

Heavy flavour tagging using machine learning technique with silicon vertex detector and Dual-Readout Calorimeter at future e^+e^- colliders

J. Huang¹, Q. Hu², S.H. Lim³, S.H. Lee, Y.J. Lee⁴, and S.W. Kim,
H.D. Yoo ^{*5}

¹Brookhaven National Laboratory, USA

²Lawrence Livermore National Laboratory, USA

³Pusan National University, Republic of Korea

⁴University of Seoul, Republic of Korea

⁵Yonsei University, Republic of Korea

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Dual-readout calorimeter (DRC) has been developed by DREAM and RD52 collaborators for last 20 years. It offers high-quality energy measurement for electromagnetic particles, hadrons and jets which is essential for the successful future lepton collider experiment [1]. CEPC (China) and FCC-ee (CERN) projects, the next e^+e^- colliders for Higgs factory and other electroweak processes, are under discussion by world-wide HEP community as a next generation experiment. The DRC has been proposed as a calorimeter of the IDEA detector concept published in Conceptual Design Reports of both future collider projects [2, 3]. The DRC would meet sufficient performance required by the CEPC and FCC-ee to achieve high precision measurements and indirect new physics searches.

A silicon vertex detector based on the ALPIDE readout chip of Monolithic Active Pixel Sensor is the innermost pixel detector in the IDEA detector concept. The ALPIDE developed for the ALICE ITS upgrade has benefits of low material budget and power consumption, and it provides an excellent position resolution ($\sim 5\mu\text{m}$) with very high efficiency ($> 99\%$). The vertex detector with the ALPIDE which will be used for ALICE and

*contact: hdyoo@yonsei.ac.kr

sPHENIX experiments is a key detector system to achieve precise measurements of heavy flavours in the future collider projects.

Heavy flavour jet tagging (HF-tagging) is widely being used to identify jets originated from heavy flavour quarks in past and current experiments. Excellent performance of HF-tagging is essential to achieve the high precision measurement for various physics processes as well as new physics searches in the future e^+e^- colliders. Recently machine learning (ML) technique is being applied to almost all aspects of experimental procedures including detector, data processing, identification and analysis. Therefore in this study, the HF-tagging with ML will be studied with the combined information from the MAPS based silicon tracker and DRC detectors. Particularly, the following items are under consideration:

- various HF-taggings for b-, c- and s-quarks,
- baseline MVA techniques such as NN and BDT,
- advanced ML techniques such as CNN, GNN and others,
- demonstration of the systematic control of fragmentation dependent jet energy scale using the combination of MAPS based silicon tracker and DRC,
- performance quantification in various physics cases, that include electroweak bosons, Higgs bosons, top quark, etc.

References

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