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(I) First application of CsI(Tl) pulse shape discrimination at an e^+e^- collider to improve particle identification at the Belle II experiment

Monday 7 June 2021 13:55 (25 minutes)

The Belle II experiment operating at the SuperKEKB electron-positron collider is the first high energy collider experiment to use CsI(Tl) pulse shape discrimination (PSD) as a new method for improving particle identification. This novel technique employs the particle-dependent scintillation response of the CsI(Tl) crystals which comprise the electromagnetic calorimeter to identify electromagnetic vs. hadronic showers. The new dimension of calorimeter information introduced by PSD has allowed for significant improvements in neutral kaon vs. photon discrimination, an area critical for the Belle II flagship measurement of $\sin(2\phi_1)$ using $B \to J/\psi K^0_L$. This talk will describe the implementation of PSD at Belle II including the development of the pulse shape characterization algorithms and new simulation methods to compute the CsI(Tl) scintillation response from the ionization dE/dx of the secondary particles produced in the crystals. The performance of PSD for K^0_L vs photon separation will be presented and the significant improvement over traditional shower-shape approaches will be demonstrated. Ongoing studies exploring new directions for PSD at Belle II will also be presented including new methods of pulse shape characterization with machine learning as well as using PSD to enhance cluster finding and low momentum charged particle identification.

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Session Classification: M-PPD Thesis prize winner talks (PPD) / Conférences des lauréats de meilleures thèses (PPD)

Track Classification: Particle Physics / Physique des particules (PPD)