Triggering with the ALICE TRD*

T. Dietel[1], *S. Kirsch*[3], *J. Klein*[2], *V. Lindenstruth*[3], *Y. Pachmayer*[2], *F. Rettig*[3], *J. Stachel*[2], *J. P. Wessels*[1], *U. Westerhoff*[4] *for the ALICE Collaboration*

[1]Institut für Kernphysik, Münster; [2]Physikalisches Institut, Heidelberg; [3]Frankfurt Institute for Advanced Studies

Introduction

The Transition Radiation Detector (TRD) in ALICE provides hardware triggers within 7 µs after an interaction, e.g. for electrons and jets. The TRD is azimuthally segmented into 18 supermodules, 13 of which are currently installed. Each supermodule consists of 30 individual tracking chambers, arranged in 6 layers with 5 chambers each. Besides the specific energy deposit, electrons can be identified by the additional detection of transition radiation produced in a fibre-foam radiator. The signals are used for both tracking and particle identification.

The front-end electronics digitizes the amplified and shaped signal. In a digital processing chain, a straight-line fit on cluster positions is calculated. The track segments are characterized by fit parameters and accumulated charge. The latter is translated into an electron likelihood by a tuned look-up table. These data are transferred to the Global Tracking Unit (GTU). Within 2 µs the track segments are combined into TRD global tracks by a 3-dimensional matching algorithm. For every track the transverse momentum with a resolution of 20 % down to 10 % in the $p_\perp$ range from 2 to 8 GeV/c and the electron probability (PID) are calculated. Based on this information, a variety of triggers can be implemented.

Electron Triggers

The TRD single electron triggers require at least one track exceeding configurable $p_\perp$ and PID thresholds. Only tracks with a contribution in the innermost TRD layer and at least four others are considered in order to maximize the rejection. Two combinations of $p_\perp$ and PID thresholds are provided to the central trigger processor. They have been in production since September 2012.

One trigger is optimized to select electrons from $\mathrm{J/\psi} \rightarrow \mathrm{e^+\,e^-}$. Due to the low mass of 3.1 GeV/c^2 of the J/ψ, this trigger has a low transverse momentum threshold of 2 GeV/c. A high electron threshold is chosen in order to keep the rejection sufficiently high, approximately 1500 in pp collisions at 8 TeV.

The second trigger extends the $p_\perp$ reach for electrons from semi-leptonic decays of heavy-flavor hadrons (open charm and beauty). The transverse momentum threshold of this trigger is set to 3 GeV/c. To achieve a comparable trigger rate, the threshold for the electron likelihood is lower allowing for a higher electron efficiency. Figure 1 shows the enhancement of electrons above the trigger threshold.

* Work supported by GSI, BMBF, HGS-HIRe, and Helmholtz Alliance HA216/EMMI

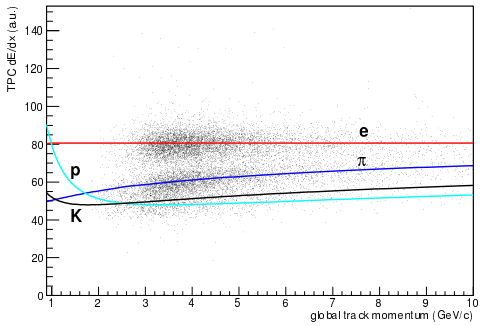

Figure 1: Ionization energy loss in the TPC as a function of momentum for tracks which fulfilled the TRD trigger condition

Jet Trigger

Jets are characterized by an increased local multiplicity. A typical jet area in $\eta - \phi$ used in jet finding, e.g. with anti-kt algorithm with $R = 0.4$, corresponds approximately to the area covered by a TRD stack. Thus, events containing 3 tracks with transverse momentum above 3 GeV/c within any TRD stack are triggered, see Figure 2. Despite being sensitive to charged tracks only, the trigger becomes fully efficient for jets of $\sim$ 100 GeV/c.

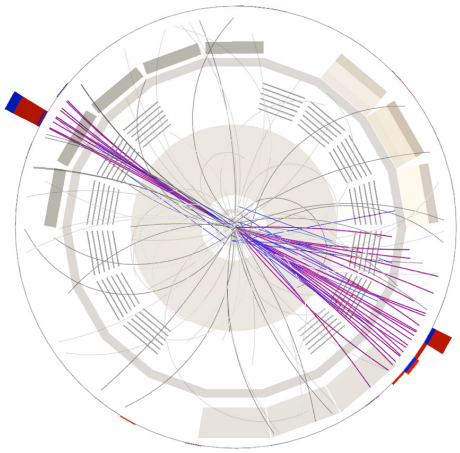

Figure 2: Event display of a di-jet event triggered by the TRD in pp collisions at 7 TeV

References

[1] J. Klein et al., Triggering with the ALICE TRD, NIM A, doi: 10.1016/j.nima.2012.05.011