Our Training Strategy

A Two-Stage Approach

- **Stage 1: Self-Supervised Pre-Training**

  - *Goal*: Force the model to learn a rich, physical representation of events.

  - *How*: A dual-objective Masked Autoencoder (MAE).

    - *Reconstruction Task:* Reconstruct masked (hidden) parts of the event.

    - *Contrastive Task: Machine learning framework for grouping hits that share the same voxel ID.*

- **Stage 2: Supervised Fine-Tuning**

  - *Goal*: Adapt the "smart" pre-trained encoder to specific physics tasks.

  - *How*: Transfer Learning - Use the pre-trained weights as a starting point and <u>fine-tune</u> for classification and regression.

    - ***Classification Task*:**
      - `NuE CC, NuMu CC, NuTau CC, NC`
    - ***Regression Task*:**
      - `Visible Momentum (E_vis, Pt_miss), Jet Momentum, Lepton Momentum`

Results

Deep Learning Model