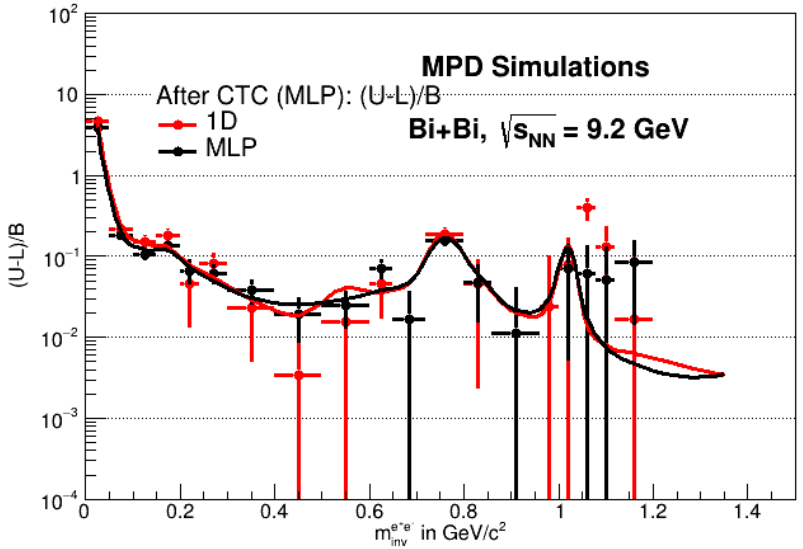
	1D 0.2 to 1.5 GeV/c2	MLP 0.2 to 1.5 GeV/c2	1D 0.2 to 0.65 GeV/c2	MLP 0.2 to 0.65 GeV/c2	1D 0.65 to 1.5 GeV/c2	MLP 0.65 to 1.5 GeV/c2
U	37561±194	79304±282	29483±172	64071±253	9736±99	18742±137
B	36329±191	76174±276	28767±170	61803±249	9210±96	17794±133
U-B	1232±272	3130±394	716±241	2268±355	526±138	948±191
(U-B)/B (%)	**3.39±0.02**	**4.11±0.02**	**2.49±0.02**	**3.67±0.02**	**5.71±0.08**	**5.33±0.06**
BFE	21	63	9	41	15	25
S	1647	3291	1025	2130	656	1244
S/B (%)	**4.53**	**4.32**	**3.56**	**3.45**	**7.12**	**6.99**
BFE	37	70	18	36	23	42

- B is combinatorial background approximated by like sign pairs.
- Similar numbers from previous results with request 25 production.
- Slight underestimation in case of 1D cuts, but within uncertainties, there is none in case of MLP.
- Hinting towards statistics issue in Request 34: though strong claim to be made after the check with more statstics.

ULS, LS and Signal: Req 25: 1D and MLP



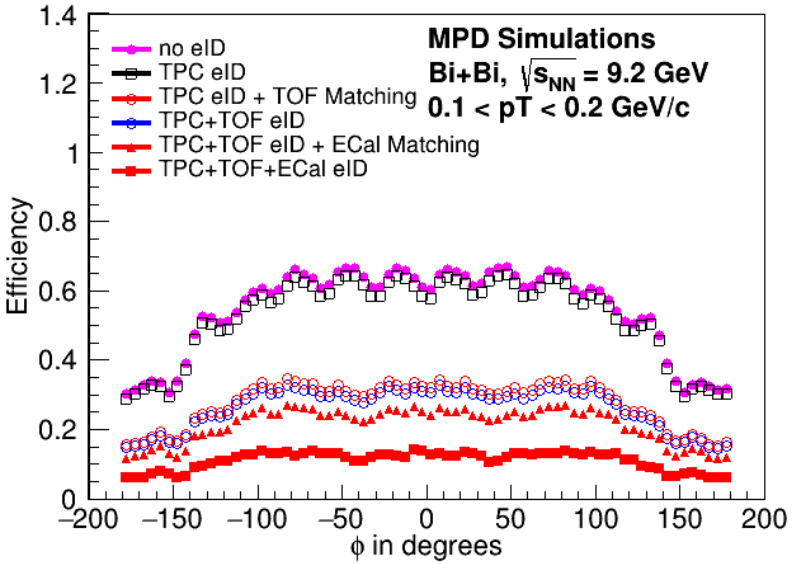


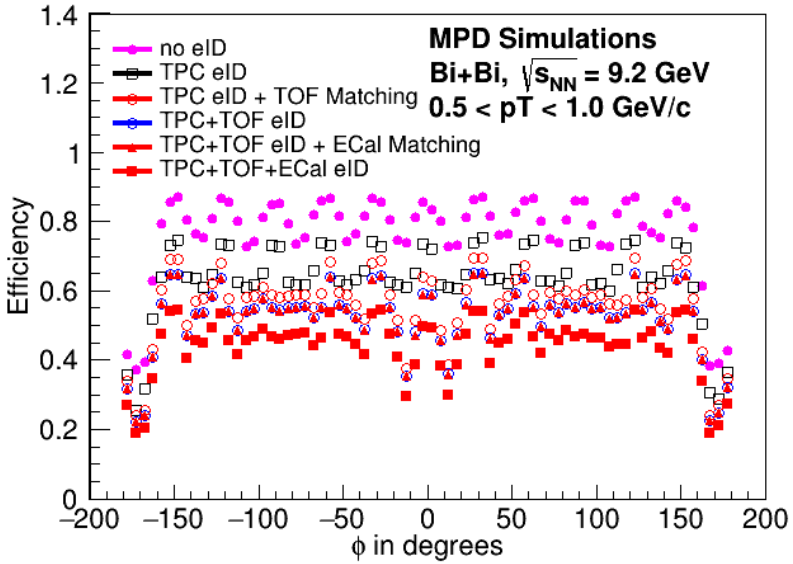


What can be done?

- The underestimate of the yield in the low mass region seems to be statistics.
- Would be interesting to have a new production with higher statistics.
- Similar to ρ, ω and ϕ decays, enhance η-Dalitz decays by some factor: Not as as large as 20 factor (e.g. 4 or 5).

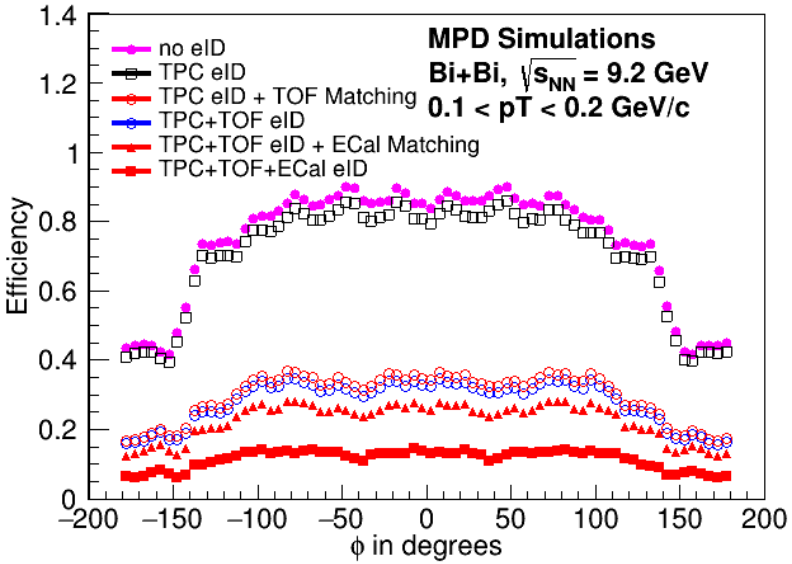
Efficiency using 1D cuts: ϕ-dependence: Nhits $>$ 39

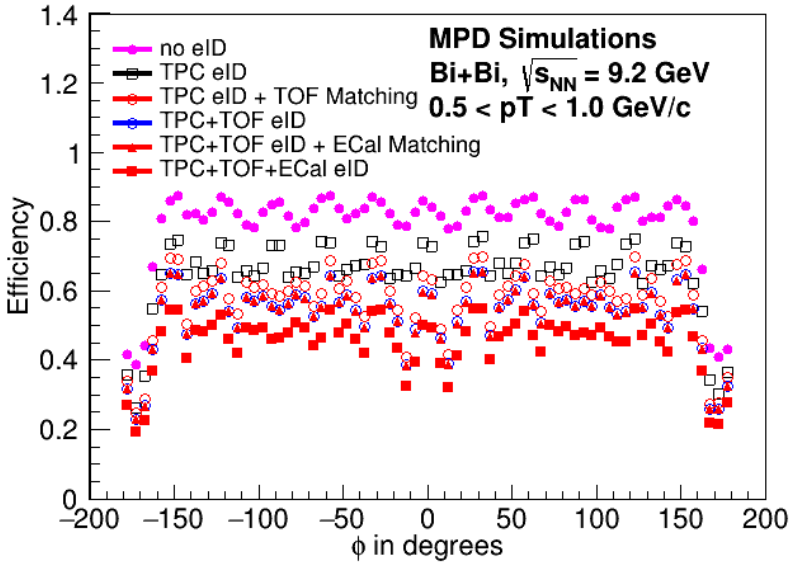




- ϕ dependence of the electron reconstruction efficiency was studied.
- TPC sector boundaries along edge effect affect the efficiency and effect is significant for high pT tracks.
- For better understanding of the problem, it may be helpful to look at information available for such cases in the TPC.

Efficiency using 1D cuts: ϕ-dependence: Nhits $>$ 20





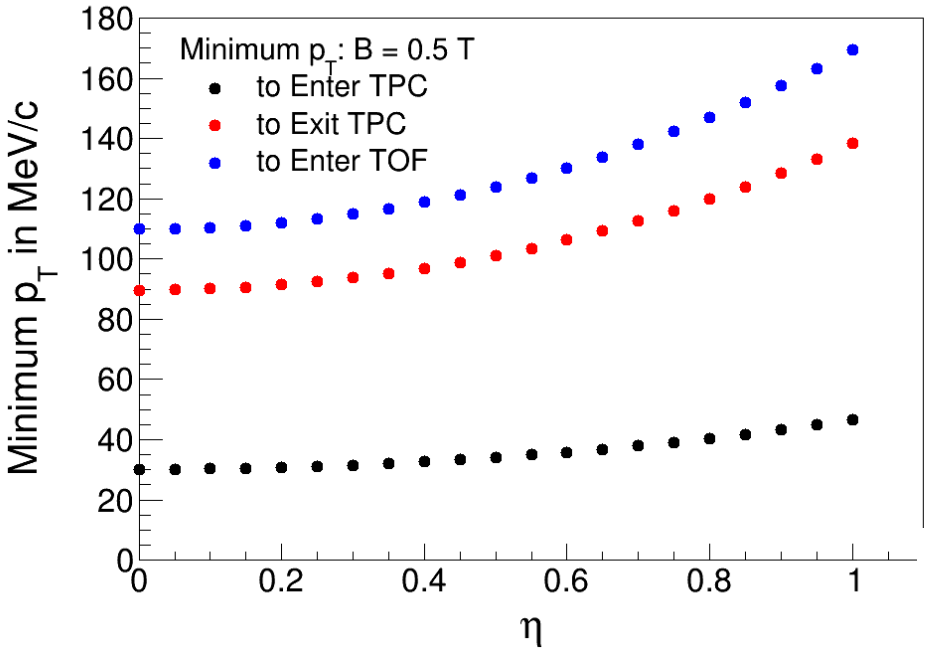
- ϕ dependence of the electron reconstruction efficiency was studied.
- TPC sector boundaries along edge effect affect the efficiency and effect is significant for high pT tracks.
- For better understanding of the problem, it may be helpful to look at information available for such cases in the TPC.
- For now, one can try to reduce the effect by lowering the lower limit on number of hits conditions (e.g from 39 to 20).

Prospects of using Low B sample (B = 0.2T) for dielectrons

Low B sample in dielectron analysis

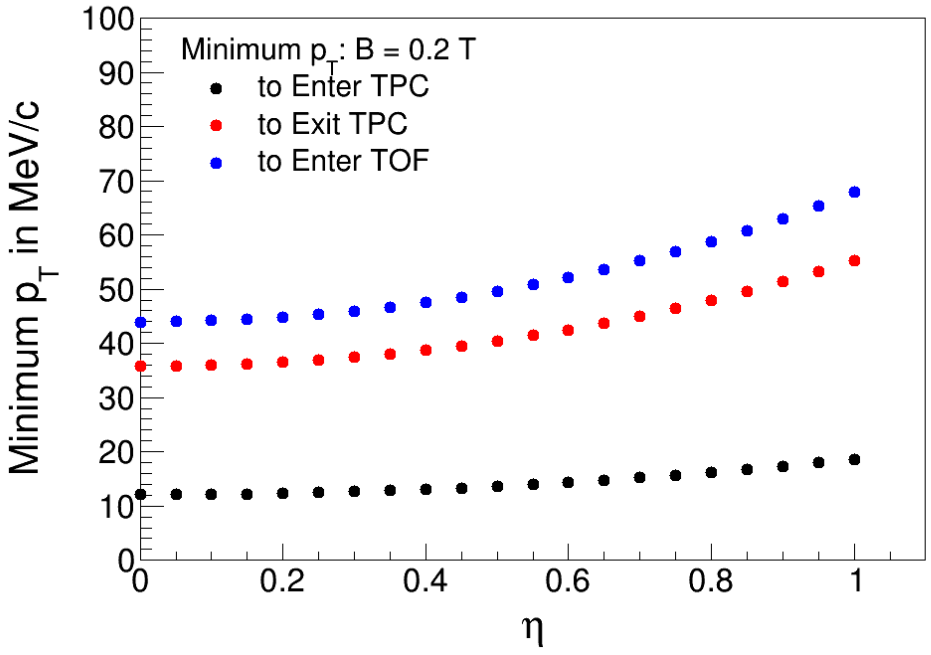
- It was suggested to use the low B sample in the dielectron analysis.
- As it would help in better reconstruction of low p_{T} tracks.
- Request 28: 10M events.
- New parameterizations were obtained for these studies.

Low B: Minimum p_T to enter or exit the TPC

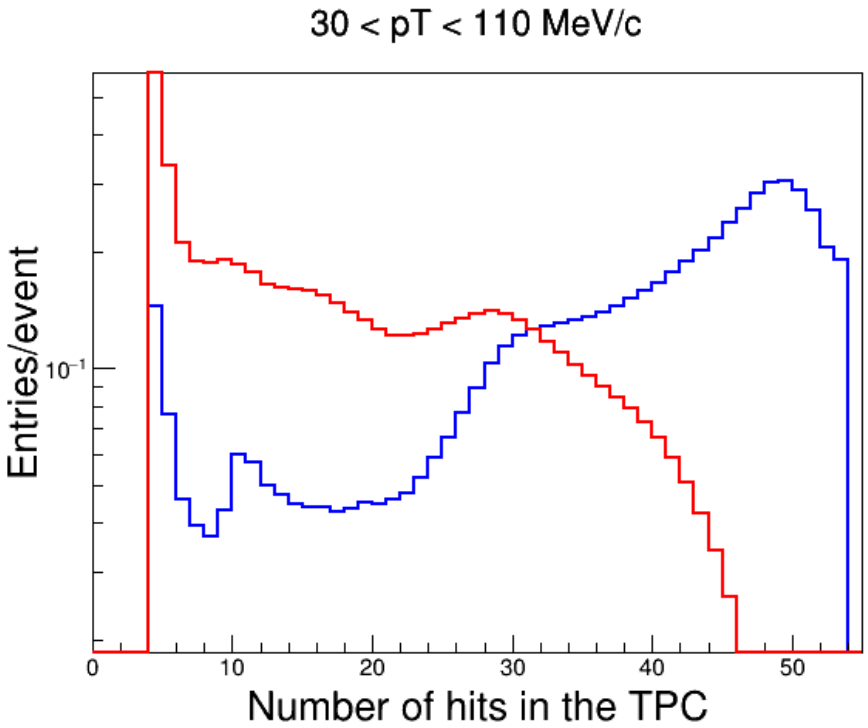


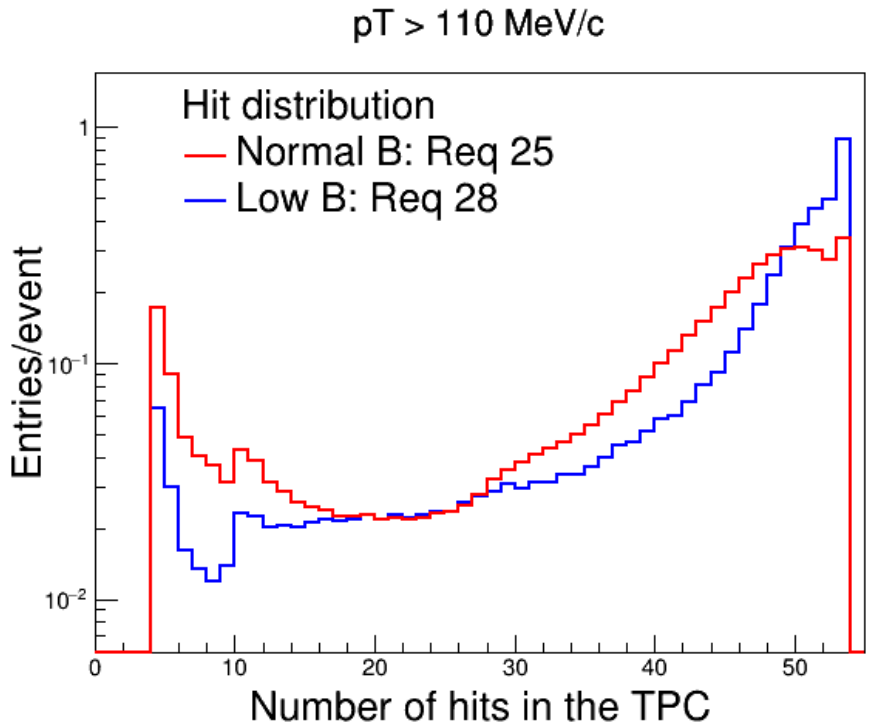
Cut-offs to enter or exit the TPC decreased with low B sample ($|\eta| \approx 0$).

- 30 MeV/c $\rightarrow \approx$ 10 MeV/c.
- 90 MeV/c $\rightarrow \approx$ 35 MeV/c.
- 110 MeV/c $\rightarrow \approx$ 45 MeV/c.



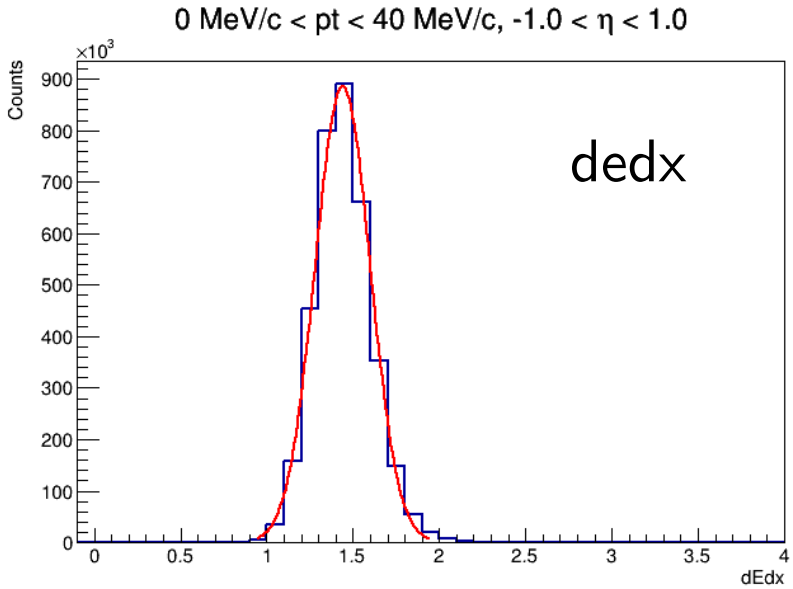
Low and Normal B: Hit distributions

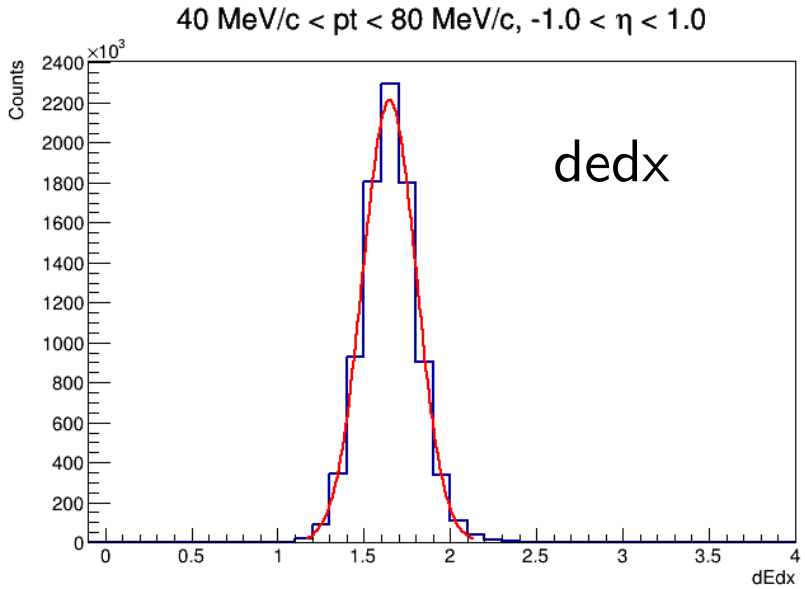


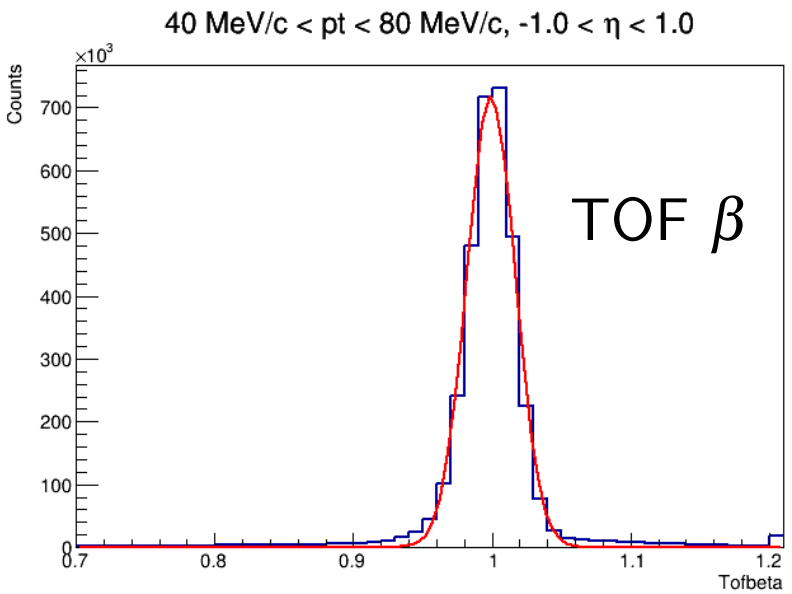


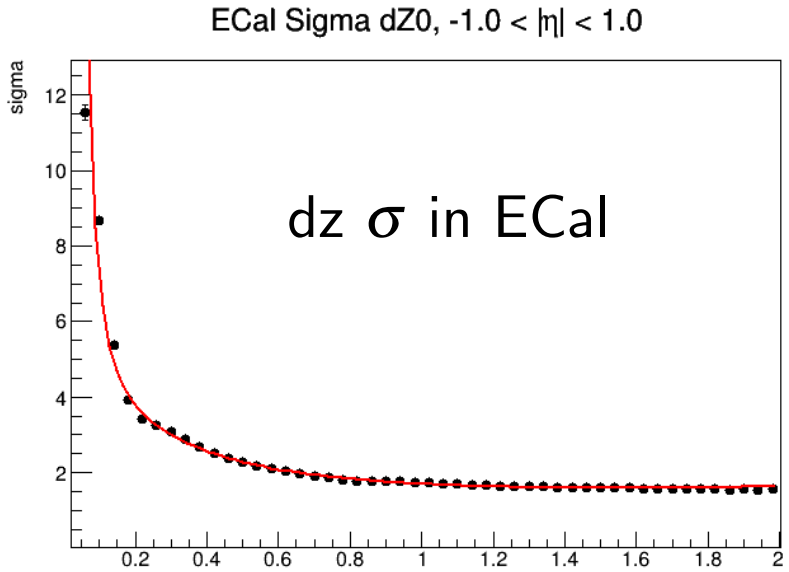
- As expected, less bending of the tracks provides better hit reconstruction at low and intermediate p_{T}.

Parameterizations

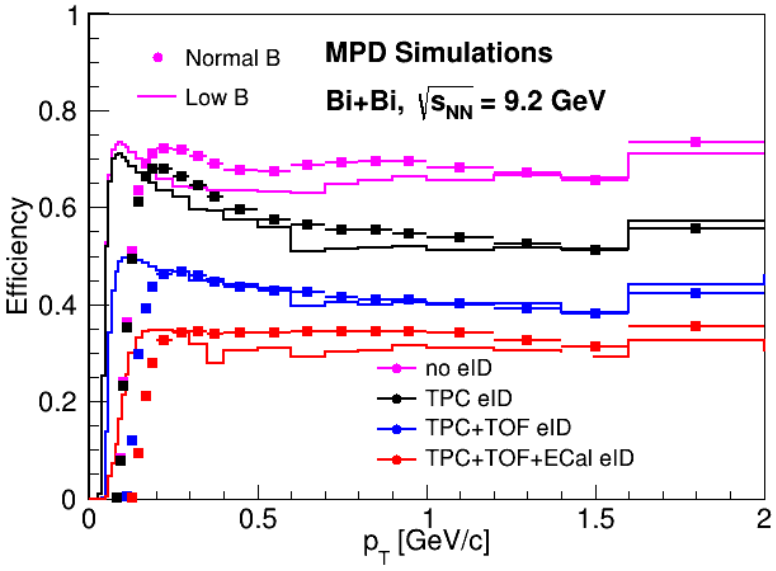


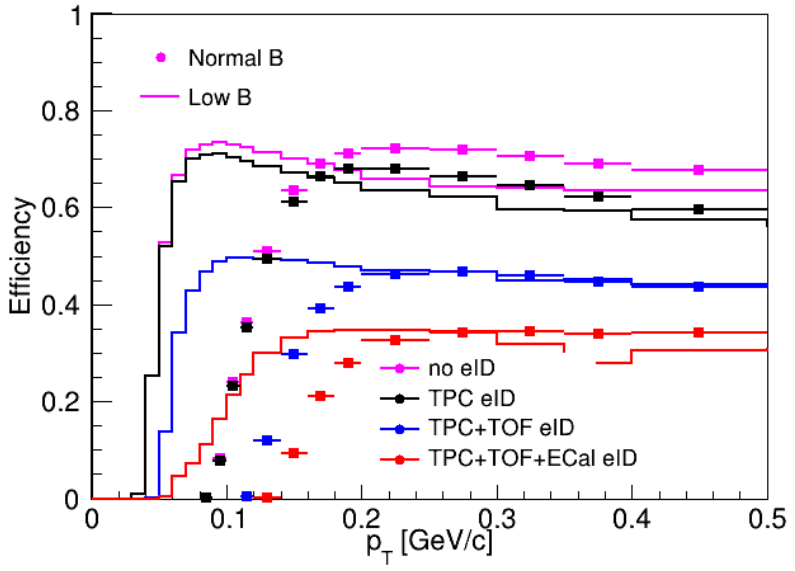




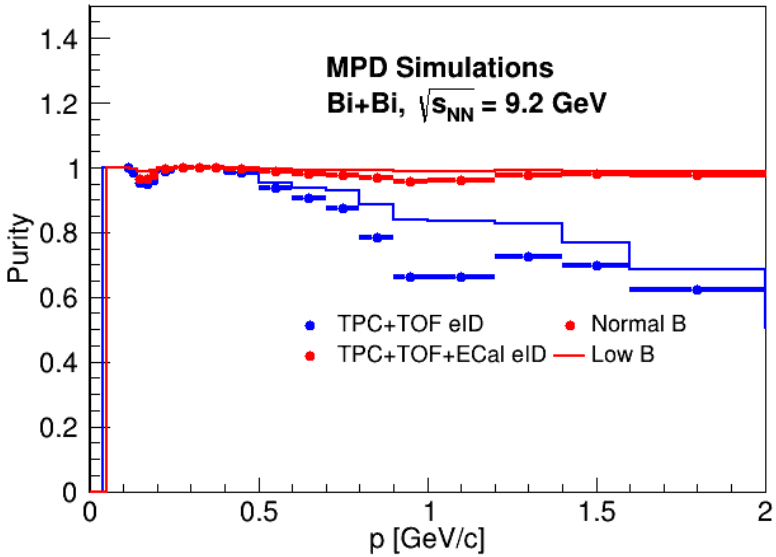


Low (Req28) and Normal (Req25) B

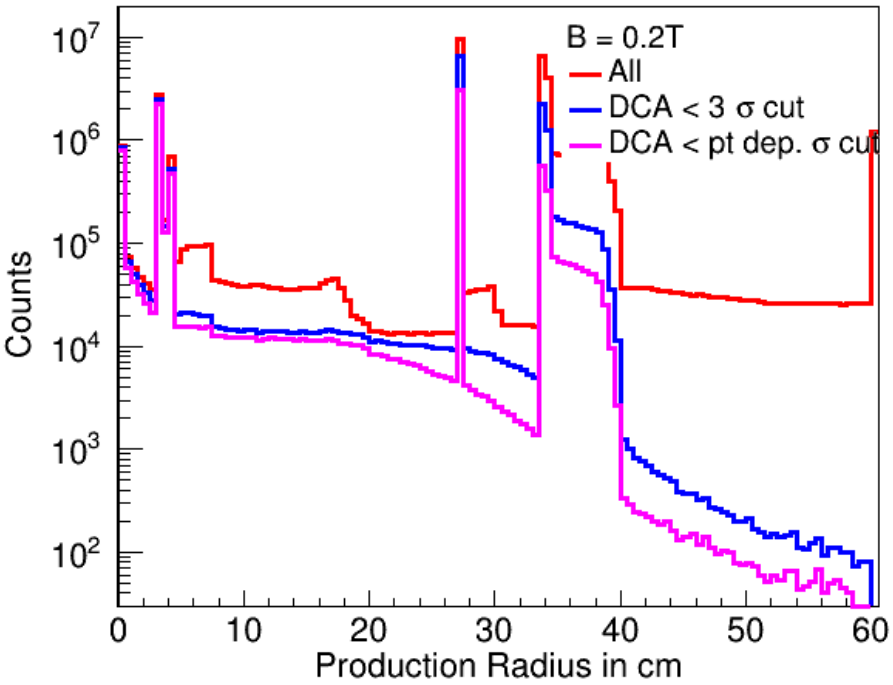




Low p_T electron tracking is improved along with similar purity, however, there is an issue.

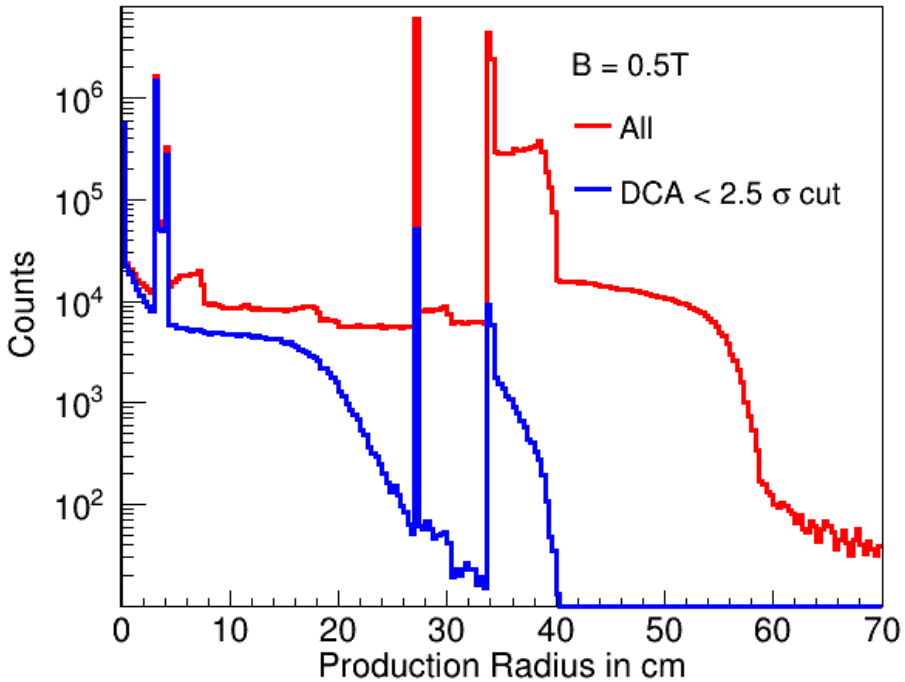


Low B

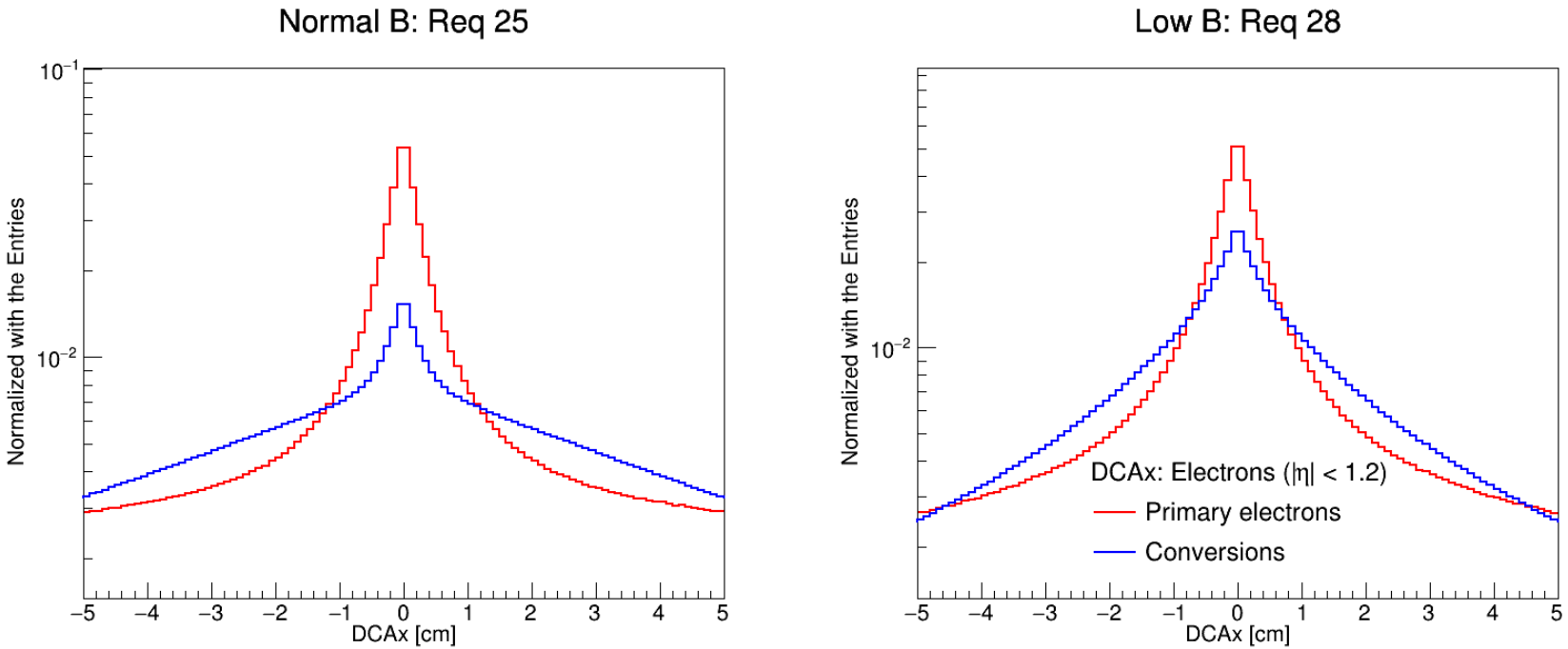


This would lead to significant increase in combinatorial background.

Conversions at large production radii are not rejected despite applying tight DCA selections.



Low and Normal B: DCAx distributions (Electrons within $|\eta| < 1.2$)



I. Secondaries (here, conversions electrons) have wider DCA in Low B compared Normal B.

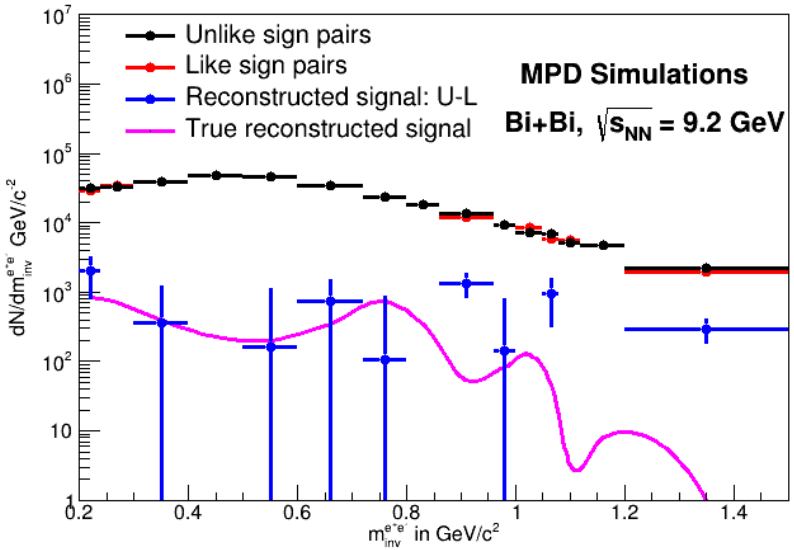
II. Shape of primary electrons (all electrons except conversions) have similar shapes.

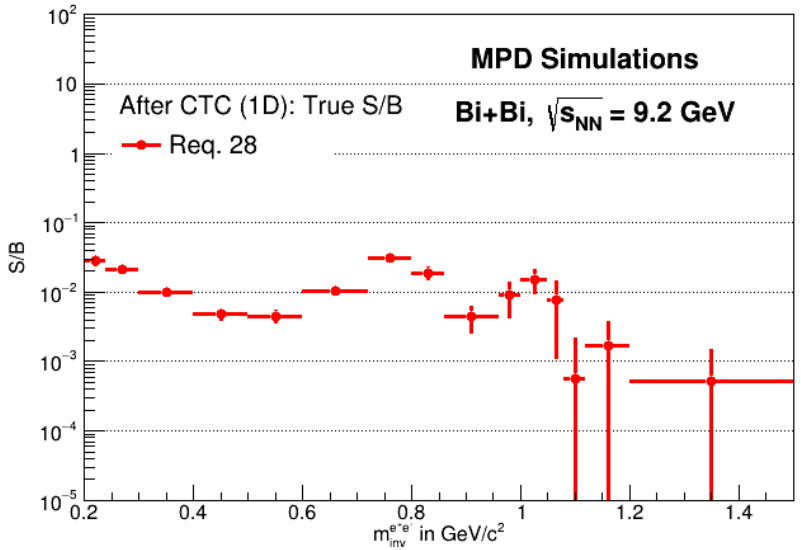
1D (Fid. < 0.7) Req. 25: B = 0.5T (31M), Req. 28: B = 0.2T (8M) Invariant mass: 0.2 to 1.5 GeV

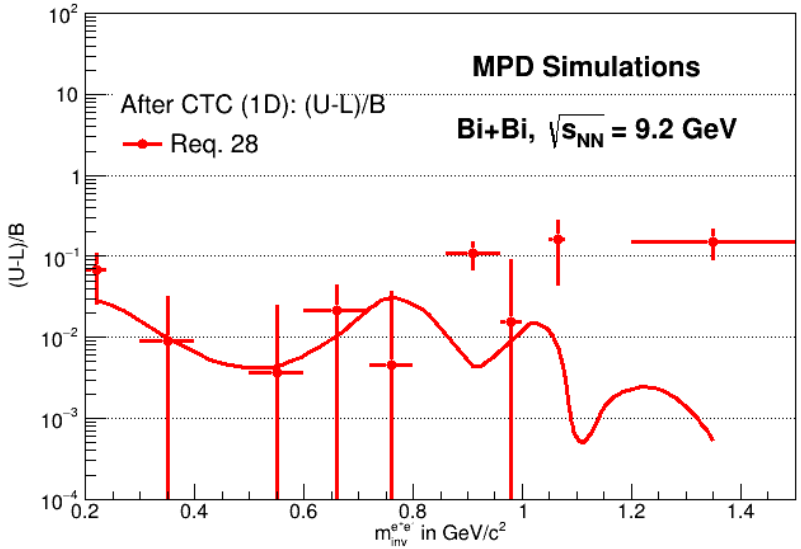
	Bef. No Further Pairing	Aft. No Further Pairing	Aft. Close TPC Cut
Invariant Mass in MeV	-	120	80
Opening Angle in degrees	-	-	10 (5)
U	113926±338	87733±296	37544±194
U	85825±293	57670±240	27190±165
B	113055±336	86901±295	36316±191
B	85369±292	57348±239	26840±164
U-B	871±476	832±418	1228±272
U-B	456±414	322±339	350±232
(U-B)/B (%)	**0.77±0.00**	**0.96±0.00**	**3.38±0.02**
(U-B)/B (%)	**0.53±0.00**	**0.56±0.00**	**1.30±0.01**
BFE	3	4	20
BFE	1	1	2
S	1793	1774	1647
S	348	317	297
S/B (%)	**1.59**	**2.04**	**4.54**
S/B (%)	**0.41**	**0.55**	**1.11**
BFE	14	18	37
BFE	1	1	2

- B - Combinatorial background approximated by like sign pairs.

ULS, LS and Signal: 1D







Conclusions

- In dielectron analysis, optimization of fiducial and veto region is being studied.
- Signal increases with wide fiducial acceptance but background increases faster: more investigation needed.
- Reconstructed signal between 0.2 to 0.65 GeV/c is underestimated: previous results with production 25 hinting towards statistics issue.
- Perhaps, enhancement of η−Dalitz decays might help reconstructing the signal in low mass region.
- TPC sector boundaries and edge effect, affects efficiency: can improve a bit by reducing the number of hits condition.
- Low magnetic field provides better track reconstruction of low pT tracks $\rightarrow$ at the cost of poor conversion rejection, and worse momentum and mass resolution.
- S/B ratio is worse than Normal B scenario (Request 25) due to large CB from conversions: however, the tuning of the pair reconstruction cuts suitable for low B might bring some improvement.

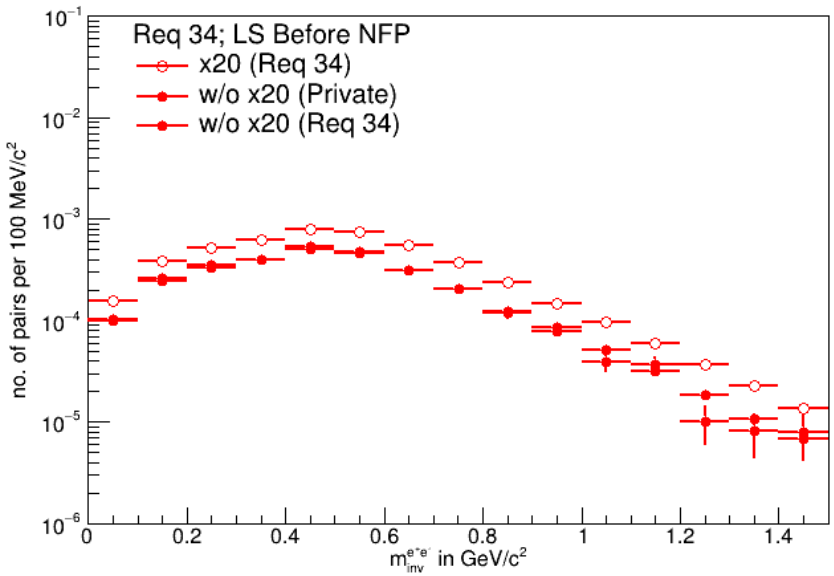
THANK YOU

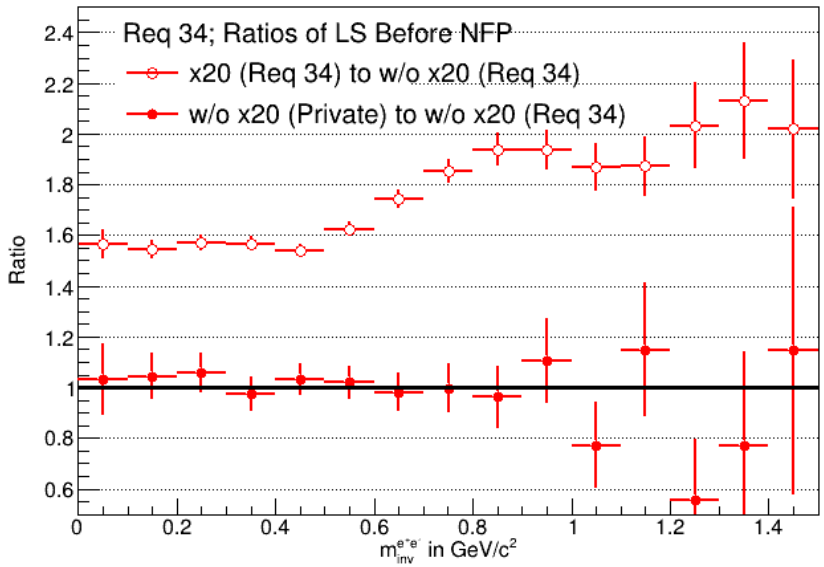
BACK-UP

What can be done?

- Similar to ρ, ω and ϕ decays, enhance η-Dalitz decays by 20 or less factor.
- However, firstly, one needs to check if 20 factor enhancement in request 34 and susequent reweighting has brought any distortion to the ULS and LS spectra.
- For this check, along with Request 25 and Request 34 sample, a private production of half a million events was generated without enhancing the branching ratio.
- Rest of the details were kept same as Request 34.

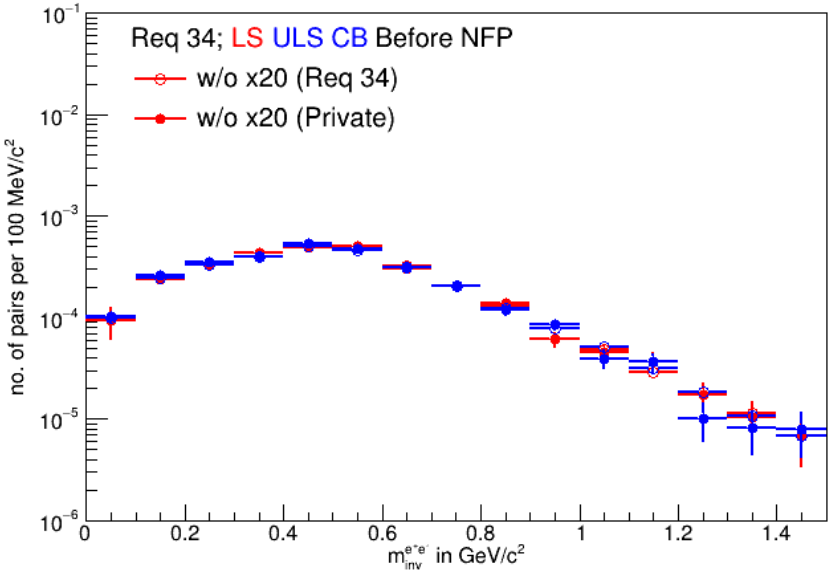
Comparision between LS: Private (547K events)

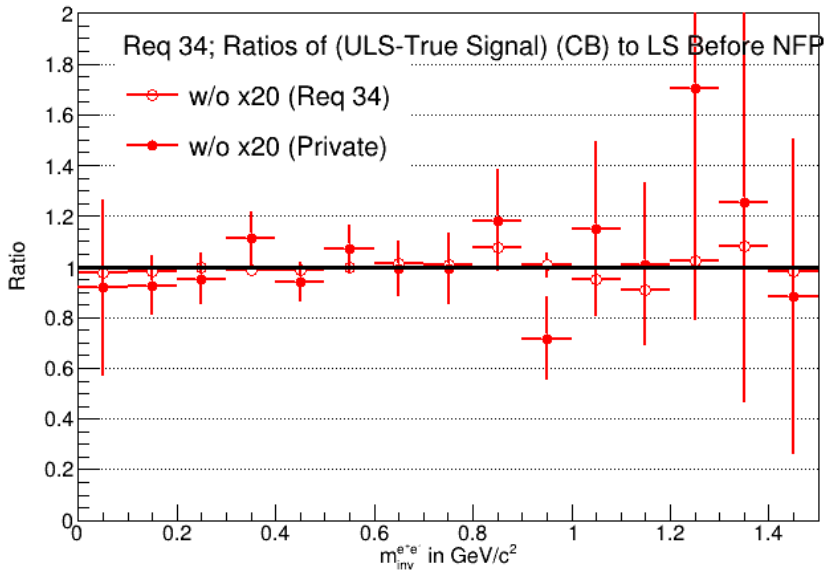




- No flat enhancement in LS after 20 factor.
- LS after reweighting back 20 factor have simialr shape as without enhancement case.

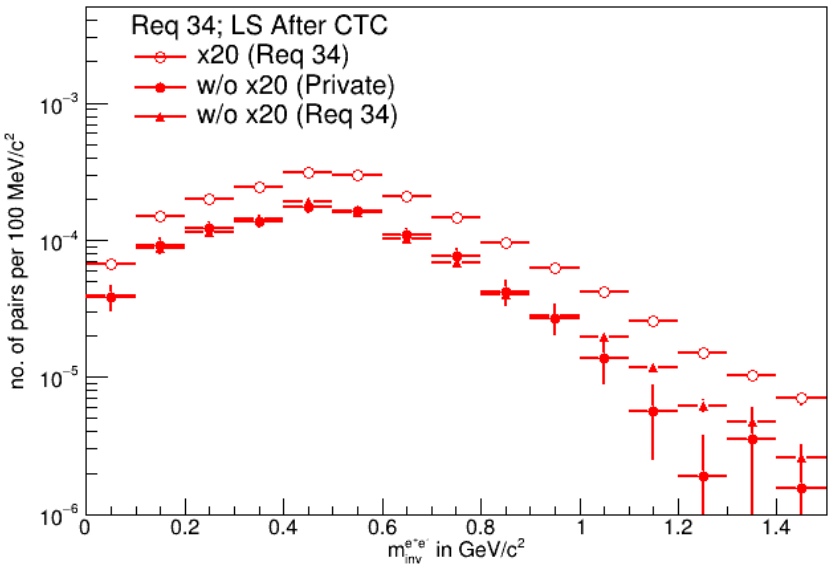
Comparision between LS and (ULS-TrueSignal)

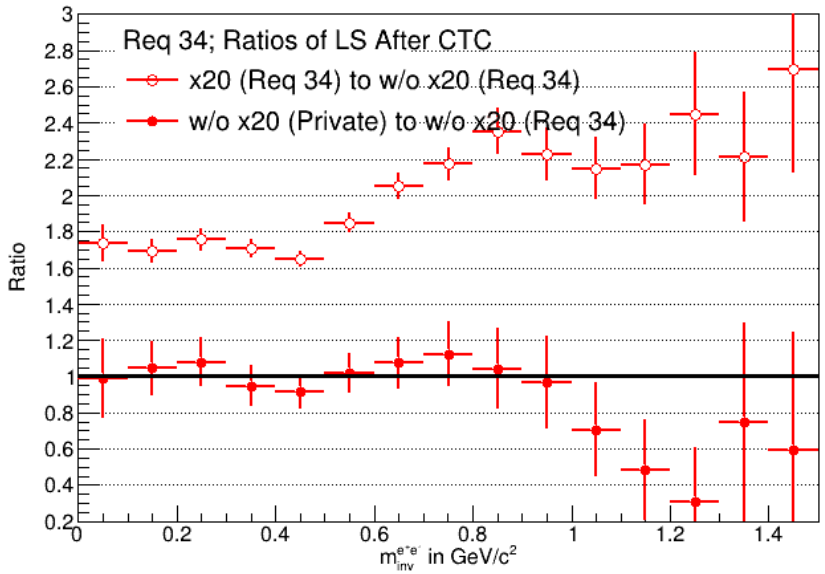




- In the analysis, combinatorial background is approximated by Like sign.
- It seems no distortion within actual combinatorial (ULS-True signal) is visible either.
- Thus, enhancing η-Dalitz may work as well: Similar excercise can be carried out for this.

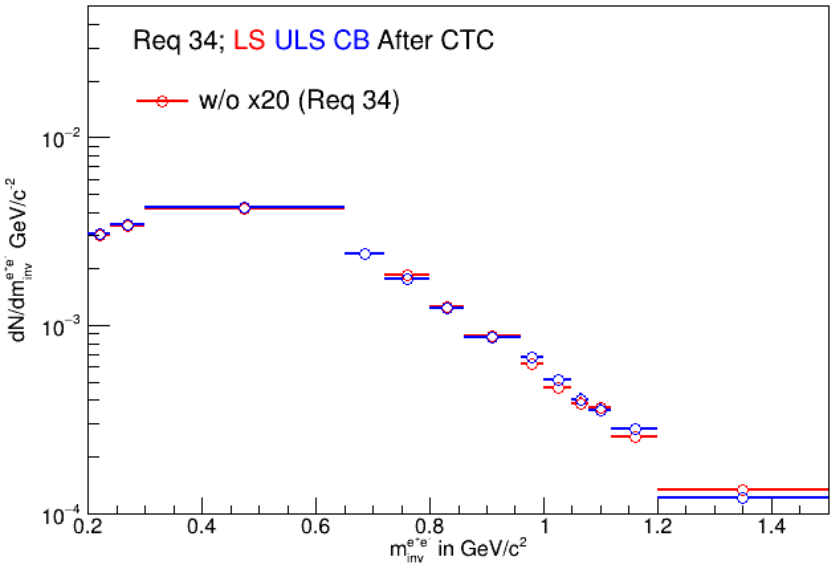
Comparision between LS: Private (547K events)

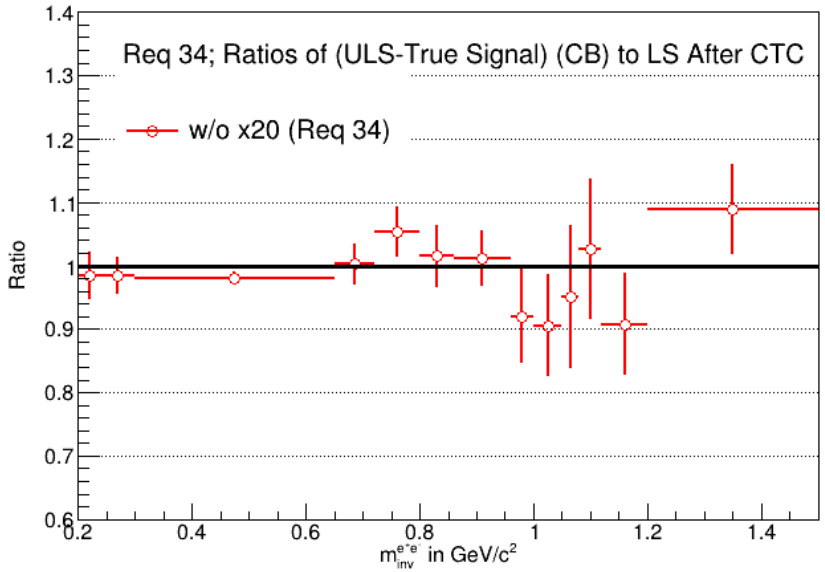




- No flat enhancement in LS after 20 factor.
- LS after reweighting back 20 factor have simialr shape as without enhancement case.

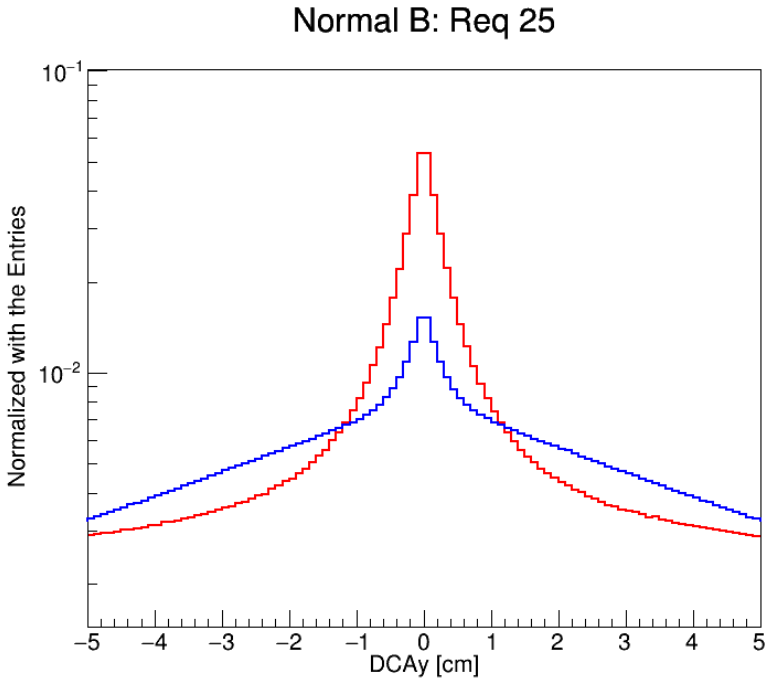
Comparision between LS and (ULS-TrueSignal)

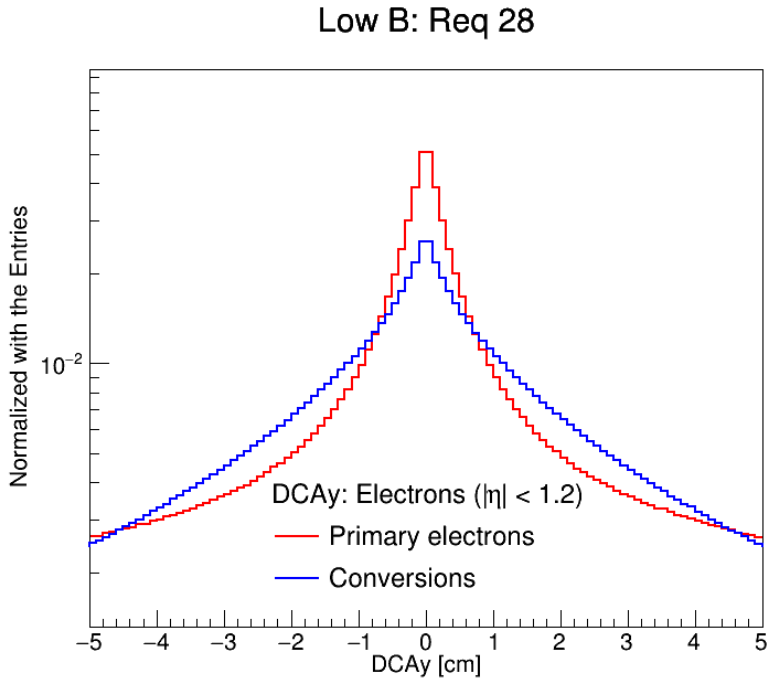




- In the analysis, combinatorial background is approximated by Like sign.
- It seems no distortion within actual combinatorial (ULS-True signal) is visible either.
- Thus, enhancing η-Dalitz may work as well: Similar excercise can be carried out for this.

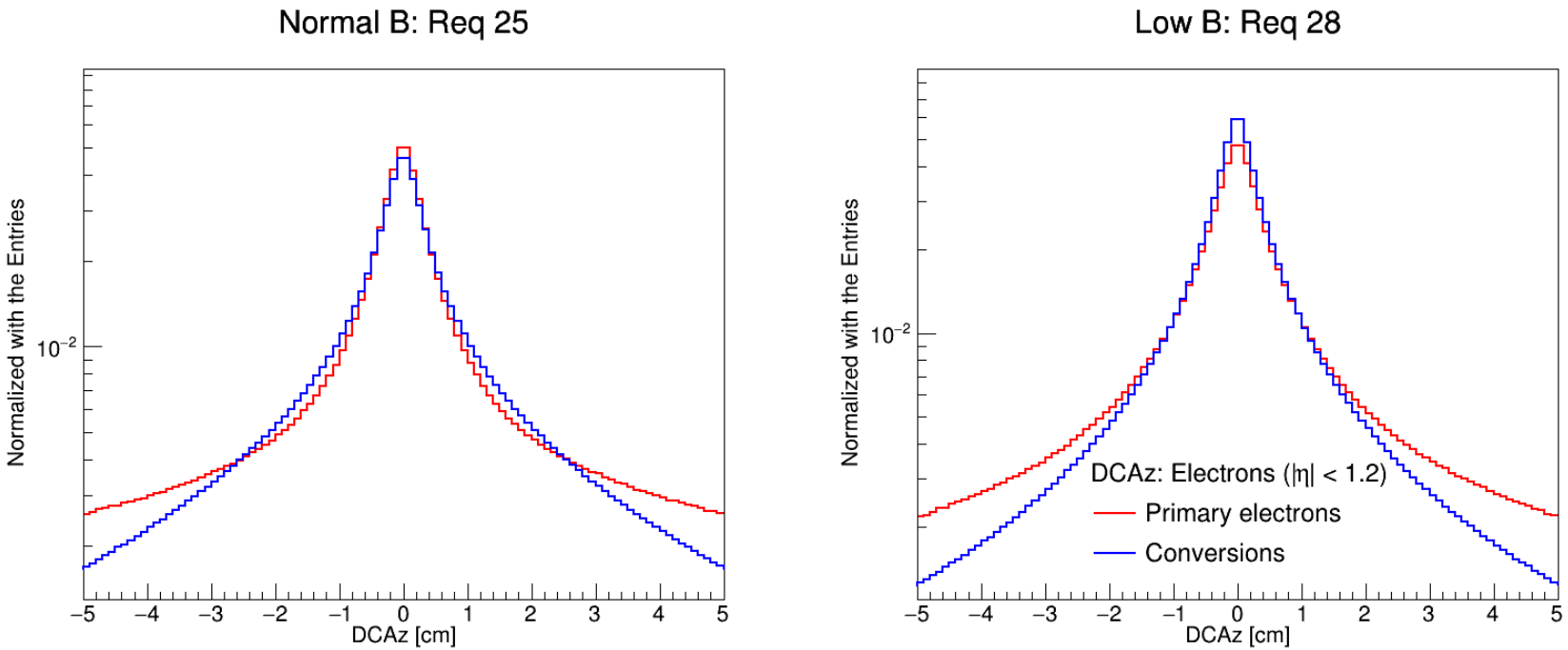
Low and Normal B: DCAy distributions (Electrons within $|\eta| < 1.2$)





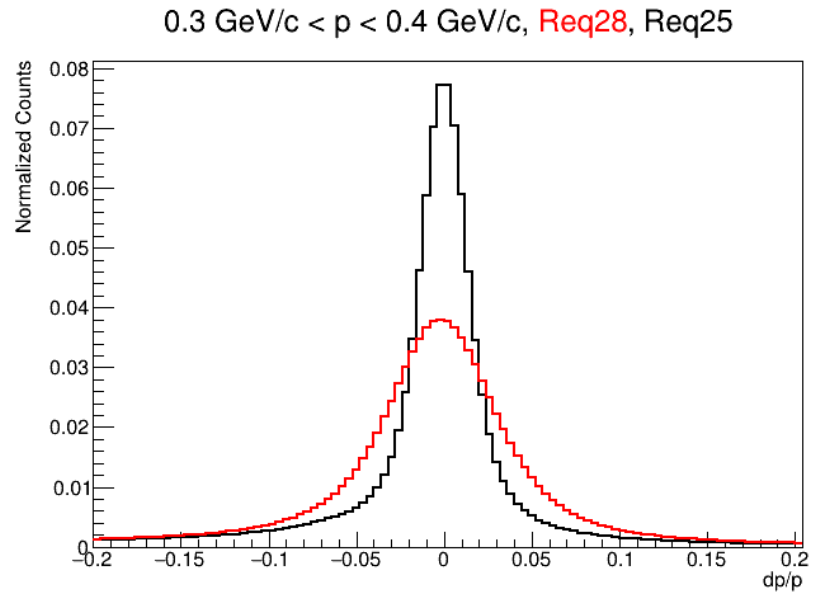
I. Same conclusion for DCAy.

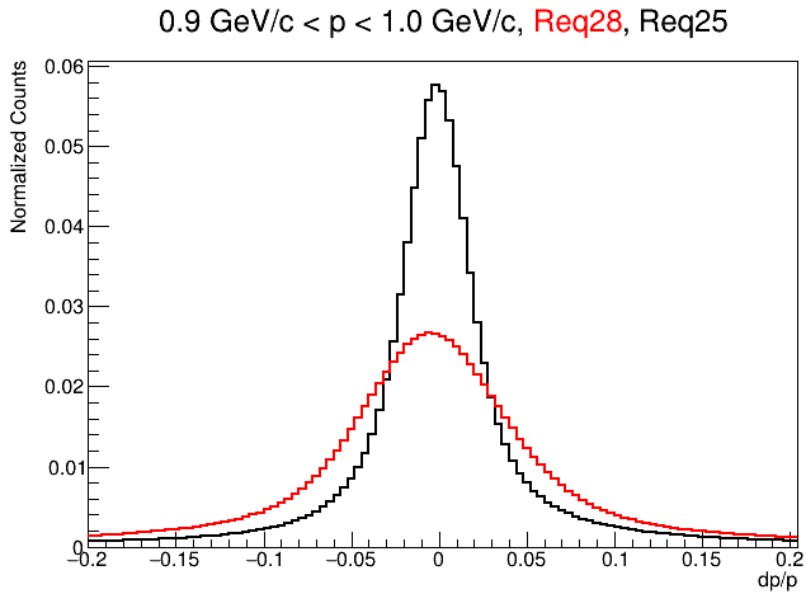
Low and Normal B: DCAz distributions (Electrons within $|\eta| < 1.2$)

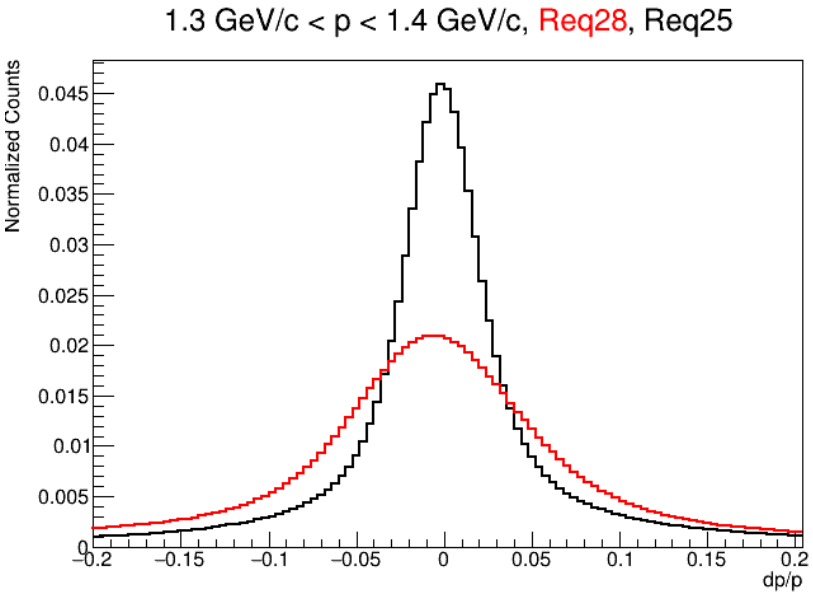


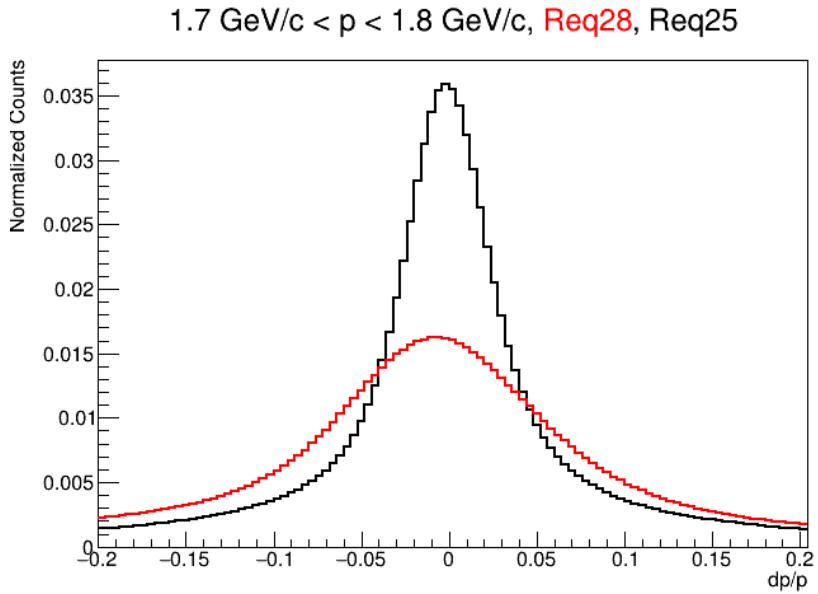
I. However, z-component of DCA has similar shapes in both Low B and Normal B.

Low (Req28) and Normal (Req25) B: Momentum resolution

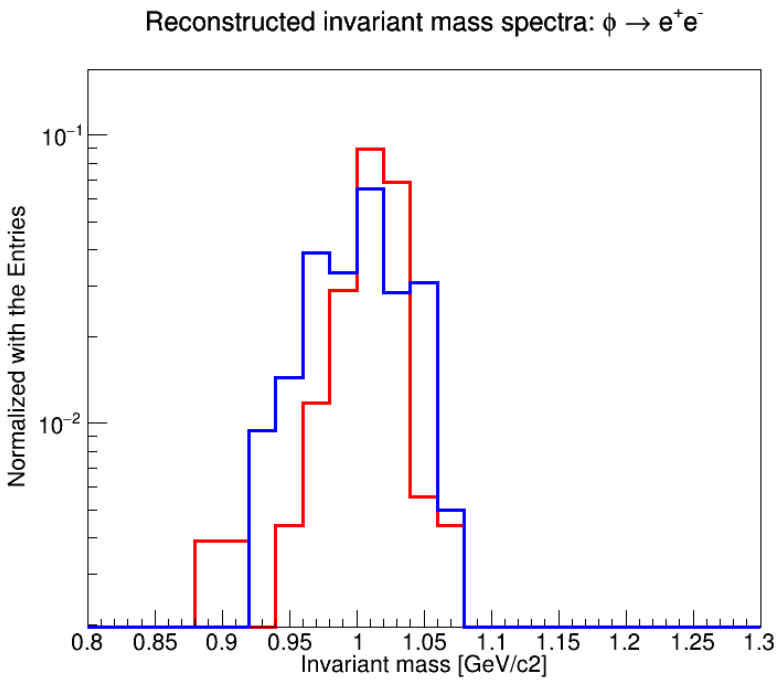


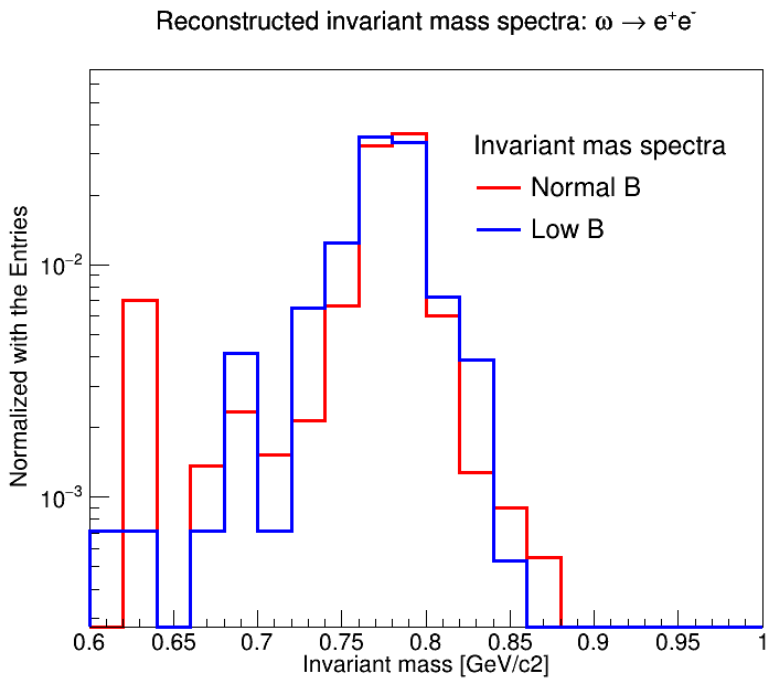






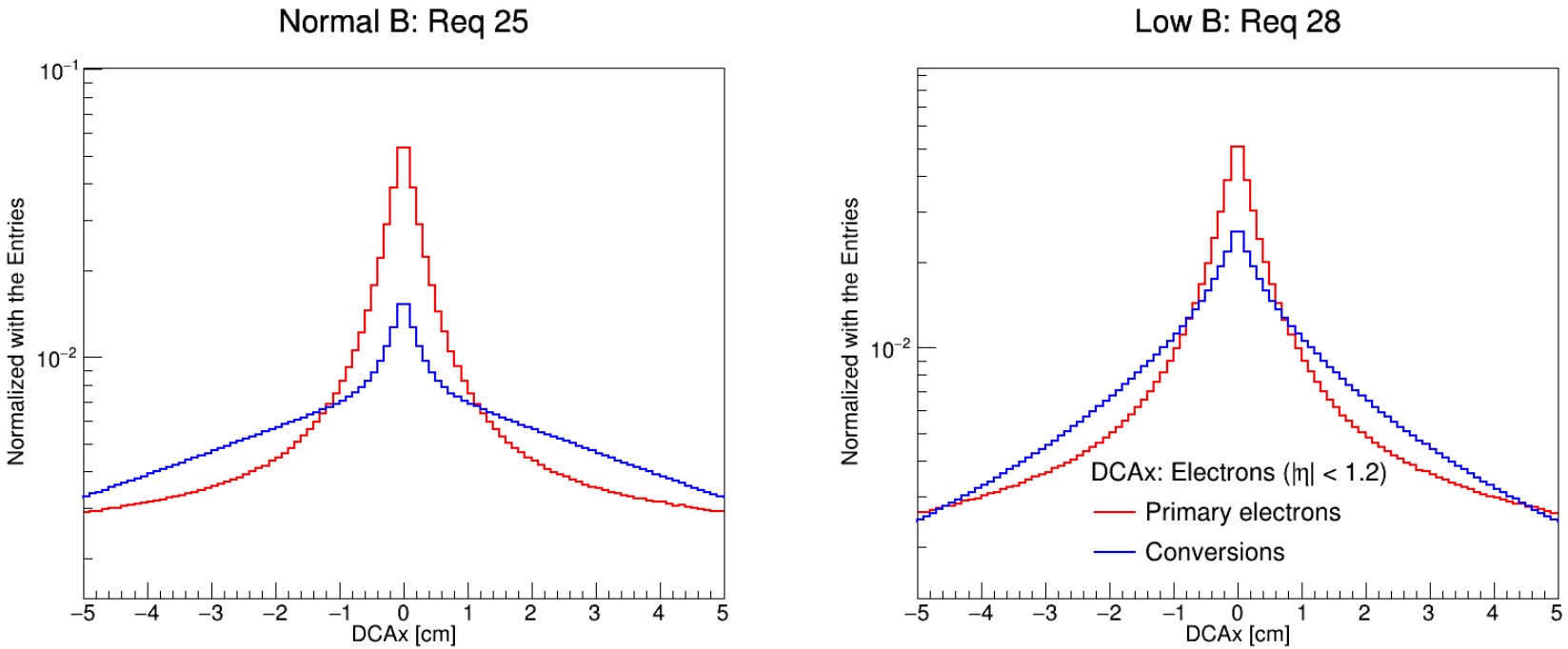
Low (Req28) and Normal (Req25) B: Mass resolution





I. Along with momentum, mass resolution also gets worse with low magnetic field.

Low and Normal B: DCAx distributions (Electrons within $|\eta| < 1.2$)



I. Secondaries (here, conversions electrons) have wider DCA in Low B compared Normal B.

II. Shape of primary electrons (all electrons except conversions) have similar shapes.

1D (Fid. < 0.7) Req. 25: B = 0.5T (31M), Req. 28: B = 0.2T (8M) Invariant mass: 0.2 to 1.5 GeV

	Bef. NFP	Aft. NFP	Aft. CTC (p_T <= 110 (50) MeV)	After CTC TPC+ECal	($p_T > 110$ (50) MeV) TPC (TOF or Not)
Mass	-	120	80	80	80
Angle	-	-	10	10	5
U	113926±338	87733±296	64731±254	55024±235	37544±194
U	85825±293	57670±240	50415±225	41858±205	27190±165
B	113055±336	86901±295	63761±253	54009±232	36316±191
B	85369±292	57348±239	50149±224	41646±204	26840±164
U-B	871±476	832±418	970±358	1015±330	1228±272
U-B	456±414	322±339	266±317	212±289	350±232
(U-B)/B (%)	0.77±0.00	0.96±0.00	1.52±0.01	1.88±0.01	3.38±0.02
(U-B)/B (%)	0.53±0.00	0.56±0.00	0.53±0.00	0.51±0.00	1.30±0.01
BFE	3	4	7	9	20
BFE	1	1	1	1	2
S	1793	1774	1743	1687	1647
S	348	317	308	302	297
S/B (%)	1.59	2.04	2.73	3.12	4.54
S/B (%)	0.41	0.55	0.61	0.73	1.11
BFE	14	18	24	26	37
BFE	1	1	1	1	2

- B - Combinatorial background approximated by like sign pairs.

MLP: Req. 34 (12.1M) (Fid. < 0.7), (Fid. < 0.75), (Fid. < 0.8), (Fid. < 0.85) (Fid. < 0.9, $|\eta| < 1.2$) Invariant mass: 0.2 to 0.65 GeV

	Bef. NFP	Aft. NFP	Aft. CTC (p_T <= 110 MeV)	After CTC TPC+ECal	($p_T > 110$ MeV) TPC (TOF or Not)
Mass	-	120	80	80	80
Angle	-	-	10	10	5
U	48438±220	30266±174	22570±150	20046±142	16005±127
U	69438±264	43458±208	32023±179	28441±169	22717±151
U	79737±282	49960±224	36574±191	32468±180	25965±161
U	90316±301	56777±238	41205±203	36601±191	29354±171
U	101418±318	64084±253	46188±215	41087±203	33012±182
U	112167±335	71101±267	50913±226	45263±213	36423±191
B	47958±219	29595±172	21968±148	19547±140	15584±125
B	68763±262	42694±207	31216±177	27713±166	22048±148
B	79109±281	49194±222	35760±189	31755±178	25287±159
B	89525±299	55812±236	40413±201	35865±189	28630±169
B	100491±317	62958±251	45288±213	40221±201	32135±179
B	111328±334	70085±265	50051±224	44527±211	35531±188

- B - Combinatorial background approximated by like sign pairs. (Fid. < 0.6, 11.6M)

MLP: Req. 34 (12.1M) (Fid. < 0.7), (Fid. < 0.75), (Fid. < 0.8), (Fid. < 0.85) (Fid. < 0.9, $|\eta| < 1.2$) Invariant mass: 0.2 to 0.65 GeV

	Bef. NFP	Aft. NFP	Aft. CTC (p_T <= 110 MeV)	After CTC TPC+ECal	($p_T > 110$ MeV) TPC (TOF or Not)
Mass	-	120	80	80	80
Angle	-	-	10	10	5
U-B	480±310	670±245	601±211	500±199	421±178
U-B	676±372	764±294	807±251	727±237	669±212
U-B	627±399	767±315	814±269	713±253	678±226
U-B	790±424	965±336	791±286	736±269	724±241
U-B	926±449	1126±356	900±302	865±285	877±255
U-B	839±473	1016±376	862±318	735±300	892±268
S	924	876	855	822	796
S	1247	1186	1157	1118	1086
S	1372	1307	1273	1229	1195
S	1549	1478	1433	1386	1343
S	1690	1617	1557	1509	1460
S	1813	1731	1660	1611	1557

- B - Combinatorial background approximated by like sign pairs.

MLP: Req. 34 (12.1M) (Fid. < 0.7), (Fid. < 0.75), (Fid. < 0.8), (Fid. < 0.85) (Fid. < 0.9, $|\eta| < 1.2$) Invariant mass: 0.2 to 0.65 GeV

	Bef. NFP	Aft. NFP	Aft. CTC (p_T <= 110 MeV)	After CTC TPC+ECal	($p_T > 110$ MeV) TPC (TOF or Not)
Mass	-	120	80	80	80
Angle	-	-	10	10	5
(U-B)/B (%)	1.00±0.01	2.26±0.02	2.74±0.03	2.56±0.03	2.70±0.03
(U-B)/B (%)	0.98±0.01	1.79±0.01	2.58±0.02	2.63±0.02	3.03±0.03
(U-B)/B (%)	0.79±0.00	1.56±0.01	2.28±0.02	2.25±0.02	2.68±0.02
(U-B)/B (%)	0.88±0.00	1.73±0.01	1.96±0.01	2.05±0.02	2.53±0.02
(U-B)/B (%)	0.92±0.00	1.79±0.01	1.99±0.01	2.15±0.02	2.73±0.02
(U-B)/B (%)	0.75±0.00	1.45±0.01	1.72±0.01	1.65±0.01	2.51±0.02
S/B (%)	1.93	2.96	3.89	4.20	5.11
S/B (%)	1.81	2.78	3.71	4.04	4.93
S/B (%)	1.73	2.66	3.56	3.87	4.73
S/B (%)	1.73	2.65	3.55	3.86	4.69
S/B (%)	1.68	2.57	3.44	3.75	4.54
S/B (%)	1.63	2.47	3.32	3.62	4.38

- B - Combinatorial background approximated by like sign pairs.

MLP: Req. 34 (12.1M) (Fid. < 0.7), (Fid. < 0.75), (Fid. < 0.8), (Fid. < 0.85) (Fid. < 0.9, $|\eta| < 1.2$) Invariant mass: 0.2 to 0.65 GeV

	Bef. NFP	Aft. NFP	Aft. CTC (p_T <= 110 MeV)	After CTC TPC+ECal	($p_T > 110$ MeV) TPC (TOF or Not)
Mass	-	120	80	80	80
Angle	-	-	10	10	5
BFE	2	8	8	6	6
BFE	3	7	10	9	10
BFE	2	6	9	8	9
BFE	3	8	8	7	9
BFE	4	10	9	9	12
BFE	3	7	7	6	11
BFE	9	13	16	17	20
BFE	11	16	21	22	26
BFE	12	17	22	23	28
BFE	13	19	25	26	31
BFE	14	21	26	28	32
BFE	15	21	27	29	33

- B - Combinatorial background approximated by like sign pairs.

MLP: Req. 34 (12.1M) (Fid. < 0.7), (Fid. < 0.75), (Fid. < 0.8), (Fid. < 0.85) (Fid. < 0.9, $|\eta| < 1.2$) Invariant mass: 0.65 to 1.5 GeV

	Bef. NFP	Aft. NFP	Aft. CTC (p_T <= 110 MeV)	After CTC TPC+ECal	($p_T > 110$ MeV) TPC (TOF or Not)
Mass	-	120	80	80	80
Angle	-	-	10	10	5
U	15730±125	10034±100	7622±87	6761±82	5485±74
U	23849±154	15306±124	11480±107	10174±101	8259±91
U	28372±168	18207±135	13571±116	12023±110	9724±99
U	33064±182	21223±146	15638±125	13832±118	11212±106
U	38609±196	24821±158	18107±135	15997±126	12941±114
U	44572±211	28822±170	20815±144	18399±136	14874±122
B	15087±123	9333±97	7010±84	6233±79	4920±70
B	22936±151	14264±119	10568±103	9378±97	7406±86
B	27280±165	17033±131	12486±112	11063±105	8739±93
B	32033±179	20100±142	14624±121	12946±114	10232±101
B	37519±194	23664±154	17040±131	15114±123	11917±109
B	43451±208	27569±166	19644±140	17349±132	13736±117

- B - Combinatorial background approximated by like sign pairs. (Fid. < 0.6, 11.6M)

MLP: Req. 34 (12.1M) (Fid. < 0.7), (Fid. < 0.75), (Fid. < 0.8), (Fid. < 0.85) (Fid. < 0.9, $|\eta| < 1.2$) Invariant mass: 0.65 to 1.5 GeV

	Bef. NFP	Aft. NFP	Aft. CTC (p_T <= 110 MeV)	After CTC TPC+ECal	($p_T > 110$ MeV) TPC (TOF or Not)
Mass	-	120	80	80	80
Angle	-	-	10	10	5
U-B	643±176	700±139	612±121	529±114	566±102
U-B	913±216	1042±172	912±148	796±140	852±125
U-B	1092±236	1174±188	1085±161	959±152	985±136
U-B	1032±255	1123±203	1014±174	885±164	980±146
U-B	1090±276	1157±220	1067±187	882±176	1025±158
U-B	1120±297	1253±237	1170±201	1050±189	1138±169
S	635	611	597	574	562
S	880	846	822	793	774
S	1000	960	929	897	876
S	1112	1068	1029	994	971
S	1232	1185	1137	1099	1074
S	1345	1294	1235	1194	1167

- B - Combinatorial background approximated by like sign pairs.

MLP: Req. 34 (12.1M) (Fid. < 0.7), (Fid. < 0.75), (Fid. < 0.8), (Fid. < 0.85) (Fid. < 0.9, $|\eta| < 1.2$) Invariant mass: 0.65 to 1.5 GeV

	Bef. NFP	Aft. NFP	Aft. CTC (p_T <= 110 MeV)	After CTC TPC+ECal	($p_T > 110$ MeV) TPC (TOF or Not)
Mass	-	120	80	80	80
Angle	-	-	10	10	5
(U-B)/B (%)	4.26±0.05	7.50±0.11	8.73±0.14	8.48±0.15	11.50±0.23
(U-B)/B (%)	3.98±0.04	7.31±0.09	8.63±0.12	8.49±0.12	11.51±0.18
(U-B)/B (%)	4.00±0.03	6.89±0.07	8.69±0.11	8.67±0.11	11.27±0.17
(U-B)/B (%)	3.22±0.03	5.58±0.05	6.94±0.08	6.84±0.08	9.57±0.13
(U-B)/B (%)	2.91±0.02	4.89±0.04	6.26±0.07	5.84±0.07	8.60±0.11
(U-B)/B (%)	2.58±0.02	4.55±0.04	5.96±0.06	6.05±0.06	8.28±0.10
S/B (%)	4.21	6.55	8.51	9.21	11.42
S/B (%)	3.84	5.93	7.78	8.45	10.45
S/B (%)	3.66	5.64	7.44	8.11	10.03
S/B (%)	3.47	5.31	7.04	7.68	9.49
S/B (%)	3.28	5.01	6.67	7.27	9.01
S/B (%)	3.10	4.69	6.29	6.88	8.49

- B - Combinatorial background approximated by like sign pairs.

MLP: Req. 34 (12.1M) (Fid. < 0.7), (Fid. < 0.75), (Fid. < 0.8), (Fid. < 0.85) (Fid. < 0.9, $|\eta| < 1.2$) Invariant mass: 0.65 to 1.5 GeV

	Bef. NFP	Aft. NFP	Aft. CTC (p_T <= 110 MeV)	After CTC TPC+ECal	($p_T > 110$ MeV) TPC (TOF or Not)
Mass	-	120	80	80	80
Angle	-	-	10	10	5
BFE	13	25	26	22	31
BFE	18	37	38	32	46
BFE	21	39	45	40	53
BFE	16	30	34	29	45
BFE	16	28	32	25	42
BFE	14	28	34	31	45
BFE	13	19	24	25	30
BFE	17	24	31	32	38
BFE	18	26	33	35	42
BFE	19	28	35	37	44
BFE	20	29	37	39	46
BFE	20	30	38	40	48

- B - Combinatorial background approximated by like sign pairs.

MLP: Req. 34 (12.1M) (Fid. < 0.7), (Fid. < 0.75), (Fid. < 0.8), (Fid. < 0.85) (Fid. < 0.9, $|\eta| < 1.2$) Invariant mass: 0.2 to 1.5 GeV

	Bef. NFP	Aft. NFP	Aft. CTC (p_T <= 110 MeV)	After CTC TPC+ECal	($p_T > 110$ MeV) TPC (TOF or Not)
Mass	-	120	80	80	80
Angle	-	-	10	10	5
U	64168±253	40299±201	30192±174	26808±164	21491±147
U	93288±305	58764±242	43503±209	38615±197	30976±176
U	108108±329	68167±261	50145±224	44490±211	35688±189
U	123380±351	78000±279	56843±238	50433±225	40566±201
U	140027±374	88905±298	64295±254	57083±239	45954±214
U	156738±396	99924±316	71728±268	63662±252	51297±226
B	63046±251	38929±197	28978±170	25779±161	20504±143
B	91699±303	56958±239	41785±204	37091±193	29455±172
B	106389±326	66226±257	48246±220	42818±207	34026±184
B	121558±349	75912±276	55037±235	48811±221	38863±197
B	138011±371	86622±294	62328±250	55336±235	44052±210
B	154779±393	97654±312	69695±264	61876±249	49267±222

- B - Combinatorial background approximated by like sign pairs. (Fid. < 0.6, 11.6M)

MLP: Req. 34 (12.1M) (Fid. < 0.7), (Fid. < 0.75), (Fid. < 0.8), (Fid. < 0.85) (Fid. < 0.9, $|\eta| < 1.2$) Invariant mass: 0.2 to 1.5 GeV

	Bef. NFP	Aft. NFP	Aft. CTC (p_T <= 110 MeV)	After CTC TPC+ECal	($p_T > 110$ MeV) TPC (TOF or Not)
Mass	-	120	80	80	80
Angle	-	-	10	10	5
U-B	1122±357	1370±281	1214±243	1028±229	987±205
U-B	1589±430	1806±340	1719±292	1523±275	1521±246
U-B	1720±463	1941±367	1899±314	1672±295	1663±264
U-B	1822±495	2088±392	1806±334	1622±315	1703±282
U-B	2016±527	2283±419	1967±356	1747±335	1902±300
U-B	1959±558	2270±444	2033±376	1786±354	2030±317
S	1559	1487	1452	1396	1359
S	2127	2032	1979	1911	1860
S	2372	2267	2202	2126	2071
S	2661	2546	2462	2380	2314
S	2922	2802	2694	2608	2534
S	3158	3024	2895	2806	2724

- B - Combinatorial background approximated by like sign pairs.

MLP: Req. 34 (12.1M) (Fid. < 0.7), (Fid. < 0.75), (Fid. < 0.8), (Fid. < 0.85) (Fid. < 0.9, $|\eta| < 1.2$) Invariant mass: 0.2 to 1.5 GeV

	Bef. NFP	Aft. NFP	Aft. CTC (p_T <= 110 MeV)	After CTC TPC+ECal	($p_T > 110$ MeV) TPC (TOF or Not)
Mass	-	120	80	80	80
Angle	-	-	10	10	5
(U-B)/B (%)	1.78±0.01	3.52±0.03	4.19±0.03	3.99±0.03	4.81±0.05
(U-B)/B (%)	1.73±0.01	3.17±0.02	4.11±0.03	4.11±0.03	5.16±0.04
(U-B)/B (%)	1.62±0.01	2.93±0.02	3.94±0.03	3.91±0.03	4.89±0.04
(U-B)/B (%)	1.50±0.01	2.75±0.01	3.28±0.02	3.32±0.02	4.38±0.03
(U-B)/B (%)	1.46±0.01	2.64±0.01	3.16±0.02	3.16±0.02	4.32±0.03
(U-B)/B (%)	1.27±0.00	2.32±0.01	2.92±0.02	2.89±0.02	4.12±0.03
S/B (%)	2.47	3.82	5.01	5.42	6.63
S/B (%)	2.32	3.57	4.74	5.15	6.31
S/B (%)	2.23	3.42	4.56	4.96	6.09
S/B (%)	2.19	3.35	4.47	4.88	5.95
S/B (%)	2.12	3.23	4.32	4.71	5.75
S/B (%)	2.04	3.10	4.15	4.53	5.53

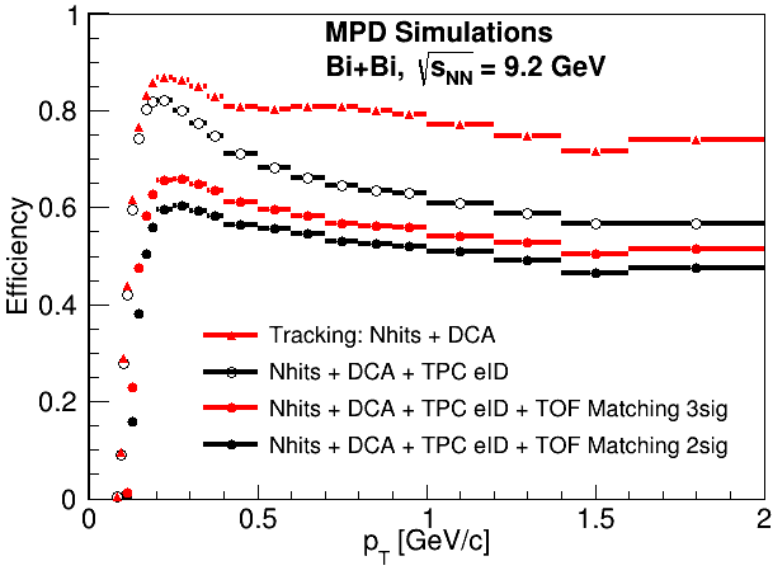
- B - Combinatorial background approximated by like sign pairs.

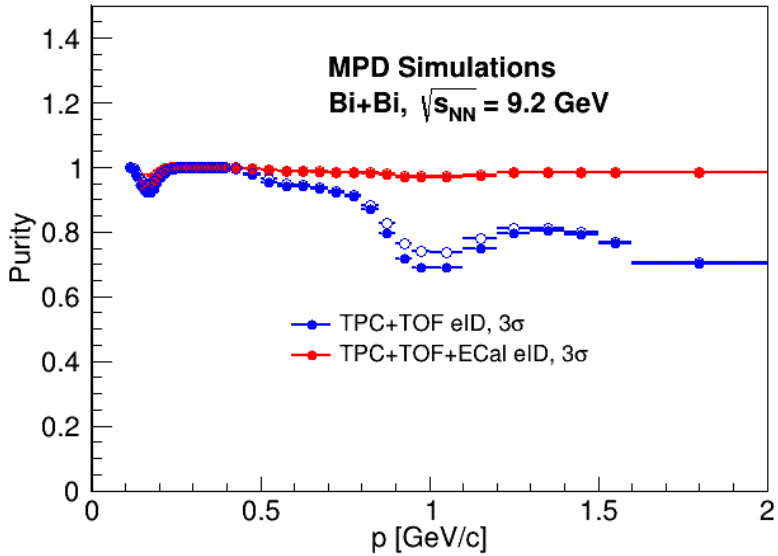
MLP: Req. 34 (12.1M) (Fid. < 0.7), (Fid. < 0.75), (Fid. < 0.8), (Fid. < 0.85) (Fid. < 0.9, $|\eta| < 1.2$) Invariant mass: 0.2 to 1.5 GeV

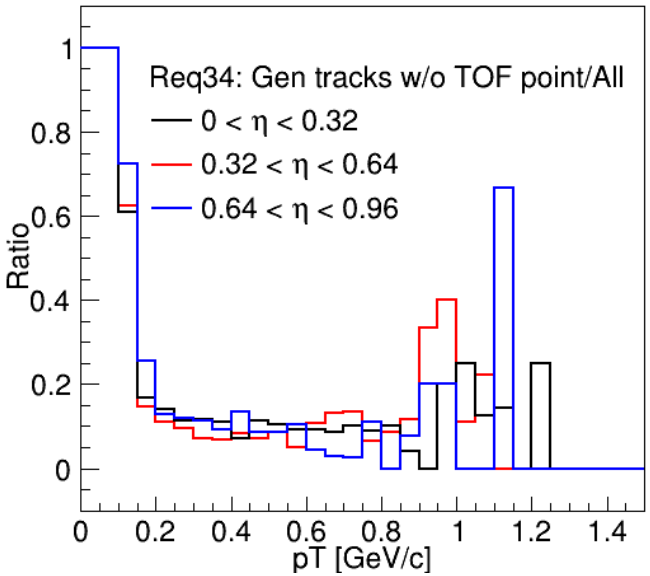
	Bef. NFP	Aft. NFP	Aft. CTC (p_T <= 110 MeV)	After CTC TPC+ECal	($p_T > 110$ MeV) TPC (TOF or Not)
Mass	-	120	80	80	80
Angle	-	-	10	10	5
BFE	10	24	25	20	23
BFE	14	28	35	31	38
BFE	14	28	37	32	40
BFE	14	28	29	26	37
BFE	15	30	31	27	40
BFE	12	26	29	25	41
BFE	19	28	35	37	44
BFE	24	36	46	48	57
BFE	26	38	49	51	61
BFE	29	42	54	57	67
BFE	31	45	57	60	71
BFE	32	46	59	62	73

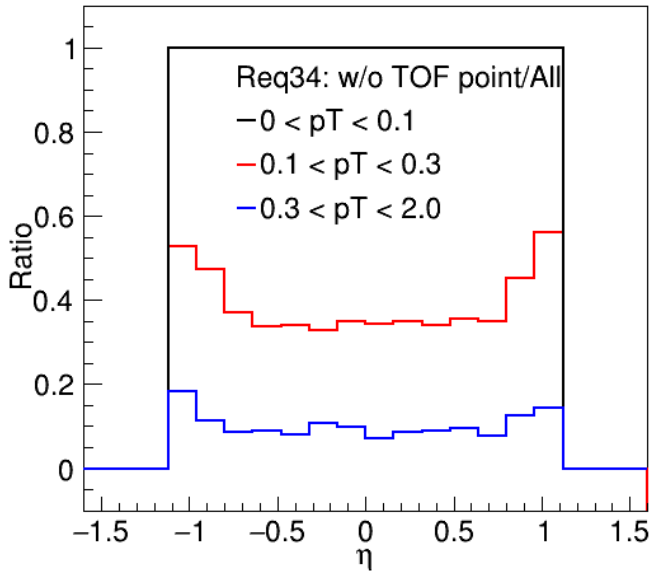
- B - Combinatorial background approximated by like sign pairs.

TOF Matching cut

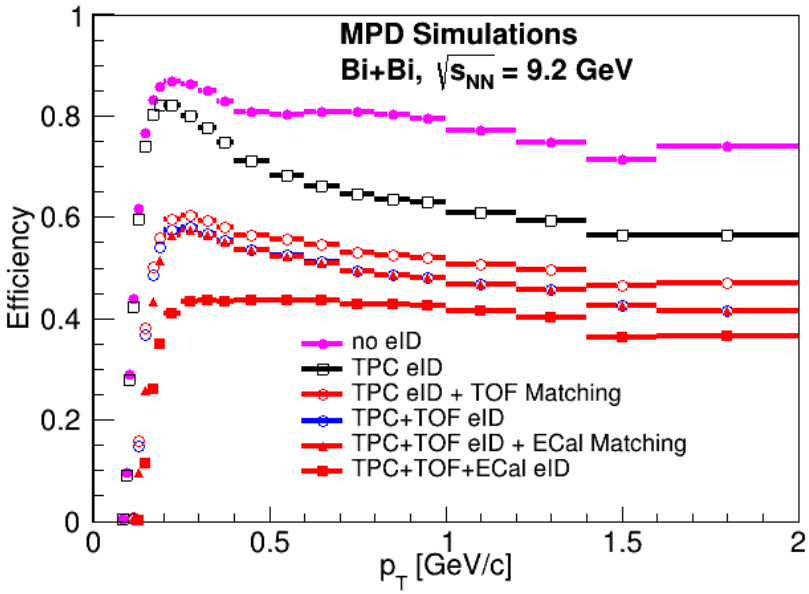


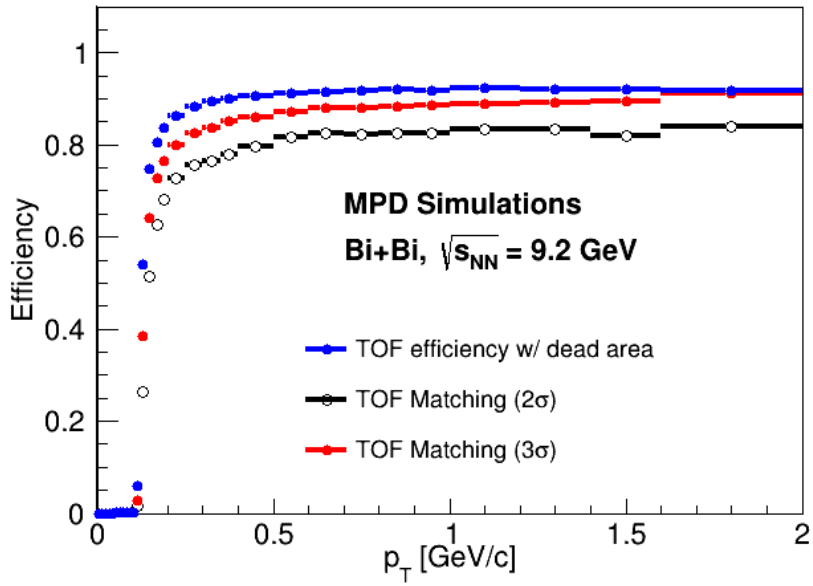






Step-wise efficiency: Req 34





Revised Analysis Strategy

$\Rightarrow$ Three electron pools:

$\rightarrow$ Pool-1 - fully reconstructed tracks[2] in fiducial area ($|\eta| < 0.7$) - $p_{\mathrm{T}} \gtrapprox 110$ MeV/c

$\rightarrow$ Pool-2 - fully reconstructed tracks in veto area $0.7 < |\eta| < 1.0$ - $p_{\mathrm{T}} \gtrapprox 110$ MeV/c.

$\rightarrow$ Pool-3 with tracks reconstructed in TPC.

- $p_{\mathrm{T}} <= 110$ MeV/c $\rightarrow$ not reaching the TOF.
- $p_{\mathrm{T}} > 110$ MeV/c $\rightarrow$ reaching the TOF.

- Step 1 - No further pairing (NFP): Tagging between Pool 1 and Pool 2.
- Step 2 - Close TPC cut (CTC): Tagging between Pool 1 and 3, and pairs within certain M_{inv} and opening angle are removed.
- Step 3: Rest of the tracks with $p_{\mathrm{T}} > 200$ MeV from Pool-1 are paired among themselves to build ULS and LS pair spectra.

[2] TOF and ECal matched tracks identified in the TPC, TOF and ECal

Track selection - 1D cuts analysis

→ Pool-1 - fully reconstructed tracks[3] in fiducial area ($|\eta| < 0.7$)

- NHits > 39, DCA $< 3\sigma$, TPC dEdX (p dep. (p < 0.8) and -1 to 2σ (p > 0.8)), TOF Matching (dϕ and d$z < \mathbf{3}\sigma$), TOF (-2 to 2σ), ECal PID (p dep. $<$ E/p < 1.5 and $\mathrm{m}^2 < 2\sigma$), ECal Matching ($< 3\sigma$).

→ Pool-2 - fully reconstructed tracks in veto area ($0.7 < |\eta| < 1.0$) (Same cuts.).

→ Pool-3 with tracks reconstructed in TPC.

- $p_{\mathrm{T}} <= 110$ MeV/c → not matched in TOF and ECal - ($|\eta| <2.5$, NHits > 10, DCA $< 5\sigma$, TPC dEdX (-4 to 4σ)).
- $p_{\mathrm{T}} > 110$ MeV/c → not matched in TOF but matched in ECal - ($|\eta| <2.5$, NHits > 10, DCA $< 5\sigma$, TPC dEdX (-3 to 3σ), ECal (p dep. $<$ E/p $<$ 1.5 and $\mathrm{m}^2 < 2\sigma$, ECal Matching ($< 3\sigma$)).
- $p_{\mathrm{T}} > 110$ MeV/c → not matched in ECal but may or may not in TOF - ($|\eta| <2.5$, NHits > 10, DCA $< 5\sigma$, TPC dEdX (-1 to 2σ), TOF PID (if matched).

- No further pairing (NFP): $M_{\mathrm{inv}} < 120$ MeV/c^2.
- Close TPC cut (CTC): $M_{\mathrm{inv}} < 80$ MeV/c^2 and opening angle < 10 or 5^o.

[3] TOF and ECal matched tracks identified in the TPC, TOF and ECal