# Jet Studies with Machine Background

Jeetendra Gupta (UIC)
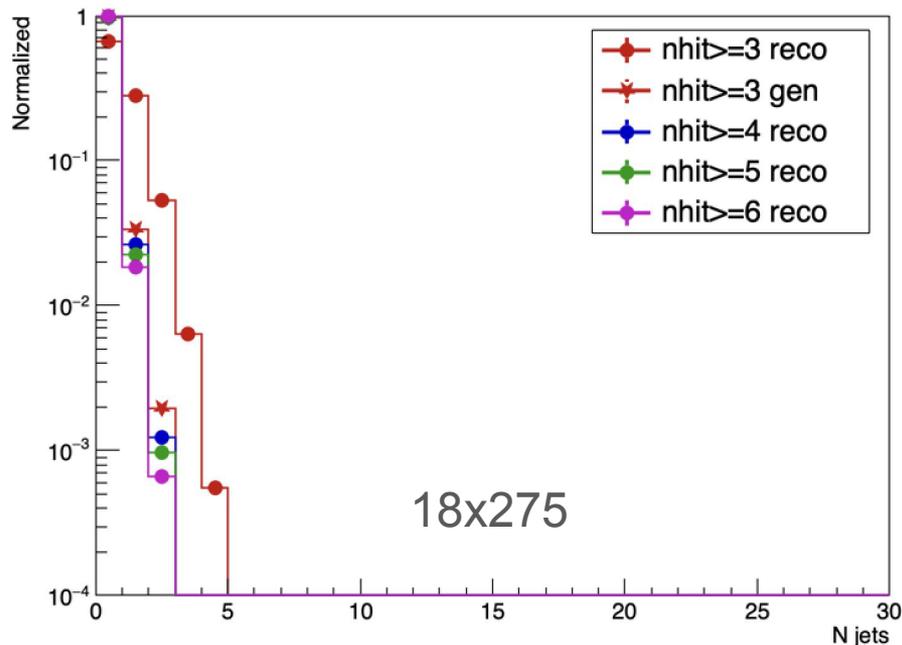Barak Schmookler (UH)
Dener De Souza Lemos (BNL)
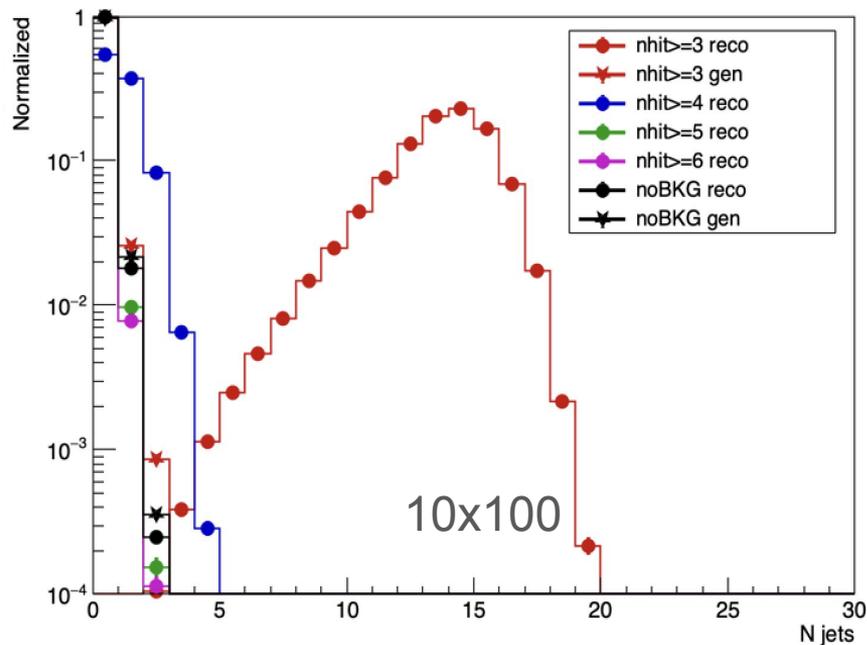
- Simulated datasets with PYTHIA8.306 and geometry 25.10 ($q^2 > 1$ GeV$^2$):
  - Without machine background
    - 10x100 (~5M ev):
      - /volatile/eic/EPIC/RECO/25.10.0/epic_craterlake/DIS/NC/10x100/minQ2=1/
    - 18x275 (~5M ev):
      - /volatile/eic/EPIC/RECO/25.10.0/epic_craterlake/DIS/NC/18x275/minQ2=1/
  - With machine background
    - 10x100 (~240k ev):
      - /volatile/eic/EPIC/RECO/25.10.4/epic_craterlake/Bkg_1SignalPer2usFrame/DIS/NC/10x100/minQ2=1/
    - 18x275 (~5M ev):
      - /volatile/eic/EPIC/RECO/25.10.4/epic_craterlake/Bkg_1SignalPer2usFrame/Synrad_18GeV_Vac_10000Ahr_Runtime_50s_Egas_18GeV_Hgas_275GeV/DIS/NC/18x275/minQ2=1/

- Jet Selection
  - Charged jets:
    - ReconstructedChargedJets
    - GeneratedChargedJets
    - Electron removed using true PID
    - Remove jets with 1 track inside
    - Jet pT > 3 GeV/c
    - $\eta$ = (-2 , 2.5)
  - anti-$k_T$ with R = 1.0
  - Jet Tree maker:
    - https://github.com/denerslemos/CHJetsReCluster

# Jet finder: Number of Jets per Events, after cuts



18x275

10x100

| nhit>=3 | ‹N reco jets› = 1.69933 | ‹N Gen jets› = 1.55992 |
| nhit>=4 | ‹N reco jets› = 1.5477 | |
| nh1t>=5 | ‹N reco jets› = 1.54297 | |
| nhit>=6 | ‹N reco jets› = 1.53639 | |

| nhit>=3 | ‹N reco jets› = 13.6478 | |
| nhit>=4 | ‹N reco jets› = 1.70873 | |
| nhit>=5 | ‹N reco jets› = 1.51564 | |
| nhit>=6 | ‹N Gen jets› = 1.51428 | |
| noBKG | ‹N reco jets› = 1.51383 | ‹N Gen jets› = 1.51682 |

# Jet finder: Multiplicity, after cuts
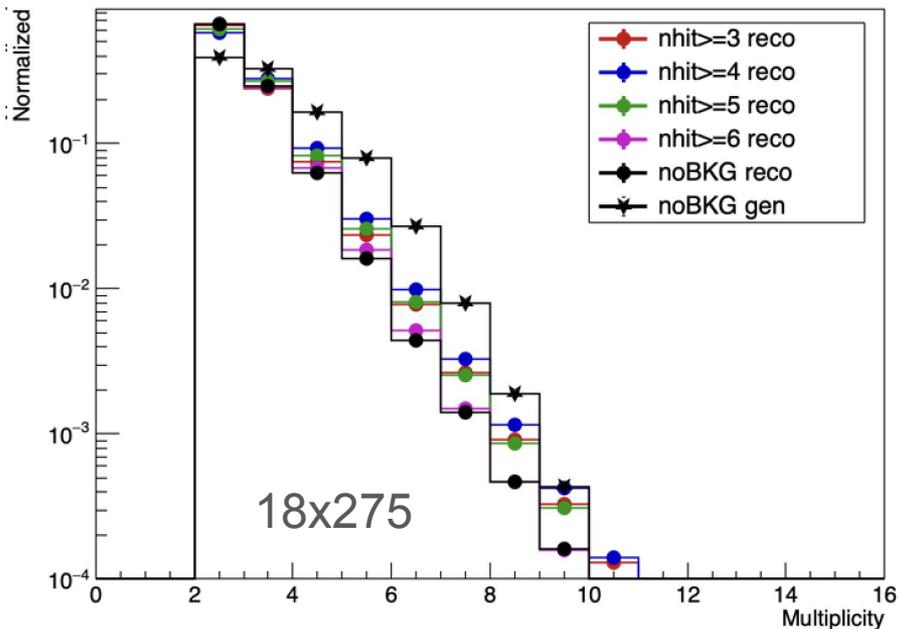


| | |
|---|---|
| nhit>=3 | ‹Reco multiplicity> = 3.01183 |
| nhit>=4 | ‹Reco multiplicity> = 3.12074 |
| nhit>=5 | <Reco multiplicity> = 3.06554 |
| nhit>=6 | <Reco multiplicity> = 2.96792 |
| noBKG | <Reco multiplicity> = 2.95014     ‹Gen multiplicity> = 3.56136 |

| | |
|---|---|
| nhit>=3 | ‹Reco multiplicity> = 32.5693 |
| nhit>=4 | <Reco multiplicity> = 3.23041 |
| nhit>=5 | ‹Reco multiplicity> = 2.9528 |
| nhit>=6 | ‹Reco multiplicity> = 2.83738 |
| noBKG | ‹Reco multiplicity> = 2.8649     ‹Gen multiplicity> = 2.99058 |
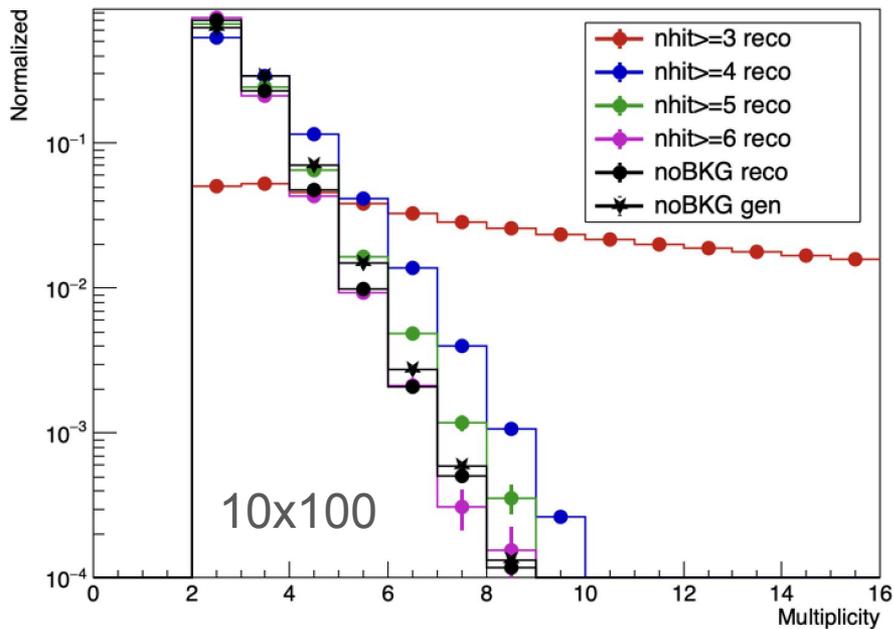
# Jet finder: pT, after cuts
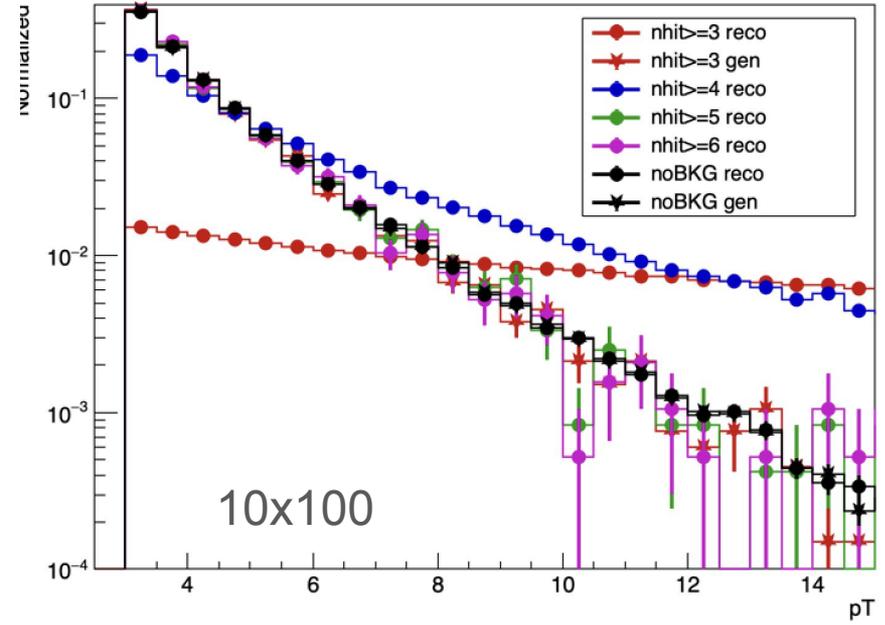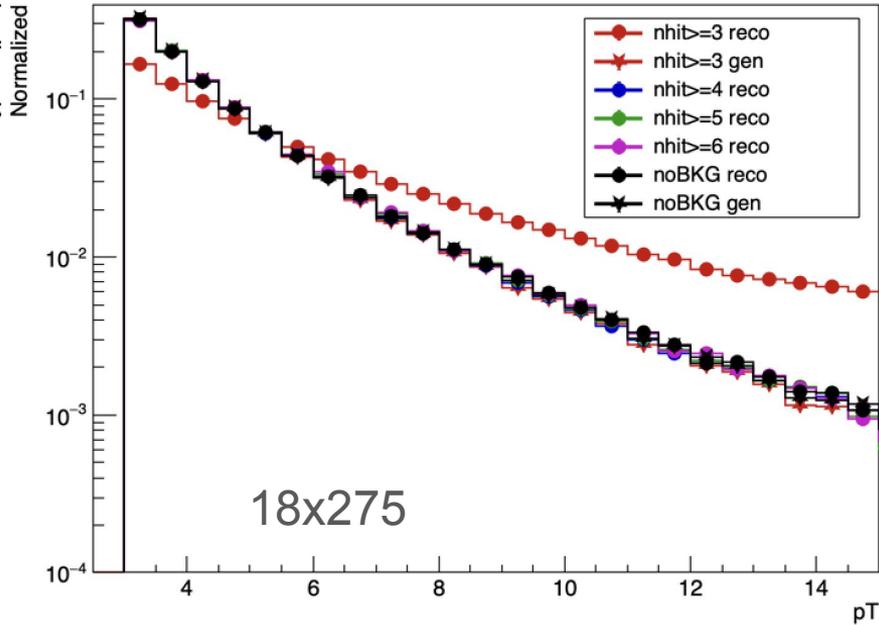


pT distribution shows that nHit >= 5 is needed to remove bkg for 10x100

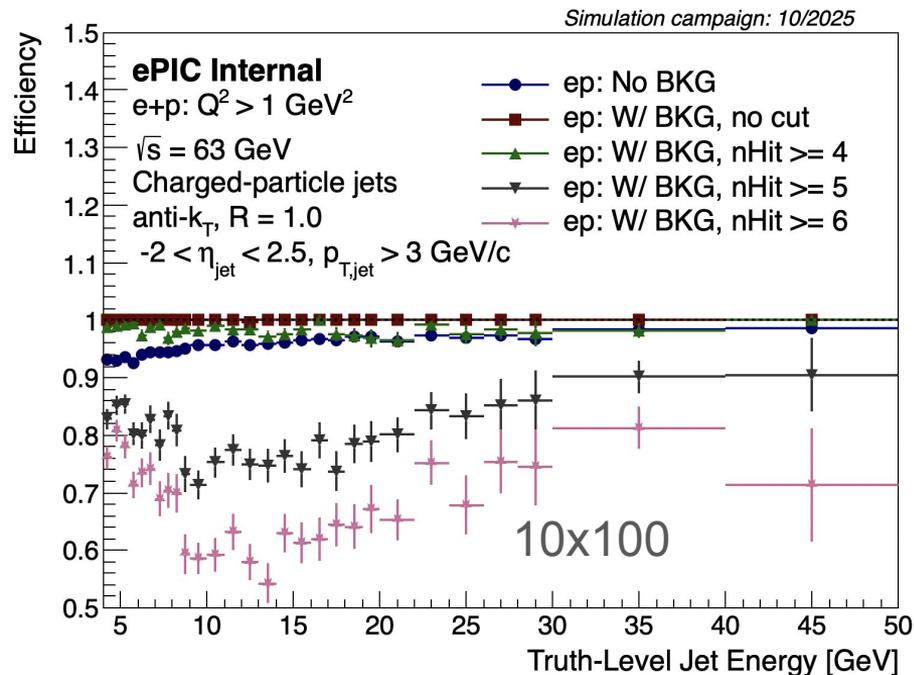# Jet finder: eta, after cuts
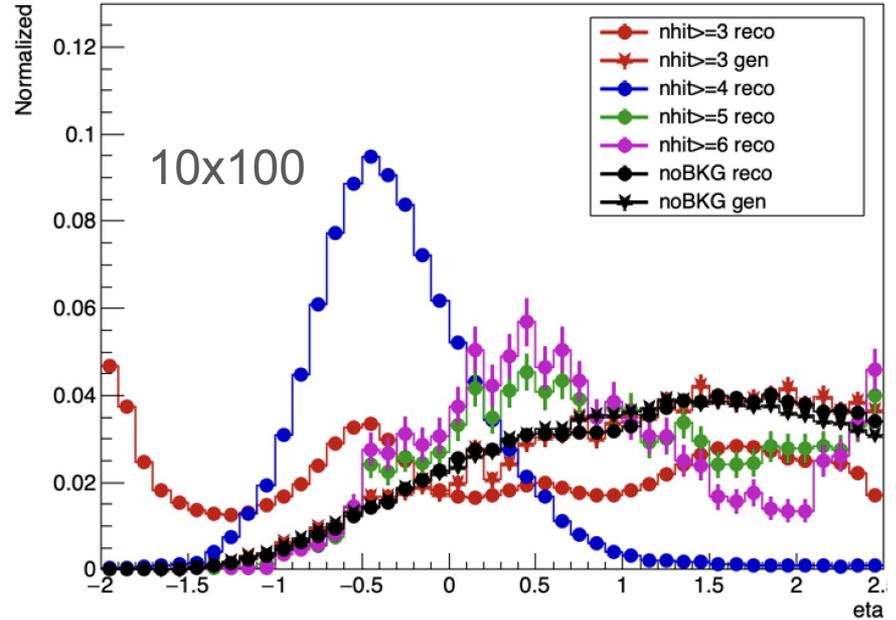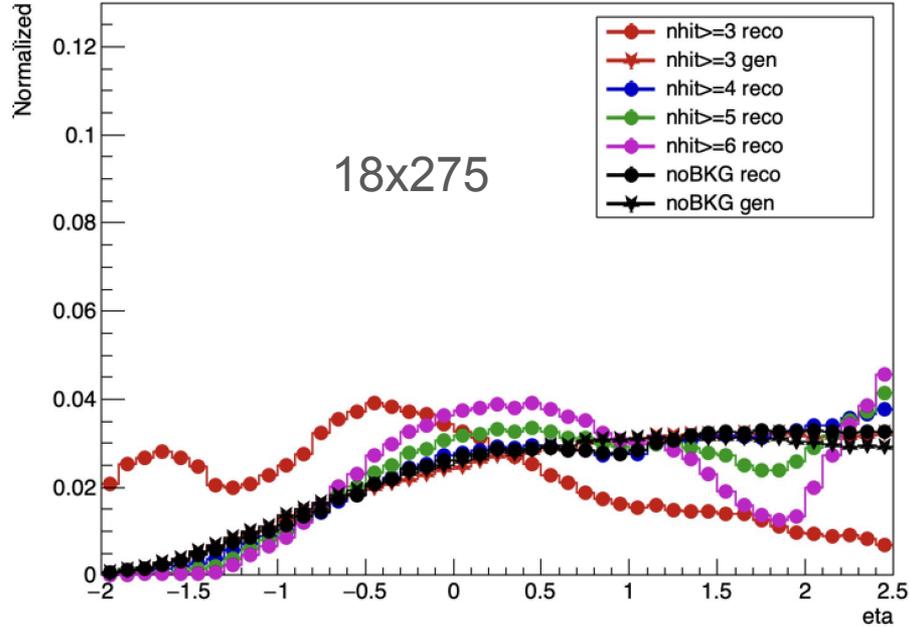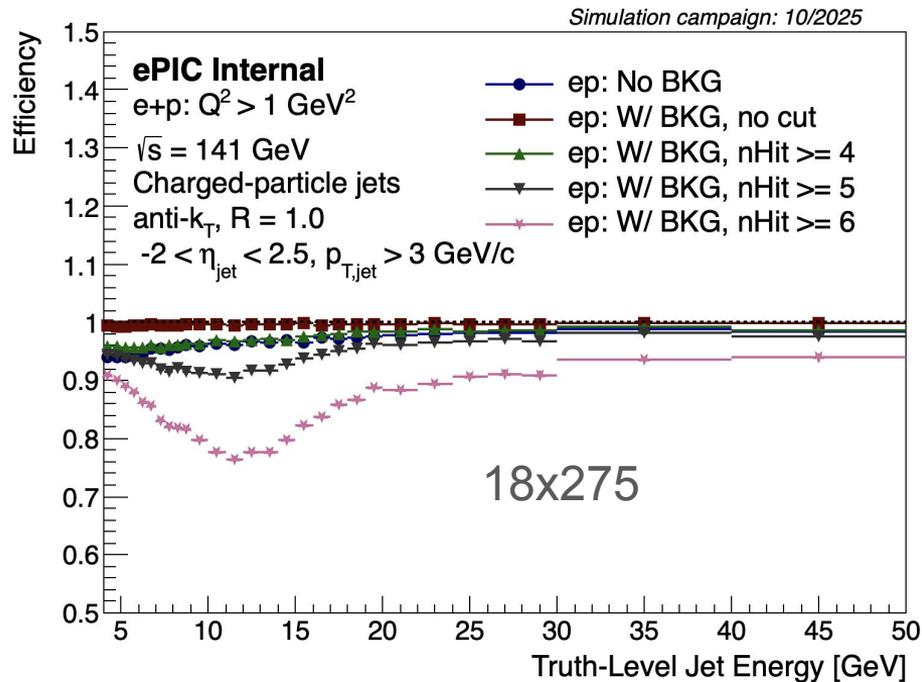


eta distribution shows that nHit >= 5 is needed to remove bkg for 10x100
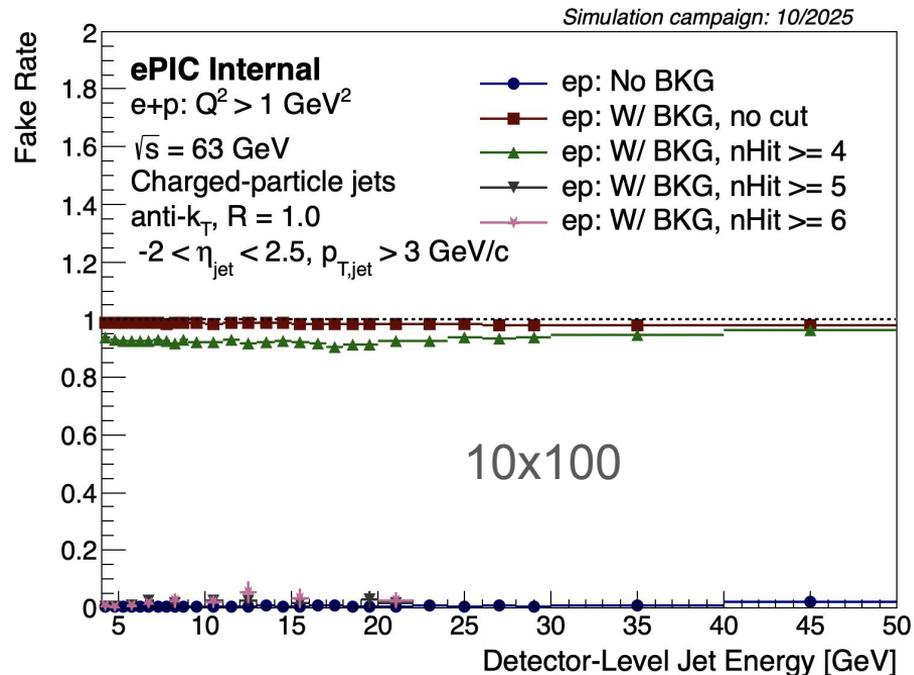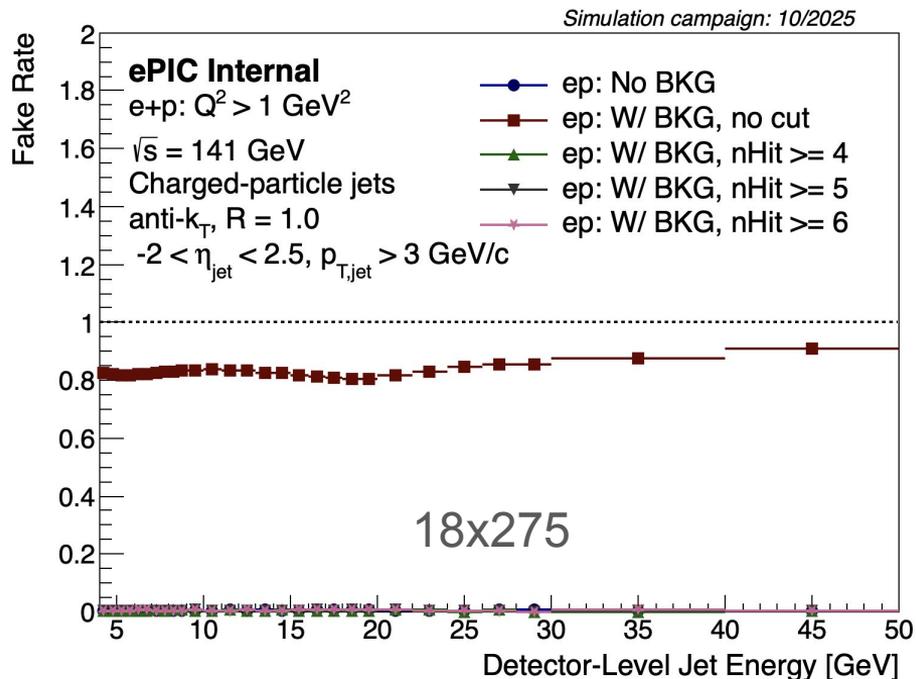
# Jet finder: phi, after cuts
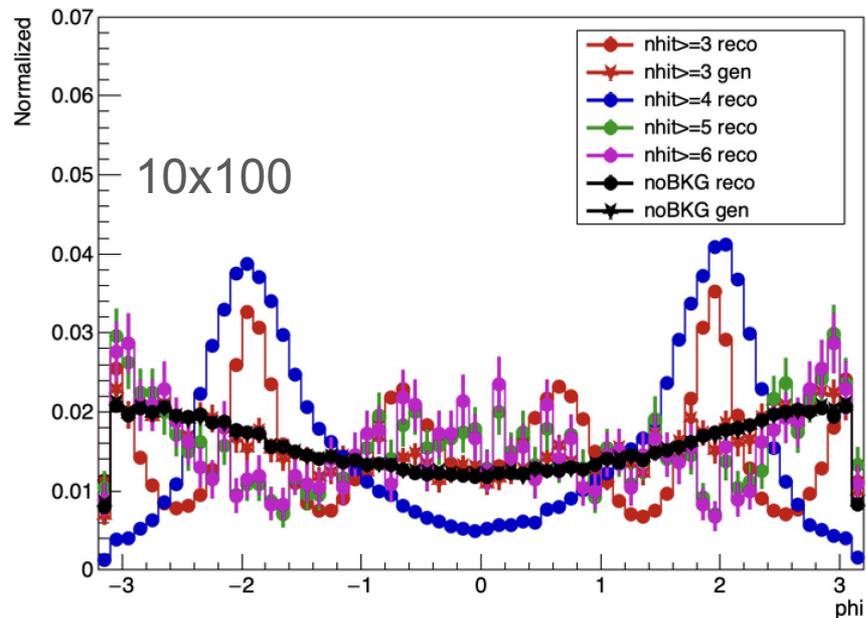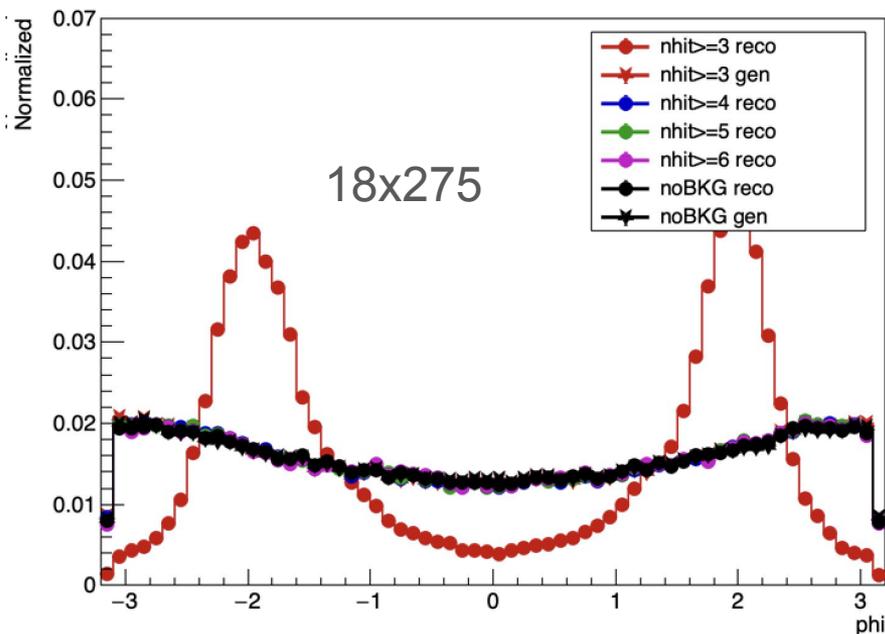


phi distribution shows that nHit >= 5 is needed to remove bkg for 10x100

# Jet finder efficiency



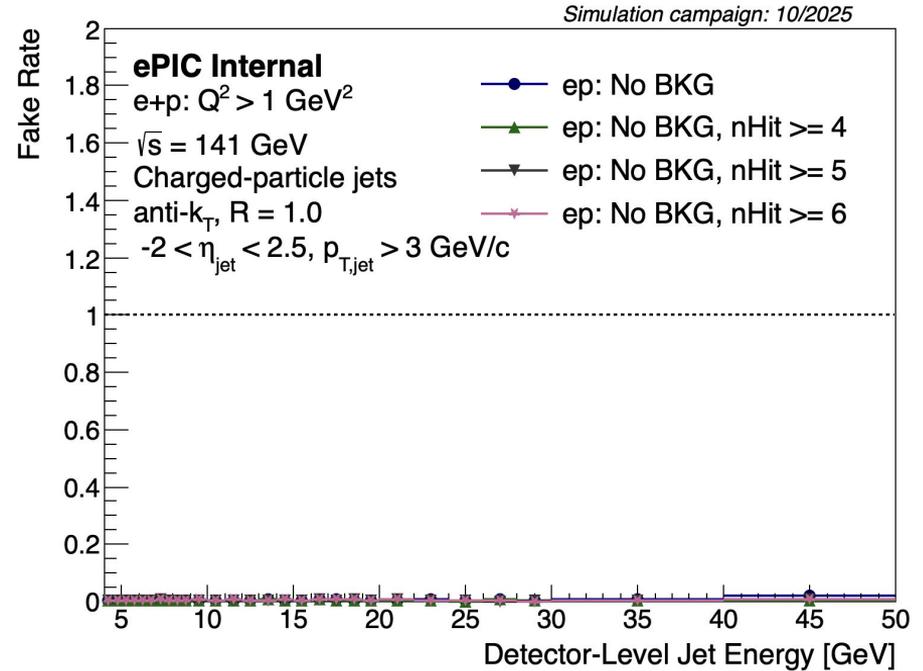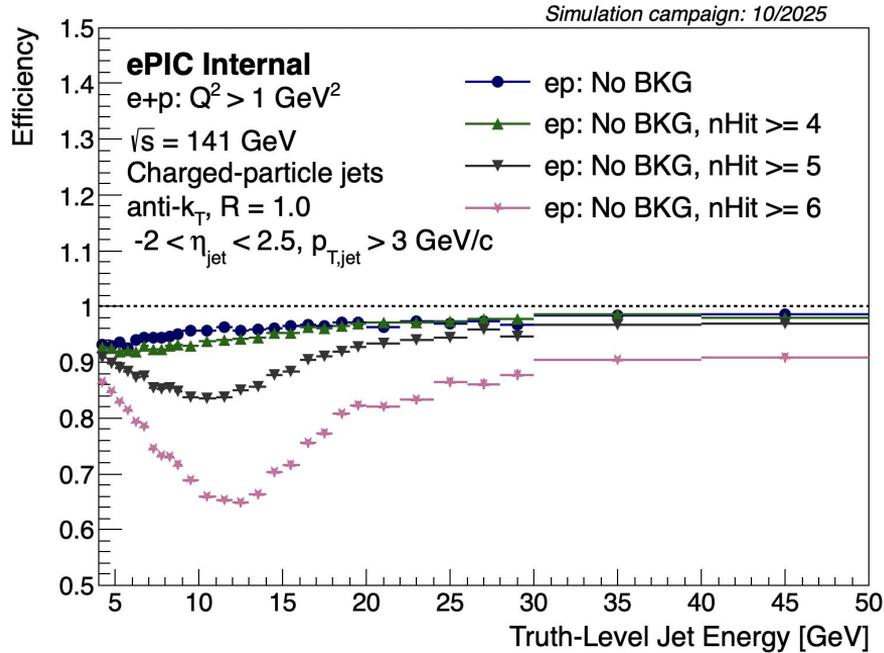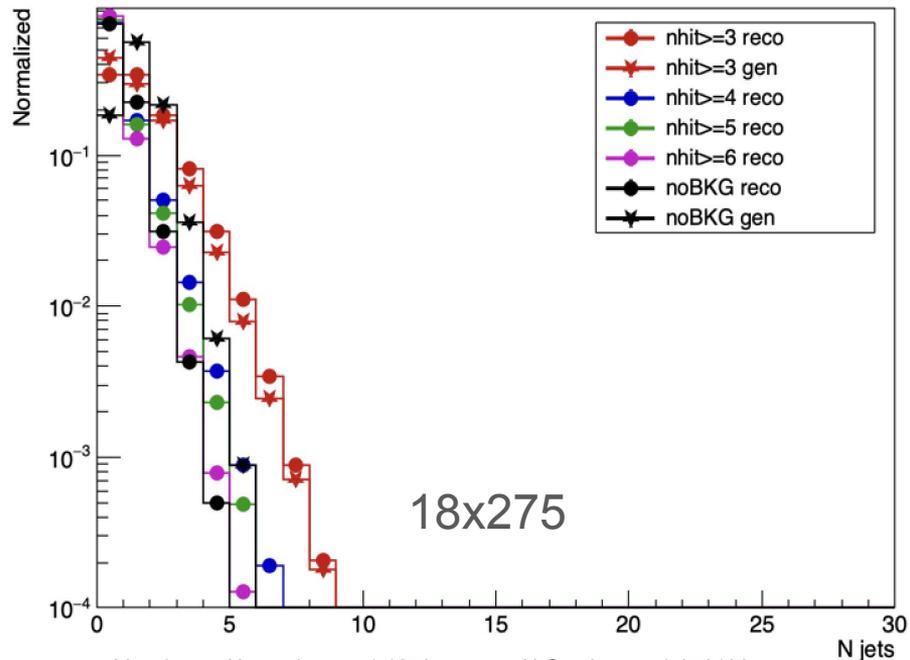Efficiency is lower for 10x100 for different cuts (more bkg?)

# Jet finder fake rate



Fake rate shows that nHit >= 5 is needed to remove bkg for 10x100

# Backup

# Jet performance without machine BKG using diff. cuts



18x275

# Jet finder: Number of Jets per Events, before cuts



| nhit>=3 | <N reco jets> = 1.16724 | <N Gen jets> = 0.976192 |
| nhit>=4 | <N reco jets> = 0.334752 | |
| nhit>=5 | <N reco jets> = 0.284367 | |
| nhit>=6 | <N reco jets> = 0.195173 | |
| noBKG | <N reco jets> = 0.299603 | <N Gen jets> = 1.12846 |

| nhit>=3 | <N reco jets> = 17.0599 | <N Gen jets> = 0.772558 |
| nhit>=4 | <N reco jets> = 1.63853 | |
| nhit>=5 | <N reco jets> = 0.210049 | |
| nhit>=6 | <N reco jets> = 0.134454 | |
| noBKG | <N reco jets>= 0.277187 | <N Gen jets> = 0.717787 |

Files Used:

root://dtn-eic.jlab.org//volatile/eic/EPIC/RECO/25.12.0/epic_craterlake/DIS/NC/18x275/minQ2=1/pythia8NCDIS_18x275_minQ2=1_beamEffe\
cts_xAngle=-0.025_hiDiv_1.0000.eicrecon.edm4eic.root
140k events

root://dtn-eic.jlab.org//volatile/eic/EPIC/RECO/25.10.4/epic_craterlake/Bkg_1SignalPer2usFrame/Synrad_18GeV_Vac_10000Ahr_Runtime_5\
0s_Egas_18GeV_Hgas_275GeV/DIS/NC/18x275/minQ2=1/pythia8NCDIS_18x275_minQ2=1_beamEffects_xAngle=-0.025_hiDiv_1.0000.eicrecon.edm4ei\
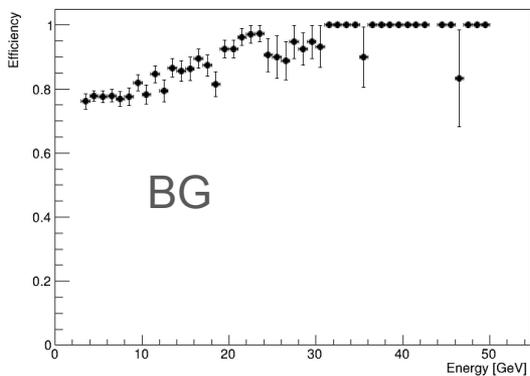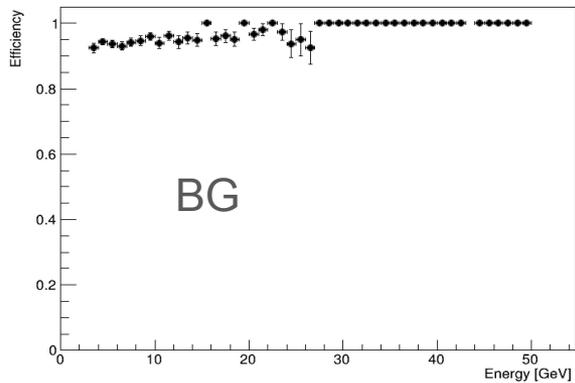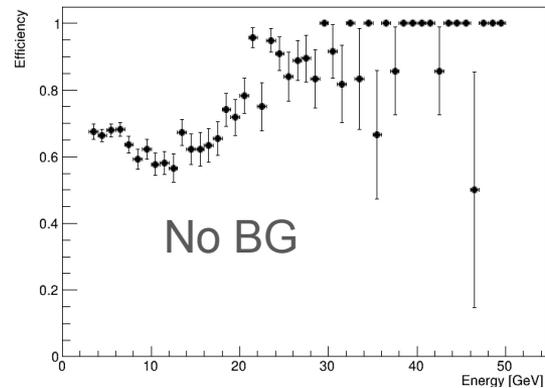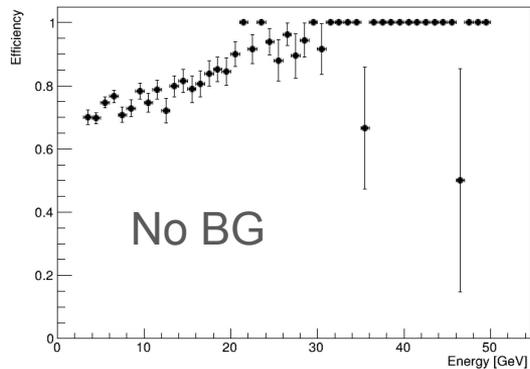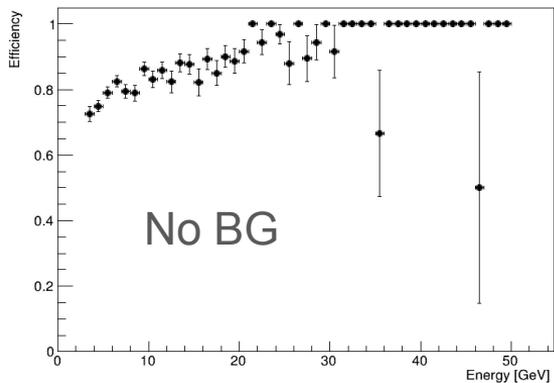c.root
106k events
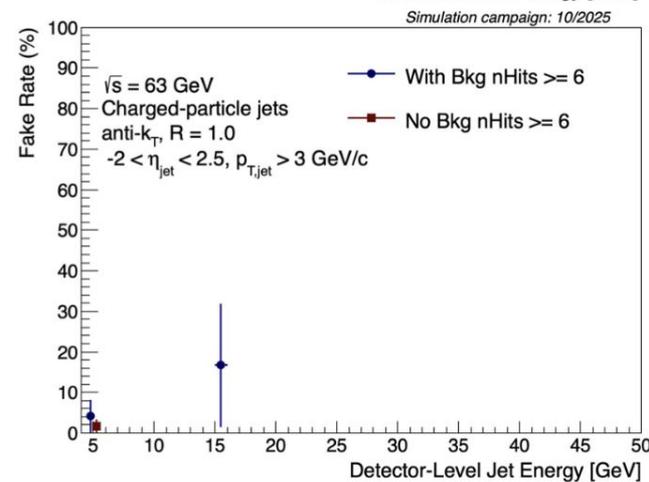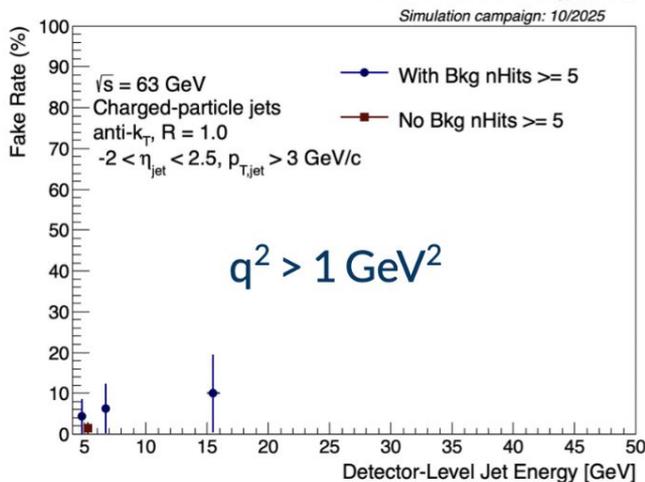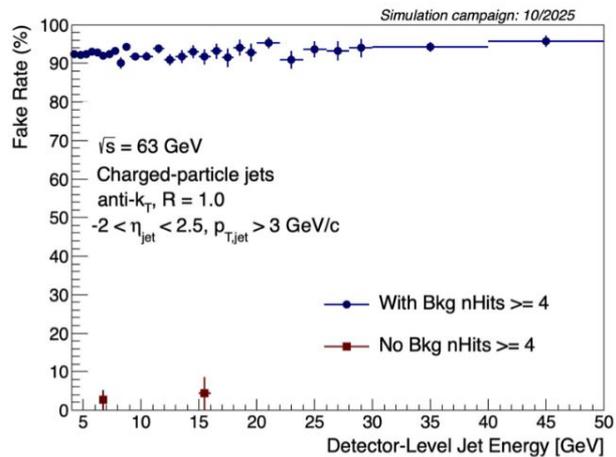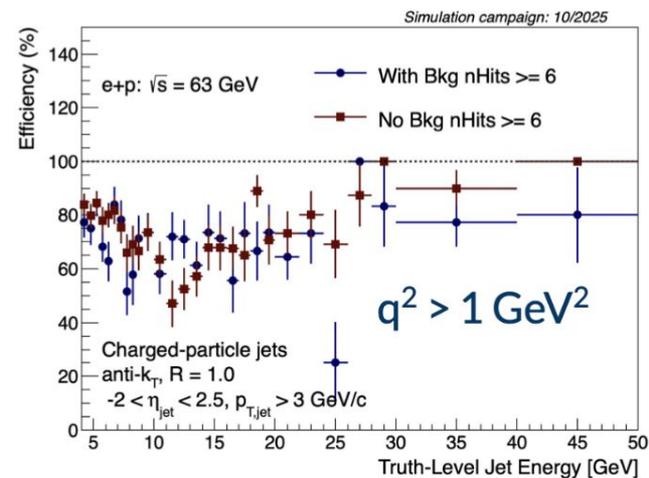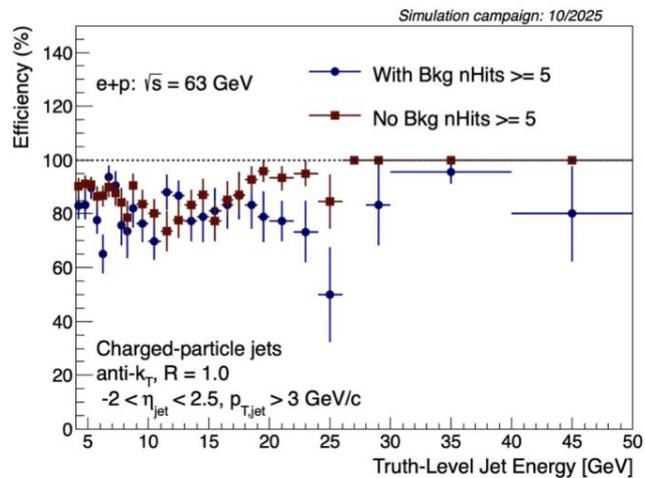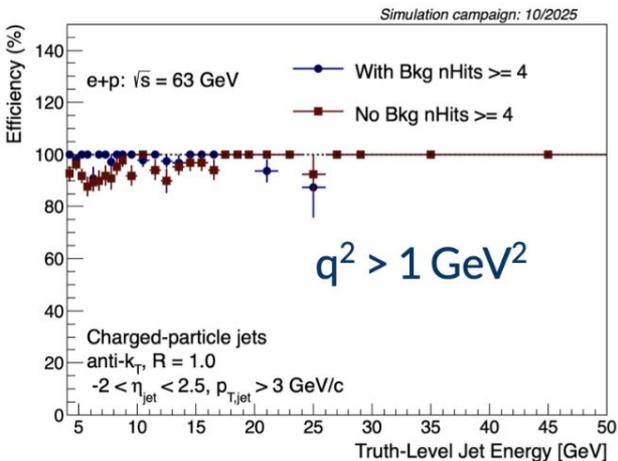
NMeasurements: >= 4    16    NMeasurements: >= 5    NMeasurements: >= 6

# Efficiency vs Energy, η = (-2 , 2.5)
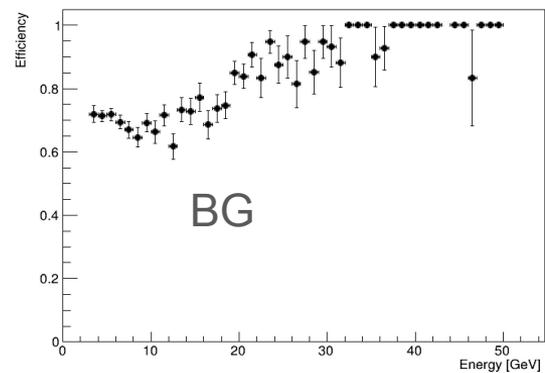


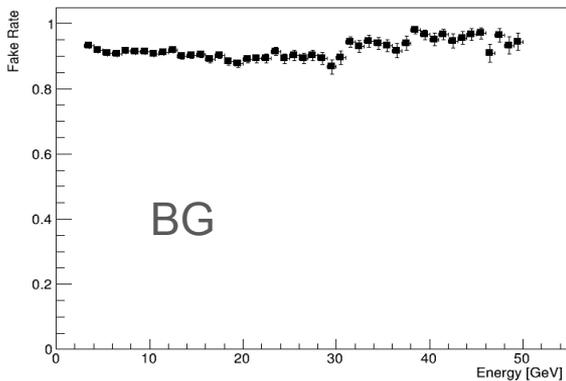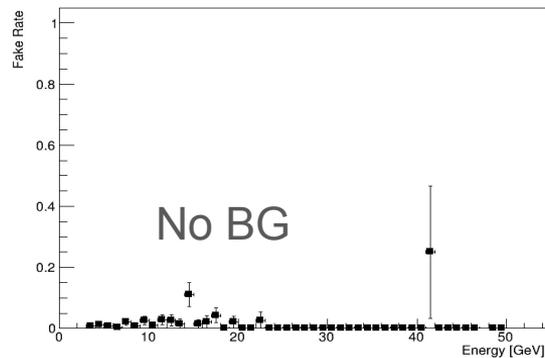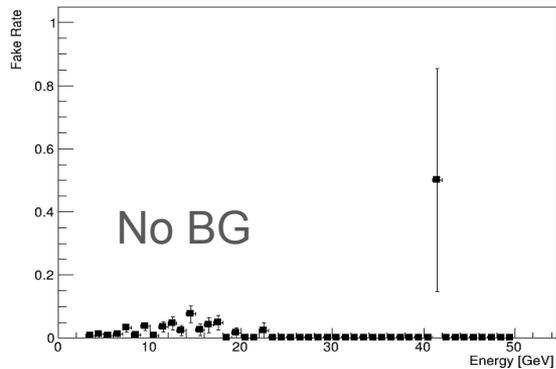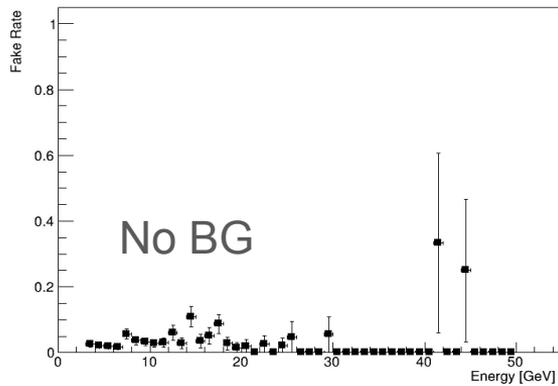nMeasurements >=3          nMeasurements >=4          nMeasurements >=5

Fake vs Energy, η = (-2 , 2.5)
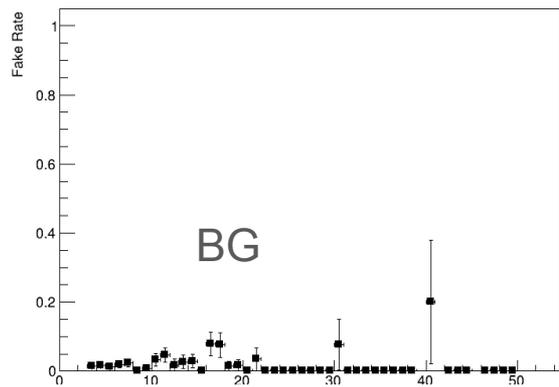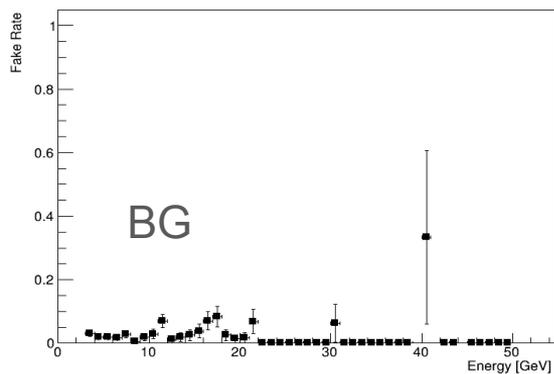


nMeasurements >=3                nMeasurements >=4                nMeasurements >=5

# Jet finder: Number of Jets per Events, after cuts



18x275

10x100

nhit>=3    ‹N reco jets› = 0.906376        ‹N Gen jets› = 0.0379573
nhit>=4    ‹N reco jets› = 0.0287526
nh1t>=5    ‹N reco jets› = 0.0246886
nhit>=6    ‹N reco jets› = 0.0196421

nhit>=3    ‹N reco jets› = 13.6477,        ‹N Gen jets› = 0.0277471
nhit>=4    ‹N reco jets› = 0.554544
nhit>=5    ‹N reco jets› = 0.0100567
nhit>=6    ‹N Gen jets› = 0.0277471
noBKG     ‹N reco jets› = 0. 0185778        ‹N Gen jets› = 0.0222749