

# Deep Learning Model: Flavour

## Classification Results

- Overall Accuracy : 77% (BDT) → **81%**.
- The most significant improvement:  $\nu_e$  CC:
  - Precision: 0.76% → 0.89%, Recall: 0.60% → 0.84%.
  - **Why?** *Pre-Train* learns generalizable representation of what a physically EM shower.
- **First Identification of Tau Neutrinos:**
  - Promising first step: **11 true  $\nu_\tau$  CC events correctly identified** (*BDT had 0% Precision*).
  - **Why?** *Pre-Train* created a feature space where rare events could become *separable* from other classes.

Class	Precision	Recall
$\nu_e$ CC	0.89	0.84
$\nu_\mu$ CC	0.82	0.94
$\nu_\tau$ CC	<b>0.79</b>	<b>0.00</b>
NC	0.73	0.58

Pred.	True $\nu_e$	True $\nu_\mu$	True $\nu_\tau$	True NC
$\nu_e$	<b>13,395</b>	789	103	726
$\nu_\mu$	1,864	<b>72,208</b>	1,705	12,748
$\nu_\tau$	0	0	<b>11</b>	3
NC	603	3,537	2,596	<b>18,403</b>

# Deep Learning Model: Visible Energy

## Regression Results

- **$E_{\text{vis}}$** : magnitude of visible\_momentum
  - For CC it corresponds to Incoming Neutrino Energy.
  - For NC it corresponds to Hadrons Energy.
- Remarkable improvement in energy reconstruction:
  - Eliminated bias for  $\nu_e$  CC.
  - The resolution is almost *halved* for all classes.

