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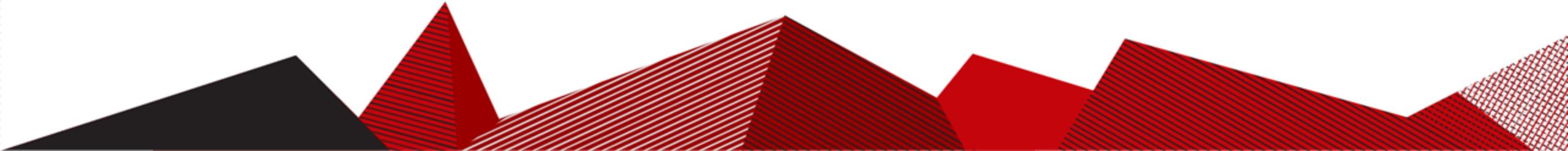
Kenny Jia

Jun 6th, 2022
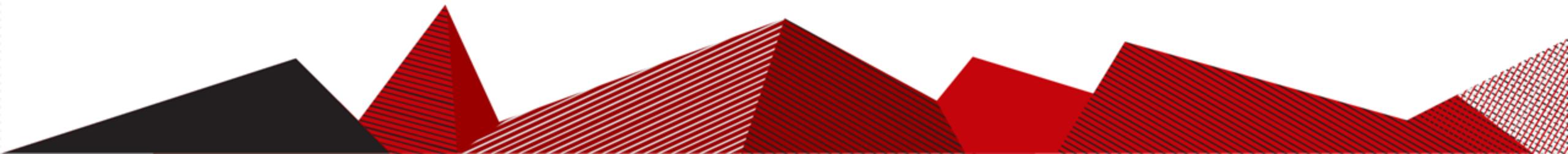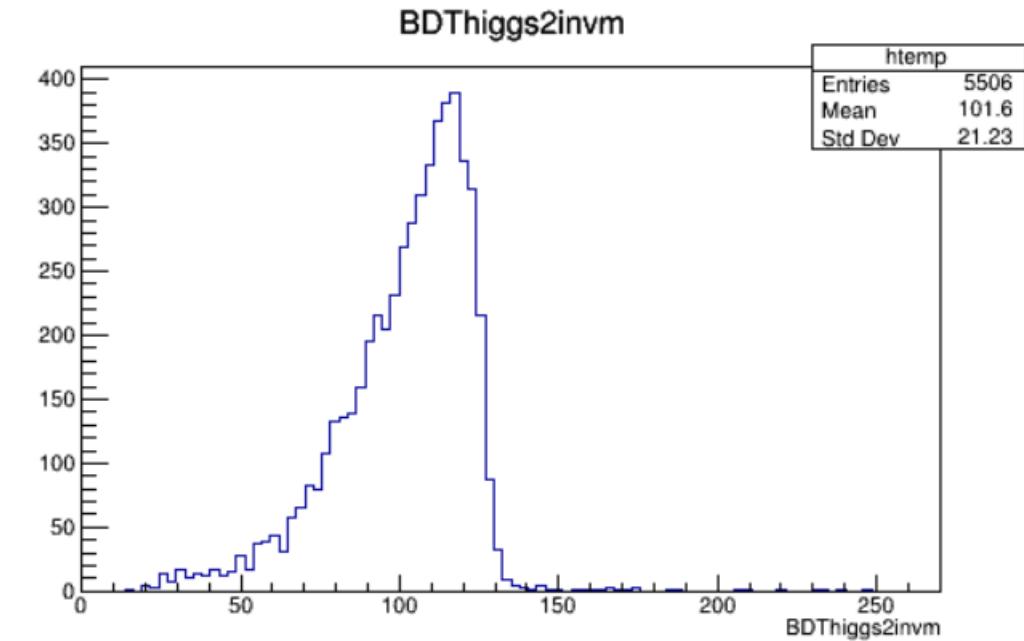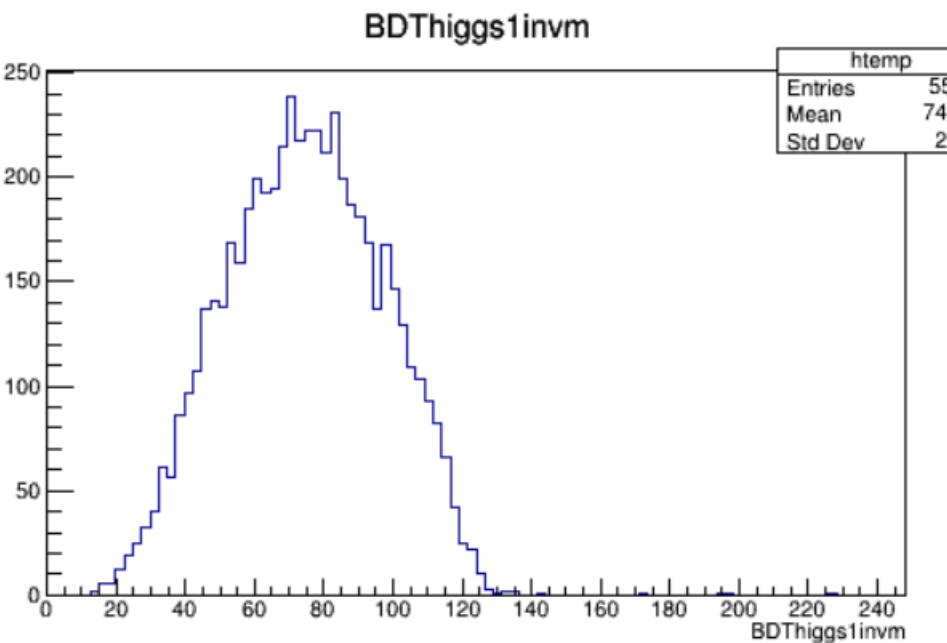
# Reconstruction of hadronically decaying di-$\tau$

- 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-$\tau$ jets = -1;
    - ΣTauTag = 2 for the tau-tagged jets pair;
    - In order to avoid selecting b jet fake tau, require Σ Btag = 0;

- Then for reconstructing the $b\bar{b}$ jets pair, we require:
    - ΣBTag =2 for the $b\bar{b}$ jets pair;
    - Require ΣTauTag =0, (Each b-tagged jets has $\Delta R > 0.5$ with each tau-tagged jet);

- 73369 events has at least 2 AKTR05 jets and 2 AKTR02 jets for reconstruction.

- 18087 events have two jets which could reconstruction of Higgs to tau tau, 18087/73369 = 24.7%.
    - We expected 41%*(TauTag-eff^2) = 26.2%.

- 5506 events pass all the reconstruction criteria, which is 5506/73369 = 7.5%.
    - We expected 41%*(BTag-eff^2)*(TauTag-eff^2) = 21.3%.
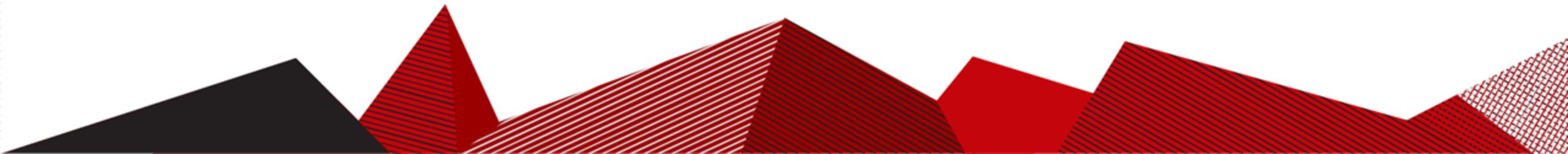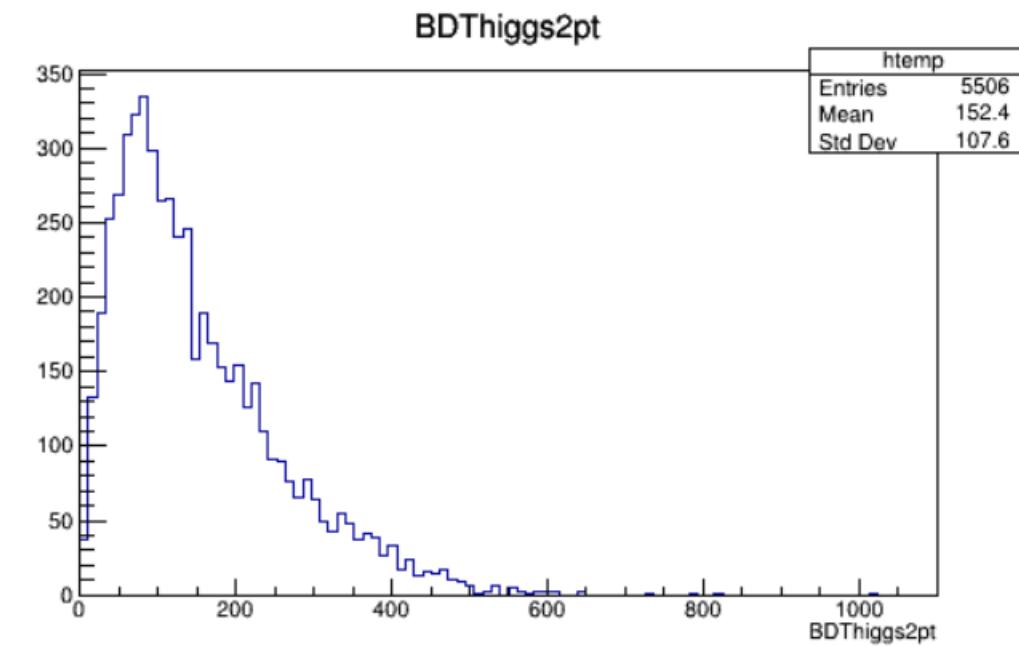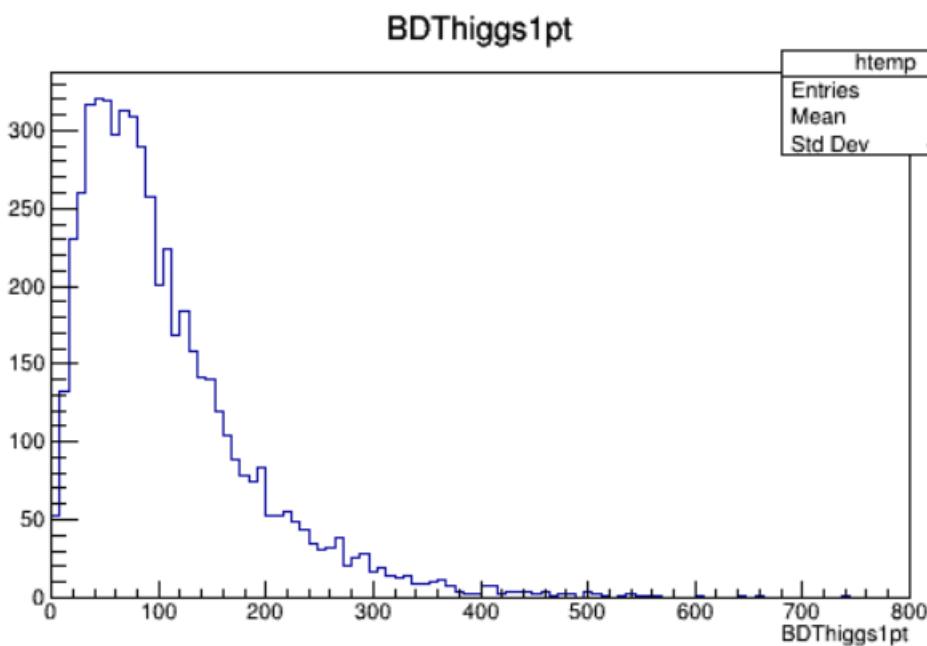
# Result
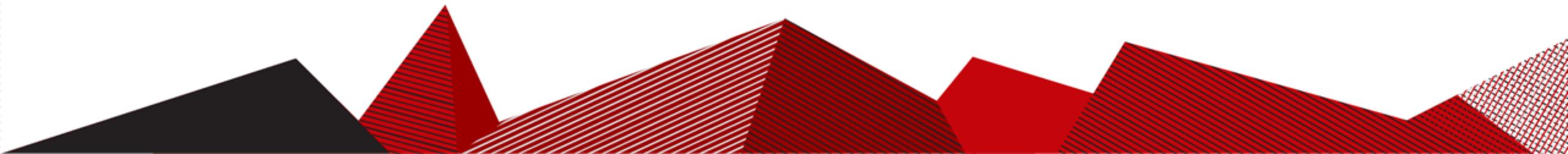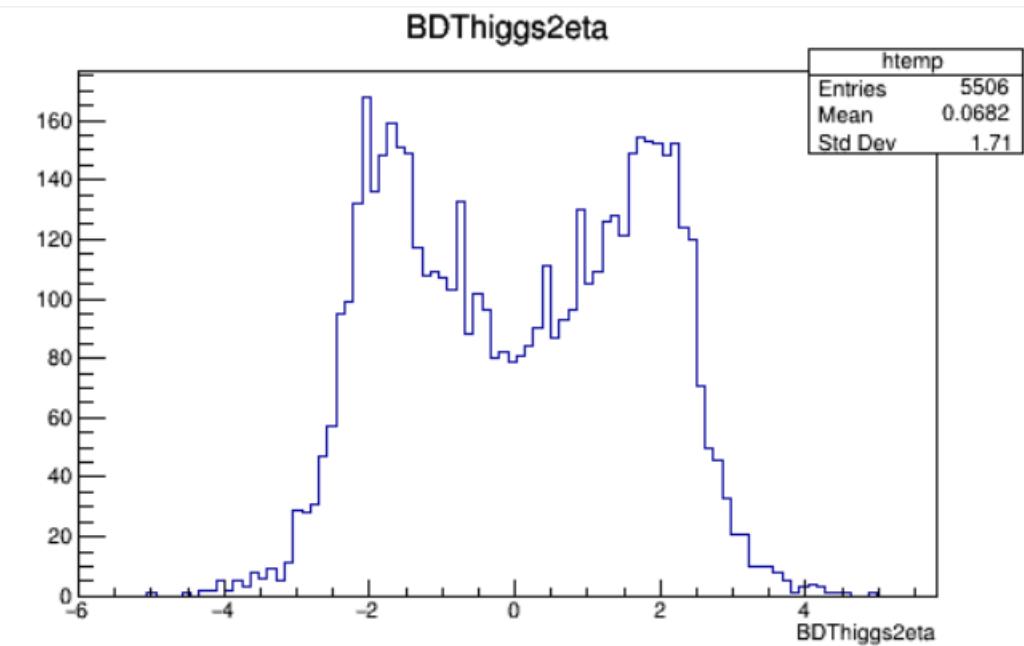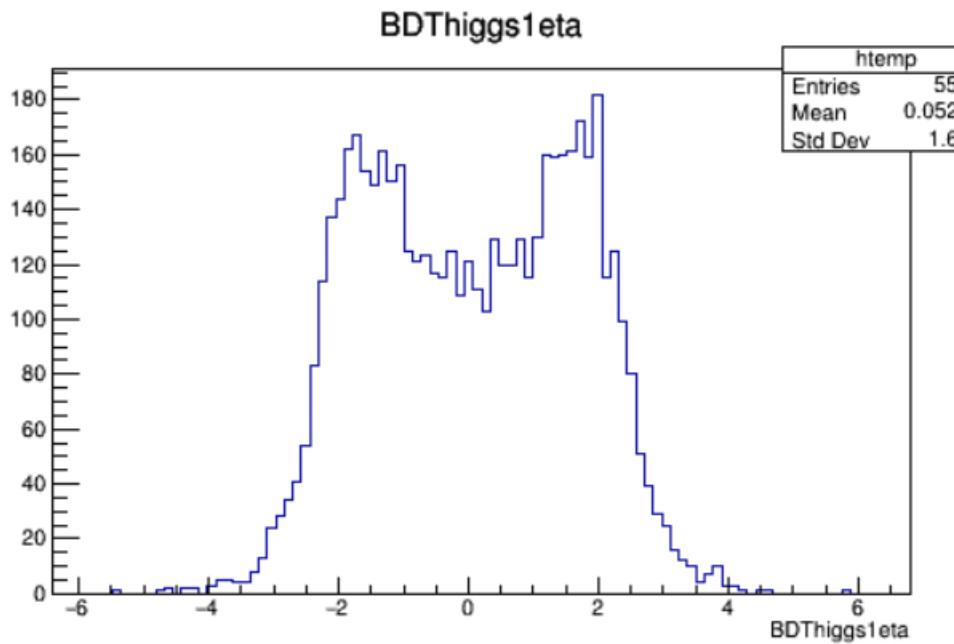
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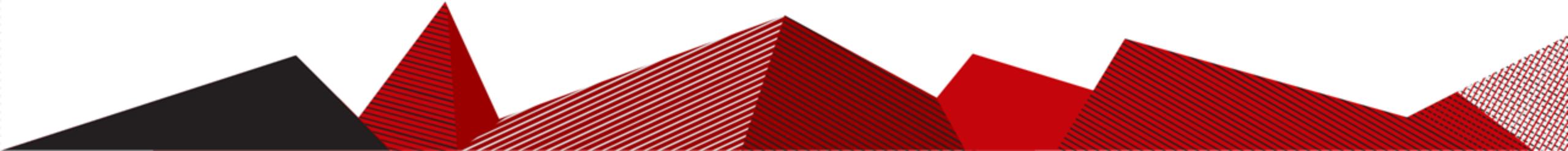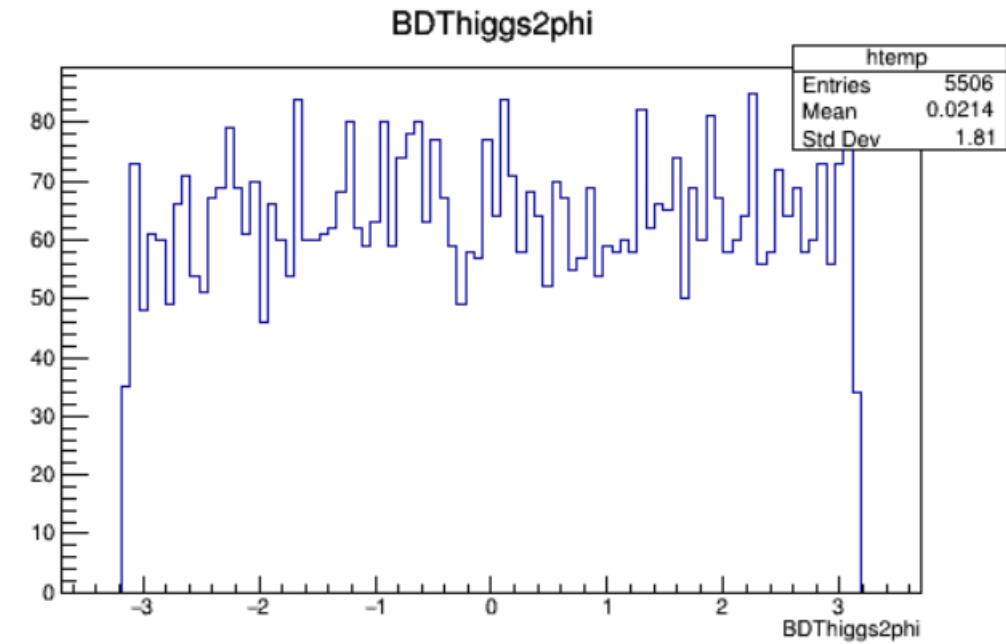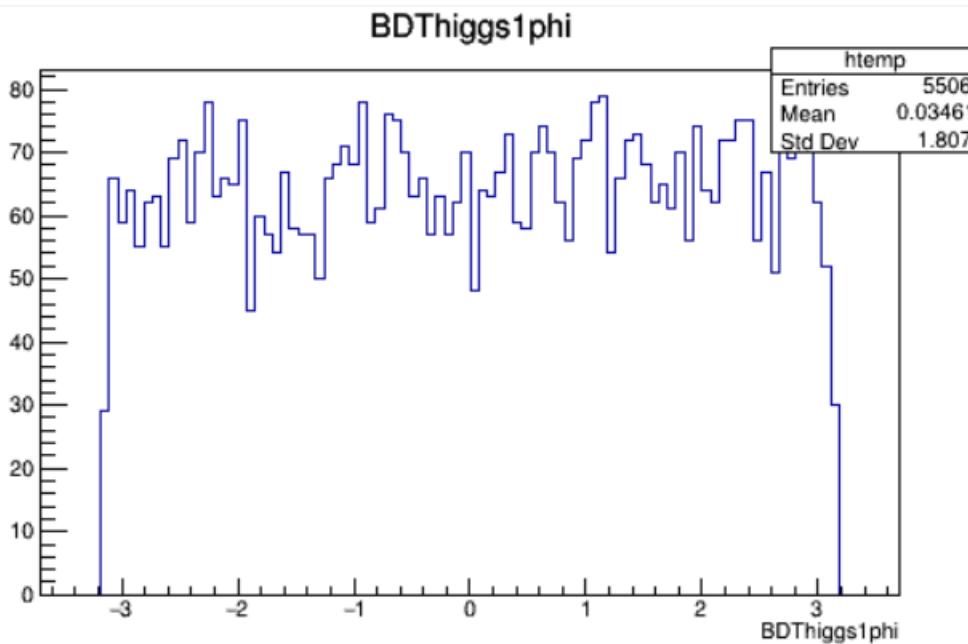
# Result

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# Where to access my code and result

- Pairing algorithm for both hadronic decay: https://github.com/cvuosalo/MuonCollider/blob/main/Delphes/src/Pairing_tau_had.C

- Script for event generation:
  - https://github.com/cvuosalo/MuonCollider/blob/main/runMGjobs/runMG_job/delphes_card_MuonColliderDet_HHstudy.tcl
  - Other sub-script are in: https://github.com/cvuosalo/MuonCollider/tree/main/runMGjobs/runMG_job/MuonCollider

- Result are accessible at:
  - root -l /afs/hep.wisc.edu/home/hjia38/Delphes/delphes_dhiggs_sig+bkg_pairmass_tau_had_10TeV.root