The integration of DEPFET into the EUDET telescope

Julia Furletova, Bonn, Germany
for the DEPFET Collaboration

Abstract

The DEPFET collaboration has a significant presence in the EUDET program, an EU initiative to support detector R&D for a future International Linear Collider (ILC). Within this programme a high resolution pixel telescope using monolithic active pixel sensors will be provided as test beam infrastructure. DEPFET sensors were the first Device Under Test (DUT), commissioning the user interfaces of this infrastructure. The readout of this two rather different approaches of pixels for the ILC vertex detector were synchronized using a custom made trigger logic unit (TLU). As analysis tool the ILC compatible analysis framework EUtelescope was used. In this presentation the current status of the integration of DEPFET into EUDET Telescope analysis frame work will be presented. An overview of foreseen future improvements of DEPFET related software will be given.

I. Introduction

The International Linear Collider (ILC) is a proposed linear particle accelerator. It is planned to have a collision energy of 500 GeV. In order to achieve the goal, a number of ILC detector R&D projects has started. In this presentation the progress of the DEPFET software development towards the ILC will be discussed.

II. DEPFET Principle and Operation

The DEPleted Field Effect Transistor (DEPFET) principe of operation is shown in Figure 1 . The DEPFET detector and amplification structure is based on planar p-chanel MOSFET structure. A deep n-implant forms a potential minimum for electrons which are collected there. The accumulated charge in this integral gate modulates the transistor current. The charge can be removed by the clear contact [1].

The DEPFET offer the unique possibility for a high spatial resolution and low noise pixel vertex detector as the innermost component of the tracking system in an ILC detector.

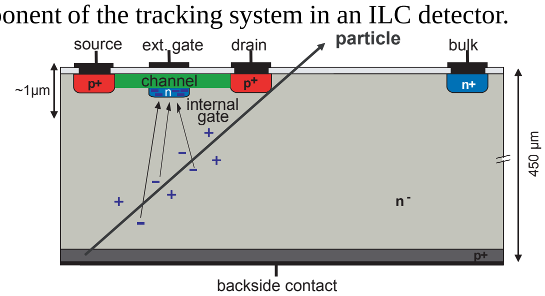

Figure 1: DEPFET Principle and Operation

A system made of 64 $\times$ 128 (33 $\times$ 22 μm pitch) DEPFET Matrix and Current Readout has been built and operated successfully in the laboratory and in various beam tests.

III. Test Beam

In September 2007 beam test measurements have been carried out at CERN SPS using pions of 120 GeV/c. During this test run DEPFET was the first Detector Under Test (DUT) user of the EUDET Telescope[3] and therefore commissioned the user interfaces of this infrastructure. The experimental setup is shown on the Figure 2.

The EUDET telescope provides up to six reference planes subdivided into two arms to allocate the DUT in between this two arms. Mechanical actuation helps to move the DUT, in this case two DEPFET sensors, through the active area of the telescope. The reference plane sensors are based on Monolithic Active Pixel Sensors (MAPS) with 256 $\times$ 256 and a pitch of $30\mu m$ (MimoTel)[2].

During the test beam the EUDET telescope and DEPFET had two independent data streams which were synchronized via the Trigger Logic Unit (TLU).

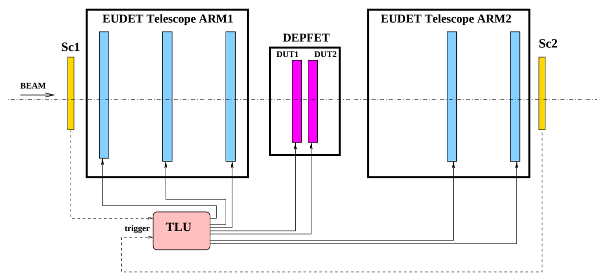

Figure 2: Test beam setup

The aim of this task was to use the standard analysis chain for DEPFET event reconstruction similar to what was used for EUDET Telescope. This gives the possibility to combine information from all detector planes, and also to use EUDET Telescope for DEPFET alignment and track reconstruction.

IV. Analysis Framework

Software plays an very important role already in the early stages of a large project like the ILC. Figure 3 shows a schematic overview of the software framework and the tools used by the international ILC community. This framework can be used for analysis of data from test beam as well as from Monte Carlo simulation [4]. LCIO (Linear Collider I/O) is a persistency framework and data model which defines an abstract event data model with cluster, hits and tracks and concrete file format to store the data.

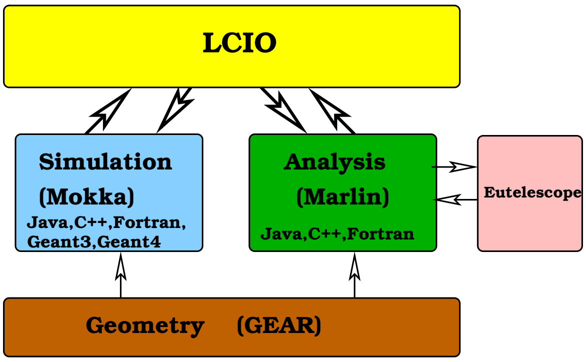

Figure 3: Schematic overview of the software frame work and the tools that are used during processing chain.

"EUTelescope" is a software package designed for data analysis of the EUDET Telescope as well as a pattern recognition and resolution determination of the DUT [5]. It has been designed to exploit as much as possible the modularity offered by Marlin (Modular Analysis and Reconstruction for Linear collider).

A special Marlin processor has been developed to convert native raw format of DEPFET data used by the DEPFET DAQ software into the LCIO standard. DEPFET related specific has been added into the standard EUTelescope packages such as for example row-wise common mode correction. The DEPFET test beam data has been processed using the EUTelescope package and then merged with EUDET Telescope events into one stream.

V. Conclusions

The ILC software framework provides a full scale analysis tools including the alignment and tracking. At the NSS 2008 in Dresden a status of DEPFET integration into ILC/EUDET analysis frame work will be presented.

Acknowledgements

This work is supported by the Commission of the European Communities under the 6th Framework Programme "Structuring the European Research Area", contract number RII3-CT-2006-026126.

VI. References

[1] M. Trimpl *et al.* , "Status of a DEPFET pixel system for the ILC vertex detector" [physics/0606104]
[2] E. Corrin,I.M. Gregor "JRA1-Status of the Demostrator Telescope" [EUDET-Memo 2007-19]
[3] L.Reuen "The DEPFET sensor as the first device under test using the EUDET JRA1 Telescope " [EUDET-Memo 2007-40]
[4] F. Gaede,J. Engels "Marlin et al..." [EUDET-Report 2007-11]
[5] A. Bulgheroni *et al.* "EUTelescope: tracking software" [EUDET-Memo 2007-20]