



Feasibility Study of Measuring the Higgs Self-coupling Using the Muon Collider

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May 31st, 2022



R02 anti- k_t jet for tau reconstruction

```
1665 module FastJetFinder FastJetFinderAKtR02 {
1666     # set InputArray Calorimeter/towers
1667     set InputArray EFlowMerger/eflow
1668
1669     set OutputArray AKtR02jets
1670
1671     # algorithm: 1 CDFJetClu, 2 MidPoint, 3 SIScone, 4 kt, 5 Cambridge/Aachen, 6 antikt,
1672     set JetAlgorithm 6
1673     set ParameterR 0.2
1674
1675     set JetPTMin 15.0
1676 }
```

```
19 module TauTagging AKT_TauTagging_R02_inclusive {
20     set ParticleInputArray Delphes/allParticles
21     set PartonInputArray Delphes/partons
22     set JetInputArray FastJetFinderAKtR02/AKtR02jets
23     set DeltaR 0.5.
24     set TauPTMin 1.0
25     set TauEtaMax 2.5
26     add EfficiencyFormula {0} {0}
27     add EfficiencyFormula {11} {0.001}
28     add EfficiencyFormula {15} {
29         (pt < 10) * (0.0) +
30         (pt >=10) * (0.80)
31     }
32 }
33
```



Reconstruction of hadronically decaying di- τ

- For highly boosted Higgs to $\tau^+\tau^-$ pairs, we reconstruct two anti- k_t jet with cone size $R = 0.2$, and requiring the following criteria:
 - charge product Q of the two leading di- τ jets = -1;
 - $\Sigma\text{TauTag} = 2$ for the tau-tagged jets pair;
 - $\Delta R < 1.5$ between two tau
- Then for reconstructing the $b\bar{b}$ jets pair, we require:
 - $\Sigma\text{BTag} = 2$ for the $b\bar{b}$ jets pair;
 - Each b-tagged jets has $\Delta R > 0.5$ with each tau-tagged jet
- Very few events passed the selection (expected $100\text{k} * \text{BR}(\text{HH} \rightarrow \text{bb}\tau\tau) * (\text{BTag-eff}^2) * (\text{TauTag-eff}^2) = 3784$).
- For debugging, I have forced the di-Higgs to decay to $\text{bb}\tau\tau$, the number of events passing selection remain very limited. My current guess is that:
 - Many b jet could be tau-tagged (e or tau). The tau selection might have selected the b. which cause the algorithm couldn't find the b in the second step.



Next step:

- Rewrite the algorithm
- Jets response scale for R02 jets