T 72: Exp. Methods II

Time: Wednesday 15:50–17:05 Location: POT/0106

T 72.1 Wed 15:50 POT/0106

Soft b-hadron vertex reconstruction tool — •Beatrice Cervato[1], Binish Batool[1], Markus Cristinziani[1], Carmen Diez Pardos[1], Ivor Fleck[1], Arpan Ghosal[1], Gabriel Gomes[1], Jan Joachim Hahn[1], Vadim Kostyukhin[1], Buddhadeb Mondal[1], Amartya Rej[1], Katharina Voss[1], Wolfgang Walkowiak[1], and Tongbin Zhao[1,2] — [1]Center for Particle Physics Siegen, Experimentelle Teilchenphysik, Universität Siegen — [2]Shandong University, China

Several interesting physical processes lead to the production of low-energy (soft) b-quarks in the final state, that may fragment into a b-hadron without the creation of a reconstructable jet. Moreover, sometimes b-hadrons in jets are so soft that their decay products are distributed over a wider angular range than the standard jet cone (the typical cone size is 0.4). The tool described in this contribution is targeting b-hadrons without jets and soft-b-hadrons inside jets, which are not detectable by standard Flavour Tagging Algorithms. For this reason, it is very important to develop and optimize such a b-tagging tool, as will be described in the presentation. After defining the efficiency and the fake rate, we estimate the tool performance using a $t\bar{t}$ reference sample, and define three working points. Subsequently, we check the tool performance at those working points using a sample with soft b-hadrons and a b-hadron-free sample. We demonstrate that the efficiency (fake rate) varies in a range that goes from 27% (0.5%) to 44% (7.1%).

T 72.2 Wed 16:05 POT/0106

Graph Neural Network based Track Finding in the Central Drift Chamber at Belle II — •Lea Reuter, Philipp Dorwath, Torben Ferber, and Slavomira Stefkova — Institute of Experimental Particle Physics (ETP), Karlsruhe Institute of Technology (KIT)

In many new physics extensions of the Standard Model, new mediator particles may decay into charged particles leaving a unique signature of a displaced vertex and charged tracks. These displaced decay products are an important signature in searches for dark sector candidates in collider experiments. The current Belle II trigger algorithm is not designed for events with displaced vertices and therefore insufficient to detect these events. Traditional tracking algorithms scale poorly with the high beam-background, which is expected to increase significantly in the upcoming data-taking of the Belle II experiment.

Therefore, we develop a Graph Neural Network (GNN) based approach to find particle tracks and displaced vertices in the Central Drift Chamber of Belle II, where we realize track measurements using a graph representation of detector hits. We use GNN-based object condensation for track finding to identify the varying number of tracks per event. The goal of this project is to improve the track finding for Belle II. Furthermore, we also implement track fitting simultaneously to the track finding, to investigate if this GNN approach can also be used in real-time application in the level 1 trigger system.

T 72.3 Wed 16:20 POT/0106

Graph building and input feature analysis for edge classification in the Central Drift Chamber at Belle II — •Philipp Dorwarth, Torben Ferber, Lea Reuter, and Slavomira Stefkova — Institute of Experimental Particle Physics (ETP), Karlsruhe Institute of Technology (KIT)

Many extensions of the Standard Model, such as inelastic dark matter models, predict long-lived particles. They can manifest with two charged tracks originating from a vertex with a large displacement from the interaction point in collider experiments. Conventional tracking algorithms are insufficient to respond to those highly displaced vertices, and they also scale poorly with an increased beam background, as expected from SuperKEKB's increased luminosity.

Graphs are an intuitive representation of hits in a tracking detector as they provide high flexibility regarding input features and the length of input vectors. Therefore, we develop a Graph Neural Network (GNN) approach for hit and edge classification in the Central Drift Chamber (CDC) at Belle II. Eventually, the output will be used for GNN-based displaced vertex and tracking algorithms. We examine different methods of graph building and analyze their performance for the classification task. In addition, we study the feasibility of using detector-level information, such as digitized signal hits, as GNN input features in both data and simulation. We find that this information provides very good discriminatory power and should therefore be used as an additional input feature for the GNN to improve the efficiency of the edge classification.

T 72.4 Wed 16:35 POT/0106

Development of a Classifier for Simulated Secondary Decay Vertices in the CMS Experiment — •Tim Graulich[1], Xavier Coubez[1,2], Wahid Redjeb[1], and Alexander Schmidt[1] — [1]III. Physikalisches Institut A, RWTH Aachen University, Aachen, Germany — [2]Brown University, USA

Secondary decay vertices are important signatures which can indicate the presence of a long-lived particle such as a b hadron. These vertices provide important information to be used in higher level algorithms, most importantly b-tagging algorithms. In order to study the performance of secondary vertex reconstruction algorithms, the investigation of simulated vertices is necessary. A classifier to find and classify secondary decay vertices in simulated events is presented, with a focus on b and c hadron decays. Furthermore, the final state decay products of the vertex are associated with it to provide reliable training information to neural networks. This talk will showcase how event generator and detector simulation data can be combined to extract the secondary vertex information from simulated data.

T 72.5 Wed 16:50 POT/0106

Introduction to columnflow — Mathis Frahm, Philip Daniel Keicher, Tobias Kramer, •Nathan Prouvost, Marcel Rieger, Daniel Savoiu, Peter Schleper, Matthias Schröder, and Bogdan Wiederspan — Institut für Experimentalphysik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg

In order to observe and measure rare processes in nature, a staggering amount of data needs to be produced and processed at particle colliders. With the advancement of the LHC towards Run 3 and HL-LHC, the flow of data as well as the complexity of the analyses will increase even more. In light of these challenges and the limited resources available, an efficient usage of computing power and disc usage is critical for future analyses.

In order to analyze data in an efficient way, a new columnar analysis tool, columnflow, has been developed. In this presentation, an introduction to columnflow is given, including an overview of the workflow and some examples of use cases.