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# HADRONIC TOP QUARK TAGGING WITH VARIABLE-SIZED JETS

BOOST 2024 - 16th International Workshop - Genova, Italy

Variable-Sized Jets

HOTVR.........................$

- Top decay products contain within a cone of size R
- HOTVR cone size: $R = 600 / p_T$
- Enhancing hadronic top identification in lower p_T range ($200 < p_T < 400$ GeV) than fixed-cone jets (anti-k_T, R=0.8)
- Useful in multiple hadronic tops scenarios like 4 top and resonance searches (ttZ' -> 4t)
  - Top p_T lower than the completely boosted regime
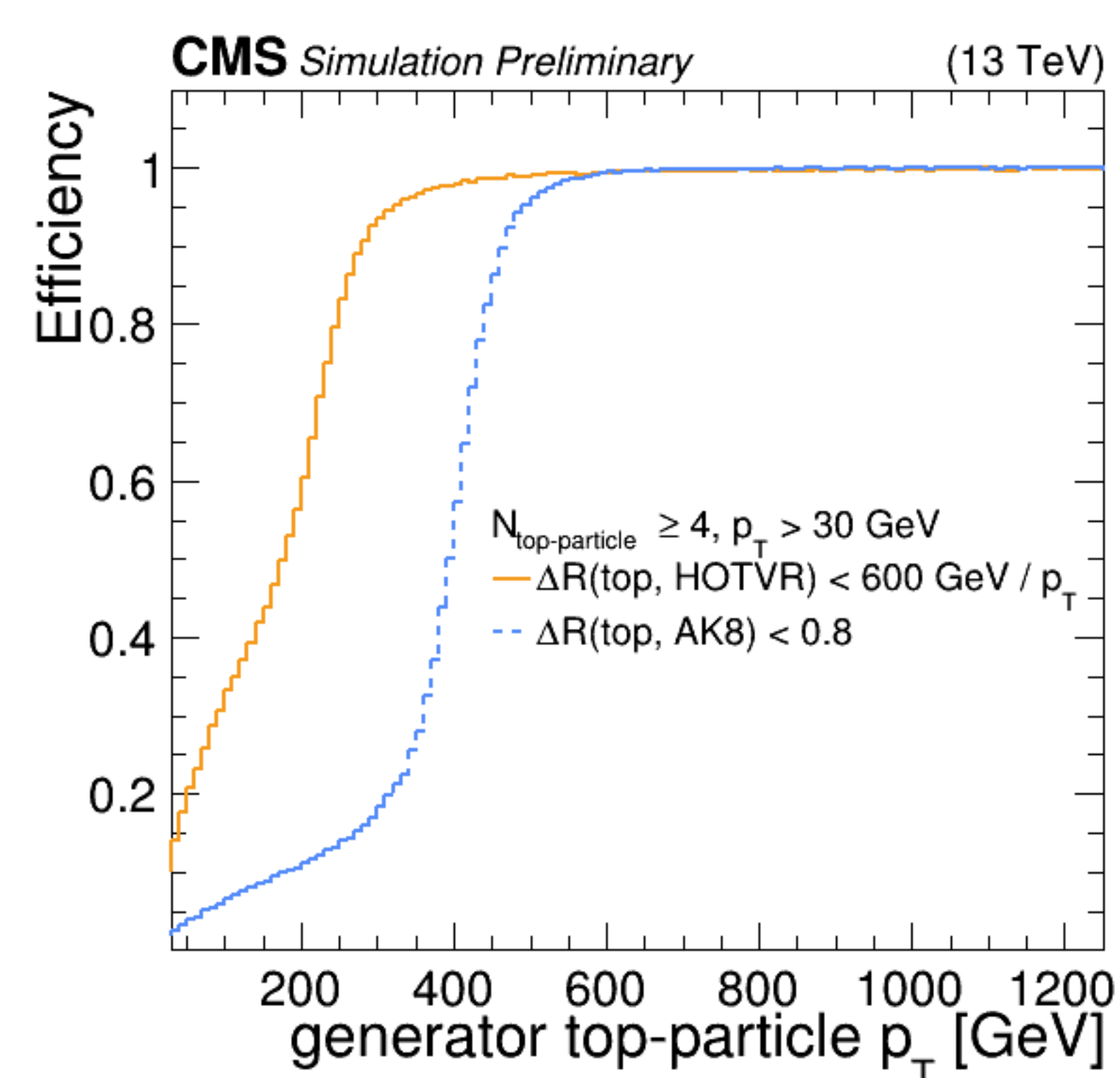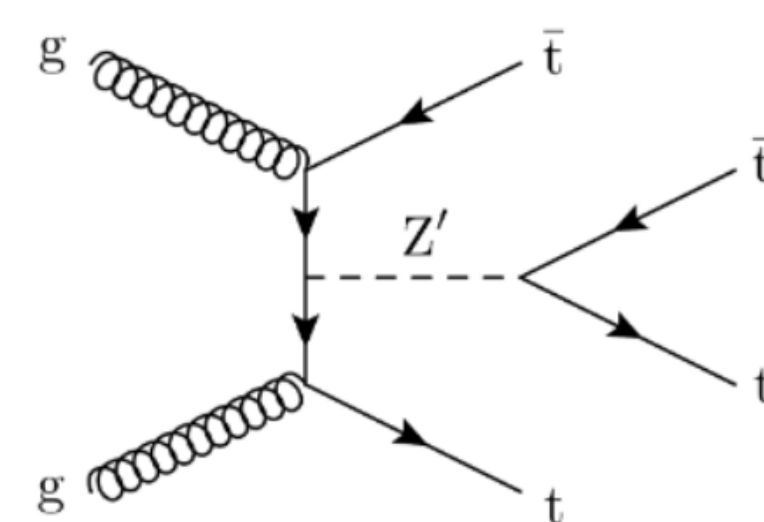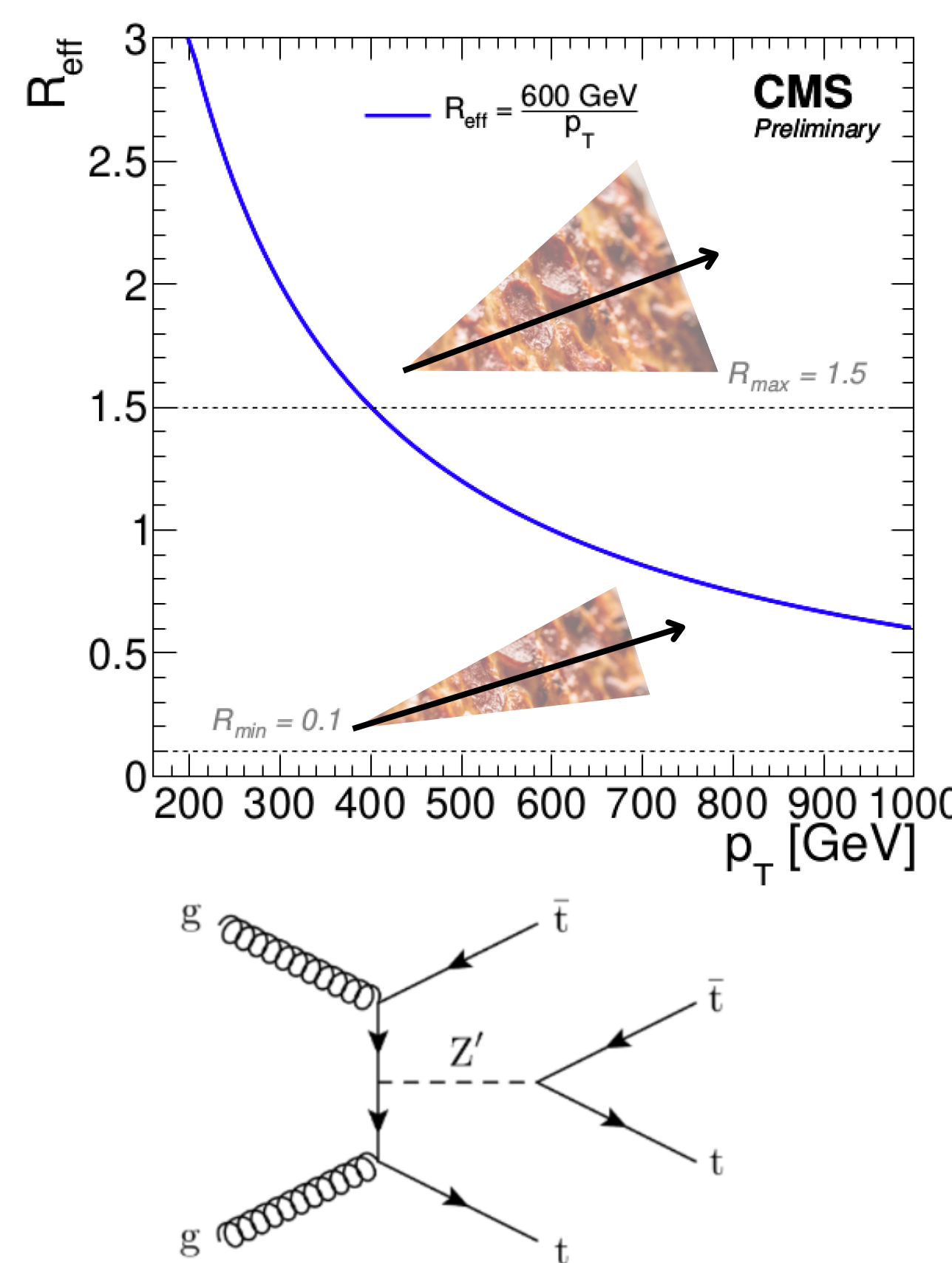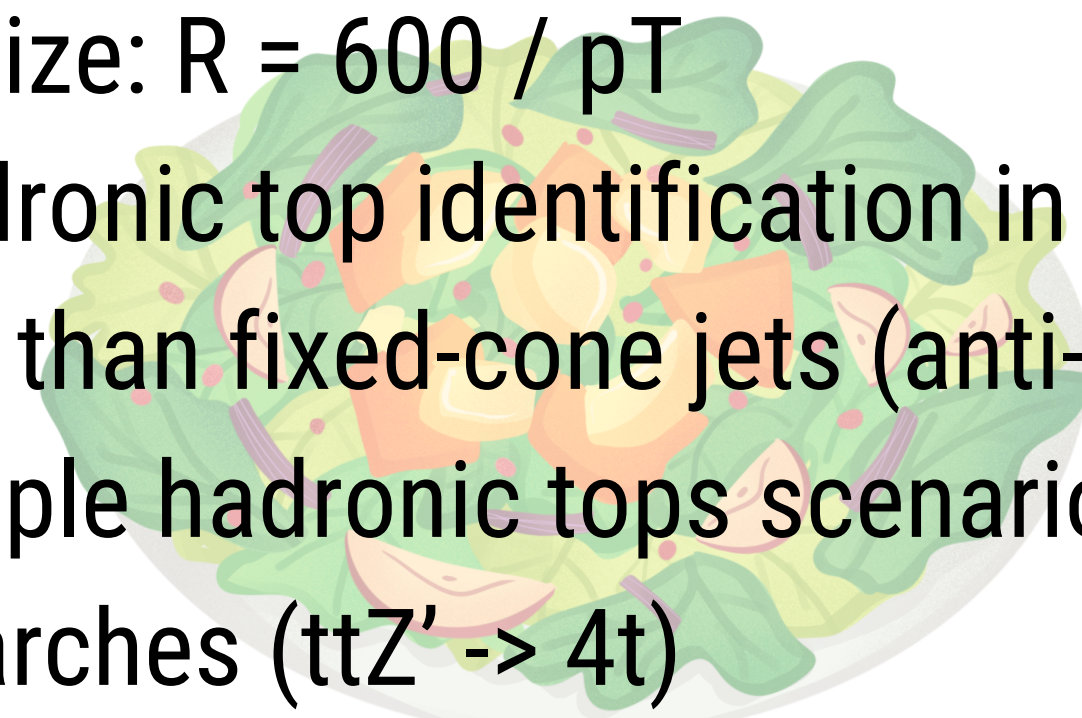
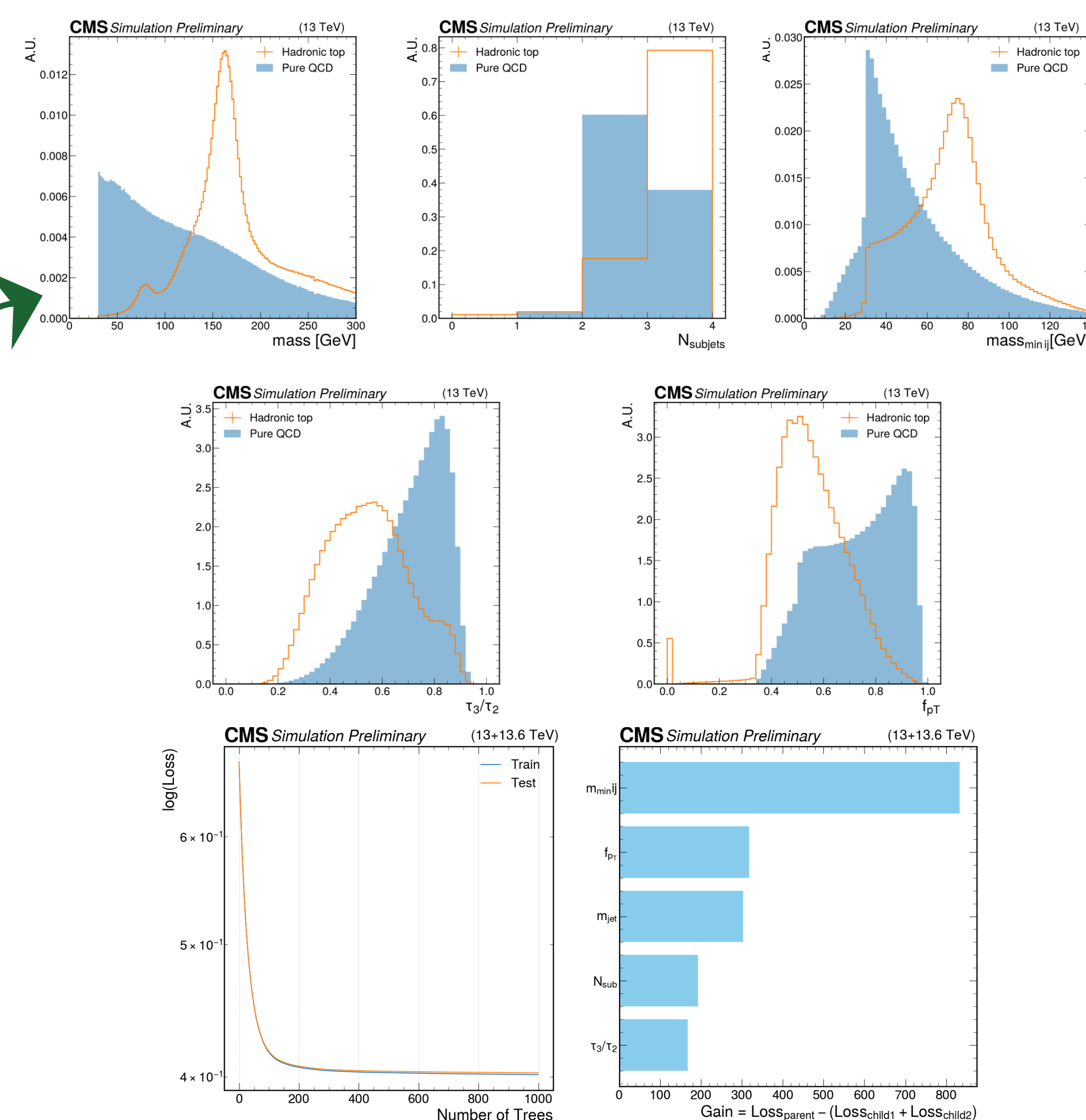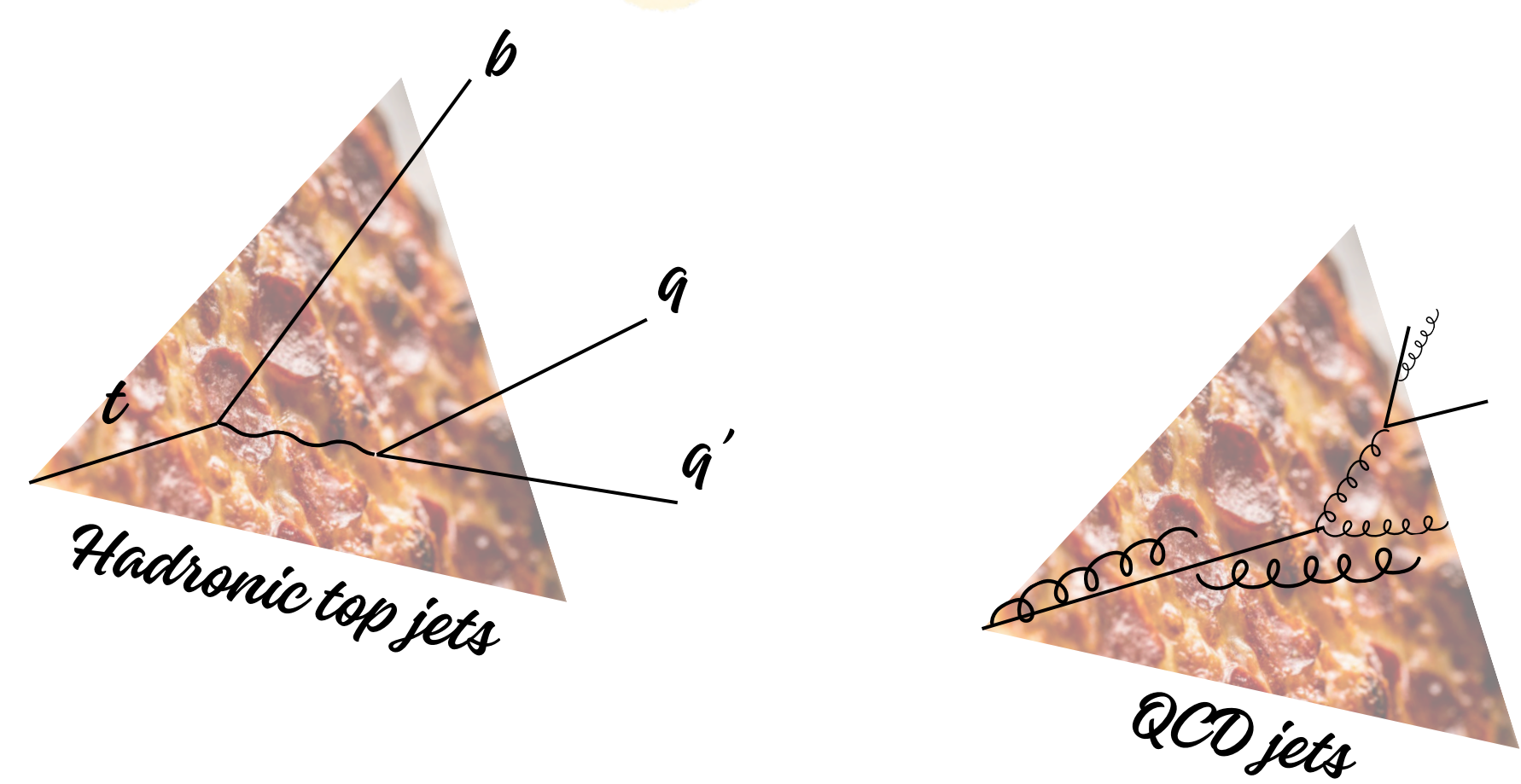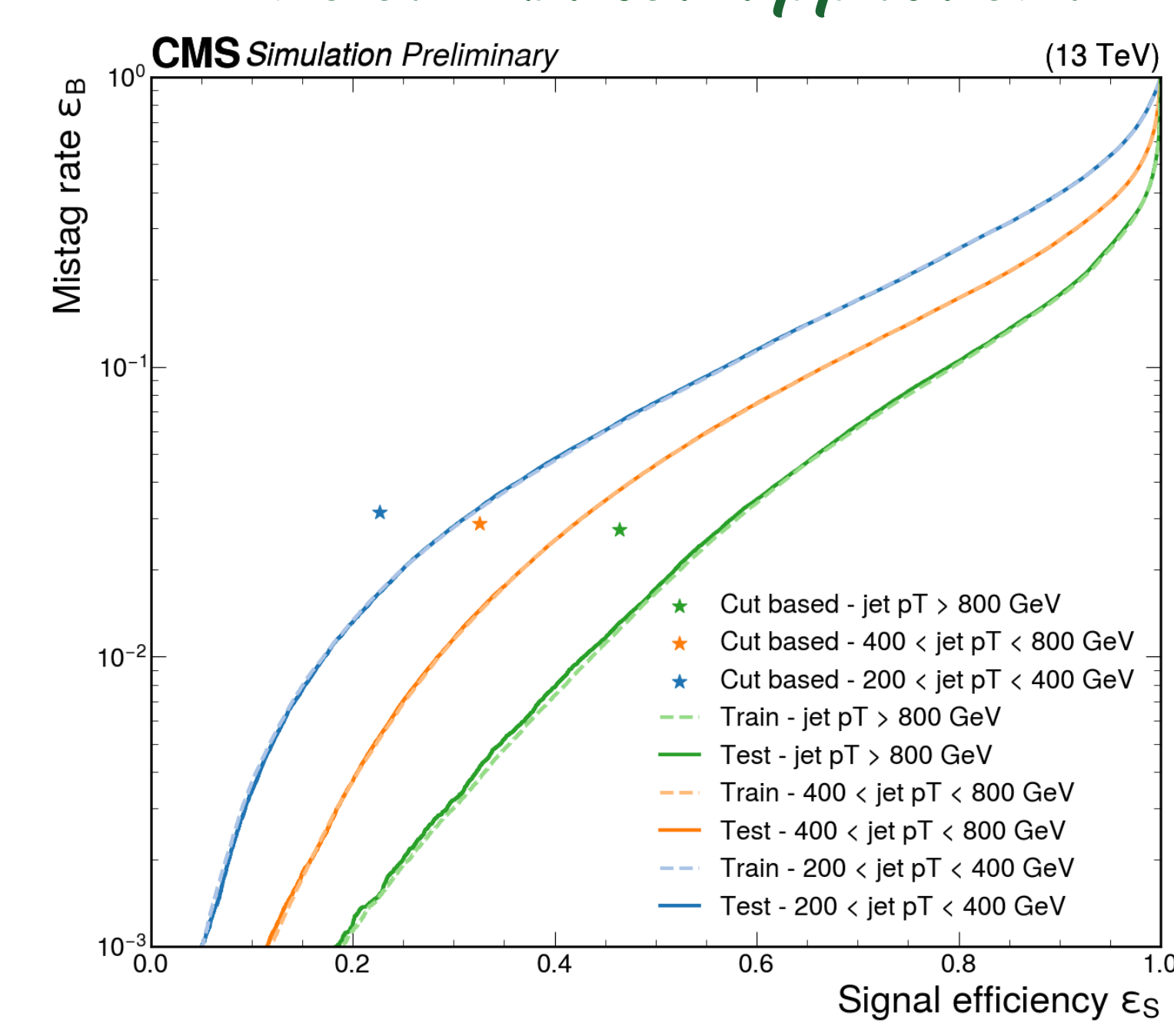*Efficiency of reconstructing generator tops in 4-hadronic top events*

Hadronic Top Tagger
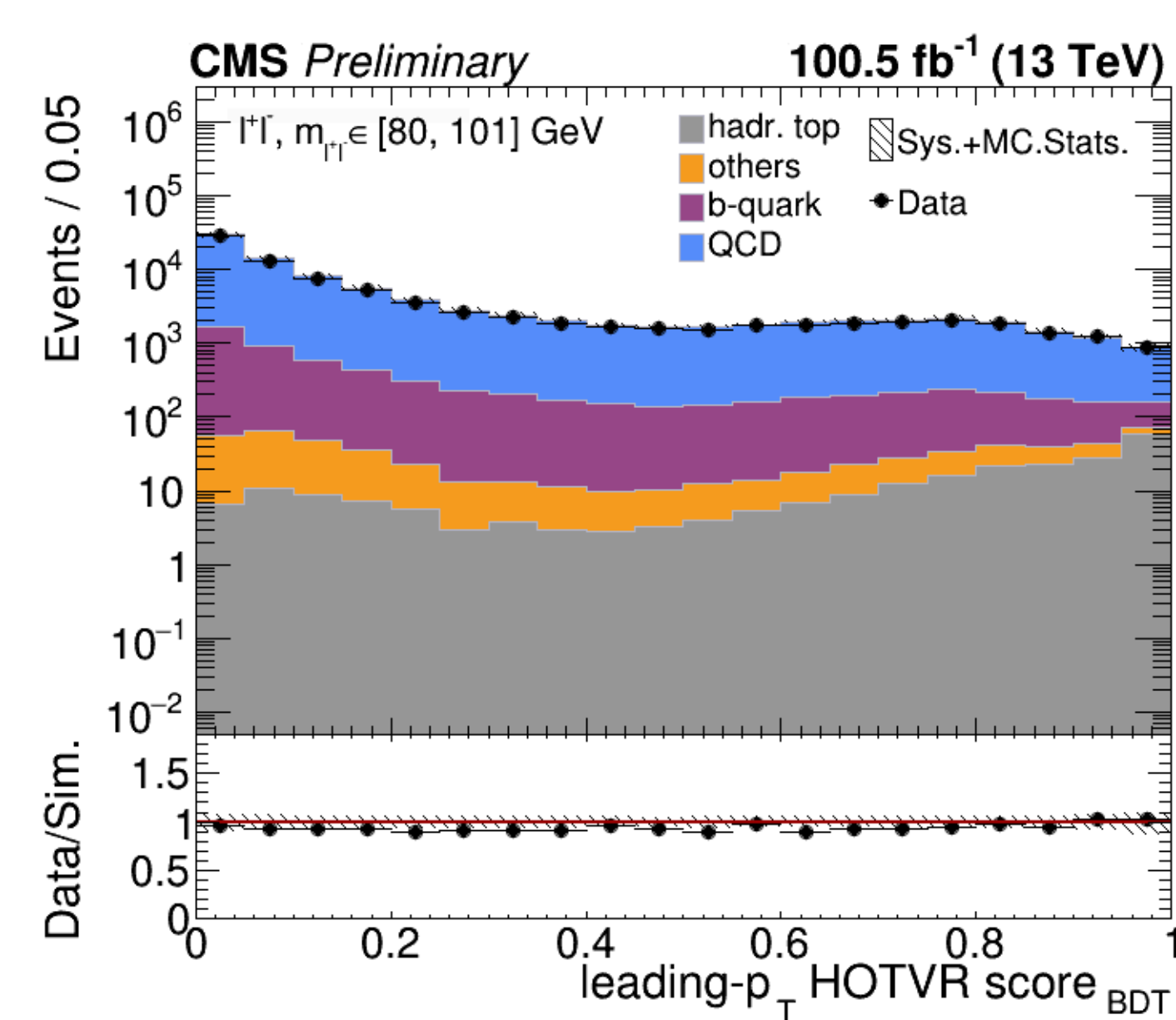
BDT DEVELOPMENT..........$$

- New HOTVR top tagger with Boosted Decision Trees
- Distinguishing hadronic top from QCD jets
- 5 input variables used for the training
  - well modelled in data
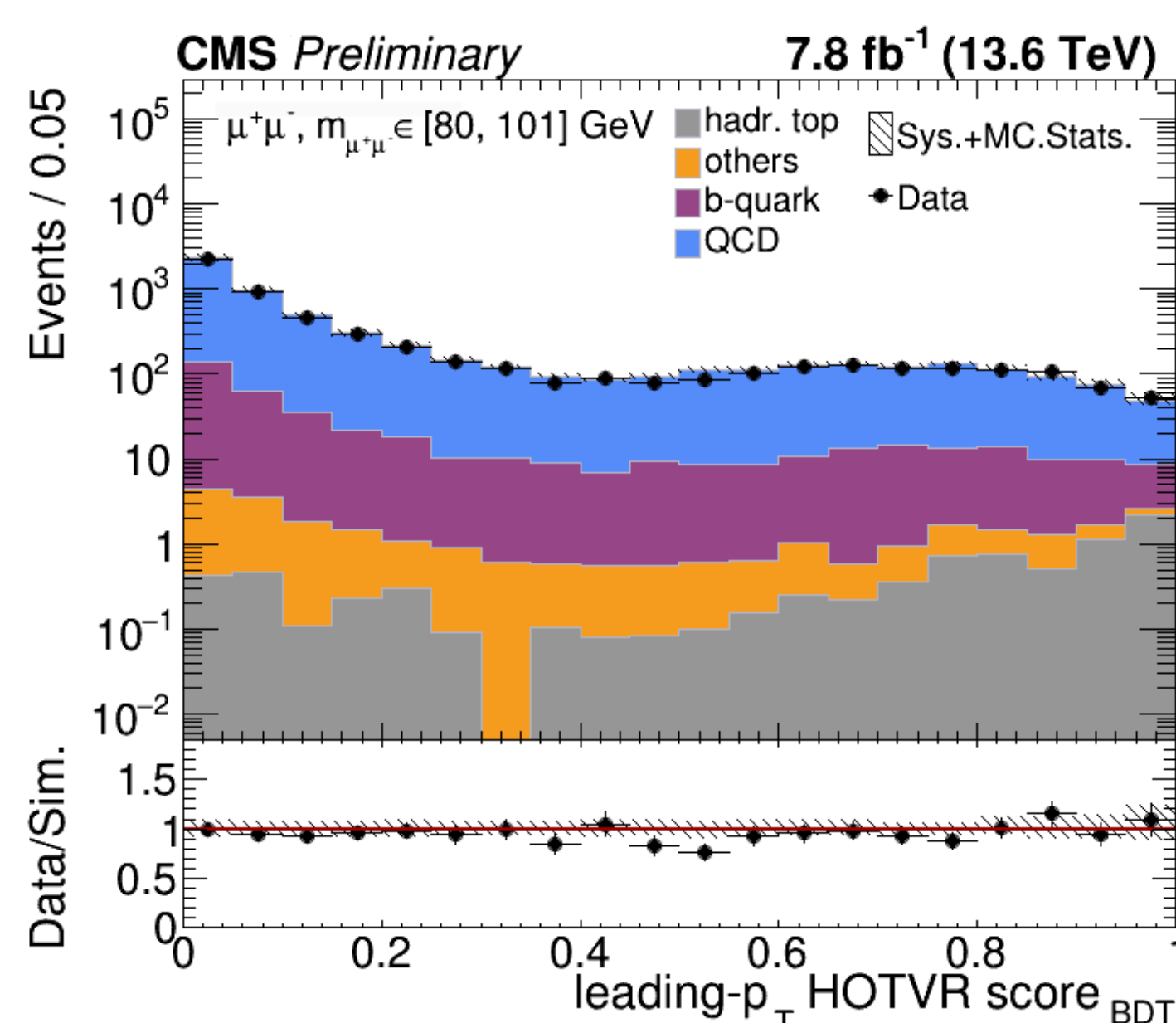 - already used in cut-based top tagging approach

10% higher signal efficiency than the cut-based approach!

Tagger Validation

2017-2018 - 13 TeV

2022 - 13.6 TeV

EVALUATION ON QCD JETS........$$$

- Validation of the BDT model in Z+jets enriched selection:
  - Two opposite sign leptons ($80 < m_{ll} < 101$ GeV) + ≥1 HOTVR
- HOTVR jets mainly originate from QCD
- Good agreement with data across the range of BDT scores
- Most important systematics accounted for:
  - Jet energy correction, ISR/FSR, pileup

HOTVR + BDT:
EFFICIENT HADRONIC TAGGER USEFUL IN MULTI-TOP FINAL STATES AND ALREADY VALIDATED WITH 13 AND 13.6 DATA AND USED IN UPCOMING CMS 4-TOP SEARCH!!!
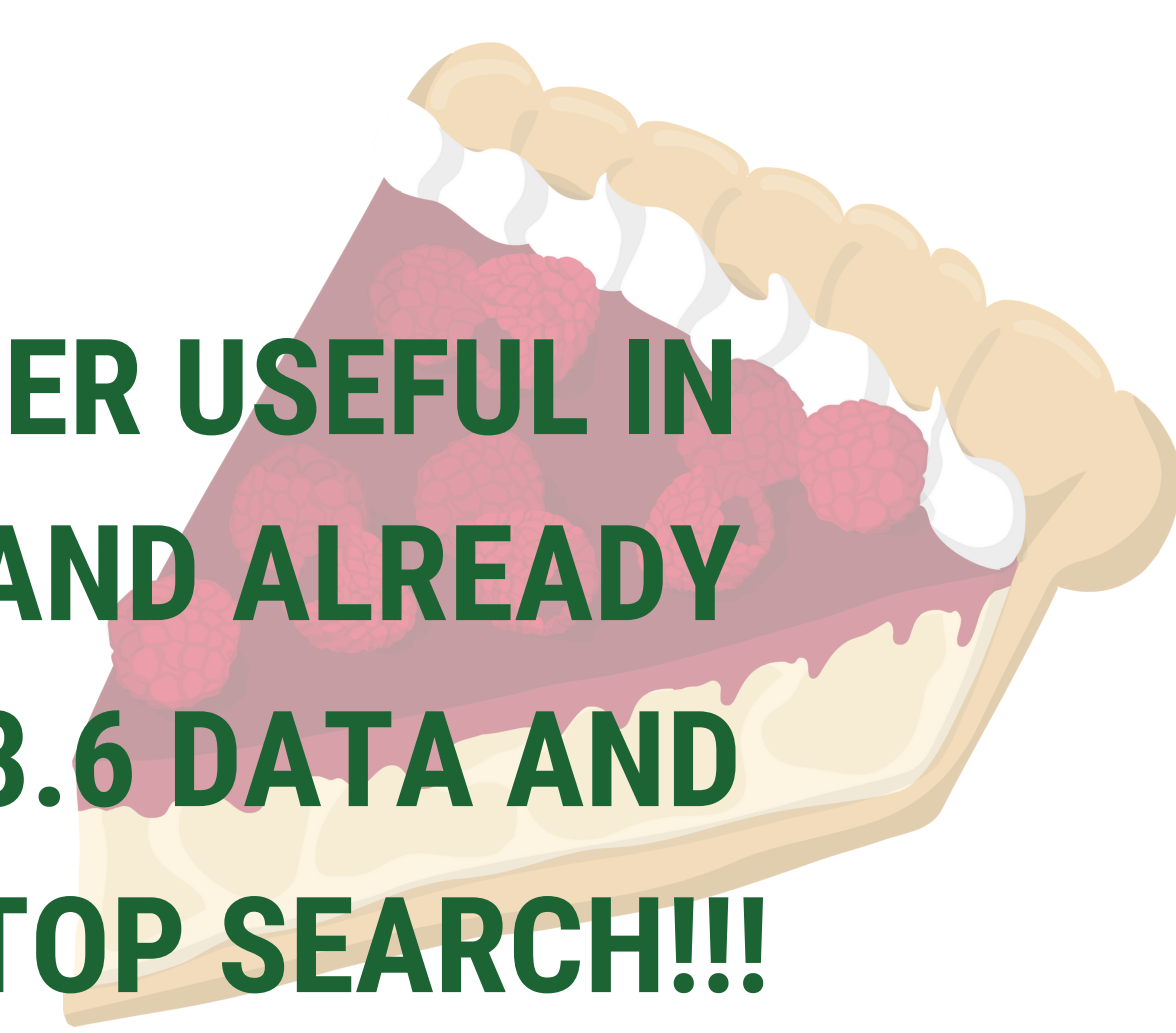
[1] T. Lapsien, R. Kogler, and J. Haller: "A new tagger for hadronically decaying heavy particles at the LHC", Eur. Phys. J. C 76 (2016), no. 11, 600; [2] CMS Collaboration: "Hadronic top quark tagging with variable-sized jets for the CMS experiment", CERN-CMS-DP-2024-038