Detectors and Physics at a Future Linear Collider

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I. SUMMARY 300 WORDS

One option of next large accelerator projects will be a linear electron-positron collider for precision studies of the higgs boson. This research project has several aspects.

Particle reconstruction is improved for the next generation high granular calorimeter. The study focuses on the pattern recognition of photons, within PandoraPFA, a world-leading pattern-recognition software for particle flow calorimetry. A sophisticated pattern recognition algorithm was implemented, which uses the topological properties of electromagnetic showers to identify photon candidates and separate them from nearby particles. It performs clustering of the energy deposits in the detector, followed by topological characterisation of the clusters, with the results being considered by a multivariate likelihood analysis. This algorithm leads to a significant improvement in the reconstruction of both single photons and multiple photons in high energy jets.

The second aspect is a simulation study on reconstruction and classification of the tau lepton decay modes. The essential step is to reconstruct tau decay products as separate entities, such as photons. Using my photon reconstruction algorithm, the resolution of energy and invariant mass of the tau decay products is improved. A hypothesis test was performed for expected decay final states. A multivariate analysis was trained to classify decay final states with a data-driven machine learning method. The performance of tau lepton final states classification is used as a benchmark for the electromagnetic calorimeter design optimisation at the ILC or CLIC.

The third aspect is a sensitivity study of higgs couplings at the CLIC, using simulated double Higgs boson production. By characterising complex events, algorithms were developed to identify isolated high energy leptons, and results were fed into a multivariate analysis. The study was done for two CLIC energy scenarios. This sensitivity study of triple and quartic Higgs self couplings would be a part of the feasibility study of the CLIC detector.

These studies improved the performance of particle flow calorimetry, provided a benchmark for the calorimeter design optimisation, and strengthened the physics cases, for future linear electron-positron colliders.