# Lund Jet Plane Using JetClass Dataset

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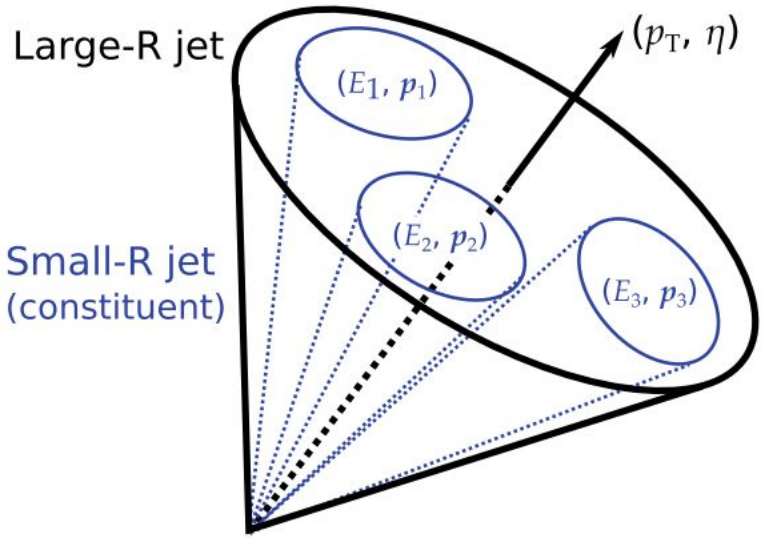
# Heavy Particle Jets

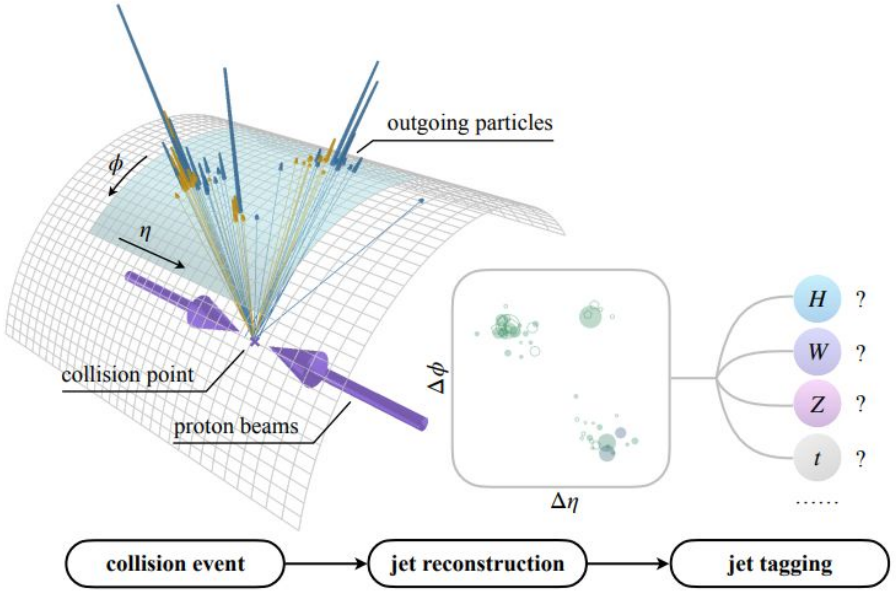
- When Heavy particles decay, their decay products become collimated, or ‘boosted’, in the direction of the original particle.
- It  is convenient to reconstruct their hadronic decay products as a single large-radius (large-$R$) jet.
- This is why for massives particles such as the W or the Higgs, the parameter R in the reconstruction algorithm takes values between [0.8,1.2].




https://link.springer.com/chapter/10.1007/978-981-15-0932-2

# What is JetClass?

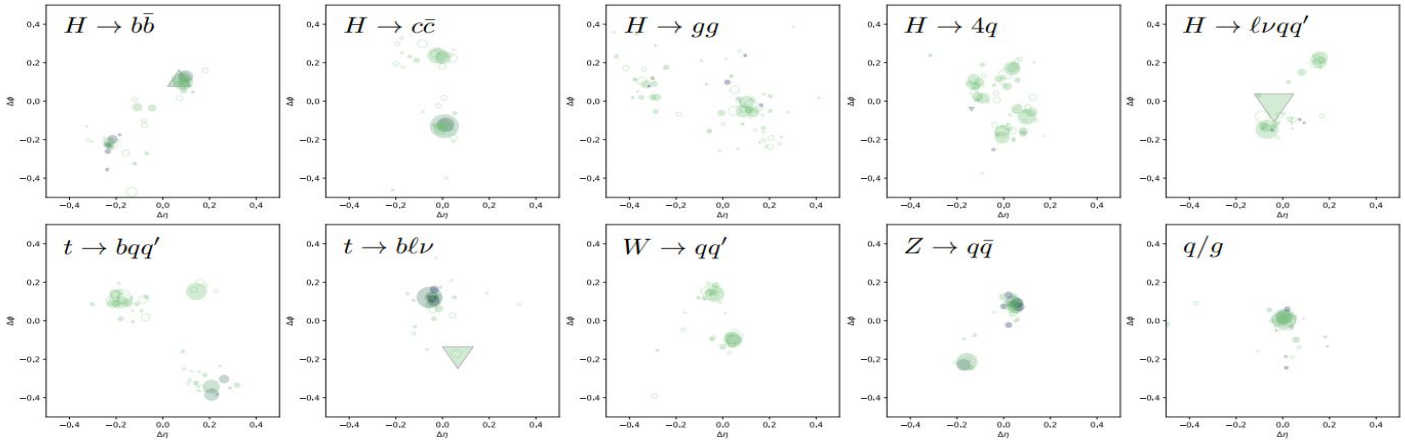
- JetClass is a Dataset published in 2024 with around of 100M of simulated data.
- The dataset contains information of jets coming from 10 different interactions.
- The size is approximately 500GB.




https://arxiv.org/pdf/2202.03772

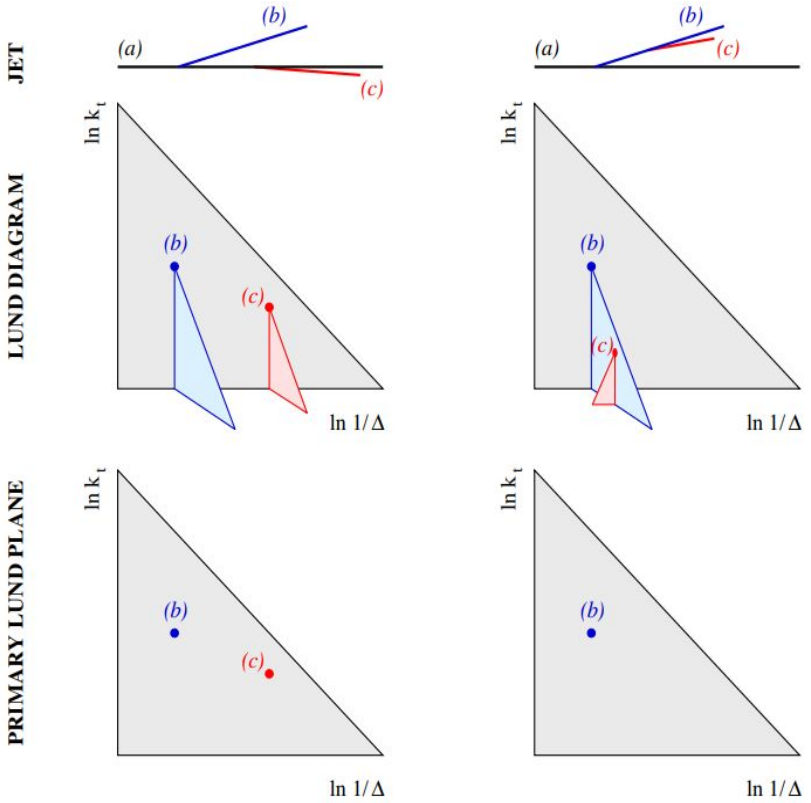
# Simulation Setup and Interactions

- The dataset is simulated using PYTHIA and the detector effects are simulated with DELPHES.
- Only jets with transverse momentum in 500–1000 GeV and pseudorapidity $|\eta| \leq 2$ are considered. The R parameter is taking equal to 0.8.
- 10 types of jets: 5 types of Higgs jets, 2 types of Top jets, W jets, Z jets and the QCD jets.



# Why Use Lund jet Plane?

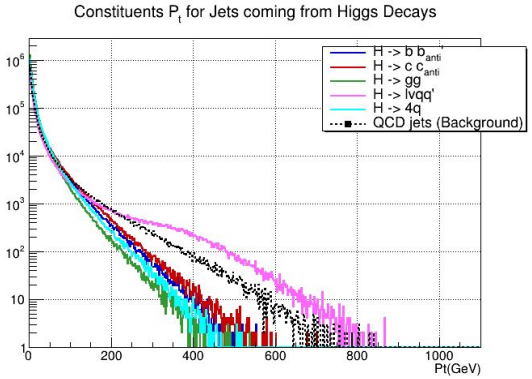
- It is an optimal method to distinguish one jet from another.
- It works as a visual tool to understand a little bit more what happens before the hadronization process.
- The variables of the plane works well as input in machine learning models for jet tagging.

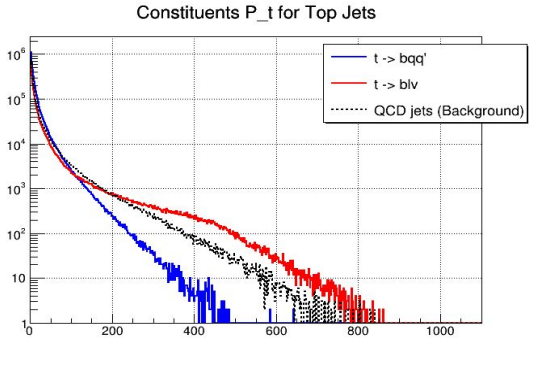


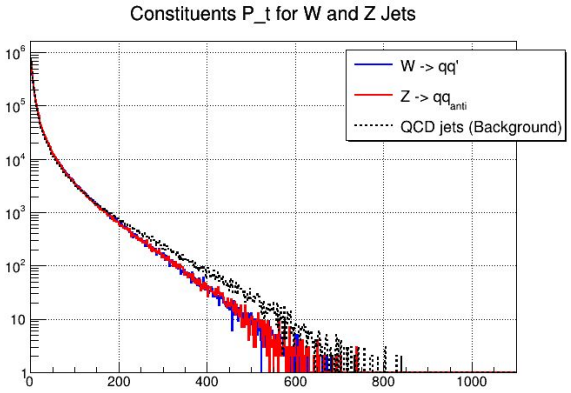

https://arxiv.org/pdf/1807.04758

# Distribution of the Kinematic Features

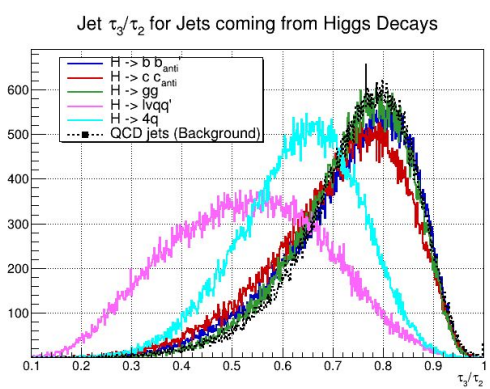
- Pt of the constituents:

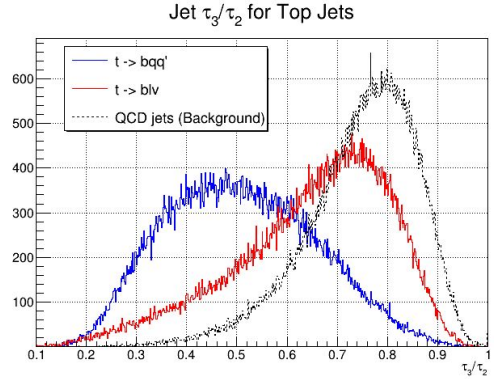


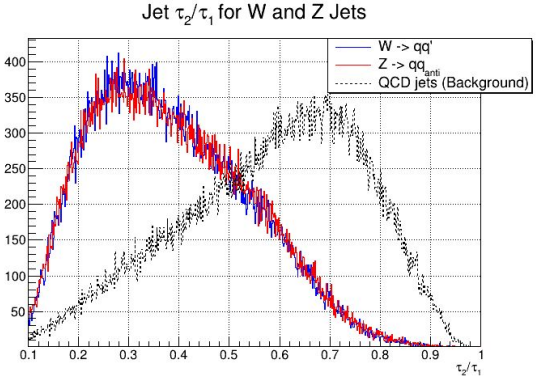



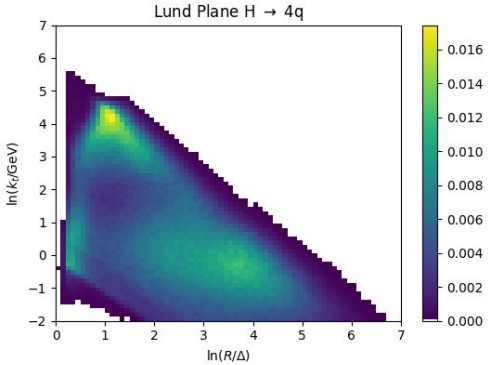

- Subjetiness (jet shape designed to identify boosted hadronic objects)

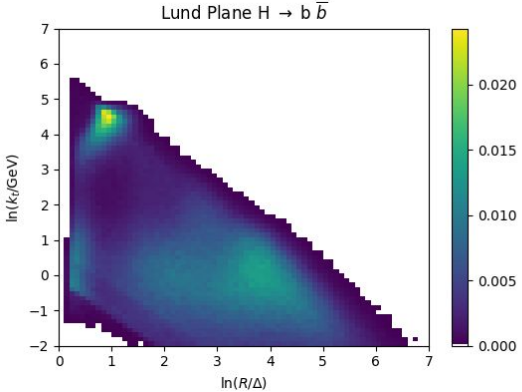


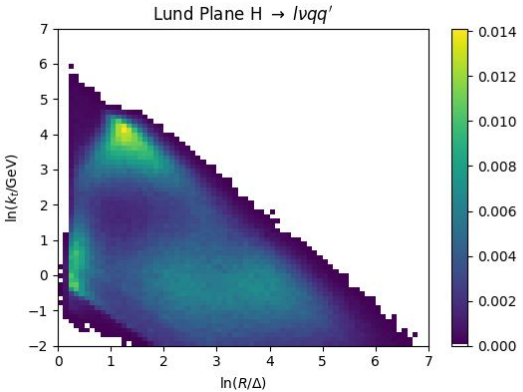



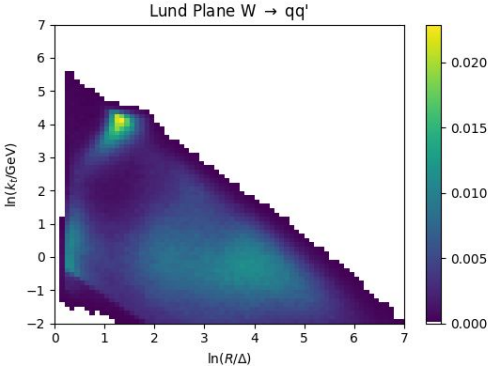



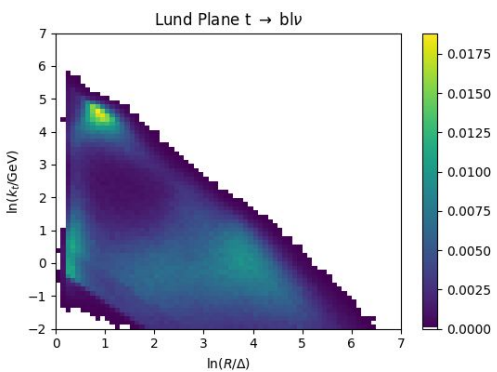
# Lund Jet Plane for the 10 Types of Jets

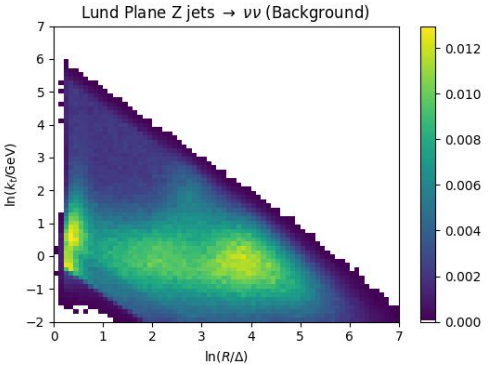


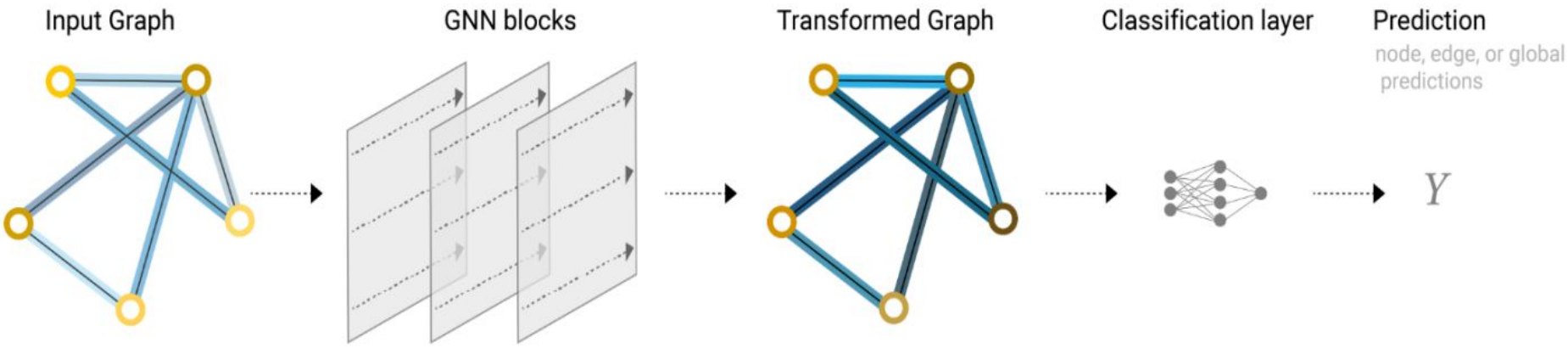



# What is coming next?

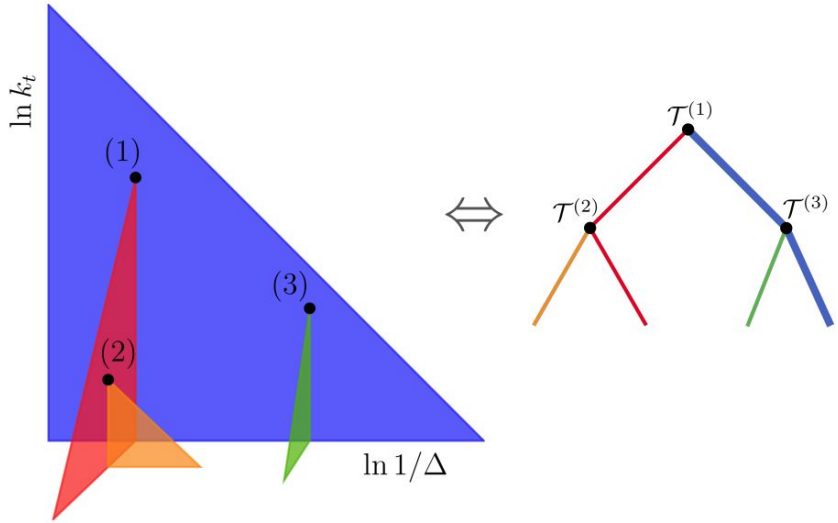
# Graph Neural Networks (GNN's)

- GNN is a deep Learning model based in neural networks methods using graph as inputs.
- A graph is an object composed by nodes and edges.



# Why Use GNN's?

- The natural splitting of the jets form a graph like structure.
- they form accurate models of their inputted data and achieve representation learning with efficiency.
- It is an optimal process to use the Lund jet plane variables in addition with machine learning methods to create a better tagger.




https://arxiv.org/pdf/2012.08526

# Thank you!