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Developing Digital Silicon Photomultiplier (dSiPM) Specifications for a High-Granularity Calorimeter with Simulations

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Calorimeters play a central role in high-energy physics experiments by enabling precise energy measurements and providing critical information for particle identification and event reconstruction. Advances in calorimeter technology are essential to meet the increasingly demanding requirements of future collider experiments, such as the FCC and muon collider, as well as non-collider experiments in neutrino physics, dark matter searches, and astrophysical observations.

One of the critical elements in calorimetry is photon detection. We investigate the performance potential of digital silicon photomultipliers (dSiPMs) for high-granularity dual-readout calorimetry, with a focus on timing resolution and photon-counting capabilities. Using detailed simulations, we develop optimized dSiPM specifications tailored for use in fiber calorimeters. These results inform design choices for future detector modules aimed at achieving enhanced time resolution, dynamic range, and reconstruction accuracy.

Authors: MADRID, Christopher (Texas Tech University (US)); DAMGOV, Jordan (Texas Tech University (US)); AKCHURIN, Nural (Texas Tech University (US)); FENG, Yongbin (Texas Tech University (US))

Presenter: MADRID, Christopher (Texas Tech University (US))

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