38th INTERNATIONAL CONFERENCE ON HIGH ENERGY PHYSICS
AUGUST 3 - 10, 2016
CHICAGO

Contribution ID: **1324** Type: **Poster**

The Timepix3 Telescope and LHCb Upgrade R&D measurements

Monday, 8 August 2016 18:30 (2 hours)

The Vertex Locator (VELO) is the silicon detector surrounding the interaction region of the LHCb experiment. At the LHCb upgrade, planned for the LHC Long Shutdown 2, the VELO detector will be upgraded to a pixel system designed to withstand a radiation dose up to 370 MRad or 8×10^{15} 1 MeV n_{eq} cm^{-2}. An additional challenge is the non uniform nature of the radiation damage, which results in requiring a guard ring design with excellent high voltage control.

The Timepix3 telescope is a high rate, data driven beam telescope created to study the performance of sensor prototypes for the VELO upgrade. When testing VELO prototypes the readout is identical to the telescope; but a simple way to integrate triggers from other detectors is also provided, in a way that tracks can be synchronised offline. Examples of LHCb upgrade detectors which have been qualified with the Timepix3 telescope are the Upstream Tracker (UT), Scintillating Fibres (SciFi), Ring Imaging CHerenkov (RICH), and Time Of internally Reflected CHerenkov light (TORCH). The telescope was installed in the SPS North hall at CERN, profiting from beam time provided by the AIDA2020 program.

The telescope consists of 8 planes with 300 μm p-on-n silicon sensors read out by Timepix3 ASICs. Tracks measured with the telescope have excellent temporal (˜1 ns) and spatial resolution (˜2 μm). The telescope has been operated with a rate of tracks written to disk up to 5 MHz - limited only by conditions at the SPS; we expect a rate capability up to approximately 30 Mtracks/s. The telescope is assembled with 2 separate arms with 4 sensors on each arm. At the center, where the spatial resolution is best, Devices Under Test (DUT) can be installed. The remote operation of the central stage provides precise rotation and translations allowing detailed studies.

In this presentation the main results on the Telescope performance will be shown such as track reconstruction efficiency and pointing resolution. A detailed comparison of the performance of the different VELO sensor prototypes produced by Micron semiconductors and Hamamatsu photonics will be presented. The evaluation programme of the prototypes includes studies to show the effects of radiation damage. The sensors were submitted to a few facilities and irradited to the maximum required fluence, mainly: JSI reactor neutrons in Ljubliana, mid energy (27 MeV) protons at KIT in Karlsruhe and high energy (24 GeV) protons from IRRAD at CERN.

A collection of preliminary results from the other LHCb detector R&D programmes will be presented in order to show the adaptability and precision of the telescope. We also present the software framework used in the reconstruction and analysis of the telescope data. During the 2015 test beam campaigns, over 37 billion tracks were recorded, which requires a reconstruction software which is fast and easy to parallelise on a distributed computing system, such as the GRID. The software is based on the Gaudi framework used by many HEP experiments including LHCb. The framework allows for flexible integration of external users with the time-stamped triggers and can reconstruct more than 15,000 tracks per second.

Primary author: SAUNDERS, Daniel Martin (University of Bristol (GB))

Co-authors: CARVALHO AKIBA, Kazu (Univ. Federal do Rio de Janeiro (BR)); VAN BEUZEKOM, Martin (Nikhef National institute for subatomic physics (NL))

Presenter: SAUNDERS, Daniel Martin (University of Bristol (GB))

Session Classification: Poster Session

Track Classification: Detector: R&D and Performance