ABSTRACT

Lepton colliders, such as FCC-ee and Multi-TeV muon collider, have been proposed as possible options to investigate the Standard Model (SM) after HL–LHC. Therefore, efforts are ongoing to design the experimental apparatus in order to maximize the discovery potential and the precision on the measurement of the SM observables, while mitigating the instrumental background induced by the beams [1].

In this context, calorimeters at the future experimental facilities will require excellent energy resolution to effectively differentiate between hadronic decays of W and Z bosons, good granularity at the O(1cm^2) level and excellent time resolution of few ns, to be compliant with the Particle Flow Algorithm (PFA) [2] that allows to reach the best performance in the jet reconstruction.

We propose an hadronic calorimeter (HCAL) consisting of a sampling of absorber and Micro Pattern Gas Detectors (MPGD) as active layer [3]. MPGDs enable stable operation with eco-friendly gas mixtures, offering high detection efficiency, excellent spatial resolution, high granularity (O(cm^2)), and resistance to radiation in intense particle fluxes (up to 10 MHz/cm^2). Furthermore MPGD technologies, such as resistive μ-RWELL [4] and MicroMegas [5], offer high spatial resolution (>50 μm), uniform response, and discharge mitigation, making them ideal for working in the future collider experiments. Currently, the latest MPGDs technologies such as resistive Micromegas and μ-RWELL are under investigation.

This contribution presents a detailed **GEANT4** [6] based simulation study of the MPGD-HCAL prototype. The simulation implements the geometry of the prototype that is going to be tested under pions beam in November 2025 at PS facility at CERN. The prototype consists of 12 layers of alternating stainless steel absorber and the MPGD. The first 8 layers have an area of 20x20 cm^2 and this setup has already been tested in the previous test beam campaigns, showing good performances also in terms of data-to-simulation agreement. The setup, both in the simulation and in the experimental prototype, is currently extended to include 4 additional layers with an area of 50x50 cm^2.

This study, carried out with pion beams with energies ranging from **1 to 10 GeV,** targets the optimization of the prototype layout in terms of shower containment and energy resolution and to support the future analysis of the experimental data.

References

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