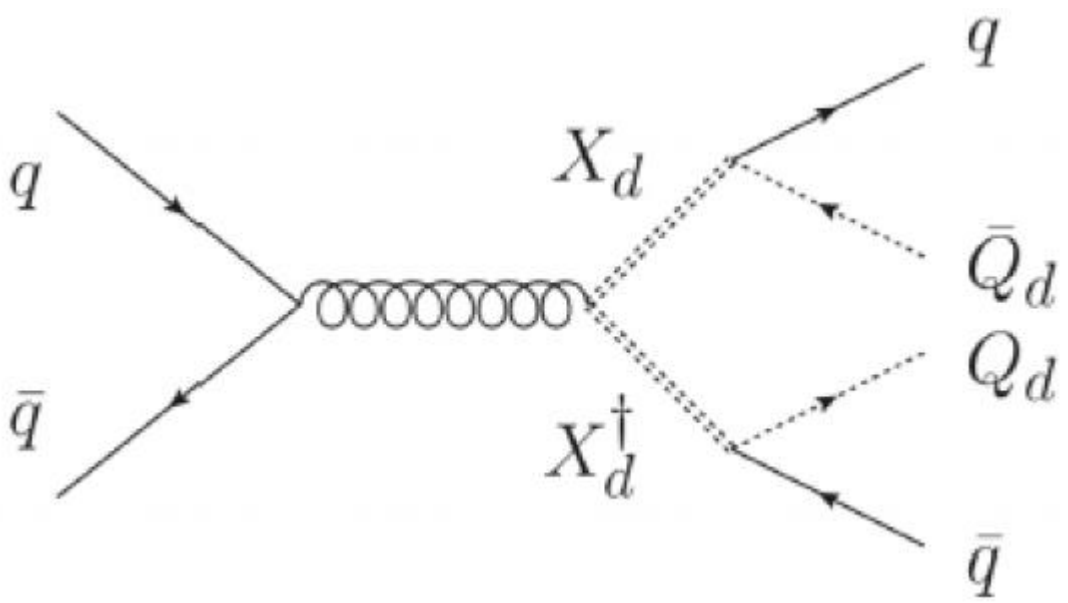
Truth Particle Statuses and IDs

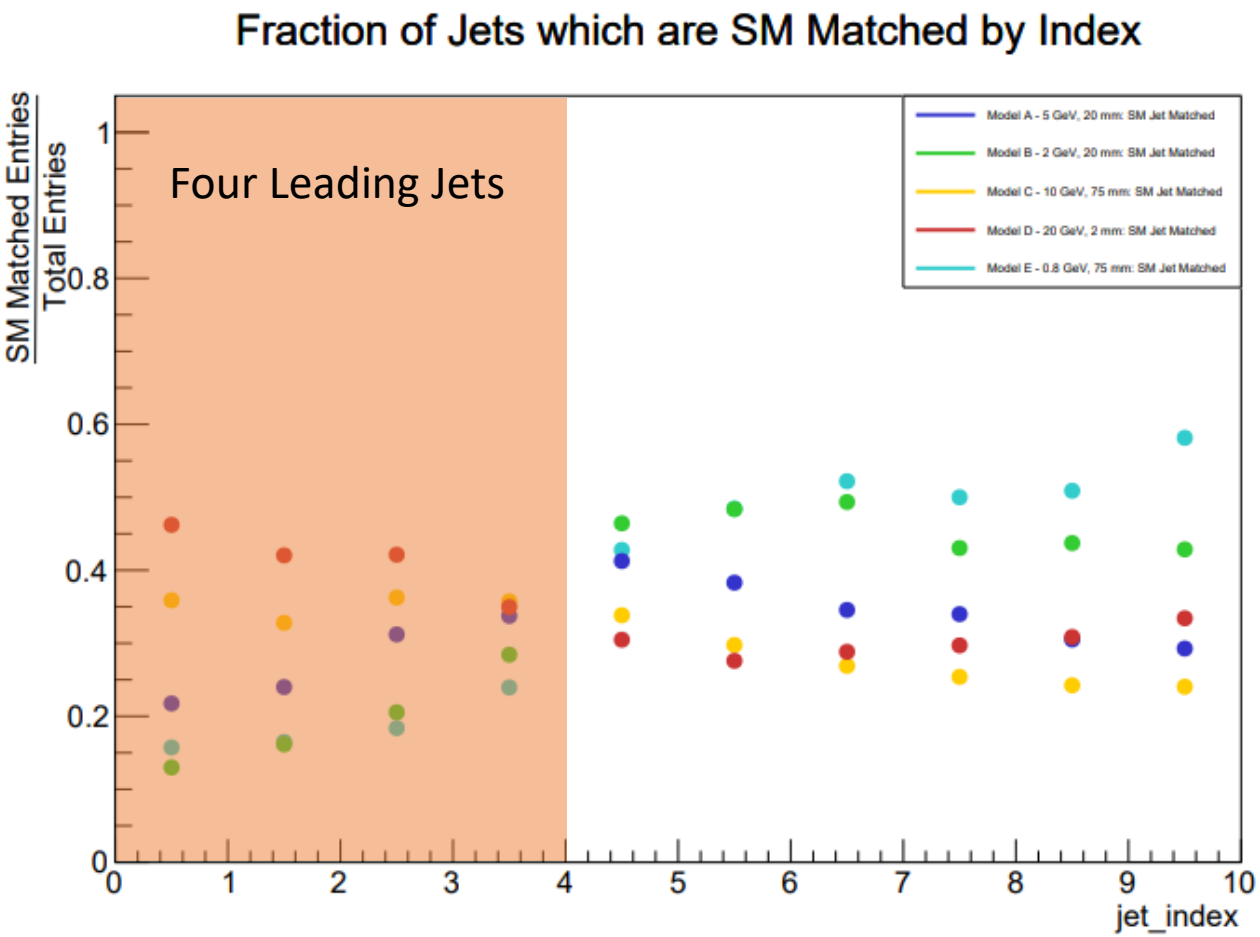
Why are there so many more dark-matched Jets?

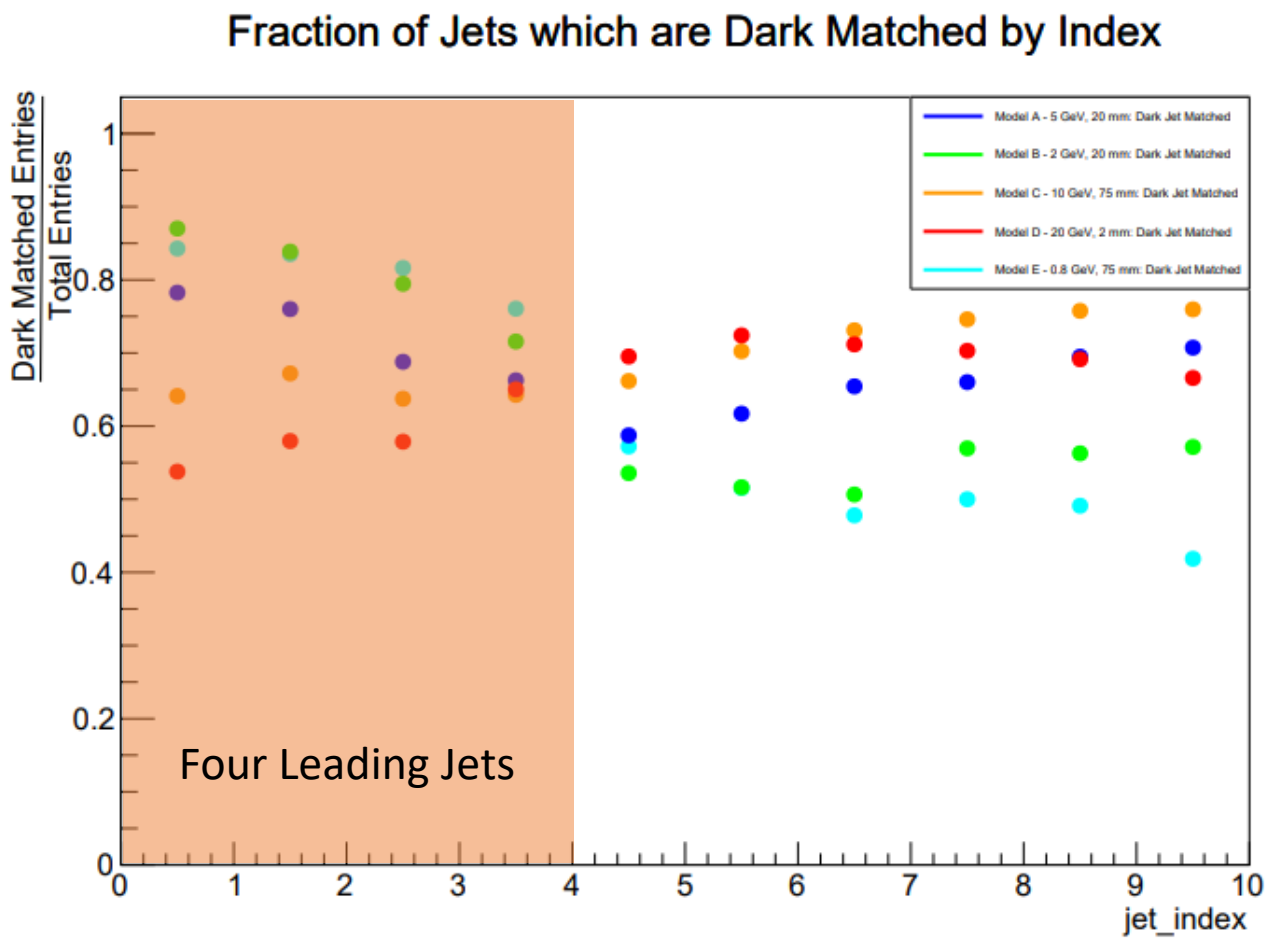
Motivation



- Would expect to have roughly equal number of QCD and Dark jets in the first four leading jets (jet index 0-3)
  - Two high-p_T jets from the SM quarks
  - Two high-p_T jets from the Dark quarks

Motivation



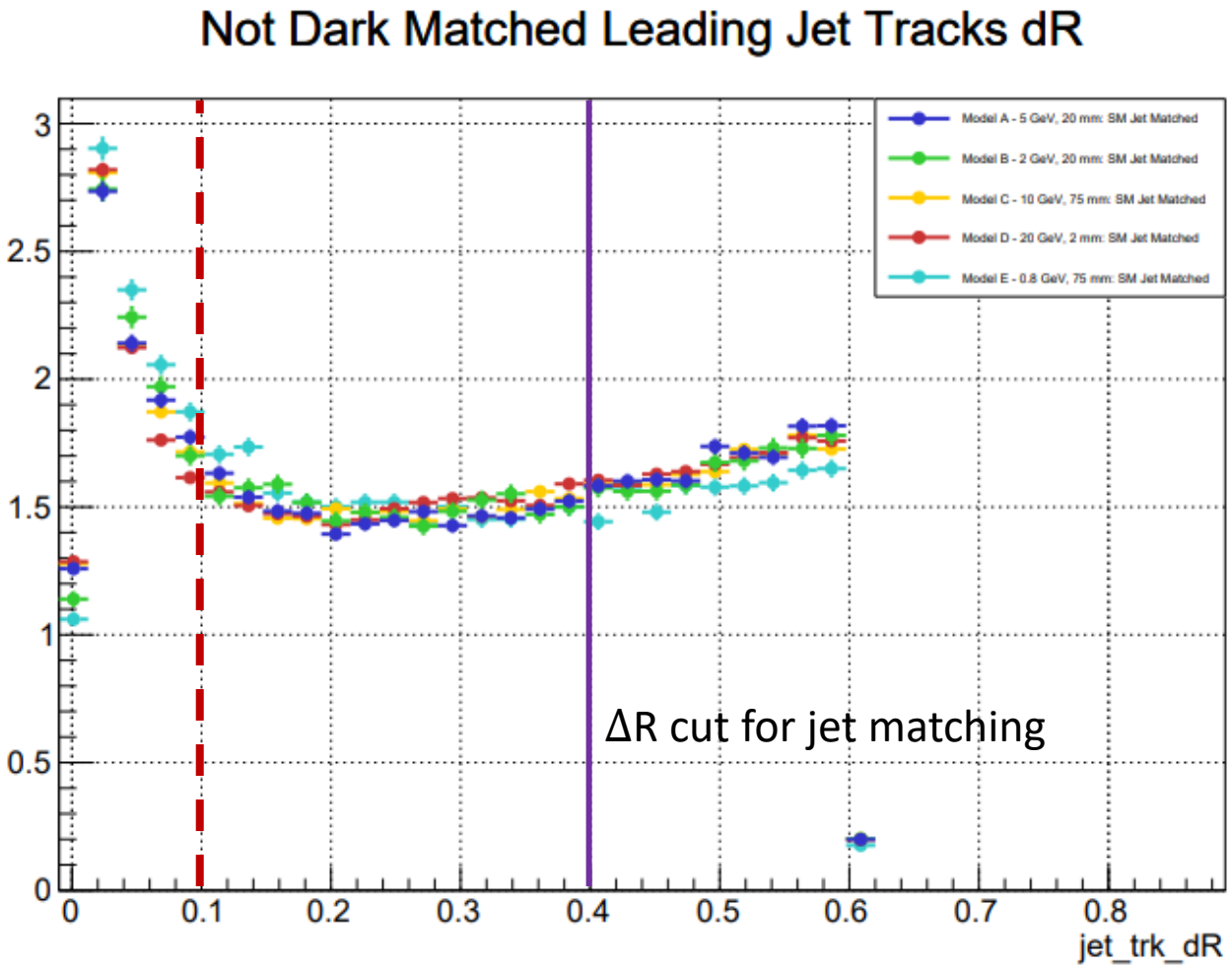


Larger fraction of the first four leading jets are dark matched

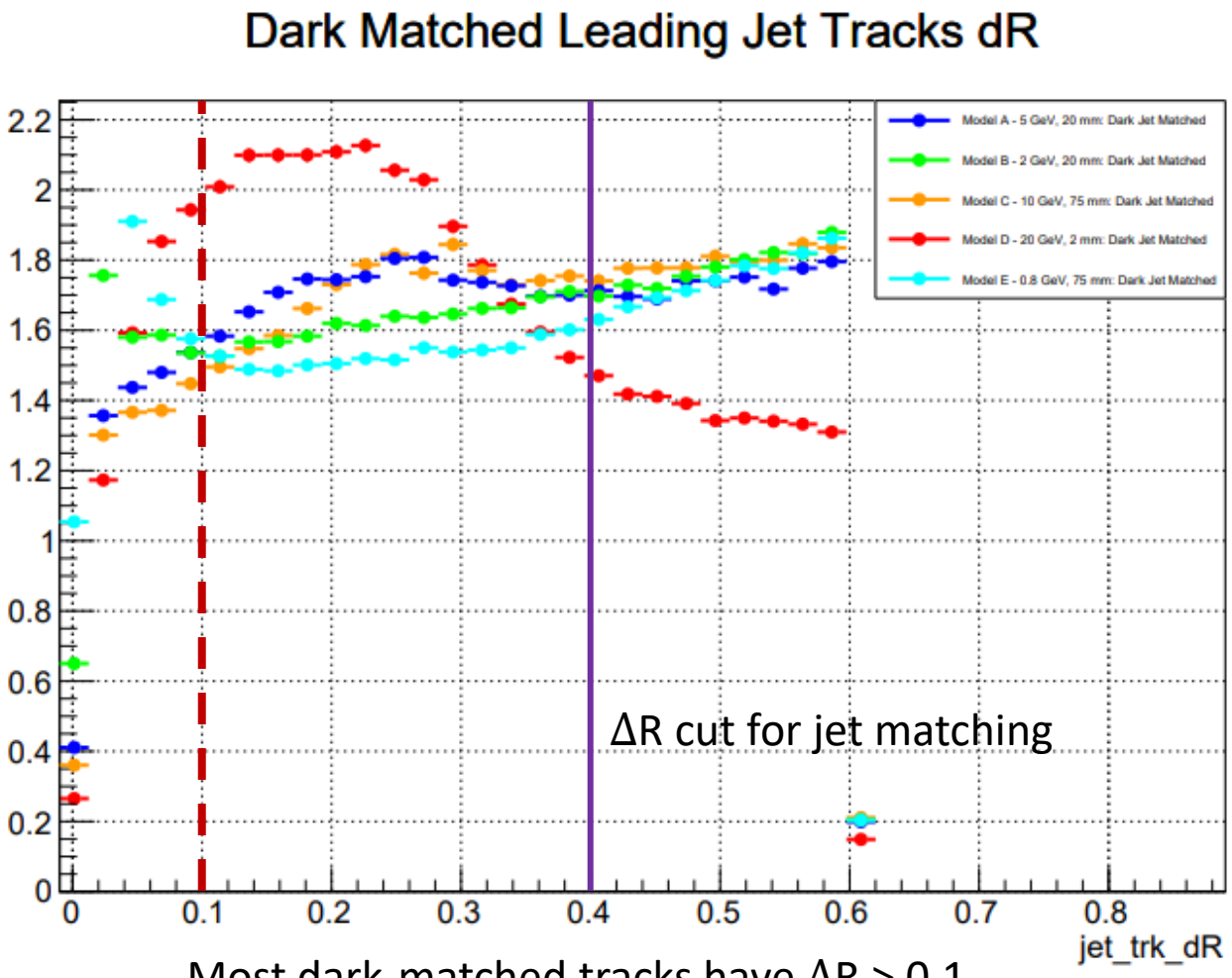
Working Assumption

- Dark Jets have larger ΔR spread when matching the constituents to the highest p_T particles
- As such, leading dark jets are being split into sub-jets, 'inflating' the fraction of jets which are dark matched with high p_T
- Note: Jet matching requires $\Delta R \leq 0.4$

Slightly unrelated but reaffirming result:



Most not dark-matched tracks have ΔR < 0.1



Most dark-matched tracks have ΔR > 0.1, especially in higher mass models

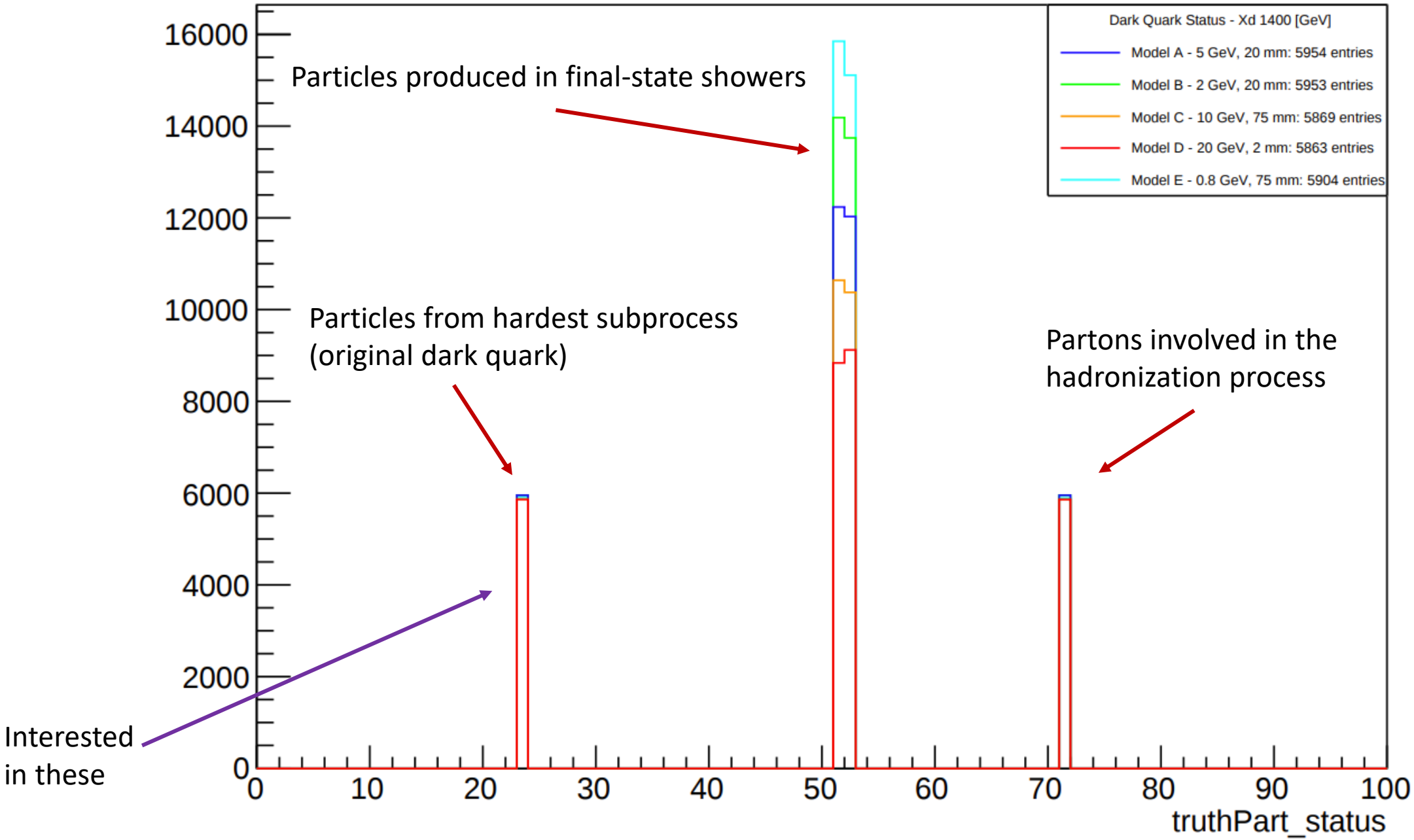
Strategy:

- Isolate the four ‘original’ quarks (using PDG ID and status)
- Loop over their children:
  - π_d and ρ_d for dark jets
  - π^+, π^-, π^0, ρ^+, and K_s for QCD jets
- Measure the ΔR spread for each case
- If dark children have larger spread, then we could conclude that they are being split more

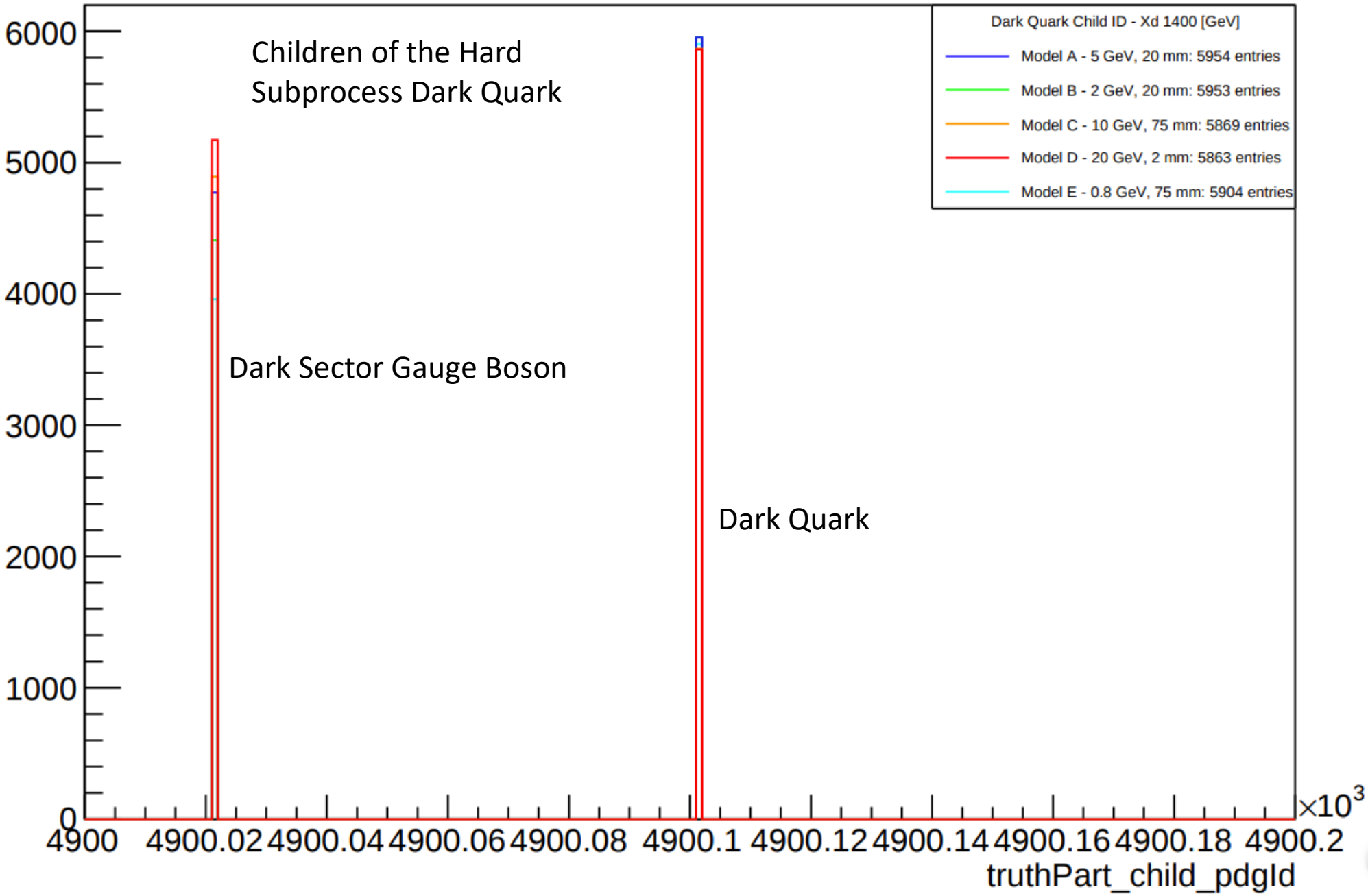
Start with dark quarks

Dark quark PDG ID = 4900101

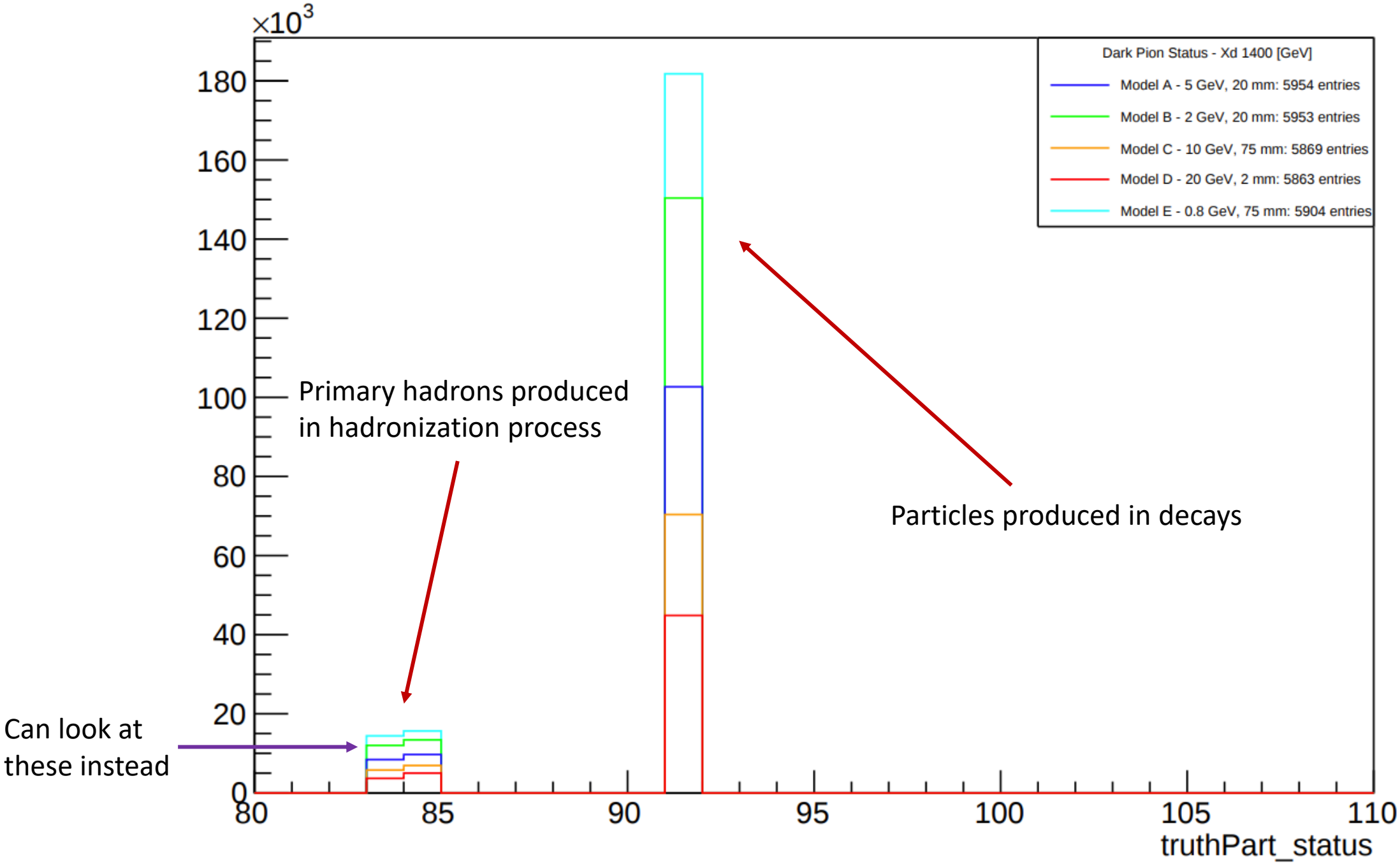
Truth Particle Status for Dark Quarks



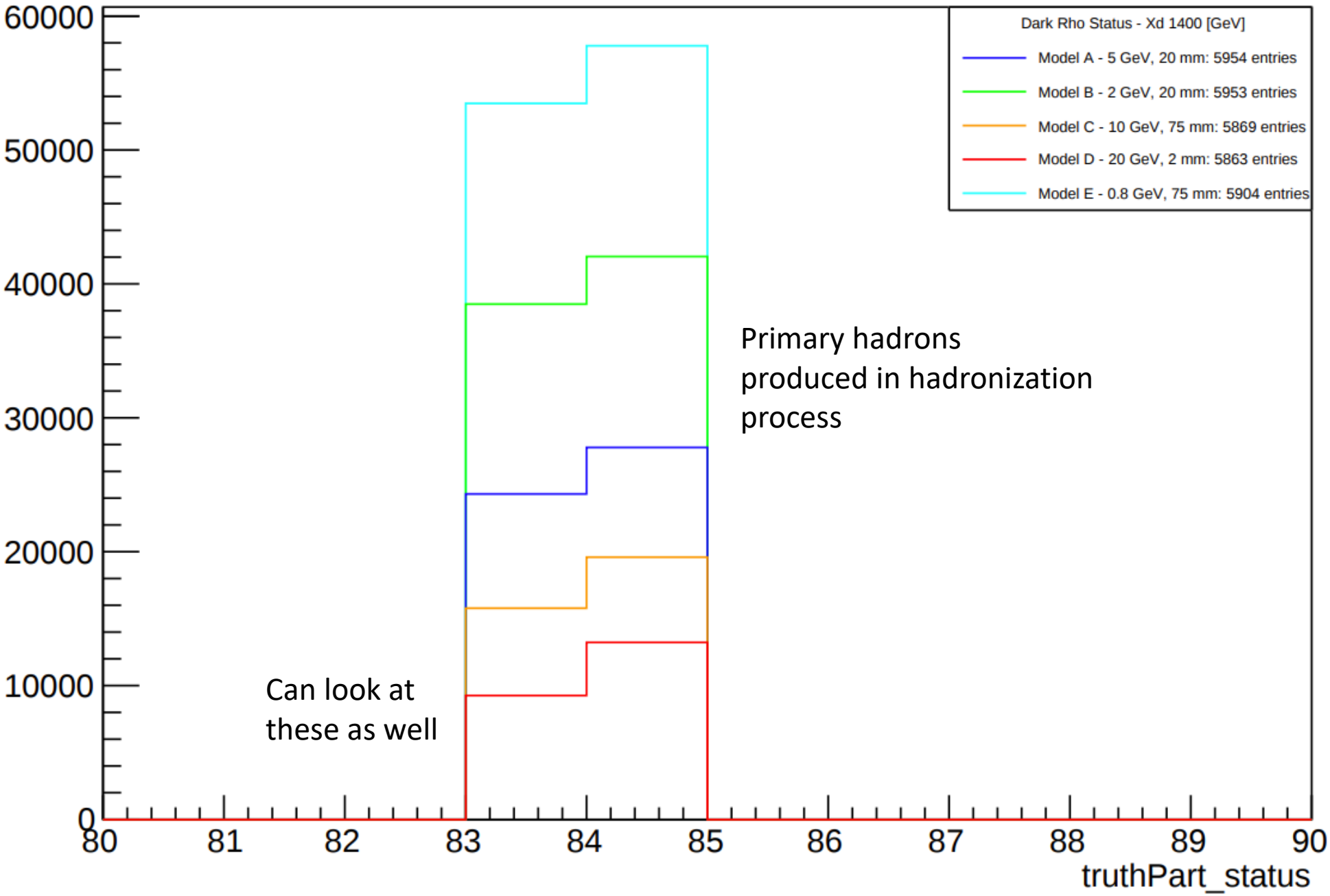
Truth Particle Child PDG ID



Truth Dark Pion Status



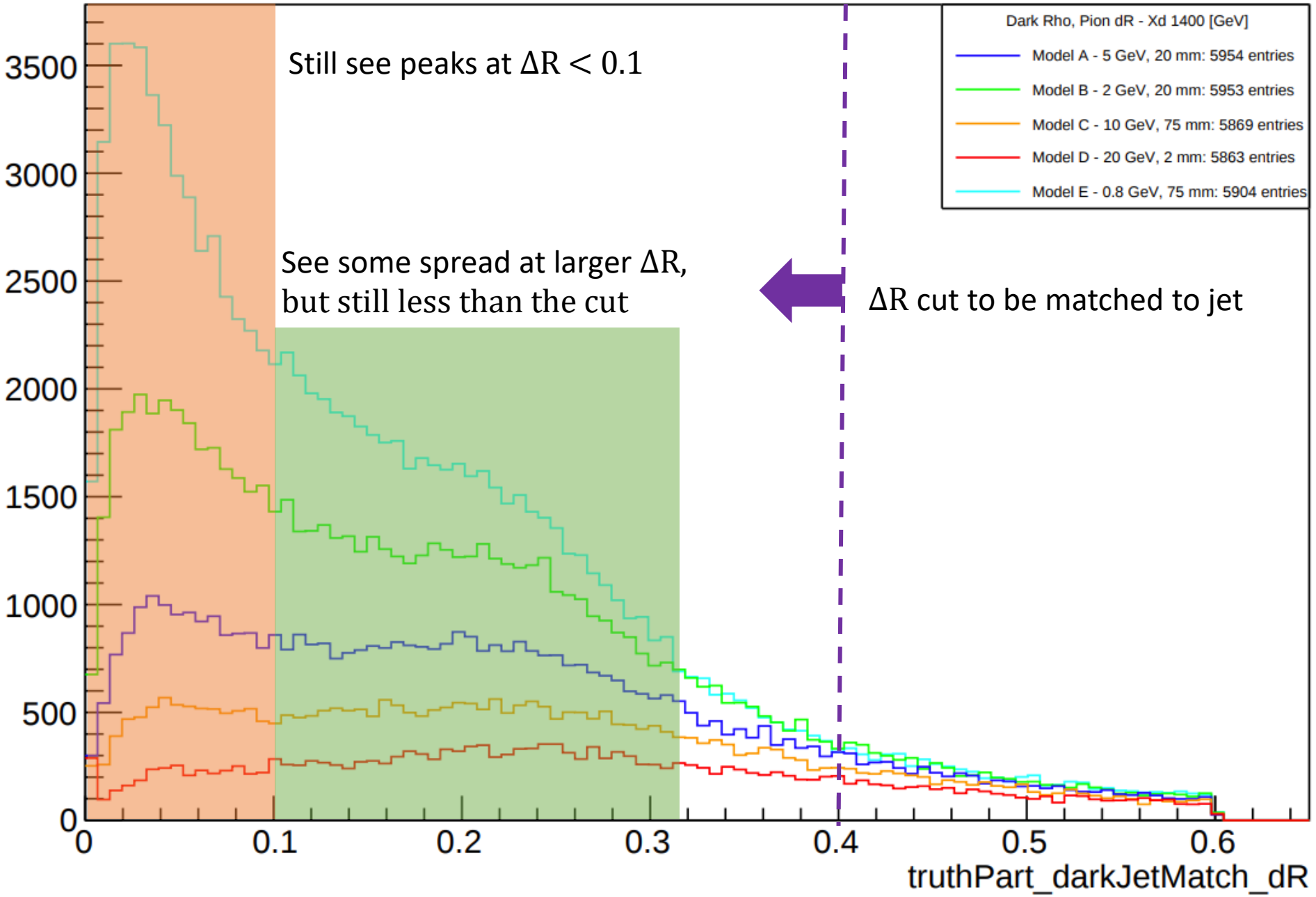
Truth Dark Rho Status



Primary hadrons produced in hadronization process

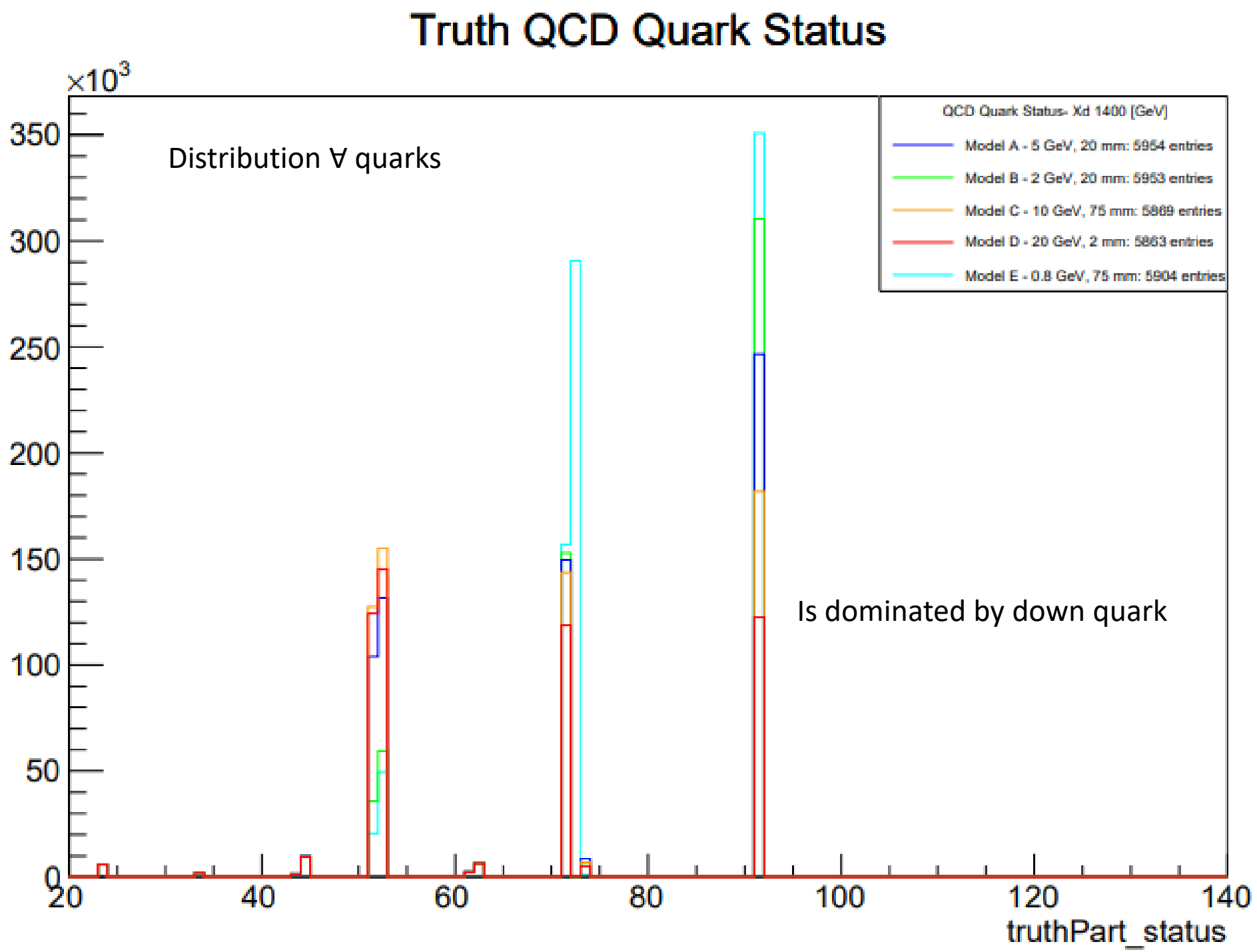
Can look at these as well

Truth Dark Rho and Pion Dark Jet Matched dR

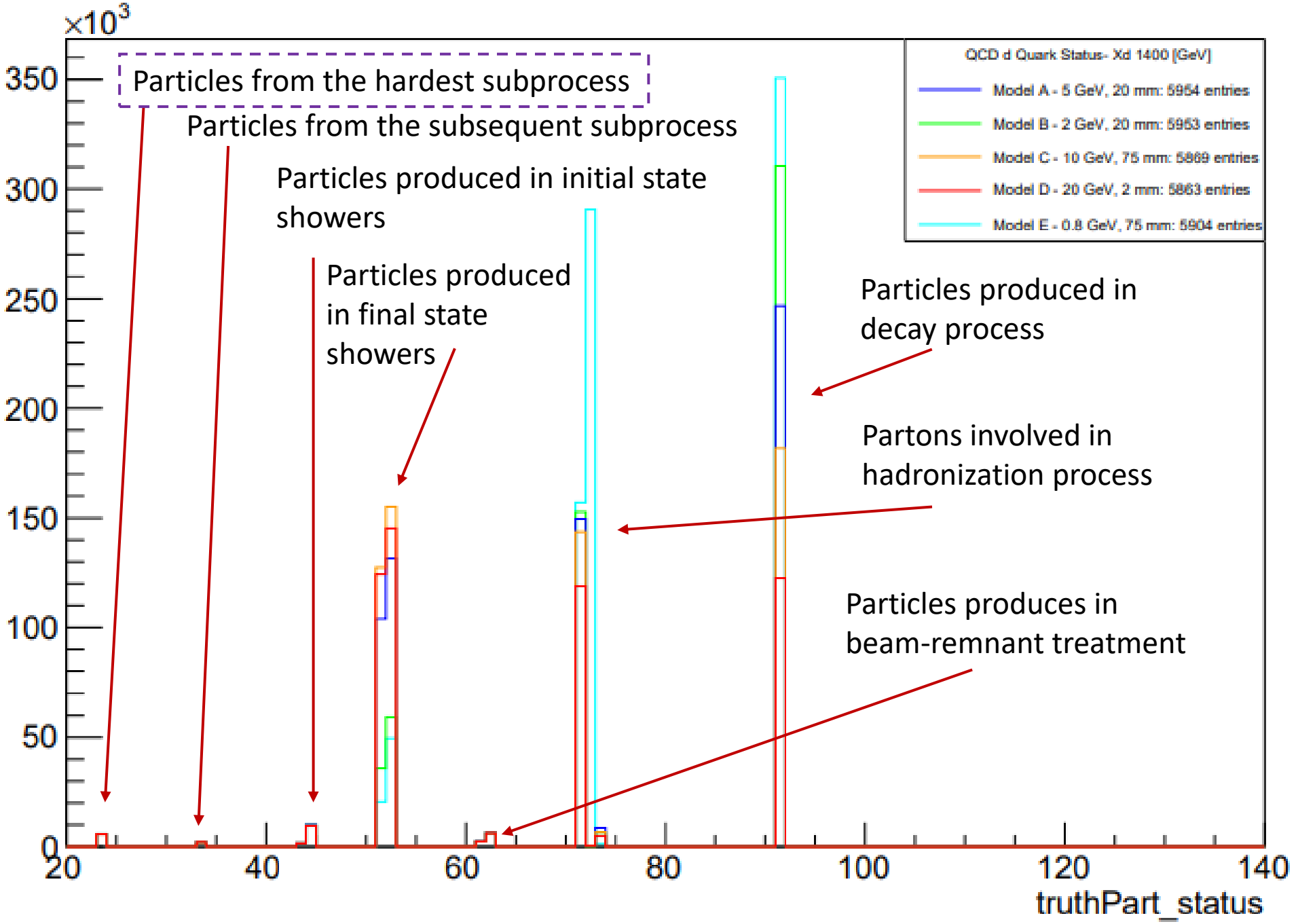


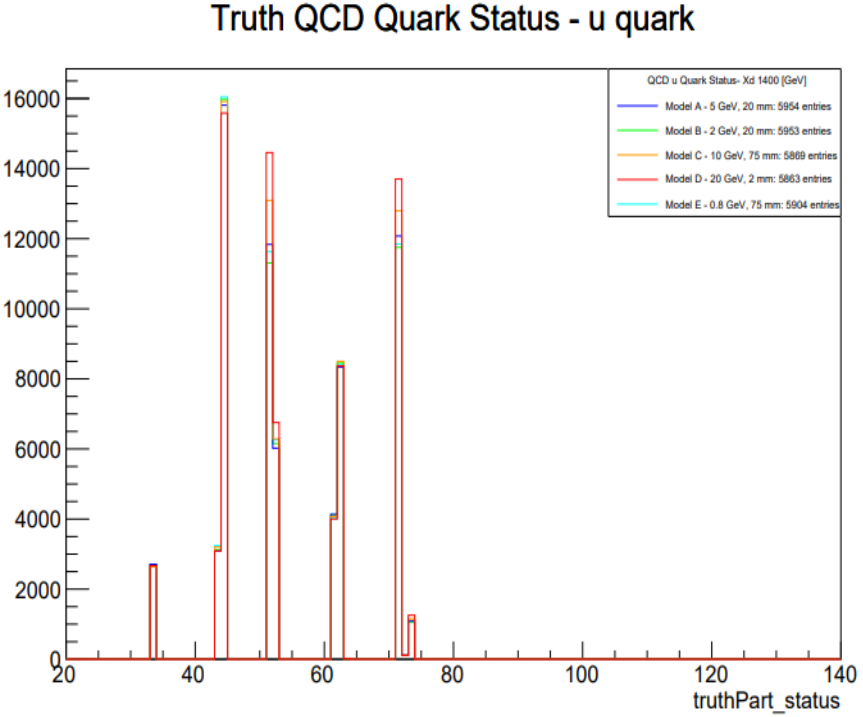
Now QCD quarks

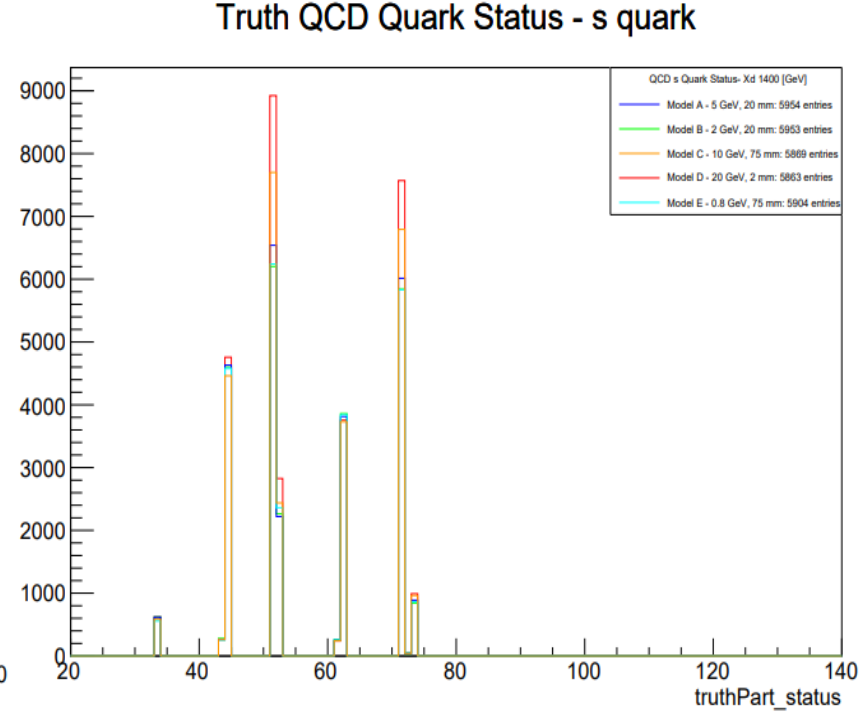
Quark PDG IDs go from 1 (d) to 6 (t) in order of mass

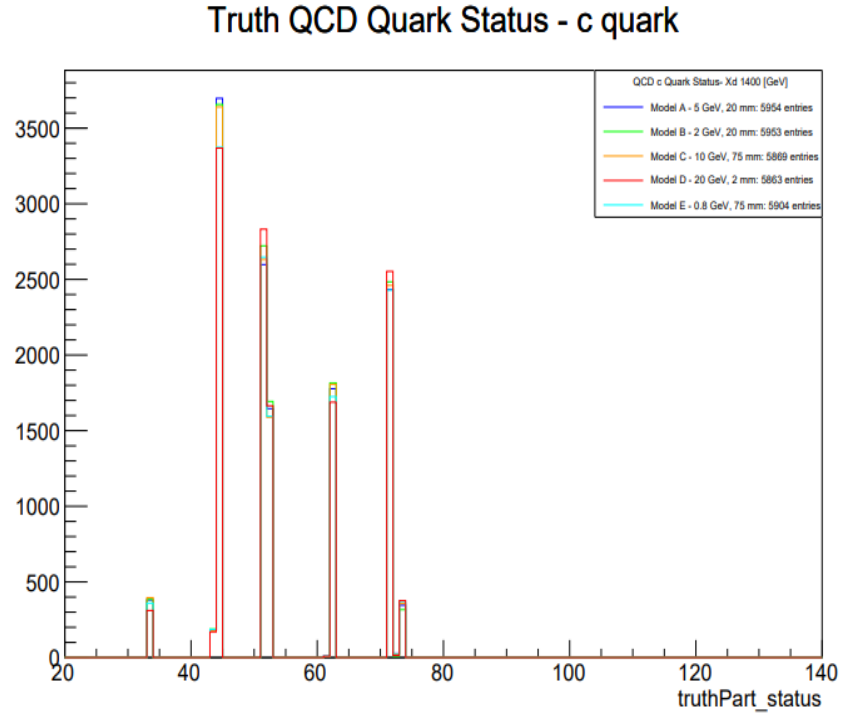

Truth QCD Quark Status
×10^3
350
300
250
200
150
100
50
0
20
40
60
80
100
120
140
truthPart_status
QCD Quark Status- Xd 1400 [GeV]
Model A - 5 GeV, 20 mm: 5954 entries
Model B - 2 GeV, 20 mm: 5953 entries
Model C - 10 GeV, 75 mm: 5869 entries
Model D - 20 GeV, 2 mm: 5863 entries
Model E - 0.8 GeV, 75 mm: 5904 entries
Distribution ∀ quarks
Is dominated by down quark

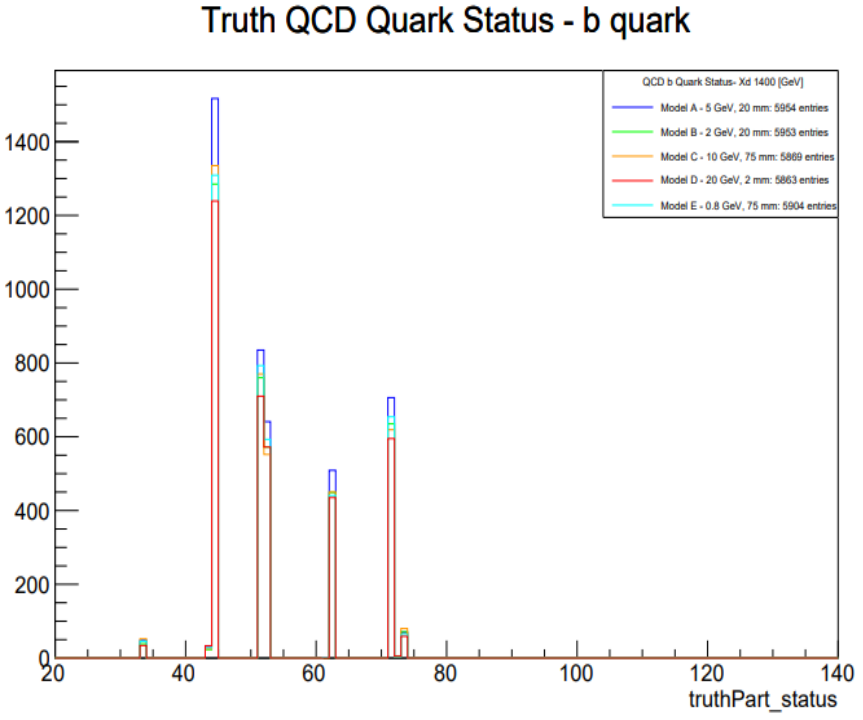
Truth QCD Quark Status - d quark

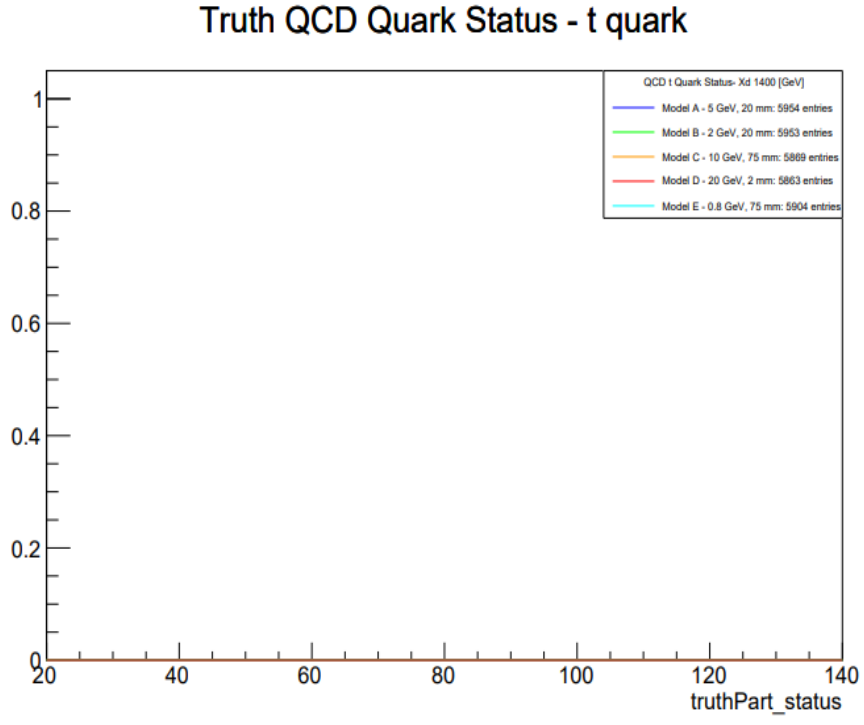








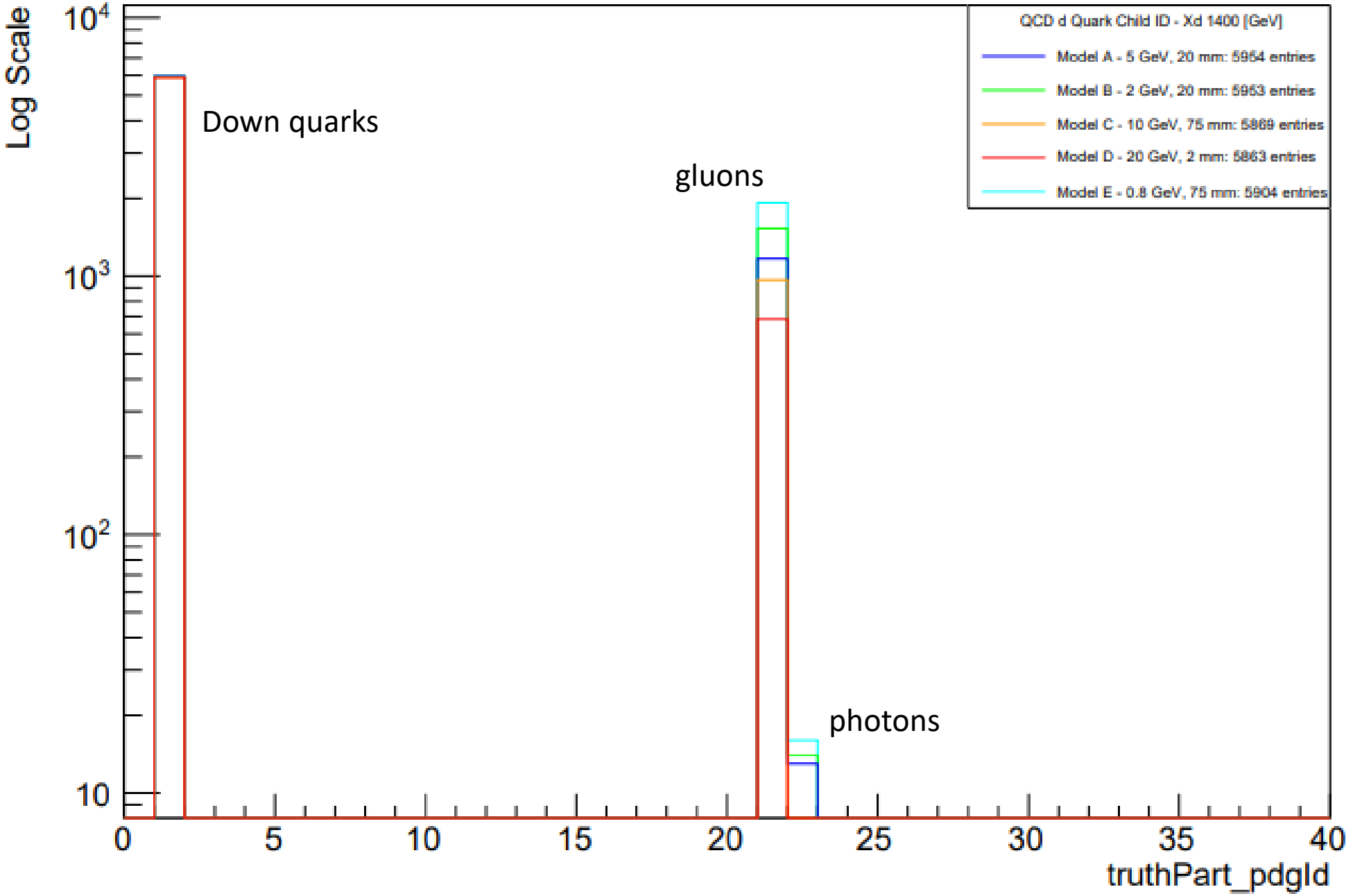


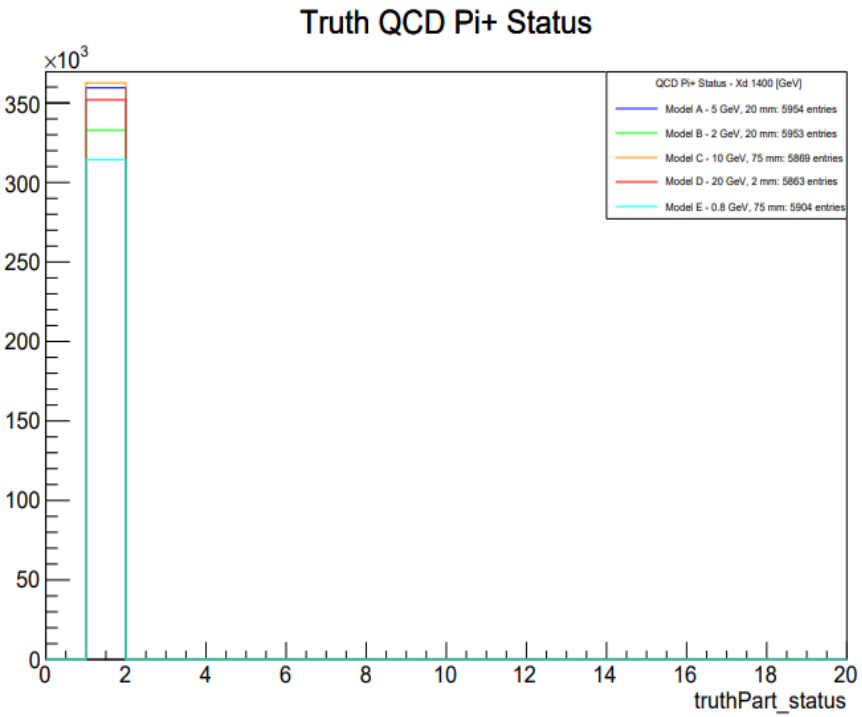


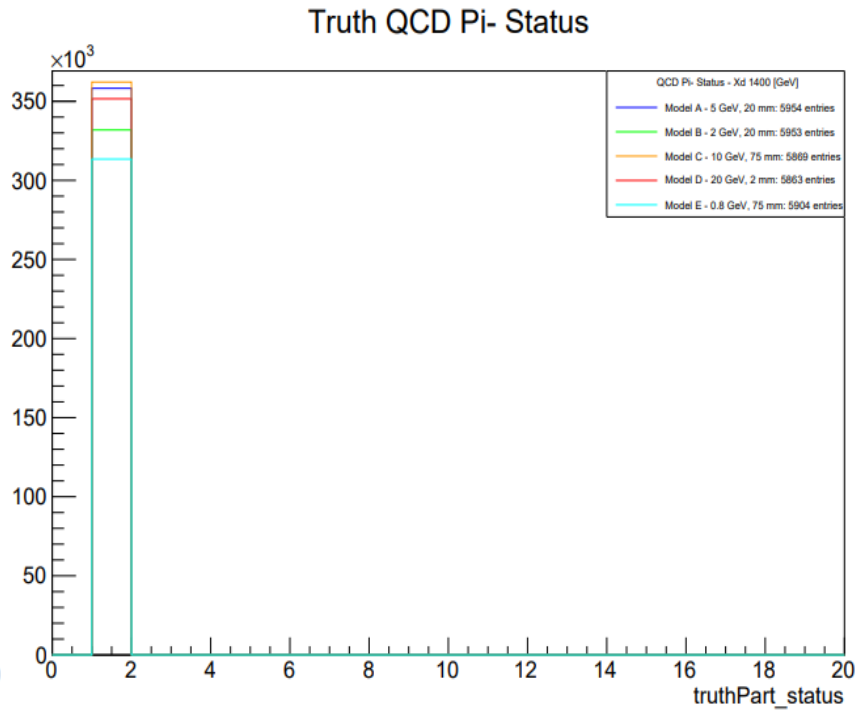
None of the other quarks are involved in the hardest subprocess

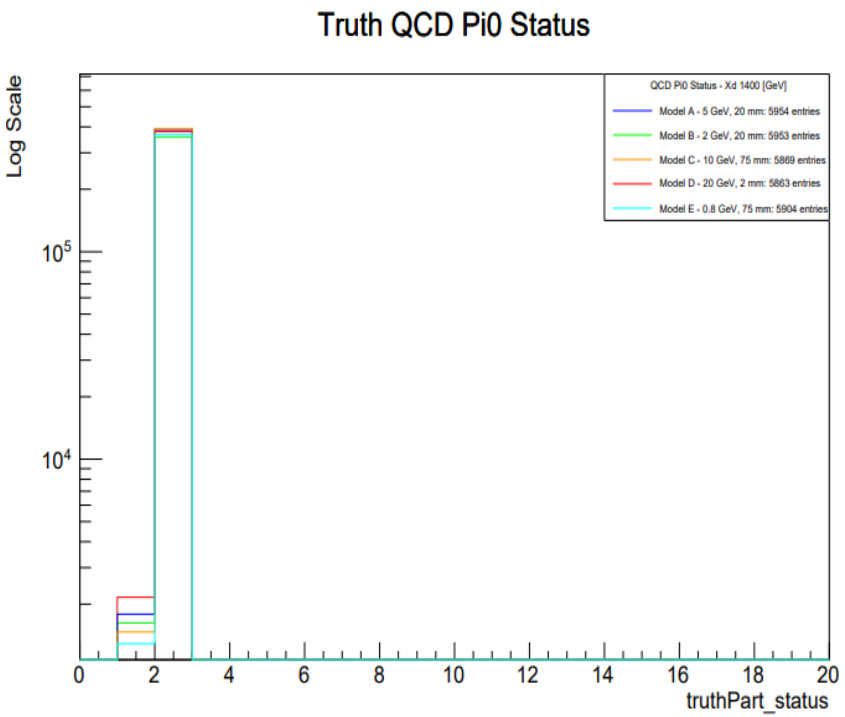
Most of these quarks are produced in initial and final state showers, or in the hadronization process

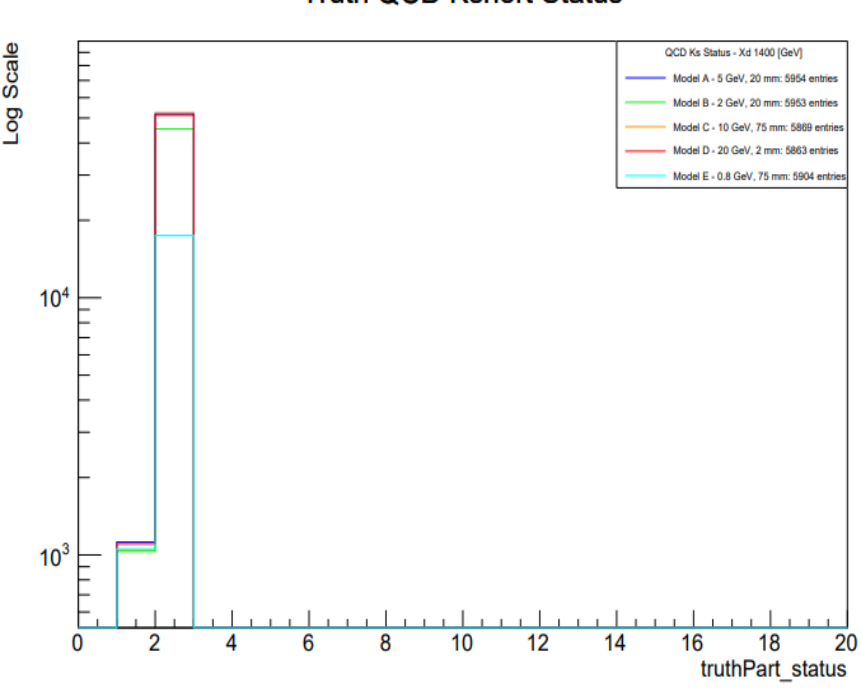
Truth QCD Quark Child PDG ID

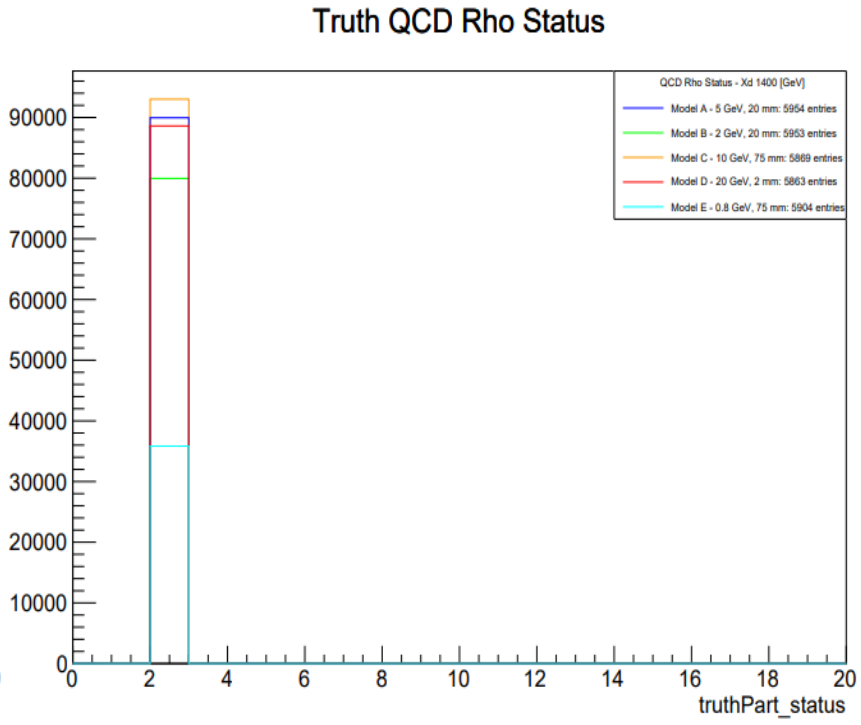












All of the QCD hadrons have statuses of 1 or 2 which do not correspond to any flag (at least in the source that I found)

Useful Resources

- Particle Status Legend: http://home.thep.lu.se/~torbjorn/pythia81html/ParticleProperties.html
- PDG ID Legend: http://pdg.lbl.gov/2018/reviews/rpp2018-rev-monte-carlo-numbering.pdf
- Hidden Valley MC Twiki: https://twiki.cern.ch/twiki/bin/view/Sandbox/HiddenValleyPythia8
- Dark Sector PDG IDs: http://home.thep.lu.se/~torbjorn/pythia81html/ParticleData.html
- Brandon's PDG ID Talk: https://indico.cern.ch/event/924497/contributions/3884716/attachments/2047883/3431760/ejets_pdgId.pdf