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CNN-Based PID Algorithms for STCF Cherenkov Detectors

The Super Tau Charm Facility (STCF) is a next-generation electron-positron collider proposed in China, operating at a center-of-mass energy of 2–7 GeV with a peak luminosity of 0.5×10^{35} $cm^{-2}s^{-1}$. In STCF experiments, the identification of high-momentum charged hadrons is critical for physics studies, driving the implementation of a dedicated particle identification (PID) system that combines two Cherenkov detection technologies: a time-of-flight detector based on internally reflected Cherenkov light (DTOF) and a ring imaging Cherenkov detector (RICH), with BTOF serving as a backup for RICH.
Recent advancements in deep learning allow end-to-end learning directly from raw detector responses. This study develops convolutional neural network (CNN)-based PID algorithms for all three PID detectors (DTOF, RICH, and BTOF) that transform the hit patterns of Cherenkov photons on photomultiplier tubes into 2D images as the primary input features while incorporating kinematic information from the tracking system for learning, thereby enabling direct prediction of different particle probabilities. Preliminary results demonstrate that this CNN model, integrating image patterns with kinematic information, achieves excellent PID capability, providing a promising solution for high-precision PID at STCF.

Significance

References

Experiment context, if any

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