EPICAL-2 Meeting - 02.10.25

Cluster Weighting

Jan Schöngarth

Energy Resolution

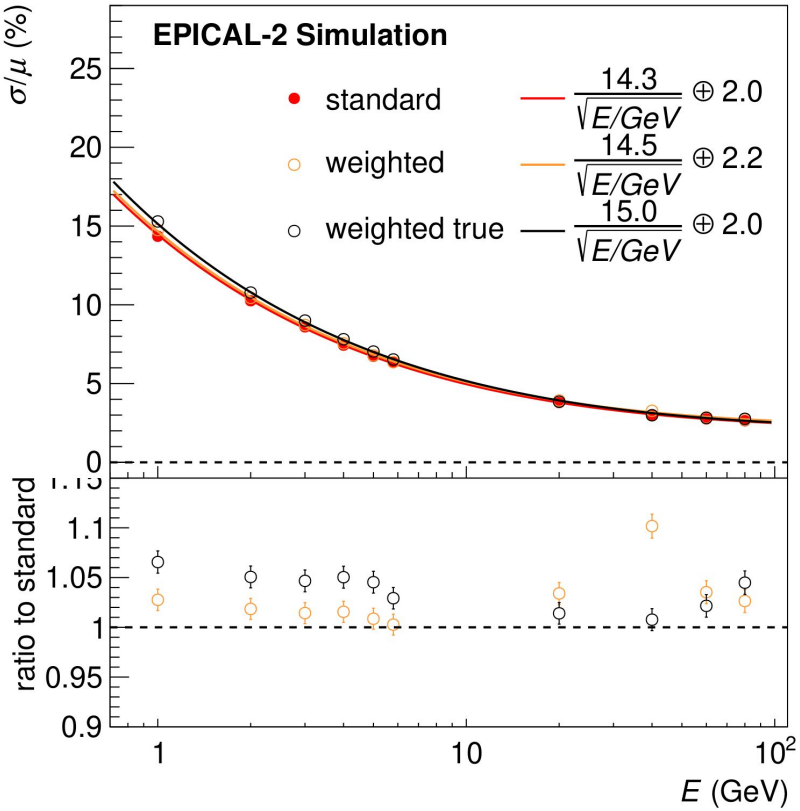
1 GeV e^-	μ	σ/μ (%)
N_{clus} standard	70.01	14.35
N_{clus} weighted true	82.2	15.3
$N_{e\pm}$	68.99	13.704
N_{ch}	69.022	13.706
$N_{contributing\ part}$	65.69	12.8
N_{part}	798.5	7.5

$$N_i = \sum_{i_{chip}} N_i^{i_{chip}}$$

- low energies: $\langle N_{contributing\ part} \rangle < \langle N_{e\pm} \rangle < \langle N_{clus} \rangle < \langle N'_{clus} \rangle$

➔ not all electrons cause hits

➔ true weighting corrects in the wrong direction



Energy Resolution

80 GeV e^-	μ	σ/μ (%)
N_{clus} standard	4300.7	2.64
N_{clus} weighted true	6383.4	2.76
$N_{e\pm}$	5363.7	2.64
N_{ch}	5366.2	2.64
$N_{contributing\ part}$	5113.4	2.55
N_{part}	61548.9	3.4

$$N_i = \sum_{i_{\mathrm{chip}}} N_i^{i_{\mathrm{chip}}}$$

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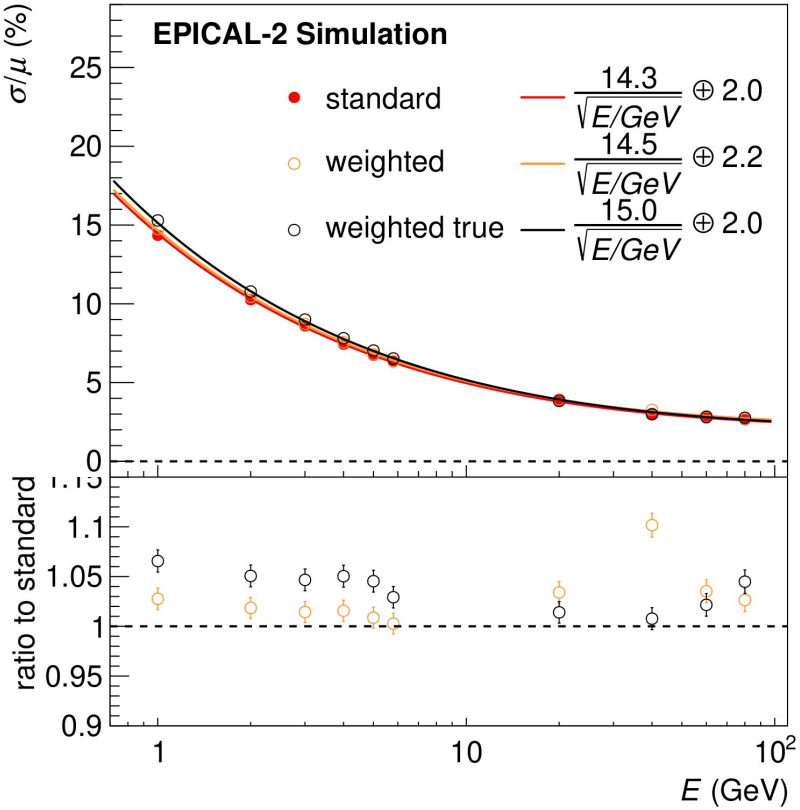
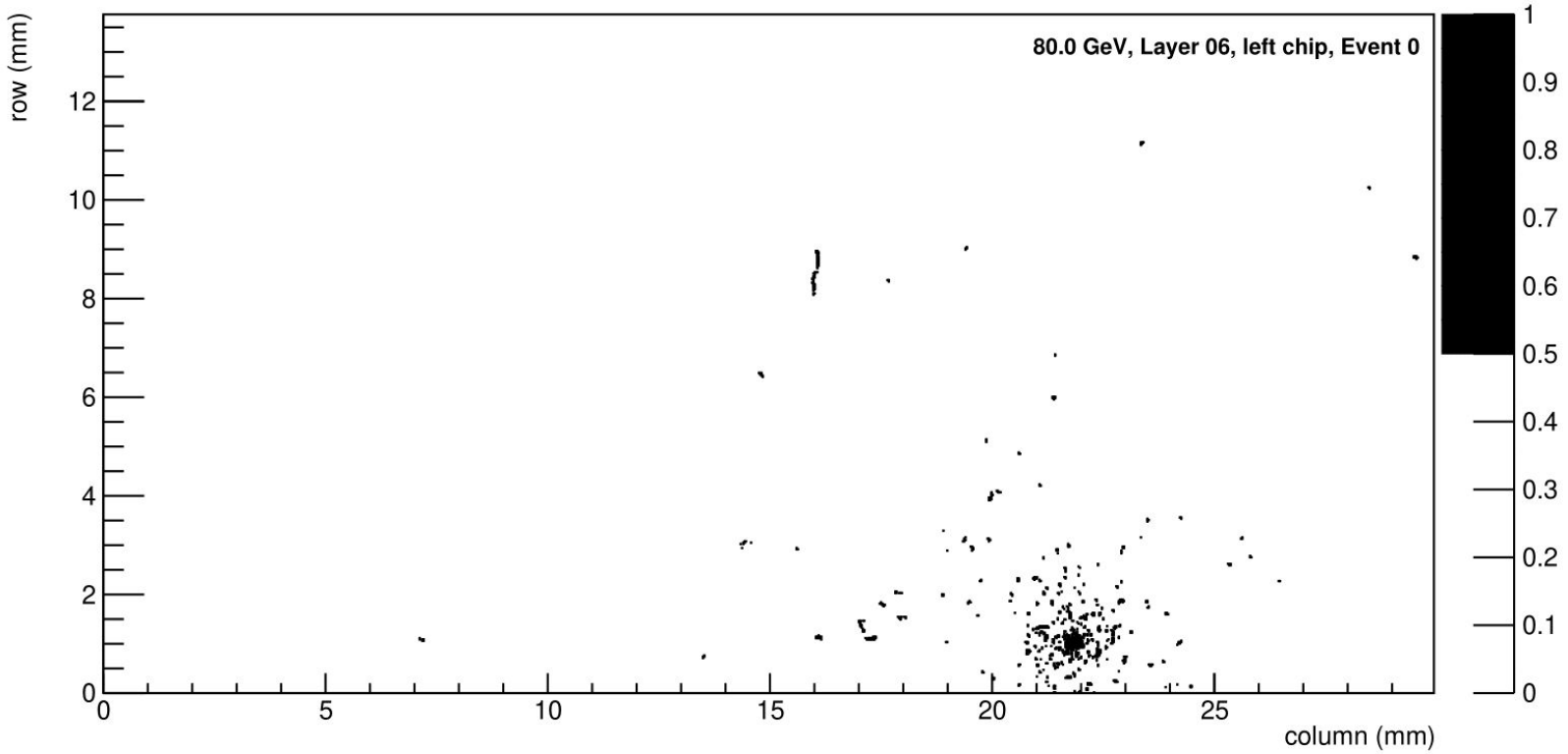


Hitmap/Partmap



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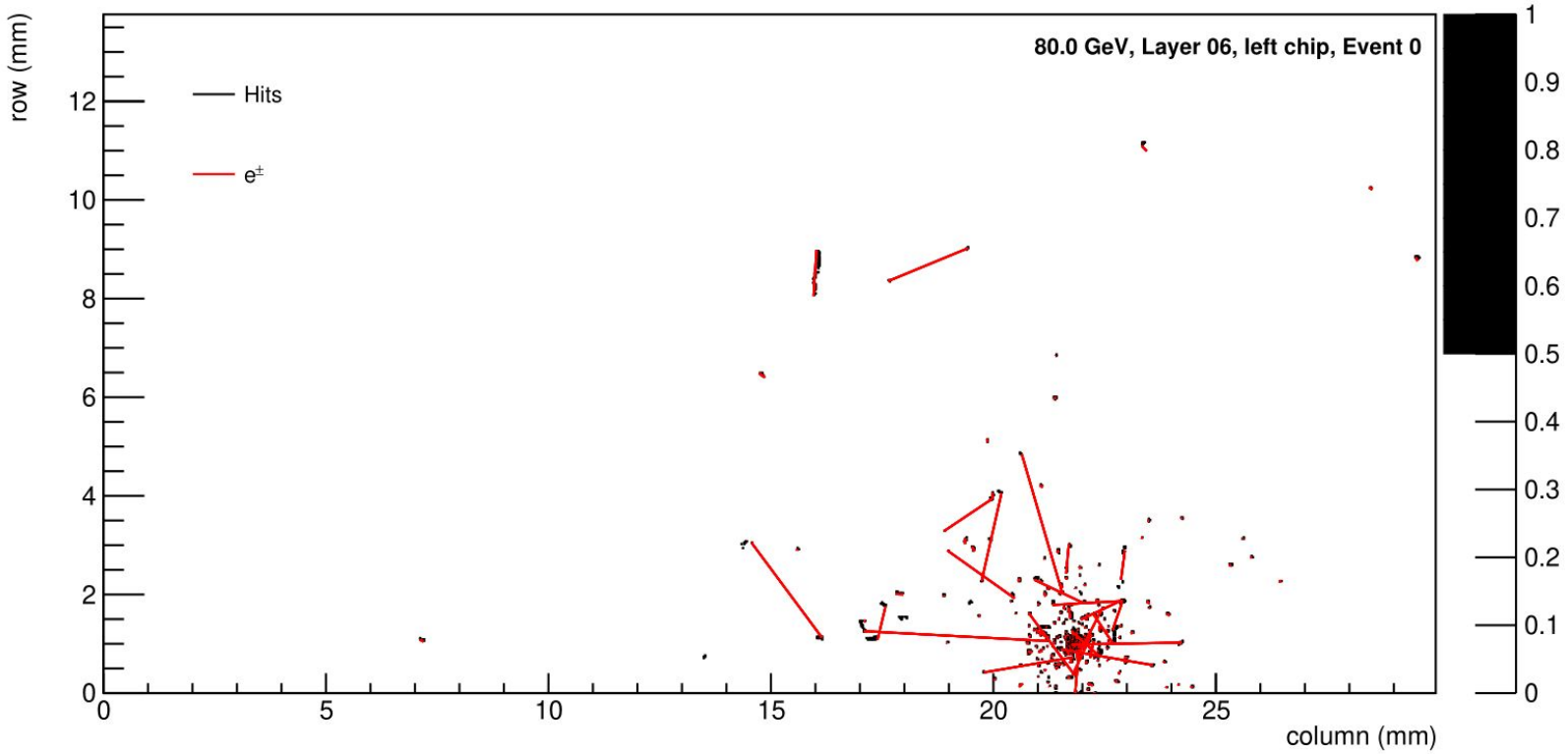

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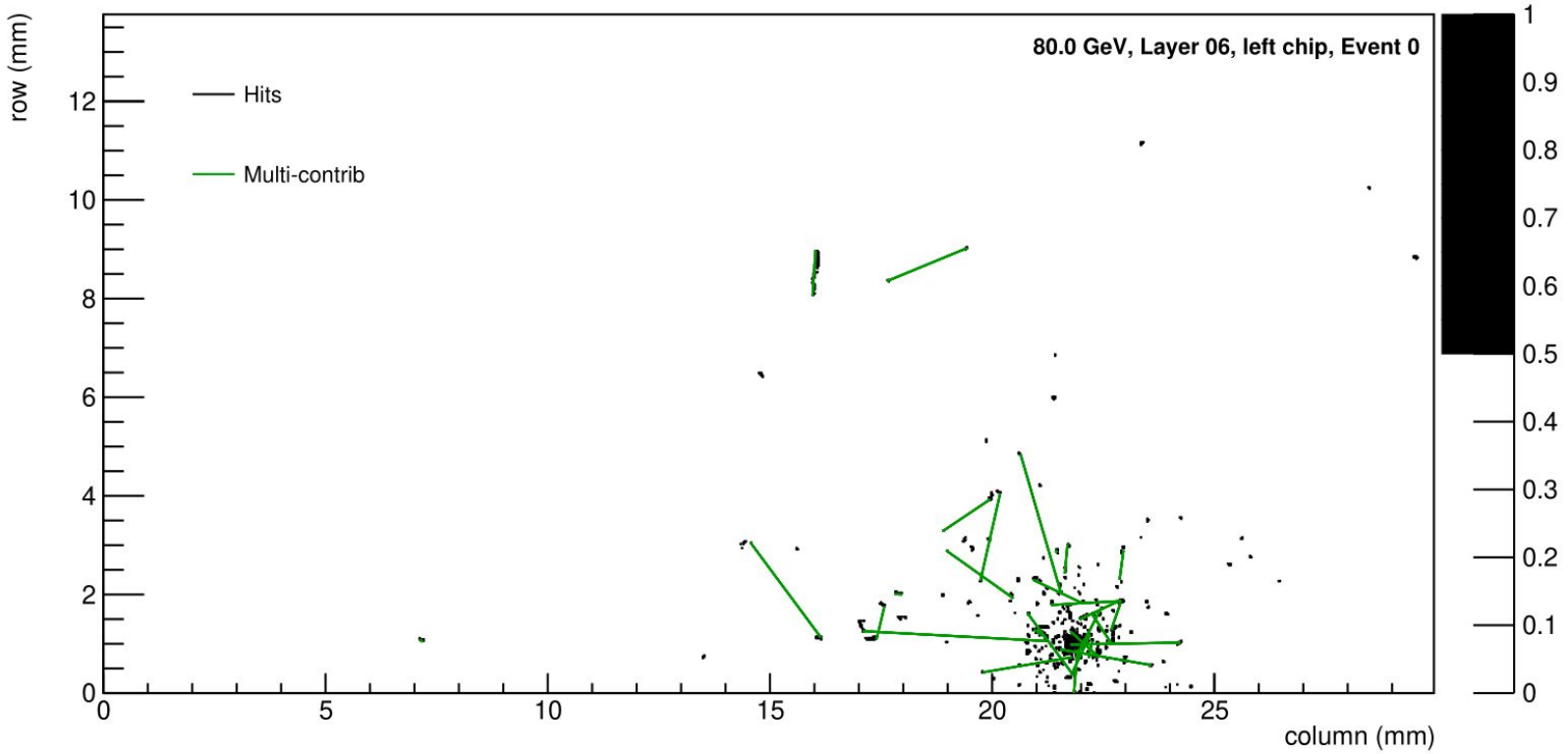

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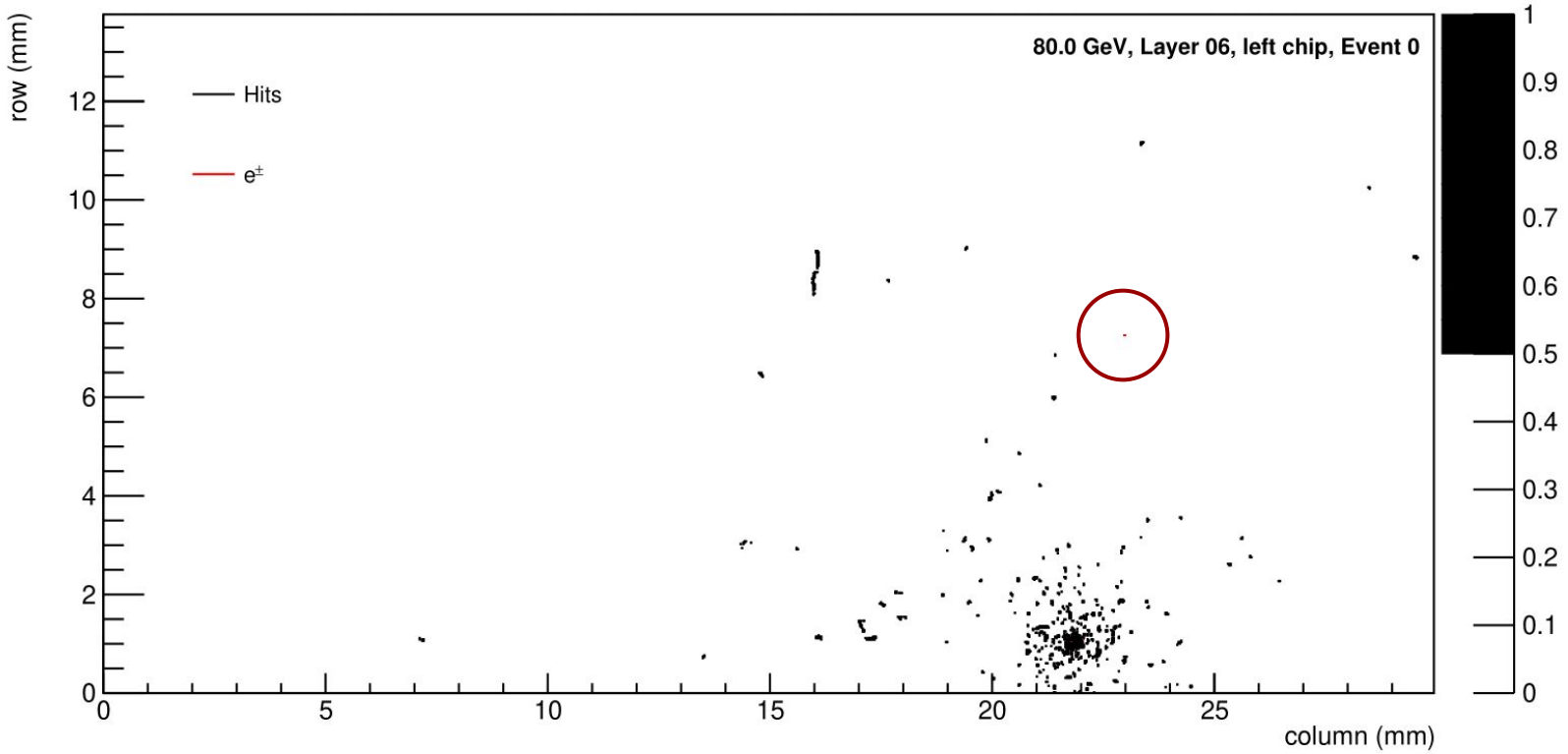

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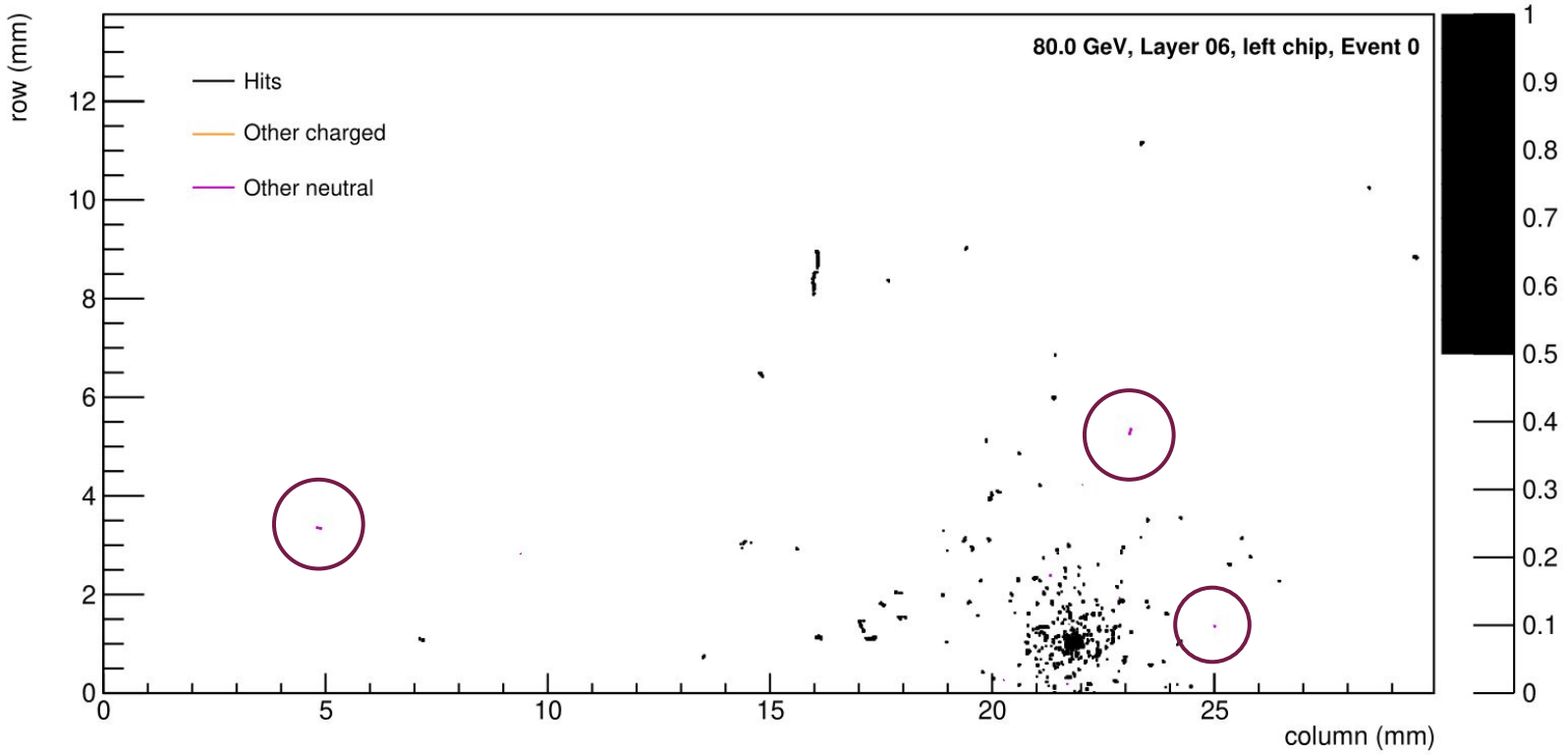

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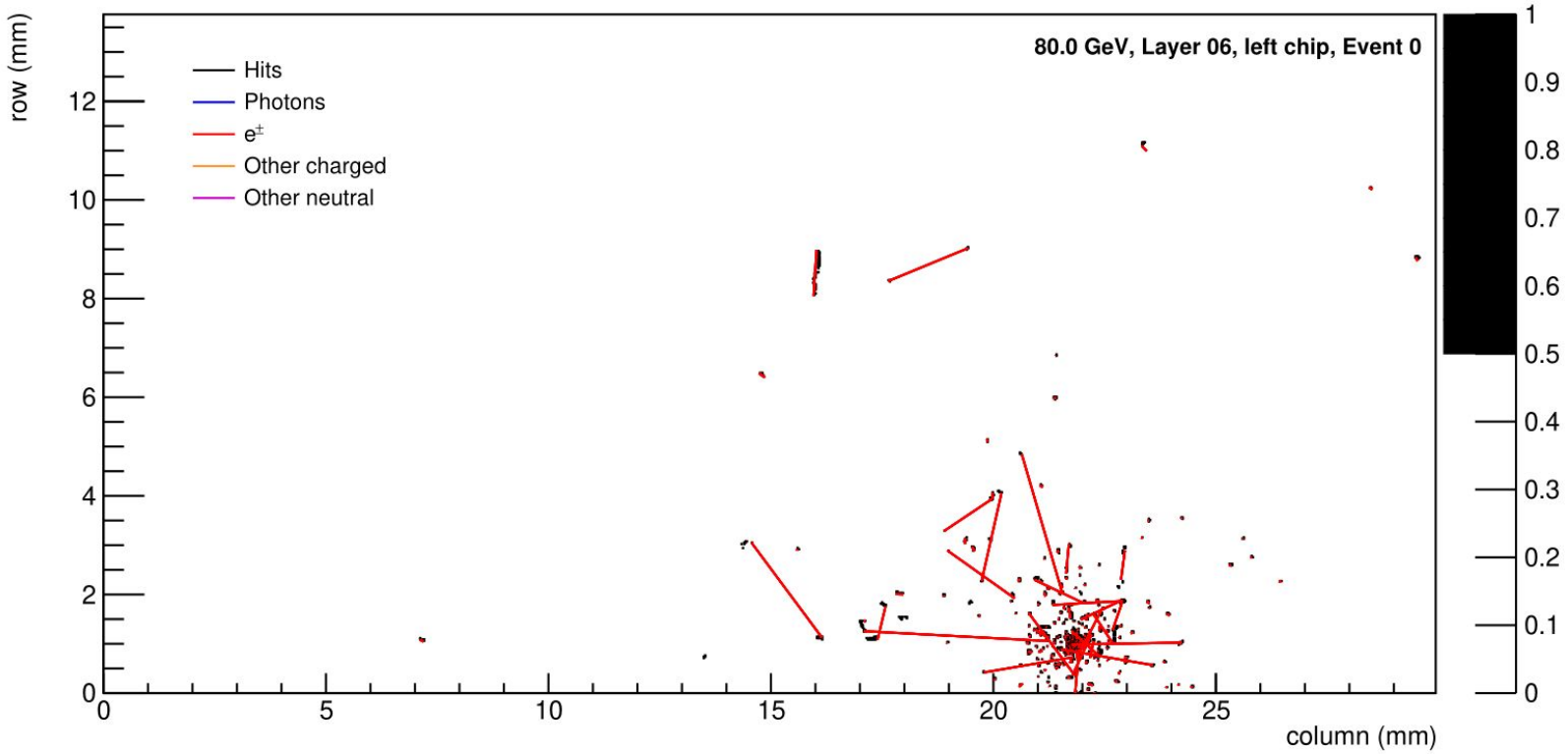

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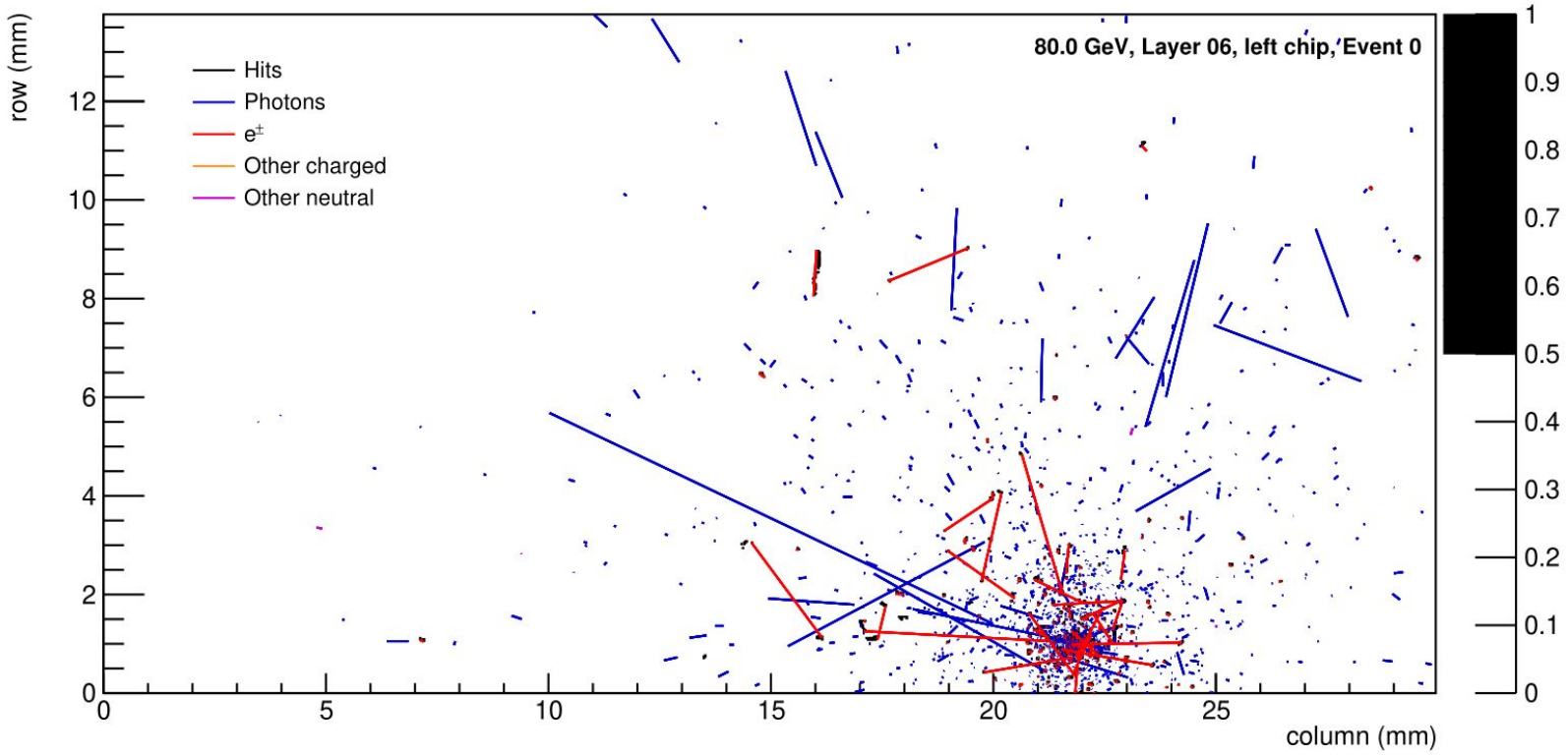

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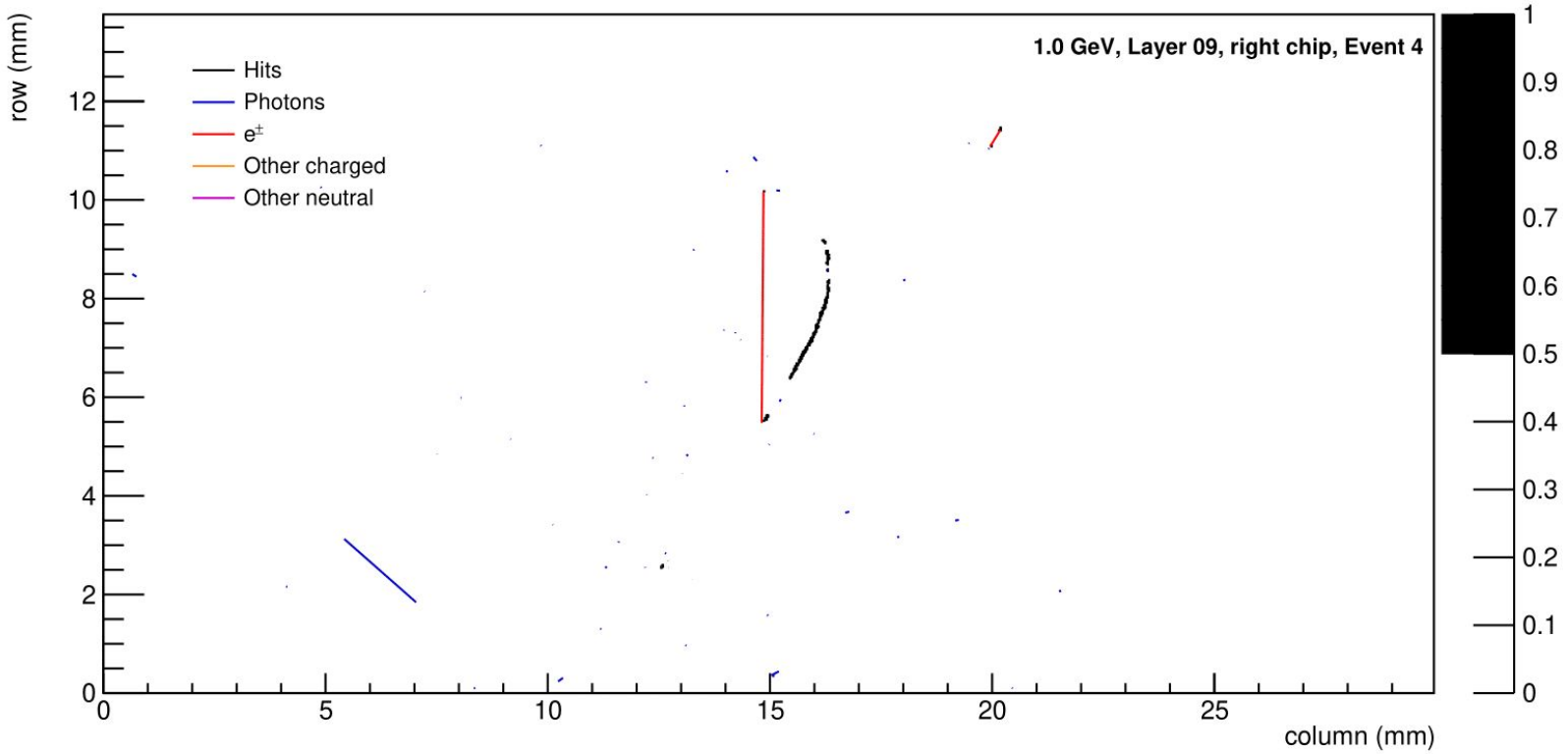
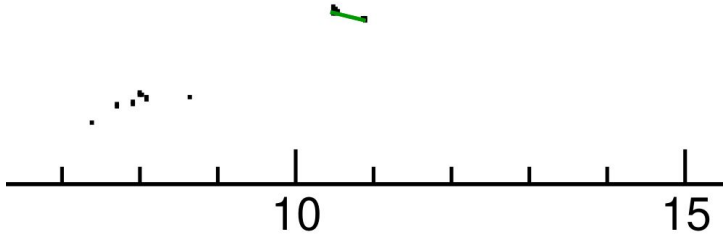


Conclusions

- electrons can cause multiple clusters (temporarily traversing through other material?)
- very few electrons may not cause a hit (low energy? Produced in substrate?)

- cluster weighting: count number of particles contributing charge to hits

➔ give each particle a total weight of 1 (1 particle producing 2 Clusters ➔ weight each Cluster with 0.5)



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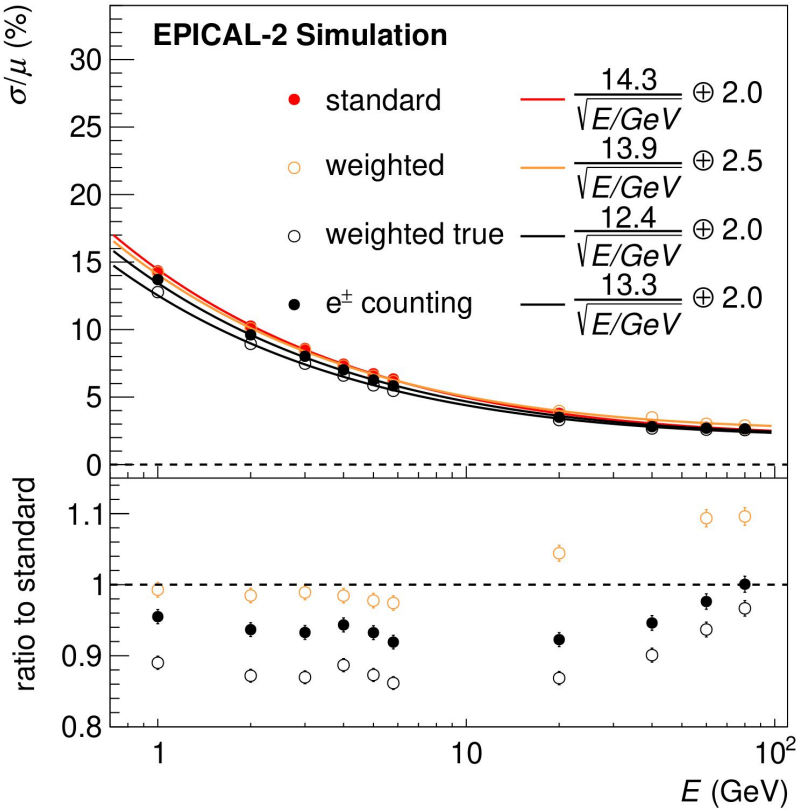
- low energies: $\langle N'_{clus} \rangle < \langle N_{contributing\ part} \rangle < \langle N_{e\pm} \rangle < \langle N_{clus} \rangle$

➔ cluster with true weight ~ contributing particles



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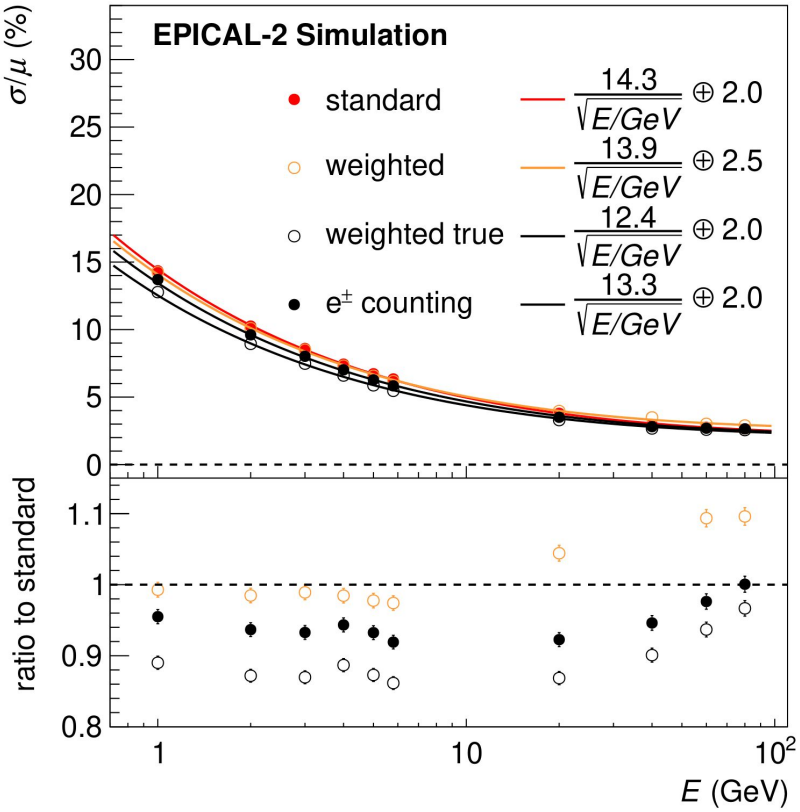
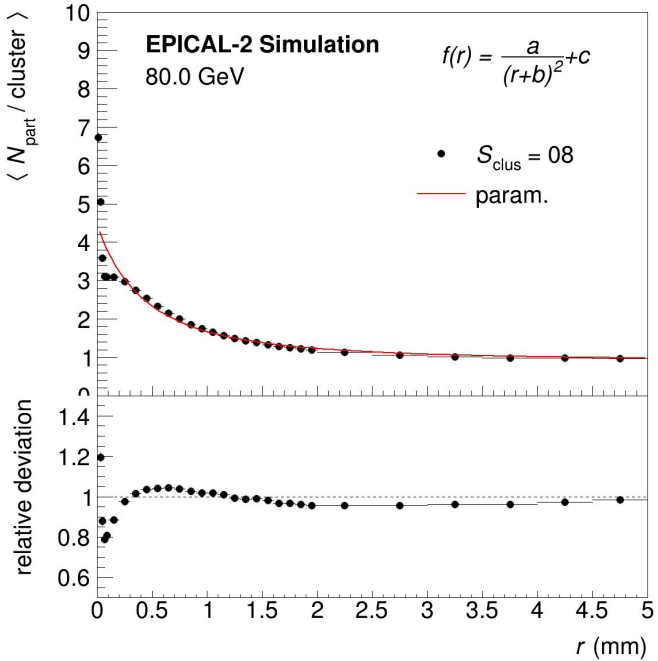
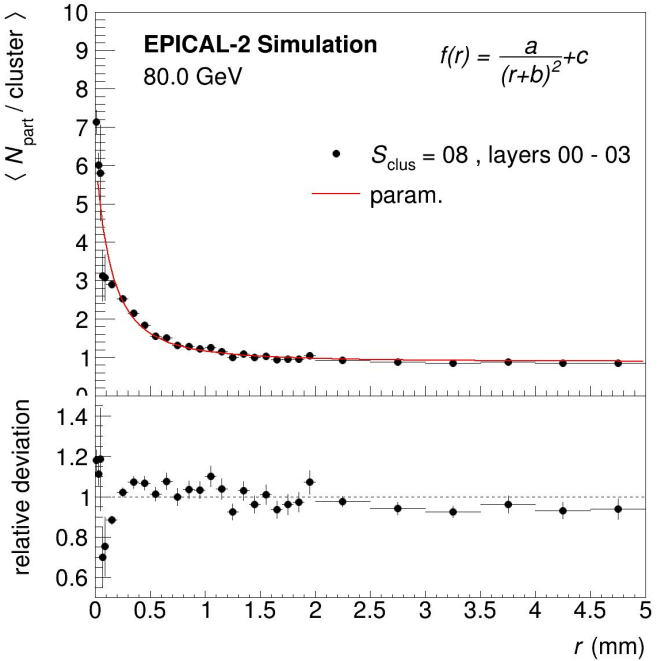


Parametrizations





- high energies, low *r*: distributions not described
- same shape in different longitudinal detector regions

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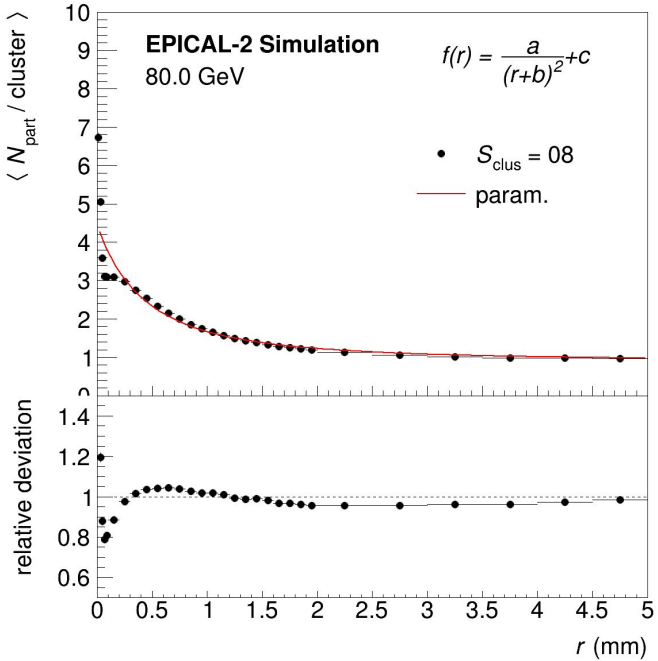

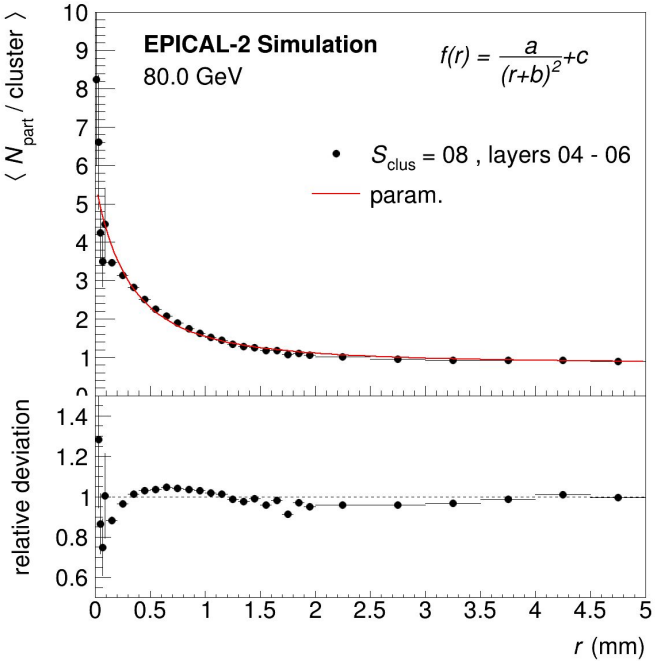

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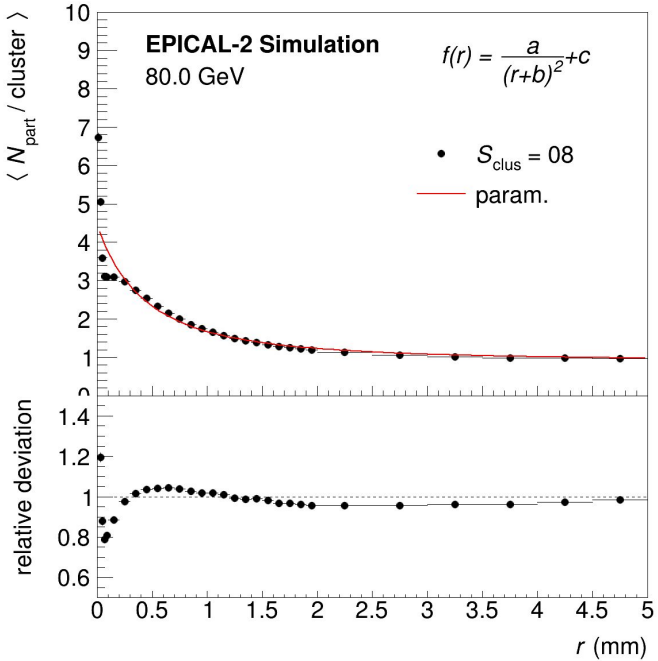

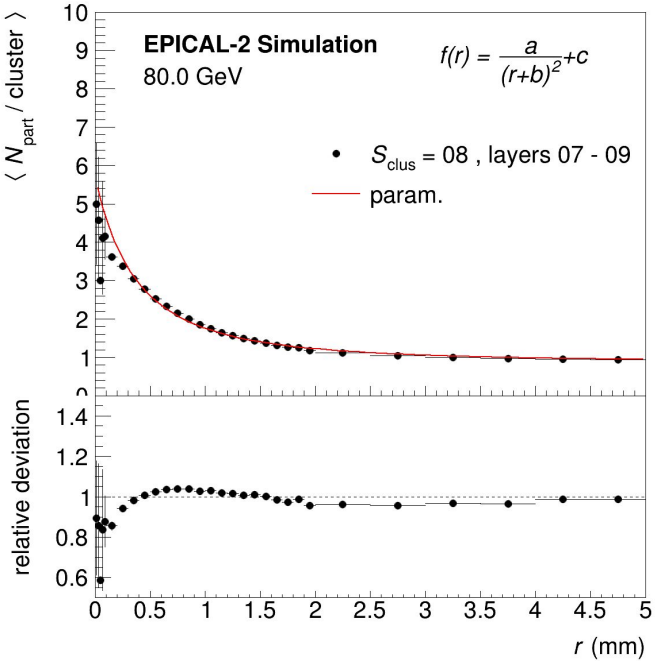

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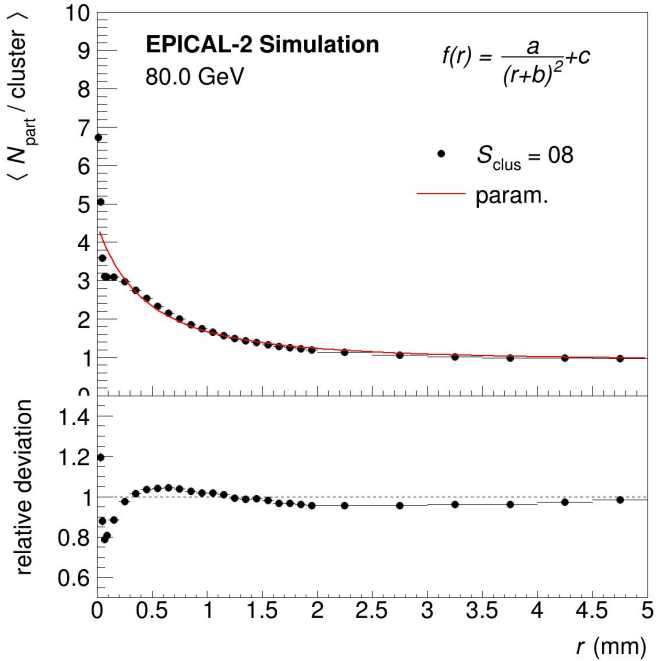

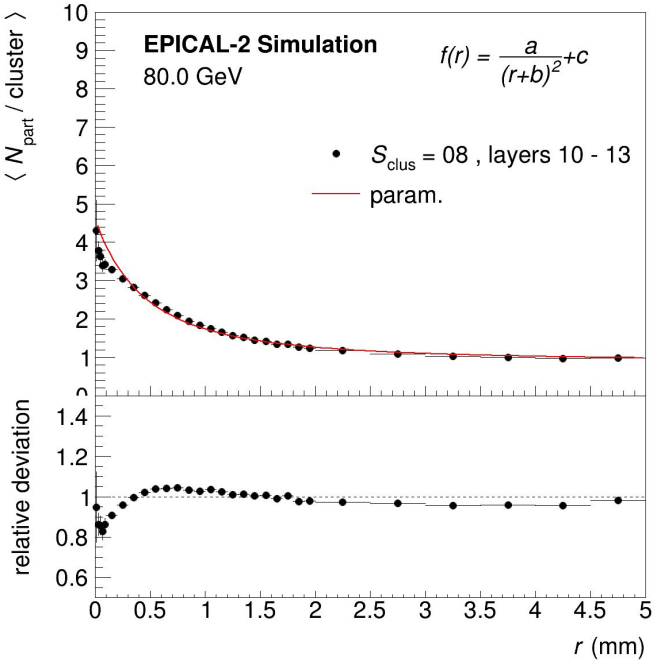

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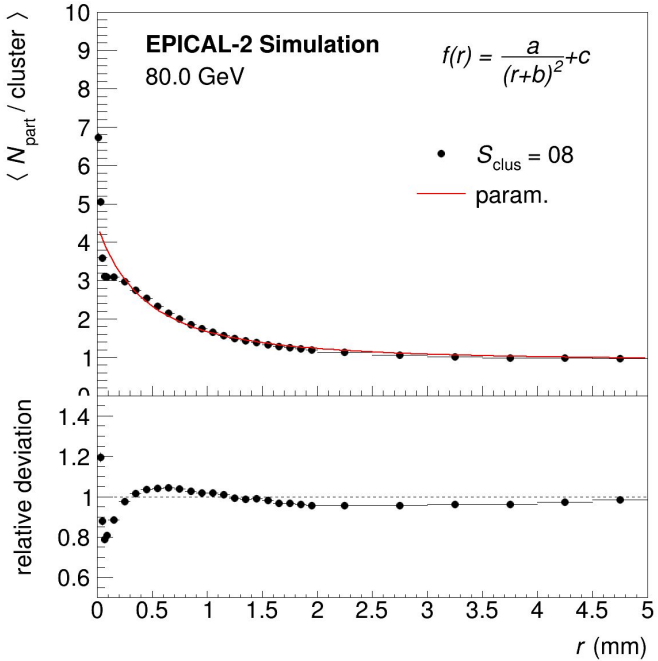

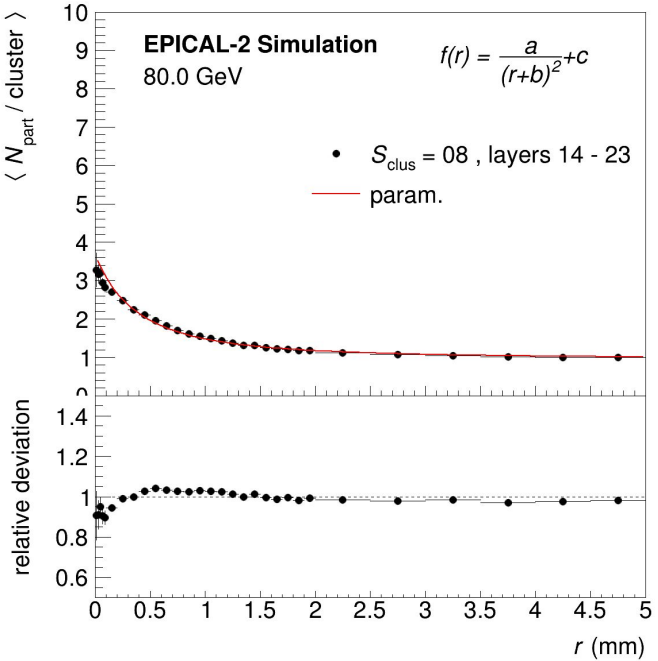

- high energies, low *r*: distributions not described
- same shape in different longitudinal detector regions

Conclusion

- new simulation allows detailed hit and particle maps

- electrons producing multiple clusters in one layer taken into account for cluster weights

➔ true cluster weights improve energy resolution

➔ cluster weighting improves energy resolution at low energies (systematic uncertainties?)

- parametrizations don’t describe mean N_{part} per cluster distributions at high energies and low r