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Pion/Kaon Identification at STCF DTOF Based on Classical/Quantum Convolutional Neural Network

The Super Tau Charm Facility (STCF) proposed in China is a new-generation electron–positron collider with center-of-mass energies covering 2-7 GeV. In STCF, the discrimination of high momentum hadrons is a challenging and critical task for various physics studies. In recent years, machine learning methods have gradually become one of the mainstream methods in the PID field of high energy physics experiments, with the advantage of big data processing.

In this work, targeting at the pion/kaon identification problem at STCF, we have developed a convolutional neural network (CNN) in the endcap PID system, which is a
time-of-flight detector based on detection of internally reflected Cherenkov light (DTOF). By combining the hit position and arrival time of each Cherenkov photon at multi-anode microchannel plate photomultipliers, a twodimensional pixel map is constructed as the CNN input. The preliminary results show that the CNN model has a promising performance against the pion/kaon identification problem. In addition, based on the traditional CNN, a quantum convolution neural network (QCNN) is developed as well, as a proof-of-concept work exploring possible quantum advantages provided by quantum machine learning methods.

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