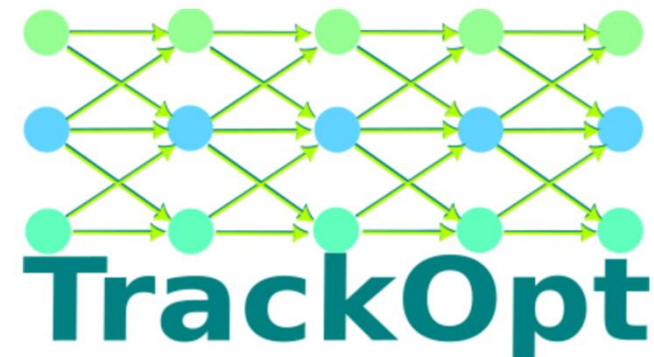
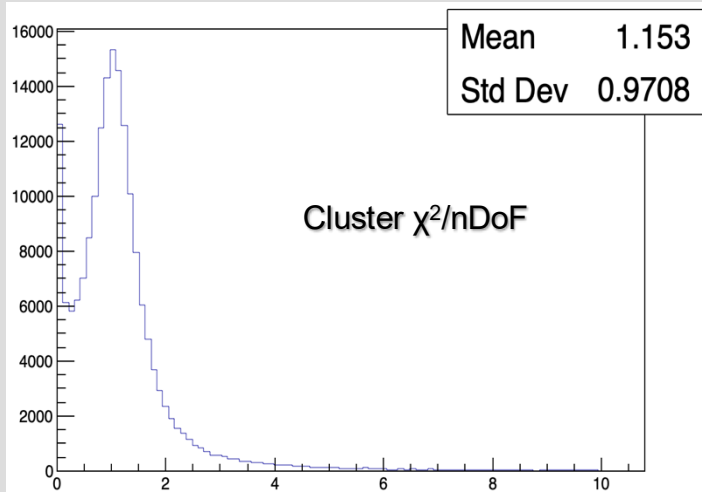


Bad cluster problem

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Mostly perfect, but some clusters have very bad χ^2 ,
mostly primary vertices(1D case)

Example: $\chi^2/NDoF = 871.94$, 37 tracks, PV

χ^2 per track: 4863.7883, 1322.6594, 2114.6815, 3309.8816, 926.4039, 797.9070, 879.0578, 23.2070, 744.2254, 595.4529, 56.4630, 44.7656, 1303.2478, 3241.7185, 945.2336, 770.6240, 17.8598, 129.7384, 946.2109, 19323.6778, 1036.7645, 6696.1123, 911.3018, 9.3334, 15.3803, 263.3842, 12.8297, 9.6115, 1.3922, 5.3469, 31.4523, 3.5731, 13.5744, 71.6958, 134.0652, 3376.0399, 6959.1572

Very bad vertex fit results (non-compact cluster)!

True track positions: -95.97183, -91.07920, -95.97183, -95.97183, -91.07920, -91.07920, -91.07920, -91.07920, -91.07920, -91.07920, -91.07920, -91.07920, -91.07920, -91.07920, -91.07920, -95.97183, -91.07920, -91.07920, -91.07920, -91.07920, -95.97183, -95.97183, -95.97183, -91.07920,

Two truth vertices (5mm distance) merging case!

Most of reconstructed tracks are incompatible, but apparently some tracks are reconstructed in between to make a path between clusters.

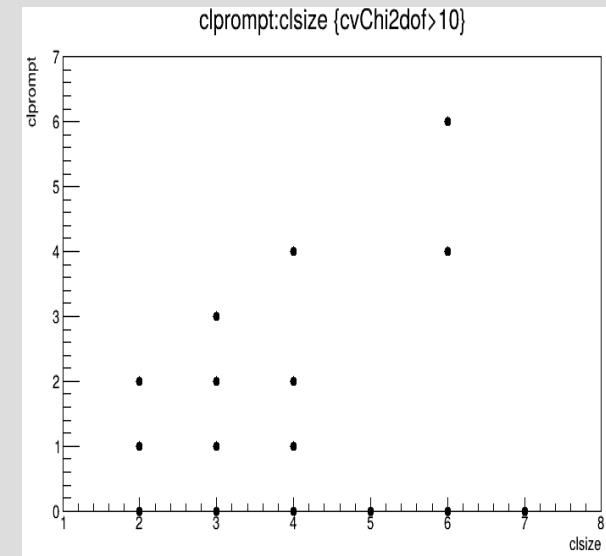
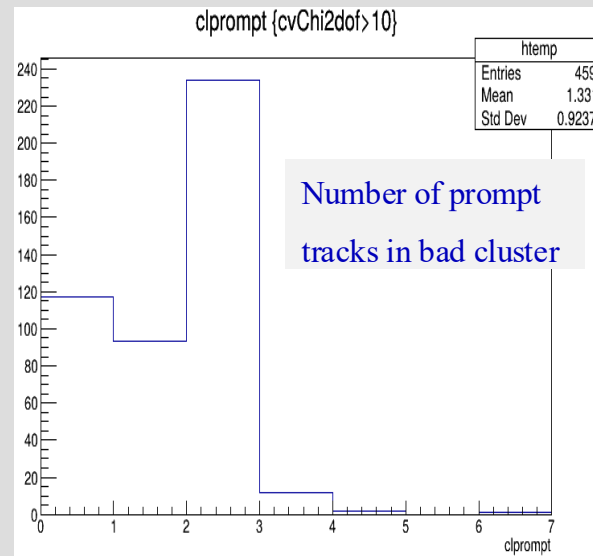
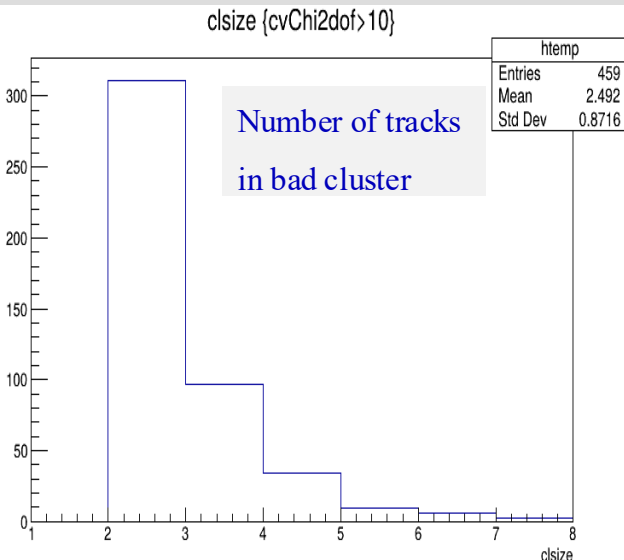


Constraints

- 1) Prompt - prompt track case: non-existing GNN edges with $|\Delta Z| < 5\text{mm}$ added with $W = -6$
 - 2) Non-prompt - prompt track case: non-existing edges added with $W = -6$
- ~5 times more lifted edges as compared to the initial (GNN) ones. No impact on CPU!

Fraction of $\chi^2/Ndf > 10$ clusters: $9.1e-3 \rightarrow 8.4e-4$

What is left... Bad clusters are small, usually mixture of prompt and secondary tracks



Secondary - secondary - secondary triplet of connected tracks:

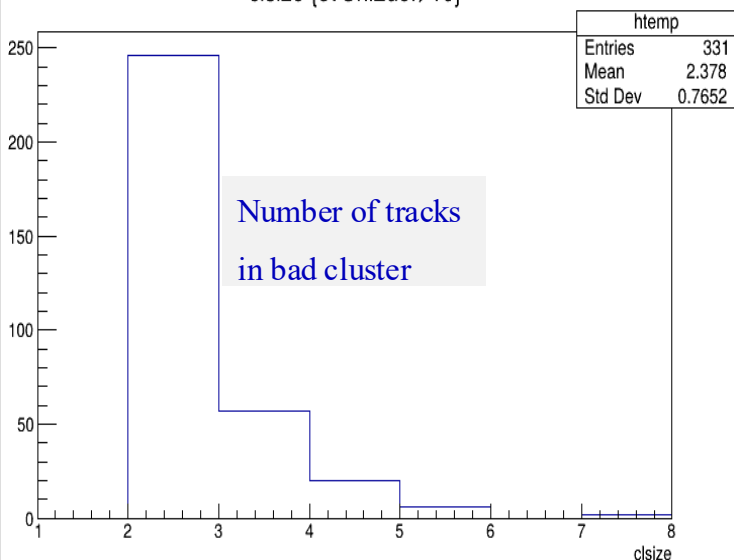
HyperEdge weight from χ^2 of the triplet vertex fit

HO Kernighan-Lin crashes without constraints. Constraints+HO Kernighan-Lin works well

Fraction of $\chi^2/Ndf > 10$ clusters: $8.4e-4 \rightarrow 5.4e-4$

Still mostly 2-track prompt+secondary bad clusters

clsizes {cvChi2dof>10}



clprompt {cvChi2dof>10}

