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Study of CNN Algorithms for PID System in STCF

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The Super Tau Charm Facility (STCF) is a next-generation electron-positron collider proposed in China, operating at a center-of-mass energy range of 2–7 GeV with a peak luminosity of 0.5×10^{35} $cm^{-2}s^{-1}$. In high-energy experiments, the identification of high-momentum charged hadrons is crucial for studying various physics processes. At STCF, the particle identification (PID) system based on Cherenkov detection technology includes a barrel Ring Imaging Cherenkov detector (RICH) and an endcap Time-of-Flight detector utilizing internally reflected Cherenkov light (DTOF). Additionally, a Barrel Time-of-Flight detector (BTOF) is designed as a backup system for the RICH. With the development of deep learning, particle identification algorithms have continued to evolve. In this study, convolutional neural network (CNN)-based PID algorithms were developed for the three sub-detectors of the PID system. By taking as input the 2D images converted from Cherenkov photon hit patterns on photomultiplier tubes, along with kinematic information from the tracking system, the model predicts the probability of different particle types. Preliminary results indicate that the algorithm effectively integrates image features with particle kinematic information, achieving outstanding performance in particle identification and offering a promising high-precision solution for PID at STCF.

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