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A new particle identification method with the Belle II calorimeter using pulse shape discrimination in CsI(Tl)

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We will present studies on the development and first implementation of a novel technique to improve particle identification at high energy physics experiments through the use of pulse shape discrimination (PSD) with CsI(Tl) scintillators used for electromagnetic calorimeters. Using $5 \times 5 \times 30$ cm^3 CsI(Tl) crystals, such as those used in the electromagnetic calorimeter of the Belle II experiment, we will discuss a new method [1] for characterizing and simulating the CsI(Tl) scintillation response for hadronic energy deposits developed with neutron and proton testbeam data collected at the TRIUMF Proton Irradiation Facility. By implementing the measured pulse shape differences between electromagnetic and hadronic energy depositions into GEANT4 simulations of an array of CsI(Tl) crystals, we demonstrate the potential for PSD to separate electromagnetic and hadronic showers in CsI(Tl) calorimeters. In particular we show the potential for using PSD to distinguish between calorimeter clusters originating from high energy photons and K_L^0 mesons or neutrons. In addition, progress on the implementation of PSD for the Belle II experiment's CsI(Tl) calorimeter will be outlined and initial performance results using first Belle II collision data will be reported.

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