High-Level View of the Phase-2 L1 trigger

- Tracks → Level 1 Trigger Correlator
- Calo → Vertexing
- Muons → Particle Flow (PF)
- PileUp Per Particle Identification (PUPPI)

Requirements:
- Tracking information
- Fine granularity calorimeters
- Adequate processing resources

Benefits:
- Better response & resolution for jets & MET
- Hadronic τ identification
- Allow for pileup mitigation techniques (PUPPI)

High Granularity Calorimeter (HGCal)

- Coverage: 1.5 < |η| < 3.0
- Radiation tolerance → Silicon layers in front and at high η
- Longitudinal granularity: 28 EM layers & 24 hadronic layers
- Lateral granularity: 0.5 or 1.2 cm² hexagonal cells
- Timing: ~50 ps
- Energy density based 2D clusters
- 3D clusters in a cone

Matching of clusters
- Clusters matched with γ (SinglePhoton sample), n (SinglePhoton sample), n (Unmatched clustered labels as noise (PU 0) or (PU 200))

ID elements
- Noise suppression cut
- Cut on BDT output of γ vs. n, n clusters
- Cut on BDT output of γ vs. n clusters

Noise suppression cut:
Exclude 3D clusters contained in only one layer ⇒ 99% photon efficiency, 75% noise rejection.

Motivation for HGCal e/y Cluster ID
- Reduce data rate and particle multiplicity
- Reduce fake photons
- First PU rejection (reduce workload on PU+PUPPI)
- Exploit cluster tagging to more efficiently and accurately create PF objects

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PUPPI

- For each particle, compute $a = \sum_{i} \frac{w_i}{\Delta x_i}$
- Weight: $w_i = f(a_i)$
- Rescale: $p_{T} = \frac{w_i}{\Delta x_i} p_{T}$
- PU-like particles ⇒ low weights
  - Particles with low weight or low $p_T$ ⇒ Discarded
  - Vertex information ⇒ Better discrimination in central region.

Implementation in PF Algorithm

Pros: No energy losses for the hadrons due to clustering.
Cons: Low resolution for the hadrons

Plans and Ongoing Work

- Study performance with new clustering algorithms
- Extend $p_T$ range for training.
- Test different implementations of the selected clusters in PF and tune PF+PUPPI to new inputs.

References: