QG tag – First look and plots

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Outlook

- To test the QG Tag (JetQGTaggerBDT) in rel 22 we are using a dijet sample:
  - mc21_14TeV
    - Geo: ATLAS-P2-RUN4-01-01-00
  - Deriv JETM1
    - Contains ghost particles not stored in PHYSVAL
    - Tracks are matched to jets using the ghost- association technique (track jets found within the catchment area of the ungroomed parent jet)
- Analysis used:
  - Same framework used by HL-LHC performance group:
    - https://gitlab.cern.ch/atlas-jetetmiss-upgrade/hllhc-jet-performance

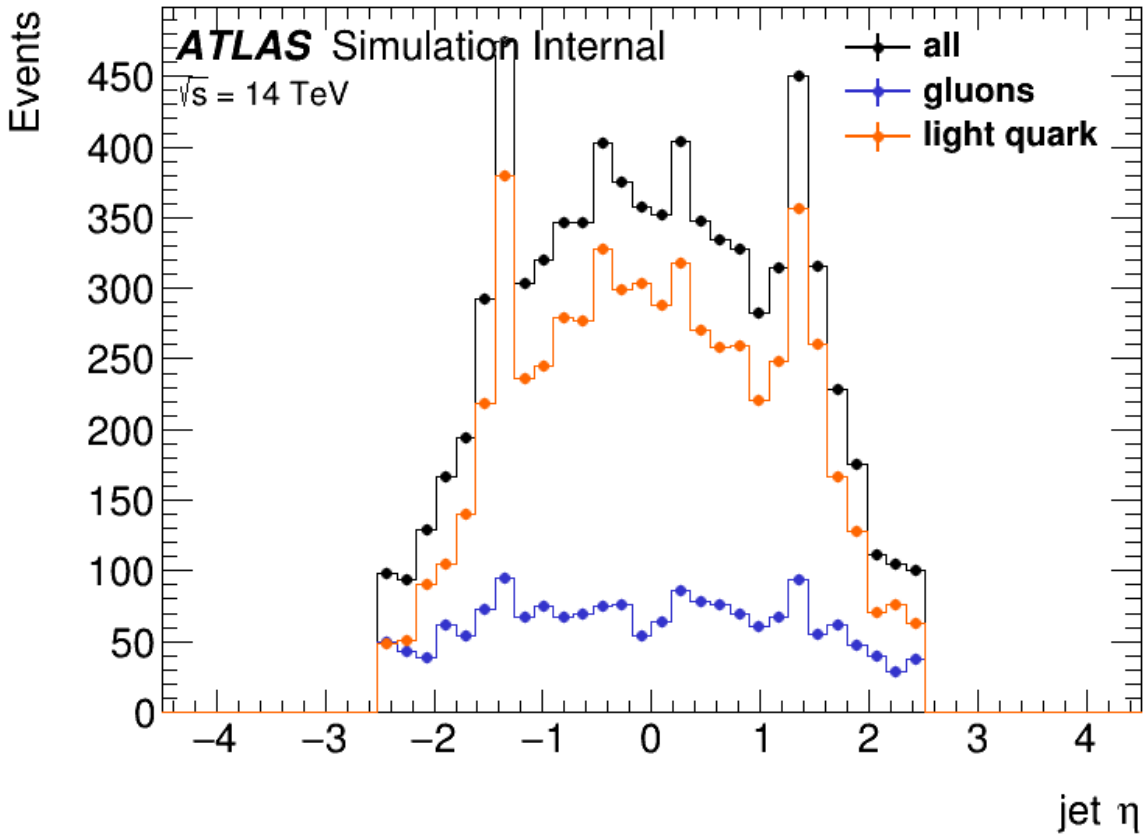
https://cds.cern.ch/record/2802919/files/ATL-COM-PHYS-2022-134.pdf

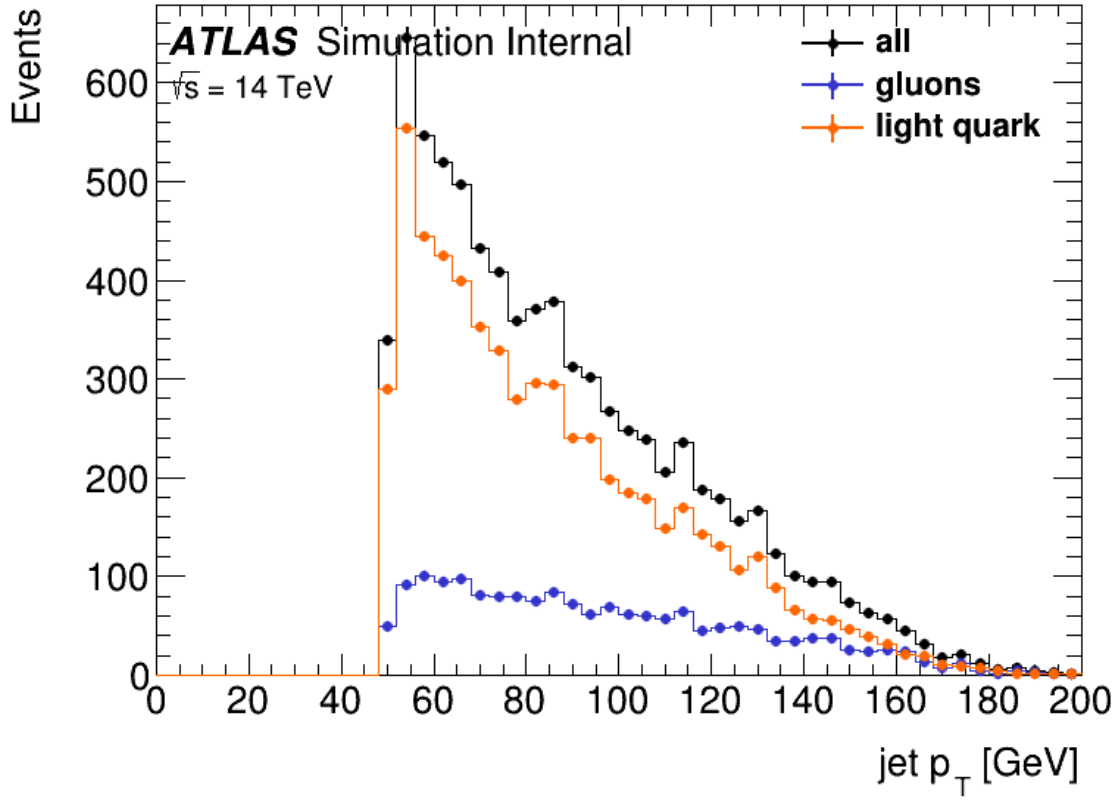
How the tagger works?

- The partonic flavour label of a jet is defined by the flavour of the highest-energy parton in the parton shower and before hadronisation within ΔR = 0.4 of the jet.
- Gluon jets have more charged constituents than quark jets on average
  - gluon jets are broader than quark jets
- Boosted Decision Tree (BDT) tagger
  - jet variables as input : Ntrk , Wtrk (width correlation) , C1trk (energy correlation) , pTjet , ηjet

$$n_{\text{track}} = \sum_{\text{trk}\in\text{jet}} \qquad w^{\text{track}} = \frac{\sum_{\text{trk}\in\text{jet}} p_{\text{T}}^{\text{track}} \Delta R_{\text{trk,jet}}}{\sum_{\text{trk}\in\text{jet}} p_{\text{T}}^{\text{track}}} \qquad C_1^{\beta=0.2} = \frac{\sum_{i,j\in\text{jet}}^{i\neq j} p_{\text{T},i} p_{\text{T},j} \left(\Delta R_{i,j}\right)^{\beta=0.2}}{\left(\sum_{\text{trk}\in\text{jet}} p_{\text{T}}^{\text{track}}\right)^2}$$

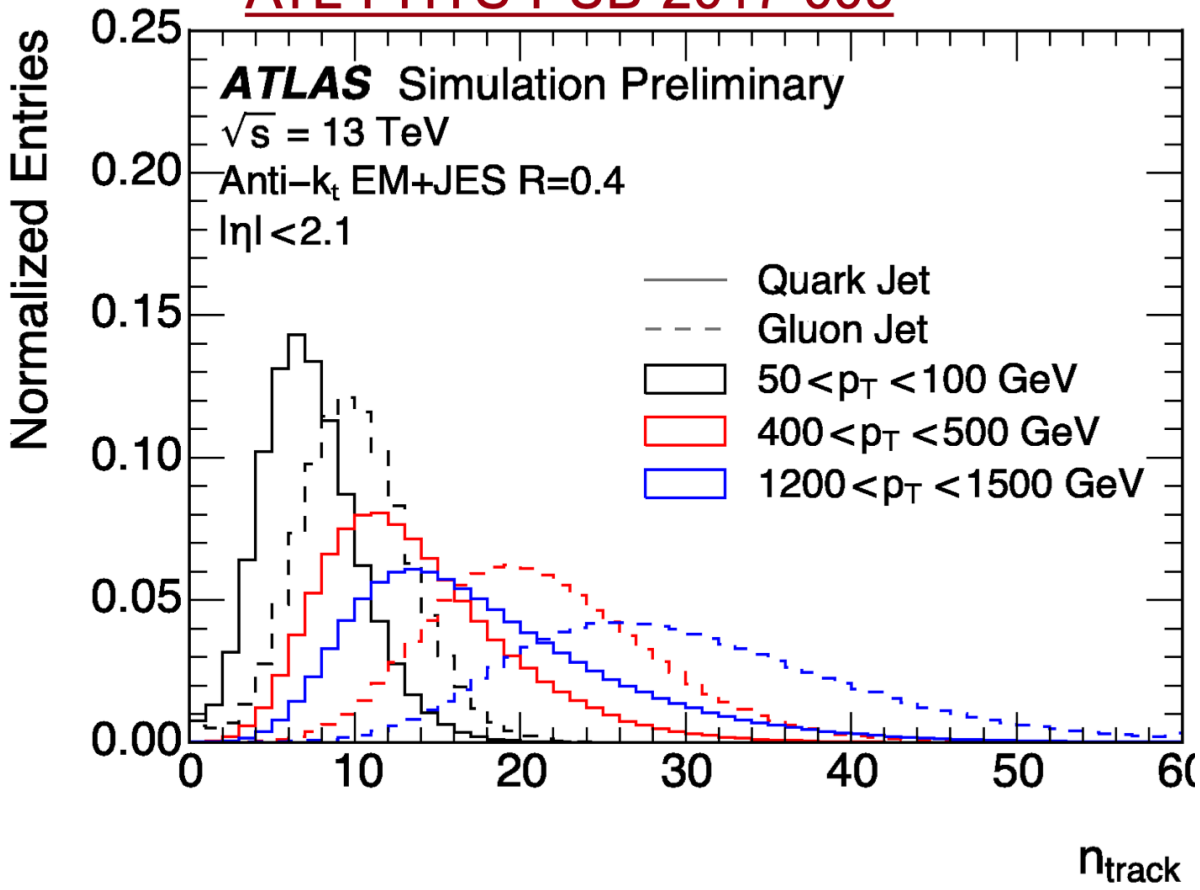
Jet pt and eta with required cuts



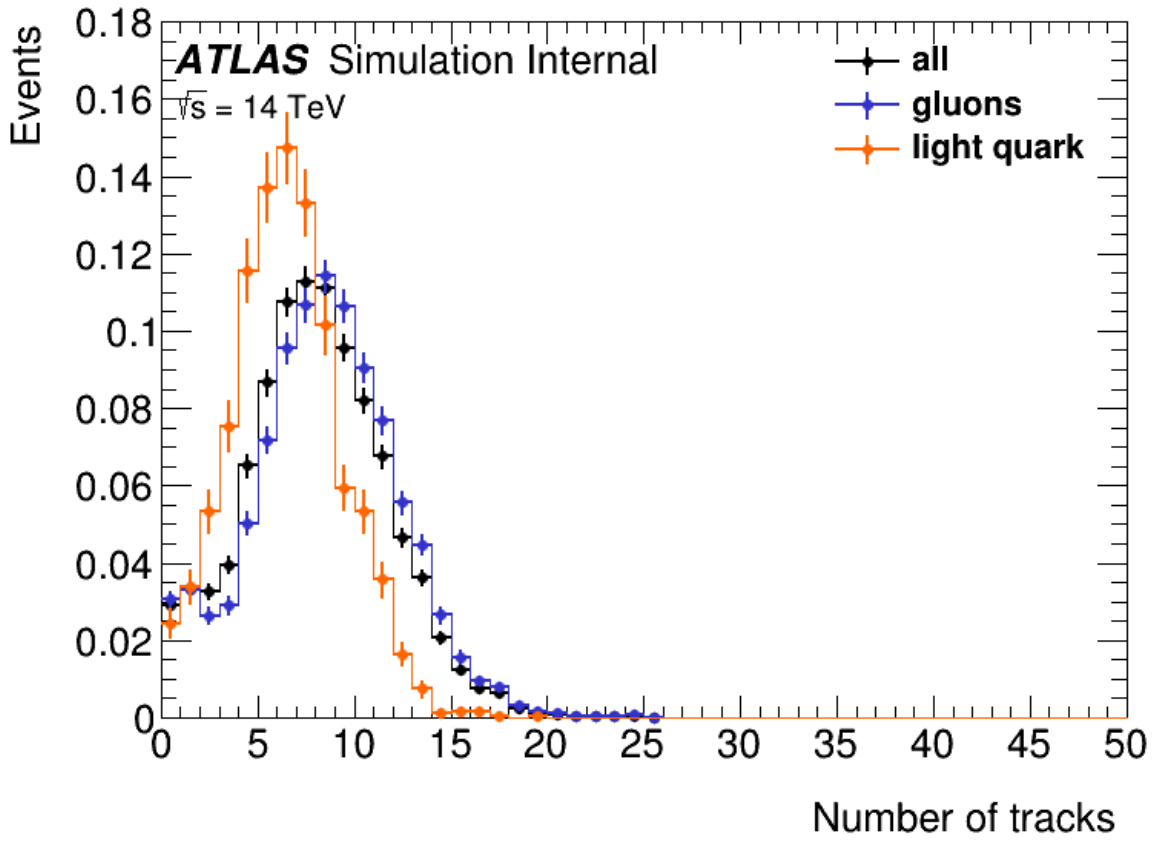


How the input variables looks like?

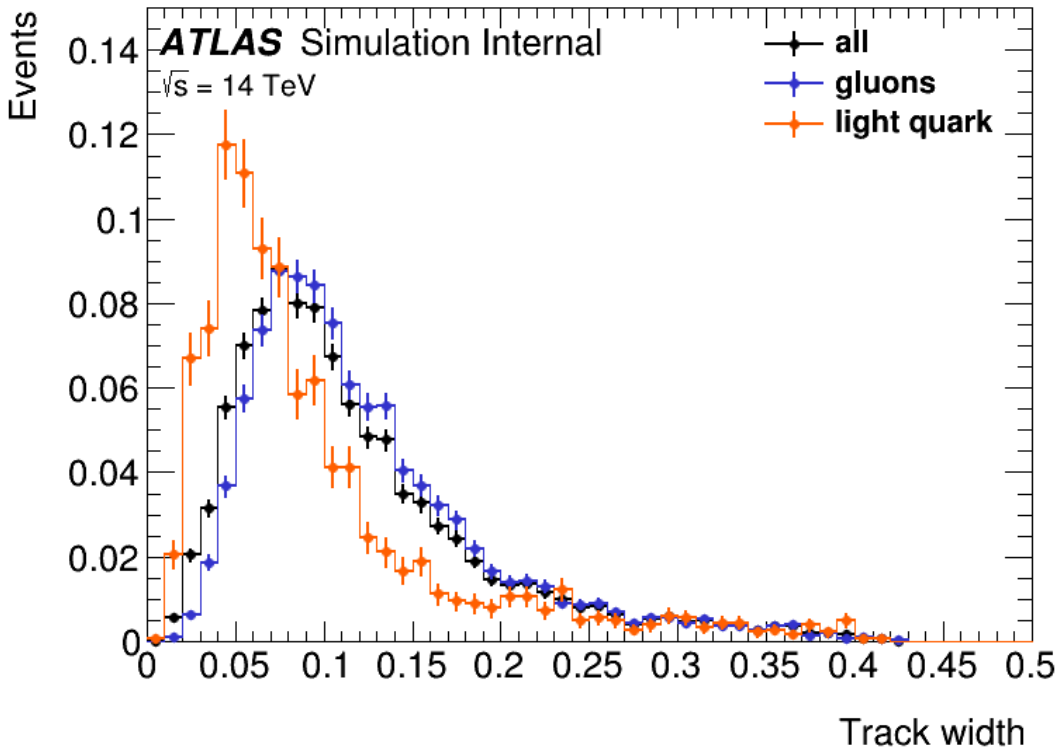
ATL-PHYS-PUB-2017-009

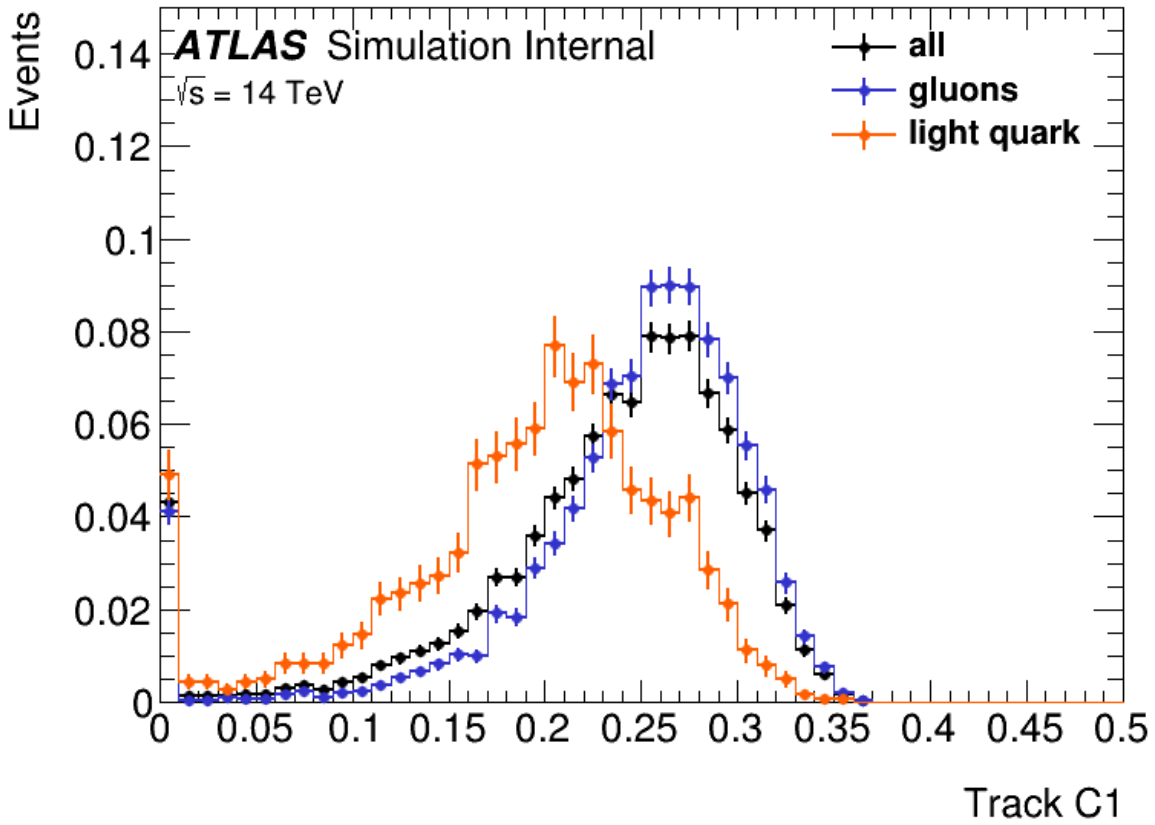


JZ5, pt > 50 GeV



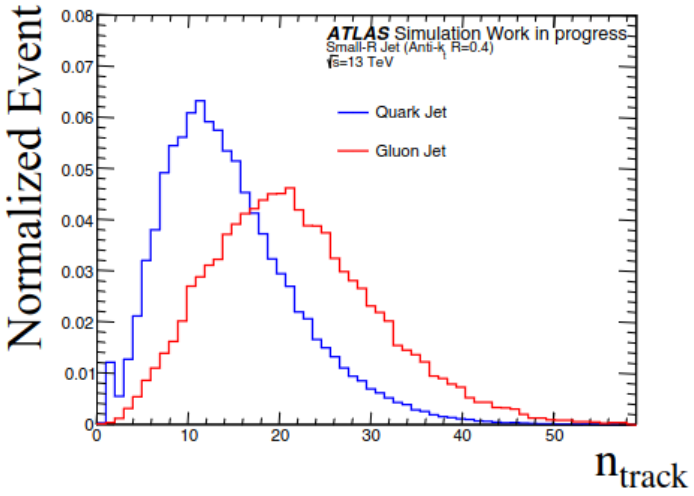
Input variables

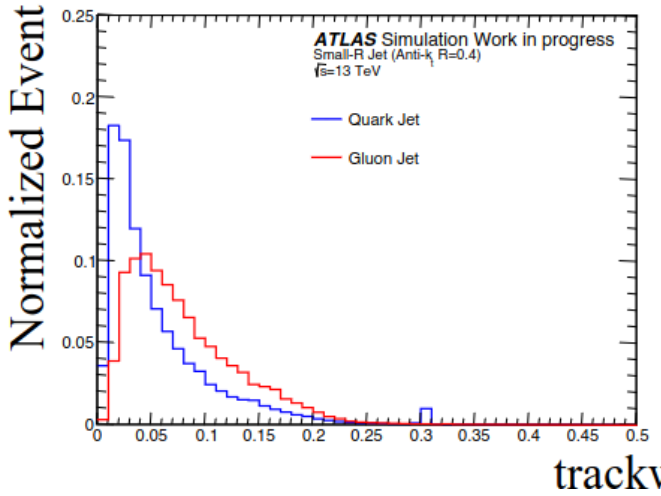


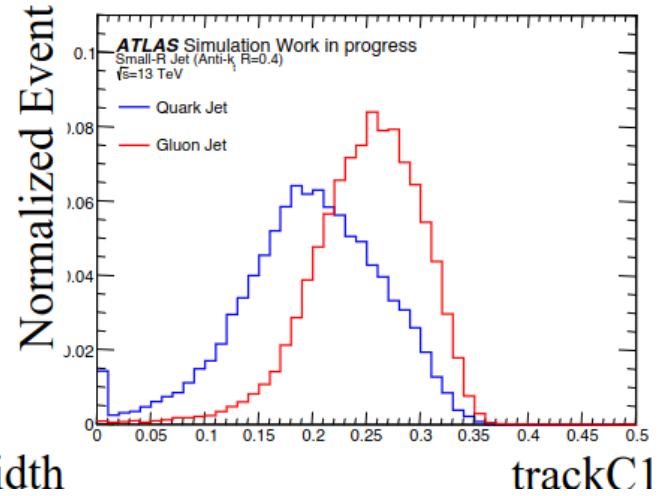


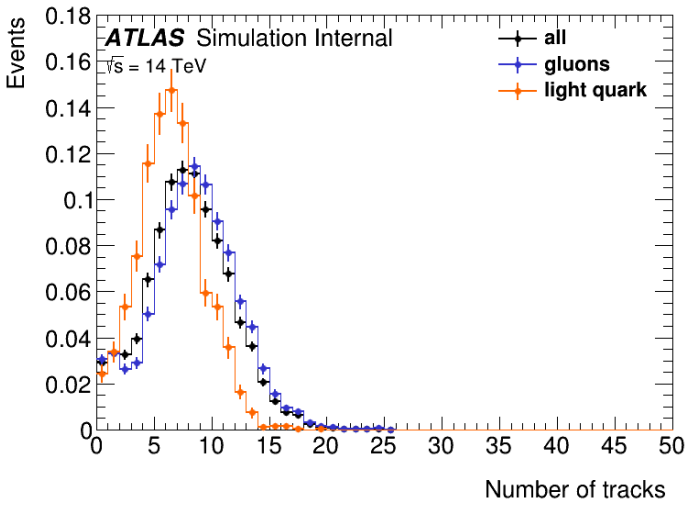
https://indico.cern.ch/event/1125863/contributions/4725294/attachments/2394452/4093797/21_evening_icepp_LU.pdf

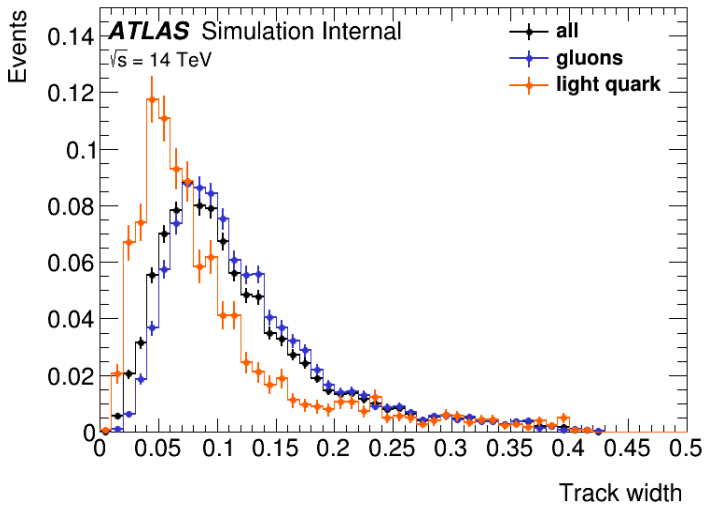
Compare with previous results

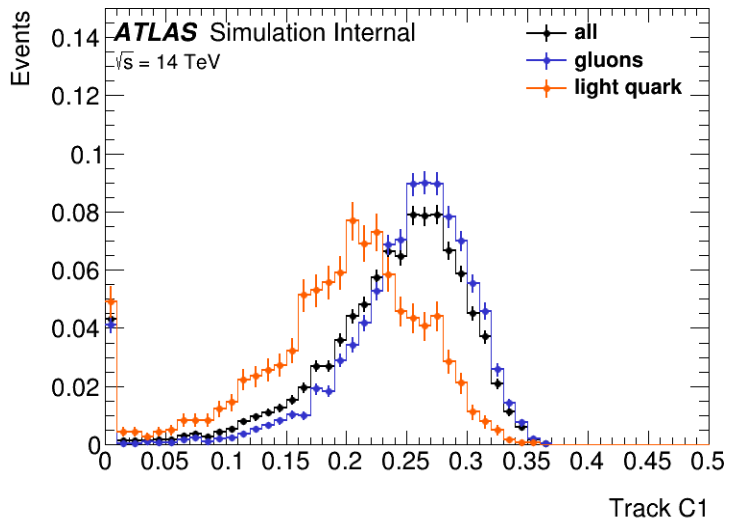




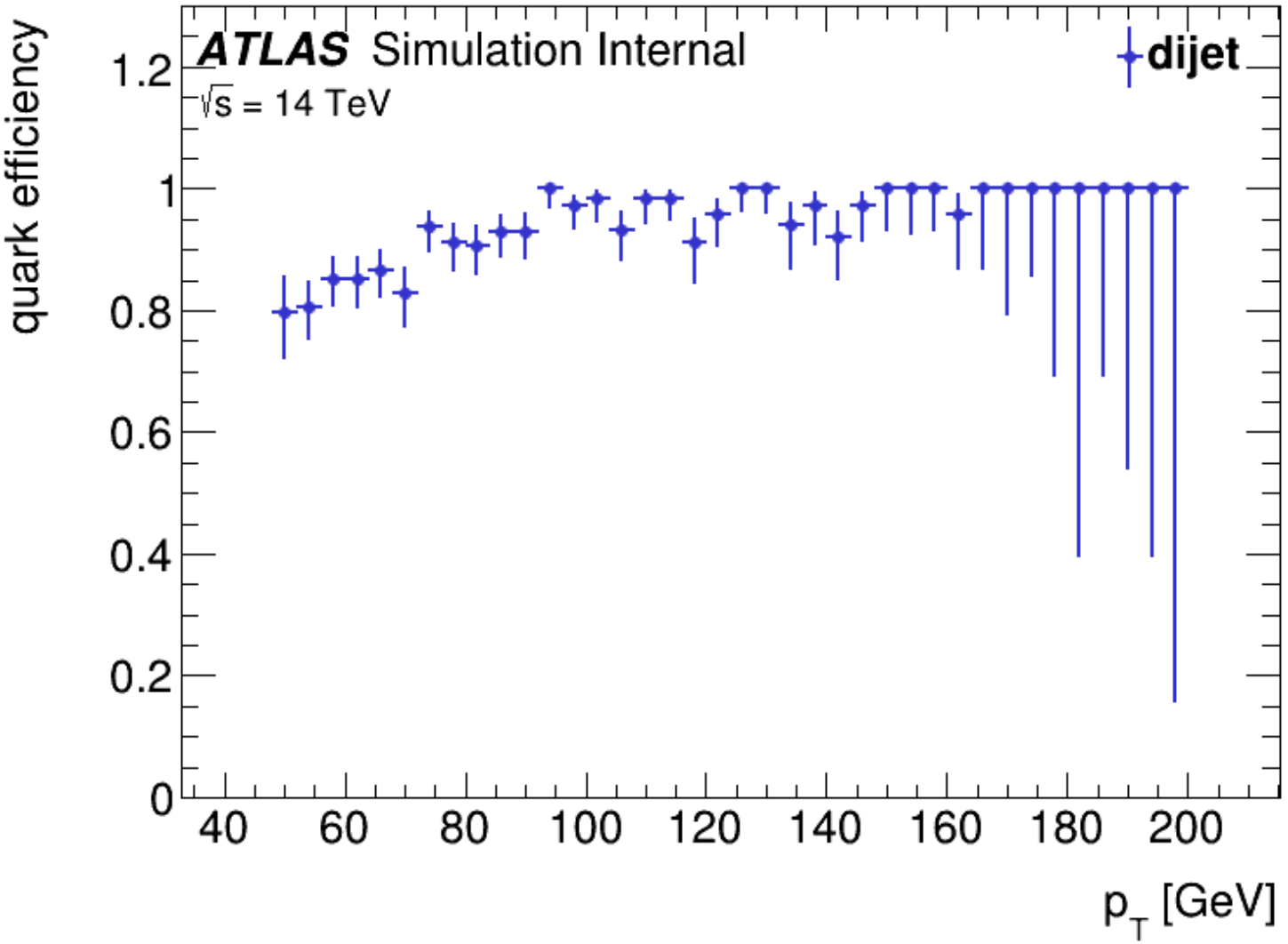




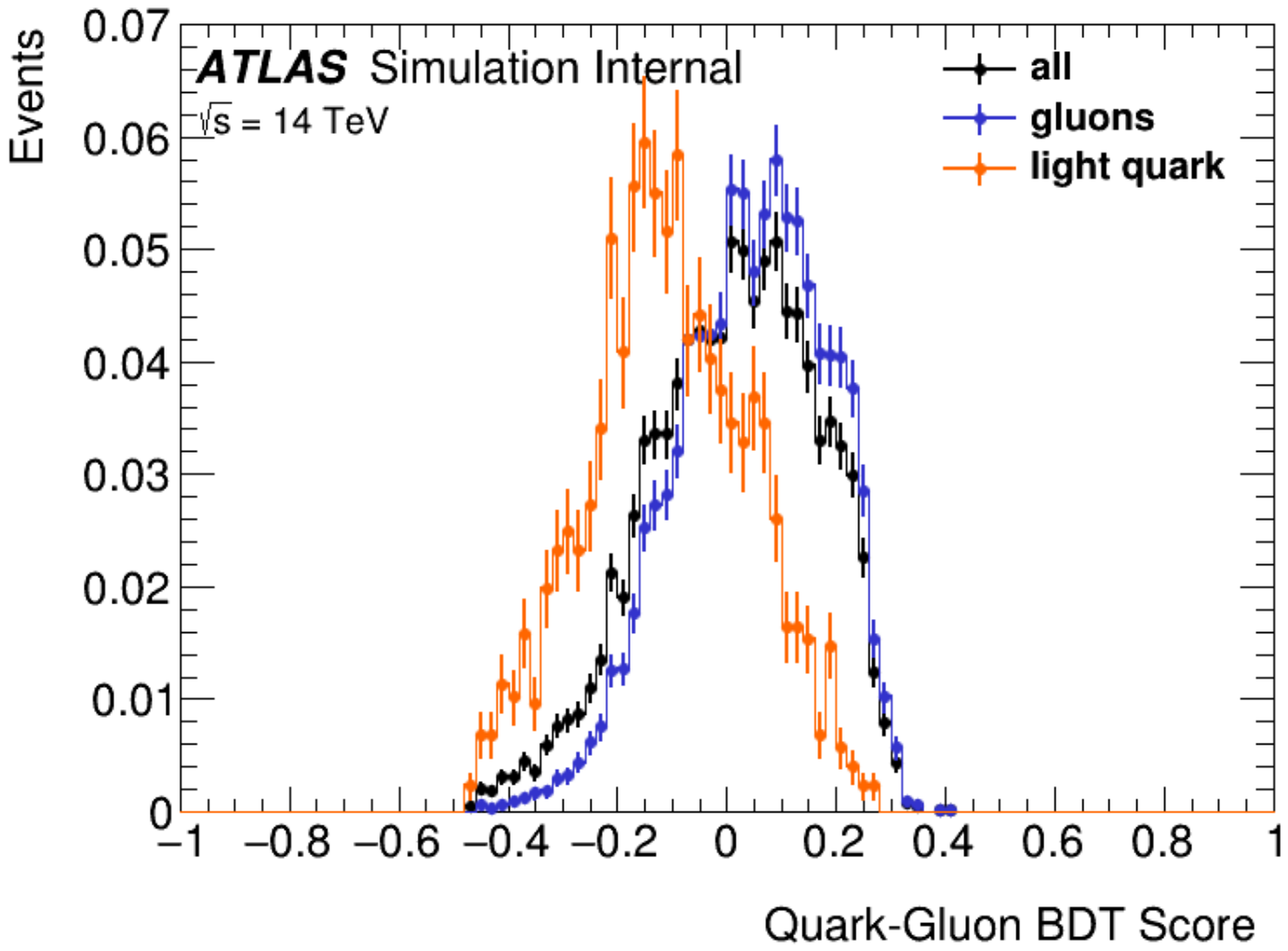




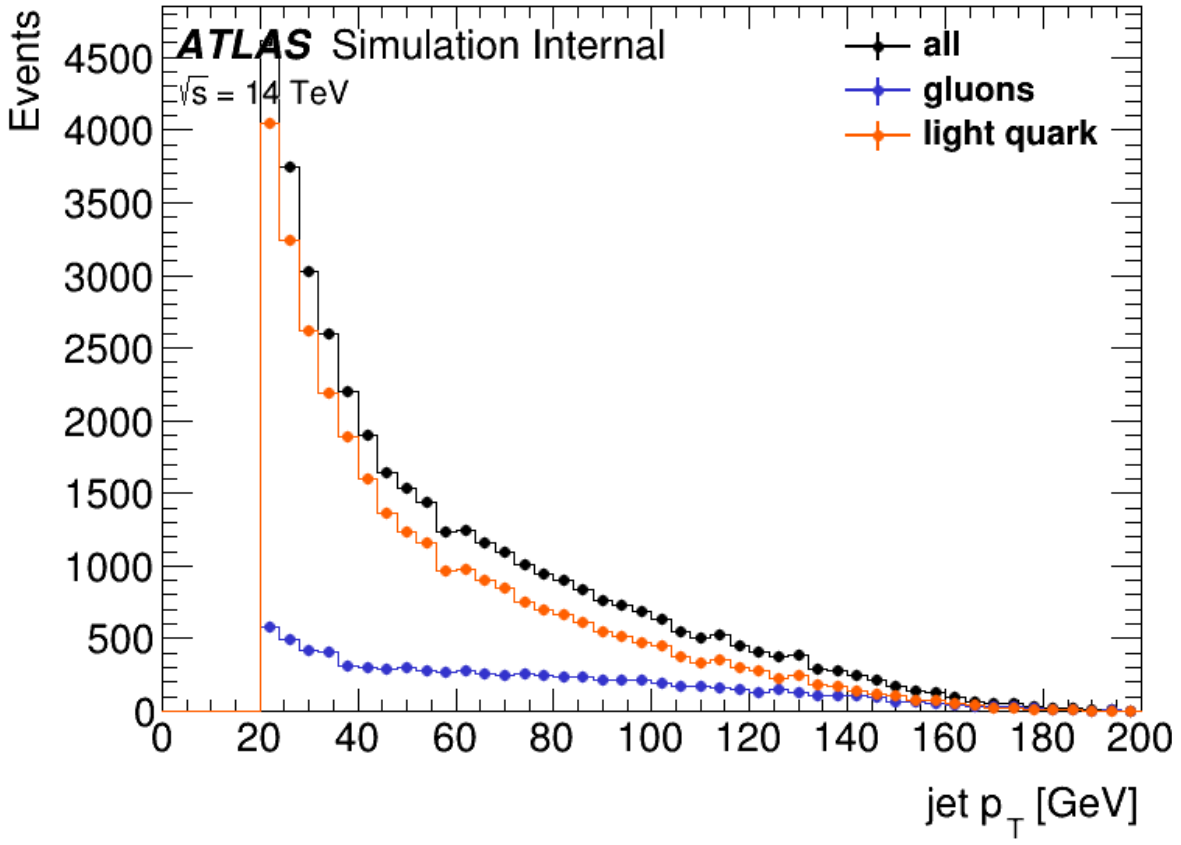
Efficiencies Quark Working Point

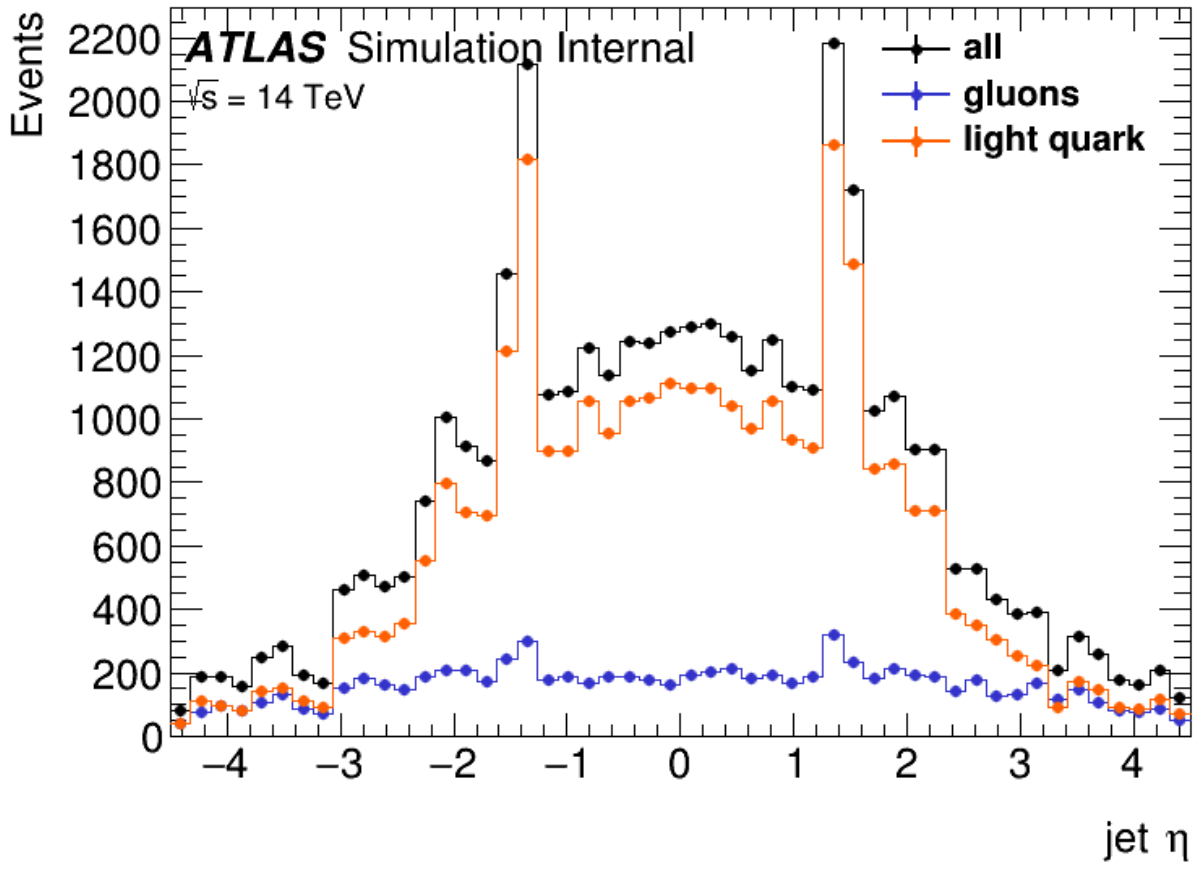


BDT Score


ATLAS Simulation Internal
√s = 14 TeV
all
gluons
light quark
Events
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1
Quark-Gluon BDT Score

And without eta requirement?





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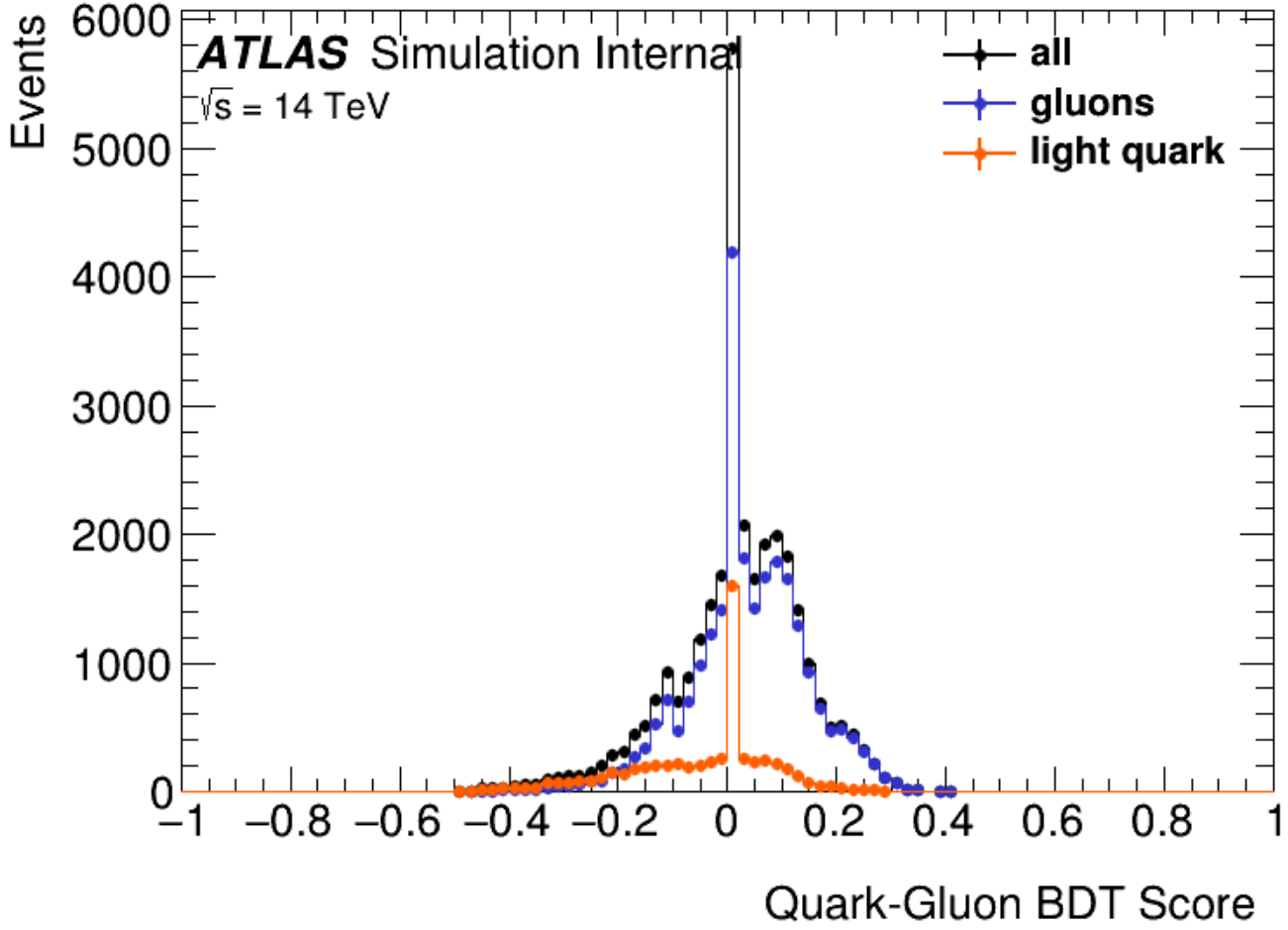
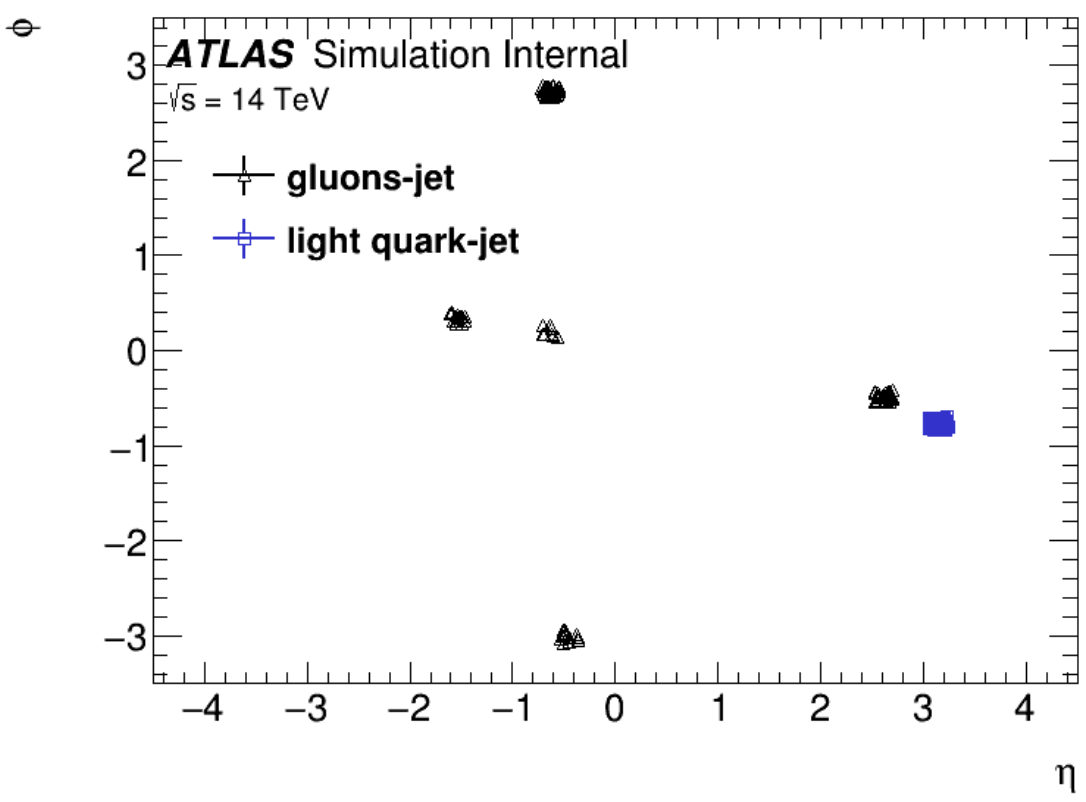
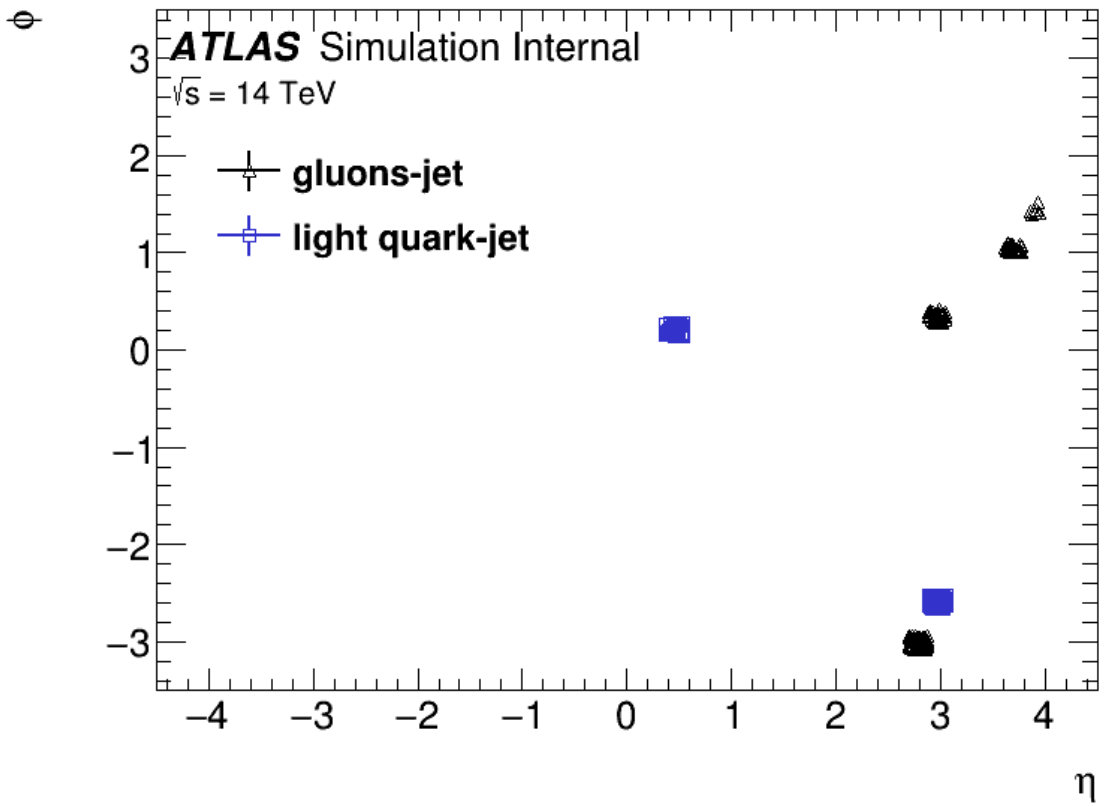
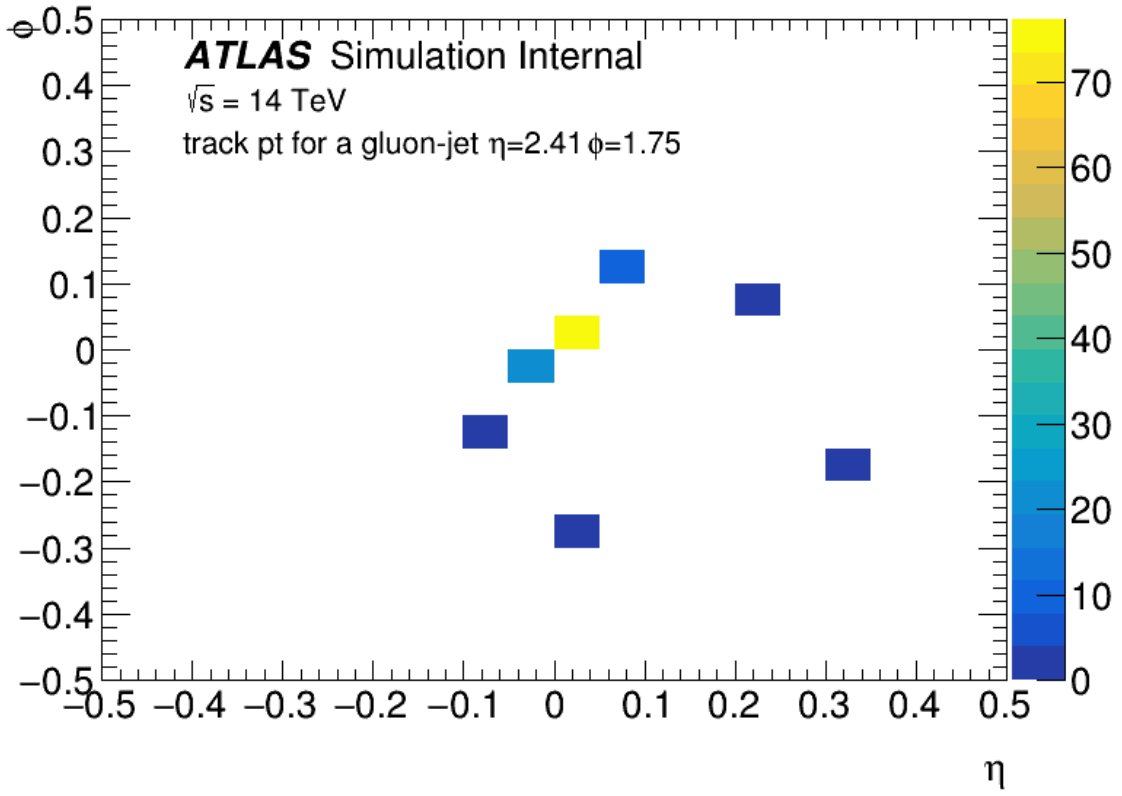


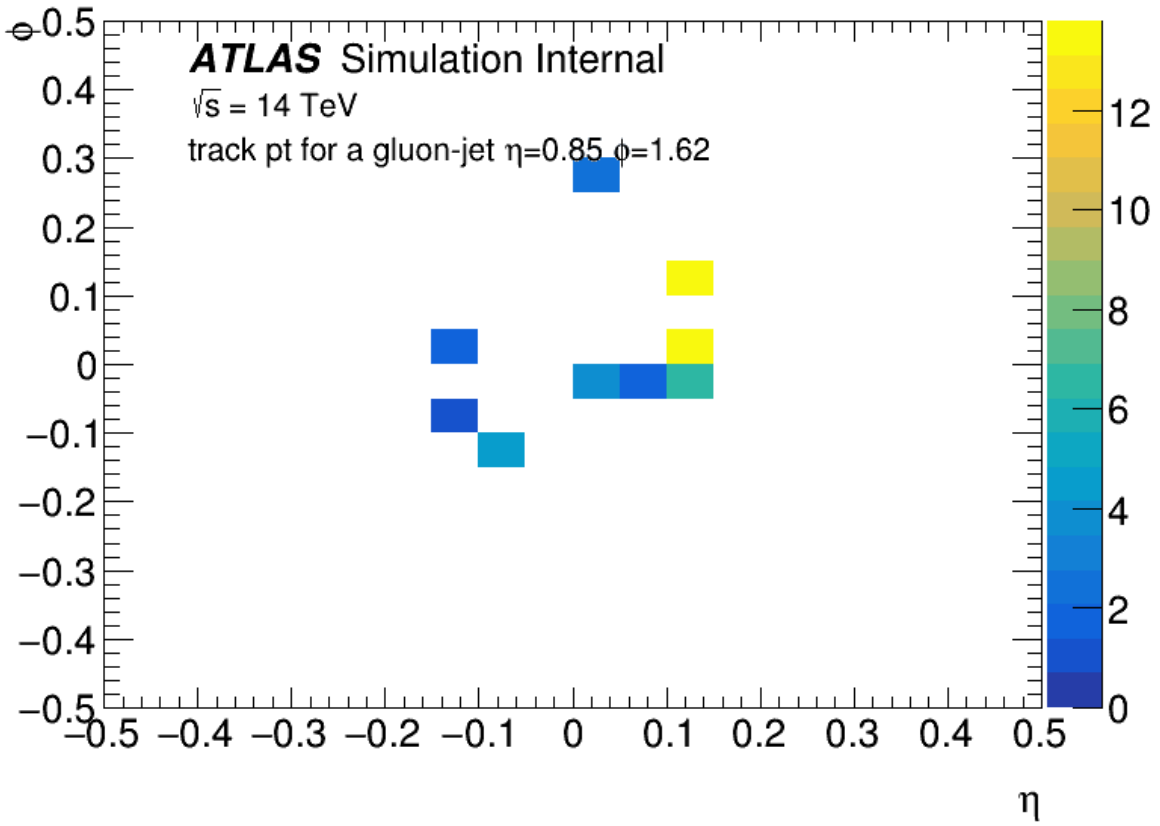
Where are located the jets?





How the tracks are distributed?





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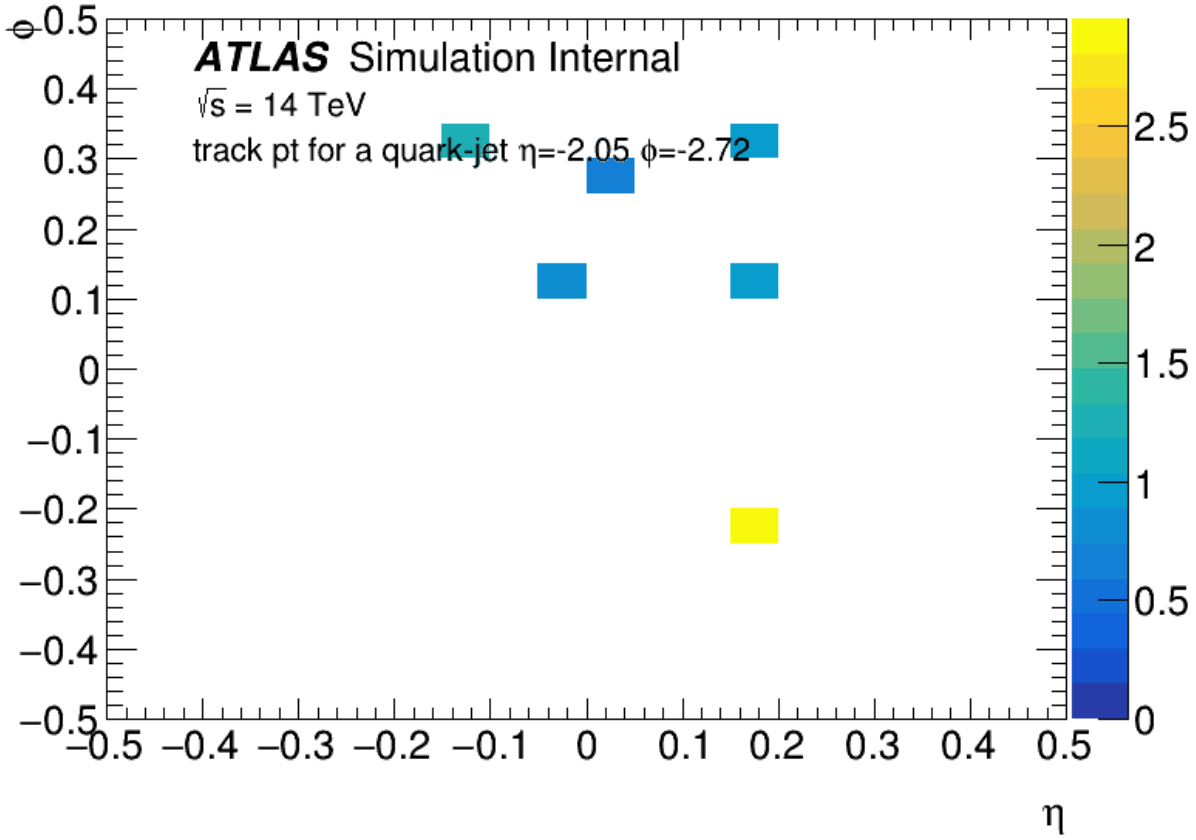
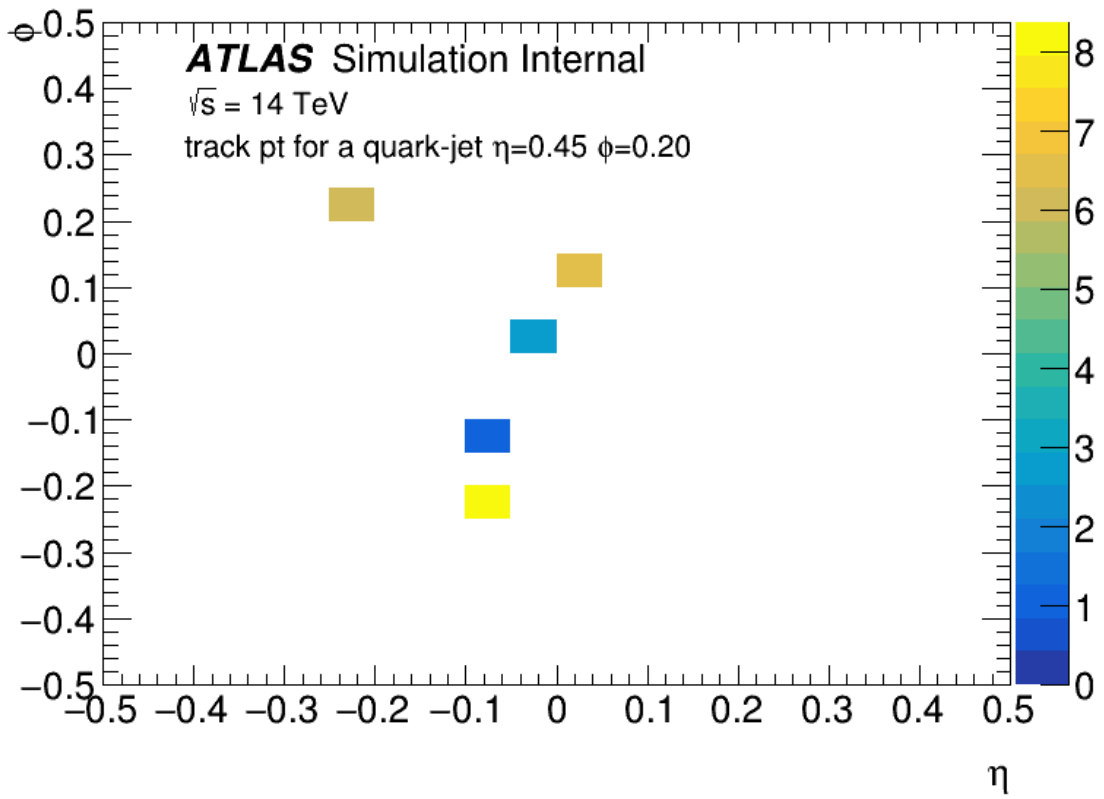
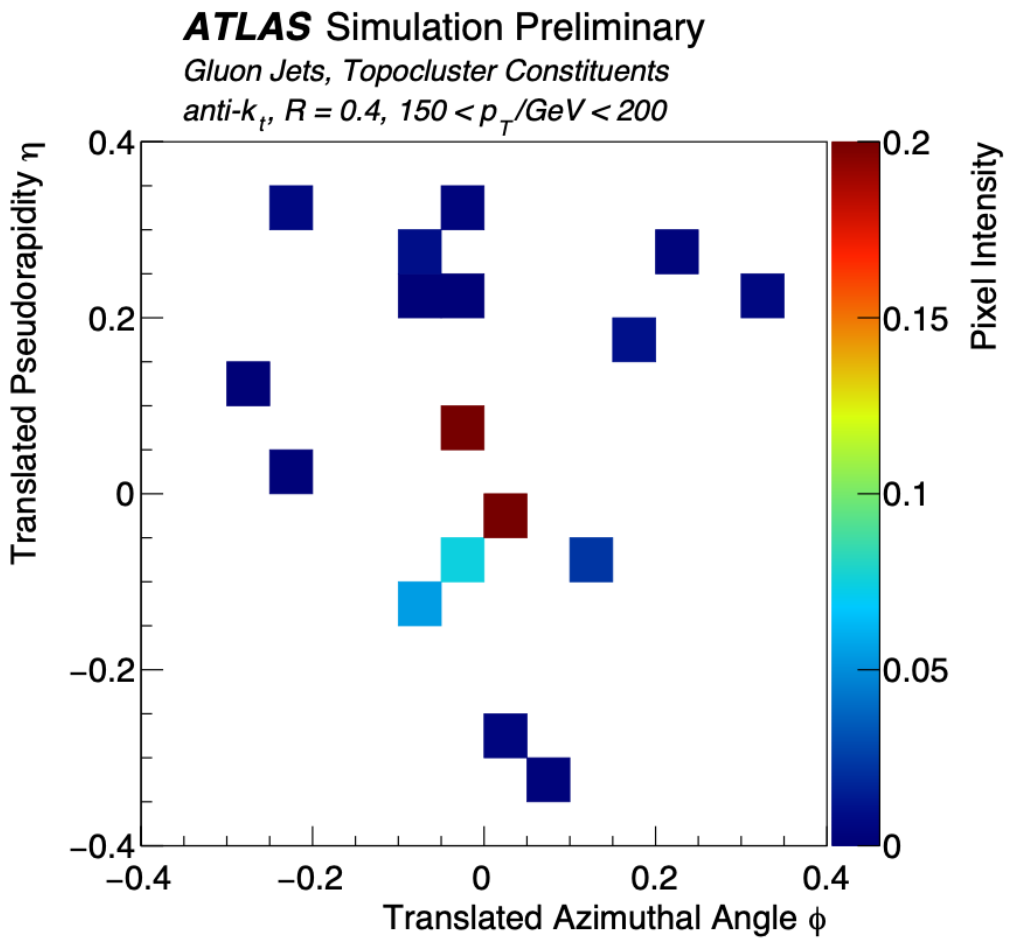
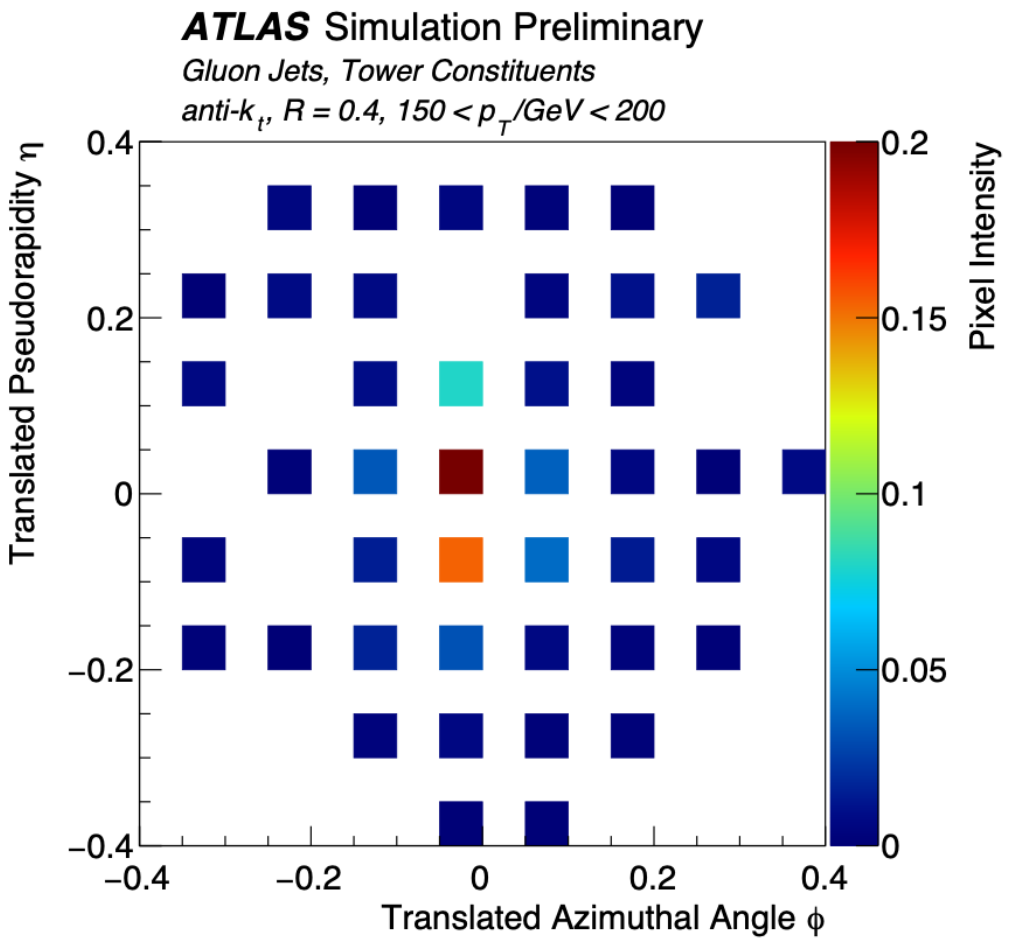




Maybe we can see more if I add more jets in the plot

Maybe try different variables





Next steps

- Define BDT for forward jets? I contacted the person doing the development for R22 still waiting the response
- Emailed to Ben Nachman for comparing my results with them, still waiting the response
- Do more maps to explore the topology of quark and gluon jets
- Contact more people?