# Qualification Task AFT 455:
Optimization of Inputs for High Level Discriminants (DL1 and MV2) to Improve Performance of B-Tagging in Heavy Ion Collisions

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Feb 6, 2020

Issue: Observed a difference in efficiency from SVF tool Performance Paper and our result.

- ATL-PHYS-PUB-2017-011: https://cds.cern.ch/record/2270366
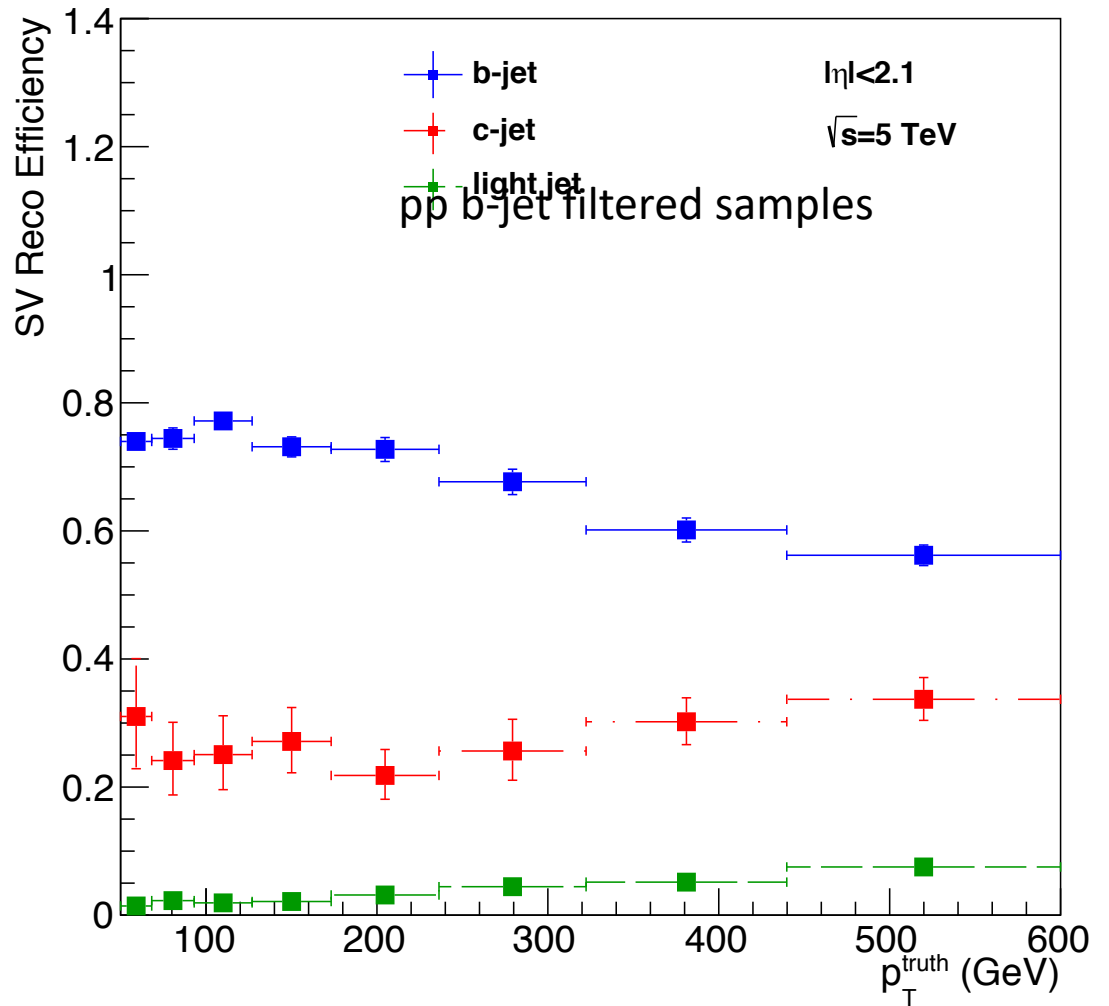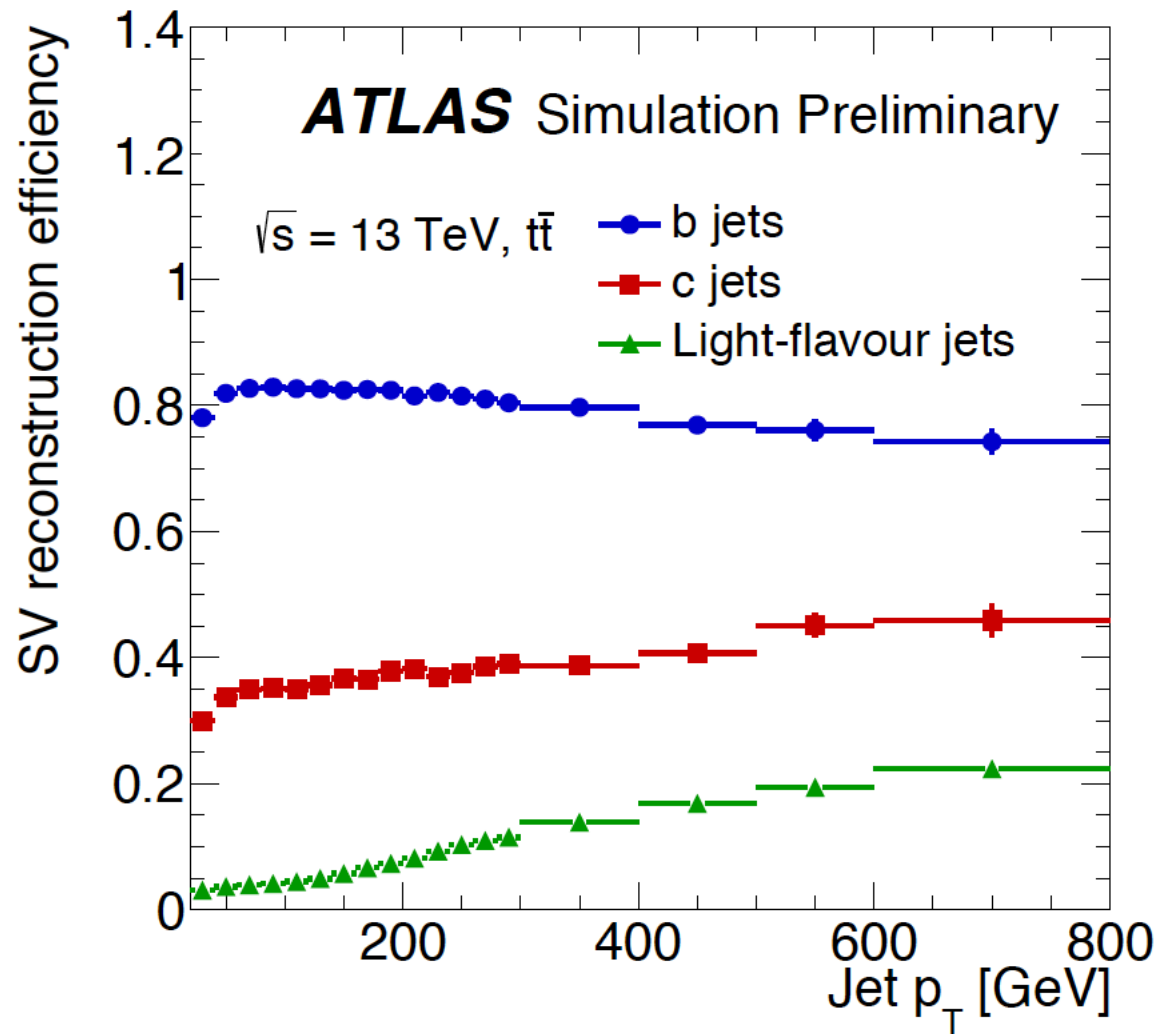
List of Things to Check

- Do we have same definition of efficiency?
- Are we looking at same physics process?
- Do we have the correct selections?

Do we have same efficiency definition?

- "the fractions of jets which have a reconstructed secondary vertex, for different jet flavours" (✔)

- "The jets are flavour labeled by matching them to weakly decaying b- and c-hadrons in the event generator record. If a b-hadron is found within a distance of dR < 0.3 from the jet axis, then the jet is labeled as a b-jet. If no b-hadron is found, the search is repeated for c-hadrons, if a c-hadron is found and no leptons are found, the jet is then labeled as a c-jet. If no match is found for c, b, or , the jet is labeled as a light-flavour jet."

Are we looking at Same Physics Process?

- Not exactly.
  - Only ttbar events: performance paper
 - bbar filtered inclusive events: our result
- Email from Chris Pollard:

  We don't expect b-jets originating from different physics processes to have the same b-tagging efficiency. b-jets in inclusive dijet events can be quite different from b-jets in ttbar events. For instance you'll likely have more jets with >1 b-hadron inside, which have a lower SV-finding efficiency. These types of jets become more common at high pT in inclusive jet production, so I would say your plot makes a lot of sense!

  - There're more multi-B hadron jets in higher pT region. (see back up)
  - However, only using single b-hadron jets did not improve the results. (see next slide)
  - Different physics processes could still be a reason.

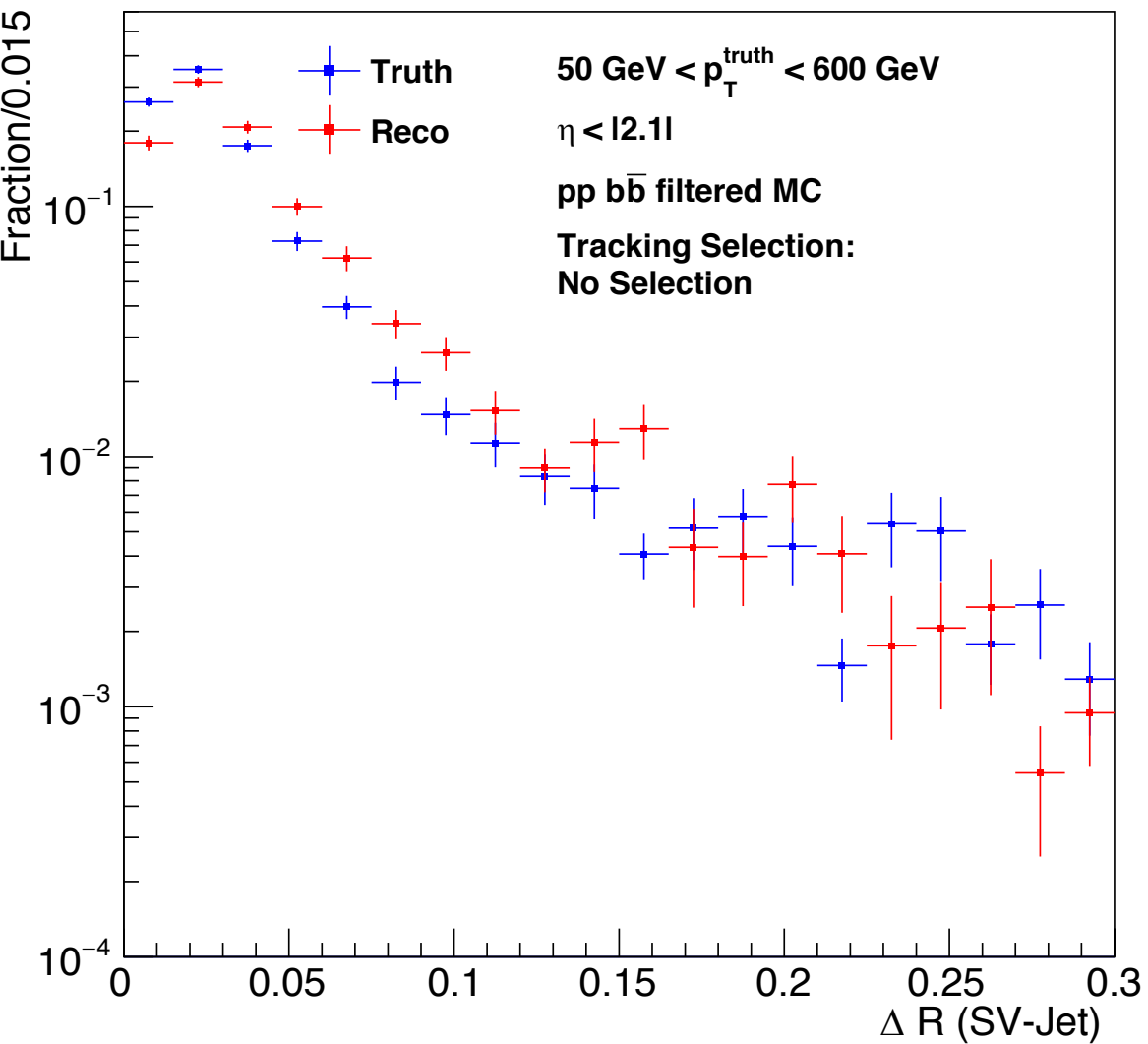# SV Reconstruction Efficiency for Unique and Multiple B Hadron Jets

SV Reco Efficiency for Different Flavors of Jets in pp
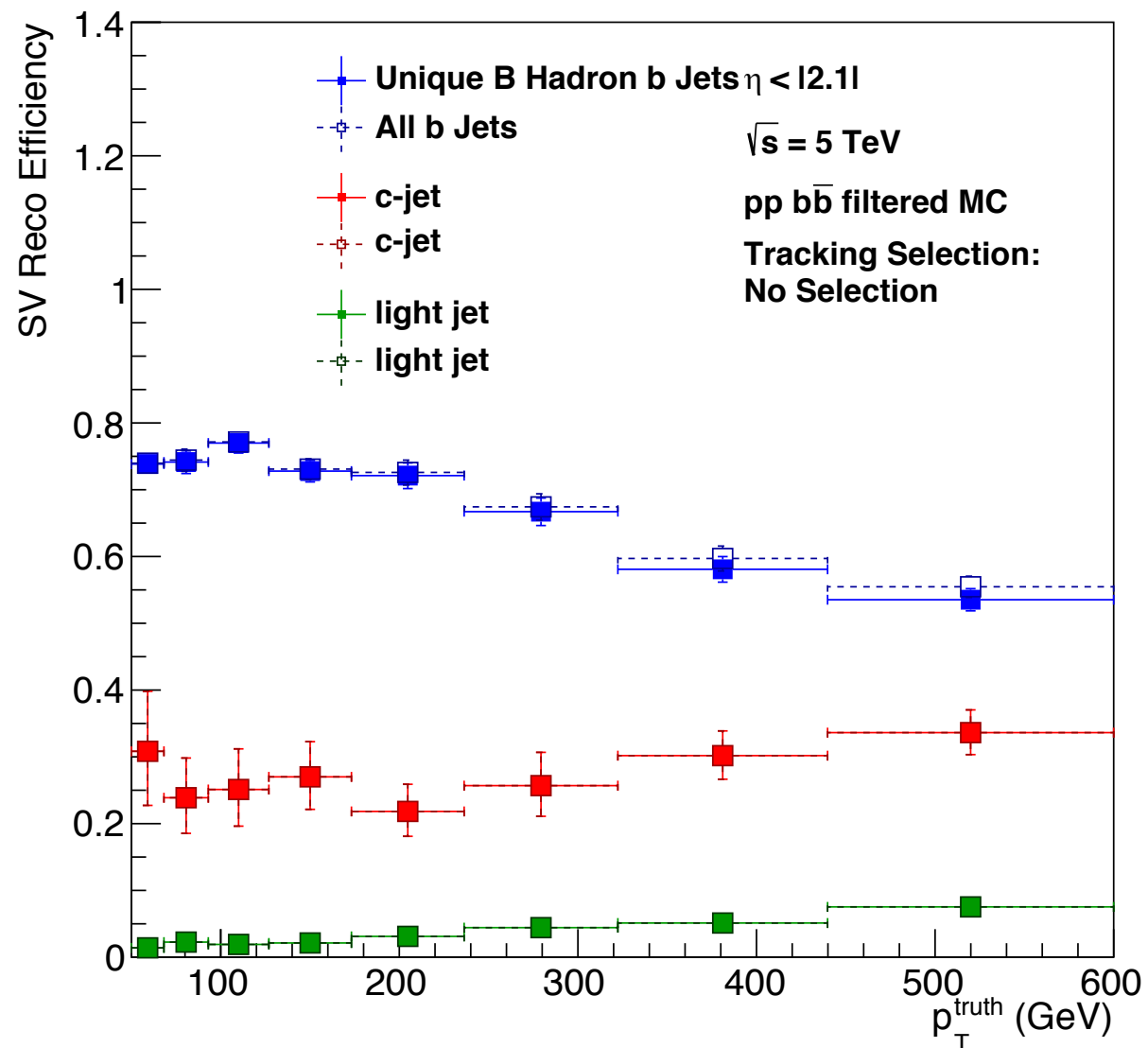
- Almost no difference in low pt region.
- Slight decrease of SV for unique b hadron jets in high pt.

From homework list: ΔR(SV-Jet) in Reco SV and Truth SV

Distribution of Δ R SV to Jet Direction for reco and truth SV in pp

- Question raised: is there a resolution issue with reco jet direction?

- Reco SV has a broader distribution.

- Peaks are both at ~0.03.

pT Dependence of SV-Jet Distance

Distribution of ΔR SV to Jet Direction for Reco SV in pp

Distribution of ΔR SV to Jet Direction for Truth SV in pp
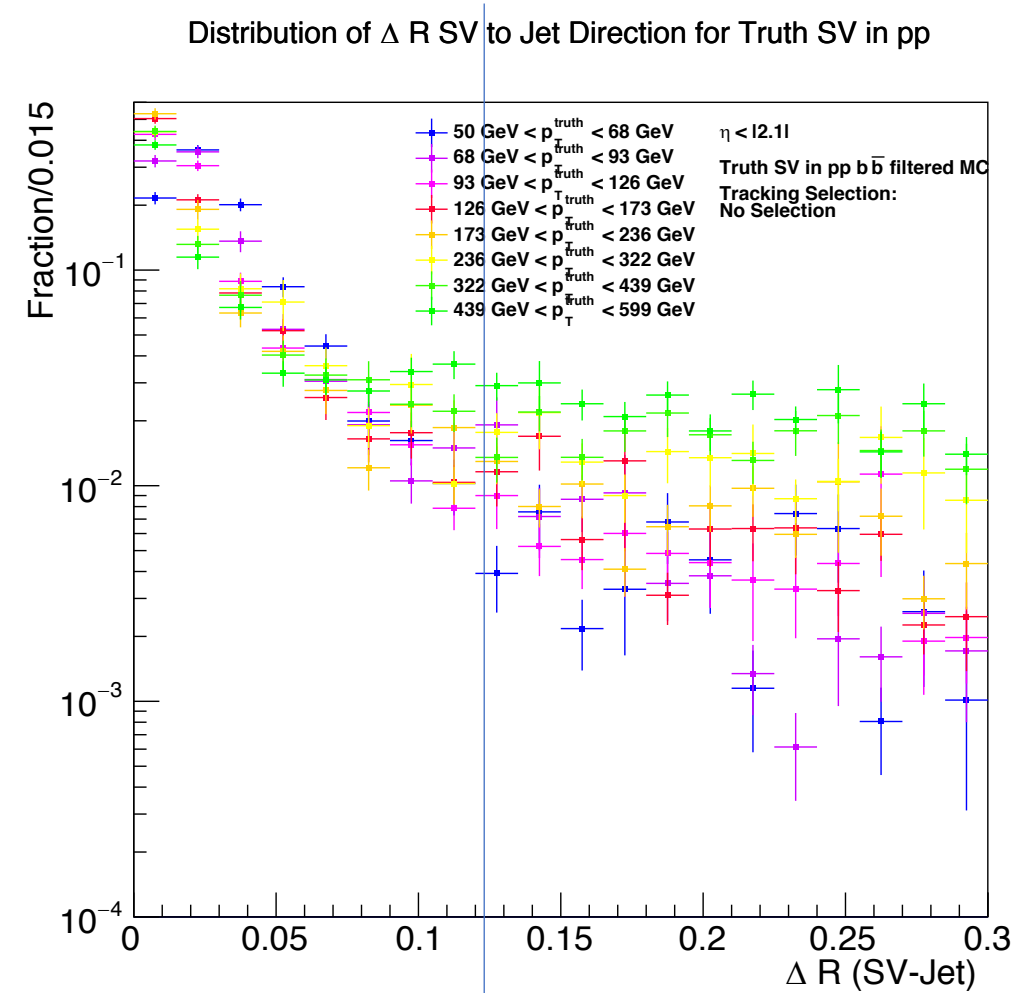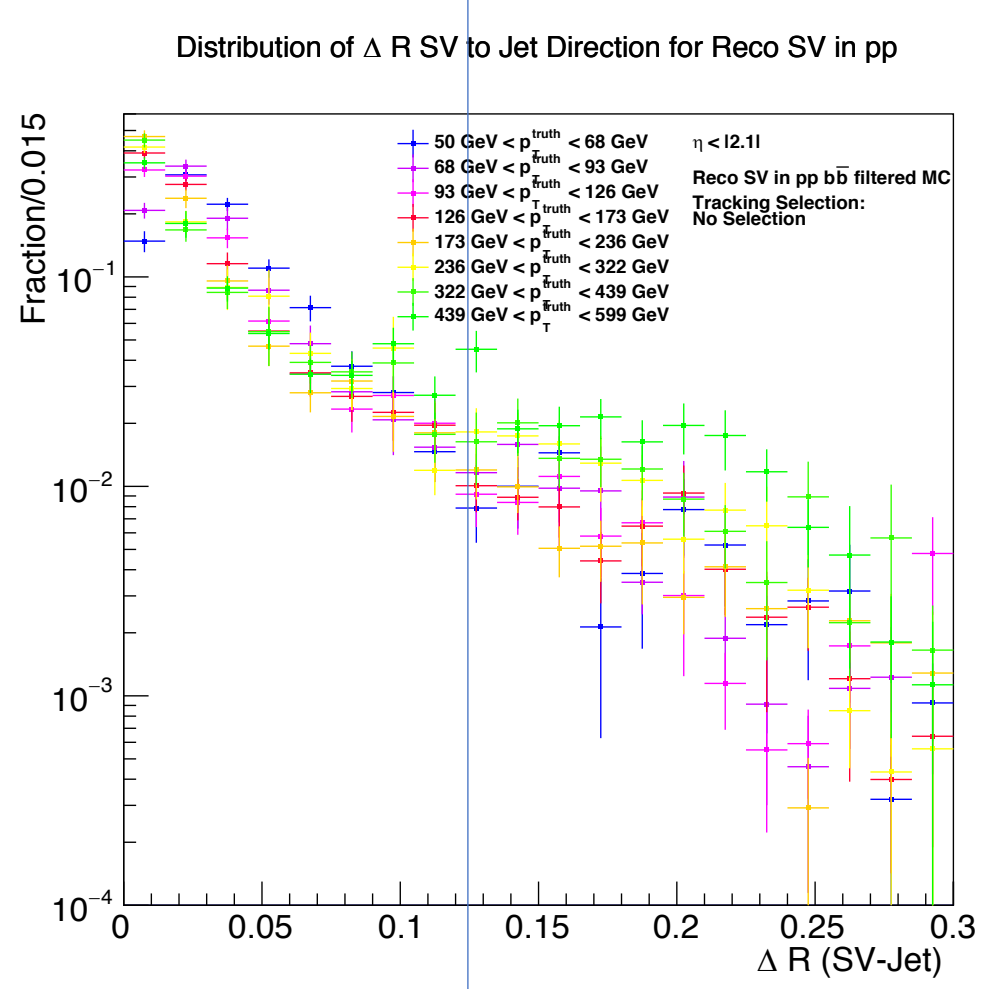
- Narrower distribution at high pt.

Plan

- Working on plotting b-hadron tracks vs fragmentation tracks.

- Compiled packages needed for changing hard-coded track selections, will play with selections.

- Check whether there're papers on performances of SVF on bbar events and compare.

Plan for homework List

- talk to Ogul & SV1 expert for how to implement track selections in SVF tool.
  - SV1 expert Vadim responded with new homework: reproduce this plot from the 2016 b-tagging performance paper: http://cdsweb.cern.ch/record/2160731/files/ATL-PHYS-PUB-2016-012.pdf
  - The way our framework works did not involve a configuration file for SV tracking selections.
    - Have installed the package, will play with change the hard-coded job options in the package.
  - Started a new repository on gitlab for the codes we're running

- Things to plot:
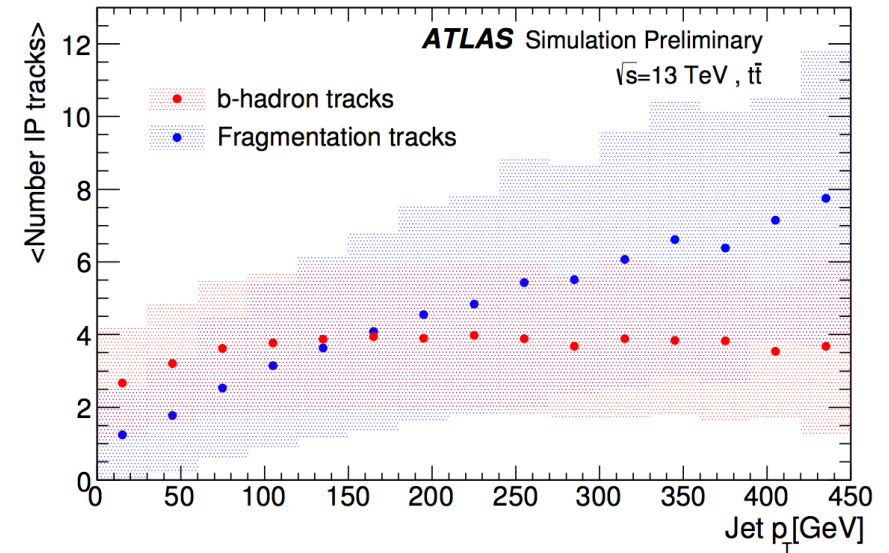 - Reco SV dR from jet axis comparing to truth SV dR from jet axis. (for different pT)

Figure 5: Average number of *b*-hadron and jet fragmentation tracks selected for the IP algorithm as a function of the jet p_T. The shaded band around the two contributions represents the RMS for each p_T bin.

Back-up

Distribution of Number of B Hadrons in b-jets in pp