Centrality at large z-vertex coordinates

V. Riabov for the MPD

- ❖ A follow-up of my previous PF presentation on 17.06.2021 and 09.09.2021
- ❖ Joint effort of many groups:
  - ✓ PHQMD event generator: V. Kireyeu
  - ✓ Centrality determination: P. Parfenov, D. Idrisov, V. Luong, A. Taranenko
  - ✓ FFD operation and simulation: S. Lobastov, V. Yurevich
  - ✓ FHCAL operation and simulation: M. Golubeva, A. Ivashkin

Last time

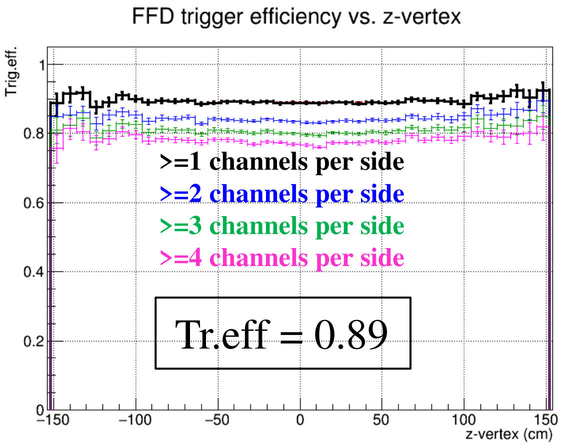
- Expect wide z-vertex distribution based on the expected NICA performance (σ_z ~ 40 cm)
- Demonstrated that MPD can trigger on events with z-vertex in a wide range
  - ✓ PF on 17.06, https://indico.jinr.ru/event/2249/
  - ✓ PF on 09.09, https://indico.jinr.ru/event/2429/

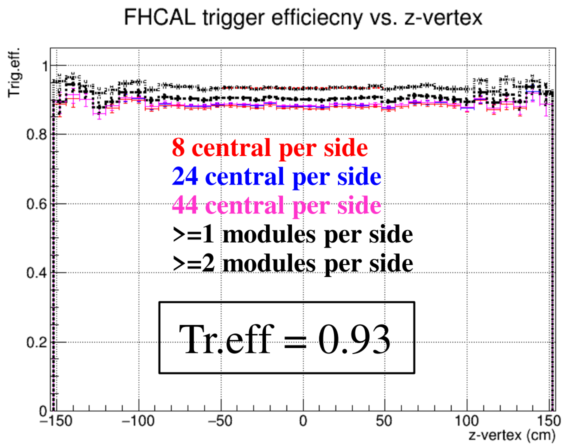
⇩

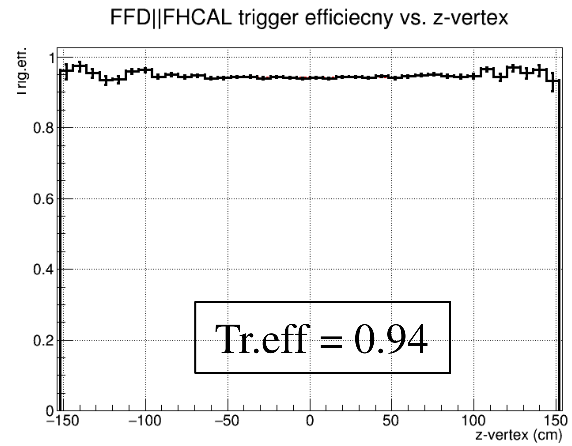
Need to understand the MPD capabilities to characterize events with large z-vertex in terms of centrality, $b/N_{part}/N_{coll}$

Trigger efficiency vs. true z-vertex

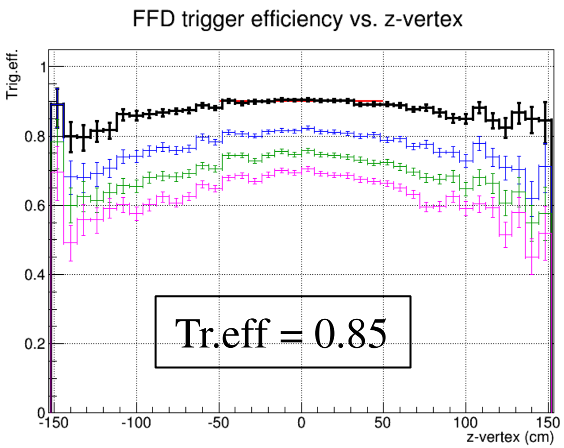
DCM-QGSM-SMM, BiBi@9.2

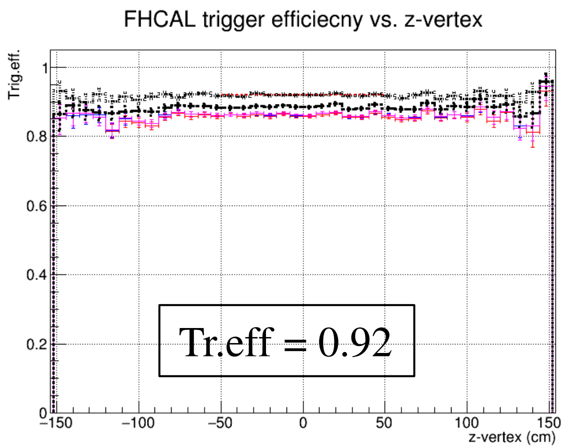


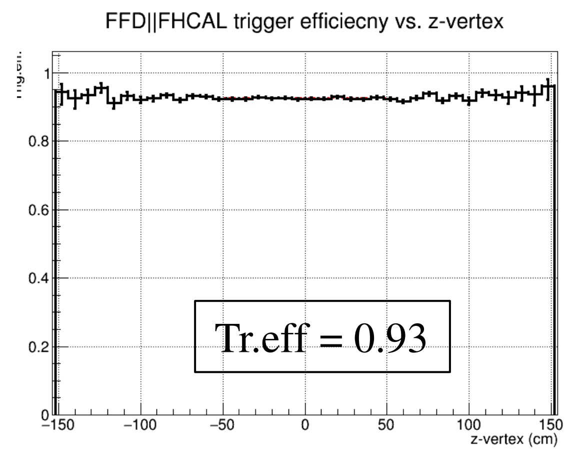




PHQMD, BiBi@9.2







- FHCAL and FFD||FHCAL efficiencies do not depend on z-vertex
- Comparable efficiencies from two event generators
- Problem of centrality event categorization at large values of z-vertex remains …

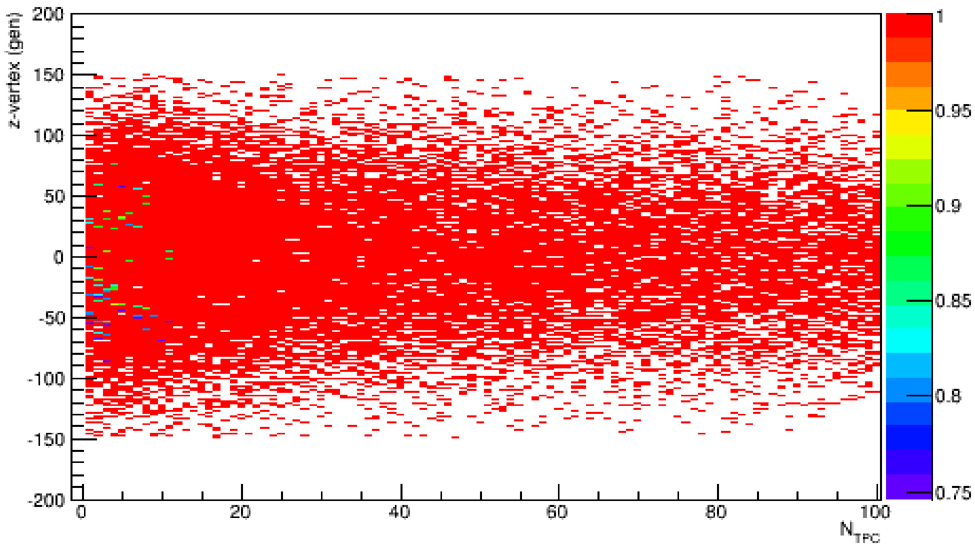
Centrality with TPC

- Centrality with TPC is asserted by the number of (primary) reconstructed tracks
  - ✓ event should have reconstructed vertex (evaluated by TPC)
  - ✓ event should have non-zero number of tracks (after all selections)

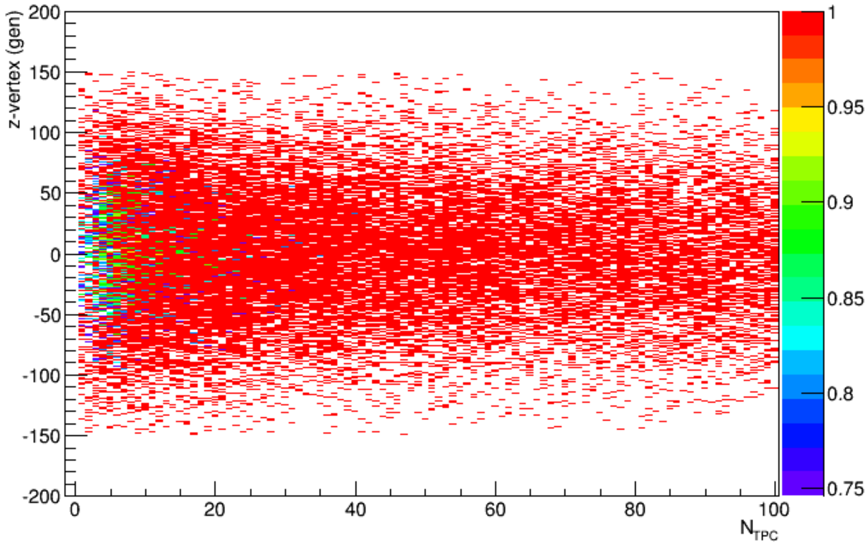
Vertex reconstruction with TPC - I

- z-vertex reconstruction was recently improved by A.Zinchenko (code committed to MpdRoot)
- BiBi@9.2, DCM-QGSM-SMM, 100k events, z-vertex by Gaussian ($\sigma = 50$ cm)
- z-vertex reconstruction efficiency vs. generated z-vertex and N_{TPC} (all tracks):

z_{vertex}^{rec}!=0



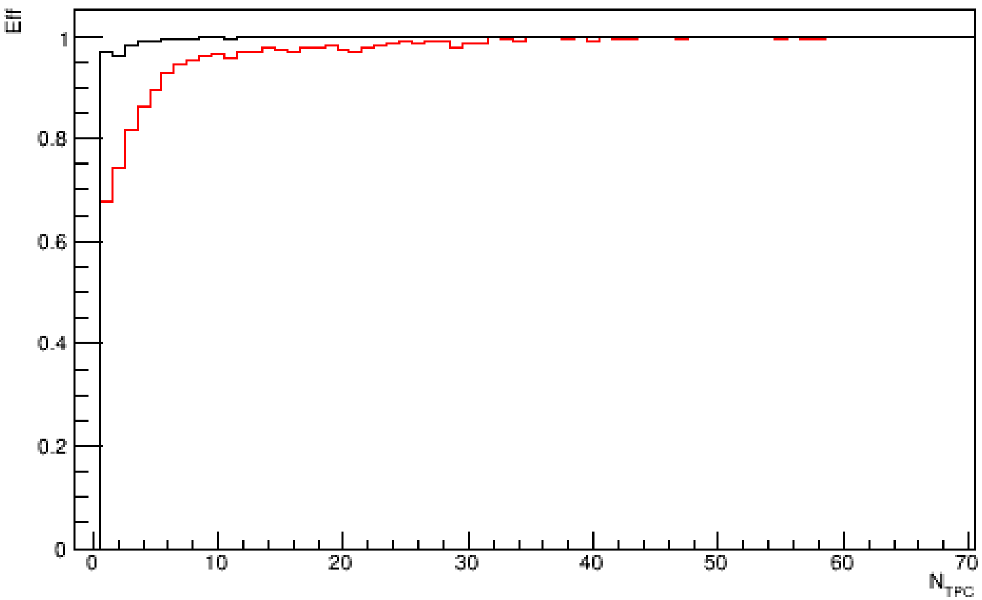
z_{vertex}^{rec}!=0 && $\left|z_{vertex}^{rec} - z_{vertex}^{gen}\right|$<2 cm

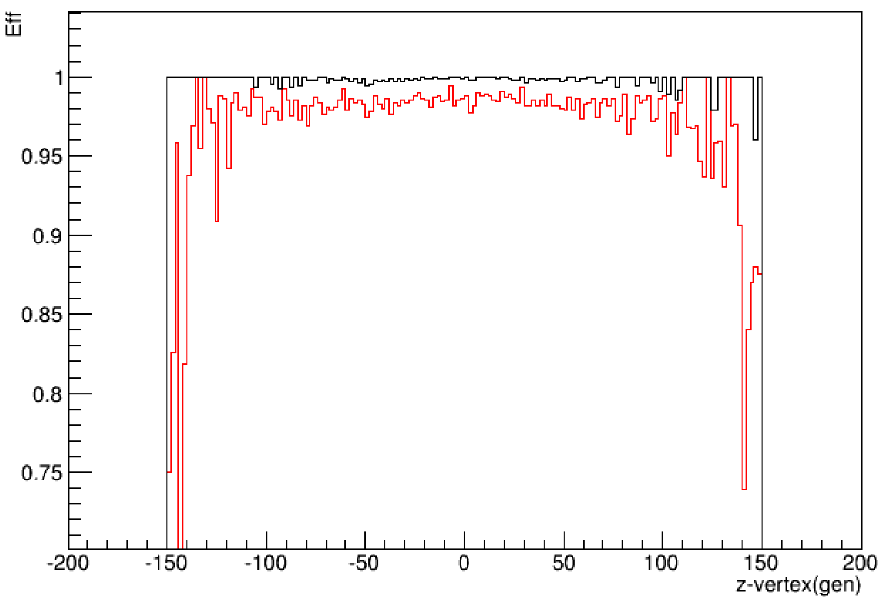


- z-vertex is reconstructed at |z-vertex| < 150 cm
- z-vertex reconstruction efficiency slightly drops at small N_{TPC} and large z-vertex
- Not all reconstructed z-vertex coordinates are meaningful, problem is most pronounced at low track multiplicities and large values of z-vertex

Vertex reconstruction with TPC - II

- Projections of 2D efficiencies from the previous slide





Black histograms: z_{vertex}^{rec}!=0;

Red histograms: z_{vertex}^{rec}!=0 && $\left|z_{vertex}^{rec} - z_{vertex}^{gen}\right|$<2 cm;

- Plots confirm conclusions from the previous slide

Conclusions (vertex with TPC)

- What z-vertex range do wee need to consider for physics studies?
- The wider the better, BUT:
  - ✓ z-vertex is not reconstructed by TPC tracks beyond ±150 cm
  - ✓ FFD at z = ±140 cm, we do not want events occurring (inside)/(very close to) the FFD
  - ✓ expected $\sigma_{z\text{-vertex}}$ ~ 40 cm*, then $3 \cdot \sigma_{z\text{-vertex}}$ ~ 120 cm

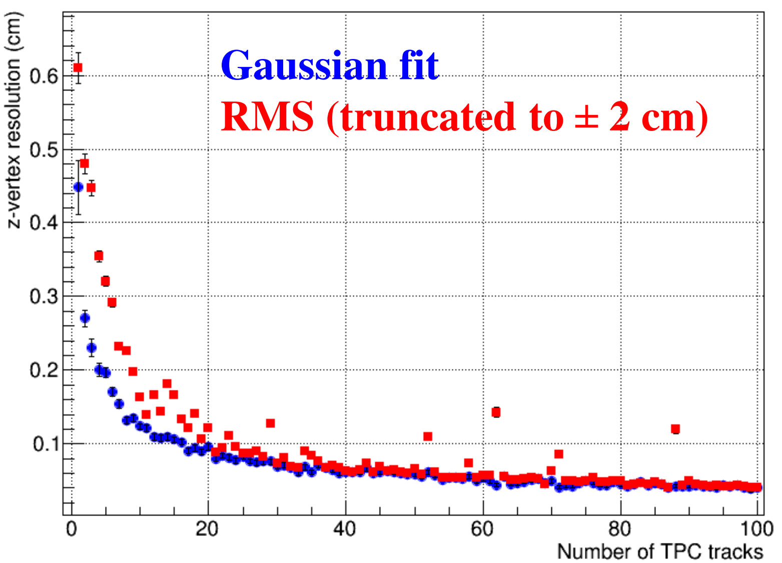
- Conclusions:
  - ✓ maximum z-vertex range for physics is $|z_{vertex}| < 120$-130 cm
  - ✓ vertex in this range can be reconstructed with the TPC
  - ✓ ~ 2% of such events will have $|z^{rec}_{vertex} - z^{gen}_{vertex}| > 2$ cm

* by A. Litvin, should be considered for all feasibility studies in BiBi@9.2

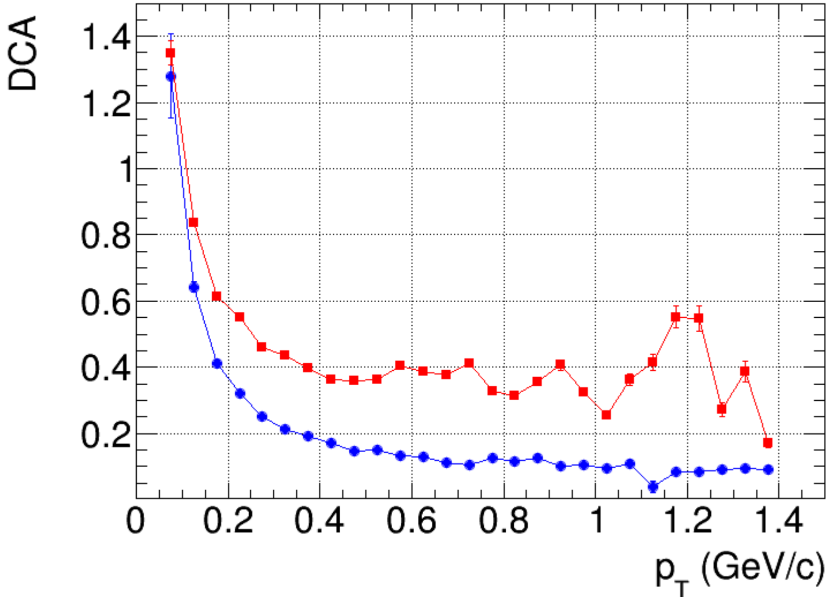
Track reconstruction with TPC - I

- The larger the number of tracks is better (higher sensitivity to peripheral collisions)
- Number of tracks in the TPC depends on track selection cuts:
  - ✓ want tracks associated with primary vertex → select only tracks matched to the vertex
  - ✓ vertex and track-to-vertex resolution depends on many factors: event multiplicity and z-vertex; track p_T, number of TPC hits etc.
  - ✓ z-vertex resolution and track-to-vertex distributions are not exactly Gaussian

z-vertex resolution vs. N_{TPC}



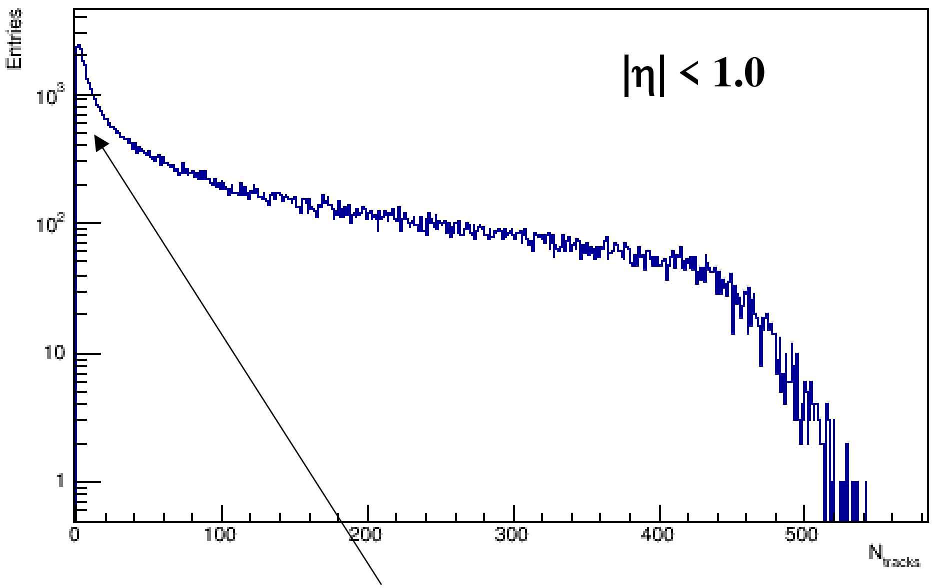
z-vertex resolution vs. p_T



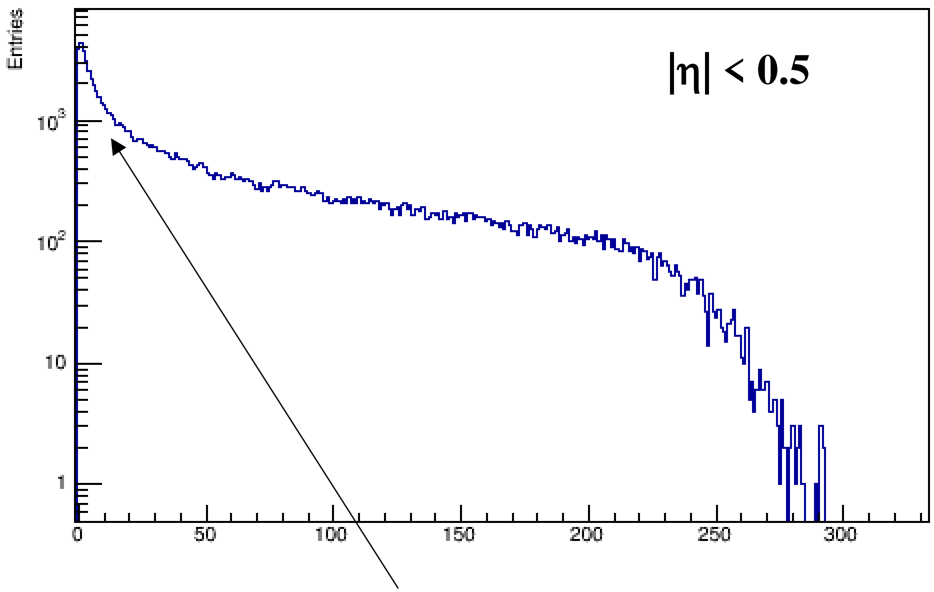
→ select tracks matched to primary vertex, $|DCA_{x,y,z}| < 2$ cm

Track reconstruction with TPC - II

- Number of tracks in the TPC depends on track selection cuts:
  - ✓ tracks associated with primary vertex → $|DCA_{x,y,z}| < 2$ cm
  - ✓ number of TPC hits, nhits > 10
  - ✓ transverse momentum, $p_T > 0.1$ GeV/c
  - ✓ rapidity cut, $|\eta| < ???$ → will be discussed later
  - ✓ … no other cuts



~ 2% events have zero tracks



~ 4.5% events have zero tracks

Centrality tests

- Centrality determination following report by P. Parfenov at Physics Forum from April, 15
- Event and track selection cuts as discussed in previous slides

$|\eta| < 1.0$

Cent, %	Mult_min	Mult_max	<b>, fm	RMS	bmin, fm	bmax, fm	<Npart>	RMS	Npart_min	Npart_max	<Ncoll>	RMS	Ncoll_min	Ncoll_max
0 - 10	314	543	3.01	1.11	1.37	4.33	338.48	34.58	291.41	393.50	762.64	99.48	628.72	920.44
10 - 20	217	314	5.40	0.69	4.33	6.27	250.87	28.69	215.79	291.41	516.03	69.97	425.12	628.72
20 - 30	148	217	7.01	0.58	6.27	7.69	185.30	23.28	158.41	215.79	348.14	52.16	282.78	425.12
30 - 40	98	148	8.30	0.54	7.69	8.87	134.74	19.05	113.91	158.41	229.00	39.08	182.89	282.78
40 - 50	62	98	9.42	0.54	8.87	9.92	95.32	15.81	79.06	113.91	144.62	29.20	112.97	182.89
50 - 60	37	62	10.41	0.55	9.92	10.90	64.79	12.69	52.11	79.06	86.57	21.01	65.13	112.97
60 - 70	20	37	11.35	0.59	10.90	11.80	41.26	10.16	32.09	52.11	47.69	14.69	34.31	65.13
70 - 80	10	20	12.24	0.65	11.80	12.66	24.39	7.64	18.11	32.09	24.18	9.41	16.51	34.31
80 - 90	4	10	13.12	0.80	12.66	13.64	12.97	5.61	8.68	18.11	11.09	5.79	7.10	16.51
90 - 100	1	3	14.26	0.98	13.64	15.04	4.87	2.85	1.01	8.68	3.47	2.47	-1.01	7.10

$|\eta| < 0.5$

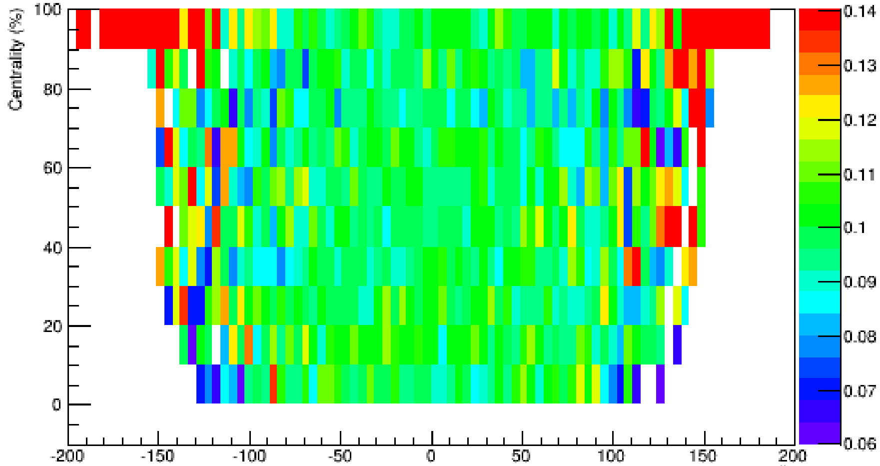
Cent, %	Mult_min	Mult_max	<b>, fm	RMS	bmin, fm	bmax, fm	<Npart>	RMS	Npart_min	Npart_max	<Ncoll>	RMS	Ncoll_min	Ncoll_max
0 - 10	164	292	2.90	1.10	1.29	4.16	341.70	33.92	298.03	393.36	773.36	96.32	648.20	922.19
10 - 20	115	164	5.16	0.73	4.16	5.98	260.74	30.55	227.40	298.03	542.70	72.66	455.15	648.20
20 - 30	80	115	6.69	0.62	5.98	7.32	198.31	25.73	172.62	227.40	380.67	56.09	316.41	455.15
30 - 40	54	80	7.92	0.59	7.32	8.46	149.12	22.16	128.52	172.62	261.82	44.34	214.63	316.41
40 - 50	35	54	9.00	0.58	8.46	9.51	109.69	18.89	92.54	128.52	174.11	34.61	139.40	214.63
50 - 60	21	35	9.99	0.59	9.51	10.47	77.37	16.01	63.71	92.54	109.61	26.75	85.01	139.40
60 - 70	12	21	10.91	0.62	10.47	11.33	52.01	13.10	41.65	63.71	64.68	19.56	48.12	85.01
70 - 80	6	12	11.78	0.69	11.33	12.18	32.68	10.83	25.53	41.65	35.28	14.20	25.49	48.12
80 - 90	3	6	12.62	0.80	12.18	13.23	19.17	8.32	13.03	25.53	17.95	9.38	11.66	25.49
90 - 100	1	2	13.99	1.04	13.23	14.97	6.75	4.91	-0.66	13.03	5.17	4.55	-3.32	11.66

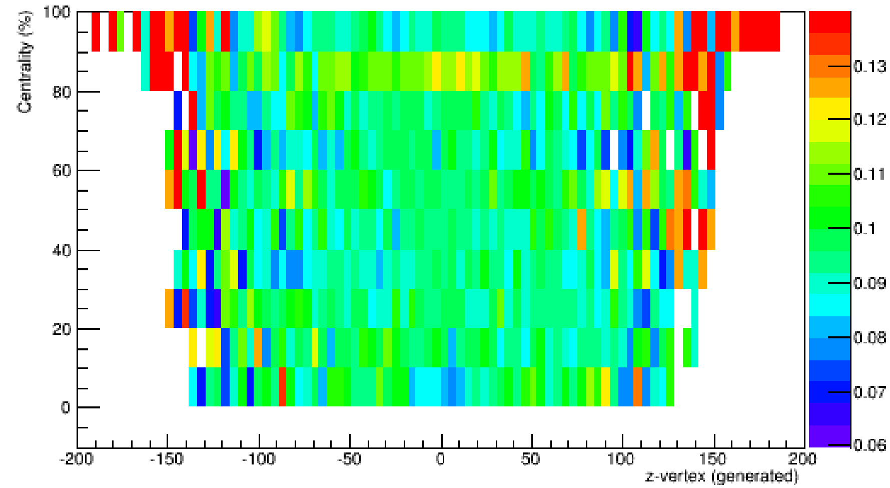
- Note small number of tracks in peripheral collisions even with rather loose track selections !!!

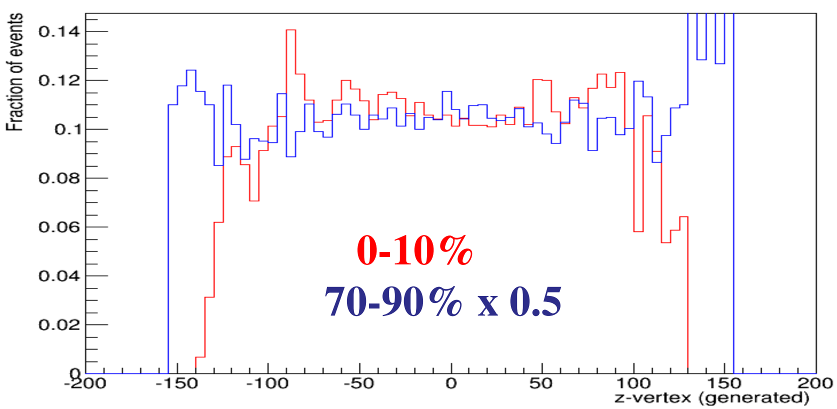
Centrality bias

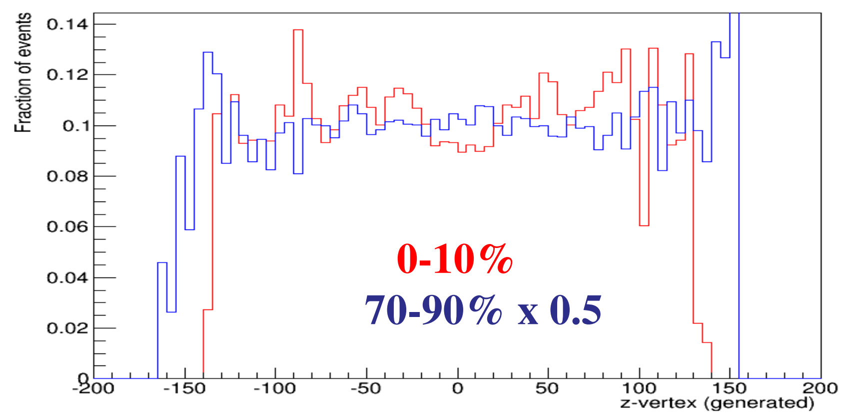
- Event distribution vs. generated z-vertex and centrality (10 bins) → expect occupancy ~ 0.1

$|\eta| < 1.0$ | **$|\eta| < 0.5$**





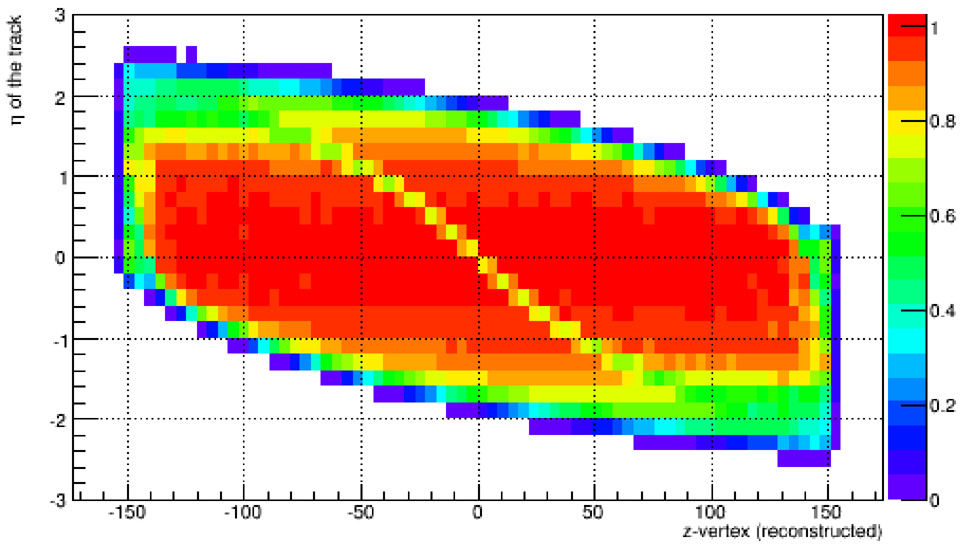


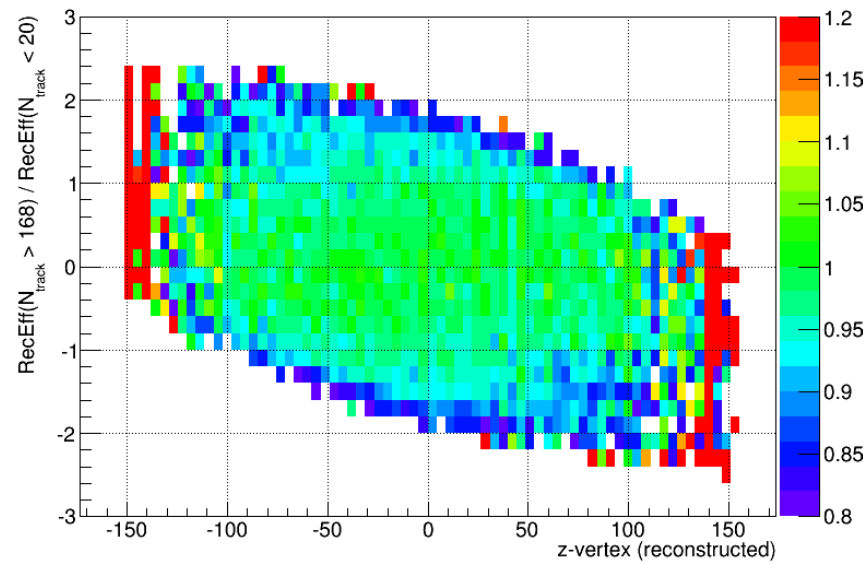


- Events leak from central to peripheral bins at large values of z-vertex, stronger with $|\eta| < 1.0$
- Track reconstruction efficiency depends on the event z-vertex and track rapidity !!!

Relative track reconstruction efficiency - I

- Track reconstruction efficiency depends on the event z-vertex and track rapidity

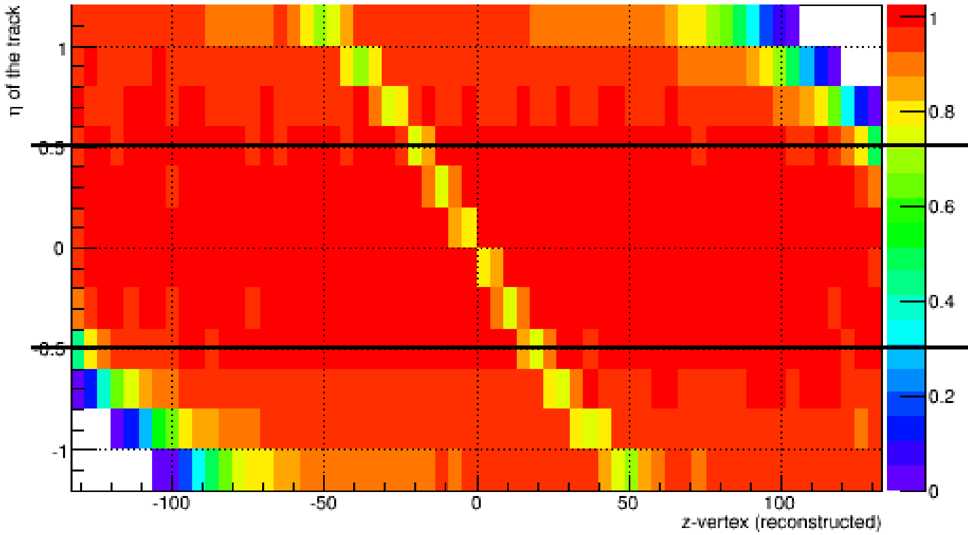


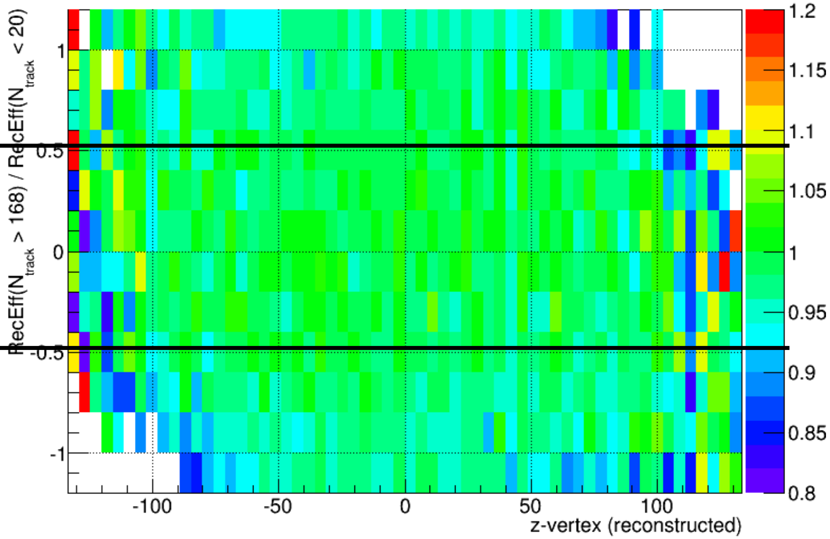


- Among other things accounts for z-dependence of the event vertex reconstruction and track-to-vertex matching efficiencies
- Clearly see effect of central membrane and the boundary effects
- The number of reconstructed tracks should be corrected for reconstruction efficiency → modified multiplicity distribution → modified centrality
- The reconstruction efficiency shows noticeable multiplicity dependence (right plot)

Relative track reconstruction efficiency - II

- Zoom in … |z-vertex| < 130 cm, |η| < 1.2

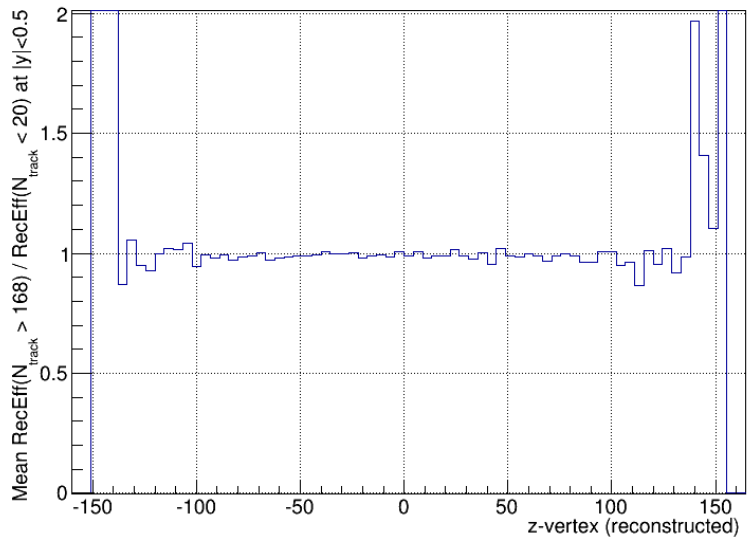




- With |η| < 1 selection we loose tracks at |z-vertex| > 100 cm → lost tracks can not be corrected for the reconstruction efficiency → limited to centrality studies at |z-vertex| < 100 cm

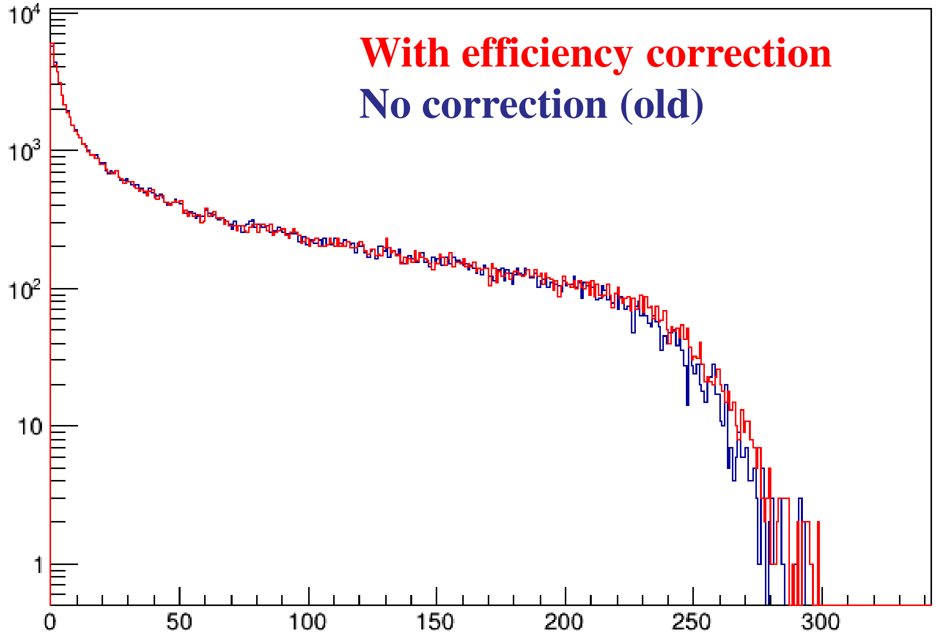
- To select events within |z-vertex| < 130 cm, the track η-range should be limited to |η| < 0.5-0.6

- The reconstruction efficiency does not show a strong dependence on multiplicity at |η| < 0.5 and |z-vertex| < 130 cm



Multiplicity distributions, |η| < 0.5

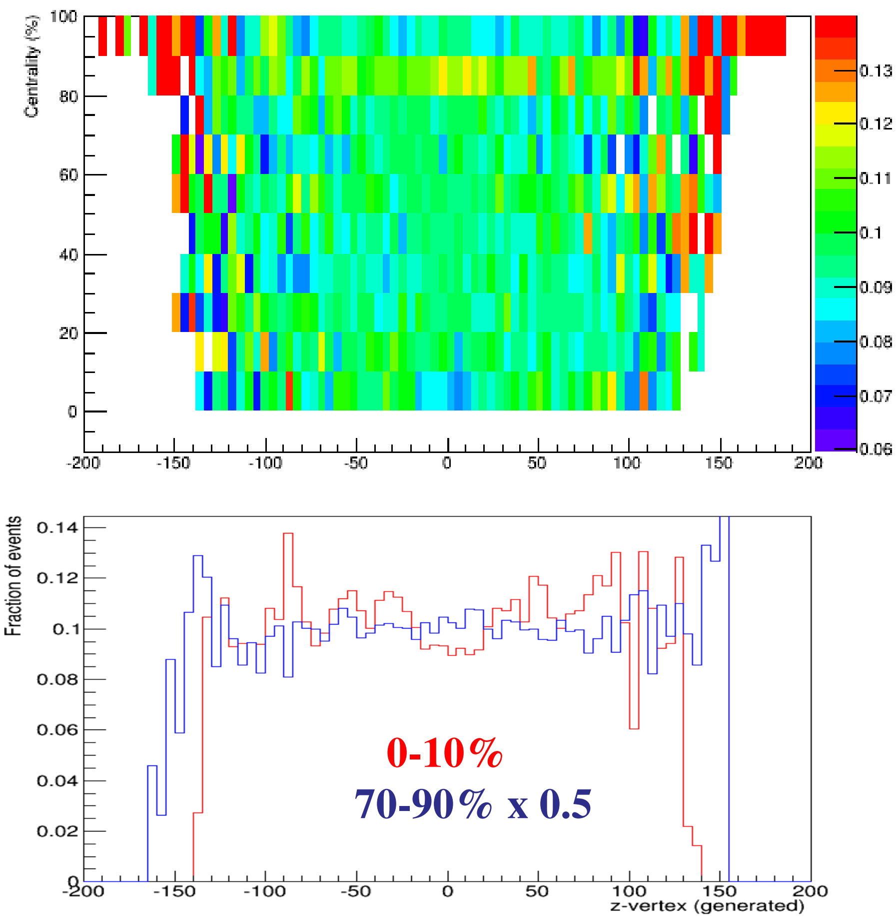
- Observe a small change in multiplicity distribution with the efficiency correction
- Definition of centrality classes hardly changes compared to slide 8



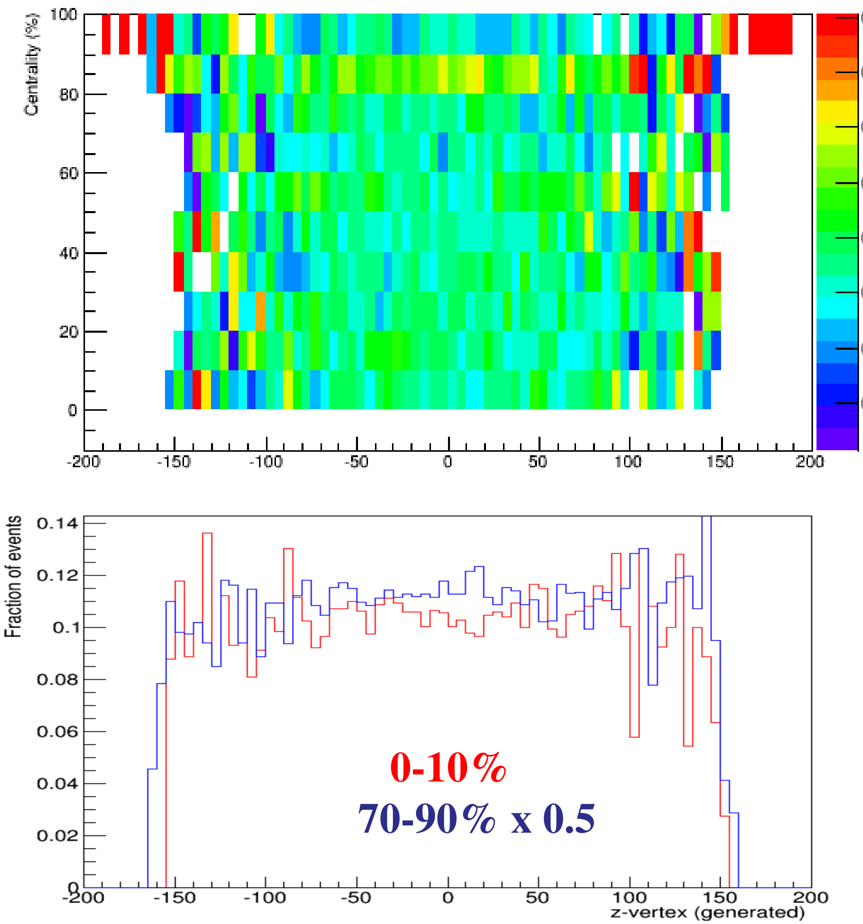
Centrality bias, |η| < 0.5

- The distributions without (left) and with (right) track efficiency corrections

From slide 9 (no efficiency corrections)



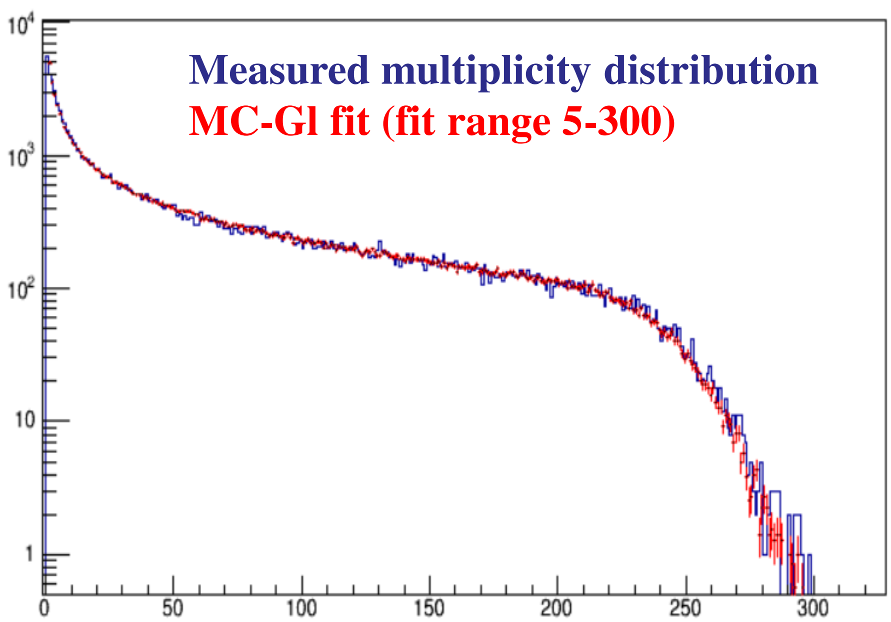
with efficiency corrections

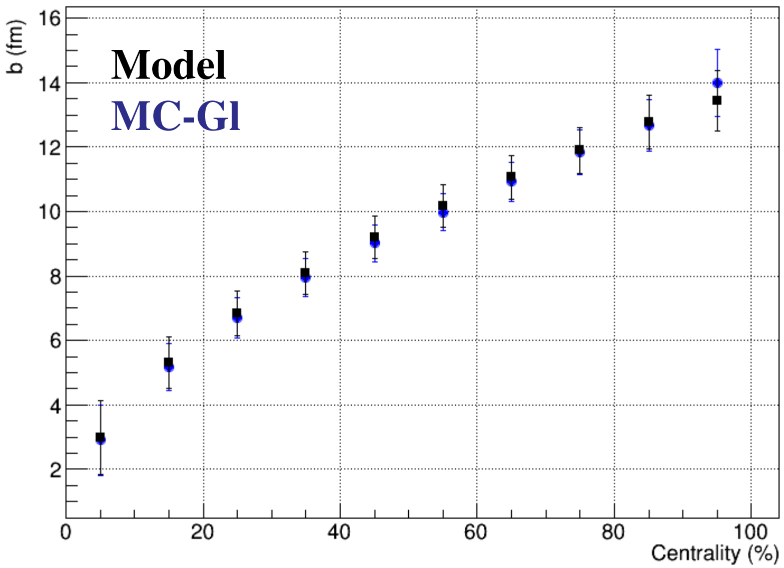


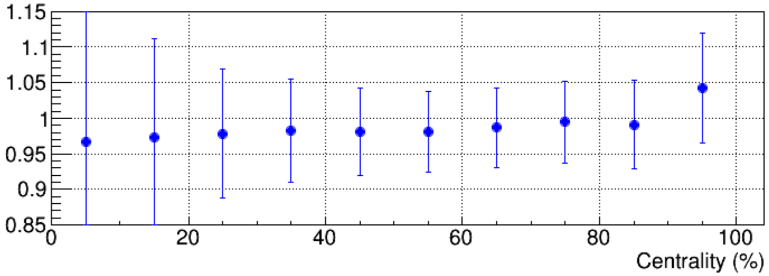
- The centrality distribution does not show z-vertex bias after the efficiency correction

Centrality with TPC - I

- DCM-QGSM-SMM, BiBi@9.2
- Event selection:
  - ✓ at least one primary track at $|\eta| < 1$
  - ✓ reconstructed vertex, z-vertex !=0
  - ✓ |z-vertex| < 130 cm
- Track selections:
  - ✓ $|DCA_{x,y,z}| < 2$ cm
  - ✓ number of TPC hits, nhits > 10
  - ✓ $p_T > 0.1$ GeV/c
  - ✓ $|\eta| < 0.5$
  - ✓ efficiency correction vs. z-vertex and η



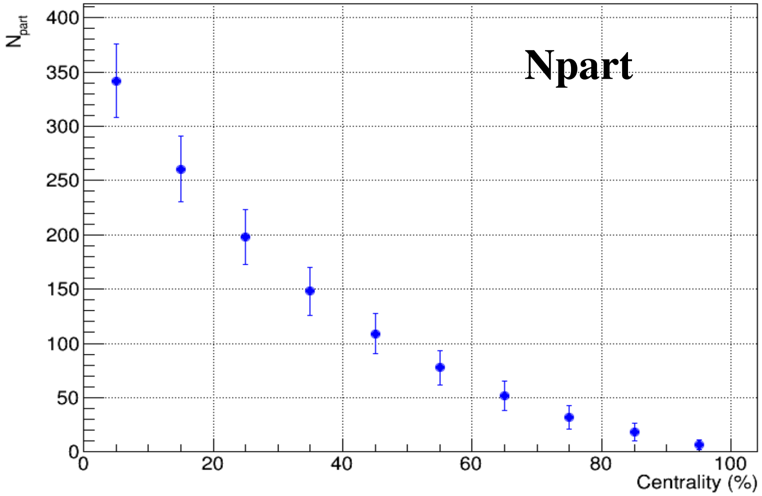


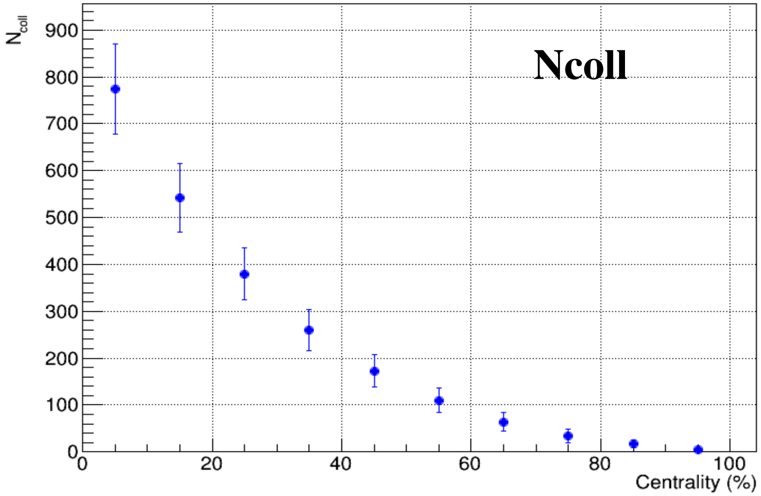


- Simulated parameters are reproduced

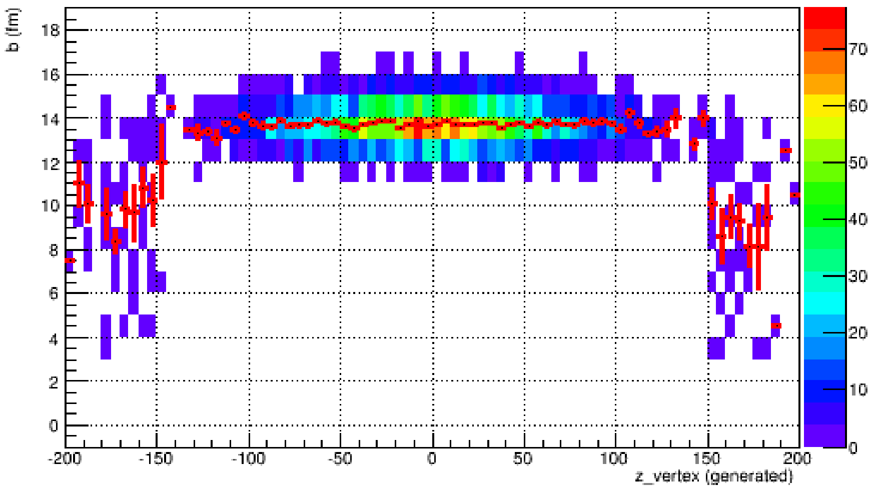
Centrality with TPC - II

- N_{part} and N_{coll} vs. centrality





- Events without centrality (number of good tracks == 0)



- ✓ rejected events are all peripheral events
- ✓ counts at |z-vertex| > 130 cm are events with misreconstructed vertices
- ✓ <b> of rejected events does not depend on z-vertex at |z-vertex| < 130 cm

Centrality vs. absolute TPC efficiency

- Default:

Cent, %	Mult_min	Mult_max	<b>, fm	RMS	bmin, fm	bmax, fm	<Npart>	RMS	Npart_min	Npart_max	<Ncoll>	RMS	Ncoll_min	Ncoll_max
0 - 10	169	303	2.91	1.10	1.30	4.18	341.39	34.00	297.05	394.37	772.36	96.59	645.28	926.56
10 - 20	118	169	5.19	0.73	4.18	6.02	259.47	30.48	225.74	297.05	539.33	72.70	450.55	645.28
20 - 30	82	118	6.72	0.62	6.02	7.37	196.85	25.58	171.06	225.74	376.91	55.63	312.60	450.55
30 - 40	55	82	7.96	0.58	7.37	8.50	147.54	21.84	127.36	171.06	257.99	43.77	212.16	312.60
40 - 50	36	55	9.04	0.57	8.50	9.53	108.28	18.44	91.75	127.36	171.34	33.81	137.91	212.16
50 - 60	22	36	9.99	0.58	9.53	10.49	77.22	15.63	63.10	91.75	109.27	26.02	83.91	137.91
60 - 70	12	22	10.93	0.62	10.49	11.36	51.49	13.08	40.99	63.10	63.87	19.64	47.06	83.91
70 - 80	6	12	11.84	0.68	11.36	12.23	31.65	10.49	24.77	40.99	33.80	13.64	24.50	47.06
80 - 90	3	6	12.67	0.80	12.23	13.28	18.57	8.12	12.48	24.77	17.27	9.11	11.13	24.50
90 - 100	1	2	14.01	1.04	13.28	14.92	6.58	4.72	-0.12	12.48	5.02	4.37	-3.03	11.13

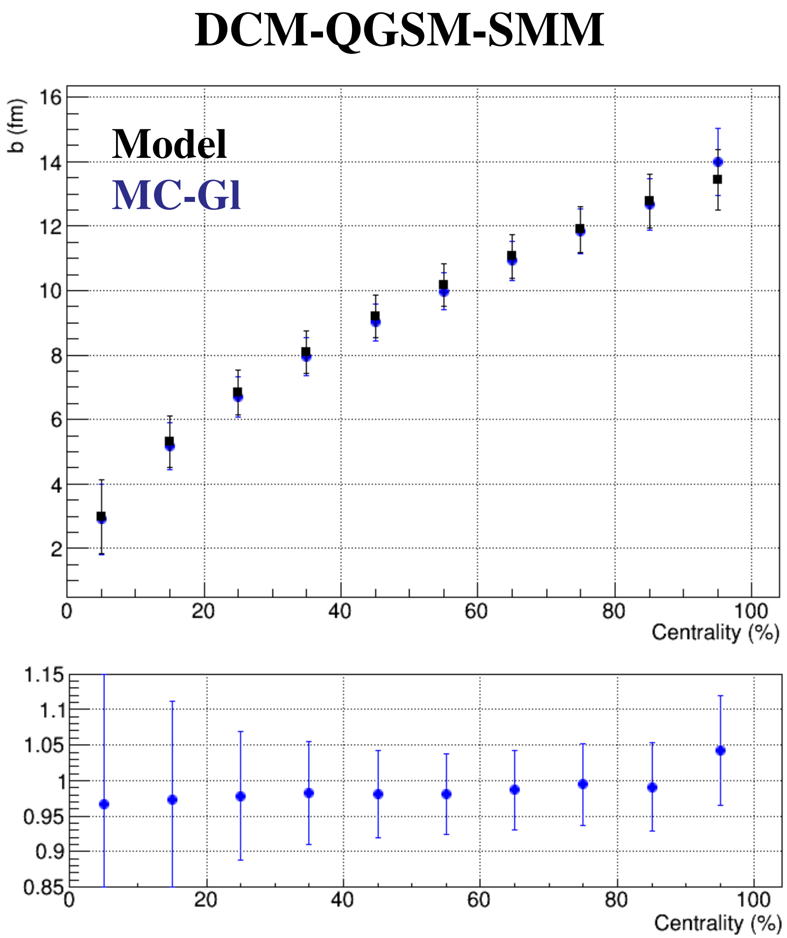
- N_{track} * 1.2:

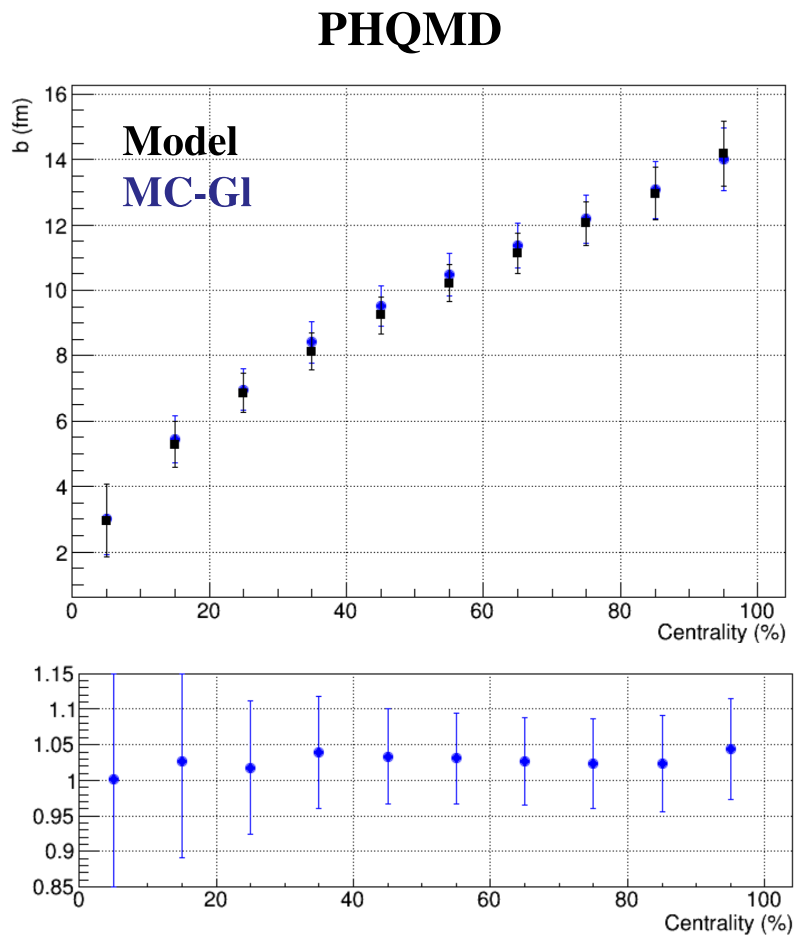
Cent, %	Mult_min	Mult_max	<b>, fm	RMS	bmin, fm	bmax, fm	<Npart>	RMS	Npart_min	Npart_max	<Ncoll>	RMS	Ncoll_min	Ncoll_max
0 - 10	203	356	2.93	1.10	1.31	4.21	340.89	33.88	295.87	393.62	770.48	96.65	641.55	923.57
10 - 20	141	203	5.25	0.71	4.21	6.09	257.18	29.65	222.99	295.87	533.16	70.79	443.58	641.55
20 - 30	97	141	6.81	0.60	6.09	7.47	193.21	24.59	167.05	222.99	367.80	53.53	303.22	443.58
30 - 40	65	97	8.07	0.56	7.47	8.61	143.48	20.52	122.94	167.05	248.69	41.00	202.44	303.22
40 - 50	42	65	9.14	0.55	8.61	9.65	104.53	17.29	87.71	122.94	163.38	31.37	129.68	202.44
50 - 60	25	42	10.13	0.56	9.65	10.61	72.93	14.55	59.79	87.71	101.33	24.03	78.02	129.68
60 - 70	14	25	11.06	0.60	10.61	11.49	48.29	11.83	38.37	59.79	58.57	17.31	43.21	78.02
70 - 80	7	14	11.93	0.66	11.49	12.36	29.81	9.44	22.60	38.37	31.23	12.01	21.83	43.21
80 - 90	3	7	12.83	0.81	12.36	13.41	16.43	7.28	10.94	22.60	14.82	7.87	9.36	21.83
90 - 100	1	2	14.11	1.01	13.41	15.02	5.80	3.89	0.43	10.94	4.29	3.47	-1.72	9.36

- N_{track} * 1.5:

Cent, %	Mult_min	Mult_max	<b>, fm	RMS	bmin, fm	bmax, fm	<Npart>	RMS	Npart_min	Npart_max	<Ncoll>	RMS	Ncoll_min	Ncoll_max
0 - 10	251	443	2.98	1.11	1.40	4.26	339.32	34.77	294.03	391.75	765.99	99.08	636.31	918.18
10 - 20	174	251	5.31	0.72	4.26	6.15	254.71	30.12	220.67	294.03	526.49	72.03	437.60	636.31
20 - 30	119	174	6.87	0.61	6.15	7.54	190.78	25.06	164.29	220.67	361.83	54.81	296.73	437.60
30 - 40	79	119	8.14	0.57	7.54	8.70	140.96	21.03	120.03	164.29	242.89	42.25	196.10	296.73
40 - 50	50	79	9.24	0.57	8.70	9.74	101.29	17.71	84.88	120.03	156.75	32.35	124.11	196.10
50 - 60	30	50	10.23	0.58	9.74	10.71	70.25	14.50	57.17	84.88	96.43	23.89	73.56	124.11
60 - 70	16	30	11.16	0.62	10.71	11.61	45.76	11.96	35.98	57.17	54.66	17.48	39.87	73.56
70 - 80	8	16	12.05	0.69	11.61	12.51	27.63	9.31	20.56	35.98	28.42	11.66	19.48	39.87
80 - 90	3	8	13.00	0.87	12.51	13.53	14.67	7.19	9.74	20.56	12.98	7.60	8.16	19.48
90 - 100	1	3	14.18	1.01	13.53	14.98	5.44	3.60	1.38	9.74	3.96	3.16	-0.74	8.16

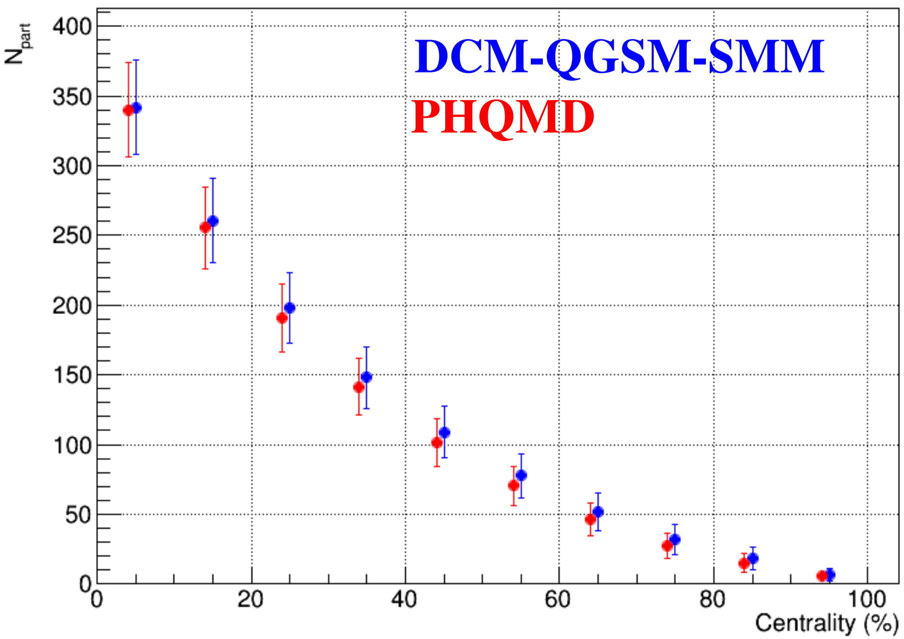
DCM-QGSM-SMM vs. PHQMD - I

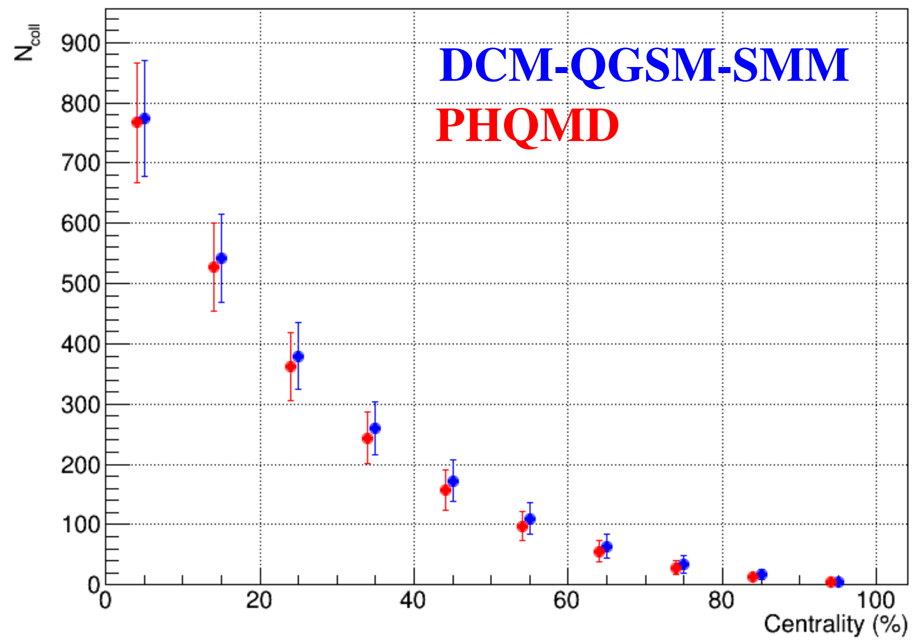




- Same event and track selections for two models
- Track multiplicity is ~ 10% higher in PHQMD → somewhat different centrality definitions
- MC-Gl calculations reproduce the generated parameters, consistent for two models

DCM-QGSM-SMM vs. PHQMD - II





- N_{part} and N_{coll} are consistent

Conclusions (centrality with TPC)

- TPC can provide centrality measurements in the wide z-vertex range, |z-vertex| < 120-130 cm
- Use of TPC as a vertex & centrality detector reduces efficiency of event selection by ~ 5 %
  → the "effective trigger efficiency" is reduced for peripheral events

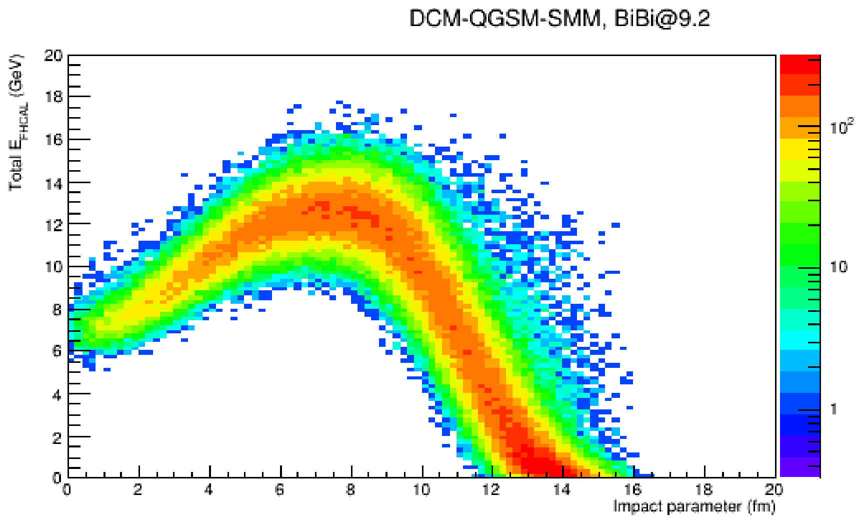
Centrality with FHCAL

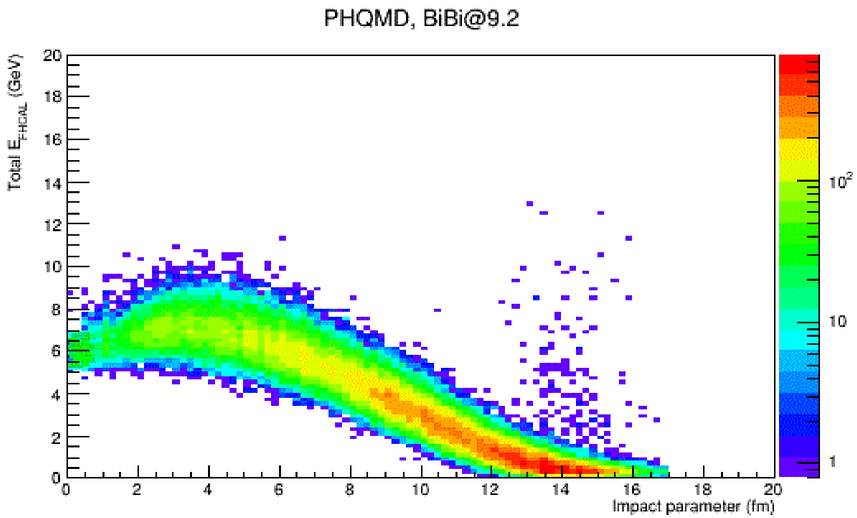
- Centrality with FHCAL is asserted by the measured energies
  - ✓ event should have non-zero measured energies in FHCAL-E and FHCAL-W
  - ✓ event vertex is not needed

- Potentially all triggered events can potentially be characterized by centrality

Total E vs. impact parameter

- BiBi@9.2:
  - ✓ MpdRoot reconstruction with Geant-4
  - ✓ σ_z^{vertex}= 50 cm – wide z-vertex distribution;





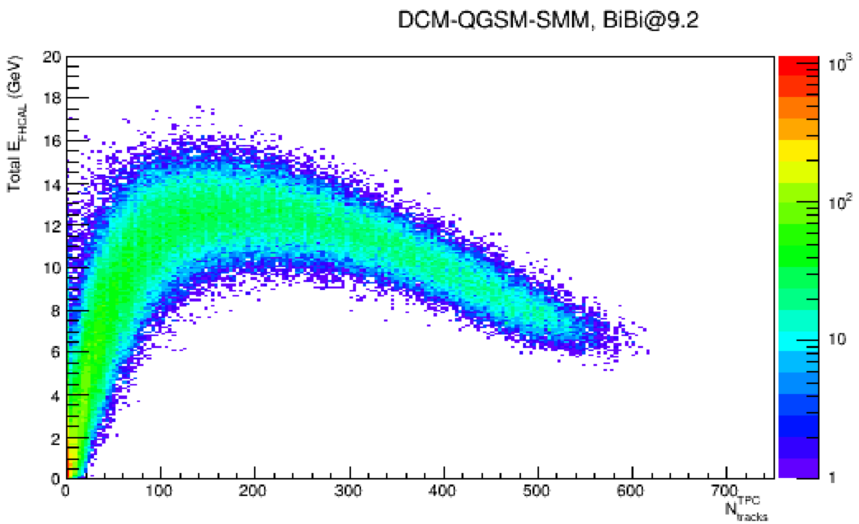
→ quite significant model dependence of the predicted FHCAL signals

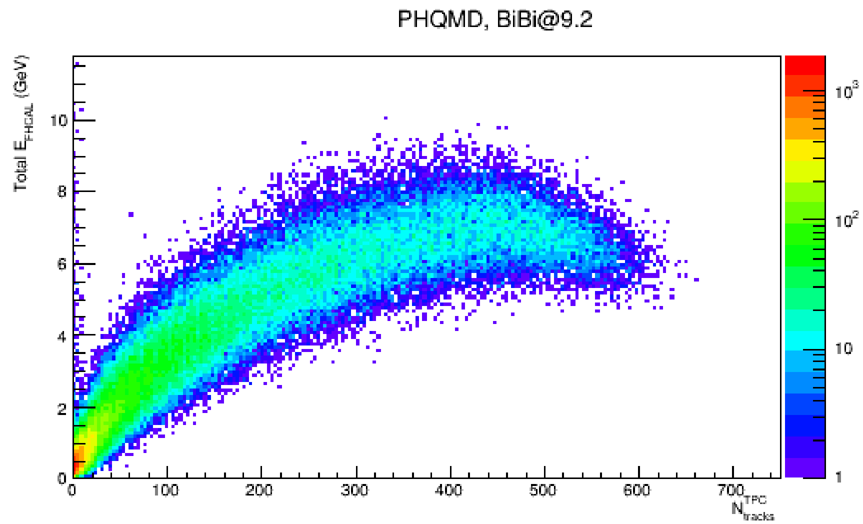
→ central-peripheral ambiguity for two event generators

→ PHQMD predicts smaller ambiguities (more linear dependence)

Total E vs. TPC multiplicity

- BiBi@9.2:
  - ✓ MpdRoot reconstruction with Geant-4
  - ✓ σ_z^{vertex}= 50 cm – wide z-vertex distribution; |z-vertex| < 100 cm
  - ✓ TPC tracks: p_T > 50 MeV/c, 5 cm matching to PV, nhits > 10, |η| < 1.0

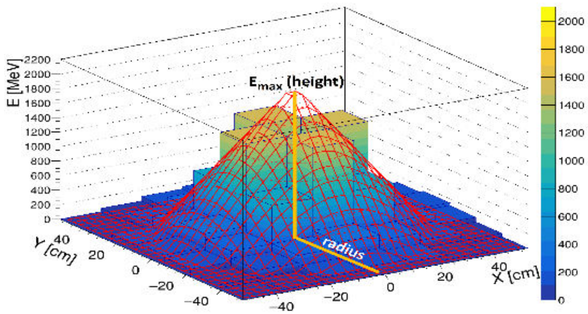


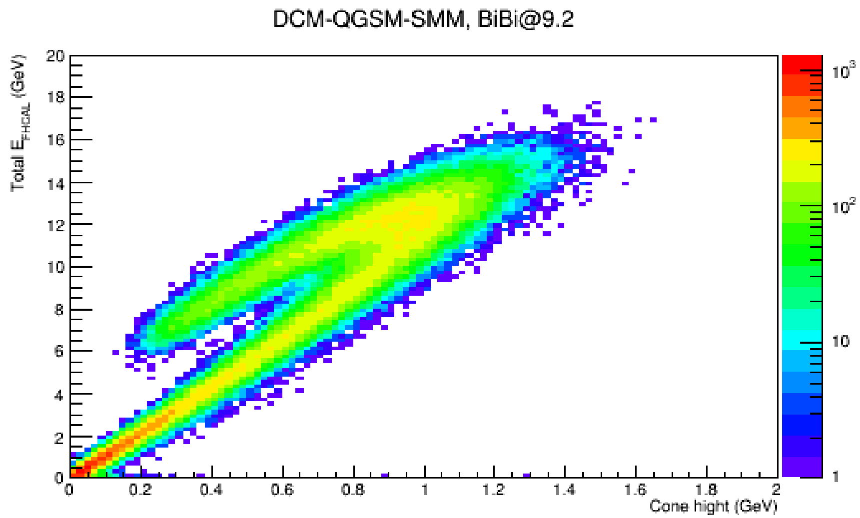


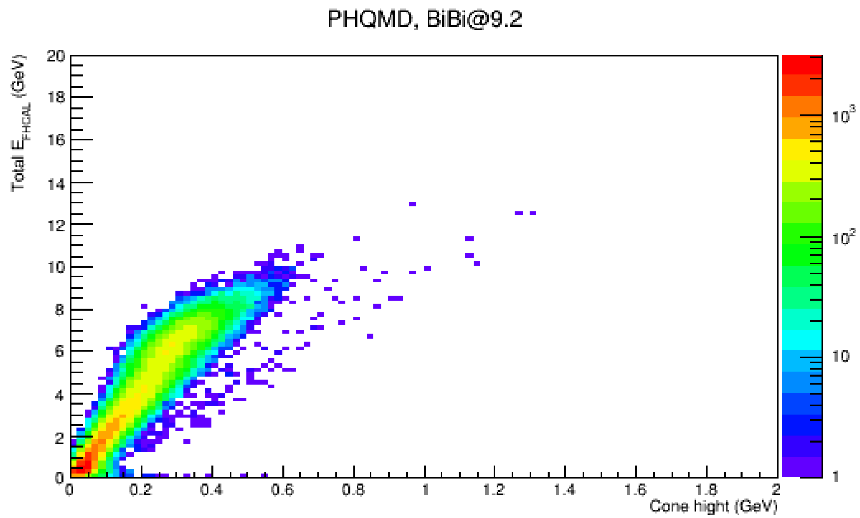
→ quite significant model dependence of the predicted FHCAL signals

Total E vs. E_{max} (cone-fit maximum)

- BiBi@9.2:
  - ✓ MpdRoot reconstruction with Geant-4
  - ✓ σ_z^{vertex} = 50 cm – wide z-vertex distribution





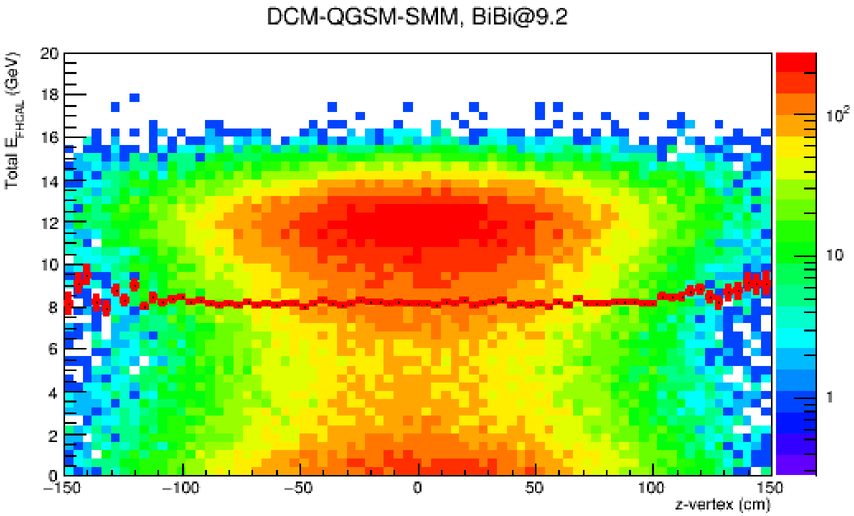


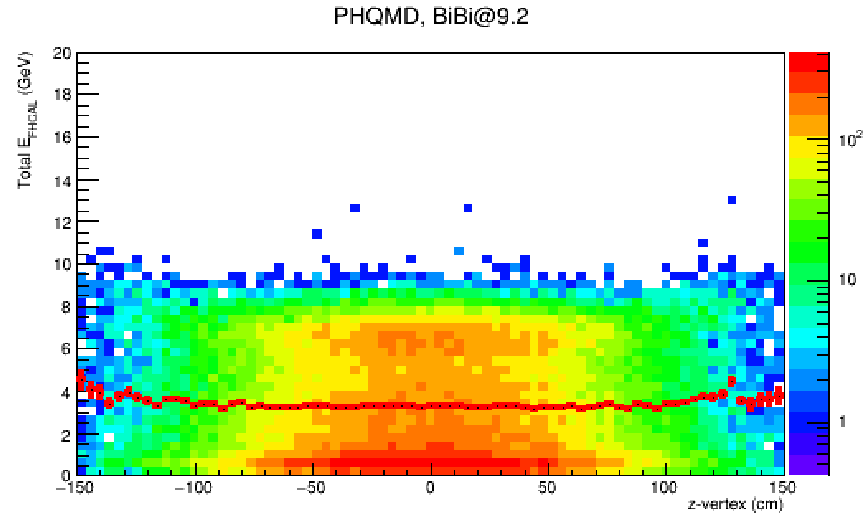
→ E vs. E_{max} correlation helps to separate central-peripheral events at the same measured total E

→ Quite significant model dependence of the FHCAL simulated signals

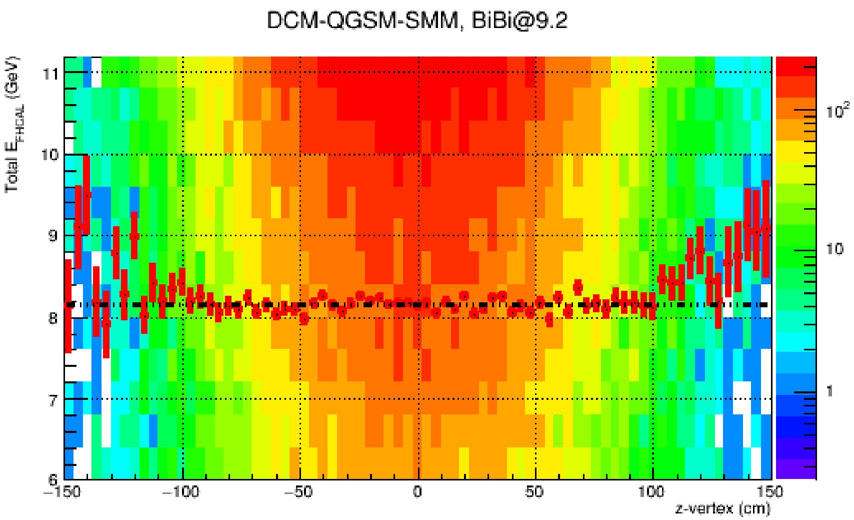
→ If there is a hook in PHQMD then it is not resolved

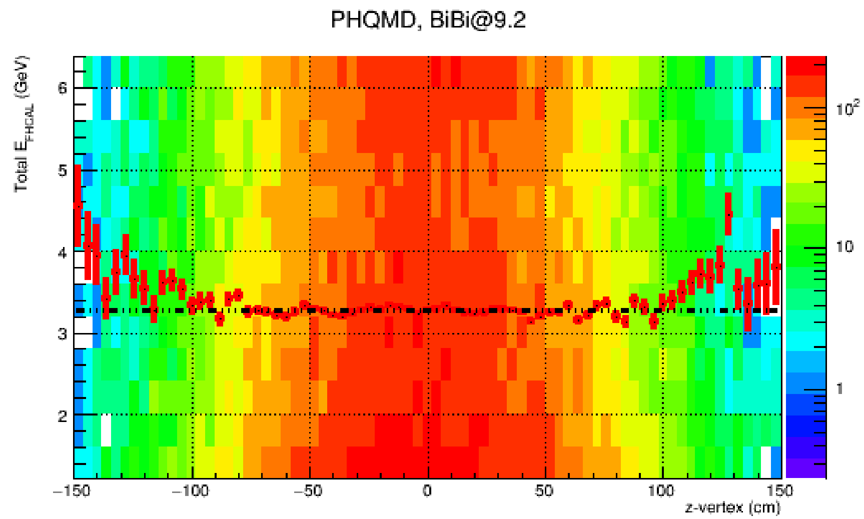
Total E vs. z-vertex





❖ Zoom-in + fit to a constant within [-100, 100] cm:





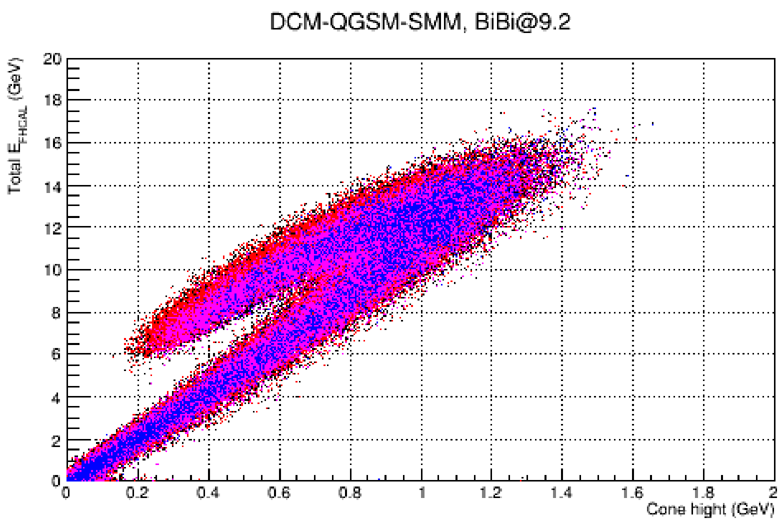
→ total E does not depend on z-vertex within |z-vertex| < 100 cm → centrality should not be biased by z-vrtx

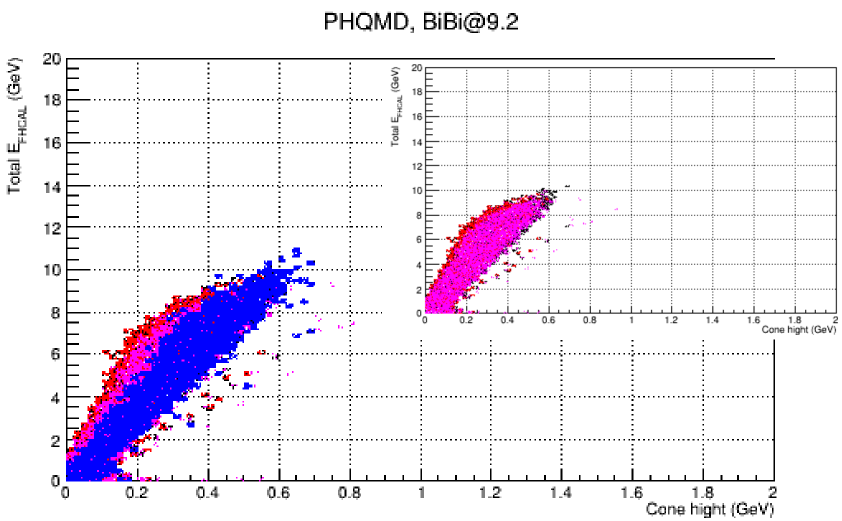
→ predictions are consistent for two event generators

Total E vs. E_{max} (cone-fit maximum)

- BiBi@9.2:
  - ✓ MpdRoot reconstruction with Geant-4
  - ✓ σ_z^{vertex}= 50 cm – wide z-vertex distribution

- Same distributions as in slide 2 divided in subsamples by z-vertex:
  - ✓ **|z-vertex| < 150 cm** ✓ **|z-vertex| < 50 cm** ✓ **50 < |z-vertex| < 100 cm** ✓ **|z-vertex| > 100 cm**





→ DCM-QGSM-SMM does not show any dependence on z-vertex

→ PHQMD shows very modest z-vertex dependence at |z-vertex| < 100 cm; at larger |z-vertex| values the shape of dependence changes (becomes more linear)

FHCAL, summary

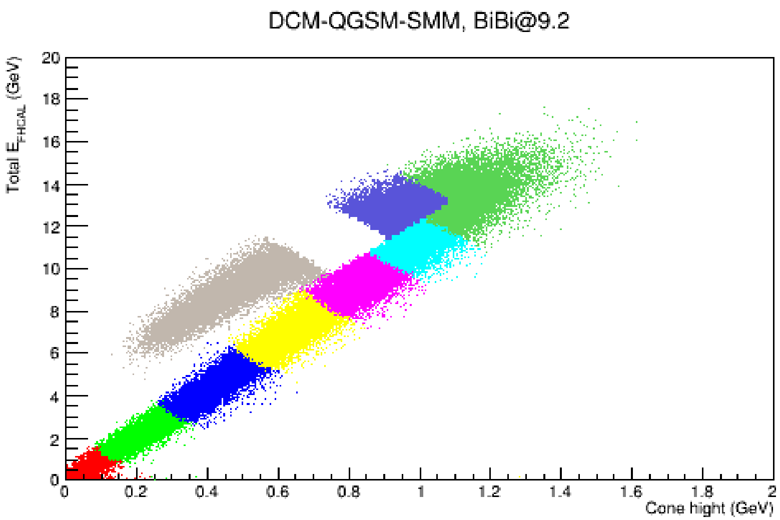
- Total energy deposition is z-vertex independent at |z-vertex| < 100 cm
- Observe non-linear effects at larger values of |z-vertex| > 100 cm
- Conclusions are qualitatively the same for two event generators

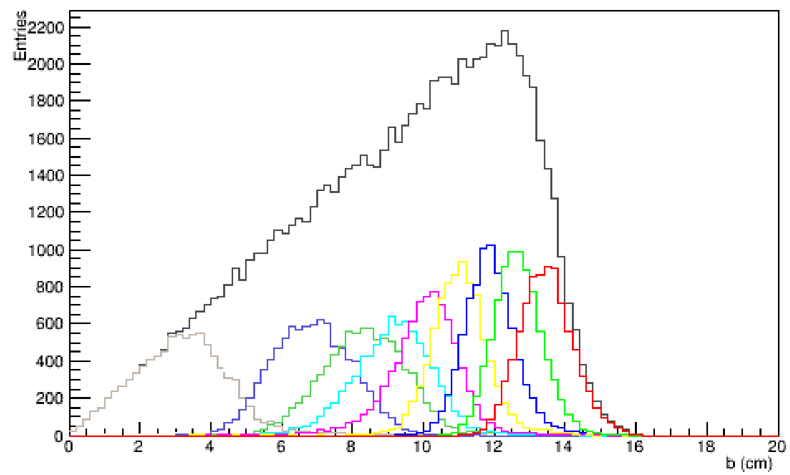
→ FHCAL can be used for centrality measurements at |z-vertex| < 100 cm

→ With external z-vertex measurements with resolution ~ cm the range can be extended with z-dependent energy correction

DCM-QGSM-SMM: centrality bins

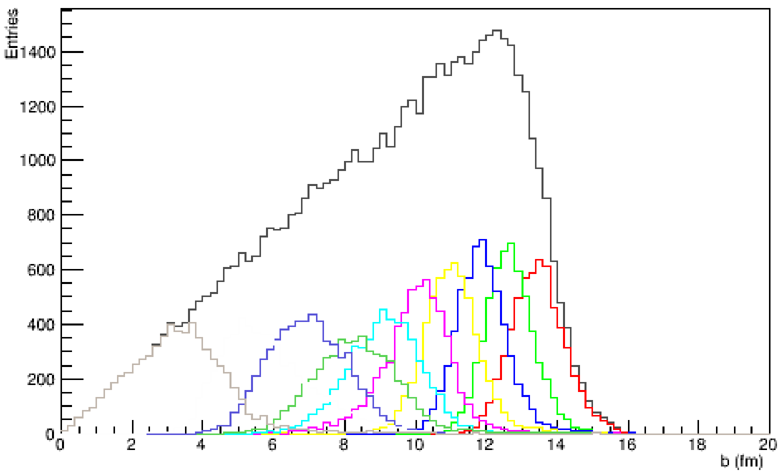
- BiBi@9.2:
  - ✓ MpdRoot reconstruction with Geant-4
  - ✓ σ_z^{vertex}= 50 cm – wide z-vertex distribution; |z-vertex| < 130 cm
- FHCAL:



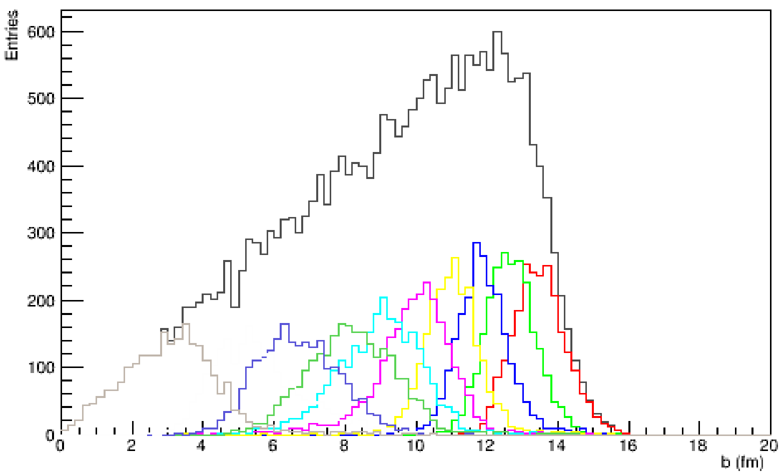


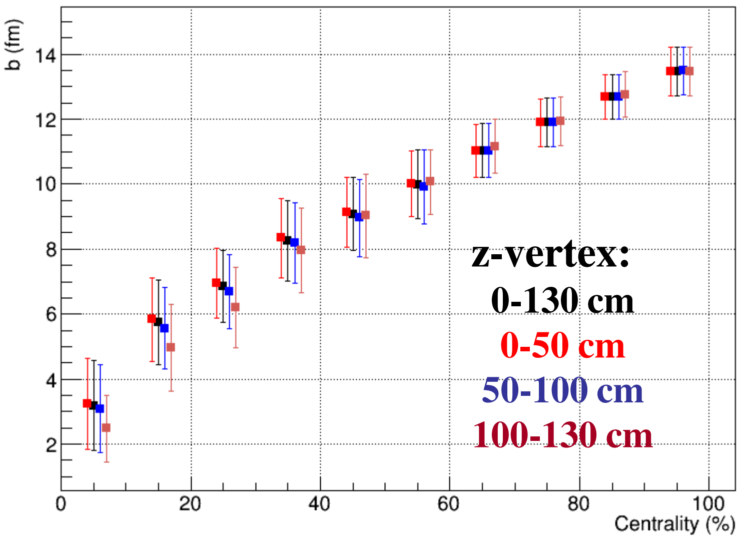
DCM-QGSM-SMM: Z-vertex bias?

|z-vertex| < 50 cm



50 cm < |z-vertex| < 100 cm

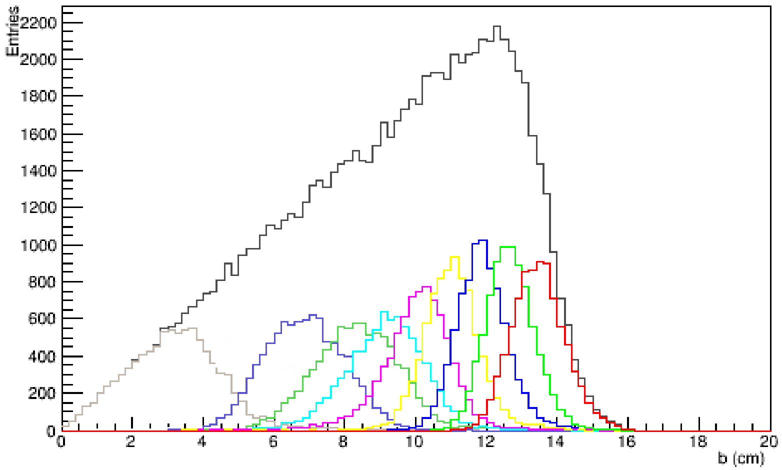




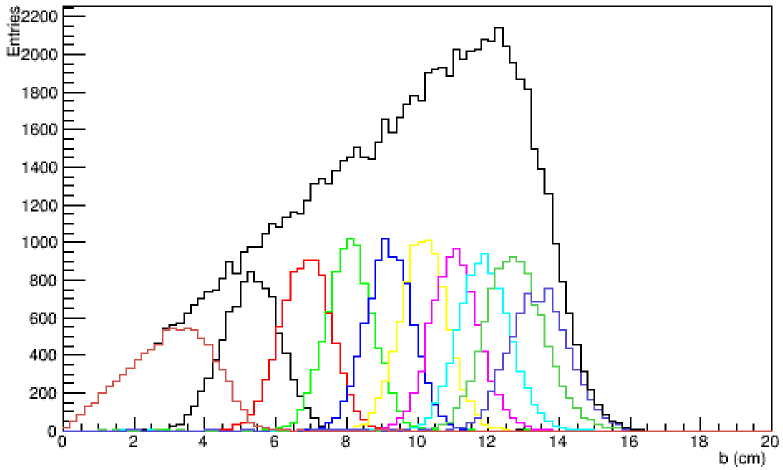
- ❖ No z-vertex bias at |z-vertex| < 100 cm
- ❖ Noticeable vertex bias at larger z-vertex values

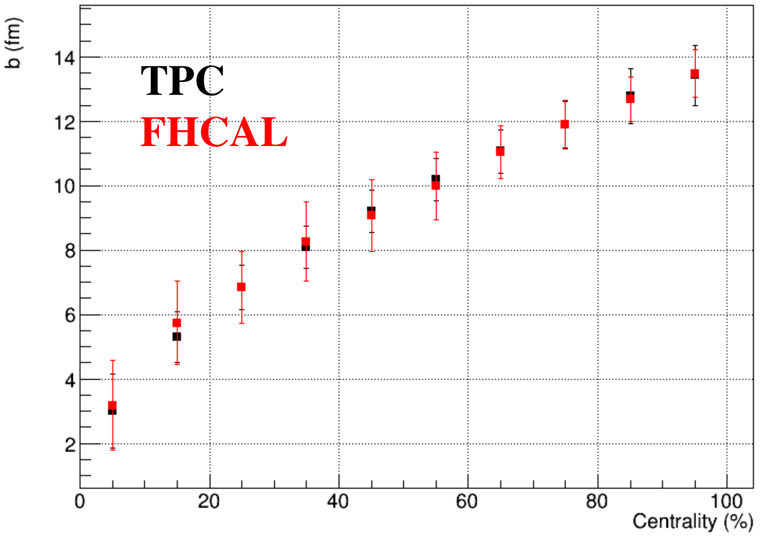
DCM-QGSM-SMM: FHCAL vs. TPC

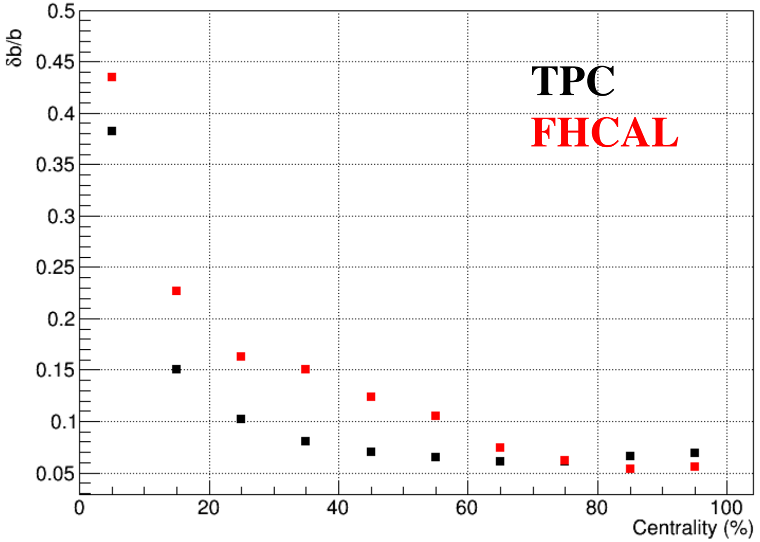
FHCAL



TPC



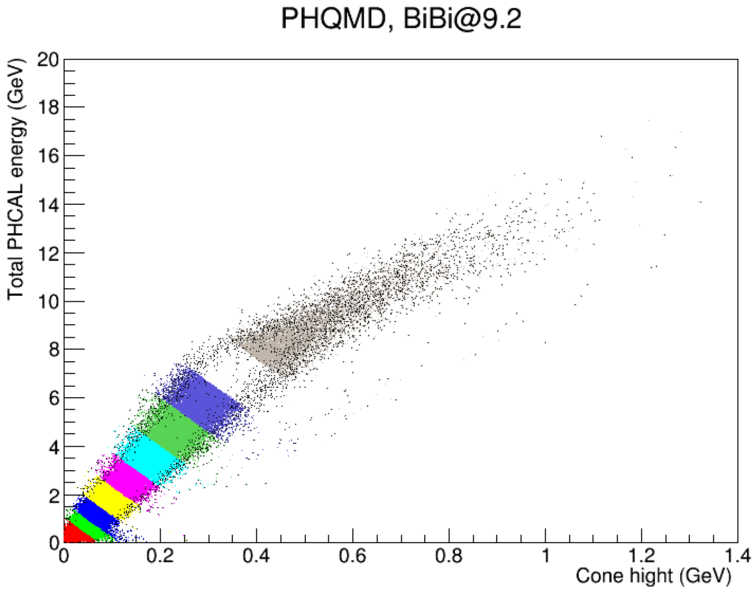


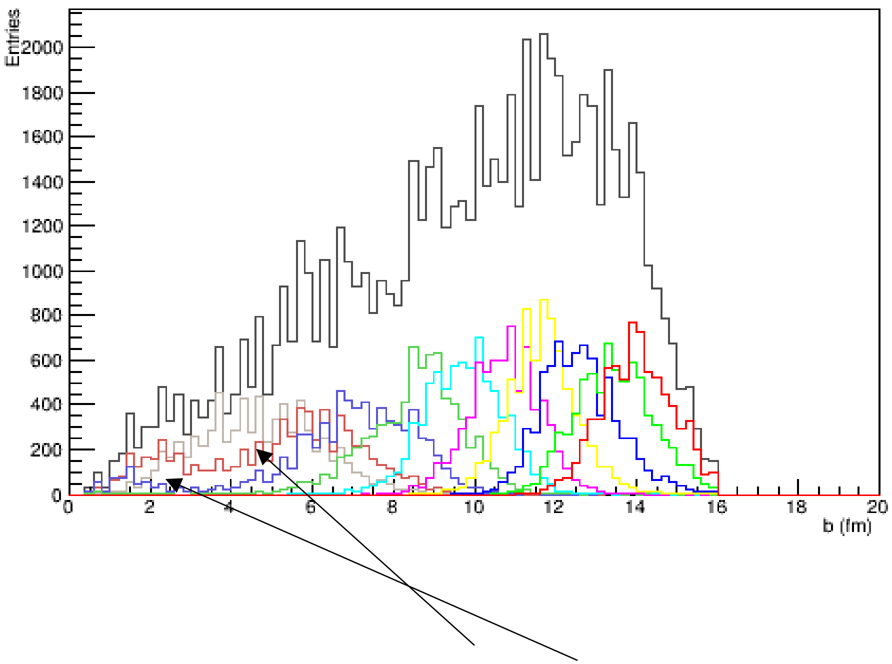


- ❖ Centrality/multiplicity classes select similar events by impact parameter
- ❖ b-resolution is generally better with the TPC except for very peripheral events

PHQMD: centrality bins

- BiBi@9.2:
  - ✓ MpdRoot reconstruction with Geant-4
  - ✓ σ_z^{vertex}= 50 cm – wide z-vertex distribution; |z-vertex| < 130 cm
- FHCAL:



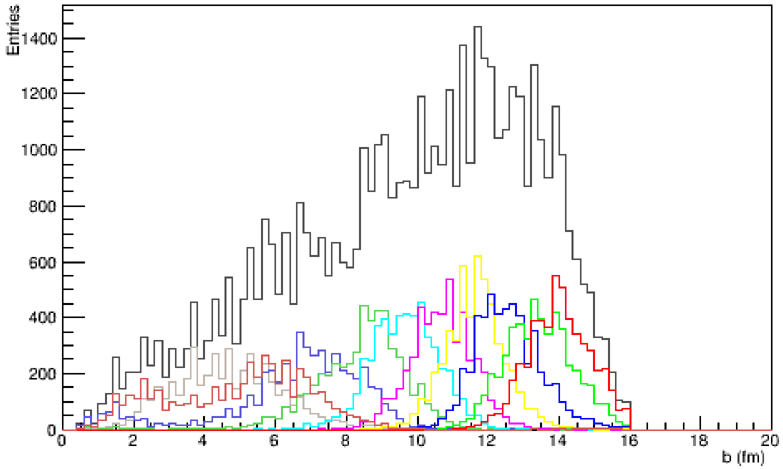


Probably there is a hook similar to that in DCM-SMM, but it is not resolved

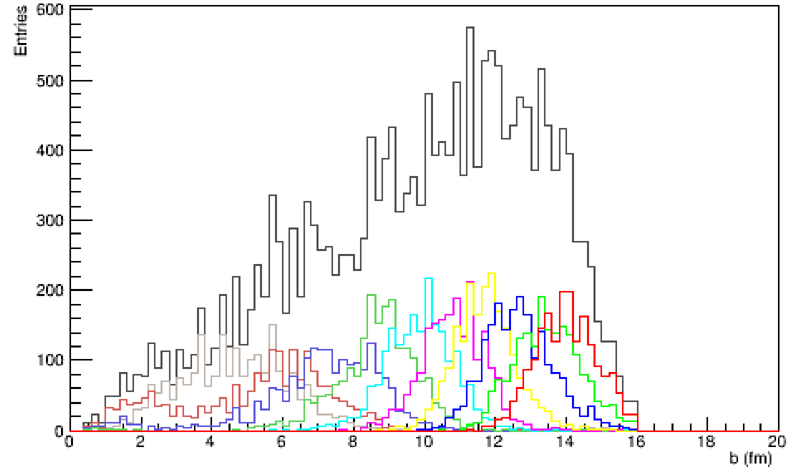
Very wide and largely overlapping distributions for 0-10% and 10-20% central collisions

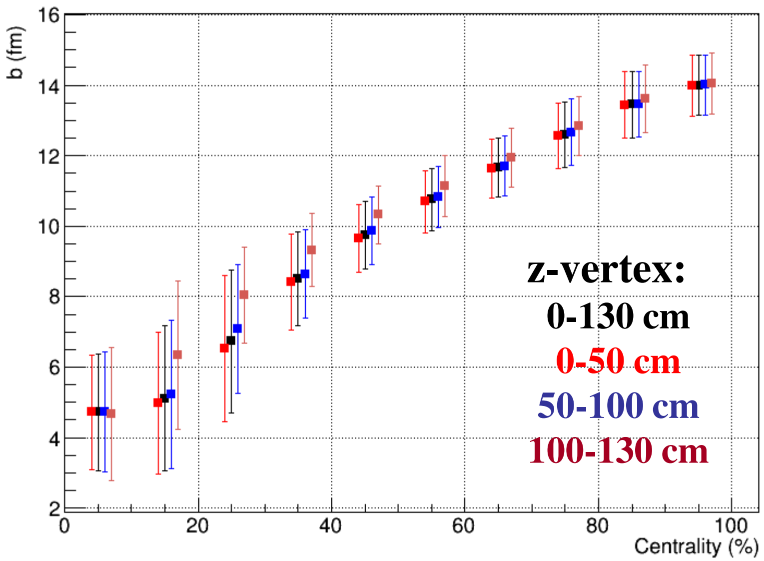
PHQMD: Z-vertex bias?

|z-vertex| < 50 cm



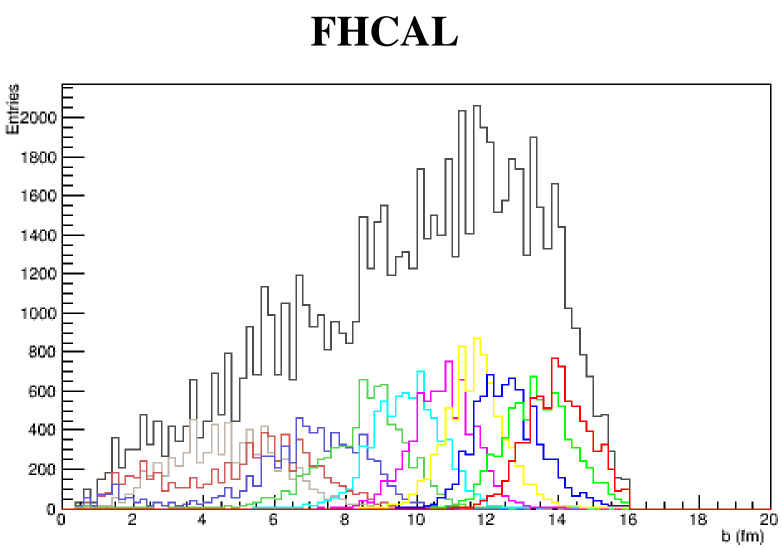
50 cm < |z-vertex| < 100 cm

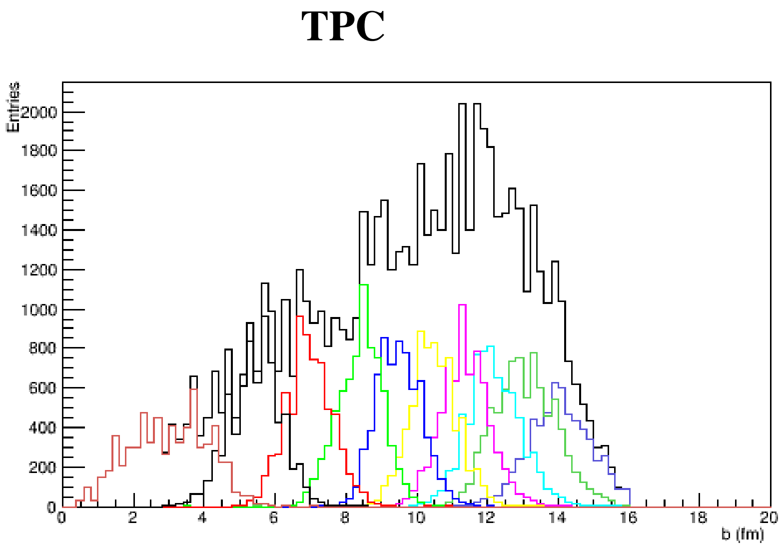


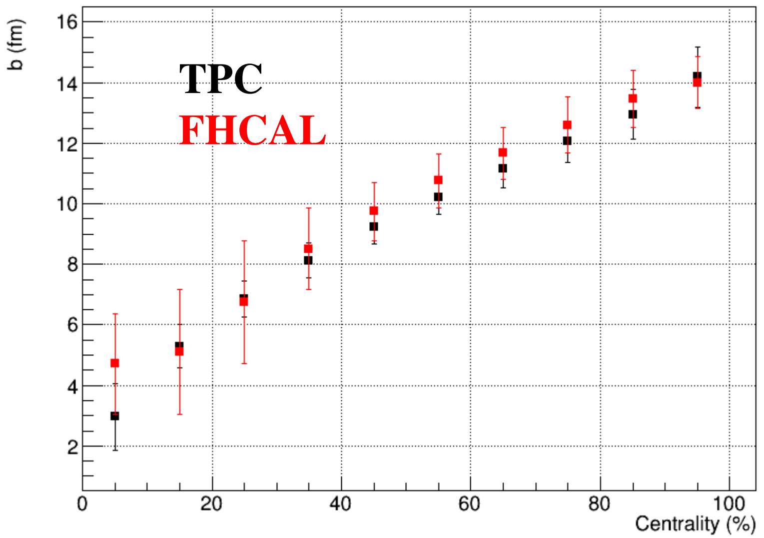


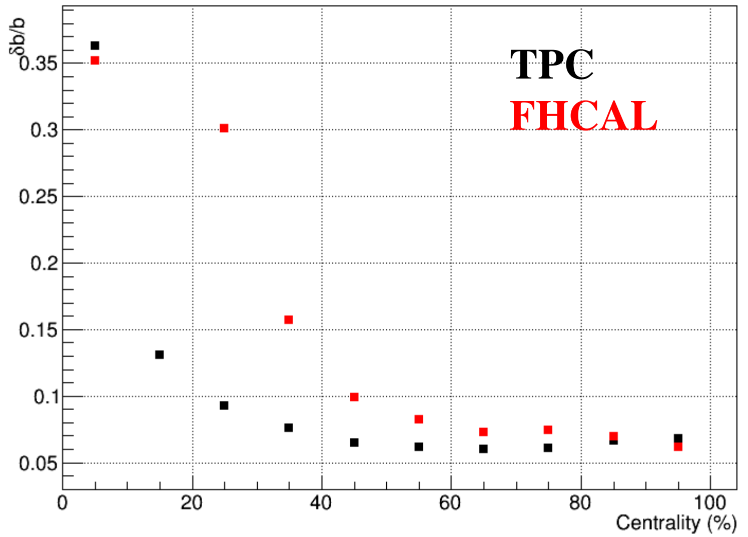
- No z-vertex bias at |z-vertex| < 100 cm
- Modest vertex bias at larger z-vertex values

PHQMD: FHCAL vs. TPC









- ❖ Centrality/multiplicity classes select similar events except for most central collisions
- ❖ b-resolution is better with the TPC except for very peripheral events

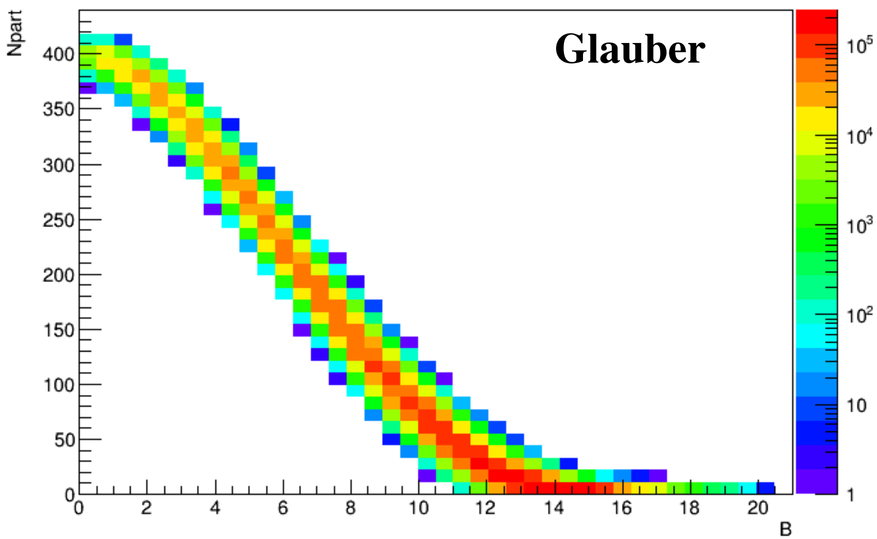
Conclusions (centrality with FHCAL)

- FHCAL is capable of measuring the event centrality at |z-vertex| < 100 cm
- > 99.9% of triggered events will be characterized by the FHCAL (vs. ~ 95% with TPC)
- Unlike for TPC, the models give quite different predictions for centrality estimations with the FHCAL:
  - ✓ DCM-QGSM-SMM predicts very similar performance of the TPC and FHCAL for centrality measurements; FHCAL has worse resolution in (semi)central collisions and better resolution in very peripheral events
  - ✓ PHQMD predicts quite different performance of the TPC and FHCAL for centrality measurements in central collisions - much worse resolution with the FHCAL → different events are selected; similar performance is predicted for peripheral events

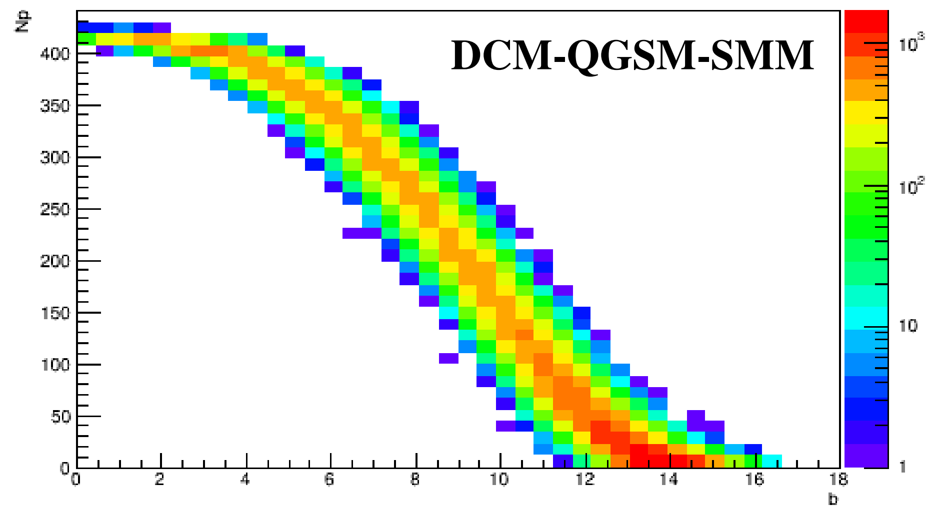
- What's missing:
  - Validation of the models at forward rapidity (NA61 ???) → work in progress
  - Glauber b, N_{part} and N_{coll} estimations based on the "measured" deposited energy → events in different centrality classes need to be characterized

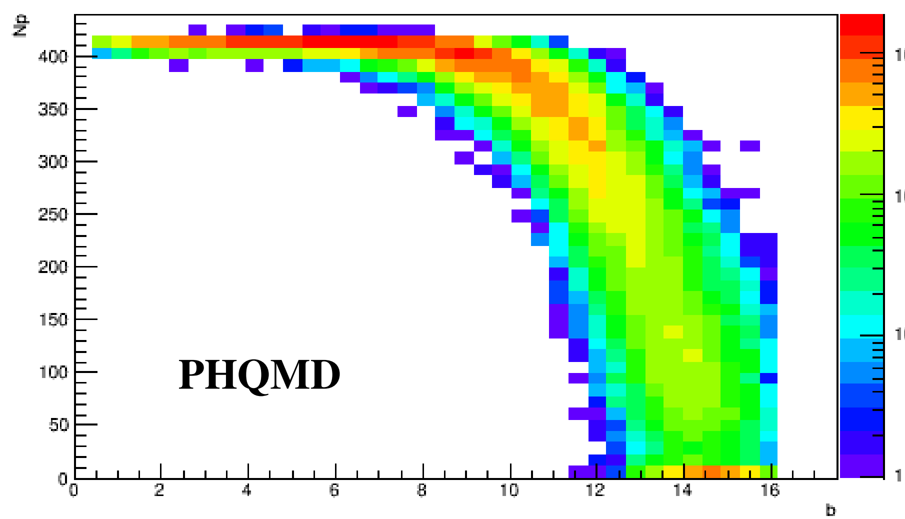
N_{part} vs. b, BiBi@9.2

- b, N_{part}, N_{coll} are provided by the model



- b is provided, N_{part} = 2A - $N_{spectators}$



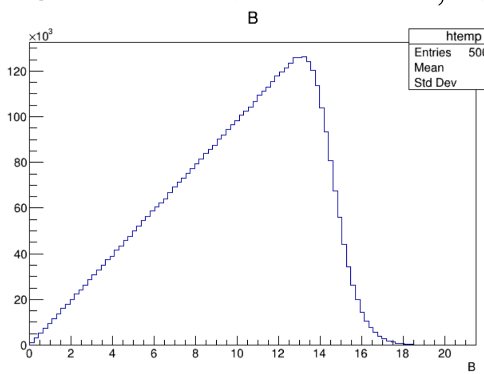


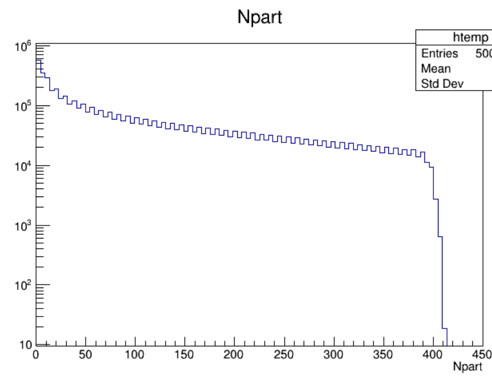
- Presumably, models use the same Glauber initial conditions (parameters may slightly vary though)
- N_{part} extracted from DCM-SMM and PHMD are not the Glauber ones → no sense to extract N_{part} distributions directly from the models
- The models effectively convert part of spectators to participants → coalescence in fragmentation ???

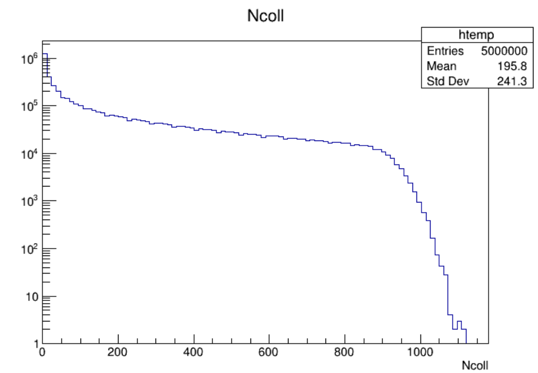
Reweighting the b-distributions

- What if we ignore the internal workouts of the models (black box) and directly relate the initial Glauber impact parameter ‘b’ taken from the models to Glauber-simulated N_{part} and N_{coll} ???

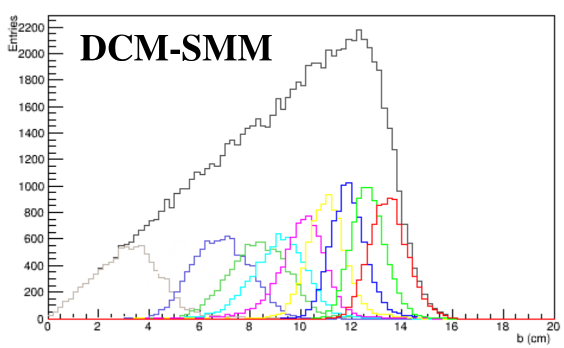
1. Glauber model relates b, N_{part}, N_{coll}

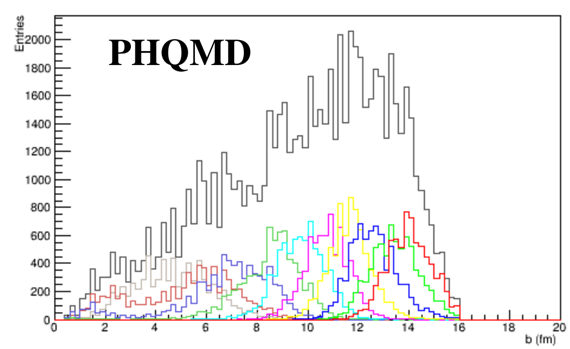






2. From FHCAL simulations we sample b-distributions for each centrality class

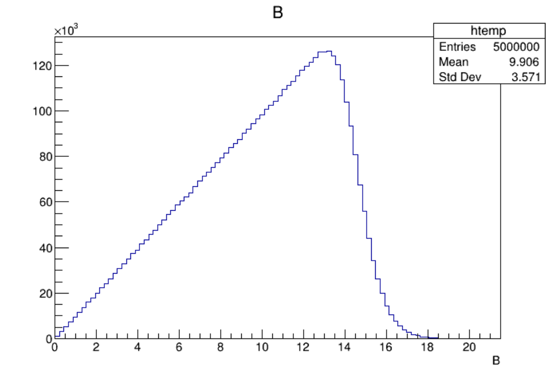


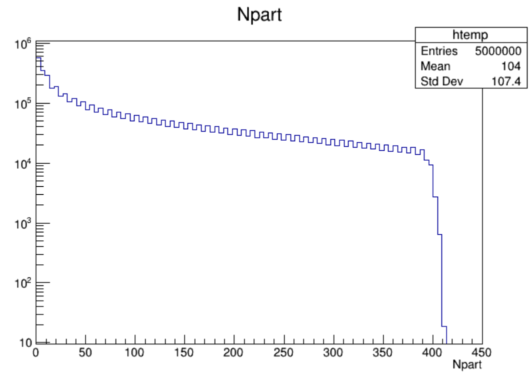


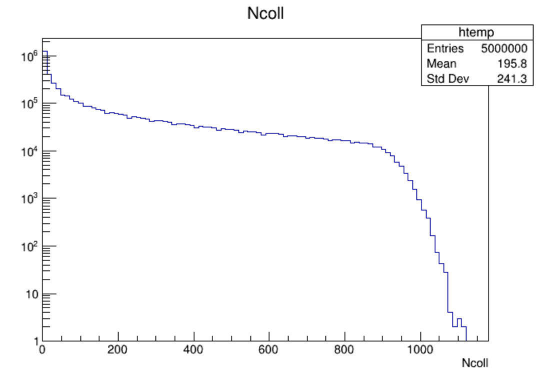
3. By weighting the Glauber’s b-distribution to those from p.2, one can evaluate N_{part} and N_{coll} distributions

DCM-QGSM-SMM, BiBi@9.2

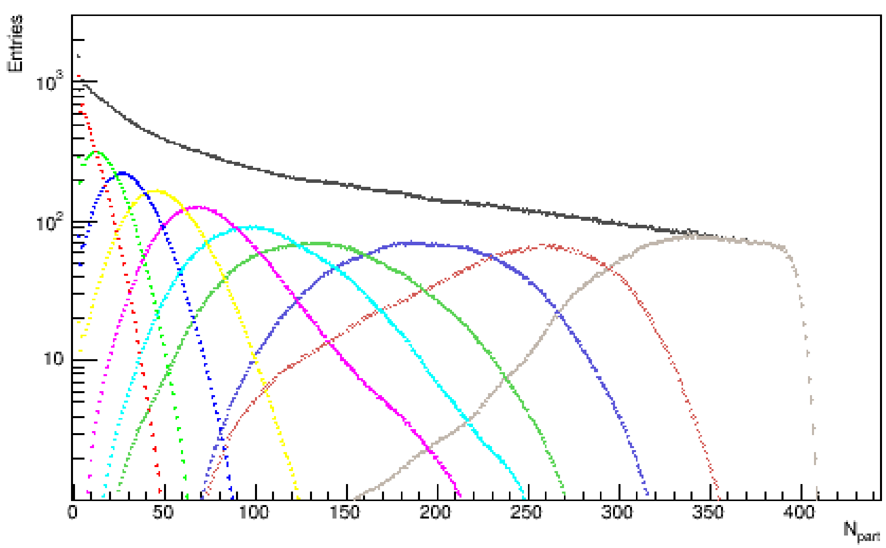
❖ Initial Glauber distributions

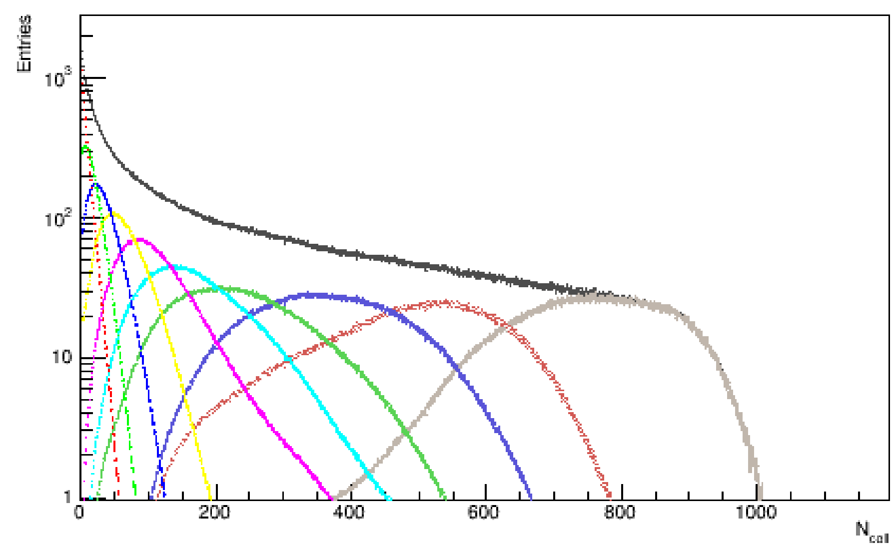






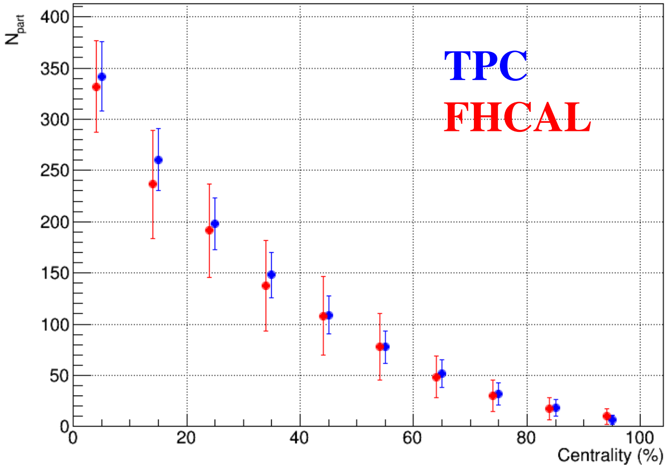
❖ Reweighted N_{part} and N_{coll} distributions:

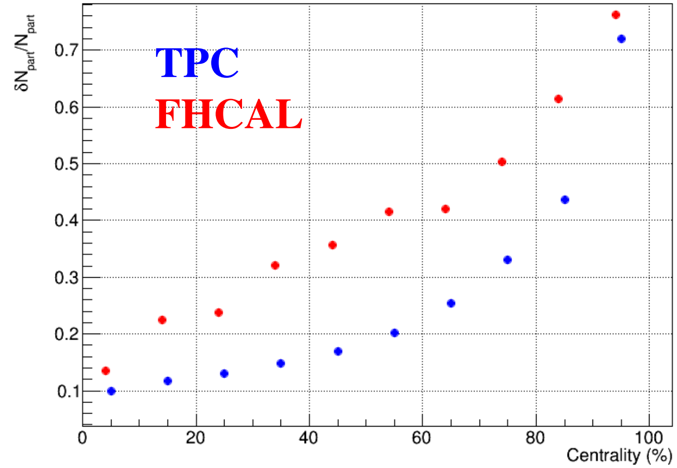




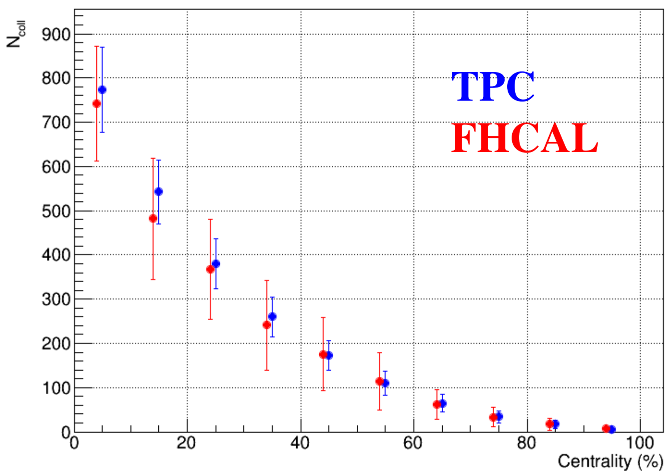
DCM-QGSM-SMM, comparison wit TPC

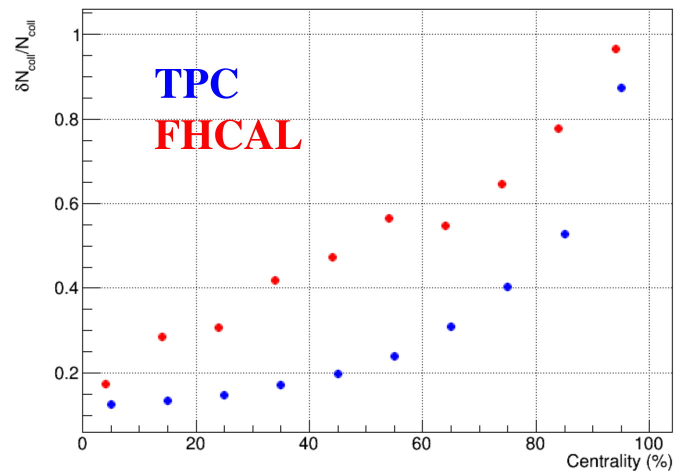
❖ N_{part}:





❖ N_{coll}:

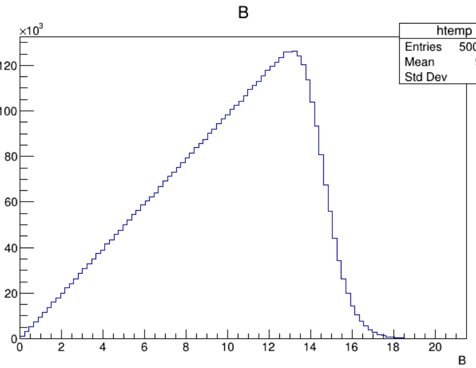


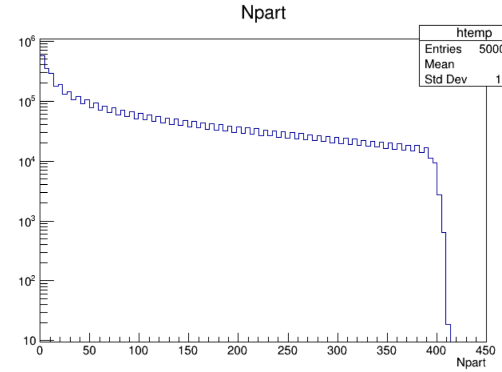


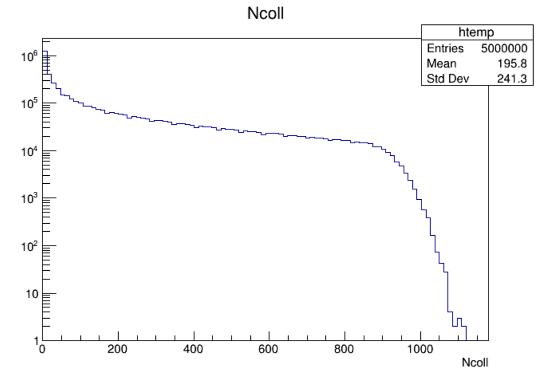
❖ Mean values are consistent, resolution is better with the TPC

PHQMD, BiBi@9.2

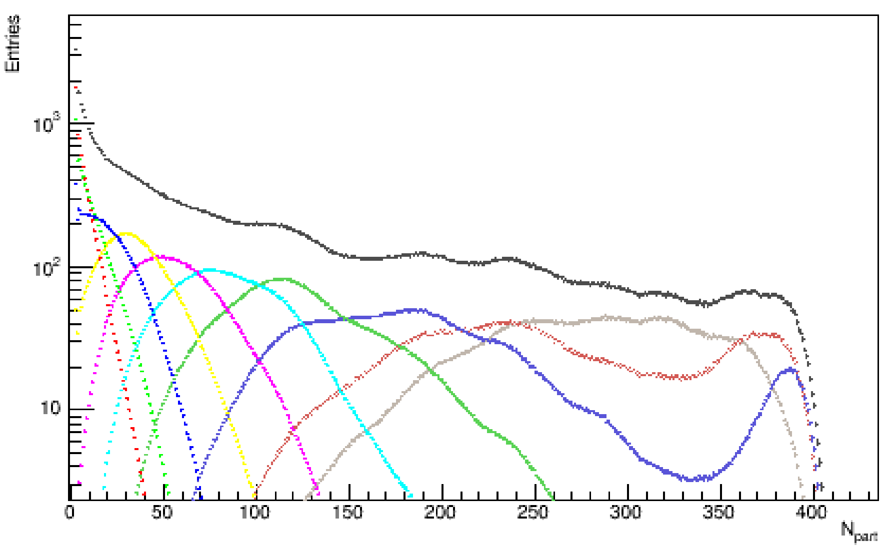
- Initial Glauber distributions

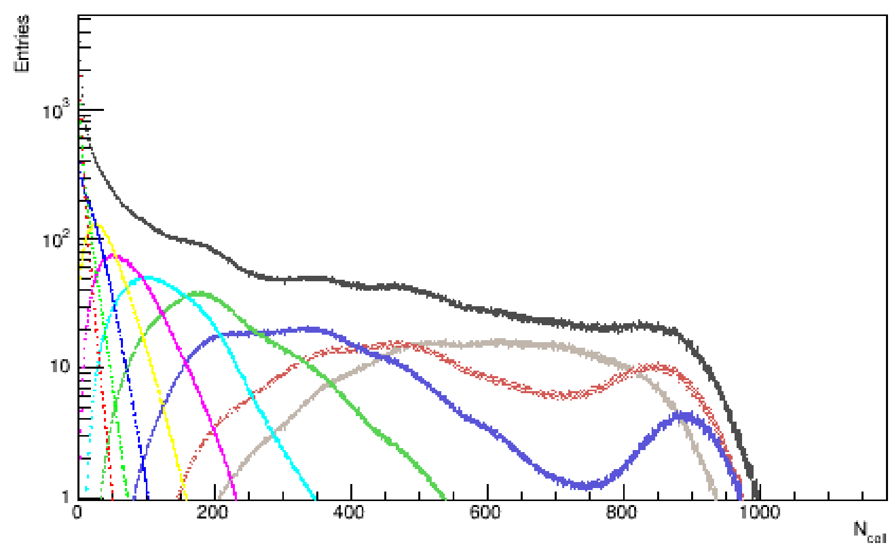






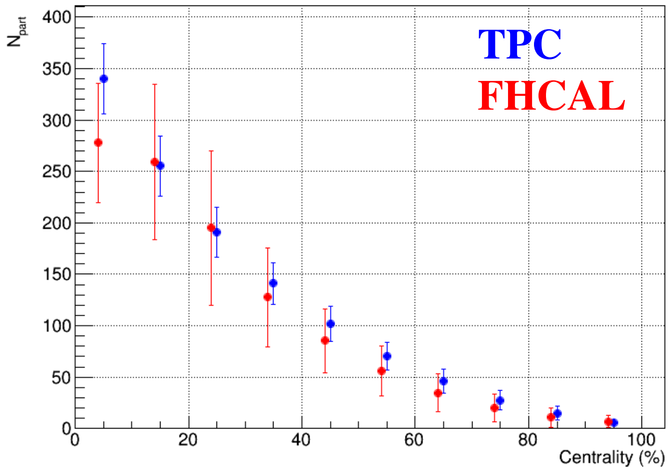
- Reweighted N_{part} and N_{coll} distributions:

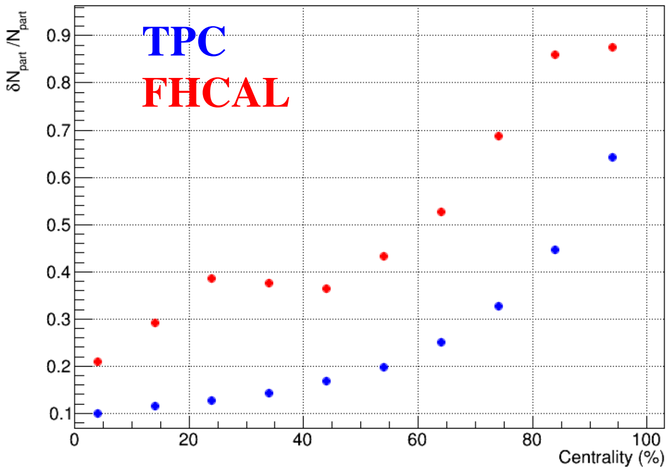




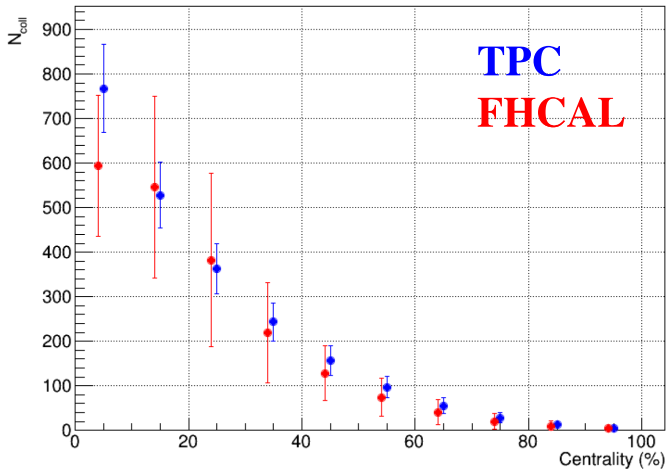
PHQMD, comparison wit TPC

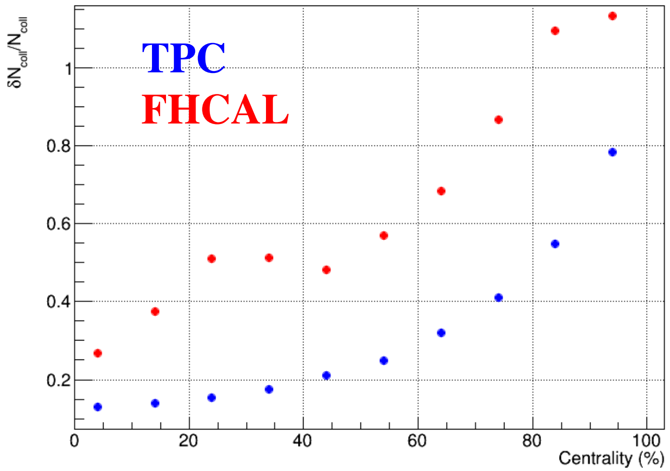
- N_{part}:





- N_{coll}:





- Mean values are similar (except for 0-10%), resolution is much better with the TPC

N_{part}, N_{coll} from FHCAL

- ❖ Is it a valid approach ???
- ❖ How to related energy to Glauber parameters???
  - ✓ relate E_{FHCAL} to N_{track} and just use E_{FHCAL} as a proxy for the multiplicity
    → can be tried, but the E_{FHCAL} vs. N_{track} correlation is rather wide and is prone to biases
  - ✓ use more sophisticated methods to related initiate state Glauber conditions to final state E_{FHCAL}
    → no developed and tested approaches

- What's missing:
  - Validation of the models at forward rapidity (NA61 ???) → work in progress
  - Glauber b, N_{part} and N_{coll} estimations based on the "measured" deposited energy

So far, there is no framework for evaluation of event centrality with the FHCAL

BACKUP