T 127: Exp. Methods III

Time: Thursday 15:50–17:05 Location: WIL/C129

T 127.1 Thu 15:50 WIL/C129

A General Track Fit based on Hit Triplets — •Mohd Talha and André Schöning for the ATLAS-Collaboration — Physikalische Institute, Universität Heidelberg

Modern particle physics experiments often deal with high particle rates and therefore use silicon detectors for particle tracking. High hit occupancies, together with a relatively large amount of material in the tracking layers, pose a big challenge for track reconstruction.

For the High Luminosity ATLAS upgrade, it is planned to perform a full reconstruction of ∼5000 tracks per event at the ATLAS Event Filter with a rate of about 100 kHz. The tracking algorithm has to run on commercial hardware. One option considered by our group is the implementation of a parallelizable track reconstruction algorithm on a farm of GPUs. The algorithm of choice is a general broken line fit based on hit triplets that was originally developed for applications with dominating multiple scattering uncertainties [N. Berger et al., JINST 9 P07007 (2014)] and has also been extended to include hit uncertainties. The latter is crucial for the reconstruction of high momentum tracks.

After motivating hit triplets as basic tracking elements for a general broken line fit, the general solution for a track fit of three hits (triplet) in a solenoidal magnetic field will be presented and discussed.

T 127.2 Thu 16:05 WIL/C129

Matrix inversion in the context of a novel track reconstruction algorithm for the ATLAS Event Filter — •Antara Paul[1] and Andre Schöning[2] for the ATLAS-Collaboration — [1]Physikalisches Institut, Universität Heidelberg, Germany — [2]Physikalisches Institut, Universität Heidelberg, Germany

The High Luminosity LHC project is expected to provide a tenfold increase of the integrated luminosity compared to the LHC. To cope with the resulting high pile-up from proton-proton collisions, the ATLAS detector, and its trigger and DAQ systems are undergoing major upgrades. As a part of the upgrade of the online event filter, a fast triplet track reconstruction algorithm is being developed based on a broken line fit. The track parameters are estimated by minimizing a χ^2 function, which includes the multiple scattering and spatial hit uncertainties at each layer. This minimization involves the inversion of a matrix.

In this context, the talk focuses on different algorithms of matrix inversion, including but not limited to LDL^T decomposition and the partition method. The speed and accuracy of each method will be presented and compared, in view of their implementation in the track reconstruction algorithm.

T 127.3 Thu 16:20 WIL/C129

Navigation and track parameter transport using a heterogeneous code design for CPUs and GPUs within the ACTS R&D project — Andreas Salzburger[1], •Joana Niermann[1,2], Beomki Yeo[3,4], Stephen Swatman[1,5], 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 — [5]University of Amsterdam

With the upcoming high luminosity era of the LHC, track reconstruction, in particular, will suffer from drastically increasing combinatorics. A promising perspective to meet these rising computing demands is the deployment of hardware accelerators which offer massive parallelism, like GPGPUs. Current state-of-the-art implementations of pattern recognition algorithms in track reconstruction are problematic to adapt to accelerator hardware architectures in several ways. For example, runtime-polymorphic geometry classes and pointer based data structures are commonly difficult to move to an accelerator device.

Within the ACTS parallelization R&D project, research is on-going to adapt a complete track reconstruction chain, from clusterization to track fitting, to run efficiently on GPUs. We show the implementation and performance of a core component of this chain: the propagation of track parameters and their associated covariances through an inhomogeneous magnetic field (*covfie* library), together with the application of material effects. The implementation is part of the *detray* library and makes use of its geometry description and navigation.

T 127.4 Thu 16:35 WIL/C129

Tracking efficiency studies for LHCb in Run 3 — Flavio Archilli[1], •Rowina Caspary[2], Giulia Frau[2], and Peilian Li[3] — [1]Università di Roma Tor Vergata, Rome, Italy — [2]Physikalisches Institut, Heidelberg University, Germany — [3]CERN

The LHCb detector is dedicated to the measurement of particles containing b- and c-quarks and has recently been upgraded, aiming to take data with an instantaneous luminosity of $2 \times 10^{33} cm^{-1} s^{-1}$ at $\sqrt{s} = 14$ TeV . The tracking system is completely renewed and a new reconstruction and trigger framework is implemented, in which all the tracking reconstruction algorithms are redesigned.

The correct evaluation of the tracking reconstruction efficiency is essential for many measurements of the LHCb experiment. However the precision of the simulation is limited, thus a data-driven approach is developed exploiting a tag-and-probe method on a sample of $J\psi \to \mu\mu$ events to cross-check the track reconstruction efficiency in data. The difference of track reconstruction efficiency between simulation and data is then evaluated and exploited as calibration parameters. In addition, the effect of hadronic interactions on the track reconstruction efficiency is estimated using $D^0 \to K\pi$ and $D^0 \to K\pi\pi\pi$ decays.

T 127.5 Thu 16:50 WIL/C129

Track reconstruction for the *Mu3e* experiment — •Alexandr Kozlinskiy — Institut für Kernphysik, JGU Mainz, Germany

The *Mu3e* experiment is designed to search for the lepton flavor violating decay $\mu^+ \to e^+e^-e^+$. The aim of the experiment is to reach a branching ratio sensitivity of 10^{-16}. The experiment is located at the Paul Scherrer Institute (Switzerland) and an existing beam line providing 10^8 muons per second will allow to reach a sensitivity of a few 10^{-15} in the first phase of the experiment. The muons with a momentum of about 28 MeV/c are stopped and decay at rest on a target. The decay products (positrons and electrons) with energies below 53 MeV are measured by a tracking detector consisting of two double layers of 50 μm thin high-voltage monolithic active pixel sensors. The high granularity of pixel detector with a pixel size of 80×80 μm together with the small material budget allows for a precise track reconstruction. The track reconstruction is optimized for low noise and high efficiency of tracking detector. This environment allows to efficiently remove incorrectly reconstructed tracks with minimal effect on tracks produced by real particles. This talk will present the details of the track reconstruction, the methods to reduce the number of fake tracks and suppress clones produced due to high hit densities.