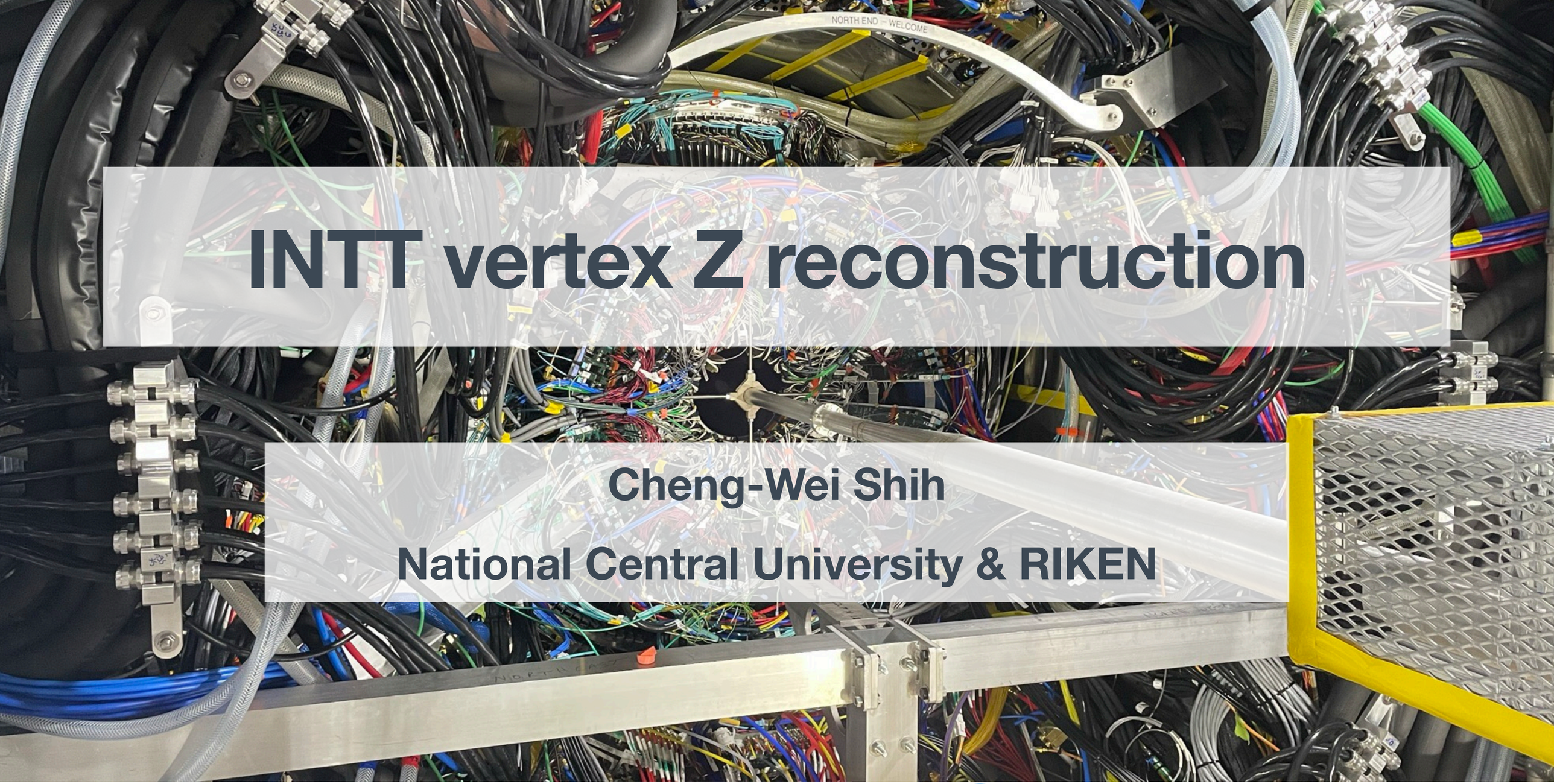


INTT vertex Z reconstruction

Cheng-Wei Shih

National Central University & RIKEN

June 19th, 2024
INTT meeting

sPHENIX INTT sPHENIX 國立中央大學 National Central University RIKEN

Vertex Z - procedures

1. Update the cluster ϕ and radius based on the reconstructed average vertex XY

2. Loop over all the inner and outer cluster pairs, keep the pairs which pass the Δϕ cut and DCA cut (proto-tracklets)

3. Move to the Z-Radius plane. For each proto-tracklets, the full strip lengths of the two clusters (inner and outer) are considered. Project the **possible vertex Z*** to the Z axis (radius = 0)

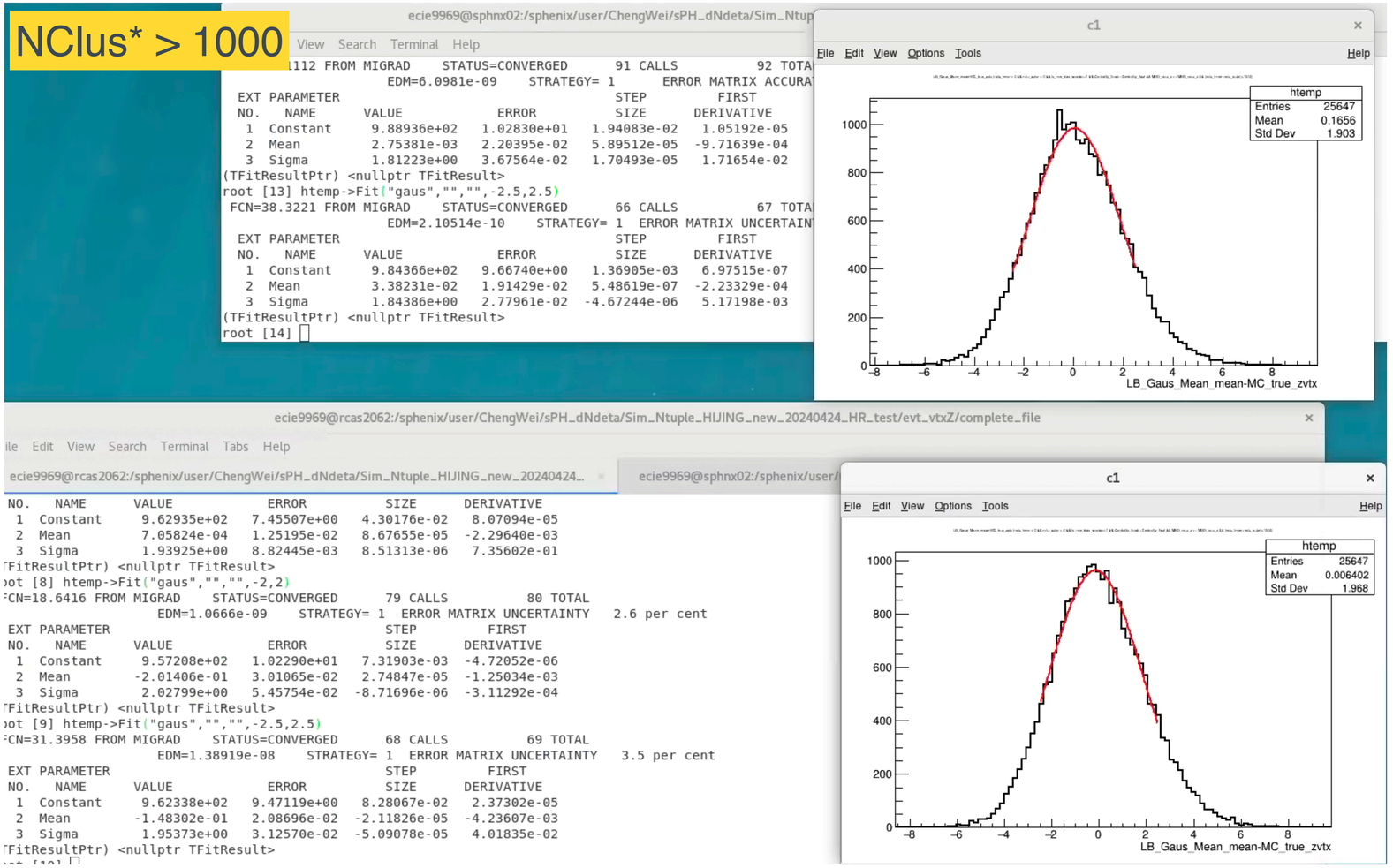
4. Fill all the **possible vertex Zs*** of all the proto-tracklets into the histogram

5. Fit the distribution with **Gaussian function + offset** to determine the reconstructed vertex Z for single event (fit parameter and fit range tunable)

Possible vertex Z*: the shapes are different based on the methods

Vertex Z improvement

- Suggestion given by Akiba san
- Idea: the weight of each combination filled into the 1D histogram should be the same, i.e., **weighting the entry by (1./"possible vertex Z range")**



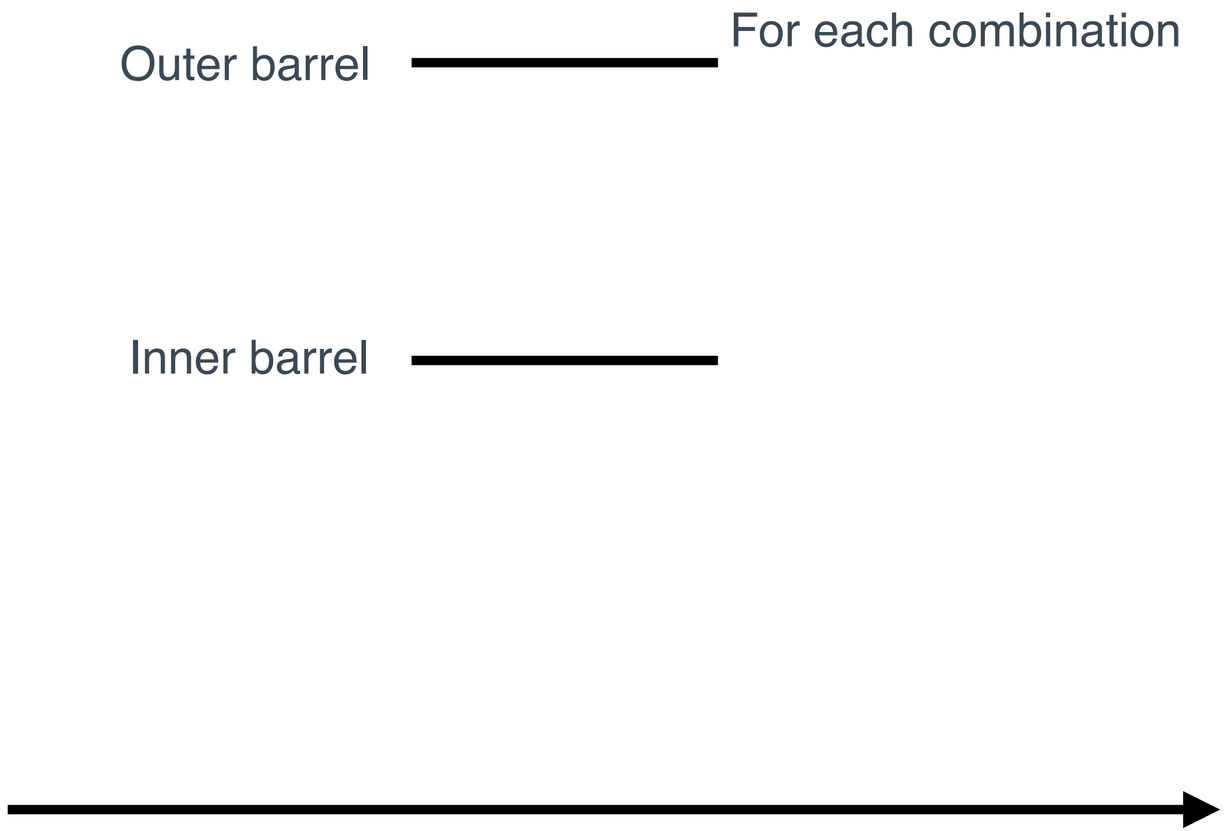
Entries weighted
Fit mean : 3.382e-02
Fit width : 1.8439e+00

Original
Fit mean : -1.483e-01
Fit width : 1.9537e+00

~6% improvements

Vertex Z improvement - trapezoidal

- Idea given by Akiba san. For each combination, take into account of the distribution of the possible vertex Z range, and normalize the distribution, and fill into the histogram. (Used to assume the Uniform distribution of the vertex Z)
- Justification of using **possible vertex Z range / sqrt(12)**: The region with higher probability is presumably selected



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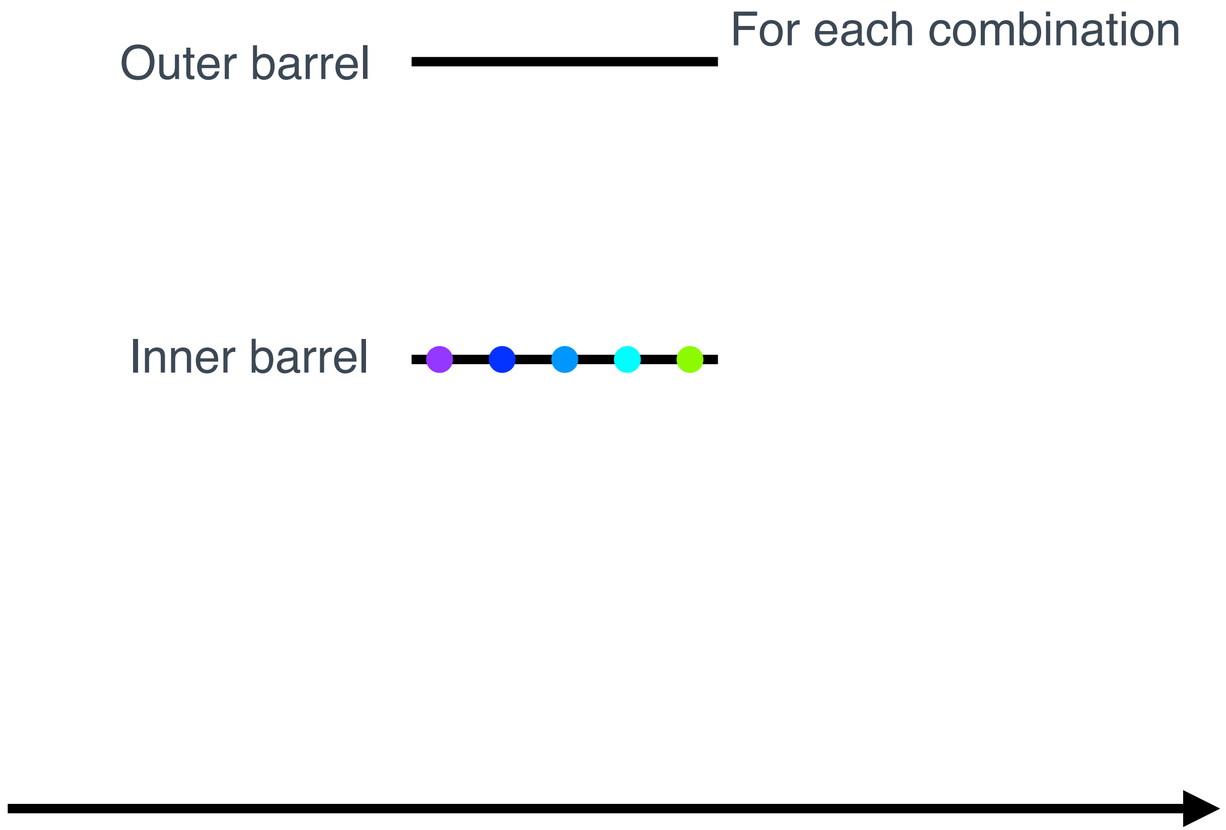

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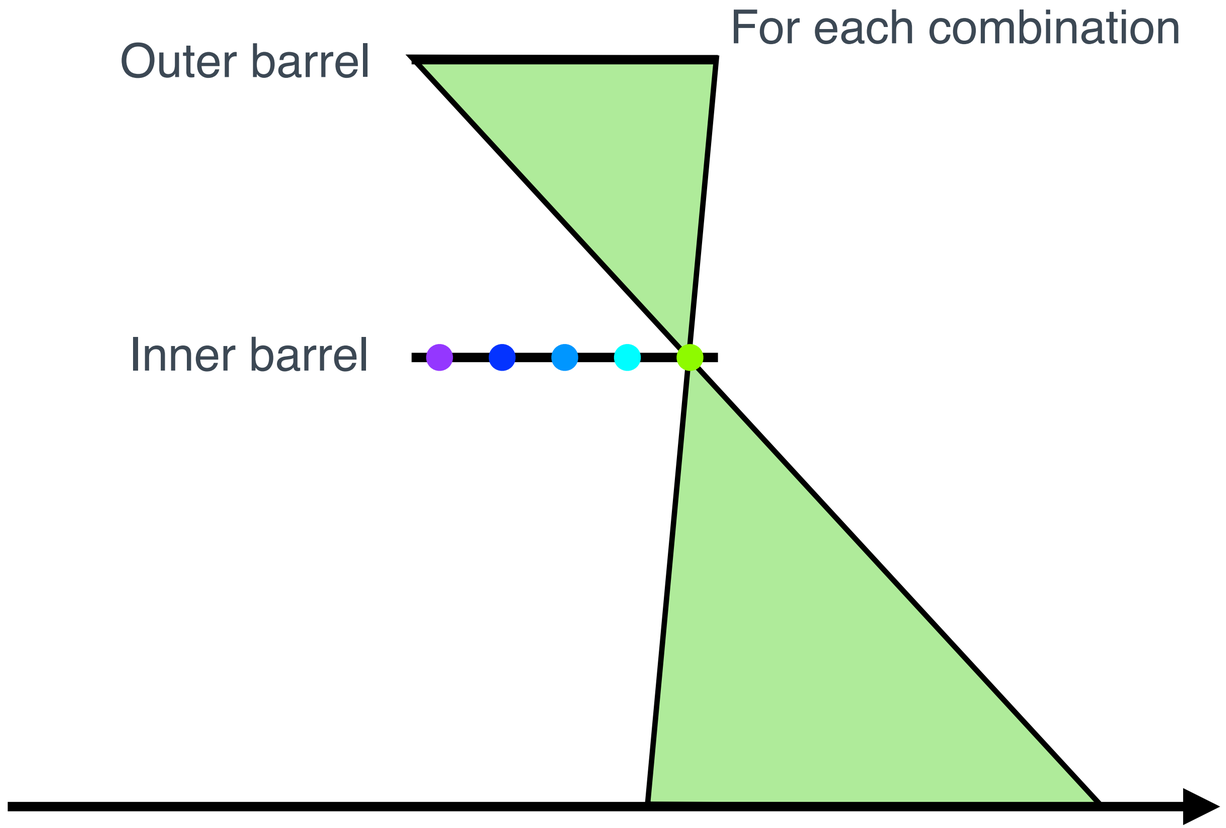

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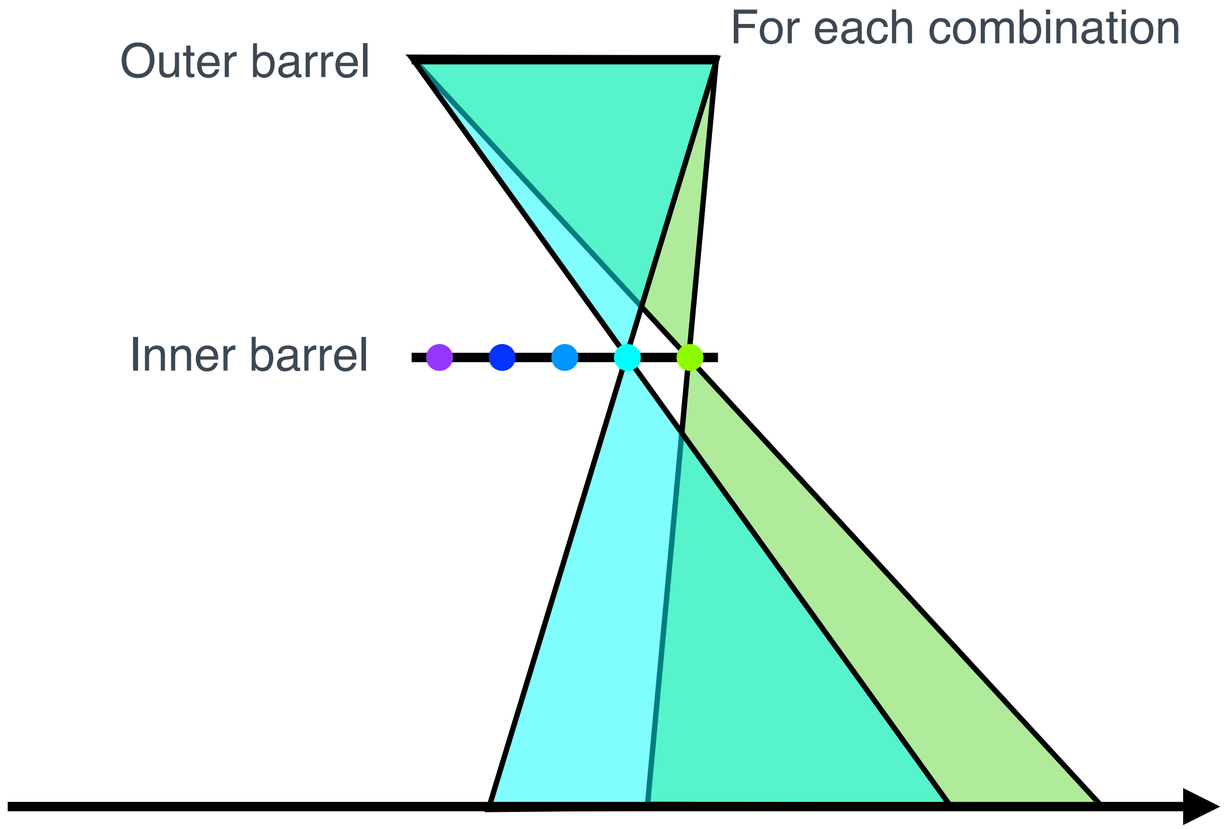

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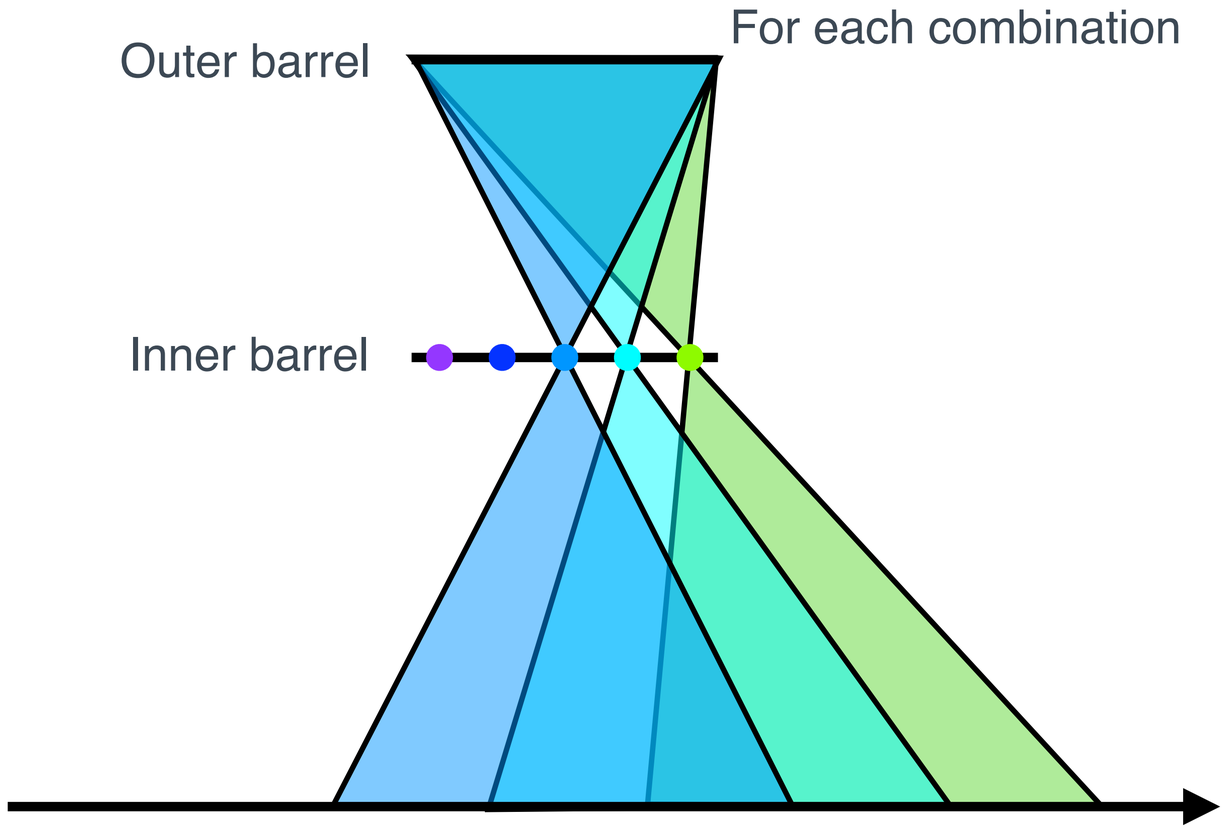

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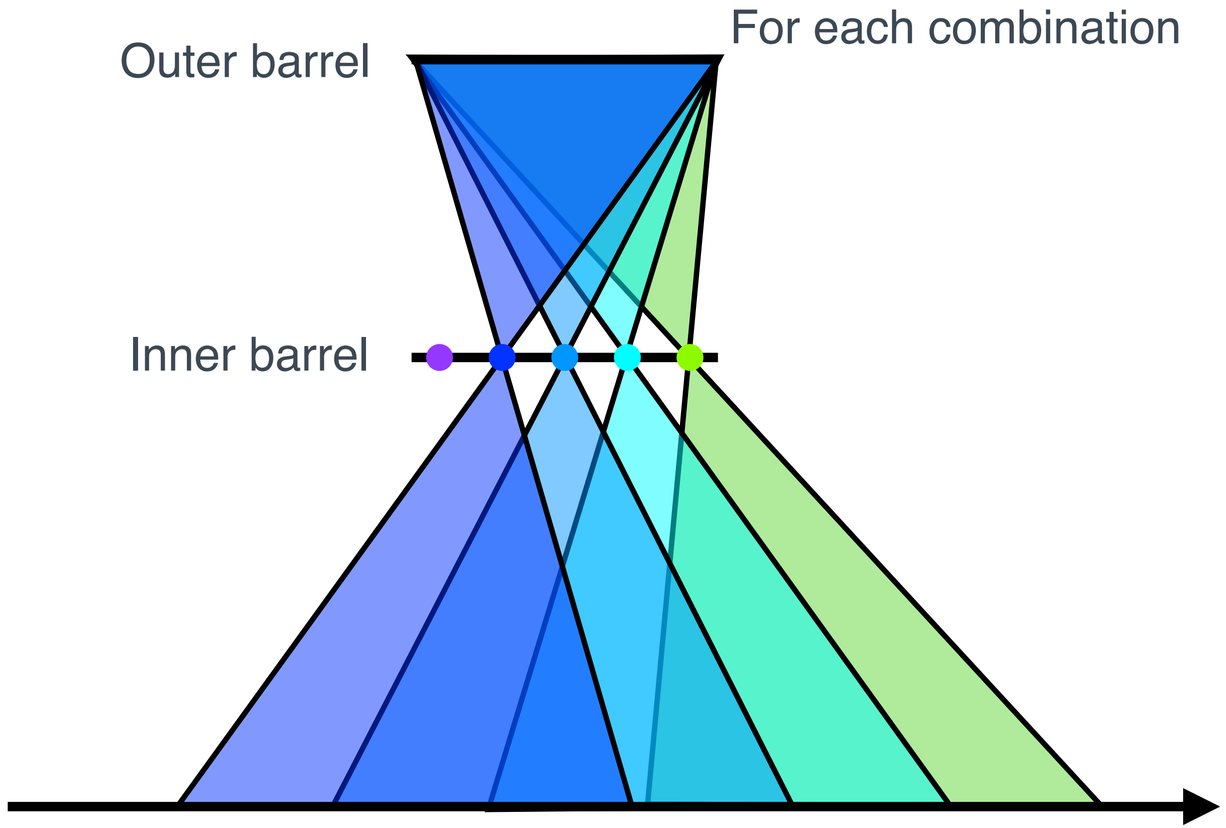

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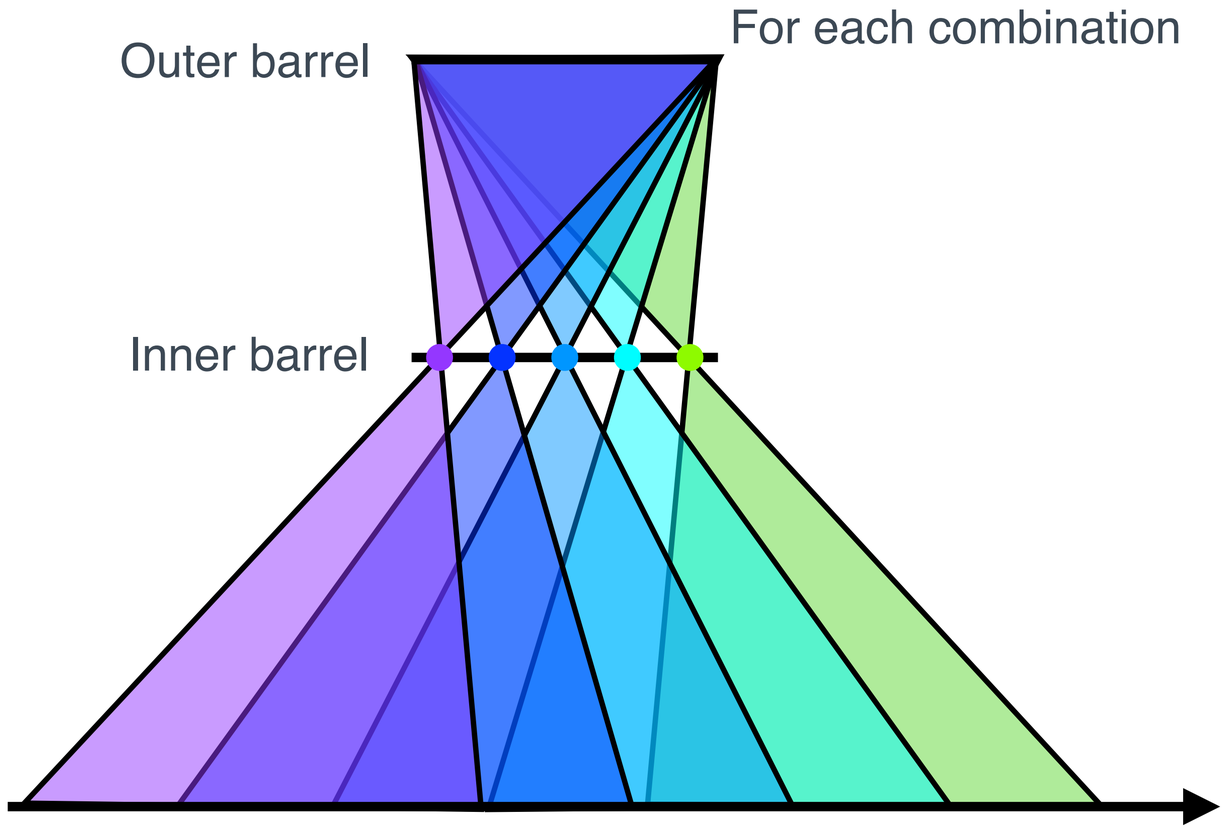

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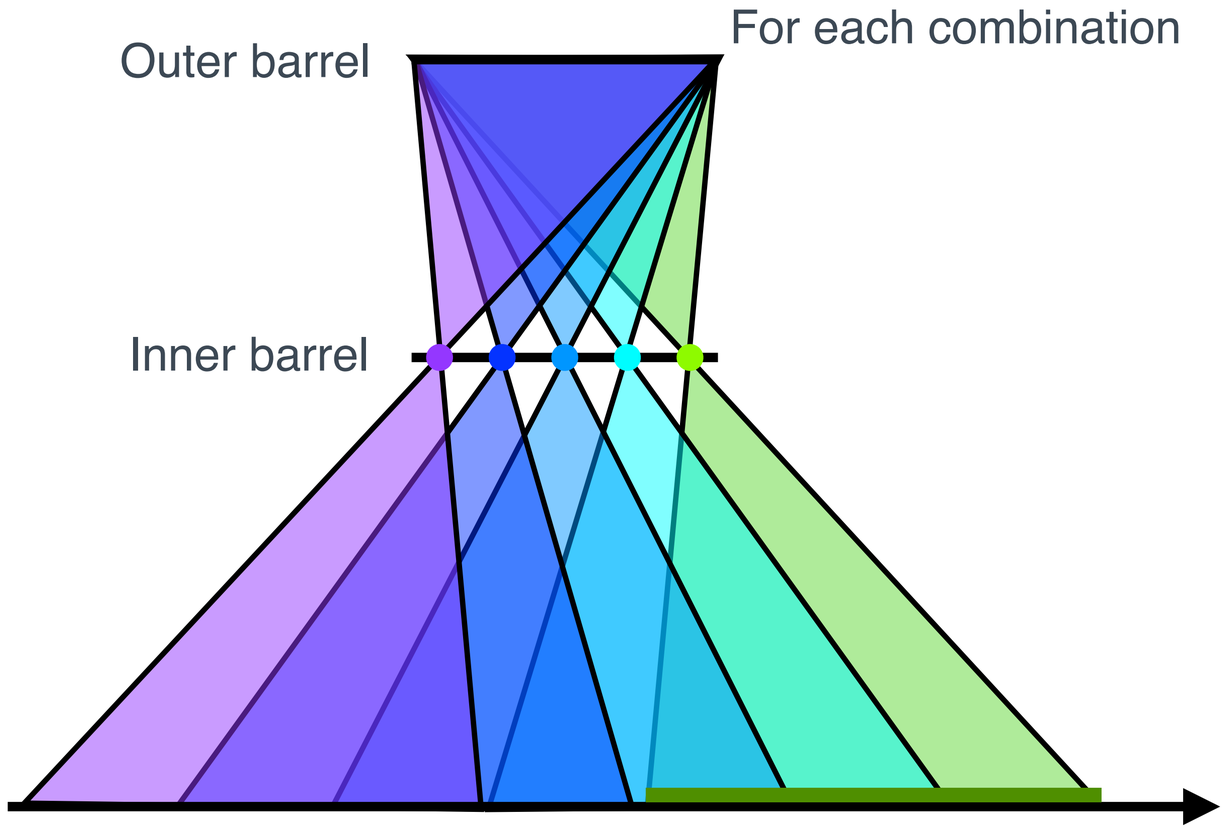

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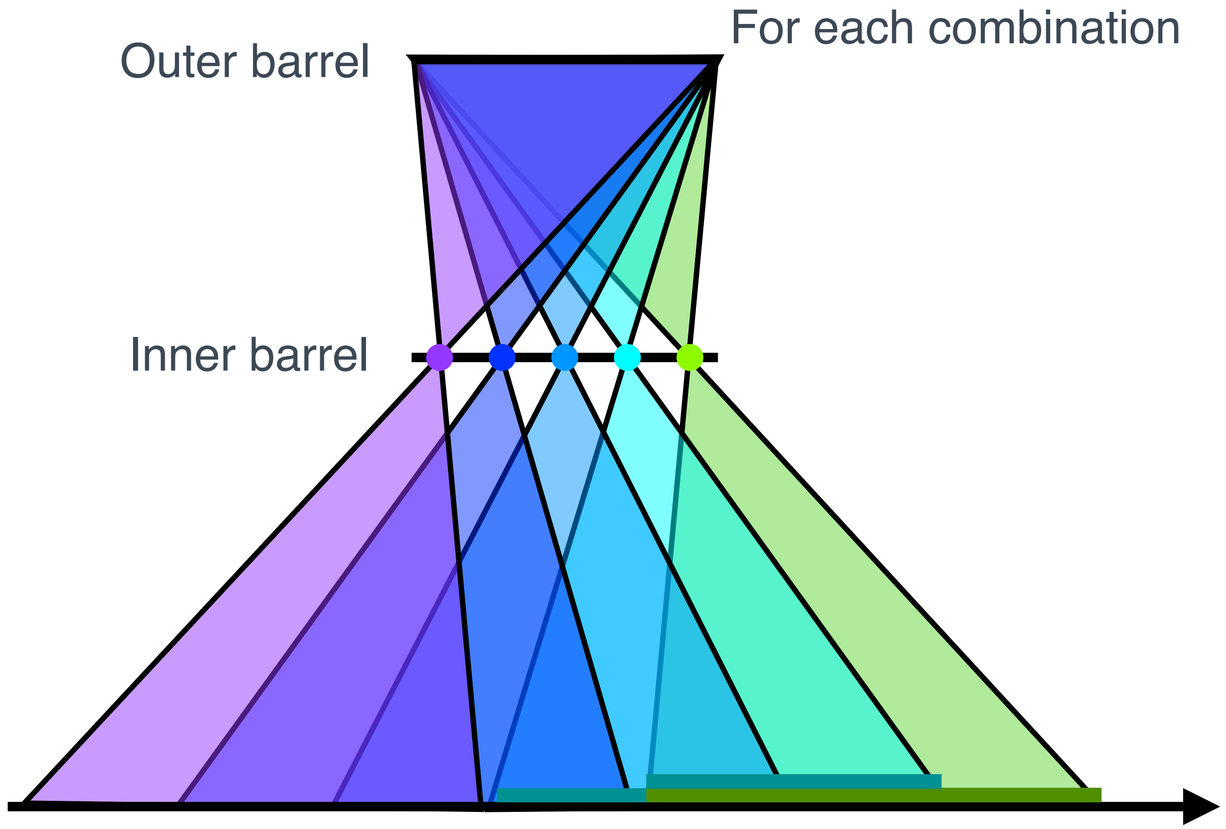

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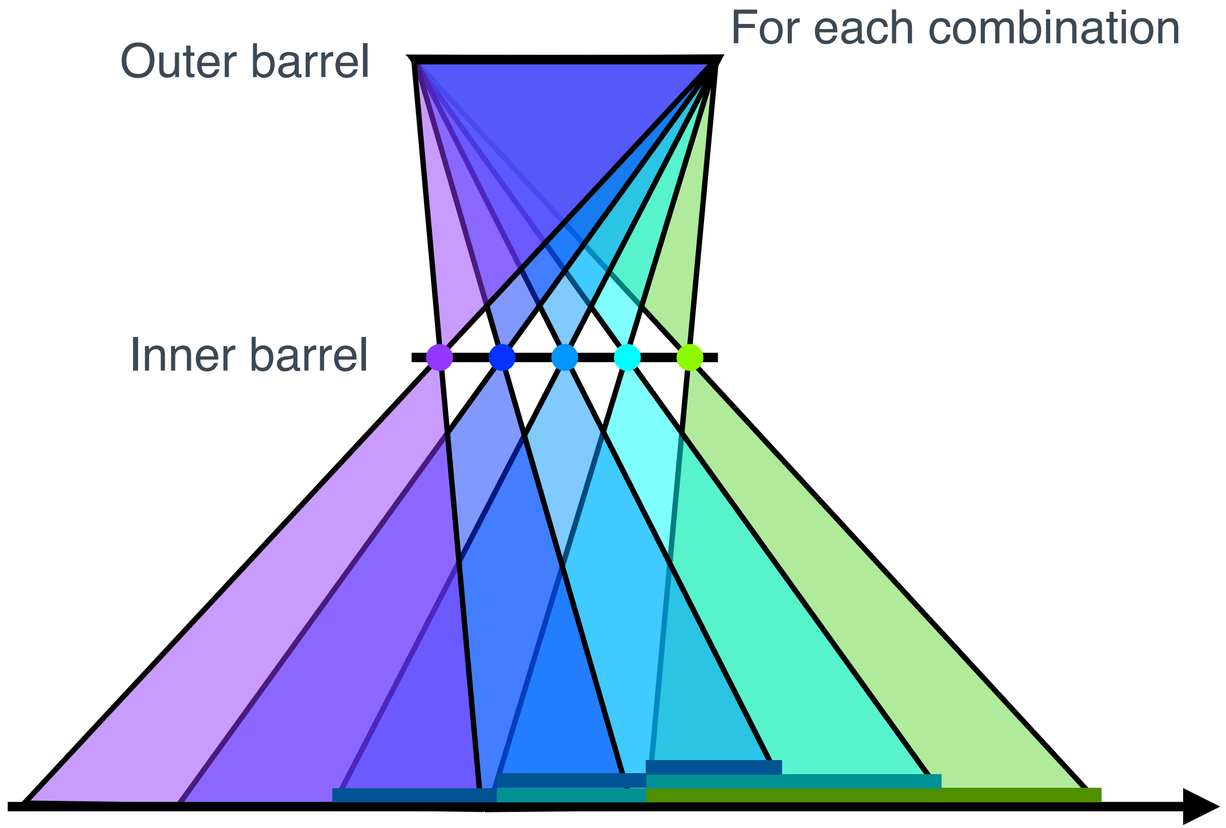

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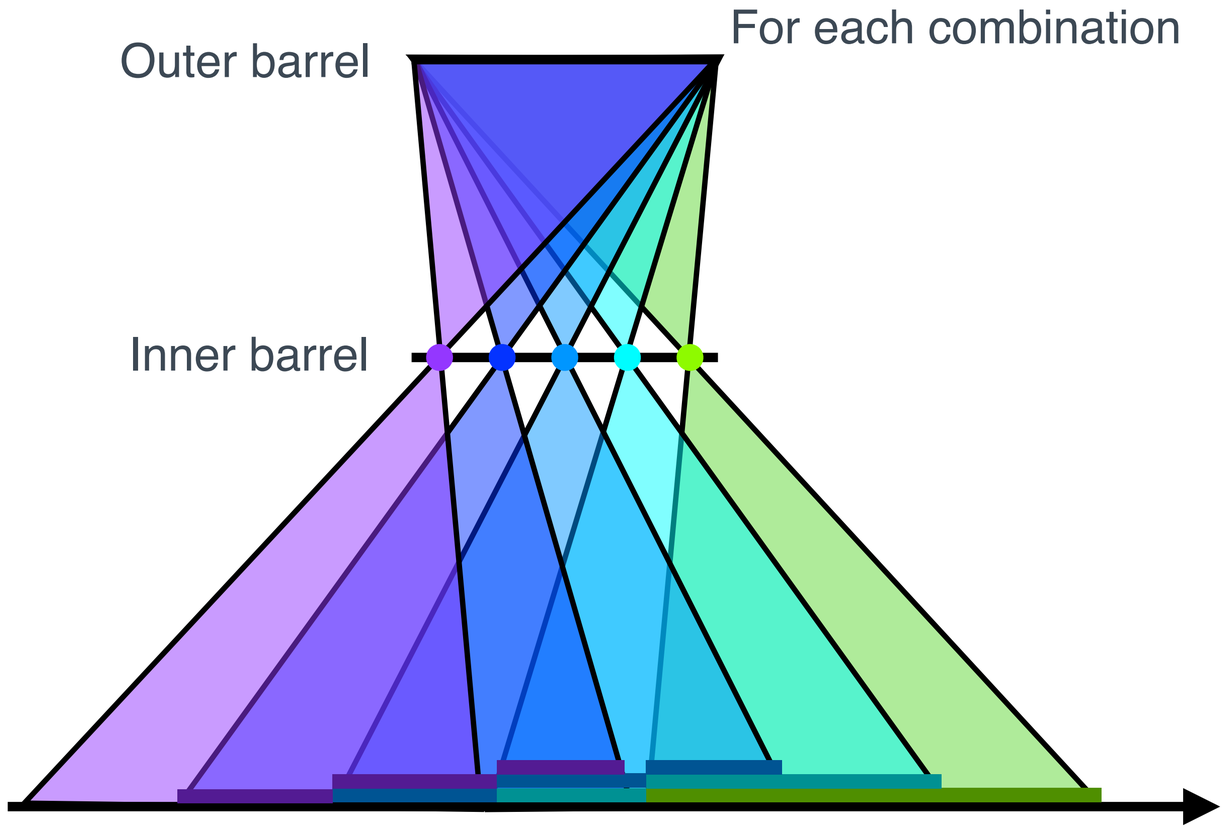

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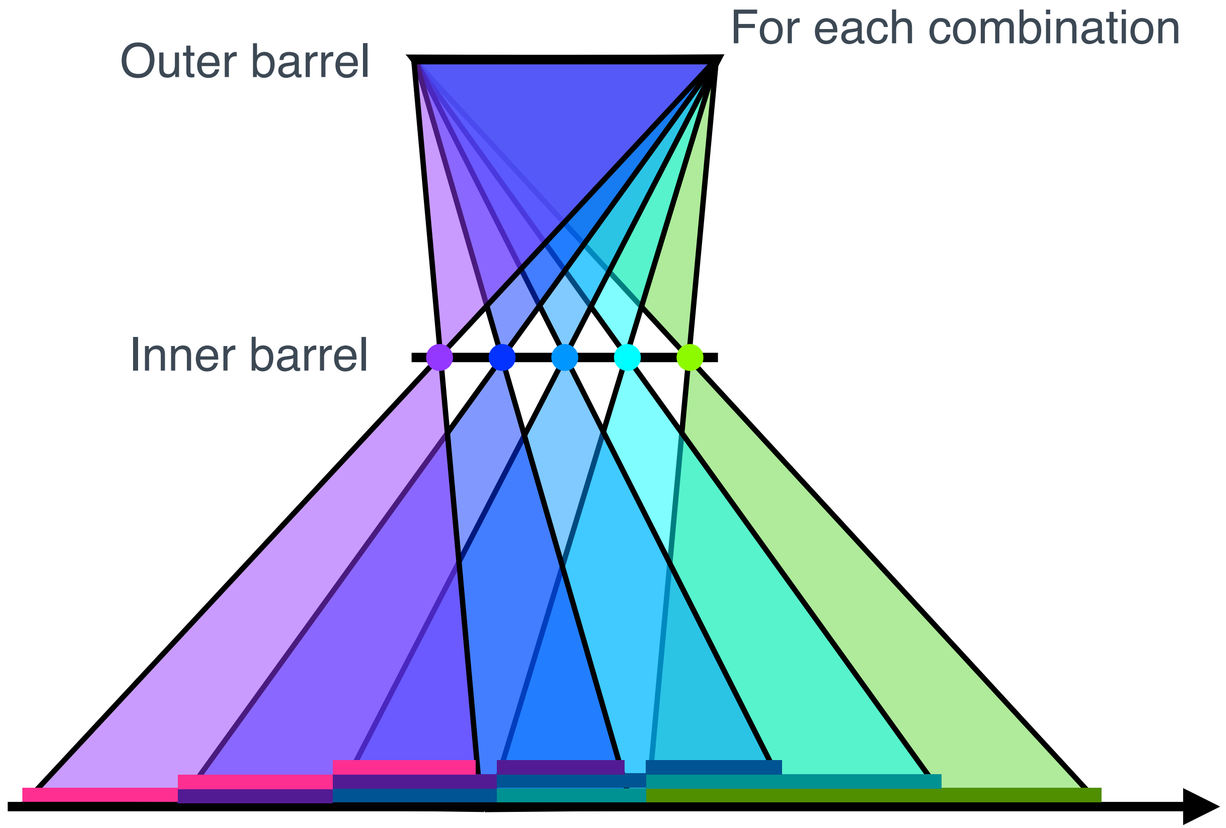

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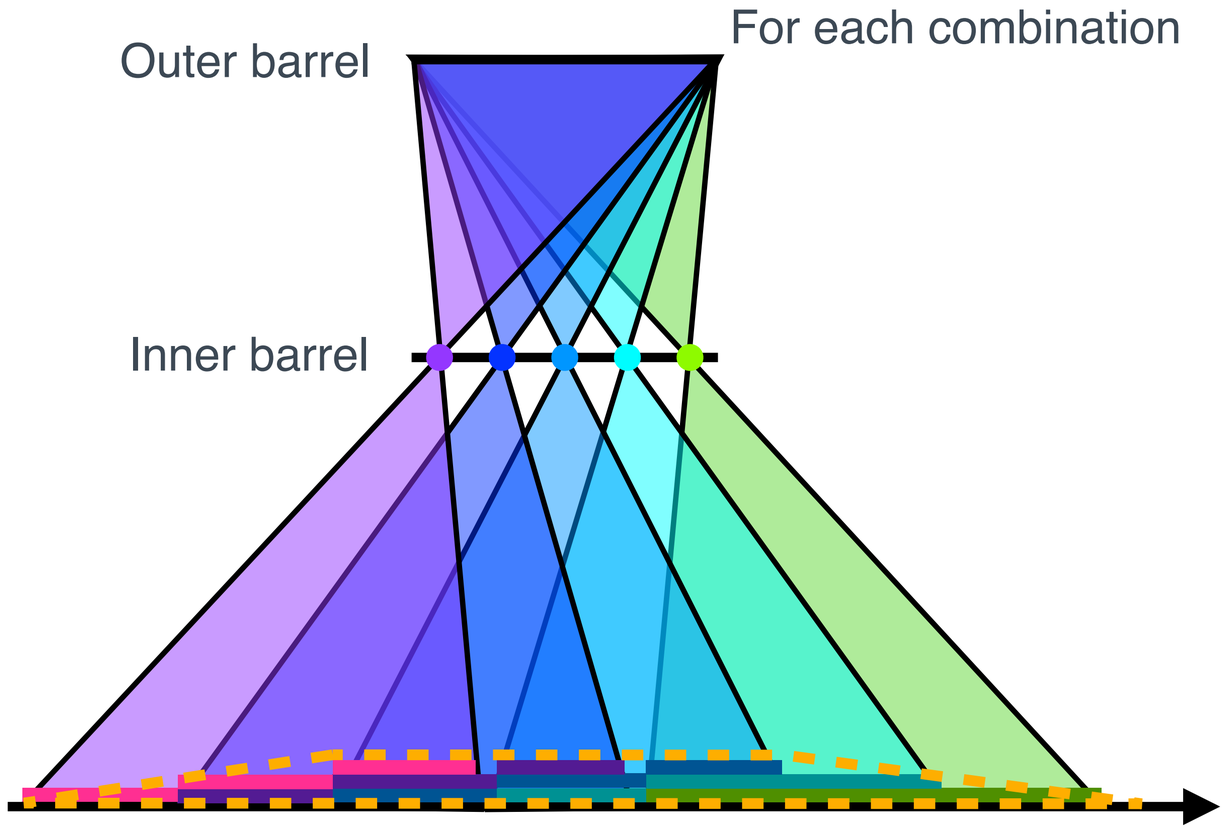

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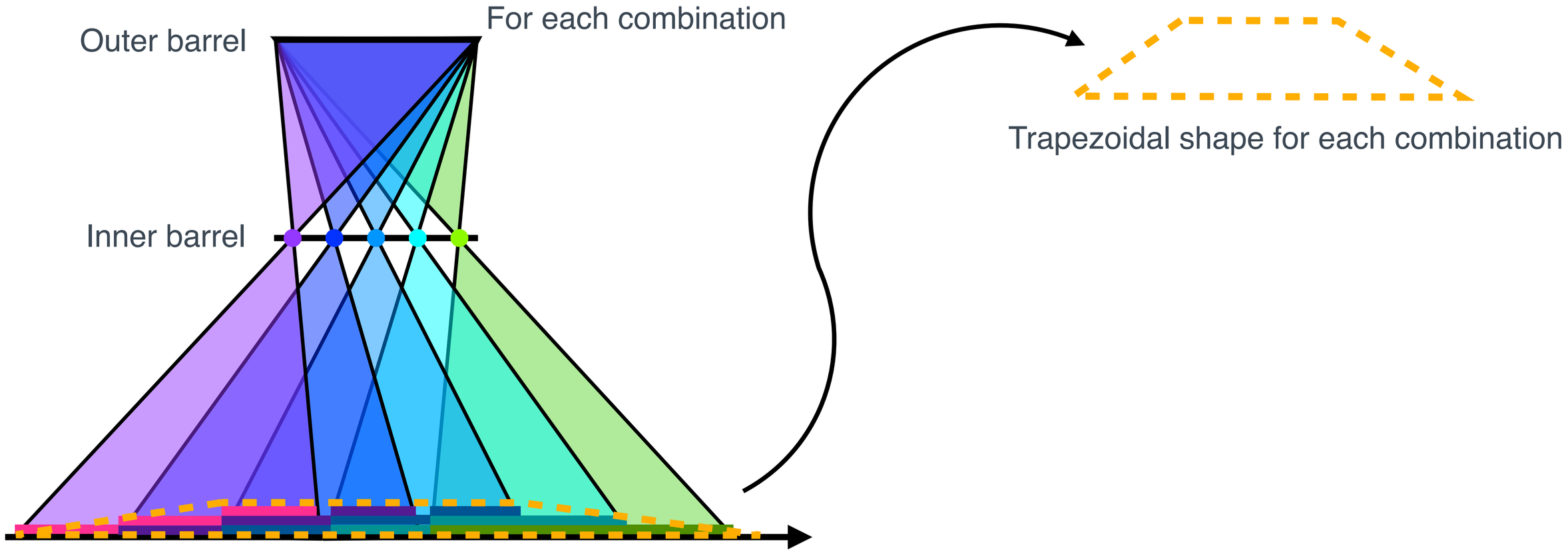

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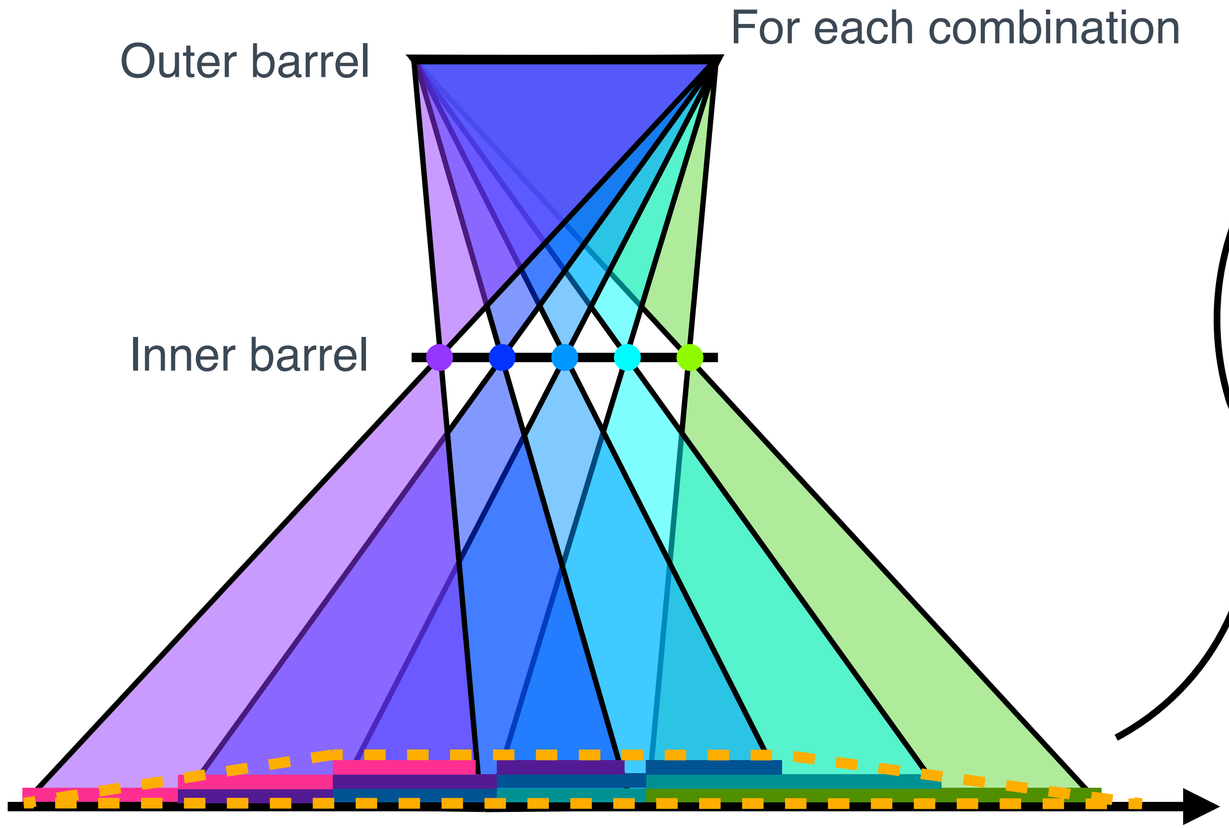
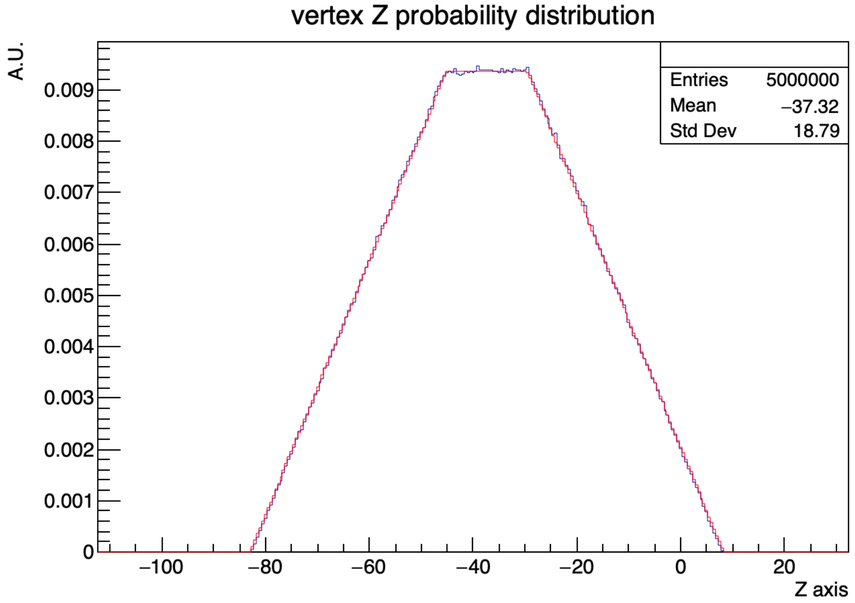


For each combination

Trapezoidal shape for each combination



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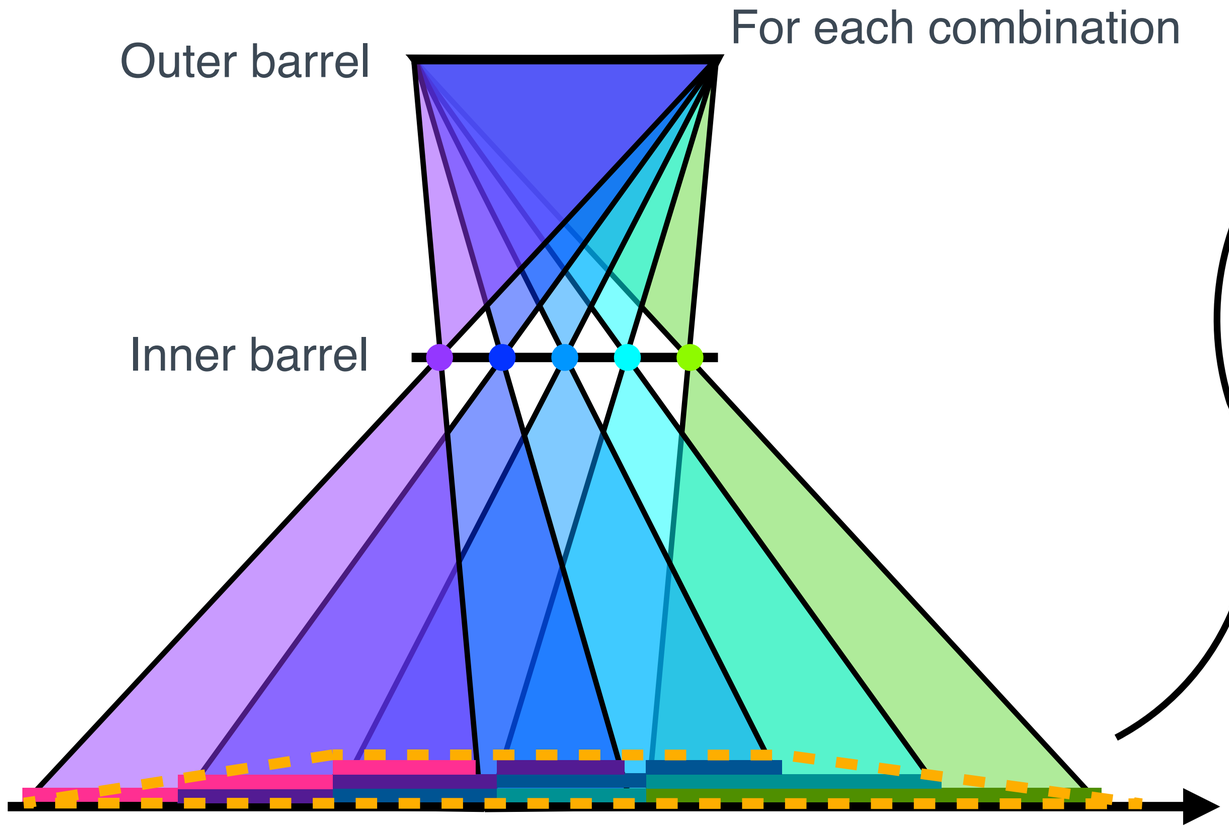

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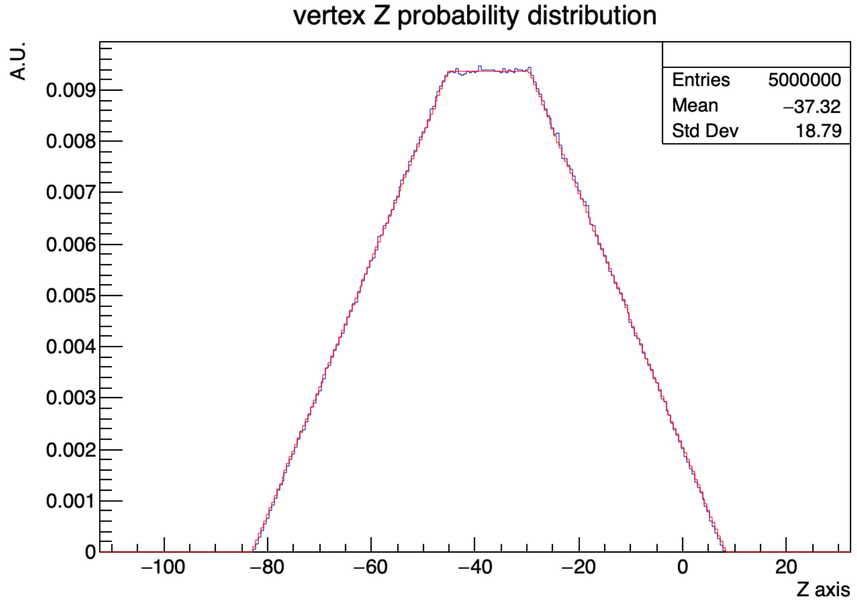
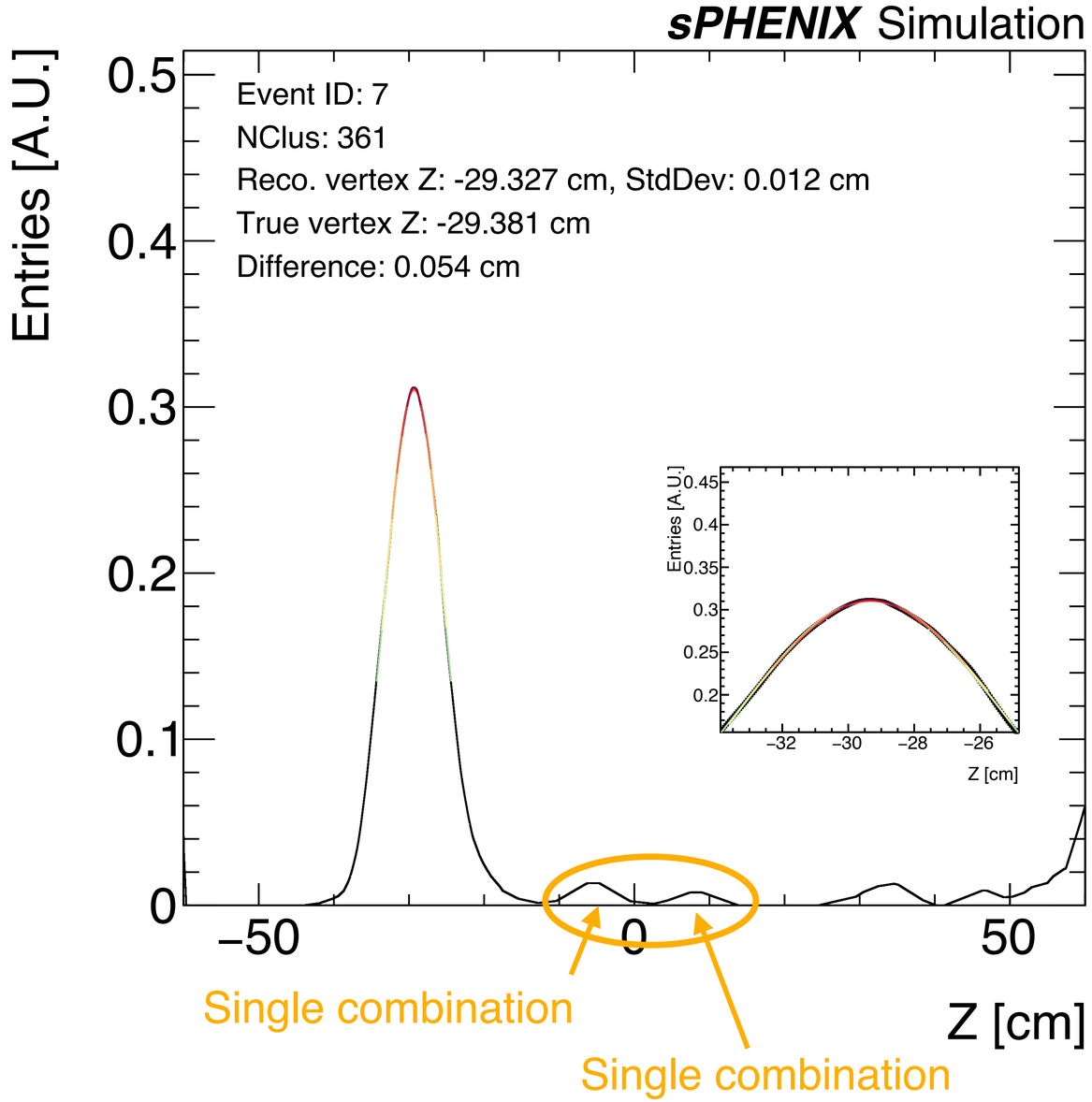


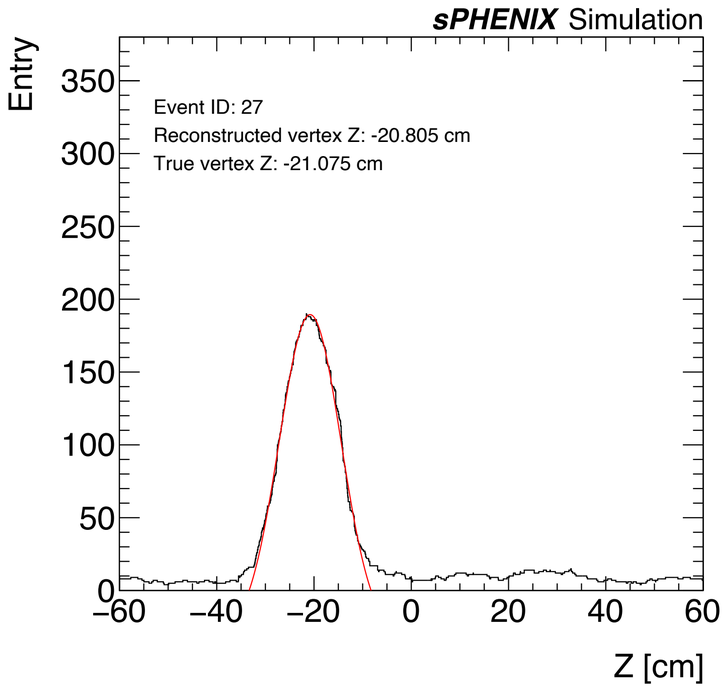
Caveat: for each combination in single event, have to have the shape, and fill that into histogram, not trivial…
Not easy, but still have the way to make it happen

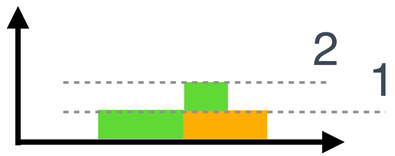
Vertex Z improvement - trapezoidal



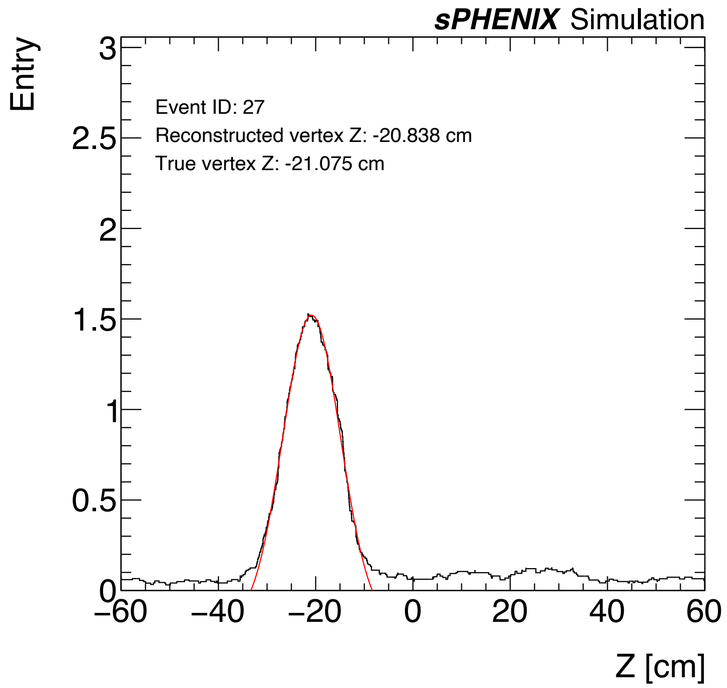
Vertex Z improvement

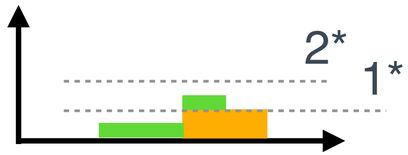
Original





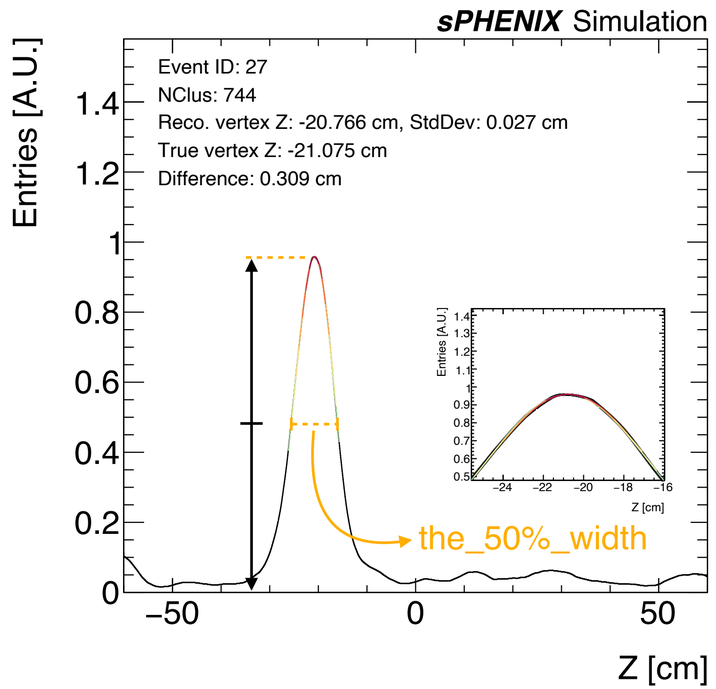
Entries weighted

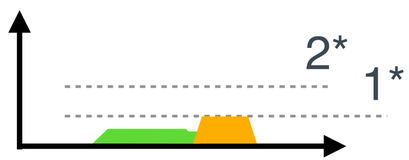




Trapezoidal

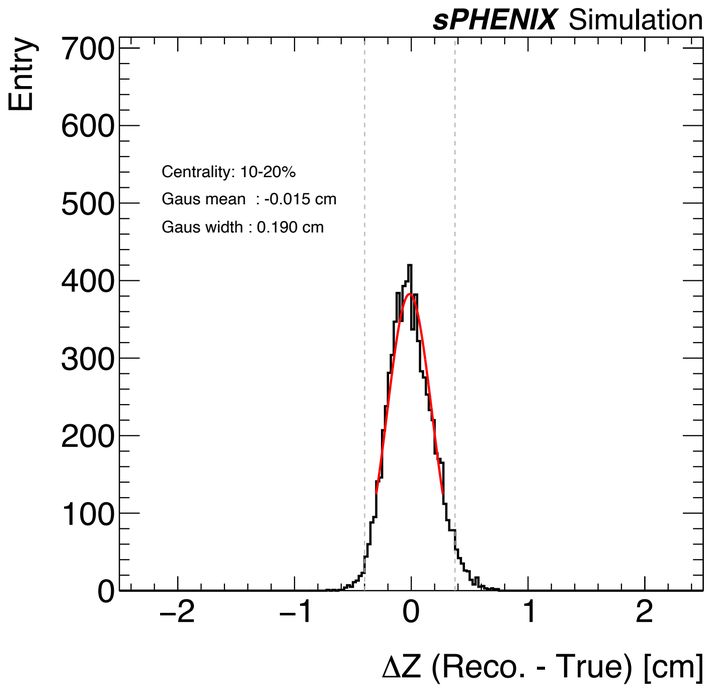
(final vertex Z given by average of 7 gaussian fits with the fit ranges of "mean ±(0.2 + 0.15 x i) x **the_50%_width**")

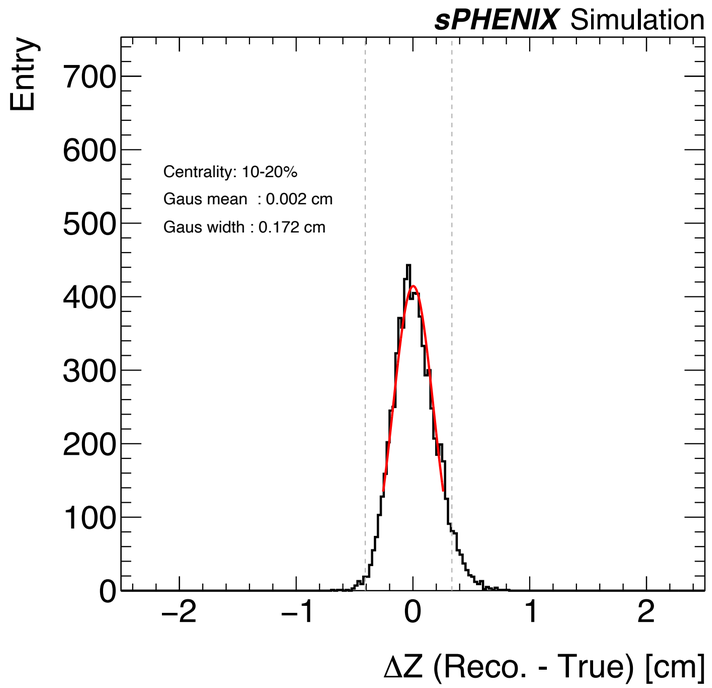




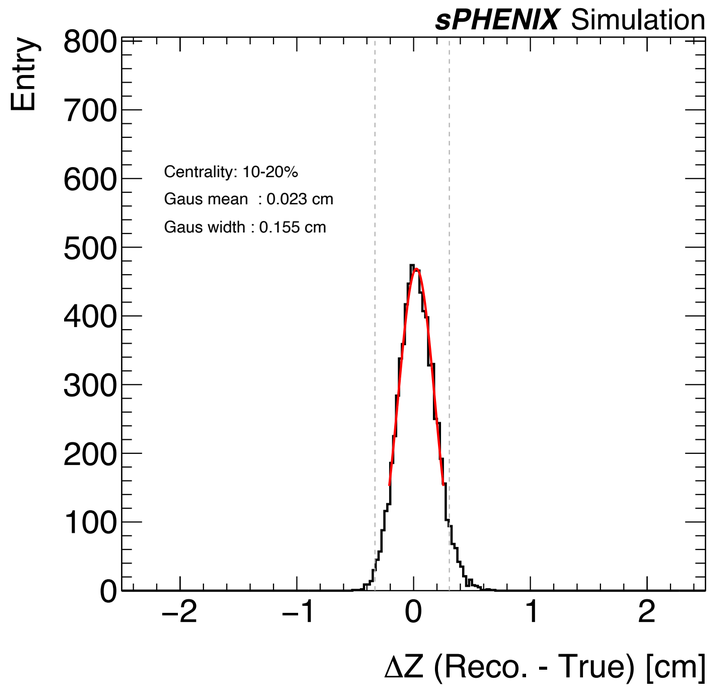
Vertex Z improvement

Very central events





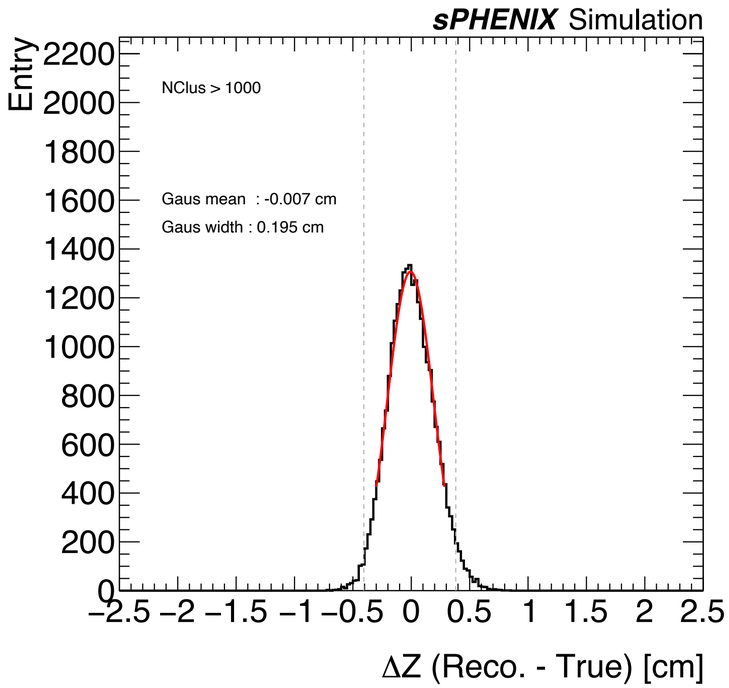
9.5% improvement

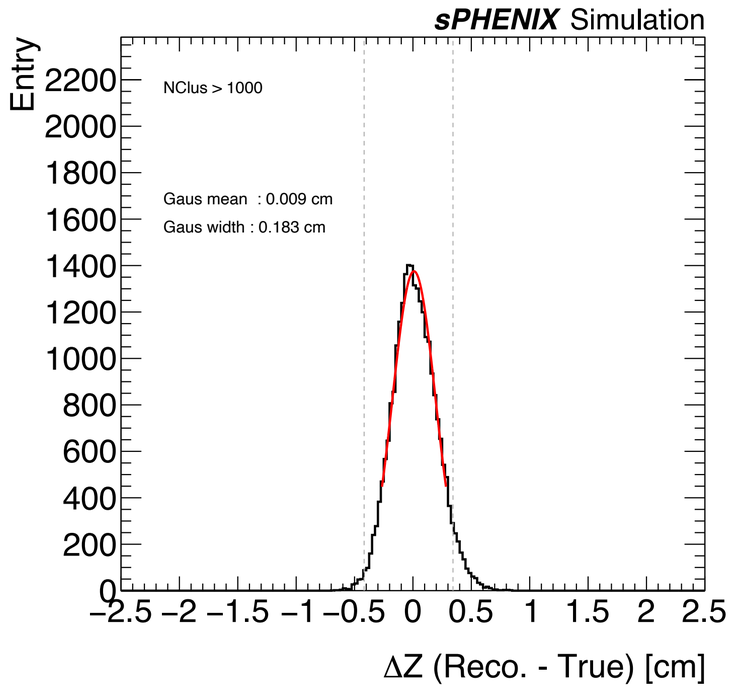


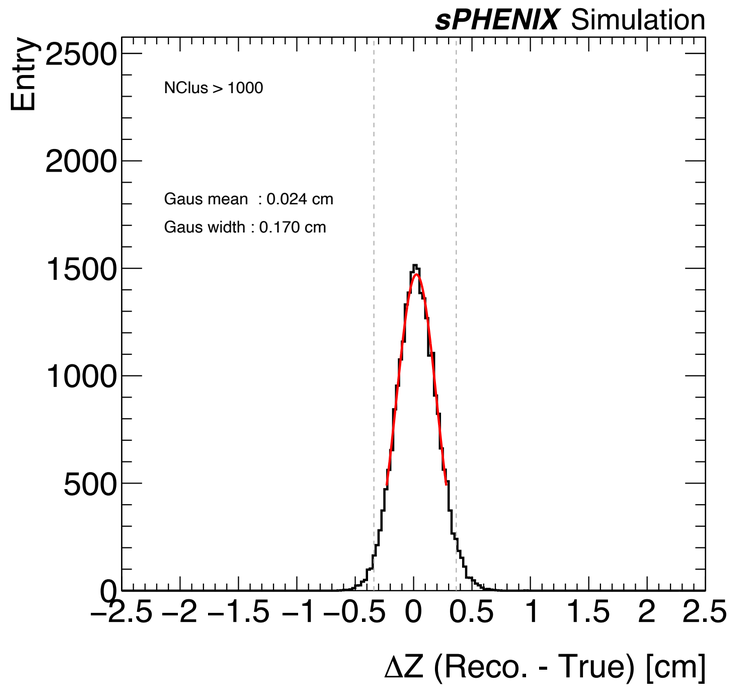
18.4% improvement

Vertex Z improvement

Number of valid clusters > 1000







6.2% improvement

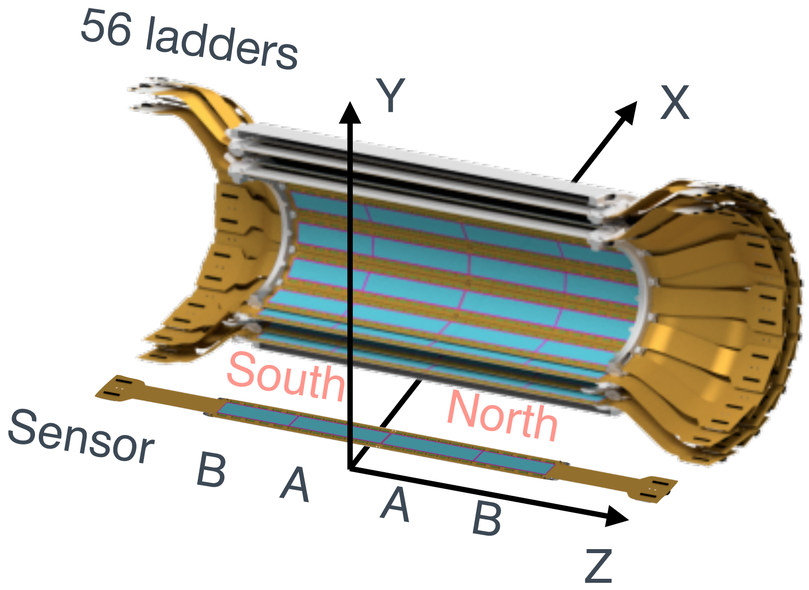
12.8% improvement

Valid clusters: cluster adc > 35 && cluster phi size < 6

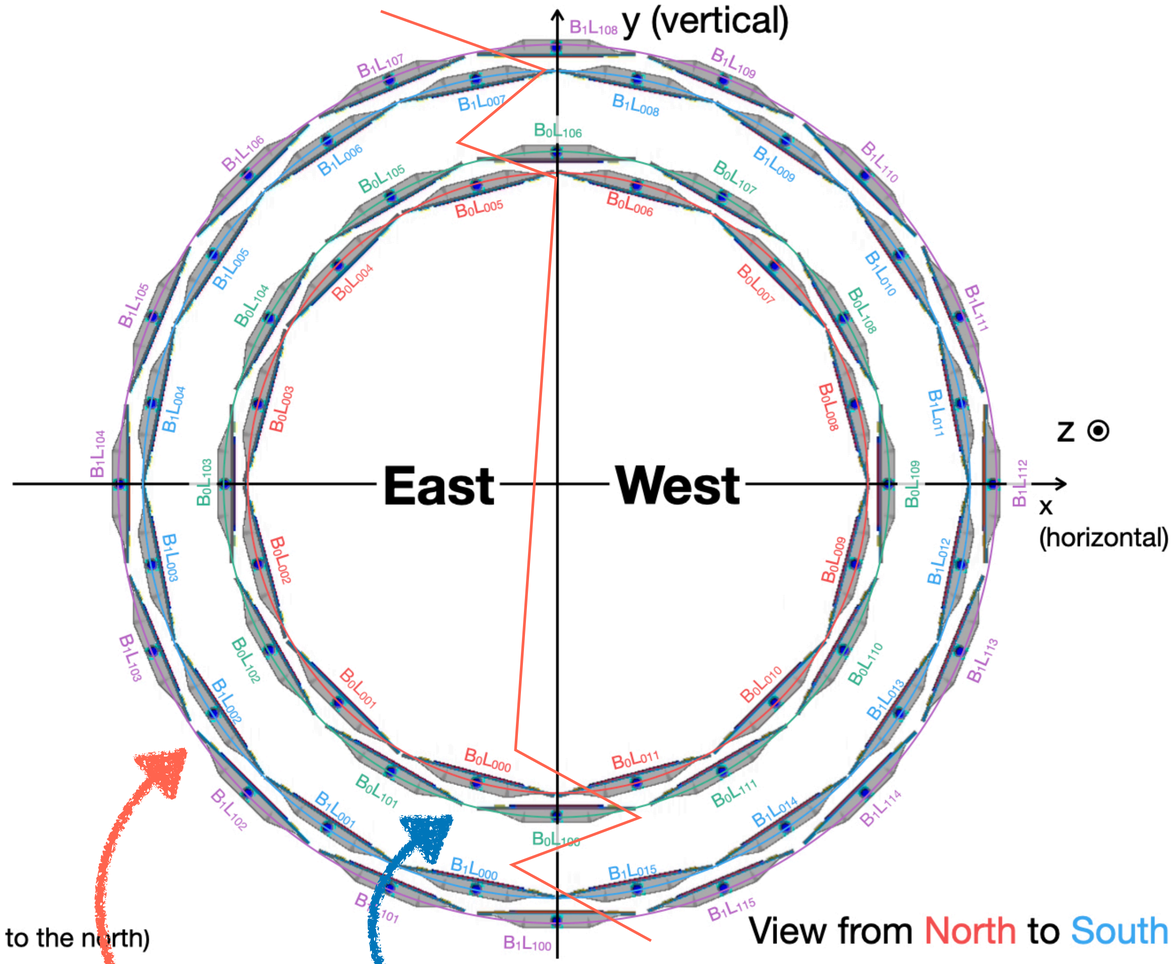
Back up

INTT geometry

INTT: 2 sensors X 2 sides of half-ladders X 56 ladders = 224 sensors



Notation: B_xL_{yzz}
- x: Barrel ID (0 for inner or 1 for outer)
- y: Layer ID (0 for inner or 1 for outer)
- zz: Ladder ID (from 0 to 15)



Axis (Right-haded coordinate)
- x-axis: $\vec{y} \times \vec{z}$
- y-axis: Vertically upward direction
- z-axis: The blue beam direction (pointing to the north)