Feasibility Study on Higgs Pair Production in Muon Collider

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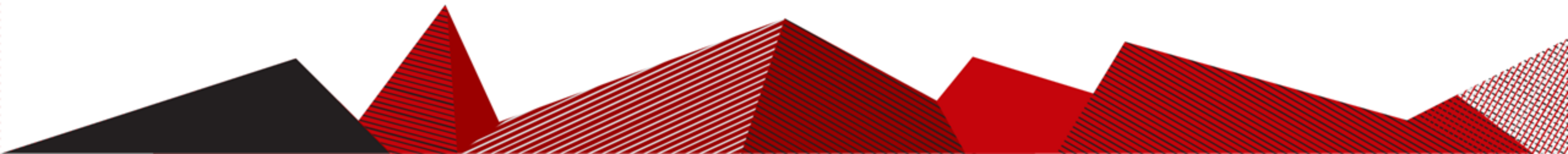
- Signal: $\mu^+ + \mu^- \rightarrow \nu_\mu + \bar{\nu}_\mu + H + H$
- Background:
  - $\mu^+ + \mu^- \rightarrow \nu_\mu + \bar{\nu}_\mu + b + \bar{b} + Z$
  - $\mu^+ + \mu^- \rightarrow \nu_\mu + \bar{\nu}_\mu + b + \bar{b} + H$
  - $\mu^+ + \mu^- \rightarrow \nu_\mu + \bar{\nu}_\mu + b + \bar{b} + b + \bar{b}$

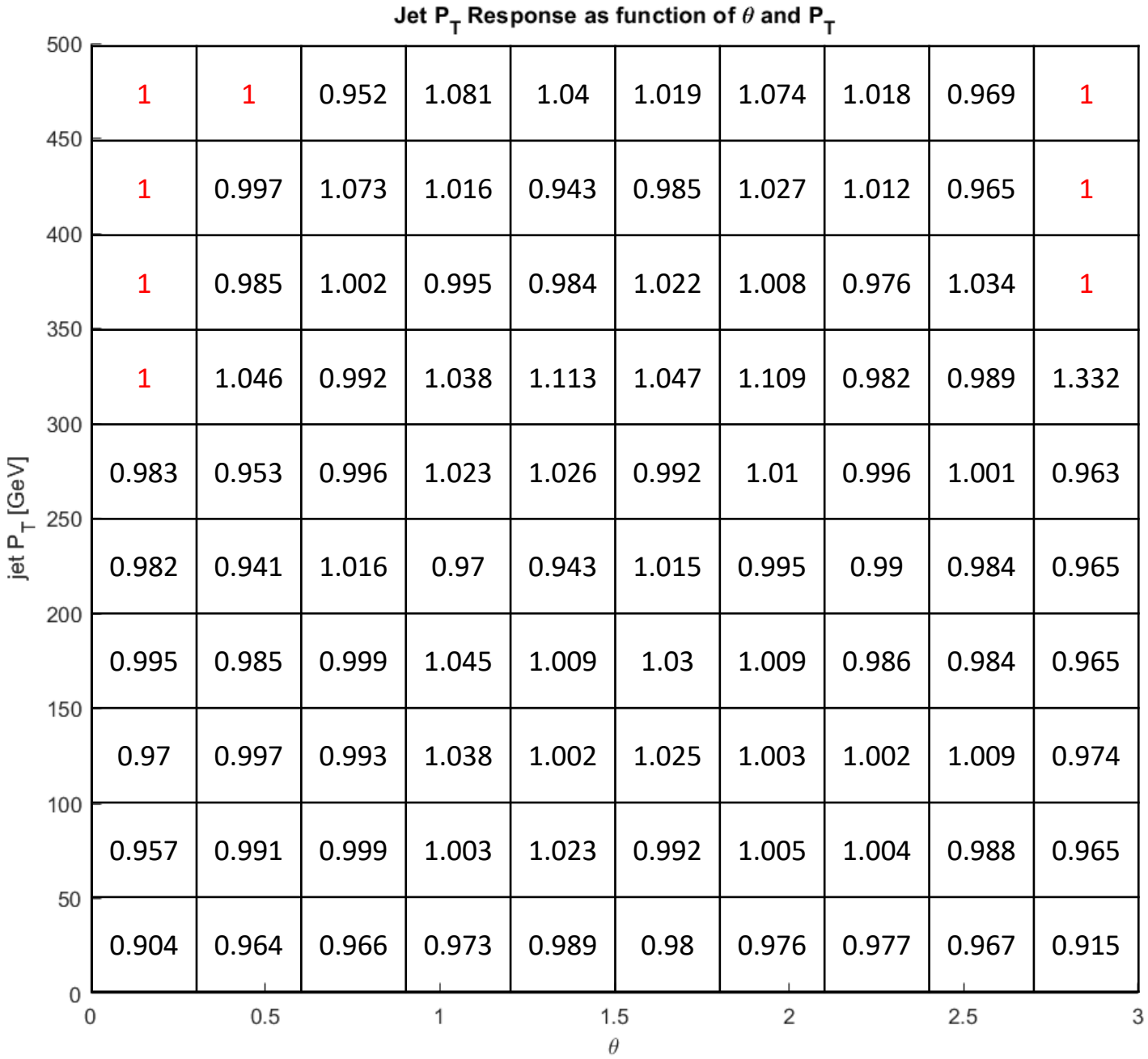
Jets Calibration



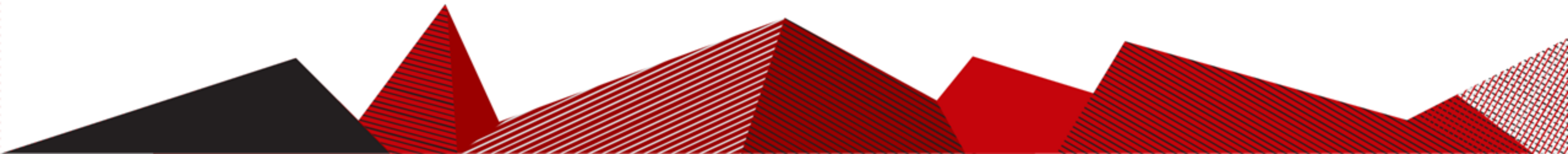
Jet P_T Response as function of θ and P_T

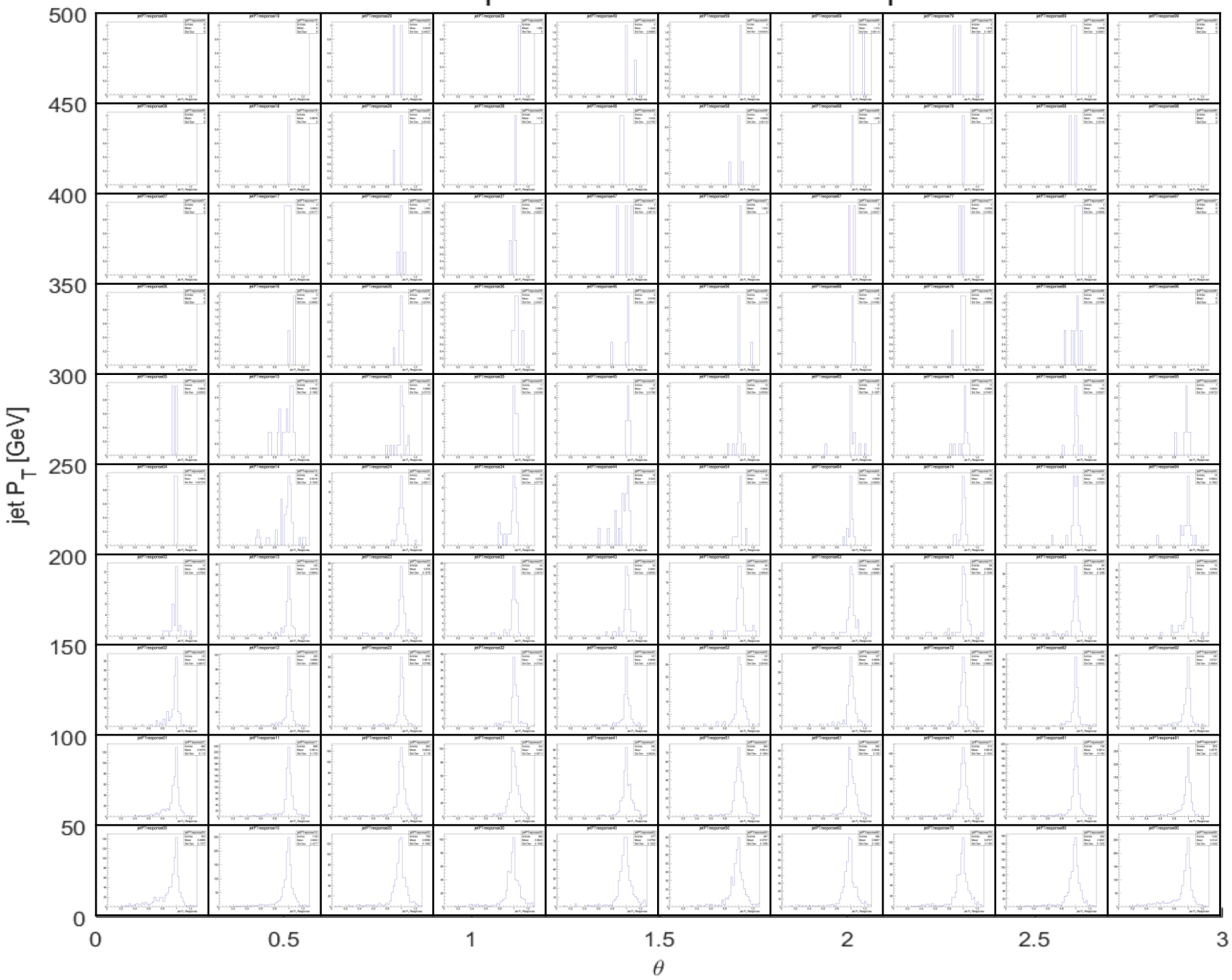
1. Try matched generator level jet with each Anti-k_t jet for events with more than or equal to 4 jets.
2. Divided the $\theta - P_T$ plane into 10-by-10 regions.
3. Calculate the average of Jet P_T response for each region:

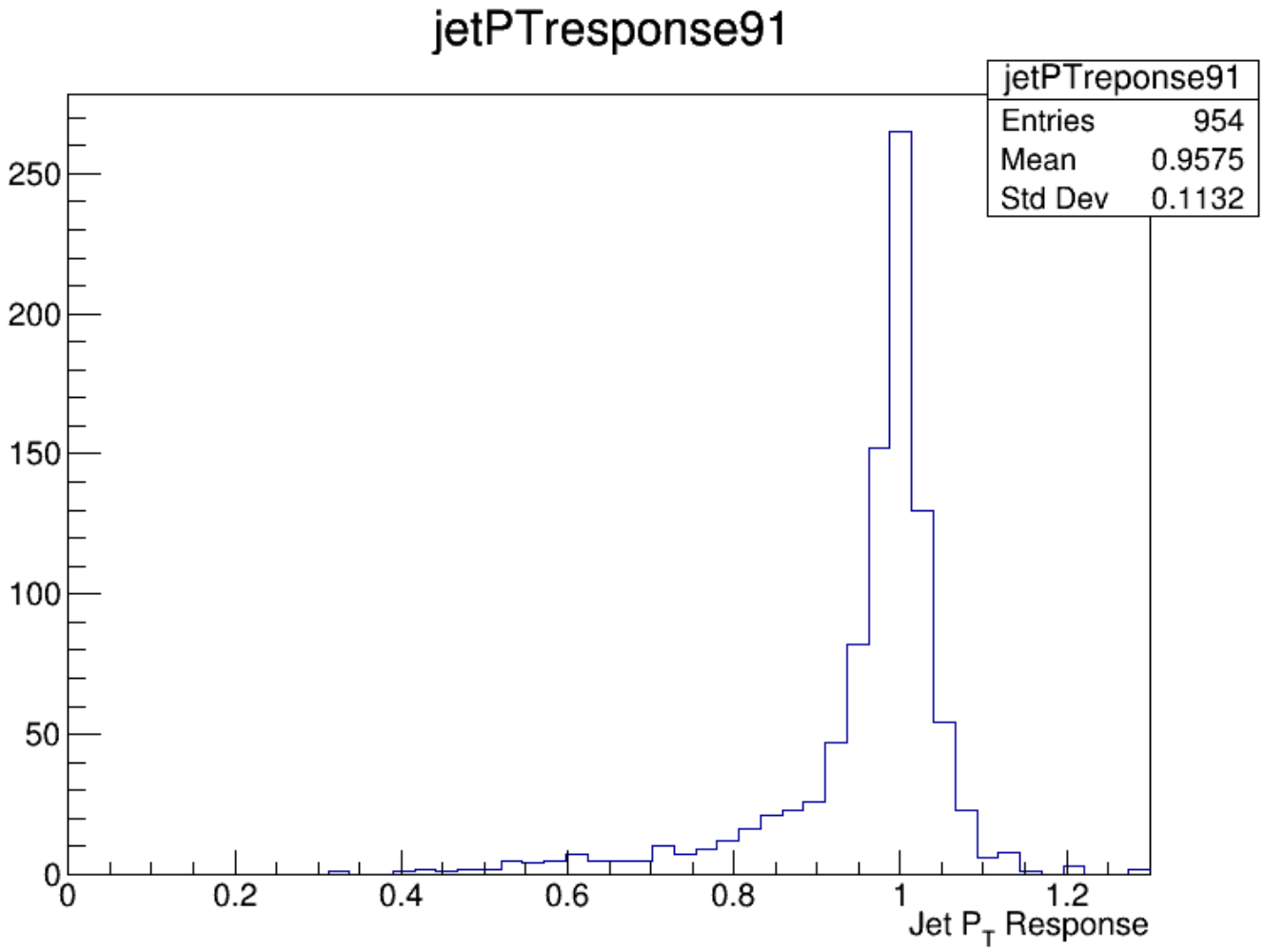
$$R_{P_T} = \frac{1}{\#\ of\ truth\ matched\ reco\ jets} \sum \frac{P_{T_{reco}}}{P_{T_{gen}}}$$


Jet P_T Response as function of θ and P_T
jet P_T [GeV]
θ
500
450
400
350
300
250
200
150
100
50
0
0
0.5
1
1.5
2
2.5
3
1 1 0.952 1.081 1.04 1.019 1.074 1.018 0.969 1
1 0.997 1.073 1.016 0.943 0.985 1.027 1.012 0.965 1
1 0.985 1.002 0.995 0.984 1.022 1.008 0.976 1.034 1
1 1.046 0.992 1.038 1.113 1.047 1.109 0.982 0.989 1.332
0.983 0.953 0.996 1.023 1.026 0.992 1.01 0.996 1.001 0.963
0.982 0.941 1.016 0.97 0.943 1.015 0.995 0.99 0.984 0.965
0.995 0.985 0.999 1.045 1.009 1.03 1.009 0.986 0.984 0.965
0.97 0.997 0.993 1.038 1.002 1.025 1.003 1.002 1.009 0.974
0.957 0.991 0.999 1.003 1.023 0.992 1.005 1.004 0.988 0.965
0.904 0.964 0.966 0.973 0.989 0.98 0.976 0.977 0.967 0.915

$\frac{P_{Treco}}{P_{Tgen}}$ distribution for each bins




Jet P_T Response as function of θ and P_T
jet P_T [GeV]
0
50
100
150
200
250
300
350
400
450
500
0
0.5
1
1.5
2
2.5
3
θ


jetPTresponse91
jetPTreponse91
Entries 954
Mean 0.9575
Std Dev 0.1132
250
200
150
100
50
0
0
0.2
0.4
0.6
0.8
1
1.2
Jet P_T Response

Next step:

1. Change the partition of the bins to look into low P_T region (0-200 GeV), as most of the jets are there.
2. Currently the Jet P_T response is calculated with the 10k events of $\nu_\mu \bar{\nu}_\mu HH$ channel (~3k truth matched jets included). Might be useful to use an easier-to-generate channel like $\nu_\mu \bar{\nu}_\mu b b \bar{b} \bar{b}$ with more events?