Contribution ID: **26** Type: **"Rapid fire" talk**

A hadronic calorimeter based on resistive micropattern gaseous detectors

Tuesday 18 March 2025 11:30 (5 minutes)

Calorimeters at future Higgs factories will require excellent energy resolutions to discriminate W and Z boson hadronic decays. The Particle Flow Algorithm (PFA), which integrates data from various subsystems, is well-suited for this task. This contribution presents the development of a hadronic calorimeter made of resistive Micro Pattern Gas Detectors (MPGD) designed for experiments at future circular collider facilities, optimized for a Particle Flow approach. In this context, a muti-TeV Muon Collider is being explored as a key use case.

Allowing for a high-granular readout (O(cm^2)), MPGDs are ideal as active layers in a sampling hadronic calorimeter for PFA. Additionally, these technologies are particularly suitable for the Muon Collider background conditions, as they are radiation-hard and capable of sustaining high rates (up to 10 MHz/cm^2). Furthermore, resistive MPGDs, such as resistive Micromegas and μ-RWELLs, provide excellent spatial resolution, operational stability (discharge quenching), and uniformity, making them highly effective for calorimetry.

This contribution presents studies on energy resolution and timing conducted through standalone Geant4 simulations and the full Muon Collider simulations framework. Additionally, we report on characterization studies conducted with muon beams at CERN SPS on resistive MicroMegas and μ-RWELLs. We evaluate their efficiency, response uniformity, and space and timing resolution. Furthermore, we present the energy response of an HCAL cell prototype consisting of eight layers (~1 λ) of alternating stainless steel and MPGD detectors tested with pion beams of energy up to 10 GeV.

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Session Classification: Calorimetry

Track Classification: Calorimetry