

# Pixel-based BIB suppression and DAQ impact at a multi-TeV Muon Collider

*Thursday 28 August 2025 12:20 (20 minutes)*

The muon collider stands out as a compelling option for future high-energy physics experiments, combining unique physics potential with significant technical challenges. One of the most critical issues is the intense beam-induced background (BIB) from muon decays, which produces low-momentum particles that lead to high detector occupancies, complicating vertexing, tracking, and overwhelming simulation resources and readout systems. This talk presents recent advances in BIB mitigation through a detailed pixel-level analysis within the official Muon Collider software framework. A central strategy is the development of a novel cluster shape analysis, leveraging correlations among pixel cluster size, charge, incidence angle, and timing to distinguish signal from background. In parallel, we investigate the impact of increased active sensor thickness - trading some precise timing resolution for improved charge deposition from minimum-ionizing muons, which enhances separation between signal and soft BIB secondaries. This enables more effective rejection of background hits through optimized thresholds and refined shape-based filtering. We demonstrate the combined impact of these techniques in reducing BIB hit rates and data bandwidth, while preserving high signal efficiency in track reconstruction. Preliminary results from high-statistics simulation will be presented, along with insights into expected readout rates, dead time, power budgets, and the potential for a simplified trigger scheme.

**Author:** RASTOGI, Angira (Lawrence Berkeley National Lab. (US))

**Co-authors:** WRIGHT, Juliet Adrienne (University of Oregon); JEANTY, Laura (University of Oregon (US)); GARG, Rocky Bala (Stanford University (US)); PAGAN GRISO, Simone (Lawrence Berkeley National Lab. (US))

**Presenter:** RASTOGI, Angira (Lawrence Berkeley National Lab. (US))

**Session Classification:** Parallel