Fragmentation function performance

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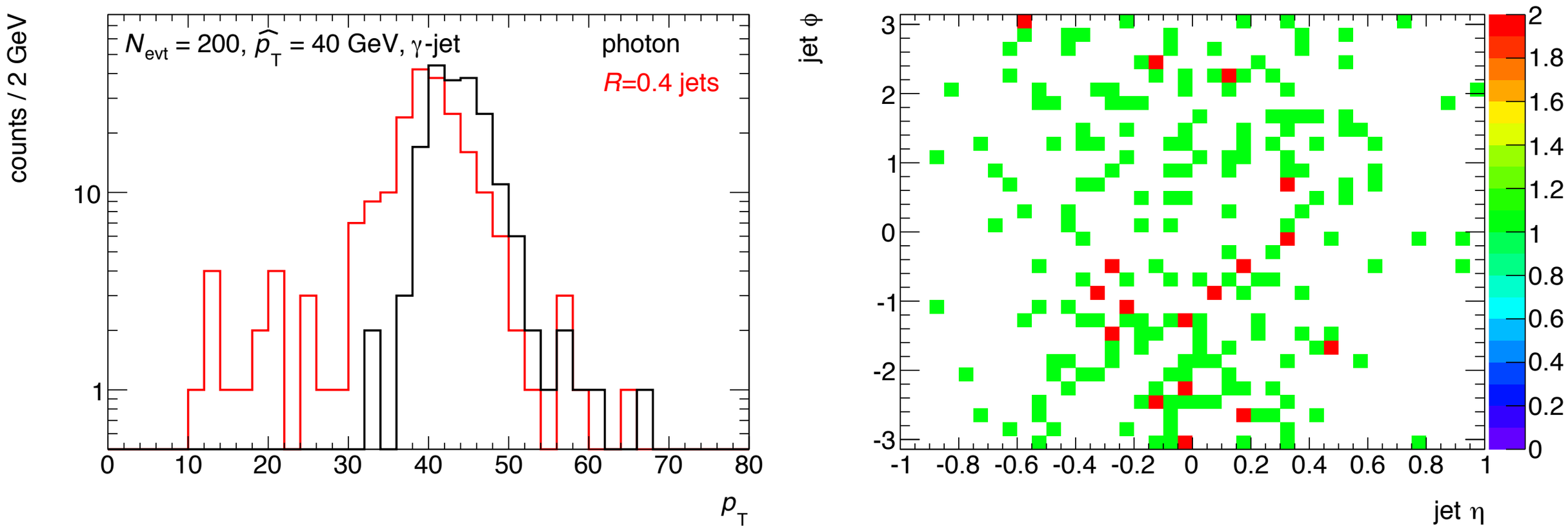
MC samples

- N_{evt} = 200 Pythia 8, photon-jet events
  - ➡ PromptPhoton:qg2qgamma and PromptPhoton:qqbar2ggamma
  - ➡ PhaseSpace:pTHatMin = 40 GeV
- Three different “HI background” levels:
  - ➡ pure Pythia
  - ➡ embedded into sHijing *b*=8fm (29% central, according to Glauber)
  - ➡ embedded into sHijing *b*=4fm (7% central)
- G4 simulation of three different tracking setups (no calo sim):
  - ➡ G4_Svtx.C : ideal “MIE setup”, 7 layers w/o inefficiency or ganging
  - ➡ G4_Svtx_pixels+strips.C : VTX setup with realistic dead areas / inefficiency in all layers, and ganged readout on the strips
  - ➡ G4_Svtx_ITS.C : mock-up inner+outer layer ITS, using it out of the box for now — work by Tony/Mike/Darren to integrate real desc.
- So for the same PYTHIA event, have nine “versions” of simulated event

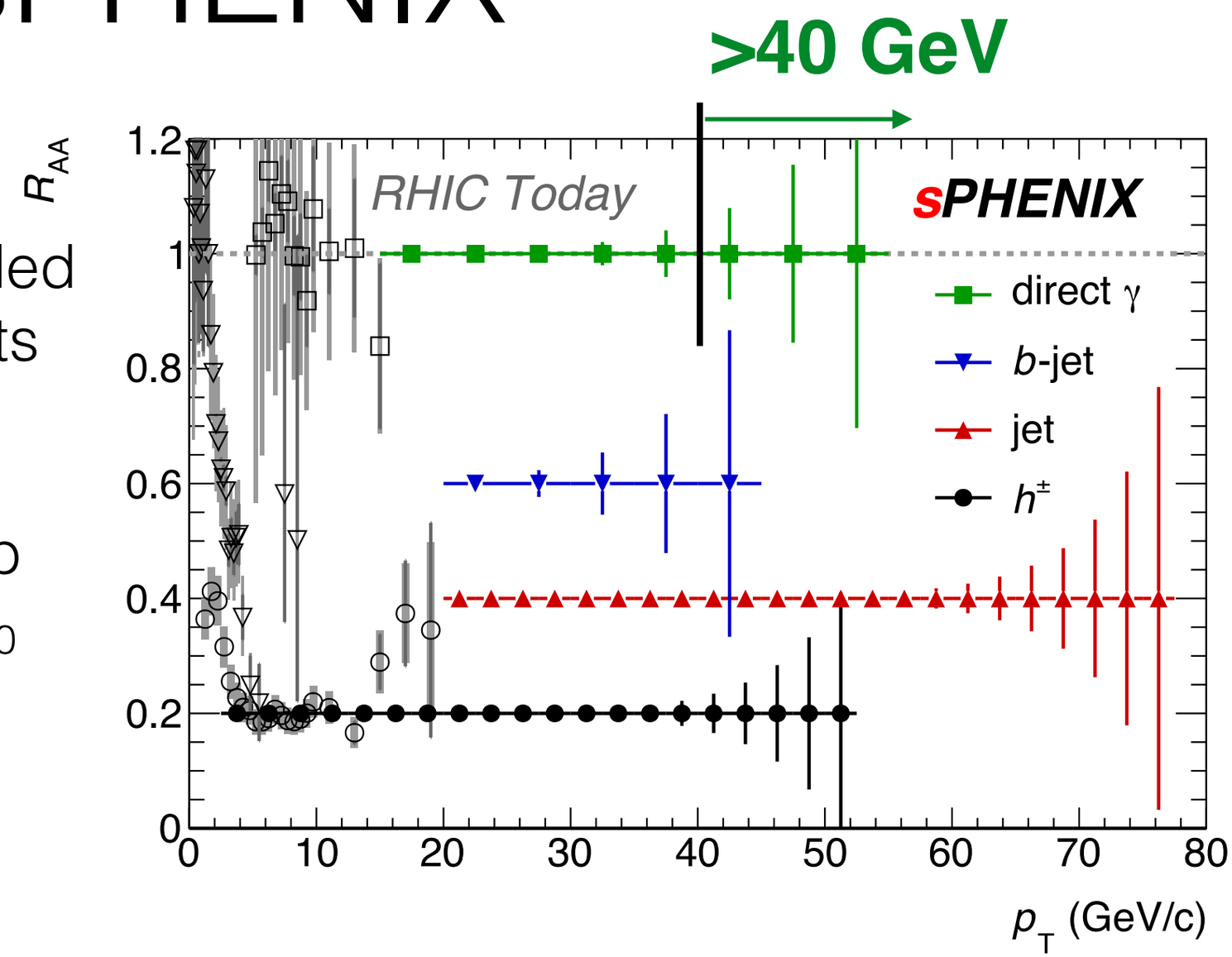
Photon and jet kinematics



- Left: p_T distribution for R=0.4 truth jets (run ONLY on Pythia particles) and photons
  - ➡ typically one non-photon truth jet with p_T > 10 GeV per event, but occasionally two
- Center and right: η/ϕ distributions for truth jets and photons
  - ➡ checked that truth quantities are identical for all nine samples
- N_{evt} = 200 is very modest, can still scale up

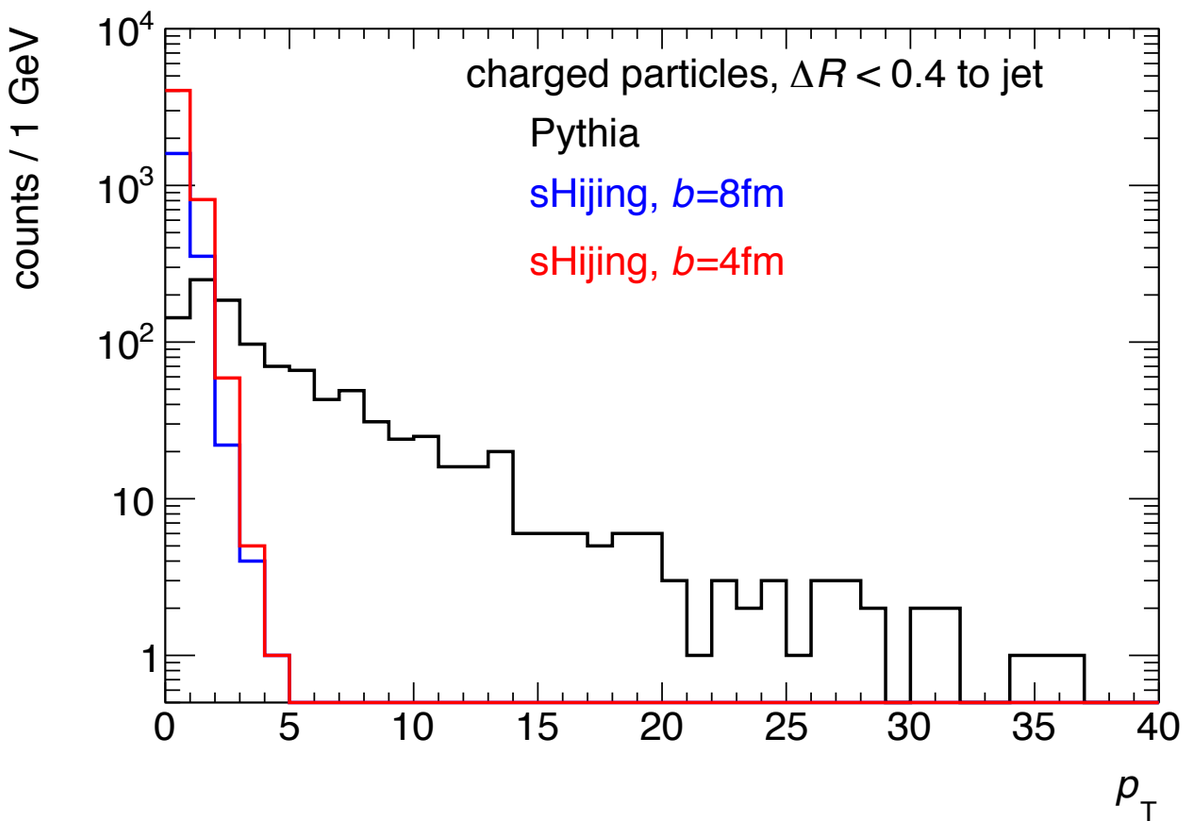
40 GeV photon-jet events in sPHENIX

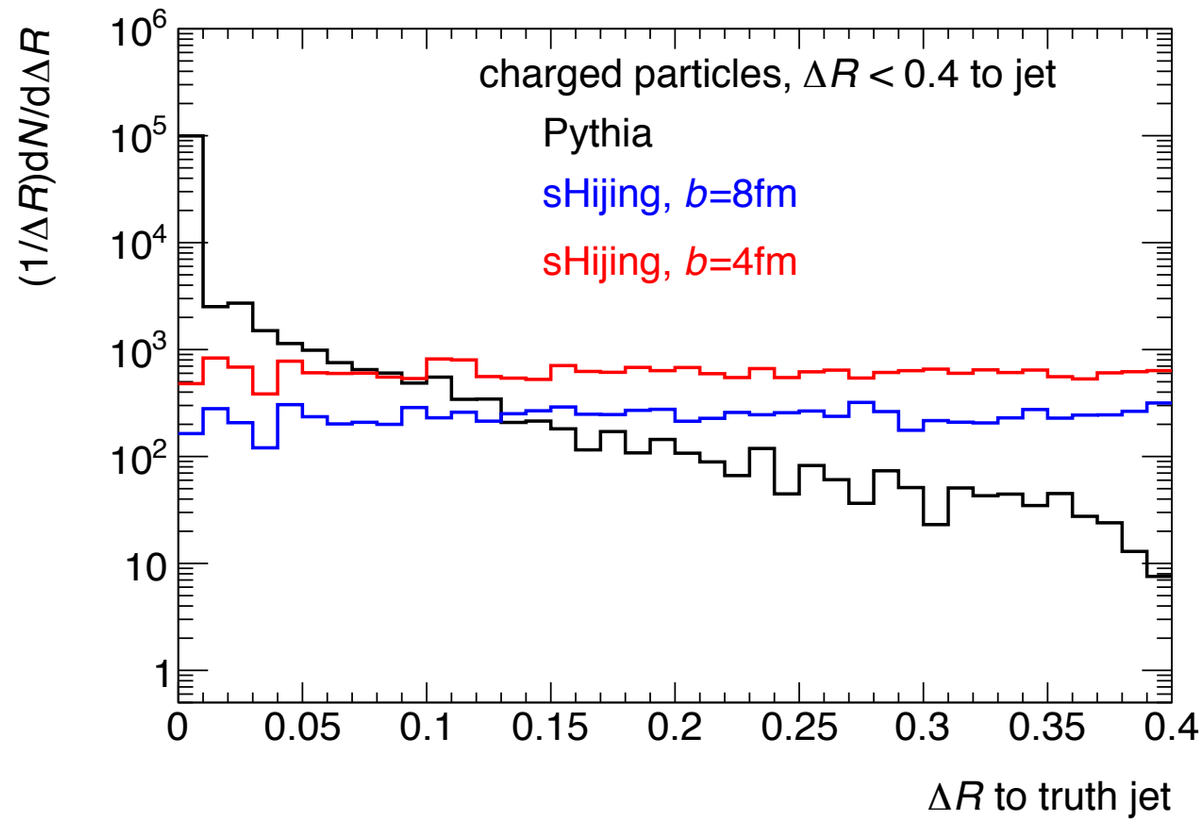
- Assuming 600 billion sampled minimum bias Au+Au events
  - ➡ 120 billion 0-20% events
  - ➡ (N_{coll} / σ_{NN}) = 800 / 42 mb
  - ➡ σ(40 GeV photon) ~ 10^{-10} mb
  - ➡ ε(vertex < 10cm) ~ 1/3



- Expect only 75 >40 GeV photons in 0-20% events
  - ➡ use 30 GeV photons, or 40 GeV dijets for more “realism”?

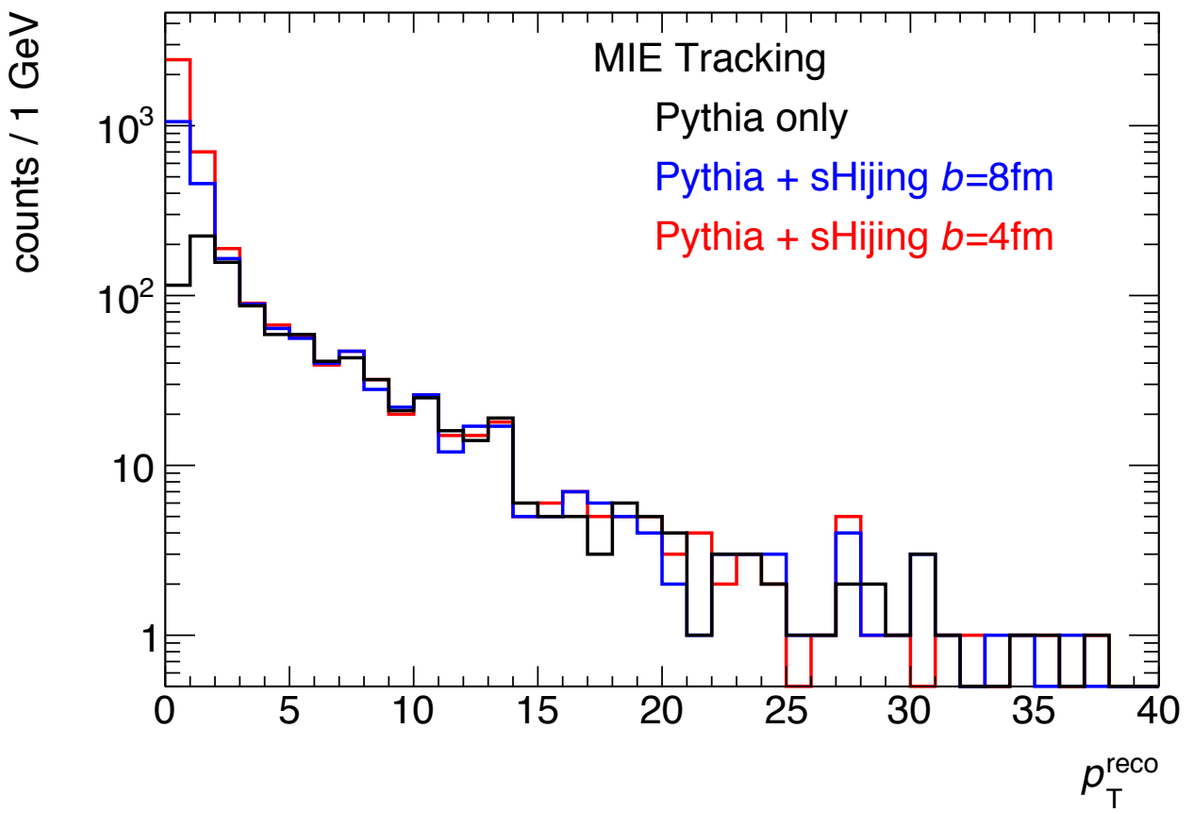
Truth-level $h^{\pm}$ distributions

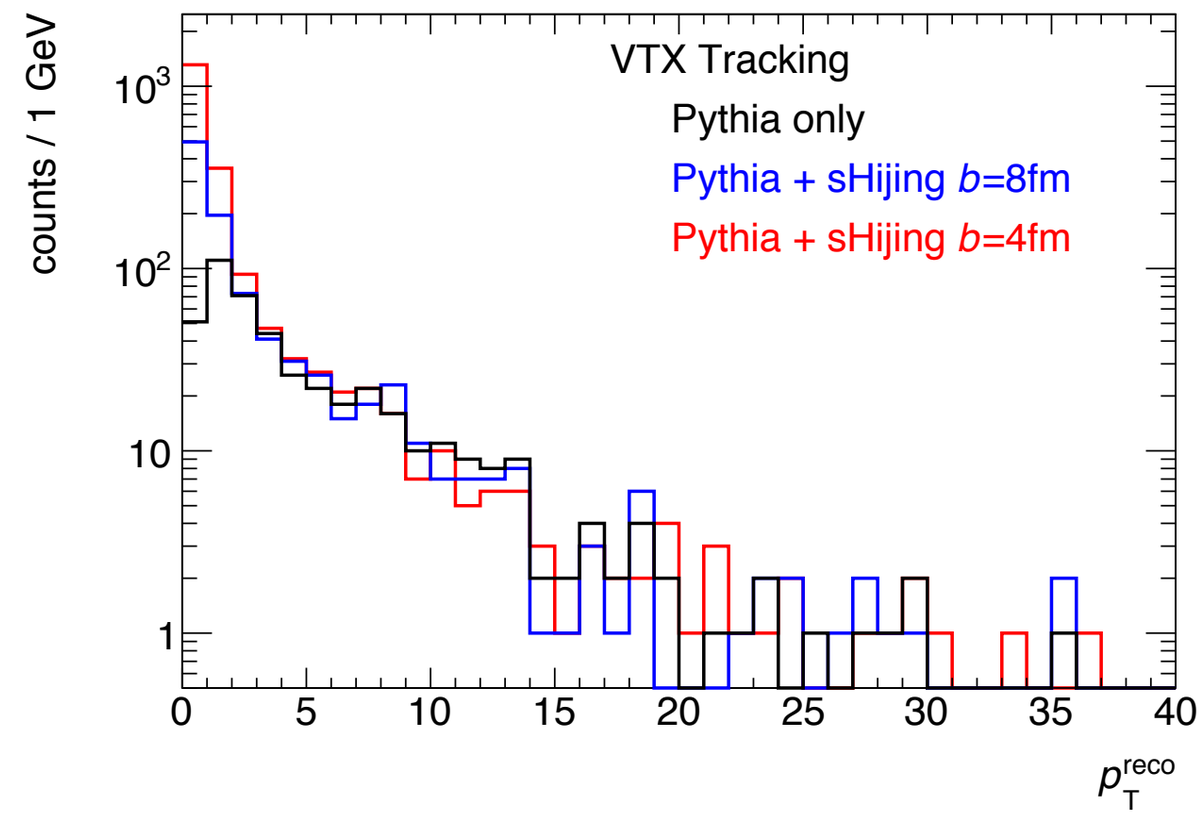


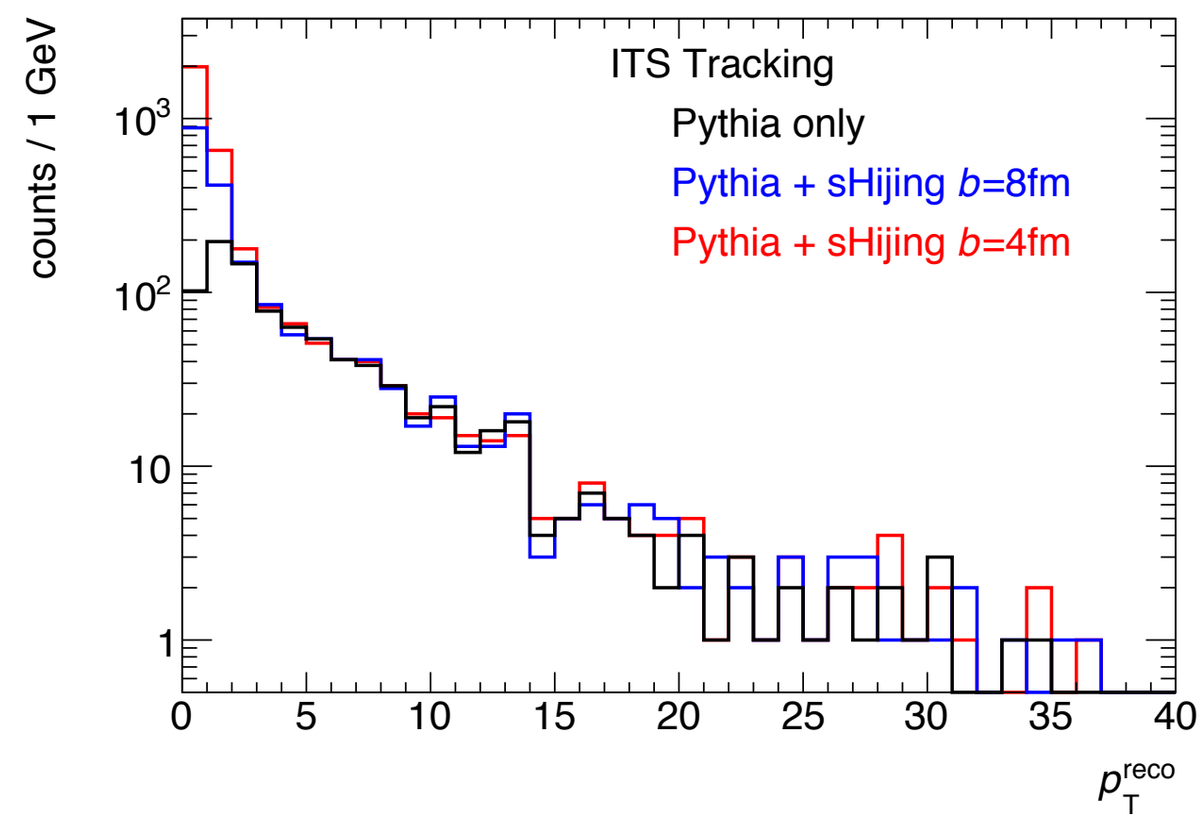


- For this update, show p_T and $1/\Delta R$-weighted ΔR distributions of >0.5 GeV charged particles with $\Delta R < 0.4$ to truth jets
- Shown here at truth-level only for each system
  - ➡ embedding lets me separate Pythia from Hijing particles
  - ➡ Pythia particles same in every system by construction

Overview of p_T^{reco} distributions

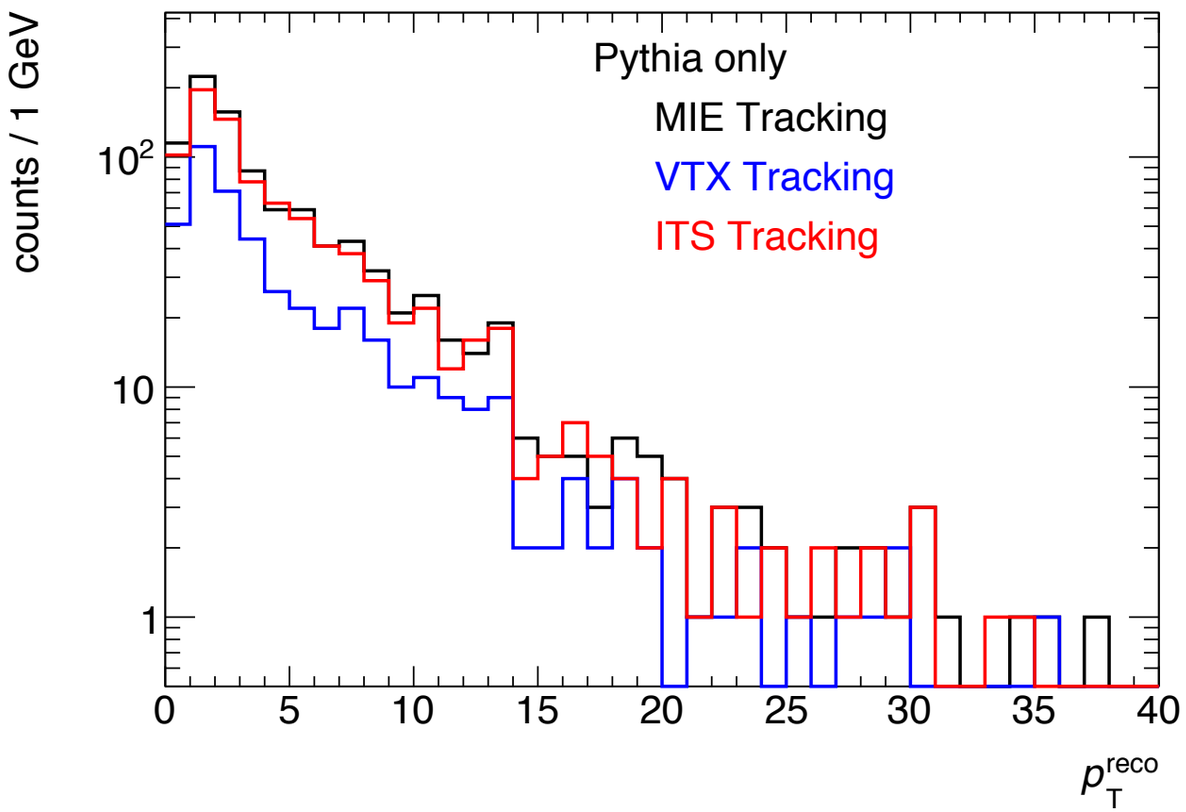


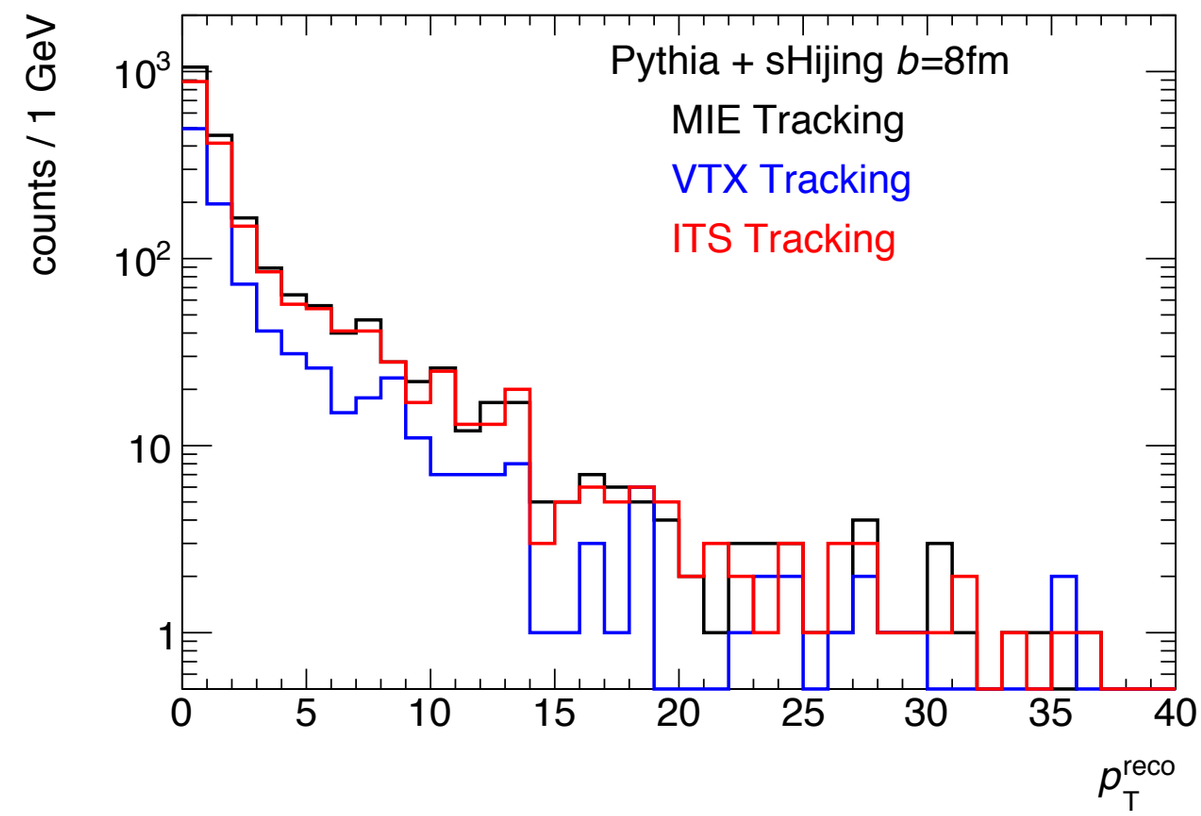


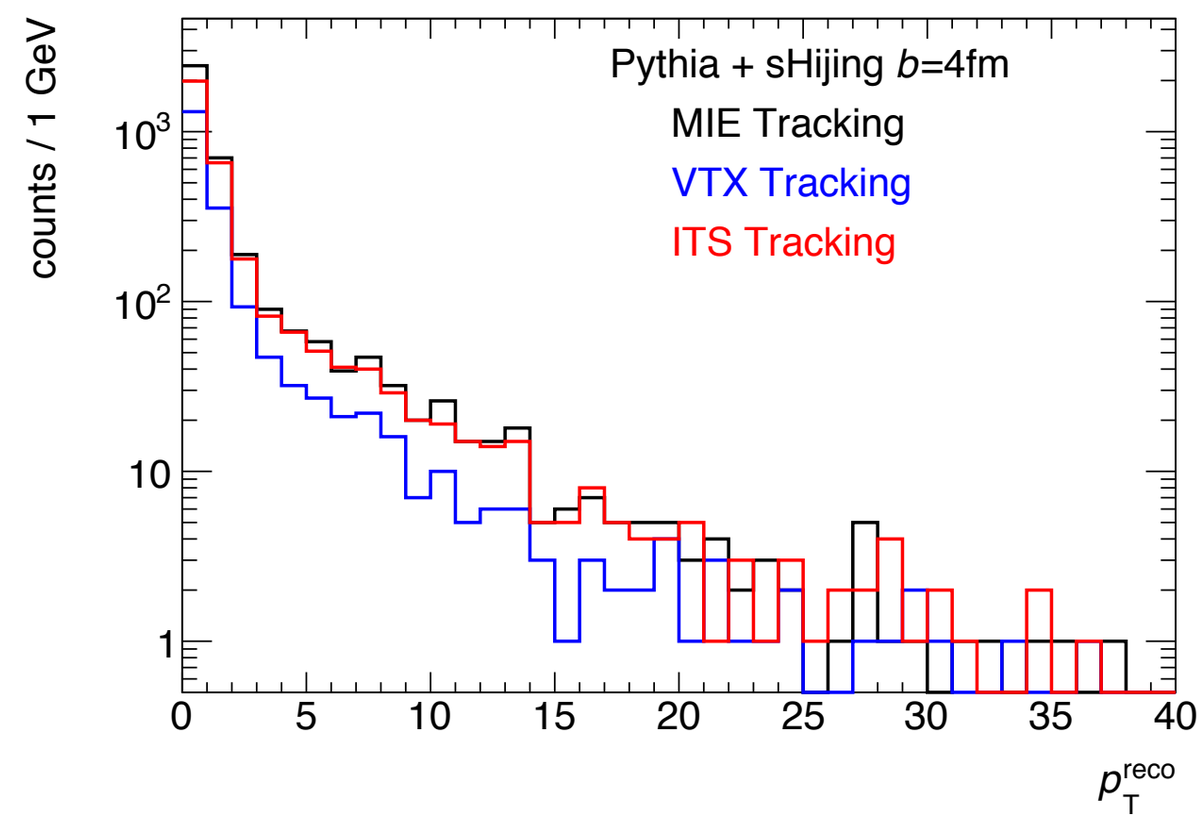


- p_T distribution of all reconstructed tracks within $\Delta R<0.4$ of truth jet
  - ➡ each panel is fixed tracking option
  - ➡ multiple systems shown on each panel

Overview of p_T^{reco} distributions

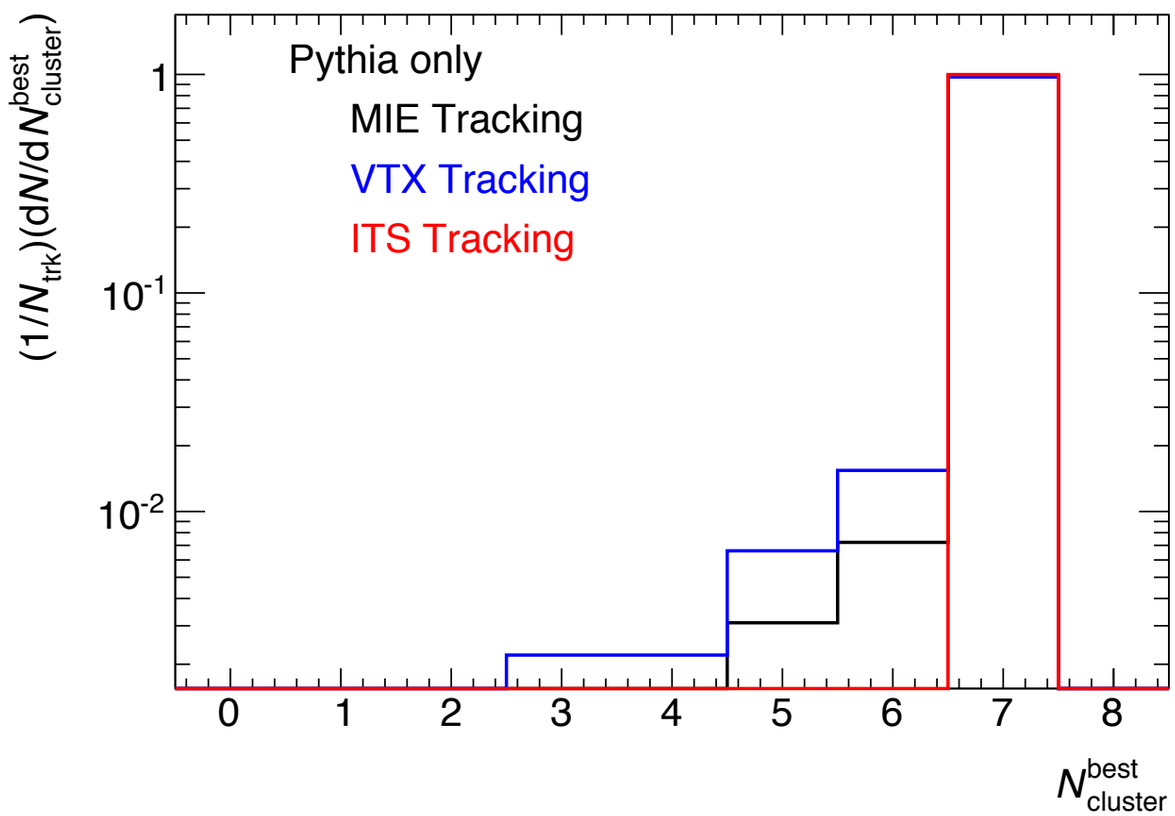


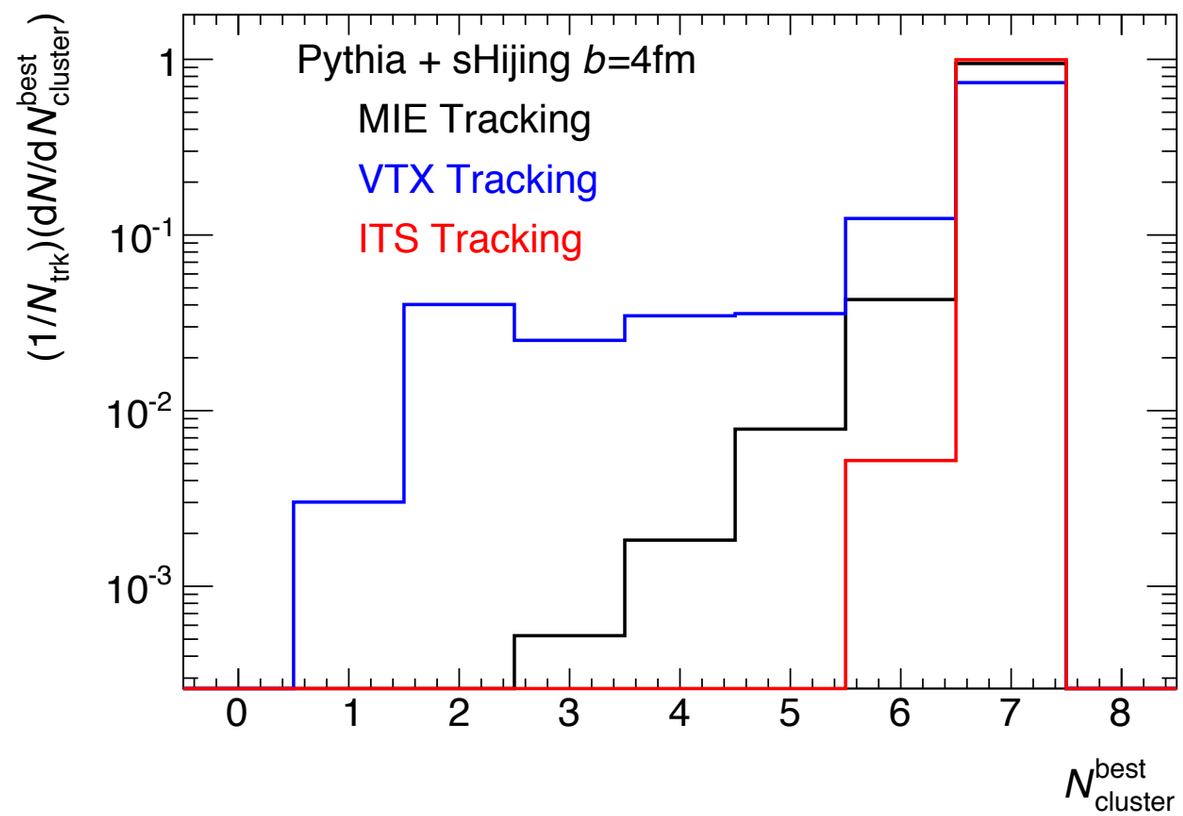




- Now each panel is a fixed system, with multiple tracking options
  - ➡ large inefficiency in VTX tracking configuration

Truth-matching determination

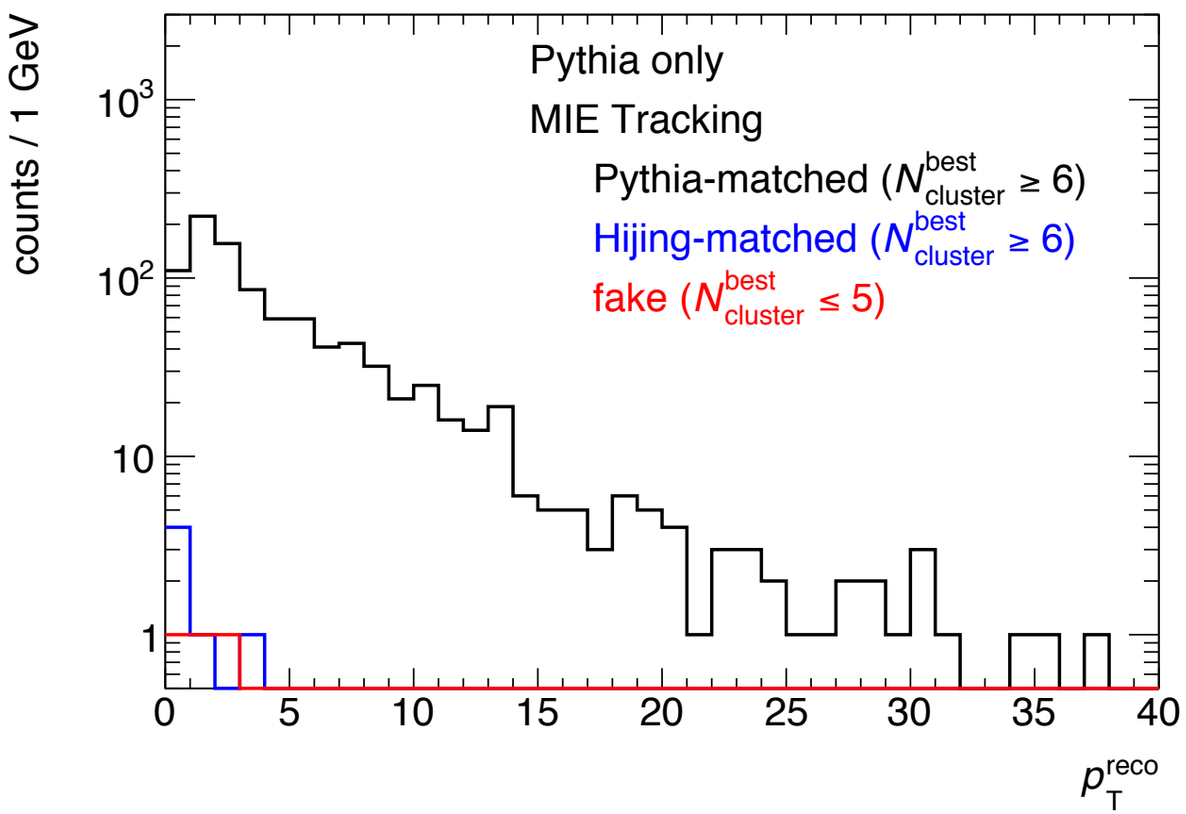


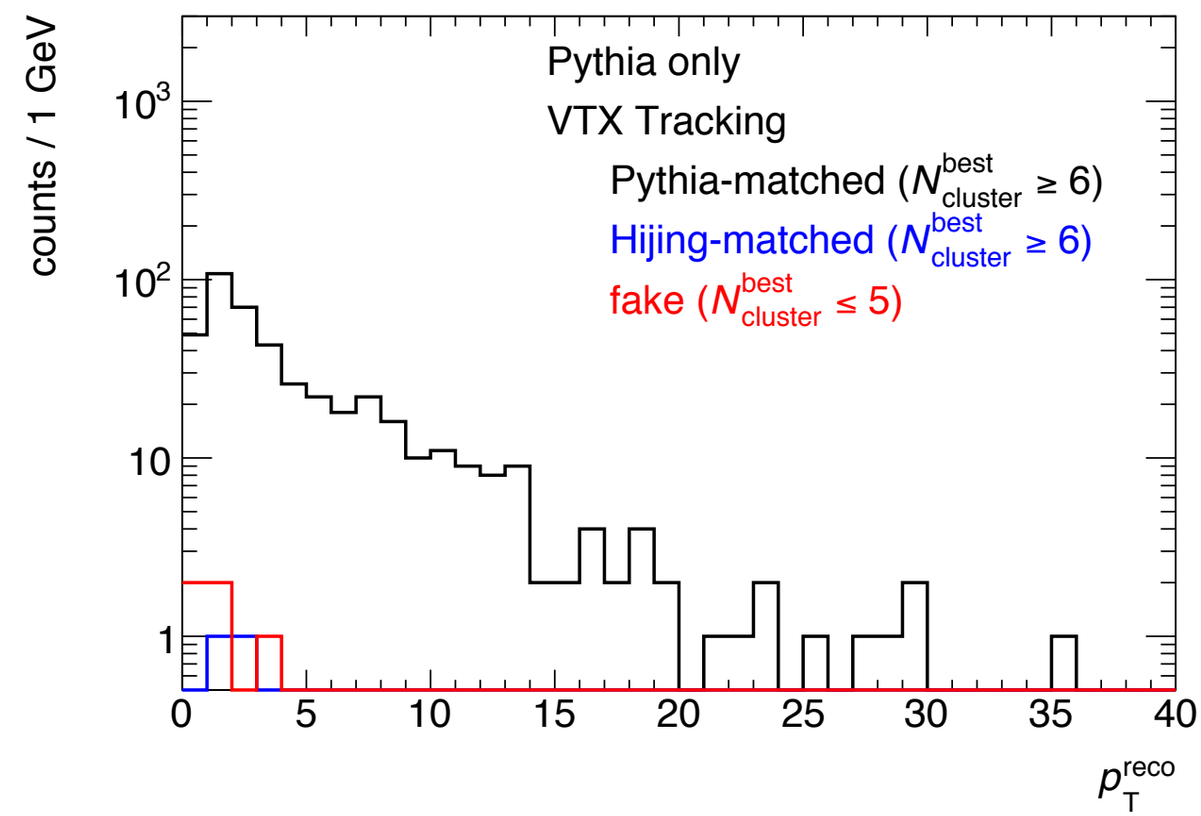


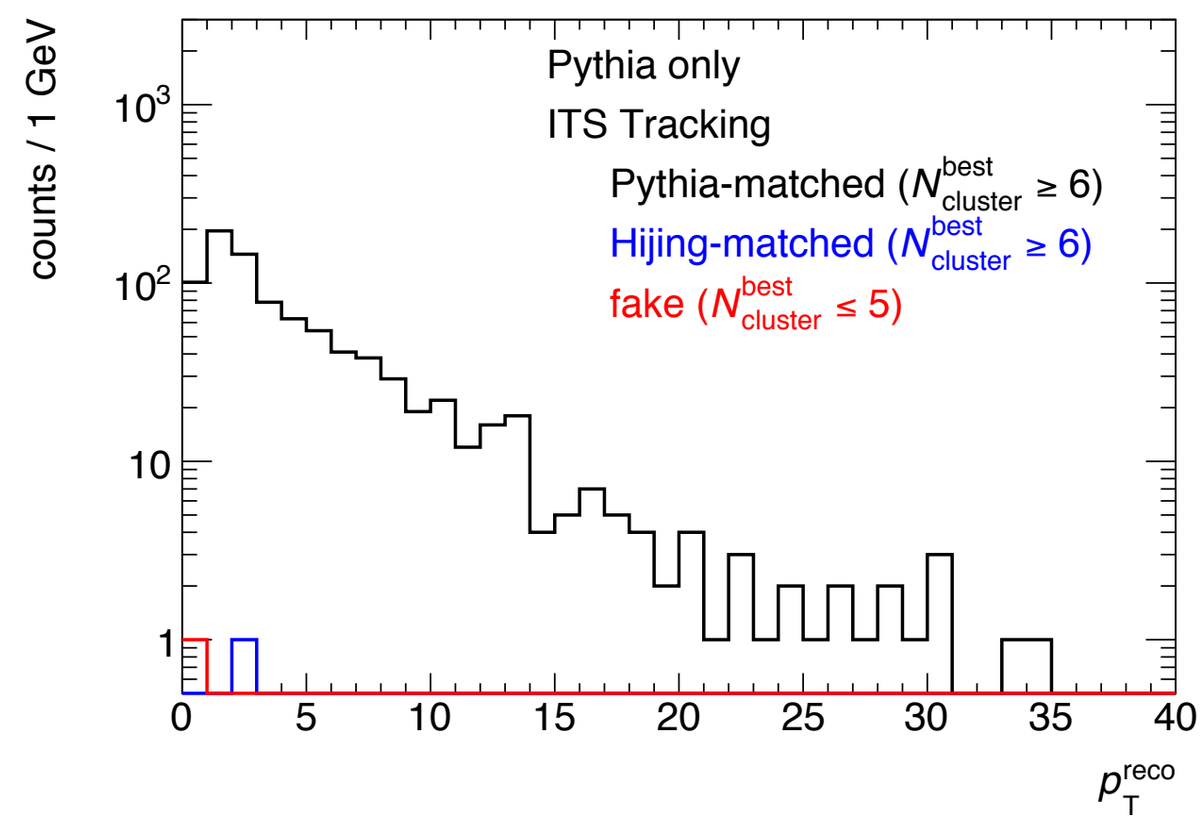
- For each reconstructed track, ask evaluator for truth particle with largest $N_{cluster}$ contribution ($N_{cluster}^{best}$)
  - ➡ if ≥6, call this a Pythia- or sHijing-associated track
  - ➡ if ≤5, call this a fake

➡ Above: distribution of $N_{cluster}^{best}$ in Pythia and Pythia + b=4fm sHijing events

Tracks by origin: Pythia only

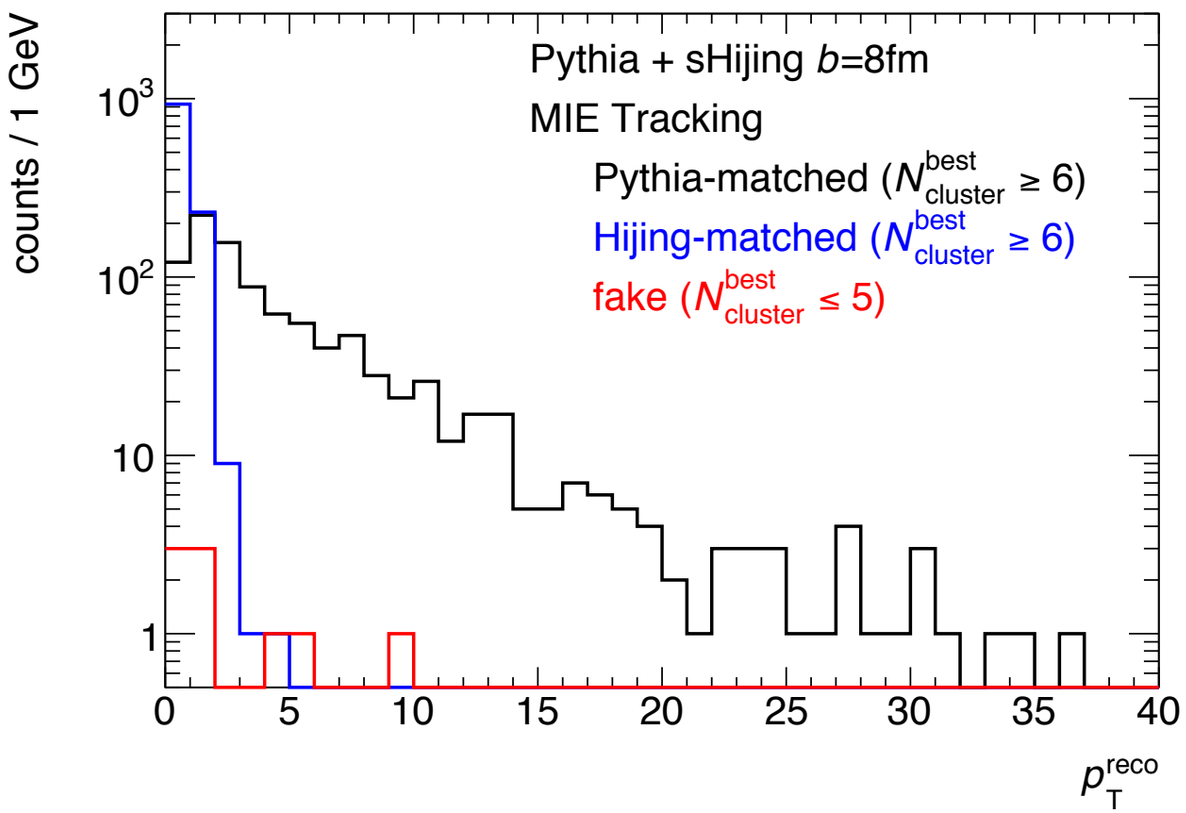


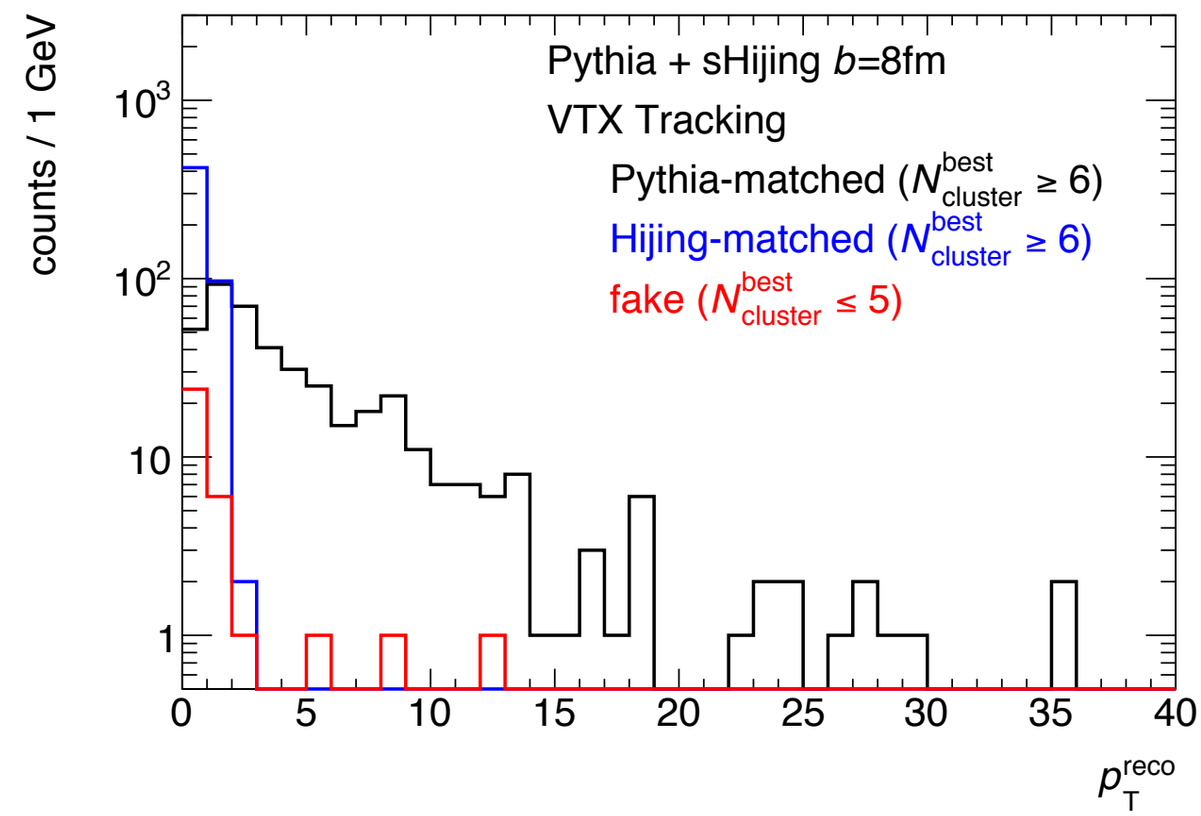


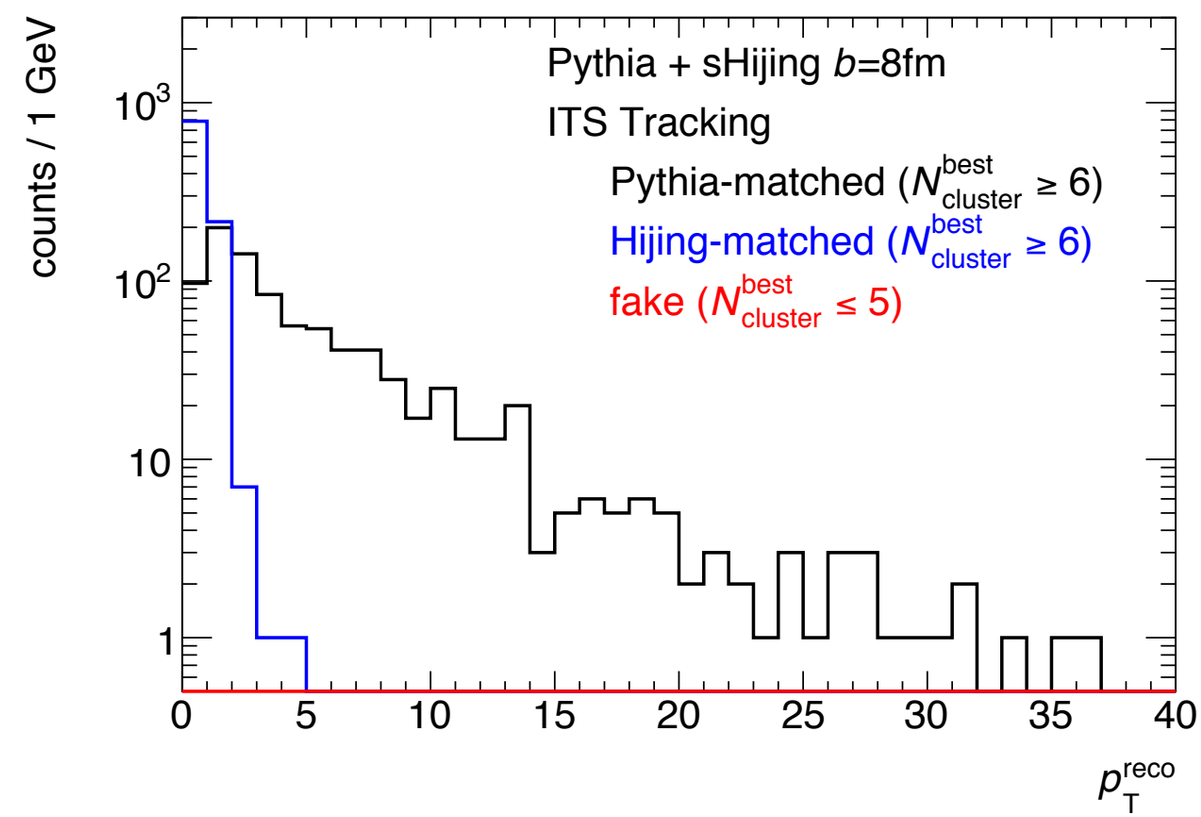


- On this slide, just Pythia
- Each panel is a fixed tracking option
  - ➡ breakdown by **Pythia**, **Hijing**, **fake**
  - ➡ **fake** rate small for all options
  - ➡ should be NO "**Hijing-matched**" — are these actually secondaries?

Tracks by origin: Pythia + *b*=8fm sHijing

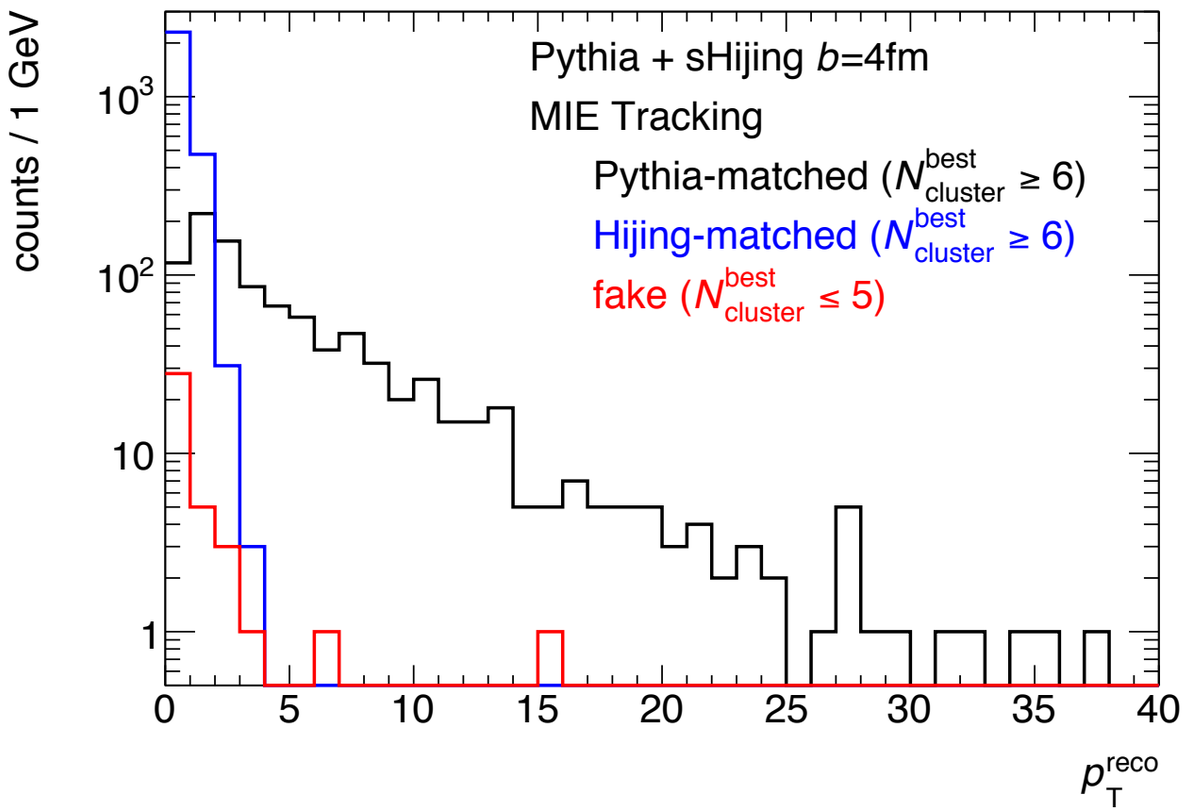


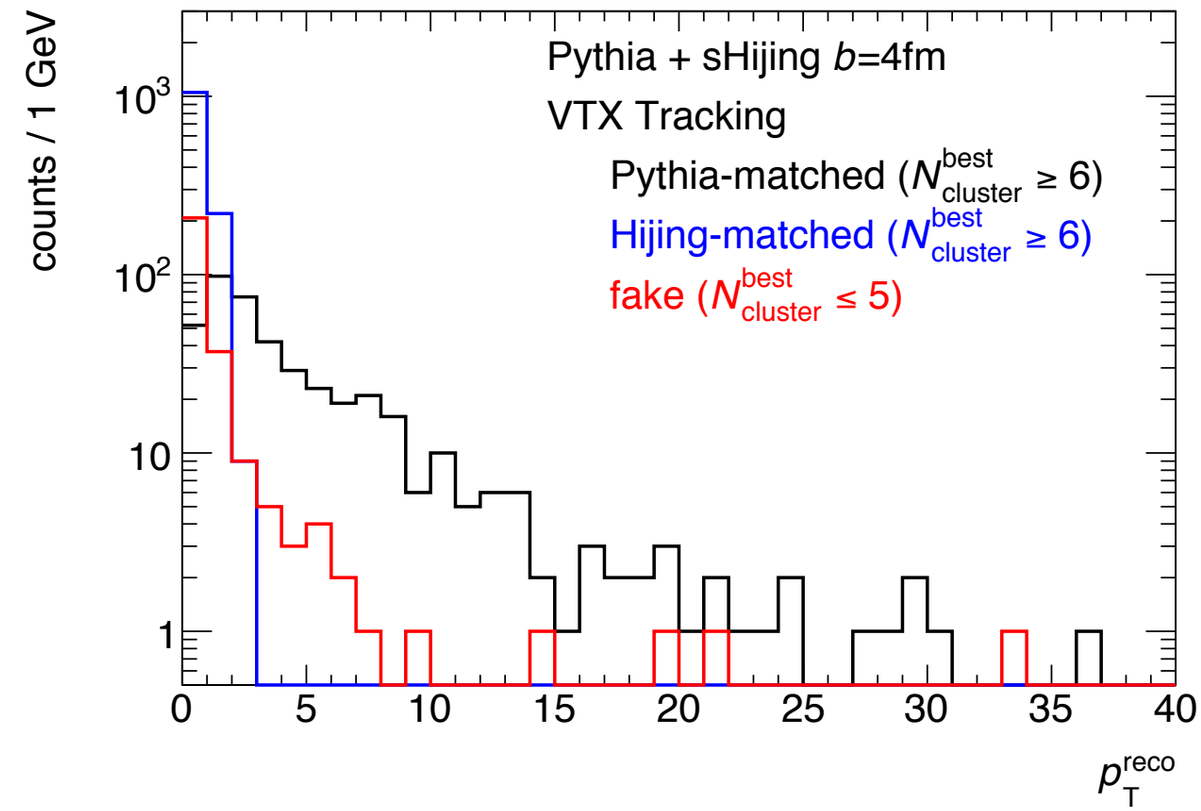


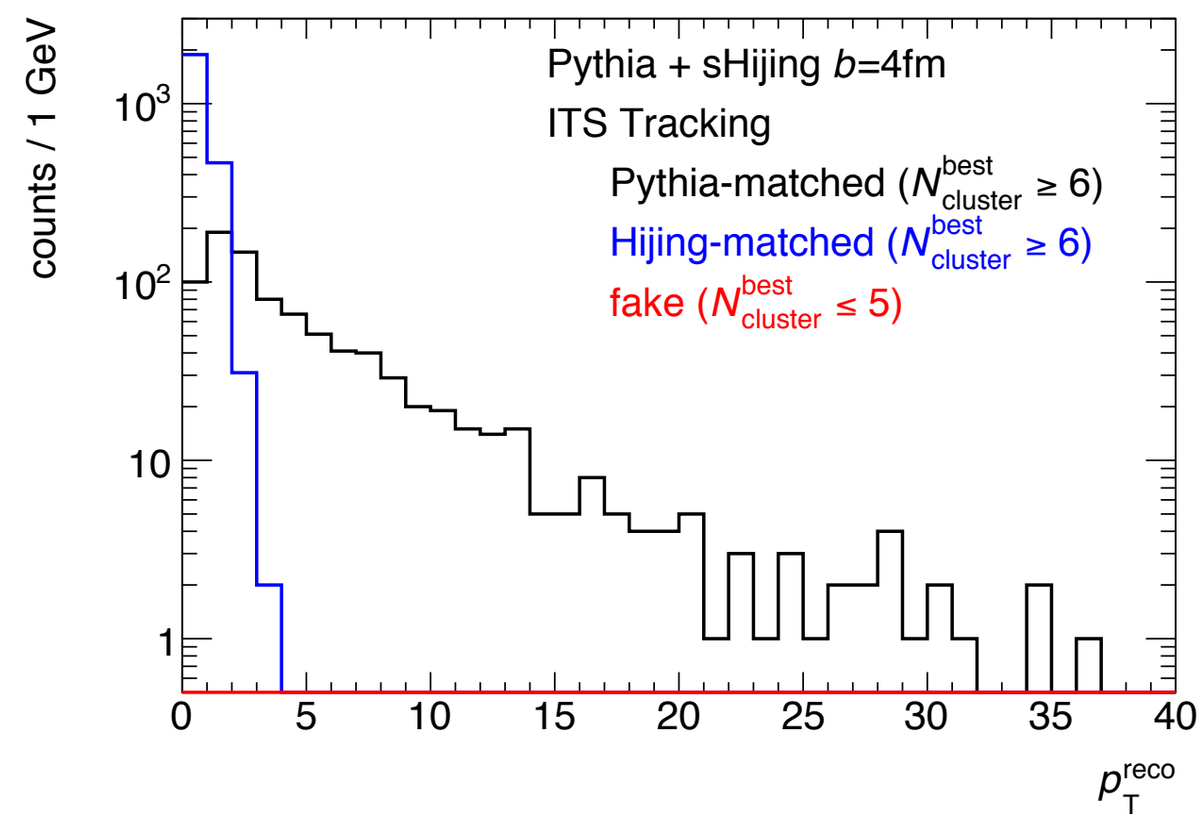


- Pythia + *b*=8fm sHijing events
  - ➡ **fake** tracks present, but mostly at low-p_T
  - ➡ obvious addition of **sHijing**-originating tracks at low-p_T

Tracks by origin: Pythia + *b*=4fm sHijing

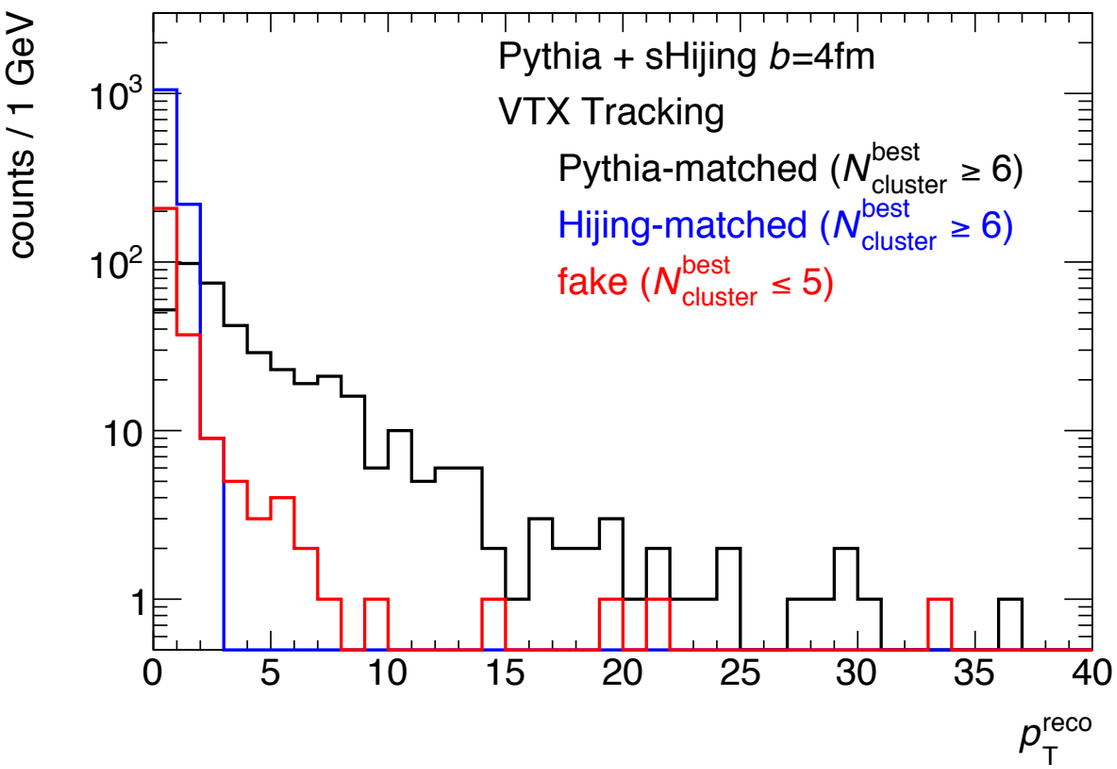


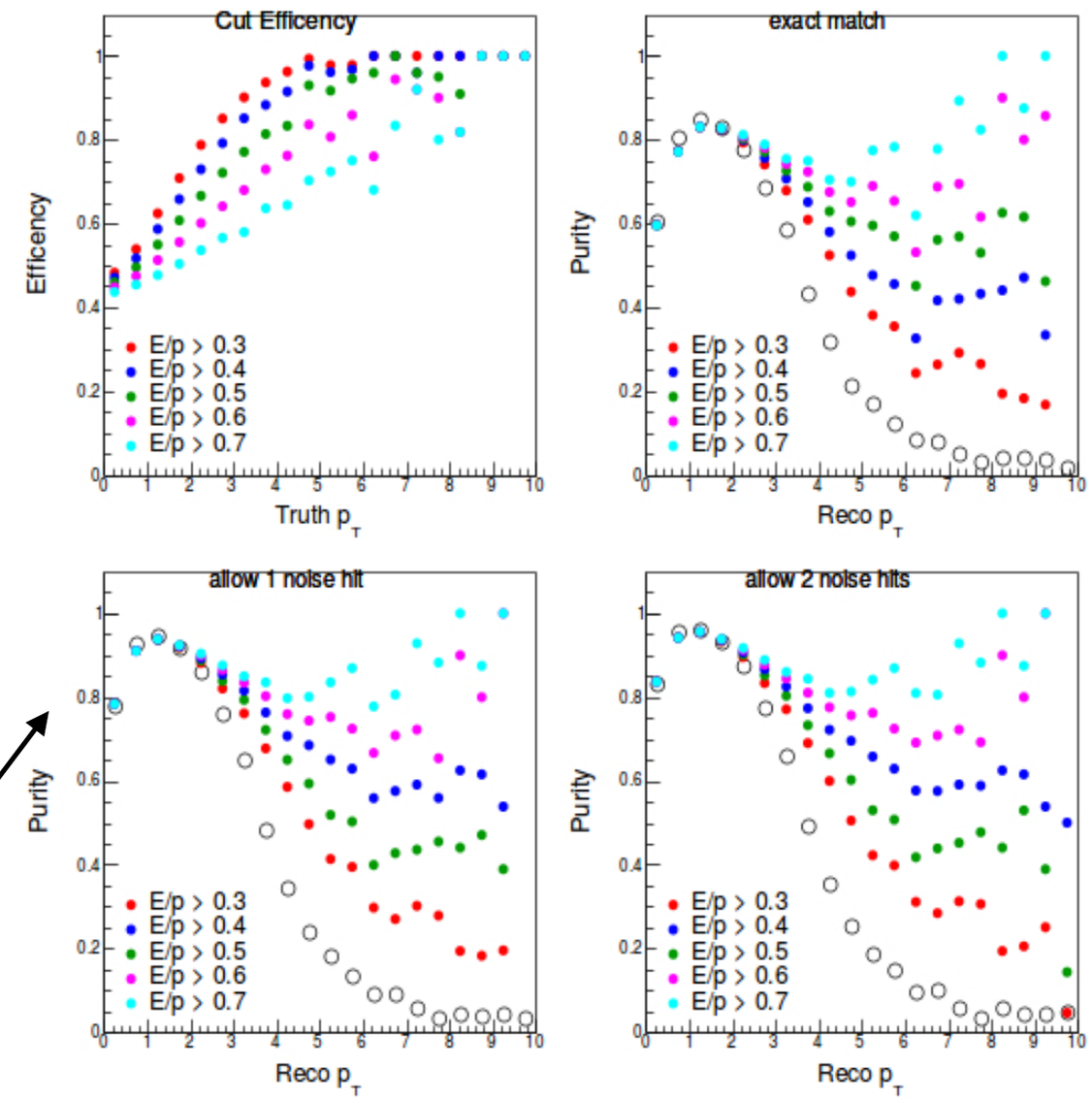




- Pythia + *b*=4fm sHijing events
  - ➡ **fake** rate at high-p_T increasing in VTX configuration
    - ➡ but need more statistics
  - ➡ ITS has no observable fakes

Comparison of fake rate





K. Hill, R. Belmont
22 March 2015 sPHENIX Sims

- Fake rate seems “milder” than previous studies of purity
  - ➡ consequence of narrowing to jet cone?
  - ➡ will check G4 setup / fake definition with Colorado group

Early conclusions

- Building framework to be able to look at jet structure observables
  - ➡ systematically vs each tracking setup
  - ➡ systematically vs different levels of HI background
- Here, focus on inclusive hadron spectra inside jets
  - ➡ G4 simulation of tracking options, but no calo sim.
- Notably worse efficiency and fake rate in VTX configuration compared to MIE or mockup “ITS”
  - ➡ possibly better than expected(?) from “inclusive” studies
  - ➡ will check G4 settings & fake definition with Kurt & Ron
- Only N_{evt} = 200 shown here, easy to scale up production
  - ➡ can wait for full implementation of ITS geometry