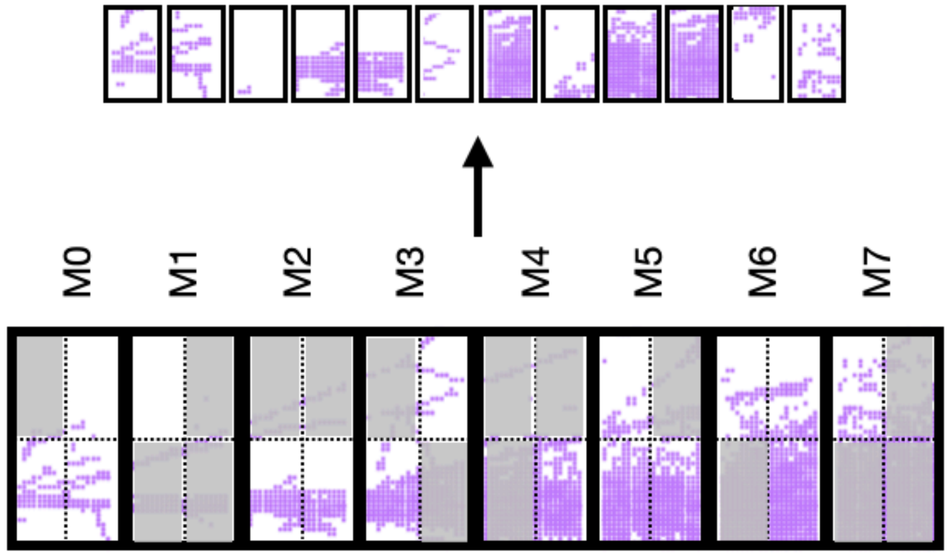
Self-Supervised?

Pipeline

- What does it mean self-supervised?
  - A type of AI that learns from large amounts of unlabeled data by creating its own "labels" or "supervision" from the structure of the data itself - by predicting missing or altered parts of the input



Info on the masked part?: Occupancy, not the Energy

Loss functions

Stage 1 and 2

- **Pre-Train, Encoder** *(Based on cosine Similarity)*
  - 1. Local Cohesion | Ltrk | "Connect the dots" of a single particle track. | Prototype Contrastive |
  - 2. Global Grouping |Lpri| Group all fragments of a single shower by origin. | Prototype Contrastive |
  - 3. Semantic Clustering| Lpid| Identify the physical type of hit. | Prototype Contrastive |
- **Pre-Train, Decoder**
  - 4. Occupancy | Locc| Predict if a masked voxel was empty or contained a hit. | Focal Cross-Entropy |
  - 5. Regression | Lreg | Predict the energy of a masked hit. | Huber Loss (Charge-Weighted)|

- **The Fine-tuning**
  - **Classification:** Flavour - Cross-Entropy, Charm - BCEWithLogits
  - **Regression**: Smooth L1 (Huber)

The total loss is a weighted sum with learnable uncertainty parameter, σ_i

$$\mathcal{L}_{\text{total}} = \sum_{i=1}^{5} \left(\frac{1}{2\sigma_i^2} \mathcal{L}_i + \log \sigma_i \right)$$