Simulation studies for miniBeBe

Implementation in MpdRoot and results

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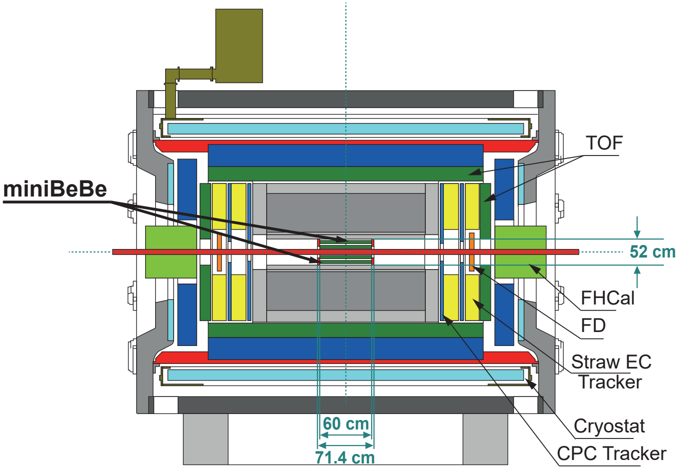
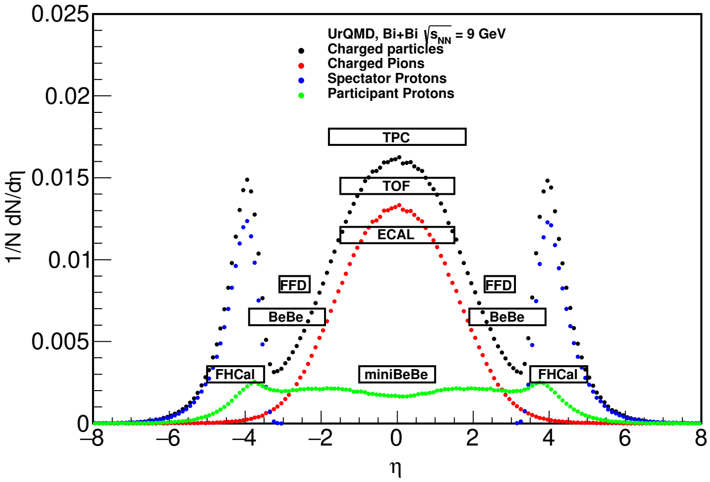
MexNICA Collaboration

Table of contents

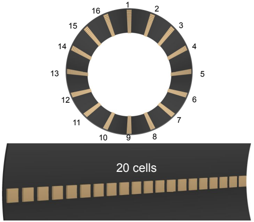
miniBeBe monitoring detector purpose

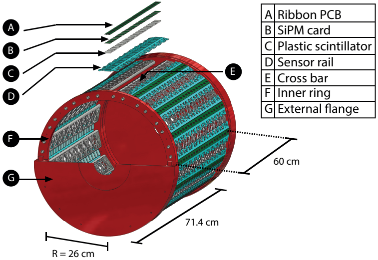


miniBeBe monitoring detector purpose



miniBeBe Characteristics



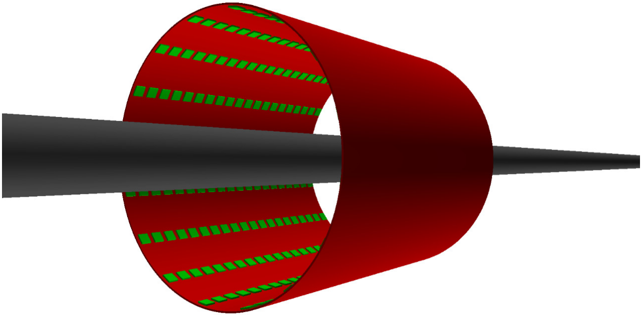


1. 16 strips, each one of length 60 cm with an array of 20 squared plastic scintillator cells with dimensions $20 \times 20 \times 3\ mm^3$.
2. 320 squared plastic scintillator cells and 1,280 SiPMs covering an effective sensitive area of $128,000\ mm^2$.
3. $|\eta| < 1.01$

MEX NICA

Implementation to MPDRoot Framework

- 950,000 Minimum Bias (b = 0 $\sim$ 15.9 fm) events for Bi+Bi collisions at $\sqrt{s_{NN}} = 9$ GeV and 950,000 events for p+p collisions at $\sqrt{s_{NN}} = 4$, 9 and 11 GeV using UrQMD.



CDR Results

The conceptual design of the miniBeBe detector proposed for NICA-MPD

Ramón Acevedo Kado[1], Mauricio Alvarado Hernández[1], Alejandro Ayala[1,2], Marco Alberto Ayala-Torres[3], Wolfgang Bietenholz[1], Dario Chaires[4], Eleazar Cuautle[1], Isabel Domínguez[5], Alejandro Guirado[6], Ivonne Maldonado[5], Julio Maldonado[7], Eduardo Moreno-Barbosa[8], P. A. Nieto-Marín[5], Miguel Enrique Patiño Salazar[1], Lucio Rebolledo[4], Mario Rodríguez-Cahuantzi[8], D. Rodríguez-Figueroa[9], Valeria Z. Reyna-Ortiz[8], Guillermo Tejeda-Muñoz[8], María Elena Tejeda-Yeomans[4], Luis Valenzuela-Cázares[6], and C. H. Zepeda Fernández[8,10]

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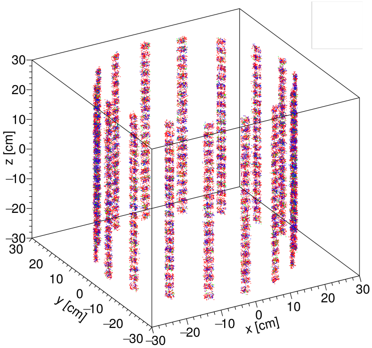
1. Energy deposited.
2. Time of flight.
3. Hits.
4. Trigger capabilities (Efficiency, multiplicity, time information and beam-gas).

Tracks



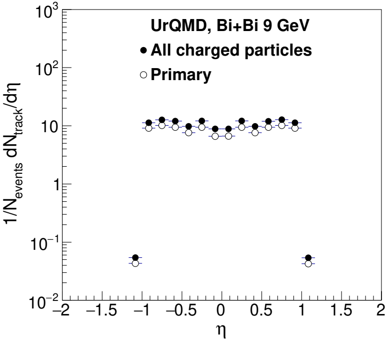
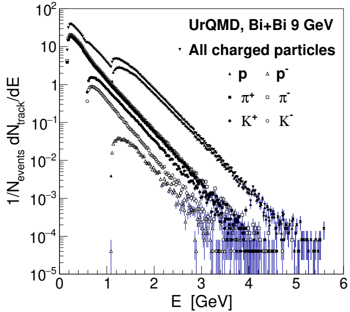


Figure: Geometry selection of the miniBeBe cells of tracks (Left). η distribution of all charged particles and primaries (Right).

Energy deposited



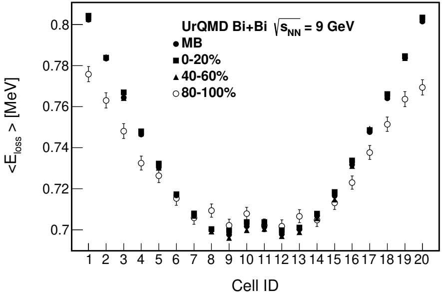


Figure: Identified particle distributions (Left). Strip-average of the energy deposited per cell for the miniBeBe in Bi+Bi at 9 GeV (Right).

Energy deposited

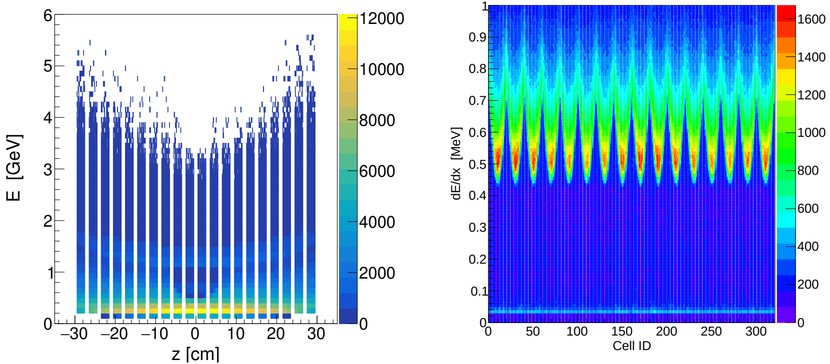
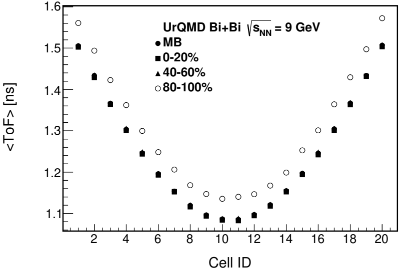


Figure: Scatter plot distribution of particles with respect to the energy they carry (Left). Energy deposited for the hits in the miniBeBe (Right).

Time of flight



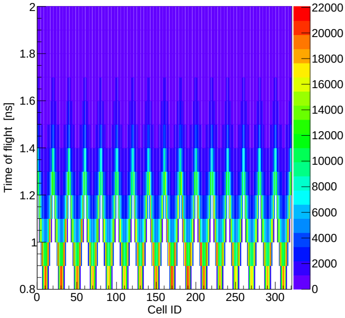
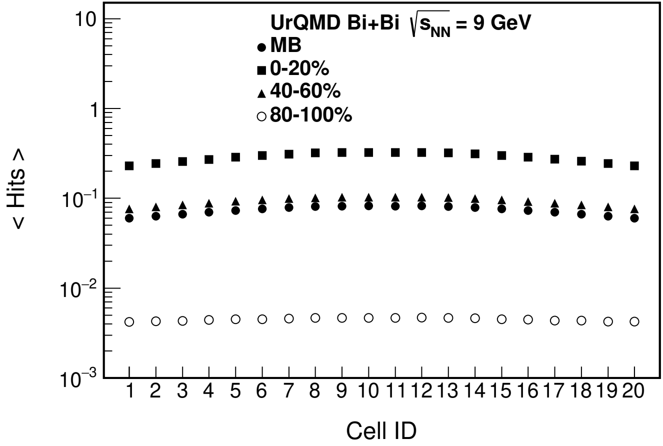


Figure: Strip-average of the time-of-flight per cell for the miniBeBe in Bi+Bi at 9 GeV (Left). Time-of-flight scatter plot for the hits in the miniBeBe (Right).

Hits



UrQMD Bi+Bi $\sqrt{s_{NN}}$ = 9 GeV
MB
0-20%
40-60%
80-100%
< Hits >
Cell ID
10
1
10^{-1}
10^{-2}
10^{-3}
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

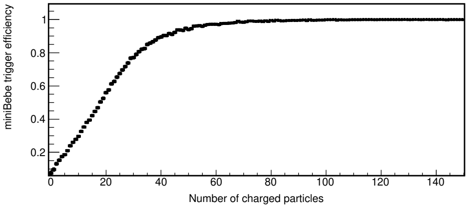
Hits

UrQMD	⟨Hits⟩	strips	0-20%	80-100%
Bi + Bi 9 GeV	per cell	16	0.2294 - 0.3248	0.0042 - 0.0047
		32	0.2294 - 0.3250	0.0041 - 0.0047
	complete detector	16	73.40 - 103.94	1.34 - 1.50
		32	146.81 - 208.03	2.65 - 3.01

UrQMD	⟨Hits⟩	strips	4 GeV	11 GeV
p + p	per cell	16	0.00043 - 0.00055	0.00100 - 0.00122
		32	0.00042 - 0.00053	0.00099 - 0.00122
	complete detector	16	0.138 - 0.176	0.320 - 0.390
		32	0.269 - 0.339	0.637 - 0.784

Table: Summary of average number of hits in miniBeBe.

Trigger capabilities (Efficiency)



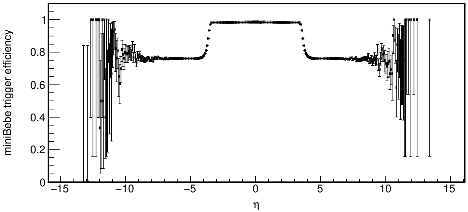


Figure: MiniBeBe trigger efficiency as a function of the charged particle multiplicity (top) and pseudo-rapidity (bottom).

Trigger capabilities (Efficiency)

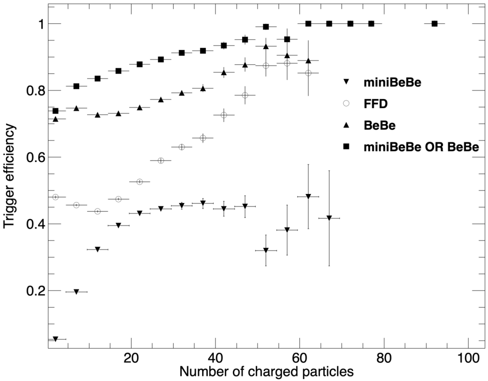


Figure: Trigger efficiency as a function of the charged particle multiplicity for p+p collisions at $\sqrt{s_{NN}} = 9$ GeV for different detectors.

Trigger capabilities (Hits)

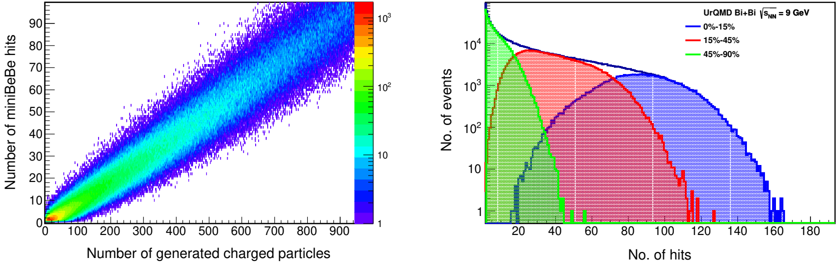


Figure: Number of charged particles that hit the miniBeBe vs. the generated number of charged particles (left). MiniBeBe multiplicity per centrality range. (right)

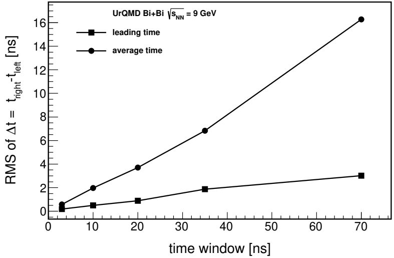
Trigger capabilities (Time information)

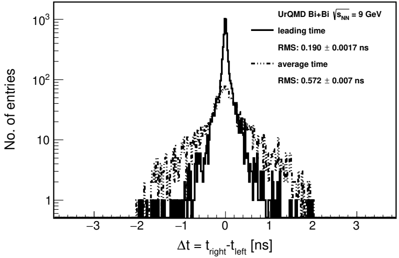
-Average hit time (average time).

-Time-of-flight of the first charged particle reaching miniBeBe (leading time).

- For $z > 0$, t_{right}.
- For $z < 0$, t_{left}.

So we want the root mean square (RMS) of the $\Delta t = t_{\text{right}} - t_{\text{left}}$.





Trigger capabilities (Time information)

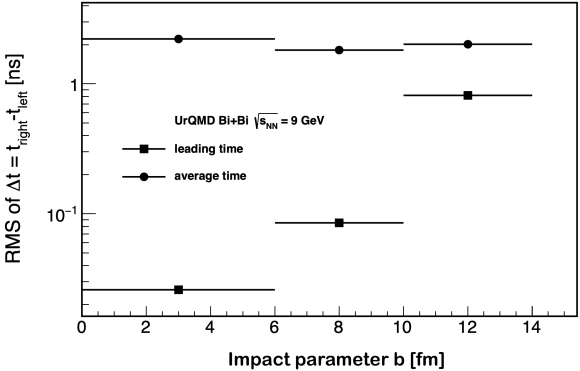


Figure: RMS of the Δt distribution as a function of the impact parameter b of the collision.

Trigger capabilities (Time information)

$$VertexMbb = \frac{t_{\rm right} - t_{\rm left}}{2} \times c.$$

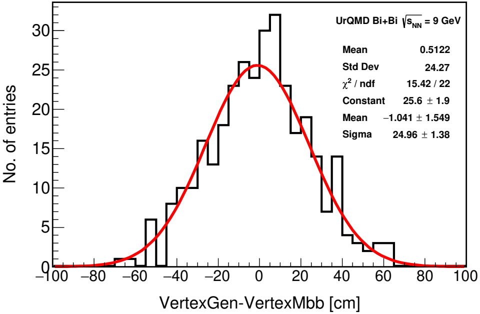


Figure: Difference between the generated vertex and the vertex determined with the leading time of the miniBeBe detector.

Trigger capabilities (Beam-gas)

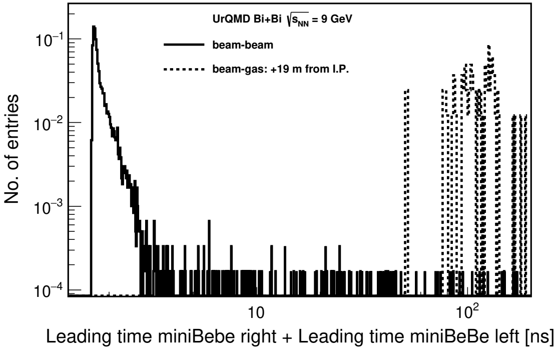


Figure: The distribution of $t_{\rm right} + t_{\rm left}$. The sum of the leading time of the miniBeBe detector for $z > 0$ and $z < 0$ is shown for beam-beam and beam-gas generated events, 19 m from the interaction point.

Work in progress (Shadow studies)

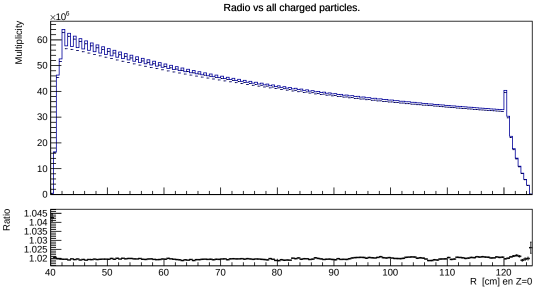
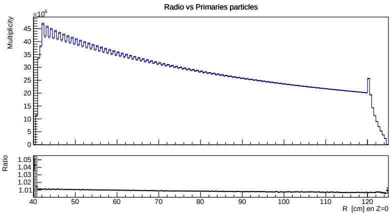
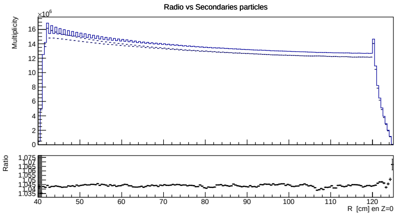


Figure: BiBi@11GeV, 331000 events, SmearGaus XY 24cm, TPC Pt cut = 0.2





Work in progress (Shadow studies)

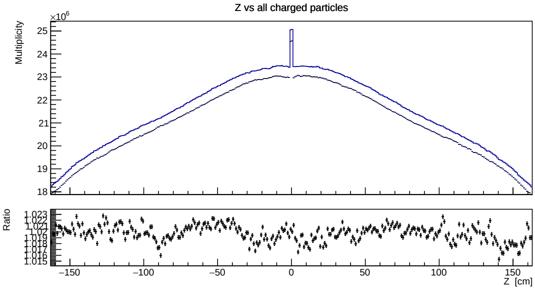
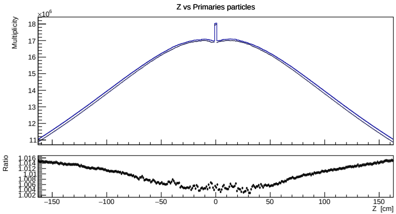
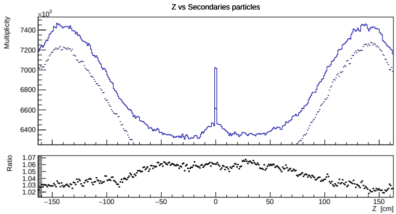
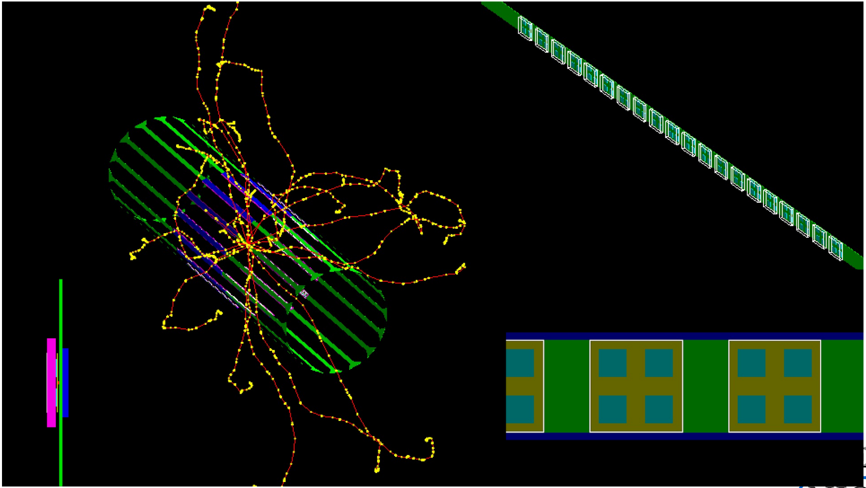


Figure: BiBi@11GeV, 331000 events, SmearGaus XY 24cm, TPC Pt cut = 0.2





Work in progress (New constructed geometry)



Thank You!

Backup

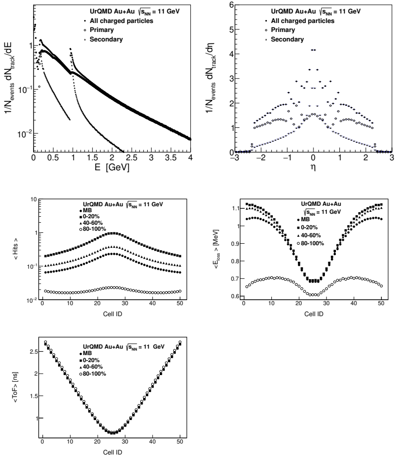


Figure 1: UrQMD Au+Au $\sqrt{s_{NN}}$ =11 GeV, miniBeBe: z=1.5m and r=5cm, BeBe pay, Ffd, smearing off

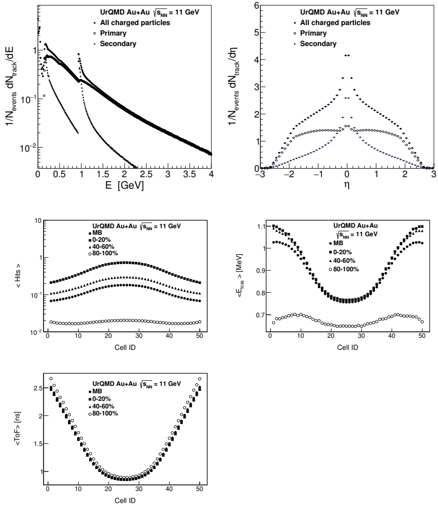


Figure 2: UrQMD Au+Au $\sqrt{s_{NN}}$ =11 GeV, miniBeBe: z=1.5m and r=15cm, BeBe pay, Ffd, smearing 60cm flat

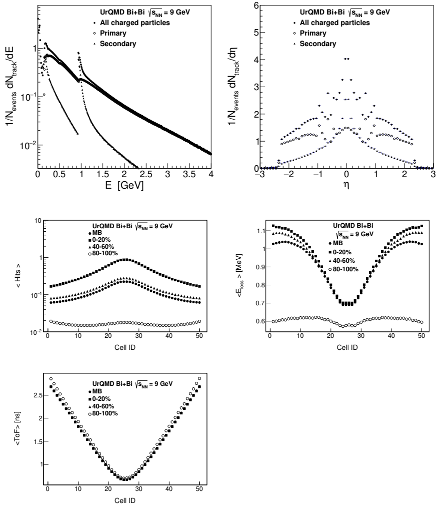


Figure 3: UrQMD Bi+Bi $\sqrt{s_{NN}}$ =9 GeV, miniBeBe: z=1.5m and r=15cm, BeBe hexagons, Ffd, smearing off

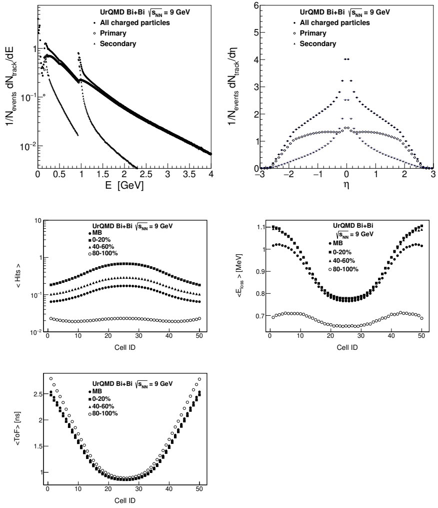


Figure 4: UrQMD Bi+Bi $\sqrt{s_{NN}}$ =9 GeV, miniBeBe: z=1.5m and r=15cm, BeBe hexagons, Ffd, smearing 60cm flat

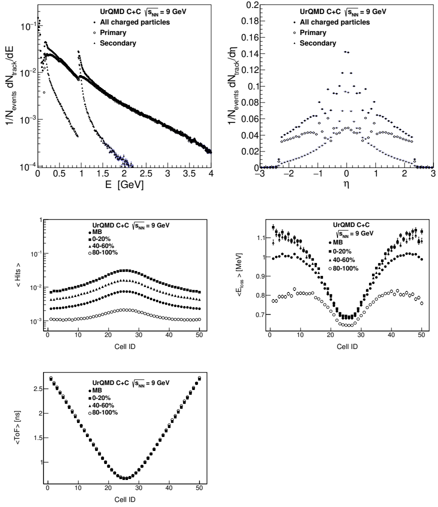


Figure 5: UrQMD C+C $\sqrt{s_{NN}}$ =9 GeV, miniBeBe: z=1.5m and r=15cm, BeBe hexagons, Ffd, smearing off

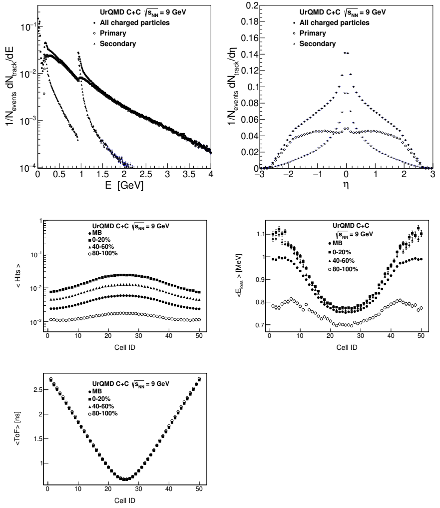


Figure 6: UrQMD C+C $\sqrt{s_{NN}}$ =9 GeV, miniBeBe: z=1.5m and r=15cm, BeBe hexagons, Ffd, smearing 60cm flat

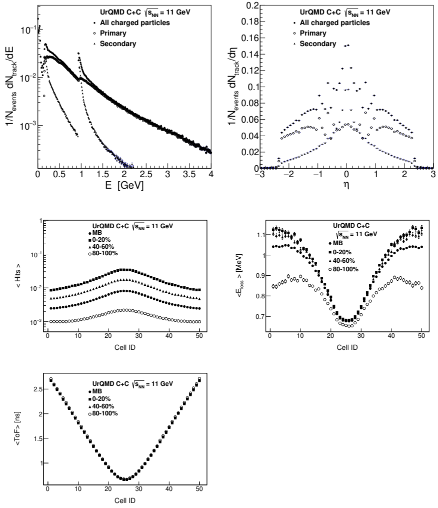


Figure 7: UrQMD C+C $\sqrt{s_{NN}}$ =11 GeV, miniBeBe: z=1.5m and r=15cm, BeBe hexagons, Ffd, smearing off

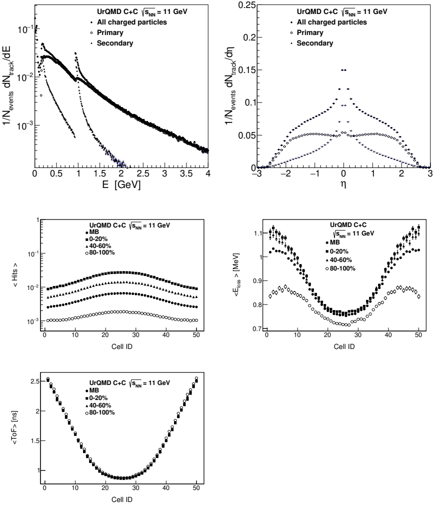


Figure 8: UrQMD C+C $\sqrt{s_{NN}}$ =11 GeV, miniBeBe: z=1.5m and r=15cm, BeBe hexagons, Ffd, smearing 60 cm flat

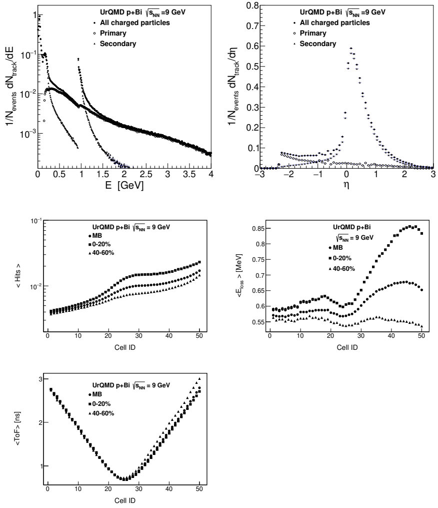


Figure 9: UrQMD p+Bi $\sqrt{s_{NN}}$ =9 GeV, miniBeBe: z=1.5m and r=15cm, BeBe hexagons, Ffd, smearing off

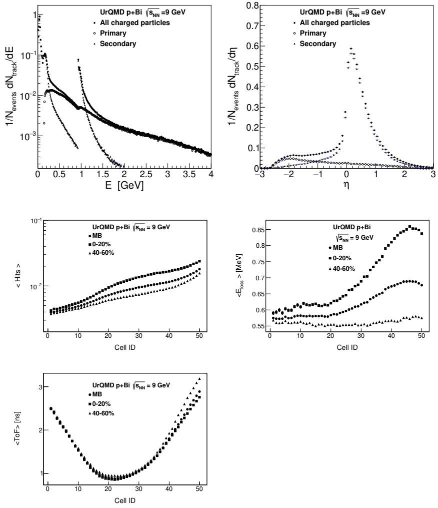


Figure 10: UrQMD p+Bi $\sqrt{s_{NN}}$ =9 GeV, miniBeBe: z=1.5m and r=15cm, BeBe hexagons, Ffd, smearing 60 cm flat

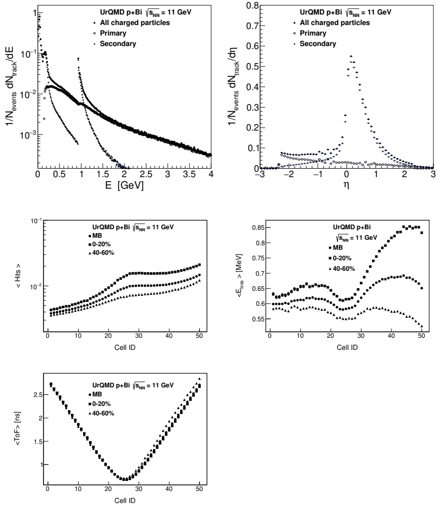


Figure 11: UrQMD p+Bi $\sqrt{s_{NN}}$ =11 GeV, miniBeBe: z=1.5m and r=15cm, BeBe hexagons, Ffd, smearing off

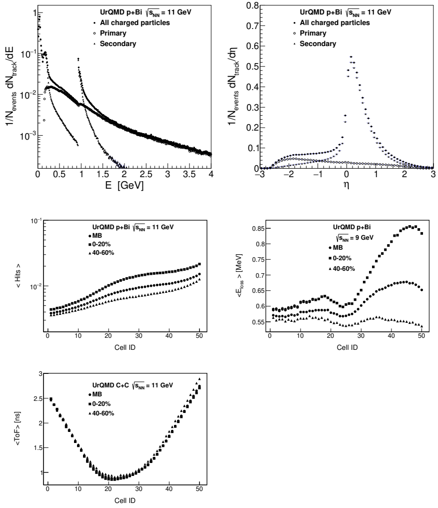


Figure 12: UrQMD p+Bi $\sqrt{s_{NN}}$ =11 GeV, miniBeBe: z=1.5m and r=15cm, BeBe hexagons, Ffd, smearing 60 cm flat

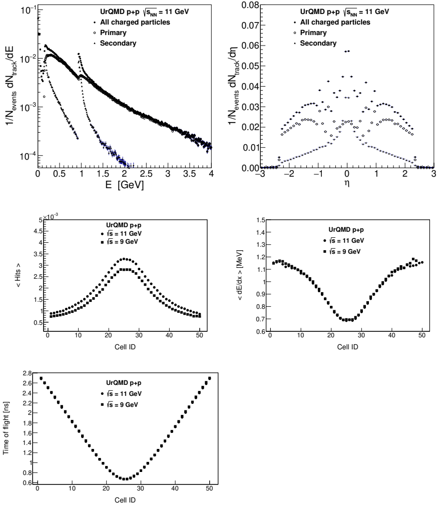


Figure 13: UrQMD p+p $\sqrt{s_{NN}}$ =9 and 11 GeV, miniBeBe: z=1.5m and r=15cm, BeBe pay, Ffd, smearing off

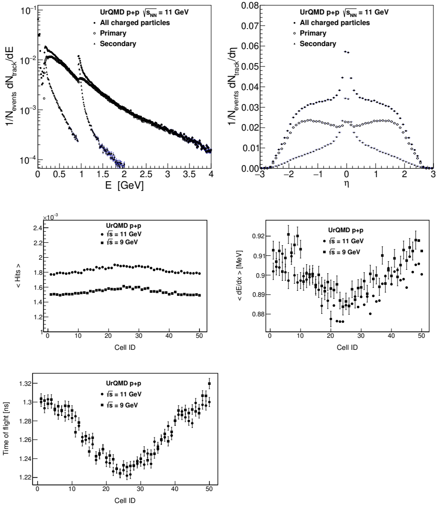


Figure 14: UrQMD p+p $\sqrt{s_{NN}}$ =9 and 11 GeV, miniBeBe: z=1.5m and r=15cm, BeBe pay, Ffd, smearing 60cm flat