

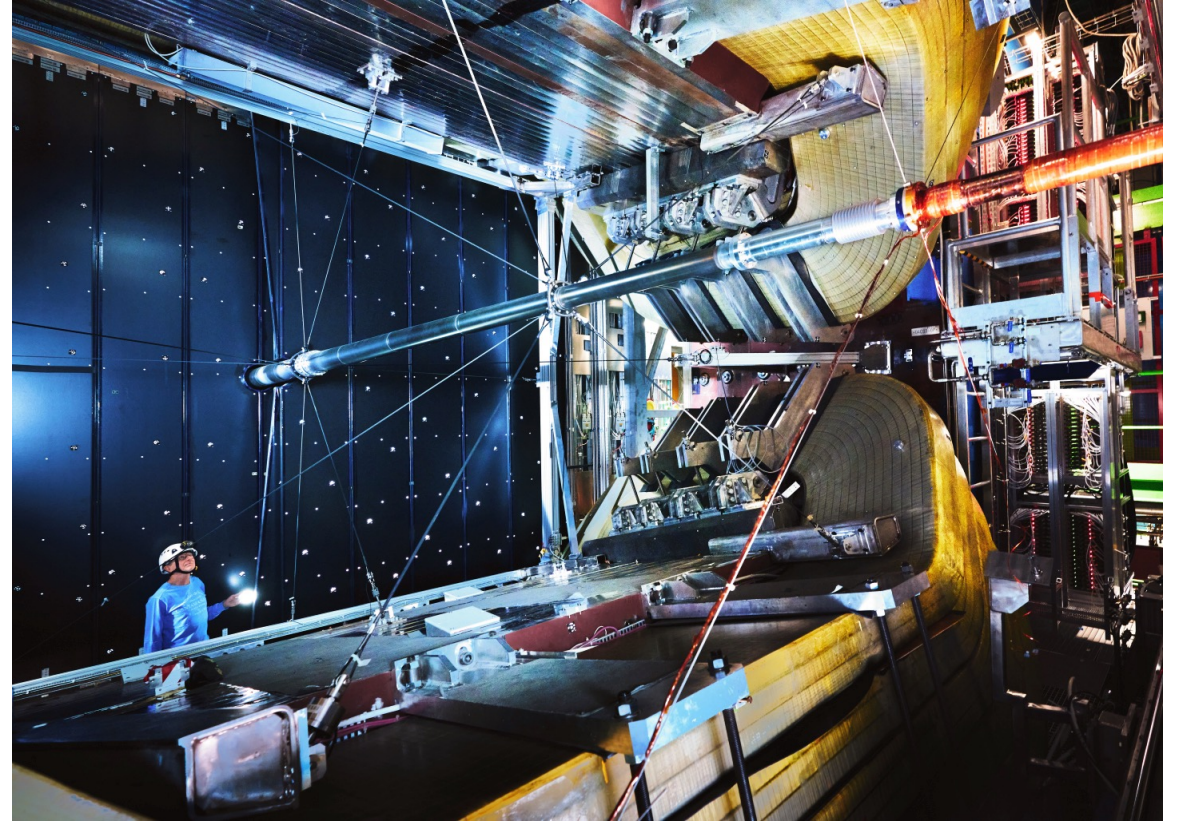
LHCb Jet Flavour Classification with a Graph Neural Network (GNN)

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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

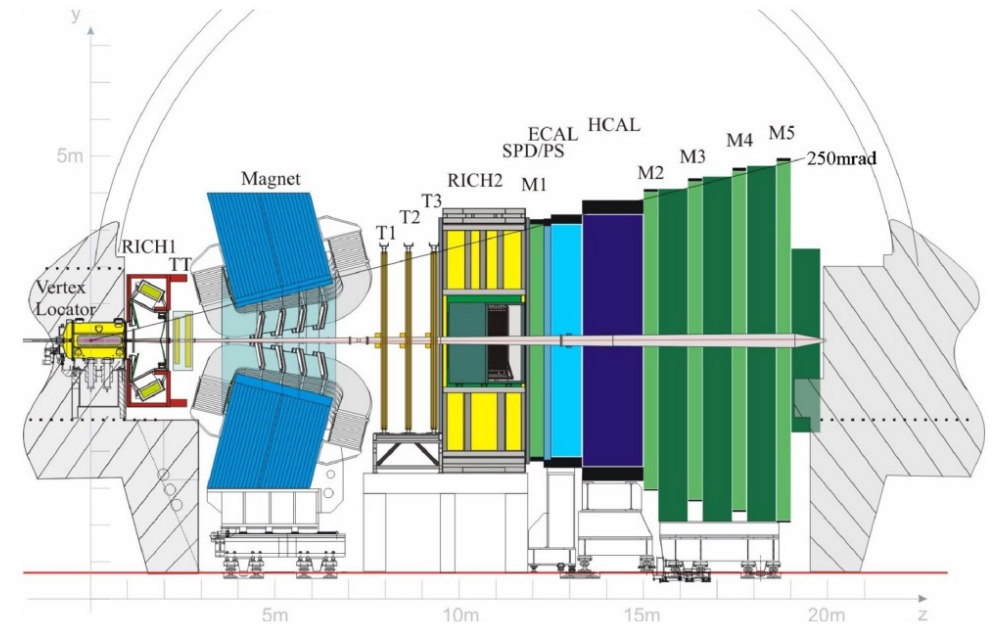
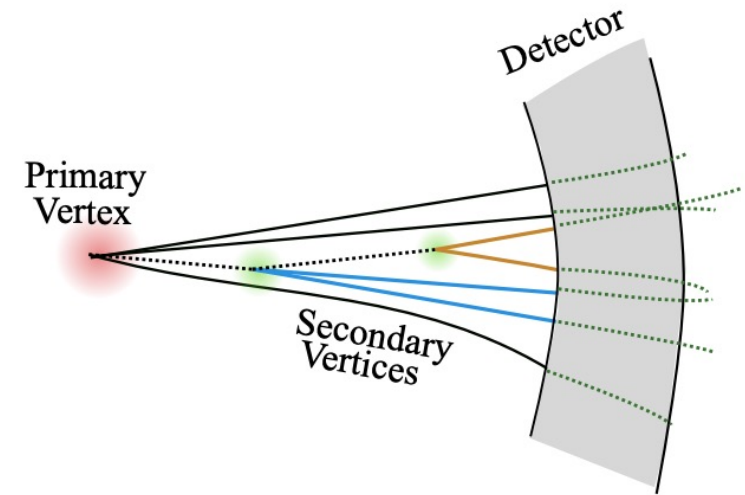
- **Mentors:**

- 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**

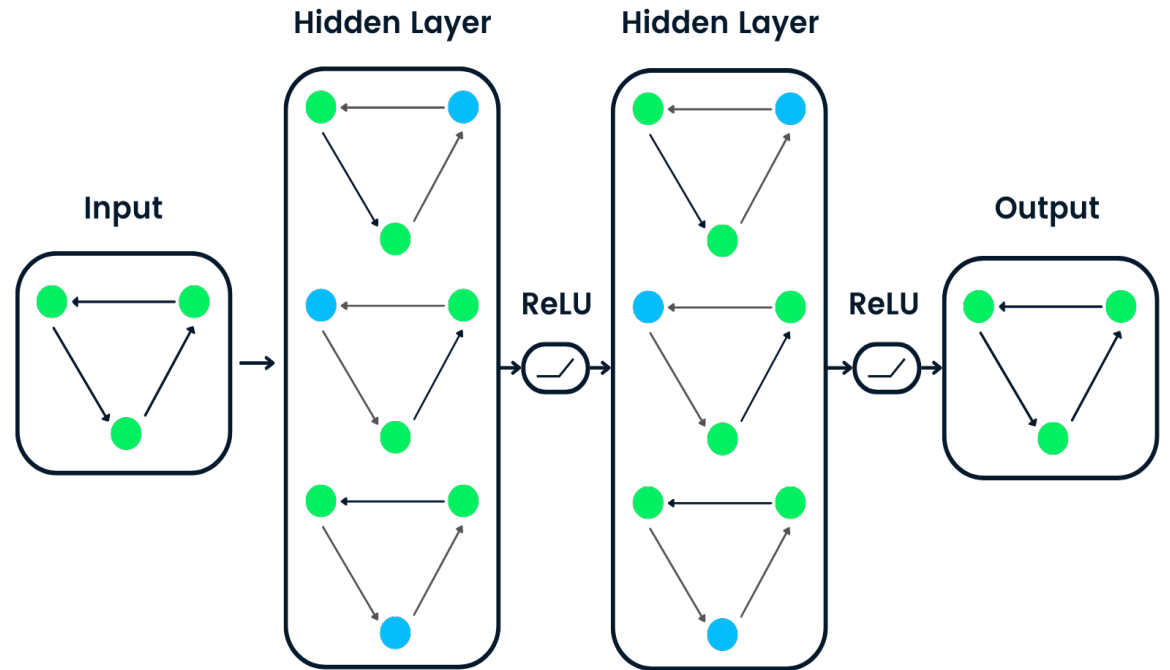
- GNN are artificial neural networks
- They process data represented as graphs
- Can be trained to identify jet flavours

- **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

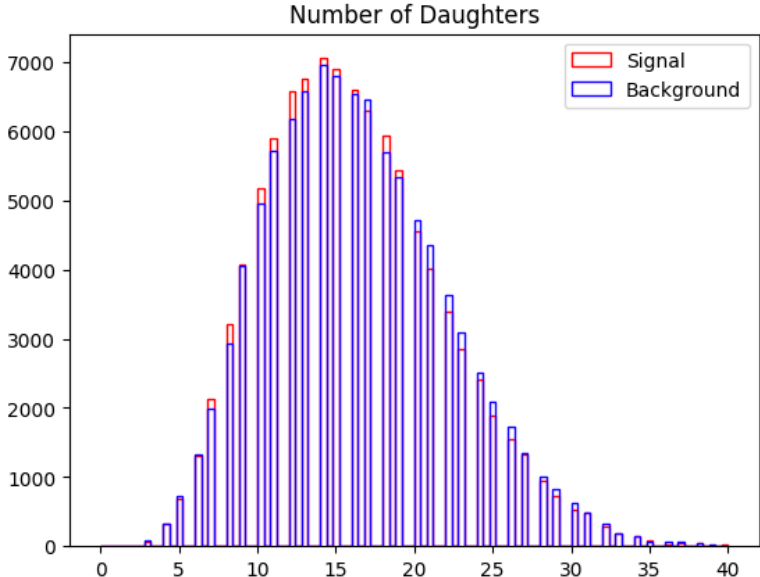
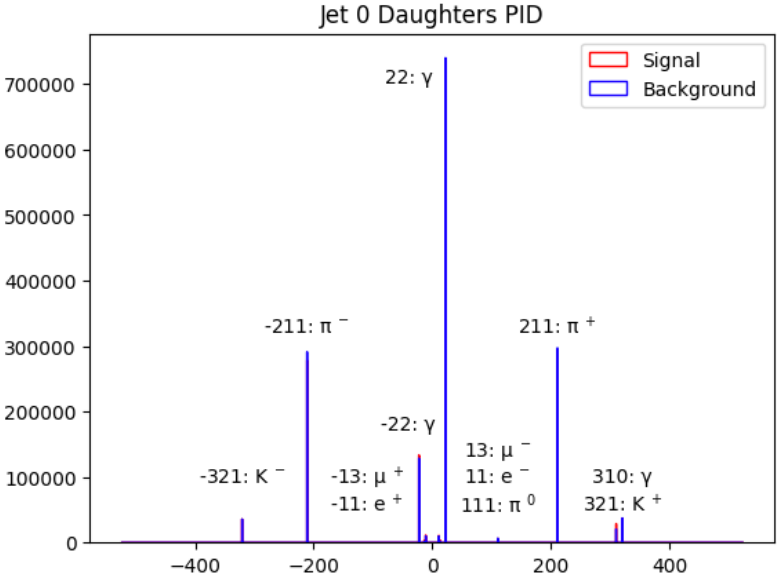
- GNN Framework**

- 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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