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MPGD-HCAL for future collider experiments: status and perspectives

The next generation of calorimeters for experimental facilities at future colliders, as FCC-ee or Muon Collider, should offer excellent spatial, time and energy resolution. This is essential to fulfil the 5D calorimetry paradigm, ensuring detectors suitable for particle-flow (PF) techniques which guarantee unprecedented precision in jet energy resolution. Such advancements will enable the measurement of Higgs couplings to quarks with sub-percent accuracy. In pursuit of this objective, we propose a novel hadron calorimeter (HCAL) utilizing resistive Micro Pattern Gaseous Detectors (MPGD). MPGD HCAL is particularly ideal for PF due to its high-granularity readout capabilities (on the order of cm^2), and is well-suited to the Muon Collider's challenging background conditions, being a radiation-hard technology with high-rate tolerance (up to 10 MHz/cm^2). Additionally, resistive MPGDs, including resistive Micromegas and μ-RWELL, provide excellent spatial resolution, operational stability (with discharge quenching), and uniformity, making them highly suitable for calorimetry. In this contribution, we will present the latest developments in the project, including simulation studies using GEANT4 and Pandora Particle Flow reconstruction within the Muon Collider framework. We will also share recent results from test beam campaigns, which focus on evaluating the performance of the MPGD active layers, such as efficiency, uniformity, time resolution, and the initial studies on the hadronic-shower response of a 8 layers MPGD-HCAL prototype using pion beams with energies up to 10 GeV.

Secondary track

Authors: ZAZA, Angela; COLALEO, Anna; STAMERRA, Anna; PELLECCHIA, Antonello; ZAVAZIEVA, Daryna; OLIVIERI, Eraldo; SIMONE, Federica Maria (Polytechnic of Bari, Physics Department, and INFN Bari); SEKHNIAIDZE, Givi; GENEROSO, Lisa; MOLERI, Luca; LONGO, Luigi; MAGGI, Marcello; BUONSANTE, Marco; ALVIGGI, Maria Grazia; CAMERLINGO, Maria Teresa; BORYSOVA, Marina; DELLA PIETRA, Massimo; IODICE, Mauro; BIGLIETTI, Michela; BIANCO, Michele; ALI, Muhammad; IENGO, Paolo; VERWILLIGEN, Piet; RADOGNA, Raffaella; DI NARDO, Roberto; VENDITTI, Rosamaria (Bari University and INFN)

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