The electron identification performance of ALICE TRD[*]

A. Andronic[1], *M. Fasel*[1,2], *L. Feldkamp*[3], *D. Lohner*[2], *X.-G. Lu*[2], *Y. Pachmayer*[2] *for the ALICE Collaboration*
[1]EMMI & GSI Darmstadt; [2]Universität Heidelberg; [3]Universität Münster

The Transition Radiation Detector (TRD) is designed to enhance electron identification in the ALICE central barrel ($|\eta| < 0.9$) and to provide a level-1 hardware trigger (about 8μs after a hadron-hadron collision) on electrons with high transverse momenta and on jets [1]. The electron identification is achieved by the detection of the specific energy loss and transition radiation (TR). Transition radiation is produced when a relativistic charged particle ($\gamma \gtrsim 1000$) traverses many interfaces of two media of different dielectric constants composing a radiator [2]. On average, in the ALICE TRD, for each electron above 1 GeV/c momentum, one TR photon (of 1-30 keV) is absorbed in the high-Z gas mixture (Xe-C0$_2$ [85-15]) of the 3.7 cm thick detector.

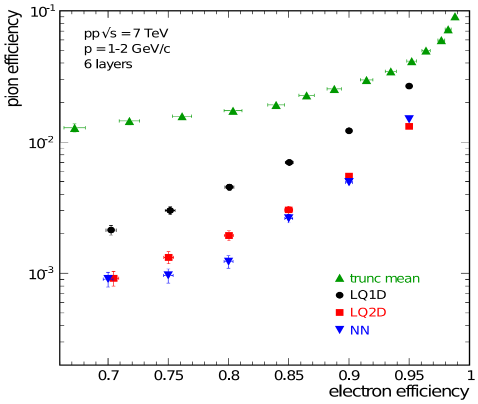

Figure 1: Pion efficiency as a function of electron efficiency for the momentum range 1-2 GeV/c for various methods (see text).

To quantify the TRD identification performance we use the data collected in proton-proton collisions at $\sqrt{s} = 7$ TeV. Using topological cuts we select clean samples of electrons from γ conversions and pions from K^0_s decays and employ also TPC and TOF particle identification. We express the performance in terms of the pion efficiency, which is the fraction of pions wrongly identified as electrons. The pion suppression factor is the inverse of the pion efficiency. We employ the following methods: (i) truncated mean; (ii) one-dimensional likelihood on the total integrated charge (LQ1D); (iii) bidimensional likelihood on integrated charge in two intervals of drift time (LQ2D); and (iv) neural networks (NN) [4]. The results are compared in Fig. 1, where we show, for tracks with signals in all six layers of the TRD, the pion efficiency as a function of the electron efficiency. While the truncated mean and the LQ1D are the simplest and, consequently, more robust methods, the full exploitation of the TRD capability is reached taking advantage of the temporal pattern of the signal, utilized in the LQ2D and NN methods. Those bring a further pion suppression factor of about two compared to the LQ1D method. The present pion suppression factors obtained from collision data confirm the design value measured in testbeams with prototypes [3].

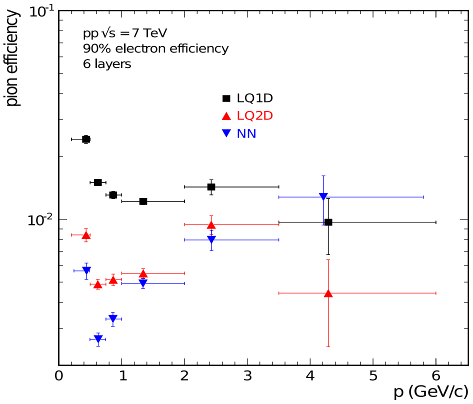

Figure 2: Momentum dependence of the pion efficiency for the LQ1D, LQ2D and NN methods. The results are for 90% electron efficiency.

The momentum dependence of the pion efficiency is shown in Fig. 2. The pion suppression improves with increasing momentum up to about 1 GeV/c as a consequence of the strong onset of TR production by electrons in this momentum range. Above 1 GeV/c TR production starts to saturate and the relativistic rise of the specific energy loss of pions leads to a reduction of the pion rejection factor.

The TRD particle identification is at present successfully used for the measurement of electrons from heavy-flavour decays [5] and for the study of J/ψ mesons.

References

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