# T 103: Methods in Particle Physics V (Event Reconstruction, PID)

Time: Friday 9:00–10:30 Location: VG 4.101

T 103.1 Fri 9:00 VG 4.101

**Improving Reconstruction in the Belle II Electromagnetic Calorimeter Using Graph Neural Networks** — •Jonas Eppelt and Torben Ferber — Karlsruher Institut of Technology

Belle II uses an Electromagnetic Calorimeter (ECL) built from Cesium-Iodide crystals to measure a particle's energy. The current clustering algorithm faces significant challenges from high background conditions, low momentum minimal ionizing particles, and hadronic particles creating multiple clusters. This affects energy resolutions, detection efficiencies for low energetic photons, and higher-level variables used in many analyses. Graph Neural Network(GNN) based methods can leverage more of the available information from the ECL and better represent the sparse and irregular geometry of the clusters. This talk will present ongoing efforts to reduce background, improve energy resolution, and analyze other variables.

T 103.2 Fri 9:15 VG 4.101

**Event reconstruction for opaque liquid scintillator detectors.** — •Kitzia Hernandez for the NuDoubt-Collaboration — Johannes Gutenberg-Universität Mainz

Opaque liquid scintillators represent a novel approach to particle detection. This technology uses Mie scattering to confine the scintillation light around its interaction point, conserving the topology of the event in comparison with classical transparent scintillators. However, the opacity of these detectors and their energy deposition topologies represent a new paradigm opening the way to new reconstruction methods.

Here, we explore the adaptation of the Cambridge-Aachen jet clustering algorithm, traditionally used in High-energy physics, for event reconstruction in opaque liquid scintillator detectors. By clustering optical photons in the x-y plane and incorporating timing information, this method can effectively reconstruct event position, energy, and particle type. Furthermore, it provides a robust framework for particle discrimination and is a reference point for comparing with more sophisticated approaches using Graphic Neural Networks.

T 103.3 Fri 9:30 VG 4.101

**Machine Learning Assisted Reconstruction of Hadron-Collider Events using Mini-Jets** — •Josef Murnauer[1], Stefan Kluth[1], Daniel Britzger[1], and Roman Kogler[2] — [1]Max-Planck-Institut für Physik, Garching — [2]DESY, Hamburg

Reconstructing impactful physical observables from hadron collider data represents challenges due to combinatorial ambiguities and experimental effects. We propose a novel approach using mini-jets (R=0.1) as the sole reconstructed objects, employing a deep neural network for observable determination. This method condenses full event information into a manageable size, demonstrating superior efficiency and generality compared to classical algorithms for future LHC analyses.

T 103.4 Fri 9:45 VG 4.101

**The Heterogeneous HGCAL event reconstruction** — •Wahid Redjeb[1,2], Alexander Schmidt[2], Felice Pantaleo[1], and Marco Rovere[1] — [1]CERN — [2]III. Physikalisches Institut A, RWTH Aachen

The High-Granularity Calorimeter (HGCAL) is a sampling calorimeter with both lateral and longitudinal fine granularity designed for the High-Luminosity LHC. The calorimeter will use silicon sensors in the high radiation regions, providing high pile-up mitigation, and scintillators in the low radiation regions. For the physics object reconstruction, a dedicated framework for HGCAL is currently under development: The Iterative Clustering (TICL), which utilizes the 5D (x,y,z,t,E) information from the reconstructed hits and returns particle properties and probabilities. Heterogeneous computing will play a fundamental role in the physics object reconstruction software to fully exploit the reach of the HL-LHC. We present an overview of the TICL framework, highlight the TICL Framework's capabilities to perform Particle Flow reconstruction in the challenging endcap region with dedicated algorithms for electromagnetic and hadronic objects. Additionally, we will describe how Performance Portability has been achieved through the Alpaka library, being able to run core parts of the Framework on GPU and on CPU with a single source code.

T 103.5 Fri 10:00 VG 4.101

**Particle Identification at Belle II using Neural Networks** — •Erik Gräter[1,2], Stefan Wallner[1], Hans-Günther Moser[1], and Martin Bartl[1] — [1]Max-Planck-Institut für Physik, München — [2]Technische Universität München

We will present advancements in the charged-particle identification at the Belle II experiment located at KEK, Japan. At Belle II we employ a neural network to combine the information from six subdetectors to identify the particle species. Improvements in the reconstruction of the subdetector information that enters the neural network were made. In the context of this we will deliver a new neural-network trained on the latest data including those improvements. With a detailed study of the performance on particle-identification Additionally, we will provide an in-depth analysis of the importance of individual neural-network input features on its classification decisions.

T 103.6 Fri 10:15 VG 4.101

**Development and testing of a neutron identification algorithm for Belle II** — Slavomira Stefkova, Florian Bernlochner, and •Georgios Alexandris — Physikalisches Institut der Rheinischen Friedrich-Wilhelms-Universität Bonn

Among the various neutral Standard Model particles, neutrons and, to a lesser extent, antineutrons are considered invisible in the Belle II detector due to their weak interaction with the detector material. A better understanding of their interaction rates is therefore crucial for analyses in Belle II that involve significant missing energy. While neutrons can only interact with atomic nuclei in the electromagnetic calorimeter (ECL) and the K0L and muon detector (KLM) through inelastic and elastic scattering, antineutrons can also be identified by the products of their annihilation with matter. This project aims to investigate the interaction properties of these neutral hadrons and use their distinct characteristics to develop particle identification (PID) algorithms for identifying neutrons. Preliminary results from these studies will be presented.