Contribution ID: **31** Type: **Poster**

Hadron Identification based on DNN at BESⅢ

Machine learning (ML), a cornerstone of data science and statistical analysis, autonomously constructs hierarchical mathematical models—such as deep neural networks—to extract complex patterns and relationships from data without explicit programming. This capability enables accurate predictions and the extraction of critical insights, making ML a transformative tool across scientific disciplines.

Particle identification (PID) is a crucial aspect of most particle physics experiments. In the study of hadronic decays, efficient PID is always essential for improving signal-to-background ratios, refining physical analyses, and advancing scientific discovery. The BESIII experiment operates in the τ-charm energy region, where the final states of physical processes are frequently composed of hadronic particles. A persistent challenge in this experiment is PID performance, especially in distinguishing pions and kaons at high momenta. Conventional PID methods, which rely on measurements of ionization energy loss (dE/dx) and time-of-flight (TOF), often prove insufficient for the demands of precision physics analyses. To address this limitation, we leverage advanced ML algorithms and utilize the extensive high-dimensional measurements of the BESIII detector to optimize PID performance.

In this study, we present an advanced DNN-based PID framework, optimized through data preparation, feature engineering, architecture design, and hyperparameter tuning, to effectively integrate information from all four sub-detectors. Compared to conventional PID methods, the DNN-based algorithm demonstrates significant improvements in efficiency, particularly in enhancing the pion/Kaon discrimination in high-momentum regions. This advancement enables BESIII experiment to achieve higher precision in physical measurements and provides valuable insights for similar studies in the field.

Significance

By utilizing machine learning methods, we have integrated information from four sub-detectors of BESIII, fully exploiting its particle identification potential.

References

Experiment context, if any

Beijing Spectrometer (BESIII) experiment

Authors: Dr ZHAO, Guang (Institute of High Energy Physics (CAS)); Prof. SUN, Sheng-Sen (Institute of High Energy Physics, Chinese Academy of Sciences); HYUAN, hyuan (中国科学院高能物理研究所)

Co-authors: LI, Gang; WEN, Shuopin (IHEP); UNKNOWN, UNKNOWN; Prof. DENG, Ziyan

Presenter: HYUAN, hyuan (中国科学院高能物理研究所)

Session Classification: Poster session with coffee break

Track Classification: Track 1: Computing Technology for Physics Research