BDT: Flavour

Classification Results

- Baseline Model:
  - A **Boosted Decision Tree (BDT)**, a conventional machine learning algorithm.
  - Serves as a robust benchmark to quantify what's possible *without* 3D deep learning.
- Input Features
  - No per-voxel 3D information.
  - Total energy sums from different calorimeter sections:
    - `FaserCal, RearCal, HCal, MuTag`
- **Strong on dominant classes:** Achieves high recall (93%) for NuMu CC, likely driven by the strong signal in the Muon Tagger. Fails completely on rare signals: Achieves 0% recall for NuTau CC.

Class	Precision	Recall
ν_e CC	0.74	0.60
ν_μ CC	0.81	0.93
ν_τ CC	0.00	0.00
NC	0.66	0.57

Pred	True ν_e	True ν_μ	True ν_τ	True NC
ν_e CC	**9,579**	1,219	250	1,911
ν_μ CC	4,116	**74,208**	1,640	11,757
ν_τ CC	0	0	**0**	1
NC	2,141	4,618	2,599	**18,201**

BDT: Visible Energy

Regression Results

- Large Systematic Bias in NC Events
  - BDT Learns average energy correction from the dominant CC events and misapplies it to the inefficient
- Performance on CC Events:
  - Best performance: NuE CC
  - Poorer resolution: NuMuCC, NuTau CC