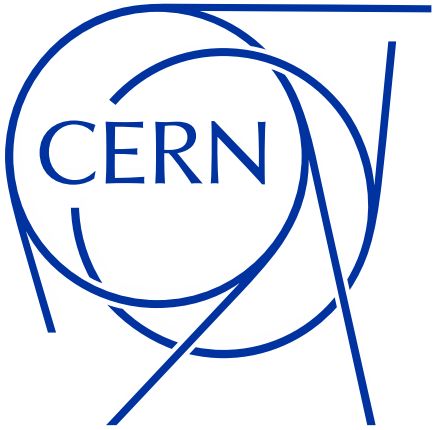


# LHCb Jet Flavour Classification with a Graph Neural Network (GNN)

**Gabriella Pesticci**

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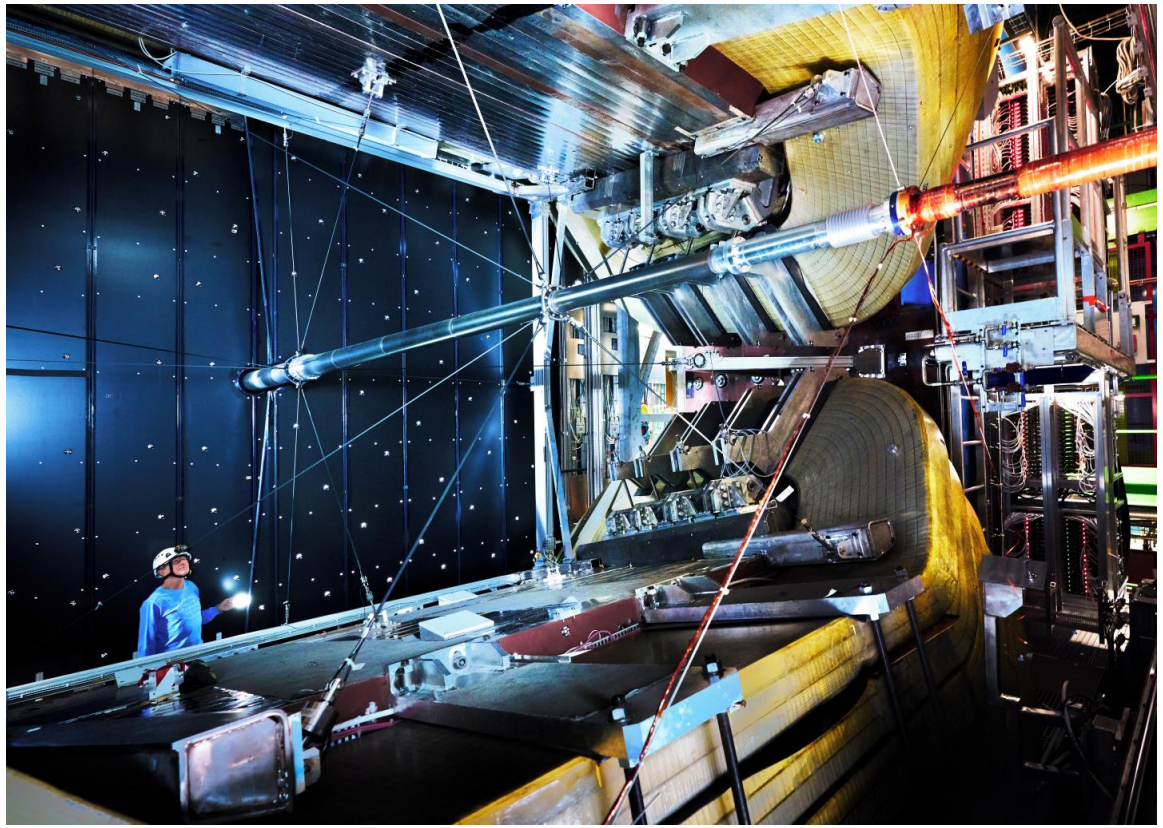
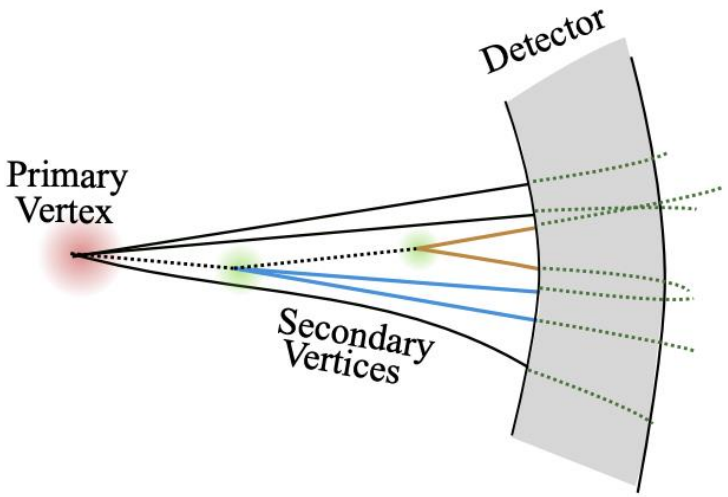
# LHCb Experiment

- Investigating the beauty (or bottom) quark
- Matter vs anti-matter
- Single-arm spectrometer and series of sub-detectors
- Focuses on forward-moving particles produced by proton-proton collisions

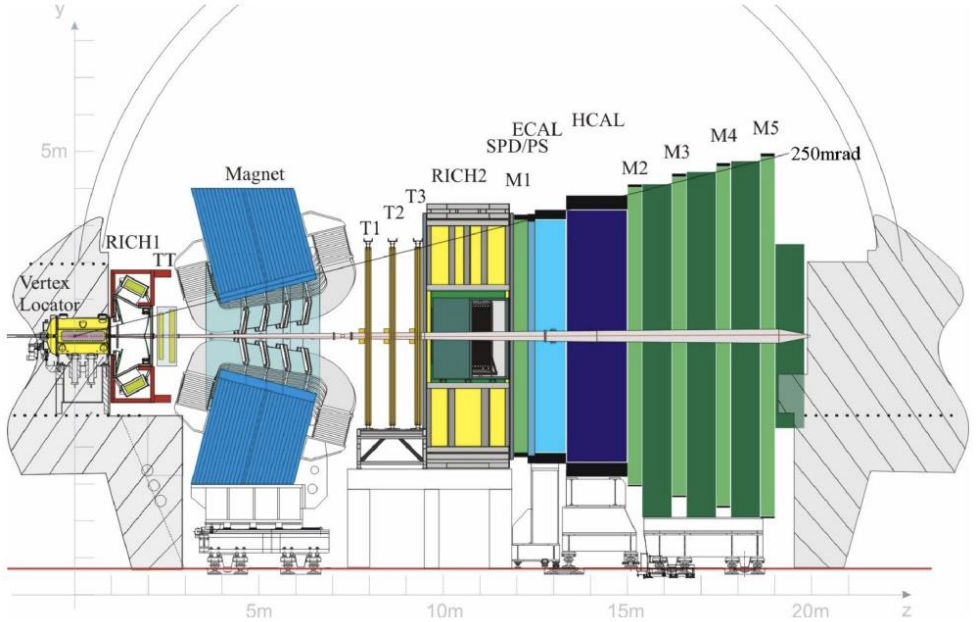


# Jet Flavour Classification

- **Mentors:**
  - Dr. Conor Henderson
  - Dr. Nathan Allen Grieser

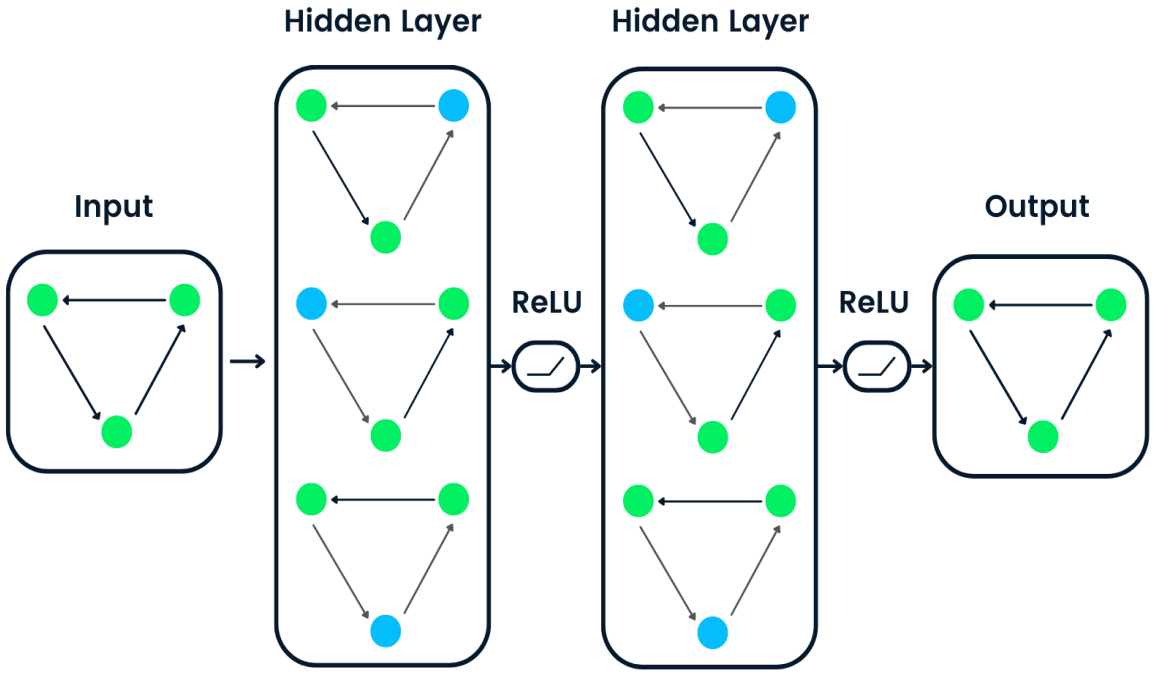



- **What are jets?**
  - Proton-proton collisions produce gluons and quarks
  - Jets are sprays of particles produced from hadronization
  - b quarks have longer lifetimes



# Graph Neural Networks (GNN)

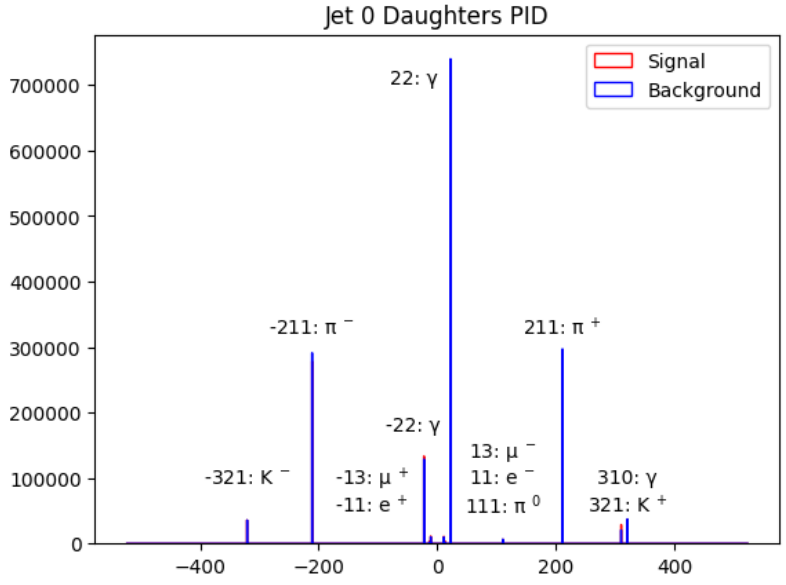
- **Deep Learning**
  - GNN are artificial neural networks
  - They process data represented as graphs
  - Can be trained to identify jet flavours
- **Architecture**
  - Composed of nodes, edges, and features
  - Uses activation functions to introduce non-linearity between layers
- **Python**
  - PyTorch → PyTorch Geometric

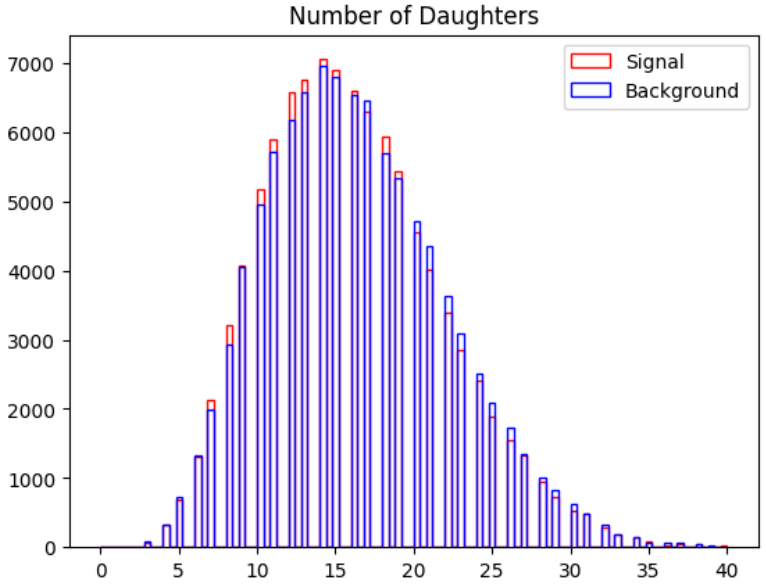


# Current Progress

- **Plotting**
  - Visualizing signal vs background dijet data
- **GNN Framework**
  - Load data
  - Creating, training, and testing the model
  - ROC and AUC
- **Setbacks**
  - Defining nodes, edges, features
  - Handling data

| | Jet0_nDaughters | Jet0_Daughters_E | Jet0_Daughters_pT |
|---|---|---|---|
| 0 | 11 | [6641.2001953125, 13513.37109375, 25441.533203... | [226.46542358398438, 235.54550170898438, 526.2... |
| 1 | 11 | [6641.2001953125, 13513.37109375, 25441.533203... | [226.46542358398438, 235.54550170898438, 526.2... |
| 2 | 11 | [6641.2001953125, 13513.37109375, 25441.533203... | [226.46542358398438, 235.54550170898438, 526.2... |
| 3 | 18 | [15737.859375, 8034.22216796875, 13624.5898437... | [723.5347290039062, 376.4151916503906, 631.710... |
| 4 | 18 | [15737.859375, 8034.22216796875, 13624.5898437... | [723.5347290039062, 376.4151916503906, 631.710... |



# References & Sights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