

The EUDET High Resolution Pixel Telescope

Ingrid-Maria Gregor, DESY
For the EUDET consortium

Abstract

A high resolution ($\sigma < 3\mu\text{m}$) beam telescope based on monolithic active pixel sensors is being developed within the EUDET collaboration. EUDET is a coordinated detector R&D programme for a future international linear collider providing test beam infrastructure to detector R&D groups. The telescope consists of six sensor planes with a pixel pitch of $30\mu\text{m}$ and can be operated inside a solenoidal magnetic field of up to 1.2T. In the last year the demonstrator telescope was tested and used by different groups at test beams at CERN and DESY.

In this presentation the high resolution beam telescope based on pixel sensors will be described. Design aspects to ease users interfacing to the general purpose mechanical setup and the data acquisition will be explained. Also a modular analysis package has been developed and used to analyse the data. Users can integrate at different levels of the analysis chain. In summer 2008 the demonstrator version of the telescope will be used by five different users (CALICE, DEPFET, MimoRoma, ISIS, SiLC). In this presentation the performance of the telescope in the different test beam will be summarised and the results will be discussed. The audience will learn how to apply for the use of this telescope and which tools are ready for the community.

Introduction

A 500GeV electron-positron linear collider is the next great international project in High Energy Physics. In order to achieve that goal, an intense international planning effort with a number of R&D projects has started. EUDET is one project within that context with the aim to improve the infrastructure for doing detector R&D for the future international linear collider. EUDET is partially funded by the European Union as a so-called "Integrated Infrastructure Initiative" within its 6th Framework Programme for Research and Technological Development. EUDET covers a number of different activities related to tracking, calorimetry and pixel R&D as well as so called networking activities which support information exchange. In this paper we shall discuss only one activity, namely the construction of a pixel beam telescope to be operated at DESY and CERN. The here described analogue telescope ("demonstrator") is only the first phase of this project; a full scale telescope will follow in spring 2009. This first test facility is already available for users since one year to satisfy the urgent test needs of various research groups working on pixel detectors in Europe. In this presentation the test beam results of the pixel beam demonstrator telescope will be discussed.

Sensors

The sensors for the telescope have to provide a single point resolution of 2 – $3\mu\text{m}$ with a minimum of material. Also, a reasonable lateral coverage is required and the readout has to be fast enough to reach a telescope frame rate of 1 kHz. The CNRS-IPHC institute in Strasbourg, France has developed, fabricated and tested a number of monolithic active pixel sensors (MAPS) with large enough arrays for the telescope. The MimoTel

prototype, was chosen for the demonstrator telescope. This chip is designed in the AMS 0.35 OPTO process with an epitaxial layer of $12\mu\text{m}$. The sensor is divided in 4 sub-arrays of 64×256 pixels each. With a pixel pitch of $30 \times 30\mu\text{m}^2$ this results in an active area of $7.7 \times 7.7\text{mm}^2$, not fulfilling the final telescope requirements, but suitable for the demonstrator. While the chip shows a good signal-to-noise ratio and high point precision of $3\mu\text{m}$, its architecture is simple without integrated data reduction. The final telescope will be constructed using the so-called Mimosa22+ chip with fully digital readout and integrated zero suppression. It will be a combination of the Mimosa22 and the Zuse01 chips, both developed in the framework of the EUDET telescope development. The geometrical parameters of Mimosa22+ will be such a way to match the DAQ readout speed and the needs for a test beam optimally.

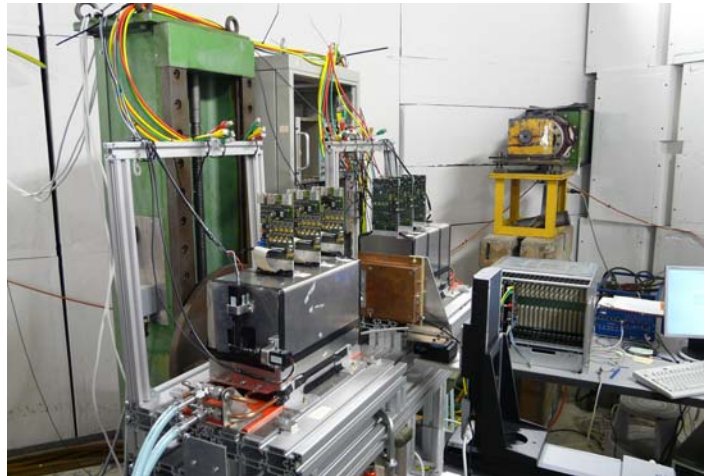


Figure 1: EUDET Demonstrator Telescope at DESY testbeam during the BeamCal test.

Outlook

In this presentation the high resolution beam telescope based on pixel sensors will be described. Design aspects to ease users interfacing to the mechanical setup and the data acquisition will be explained. Also a modular analysis package has been developed and used to analyse the data from test beams in 2007. Users can integrate at different levels of the analysis chain.

In summer 2008 the demonstrator version of the telescope will be used by five different users (CALICE digital HCAL, DEPFET, MimoRoma, LCFI, SiLC). In this presentation the performance of the telescope in the different tests will be summarised and the results of various test beam periods will be discussed. The audience will learn how to apply for the use of this telescope and which tools ready for the community.

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