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Shower maximum detectors based on pixelated micro-channel plates

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Future calorimeters and shower maximum detectors at high luminosity colliders need to be highly radiation resistant and very fast. One exciting option for such a detector is a calorimeter composed of a secondary emitter as the active element. In this report we outline the study and development of a secondary emission calorimeter prototype using micro-channel plates (MCP) as the active element, which directly amplify the electromagnetic shower signal.
We demonstrate the feasibility of using a bare MCP within an inexpensive and robust housing without the need for any photocathode, which is a key requirement for high radiation tolerance. Test beam measurements of the prototype were performed with 120 GeV primary protons and secondary beams at the Fermilab Test Beam Facility, demonstrating basic calorimetric measurements and precision timing capabilities. Using multiple pixel readout on the MCP, we demonstrate a transverse spatial resolution of 0.8 mm, and time resolution better than 40 ps for electromagnetic showers.

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