Fifth MODE Workshop on Differentiable Programming for Experiment Design



Contribution ID: 127

Type: Talk

A Multiple Readout Ultra-High Segmentation Detector Concept For Future Colliders

Thursday 12 June 2025 12:30 (25 minutes)

The Meadusa (Multiple Readout Ultra-High Segmentation) Detector Concept is an innovative approach to address the unique challenges and opportunities presented by the future lepton colliders and beyond. The Meadusa concept prioritizes ultra-high segmentation and multi-modal data acquisition to achieve ultra-high spatial, timing and event structure precision in particle detection. By combining a diverse array of active materials and readout technologies, Meadusa design is intended to be optimized for specific single particle and jet energy resolution, single particle identification and flavour tagging capabilities.

The Meadusa concept is based on bringing together multiple, highly granular active elements with complementary sensitivities to different particle species in a single detector layer. The Meadusa detector is expected to embed cutting edge technologies and recent findings in optical, solid-state and gaseous detectors. The conceptual development has started as an initial design and is expected to evolve with the advancement of relevant technologies and following the performance estimation and optimization with advanced machine learning and artificial intelligence techniques and experimental validation.

Here we report on the foundations of the concept, the description of the initial design and the preliminary performance parameters under various experimental conditions and using novel machine learning techniques.

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Track Classification: Applications in Particle Physics