Finding Higgs
Efficiency vs rejectivity of b-taggers at LHCb

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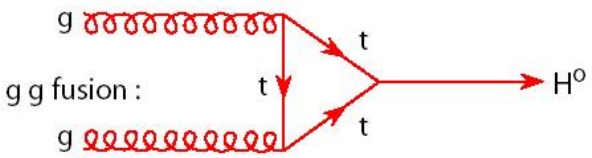
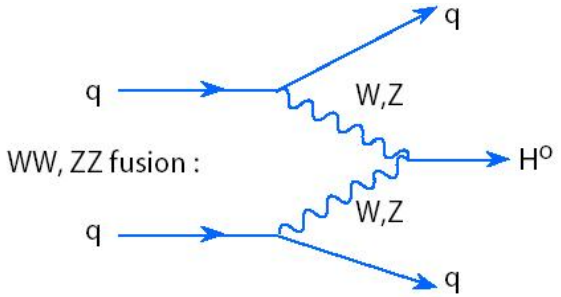
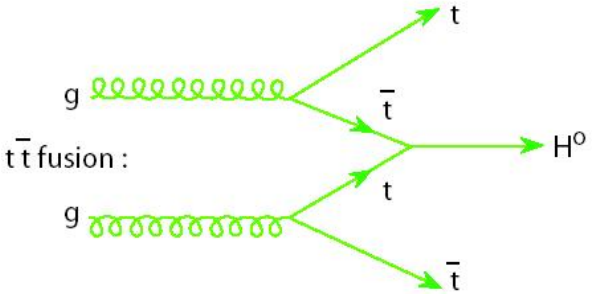
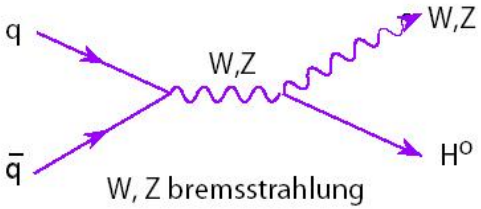
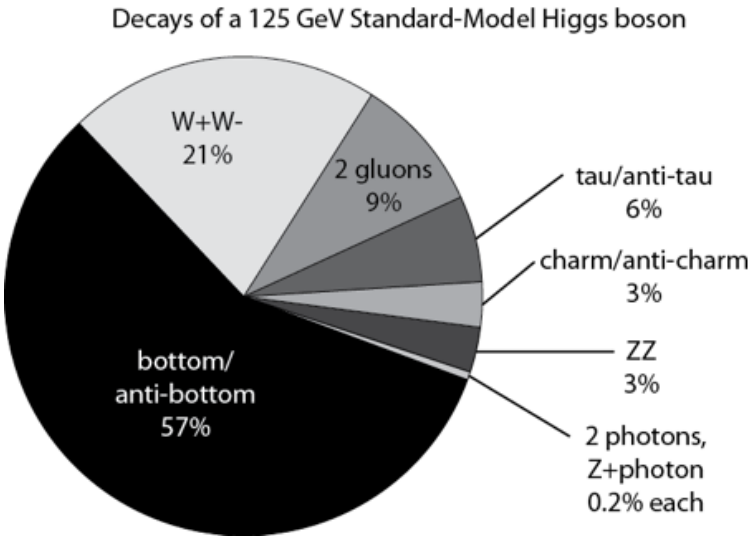
Higgs boson-production and decay

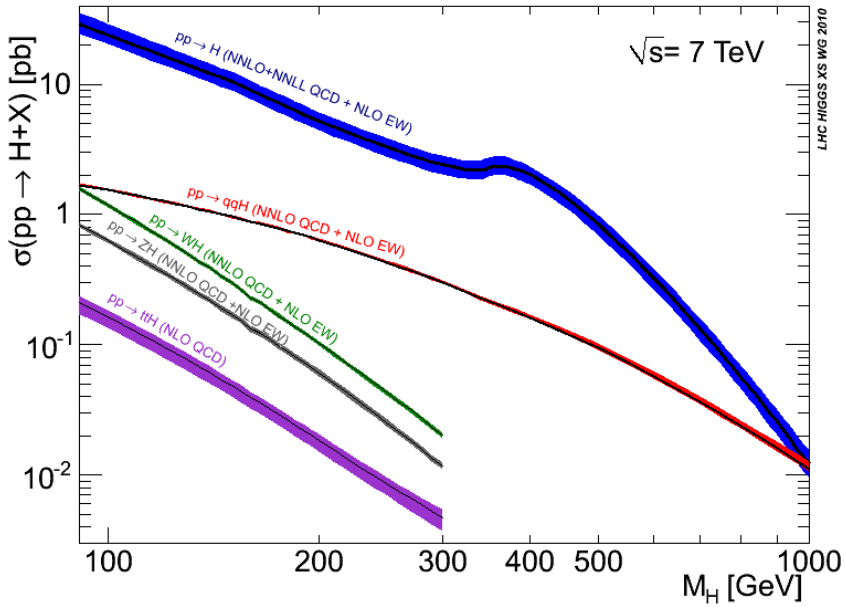






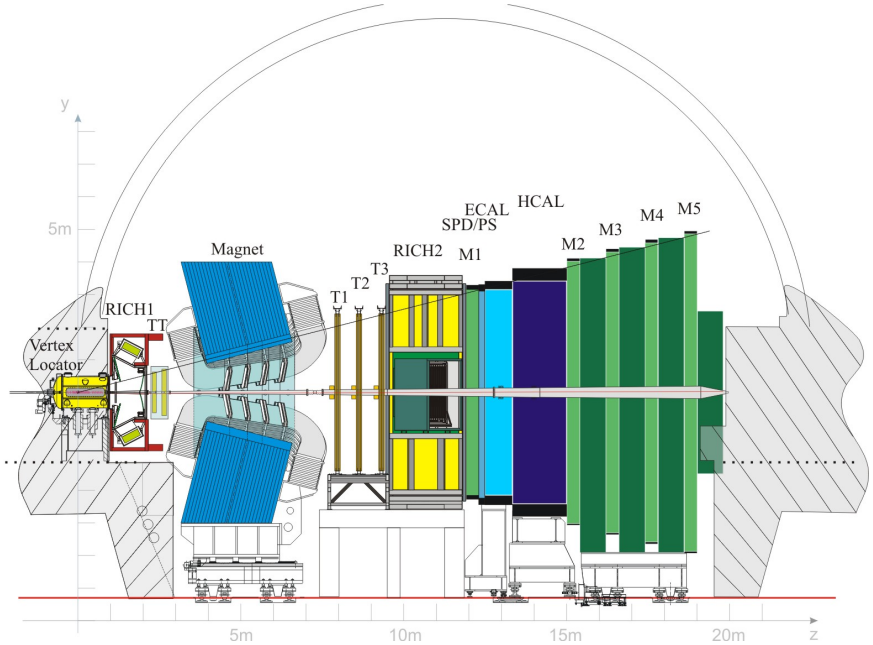


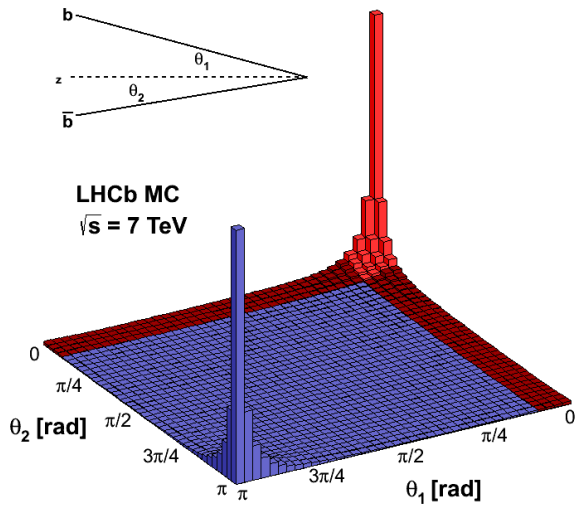




LHCb

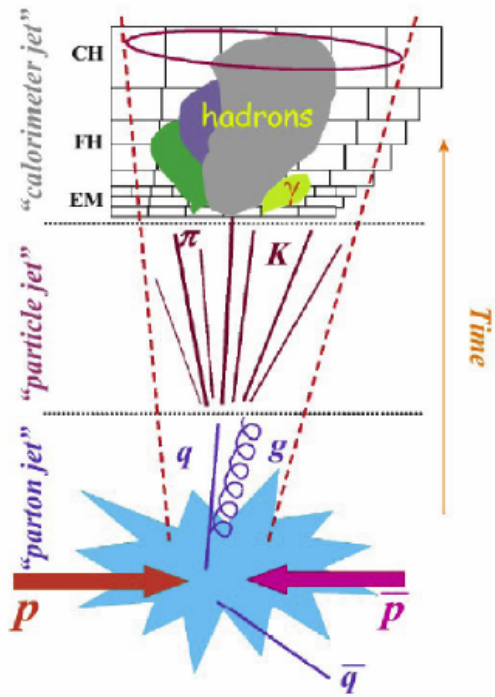
- Designed for detection of low angle production-b physics
- Depending a lot on trackers
- Magnet's polarity alternates
- η range: 2-4.5

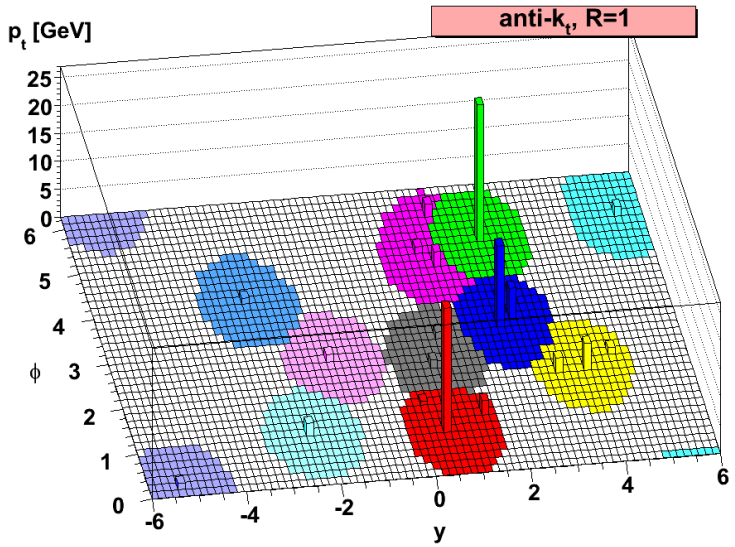




Jets

- Jets are complex objects, consequence of parton hadronization
- Used algorithm for merging jets is anti-k_t
- In our case we have dijets - two jets.
- Variable InJet for b quark: 0 - unlikely b quark in the jet; 2 - B meson in the jet has been reconstructed independently.

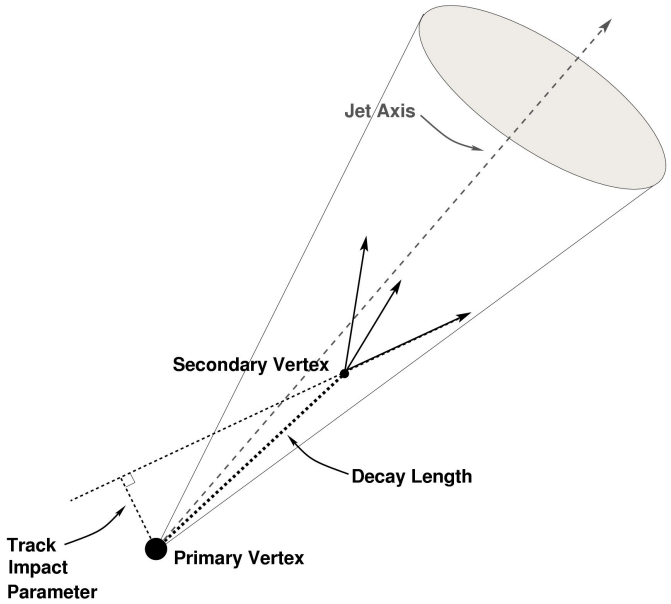


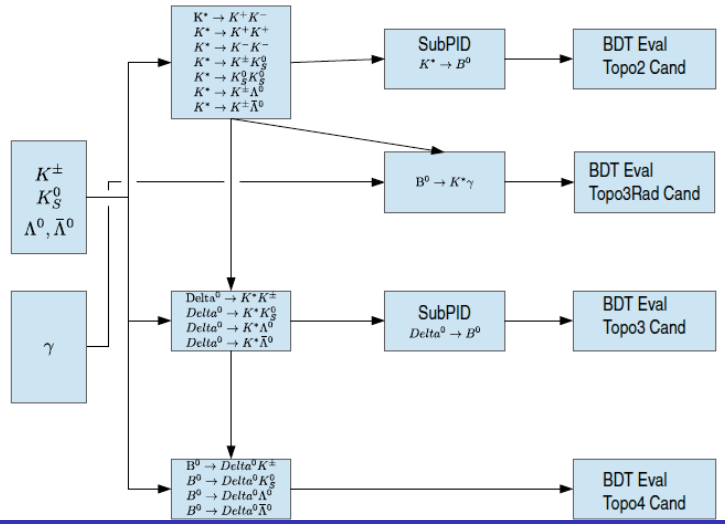


Btagging

B-taggers tell you whether there is a b quark in a jet.
Tested b-taggers:

- SV - tries to reconstruct secondary vertex. Output: 0 or 1
- Topo - trigger decision lines. Output: 0 or 1
- Offtopo BDT - less strict selection than Topo, thus higher efficiency Output: value between 0 and 1, or -1
- OffTopo - OffTopo BDT with cut at 0. Output 0 or 1.

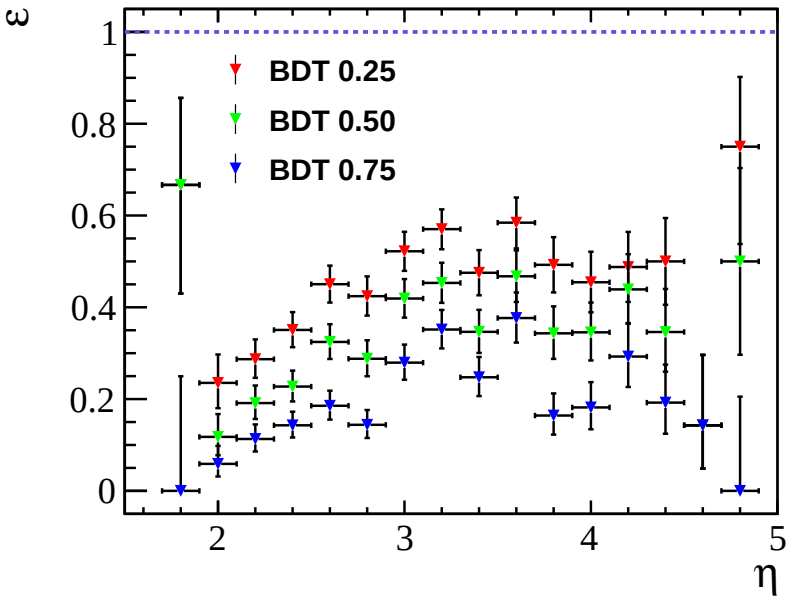


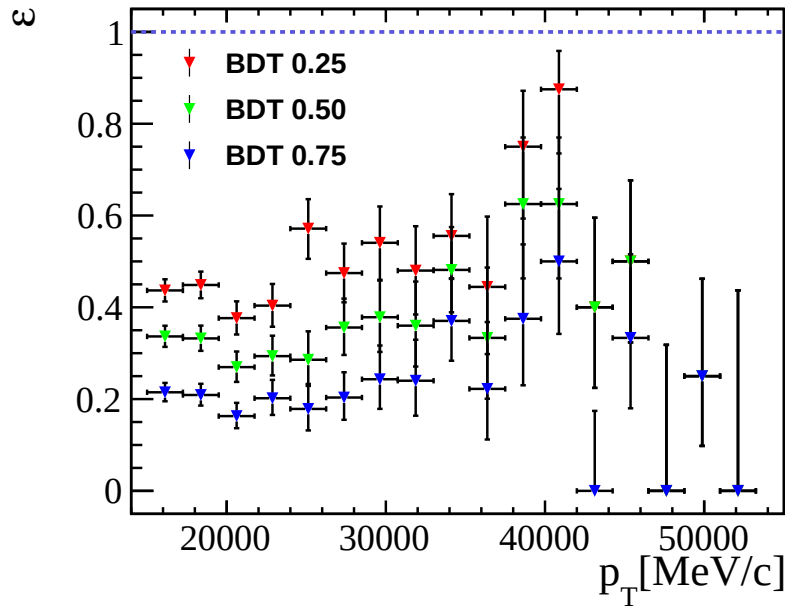


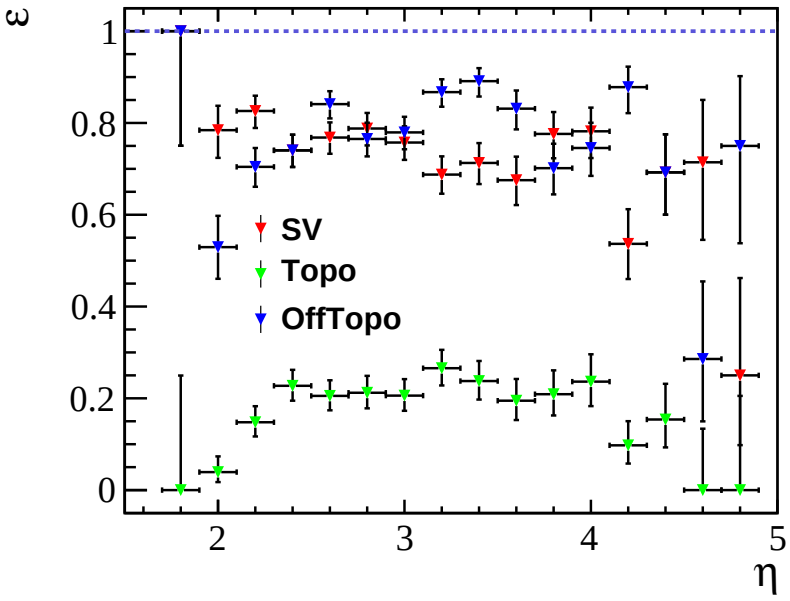
Calculating efficiency and rejection

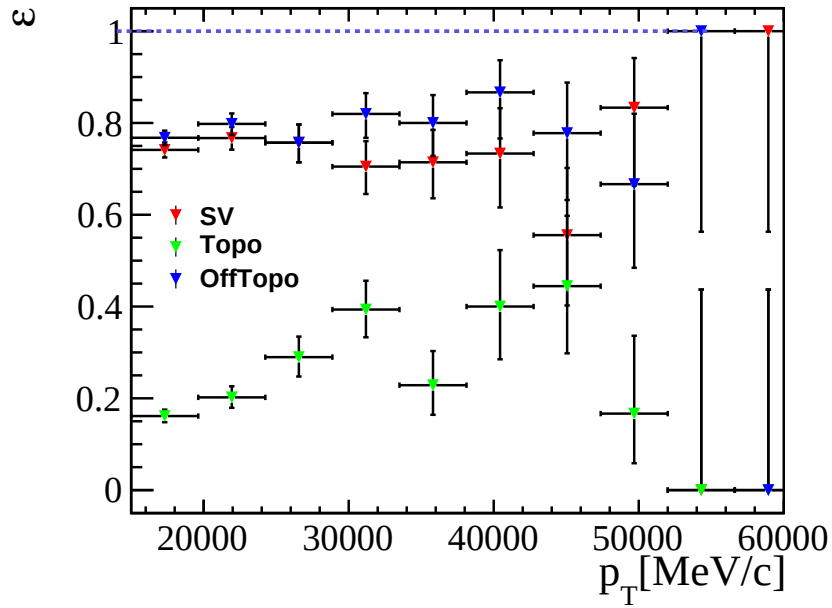
- Signal contains two b jets. Background composed of light parton jets, roughly 1000 light parton jets per b jet.
- Two sets of real data. Cut at jet $p_T > 15 GeV$
  - Signal: dijet events containing B mesons.
  - Background: minimum bias events. Dominated by light parton jets.
- Variables in signal sample tell us if there is a B meson in one of the jets: proof for b quark.
- Reading tagger output.
- Perform an operation called BayesDivide to compute efficiencies.
- For minimum bias data we know there is scarcely any b quark. High rejection expected.

Efficiency:Injet=0

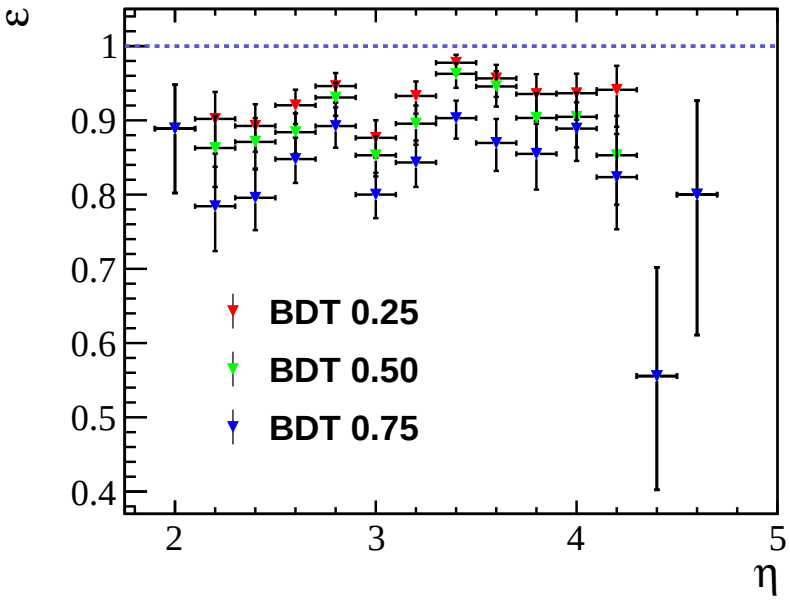


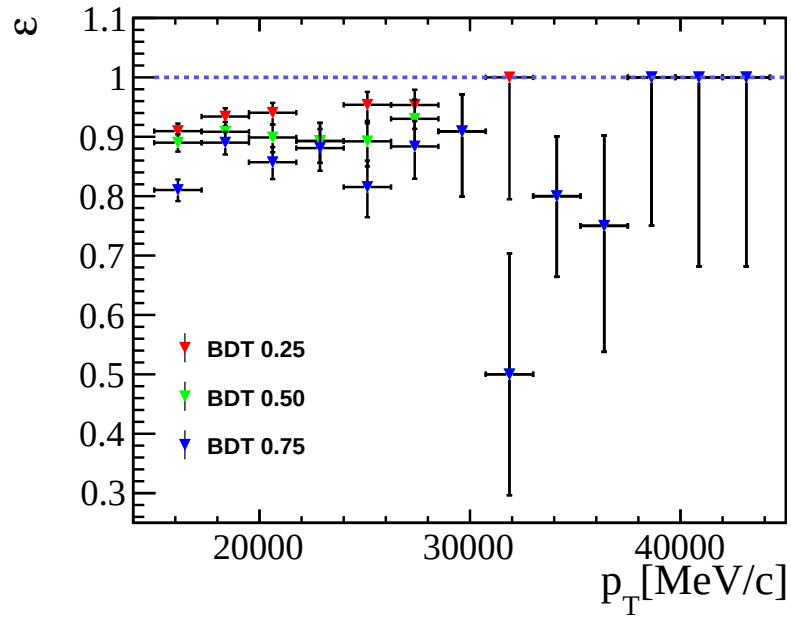


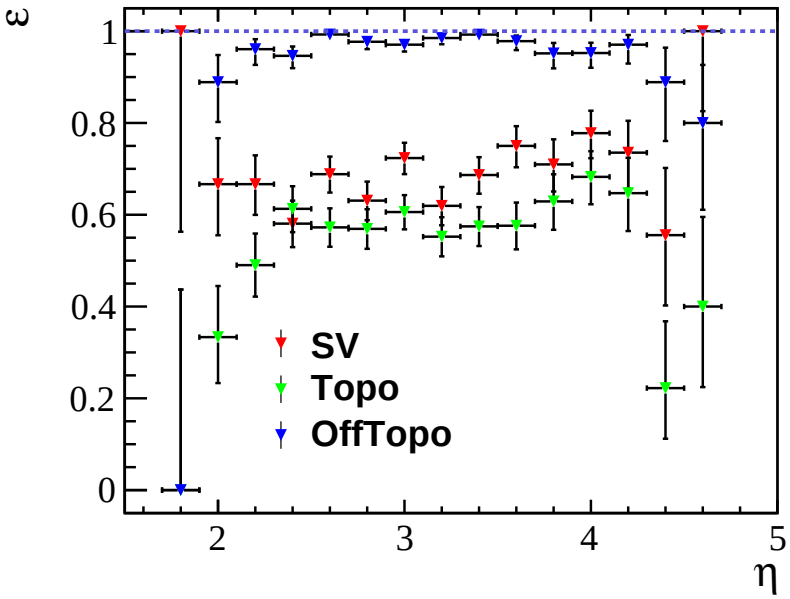


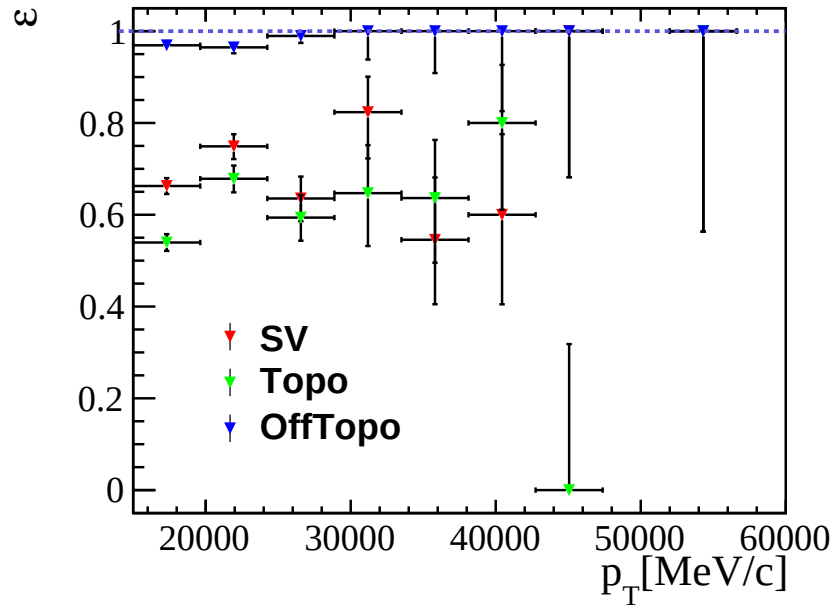


Efficiency:Injet=2

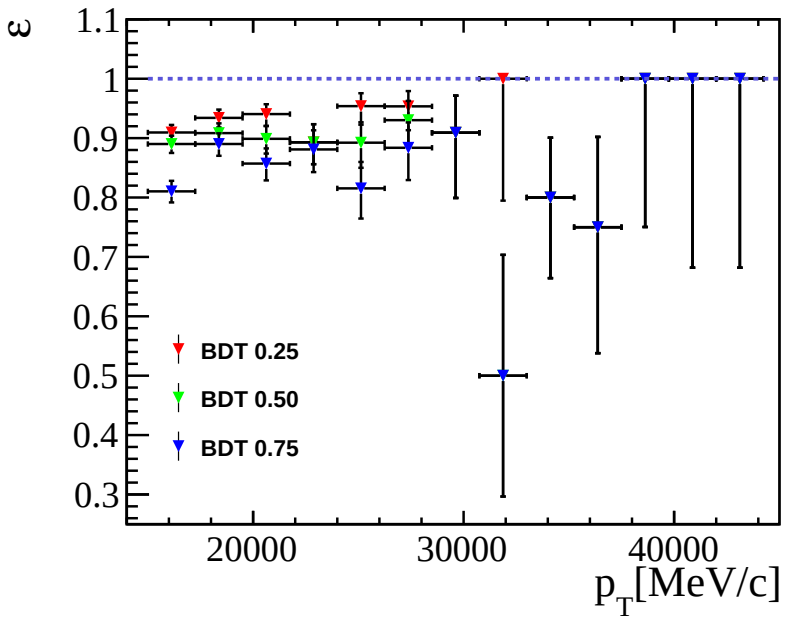


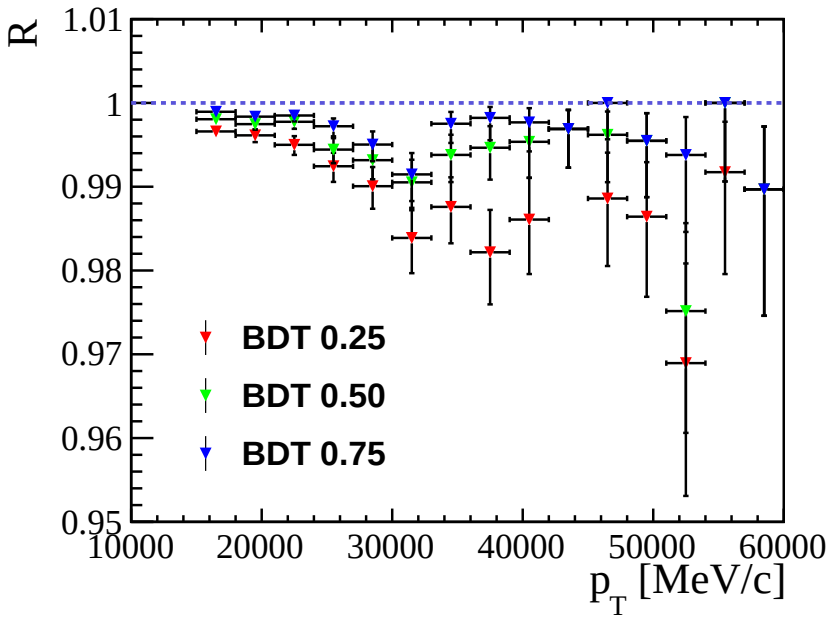


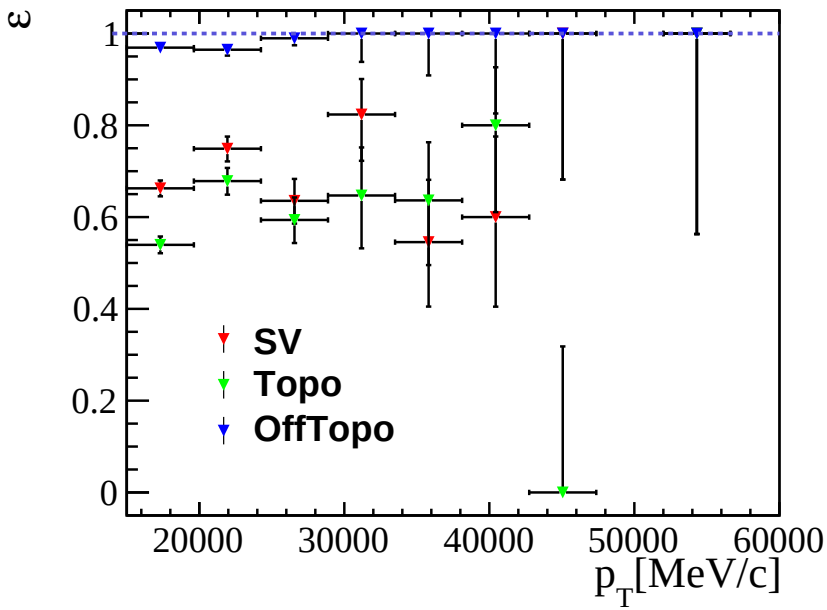


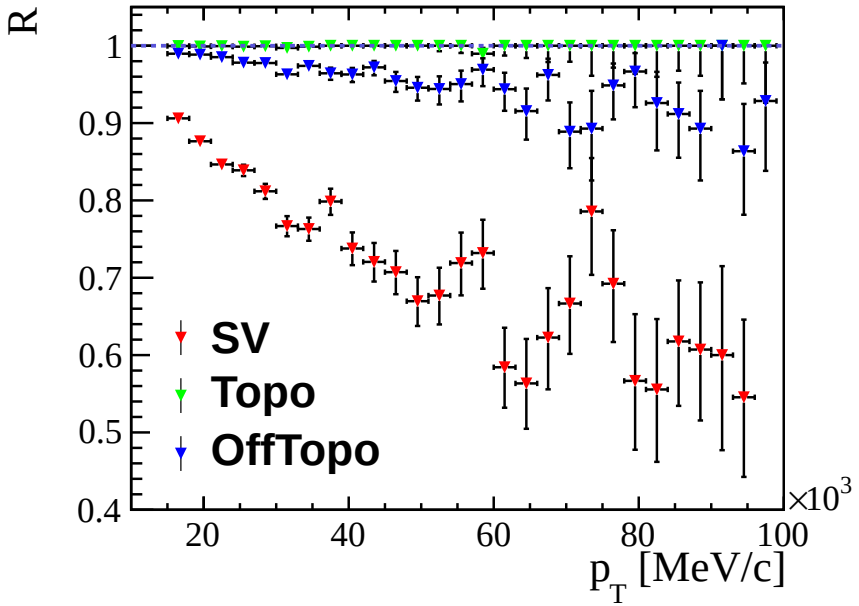


Rejection vs efficiency for p_T

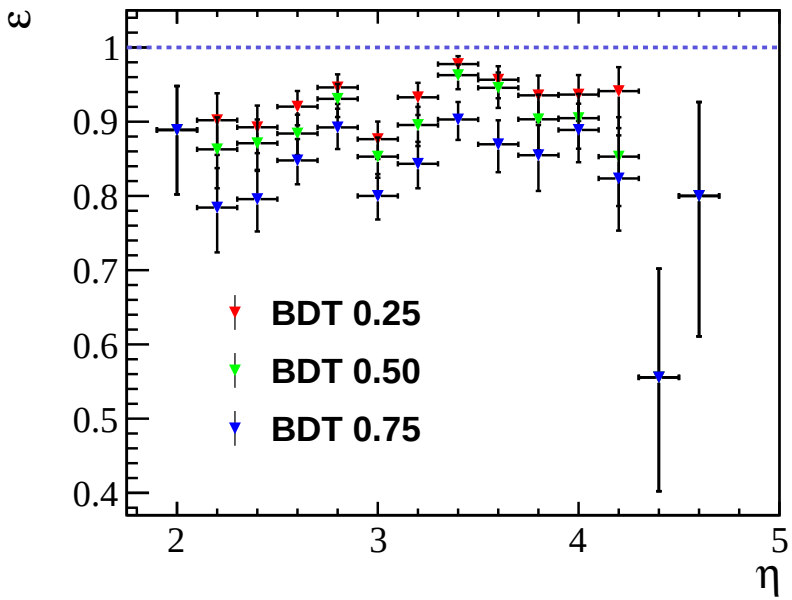


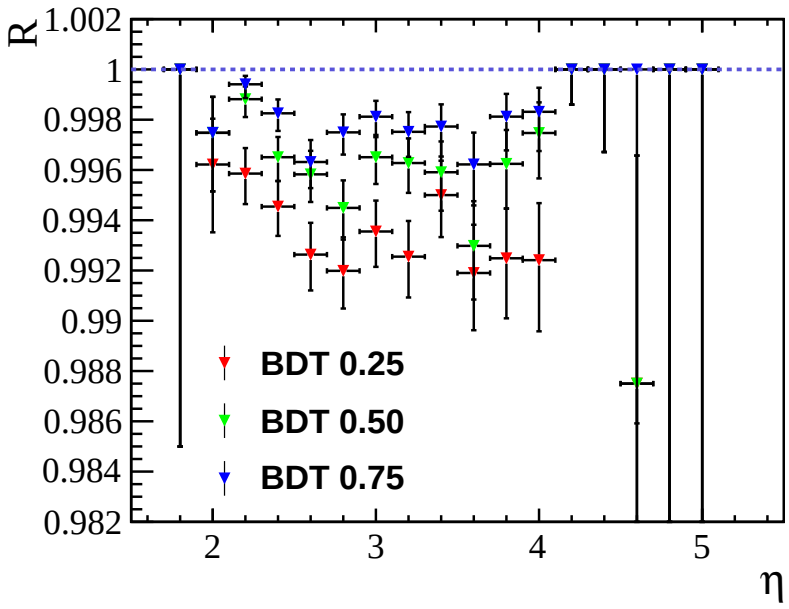


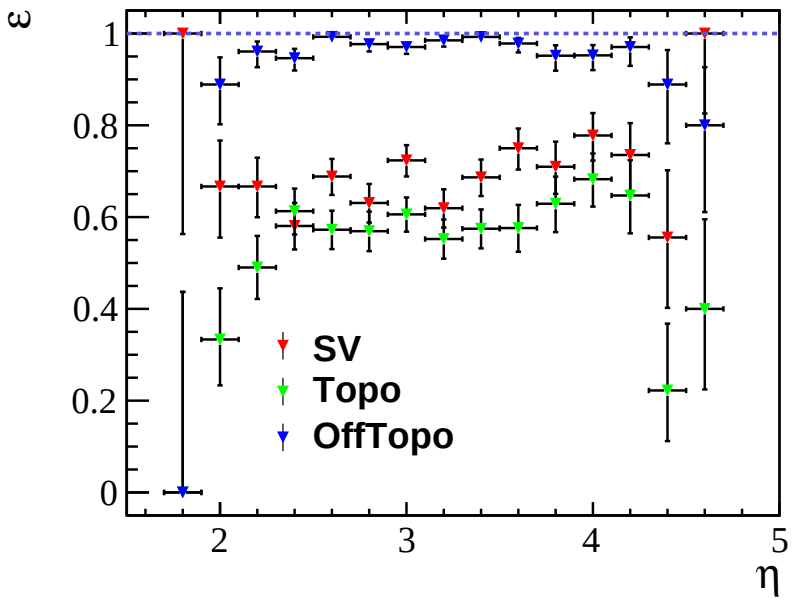


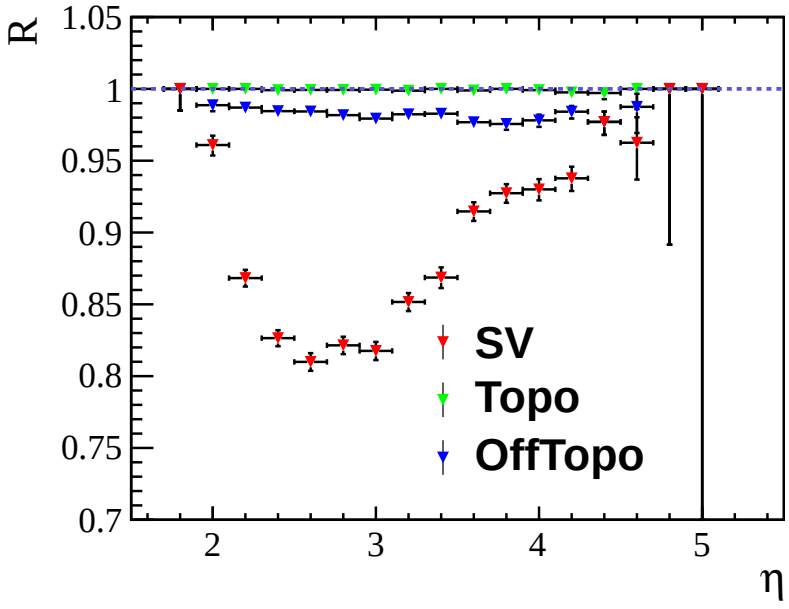


Rejection vs efficiency for η









Conclusions

- The analysis of two sets of data has been done, testing efficiency and rejection of different taggers.
- Offtopo BDT with appropriate cut gives very satisfying results.
- Topo: low efficiency, but very good rejection.
- SV too loose.
- Similar analysis should be performed, testing rate of fakes for c quarks.
- Dependency of efficiency on other variables. For example $\Delta\Phi$.