T 16: Experimental Methods (general) 1

Time: Monday 16:15–18:30 Location: T-H29

T 16.1 Mon 16:15 T-H29

Measurement of the CMS offline tracking efficiency from the ratio of reconstructed D^* and D^0 mesons — •Yewon Yang and Achim Geiser — DESY, Hamburg, Germany

The efficiency for offline track reconstruction in CMS is measured directly from the data using a novel method. This method is based on taking the ratio of charm mesons reconstructed in the decay chains $D^{*\pm} \to K^{\mp}\pi^{\pm}\pi_s^{\pm}$ and $D^0 \to K^{\mp}\pi^{\pm}$, using the special kinematics of the so-called 'slow pion' π_s from D^* decay. It also requires the treatment of the a priori unknown mixture of prompt (from charm) and non-prompt (from beauty) contributions to the final states. Details of the method are explained and first results for the actual tracking efficiencies are presented.

T 16.2 Mon 16:30 T-H29

Clustering and tracking in dense environments with the ITk — •Nicola de Biase — DESY Hamburg

Dense hadronic environments, encountered in particular in the core of high-p_T jets or hadronic τ decays, present specific challenges for the reconstruction of charged-particle trajectories (tracks) in the ATLAS silicon-pixel tracking detector, as the charge clusters left by different ionising particles in the silicon sensors can merge with a sizeable rate. Tracks competing for the same cluster are penalised for sharing it, leading to a loss in tracking efficiency.

In the current ATLAS Inner Detector, a machine learning algorithm is used for classifying and splitting merged clusters with minimal efficiency losses, leading to better performances of Clustering and Tracking in Dense Environments (CTIDE). The new Inner Tracker (ITk), which will replace the current Inner Detector as part of the ATLAS phase-2 upgrade, will benefit from an improved granularity thanks to its smaller pixel sensor size, which might render such a procedure unnecessary.

In this talk, the expected performance of the ITk in dense environments will be discussed, addressing the question of whether a cluster splitting procedure is necessary.

T 16.3 Mon 16:45 T-H29

Clustering and Tracking in Dense Environment studies of the ATLAS ITk Strip Detector for the HL - LHC Upgrade — Katharina Behr, Nicholas Styles, and •Akhilesh Tayade — DESY, Hamburg, Germany

The new **I**nner **Track**er (ITk) in the ATLAS detector is being built as a part of the HL-LHC upgrade. The High Luminosity upgrade will see an increase in track density, pile up and collisions per bunch crossing. Correspondingly, the current offline tracking reconstruction is being upgraded to handle this. Strongly boosted objects give highly collimated tracks. Reconstructing these tracks can be crucial in discovering new physics. Highly collinear and dense tracks are likely to share pixel or strip clusters for which they are penalized in the track reconstruction. Machine learning techniques are employed for the current ATLAS Pixel Detector to resolve the ambiguities due to cluster merging. In this talk, we discuss whether similar techniques are needed for clusters in the ITk strip detector.

T 16.4 Mon 17:00 T-H29

Jet Vertex Tagger in release 22 — •Abdullah Nayaz[1], Teng Jian Khoo[2], and Cigdem Issever[3] — [1]Humboldt University, Berlin, Germany — [2]Humboldt University, Berlin, Germany — [3]Humboldt University, Berlin, Germany

Pile-up mitigation is a crucial part of many important Particle Physics analysis e.g. HH->4b. The Jet Vertex Tagger (JVT) is a multivariate pile-up suppression variable developed for the ATLAS experiment that combines information from other track based pile-up variables and plays a major role in ATLAS analysis. In this study, as part of the preparation for Run 3 data-taking and analysis, the performance of JVT has been checked for the new release 22 Track to Vertex Association (TTVA) working points using Monte-Carlo simulated dijet data samples. First, the TTVAs that result in a good performance of the JVT have been identified. Furthermore, to increase the JVT performance, a Multilayer Perceptron Neural Network (NN) has been used to retrain the JVT for release 22. The training was done separately for offline and trigger level jets, varying the inputs to the NN to optimise the separation of hard scatter and pile-up jets. Some improvement on the JVT performance was observed after the training process which will be beneficial for Run 3 ATLAS analyses.

T 16.5 Mon 17:15 T-H29

Global χ^2 fitter for Acts — Florian Bernlochner, Jochen Dingfelder, and •Ralf Farkas — Physikalisches Institut der Rheinischen Friedrich-Wilhelms-Universität Bonn

The reconstruction of trajectories of charged particles is a crucial task for most HEP experiments. The Acts (A Common Tracking Software) aims to be a generic, framework and experiment-independent toolkit for track reconstruction, initially started from the ATLAS tracking software. My talk summarizes the recent development of a global χ^2 fitter for Acts, which complements and validates the existing (Combinatorial) Kálmán Filter.

T 16.6 Mon 17:30 T-H29

Track Reconstruction of the FASER Experiment — Florian Bernlochner, •Tobias Böckh, Jochen Dingfelder, and Markus Prim — Physikalisches Institut der Rheinischen Friedrich-Wilhelms-Universität Bonn

FASER (ForwArd Search ExpeRiment) is a new, small and inexpensive experiment designed to search for light, weakly interacting particles during Run 3 of the LHC. Such particles may be produced in large quantities in proton-proton collisions, travel for hundreds of meters along the beam axis, and can decay in two charged Standard Model particles. To reach its physics goals, a good hit resolution, and track reconstruction to separate the two closely-spaced, oppositely charged tracks is essential. In this talk, I review the track reconstruction, which is based on the ACTS toolkit. ACTS aims to provide an experiment-independent toolkit for track reconstruction.

T 16.7 Mon 17:45 T-H29

detray - a GPU-friendly tracking geometry description — Andreas Salzburger[1], •Joana Niermann[1,2], Beomki Yeo[3,4], Attila Krasznahorkay[1], and Stan Lai[2] — [1]CERN — [2]II. Physikalisches Institut, Georg-August-Universität Göttingen — [3]Department of Physics, University of California — [4]Lawrence Berkeley National Laboratory

With the next generation high luminosity experiments, the computational demand of particle track reconstruction will increase strongly. A potential way to tackle this is by offloading highly parallelizable tasks to an accelerator device. Existing codebases need to be adapted to e.g. specific host and device memory management and the calling of dedicated compute kernels, while avoiding code duplication as much as possible. Designed to be integrated into ACTS (A Common Tracking Software), which provides efficient algorithms for common tracking tasks, detray is an ongoing R&D effort to formulate the tracking geometry description for heterogeneous hardware. In order to propagate track states through the geometry model, detray follows the navigation design established in ACTS, but presents the geometry in a GPU-friendly way. It makes use of flat container structures without runtime polymorphism, a dedicated memory management scheme provided by the vecmem library, as well as direct indexing to link the geometry data, which together allows to instantiate the geometry model in host and device code. This talk gives an overview of the detray tracking geometry description and highlights the advantages and challenges of this GPU-friendly approach.

T 16.8 Mon 18:00 T-H29

ATLAS Primary Vertexing with ACTS — •Bastian Schlag[1,2], Andreas Salzburger[1], Markus Elsing[1], Christian Schmitt[2], and Volker Büscher[2] — [1]CERN — [2]Johannes Gutenberg-Universität Mainz

The reconstruction of particle trajectories and their associated vertices is a crucial task in the event reconstruction of most high energy physics experiments. In order to maintain or even improve upon the current performance of tracking and vertexing algorithms under the upcoming challenges of increasing energies and ever increasing luminosities in the future, major software upgrades are required.

Based on the well-tested ATLAS tracking and vertexing software, the ACTS (*A Common Tracking Software*) project aims to provide a stan-

dalone, modern and experiment-independent toolkit of track- and vertex reconstruction software, specifically designed for parallel code execution. The newly developed ACTS vertexing software suite provides thread-safe, highly performant and state-of-the-art vertex reconstruction tools that have been fully integrated and validated in the ATLAS software framework AthenaMT. Due to its superb physics and CPU performance, the ACTS vertexing software will be used as the default primary vertex reconstruction tool in ATLAS for LHC Run 3.
Additionally, an entirely new vertex seed finding algorithm with great physics performance and CPU speed-ups of up to a factor of 100 in high pile-up environments has been developed and implemented in ACTS. This talk presents an overview of the ACTS vertexing software suite, its performance in ATLAS as well as latest developments.

T 16.9 Mon 18:15 T-H29

Electron reconstruction and identification with the ATLAS detector — •Asma Hadef and Lucia Masetti — Johannes Gutenberg Universität, Mainz, Germany

Electrons are important objects both for the search for new physics and for precision measurements. In the ATLAS detector, electrons in the central detector region are triggered by and reconstructed from energy deposits in the electromagnetic (EM) calorimeter that are matched to a track in the inner detector. Electrons are distinguished from other particles using identification (ID) criteria with different levels of background rejection and signal efficiency. The electron ID used in ATLAS for Run 2 is based on a likelihood discrimination to separate isolated electron candidates from candidates originating from photon conversions, hadron misidentification and heavy flavor decays. The performance of the electron reconstruction and ID algorithms is evaluated by measuring efficiencies using tag-and-probe techniques with large statistics samples of isolated electrons from $Z \to ee$ and $J/\psi \to ee$ resonance decays. These measurements were performed with pp collisions data at $\sqrt{s}$ =13 TeV in 2015-2018 corresponding to an integrated luminosity of 139 fb^{-1} and studied as a function of the electron's transverse momentum, pseudorapidity and number of primary vertices. Furthermore, in order to achieve reliable physics results, the simulated samples need to be corrected to reproduce the measured data efficiencies as closely as possible. For this reason, the efficiencies are estimated both in data and in simulation. The scale factors (data to MC efficiency ratios) are then estimated and provided to all physics analyses involving electrons.