L0 trigger:
Multi-vertex PU suppression

Tomás Bazzano - Gustavo Otero y Garzón - Ricardo Piegaia - Ariel Schwartzman

PPES + Upgrade Physics 6th ML WS
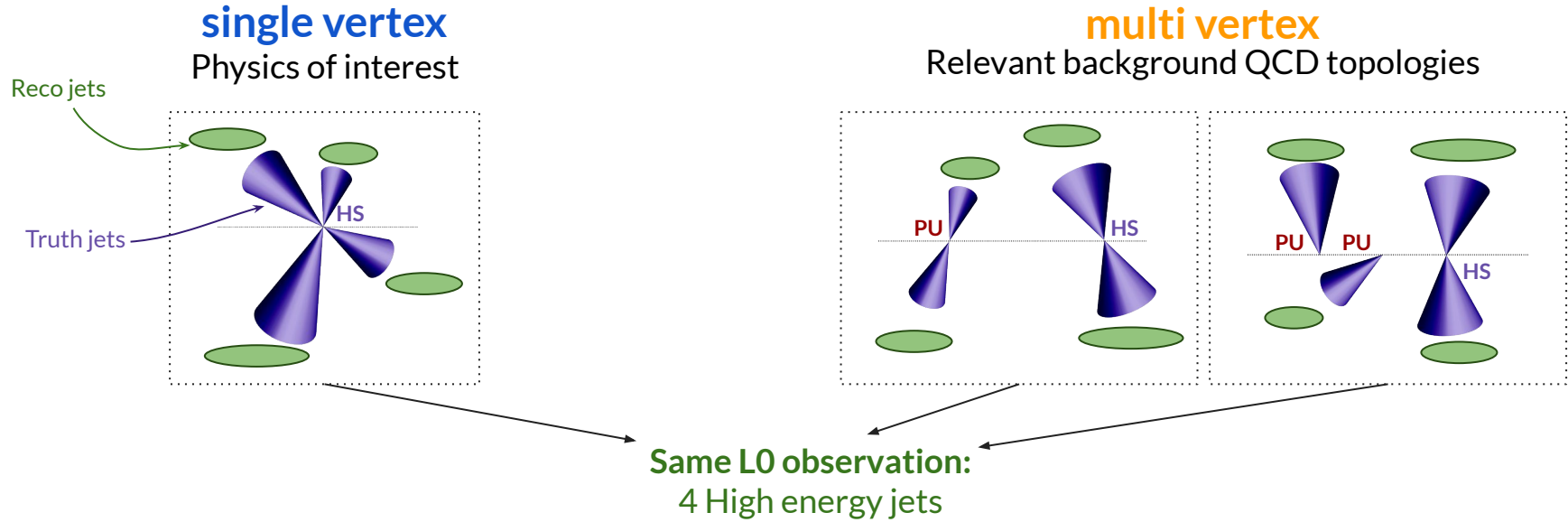
Overview

- Several vertices from hard QCD interactions are expected under Run 4 luminosity conditions.

- **L0 Multi-vertex PU suppression**: discrimination between single-vertex and multi-vertex 4+ jets QCD events.

- *Signal Agnostic:* any analysis with a 4 jet final state benefits from this trigger improvement, for example HH 4b.

- Multi topological variables suggest approaching this study using ML techniques.

single vertex
Physics of interest

Reco jets

HS

Truth jets

multi vertex
Relevant background QCD topologies

PU   HS

PU   PU
                 HS
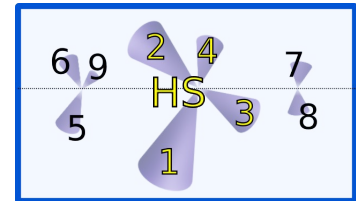
Same L0 observation:
4 High energy jets

Signal definition
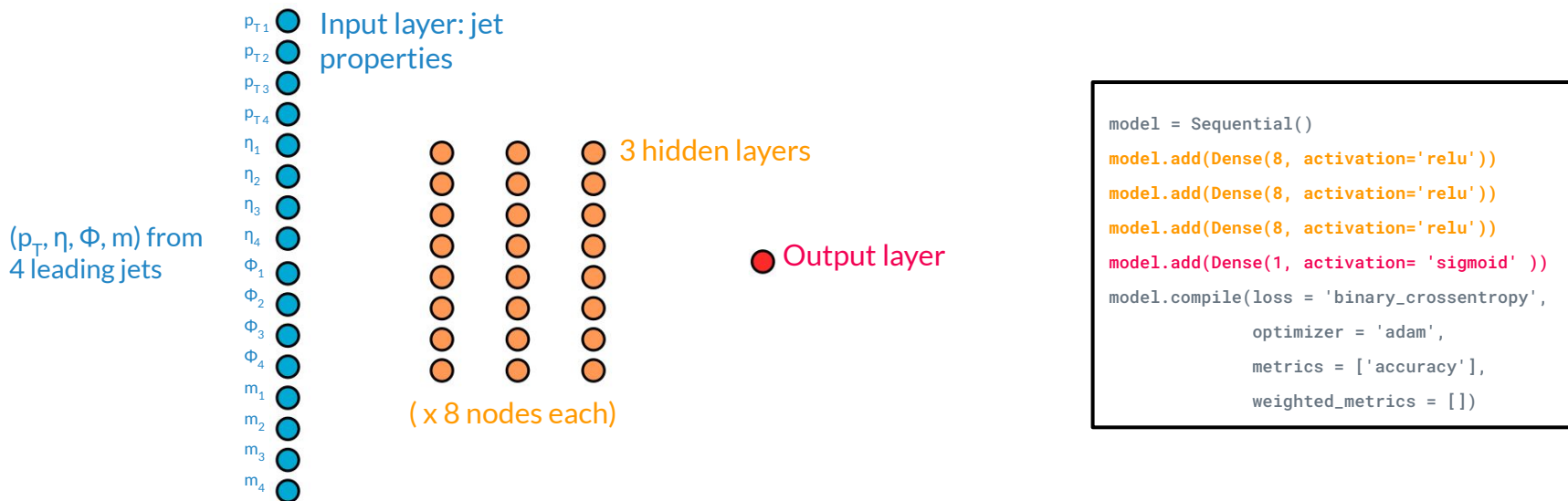
Reconstructed Calo Jets

Matching

HS Truth Jets

Single vertex event:
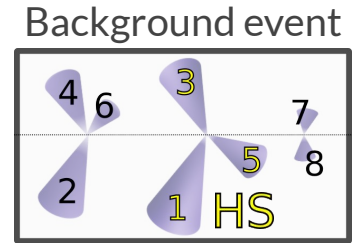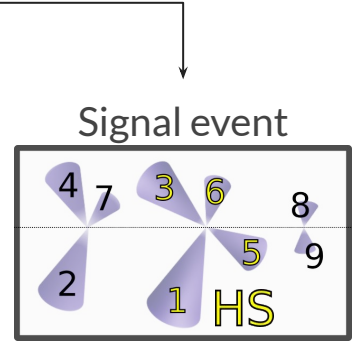4 matches (4 HS vertices)
between the first 4 reco.

6 9   2   4   7
      HS
5   3   8
      1

3

Fully connected NN

p_{T1} Input layer: jet properties
p_{T2}
p_{T3}
p_{T4}
η_1
η_2
η_3 3 hidden layers
η_4
Φ_1 Output layer
(p_T, η, Φ, m) from 4 leading jets
Φ_2
Φ_3
Φ_4
m_1 (x 8 nodes each)
m_2
m_3
m_4

```
model = Sequential()
model.add(Dense(8, activation='relu'))
model.add(Dense(8, activation='relu'))
model.add(Dense(8, activation='relu'))
model.add(Dense(1, activation= 'sigmoid' ))
model.compile(loss = 'binary_crossentropy',
              optimizer = 'adam',
              metrics = ['accuracy'],
              weighted_metrics = [])
```
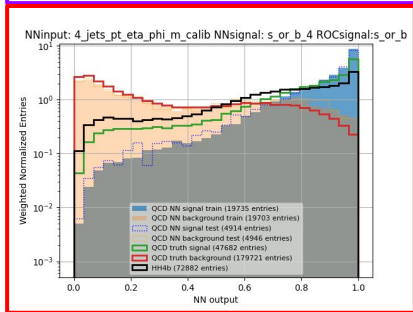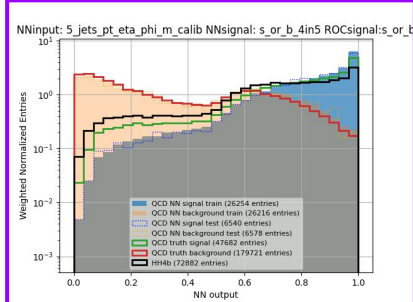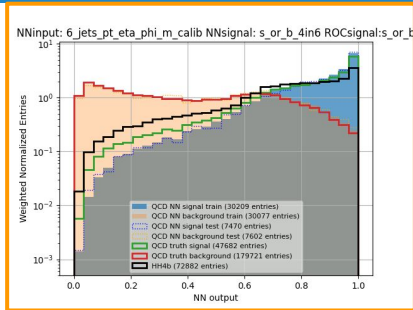
Events are classified as single-vertex or multi-vertex by matching truth (HS vertex) jets.
No physics signal was used for training. All training was done on QCD dijet events.

Performance

Thank you