Transition Radiation Spectra measured with Prototypes of the ALICE TRD

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In 2004 we carried out an extensive investigation of Transition Radiation (TR) properties using ALICE TRD prototype drift chambers. They are constructed similar to the final ALICE TRD chambers [1], but have a smaller active area. To back up and complement similar measurements from two years earlier [2], we now tested different radiator configurations and increased the beam momentum to 10 GeV/c. The measurements were performed at the T9 secondary beam line at the CERN PS. A dipole magnet was used to deflect the beam after passing through the radiator. We were thus able to separate the energy deposited by TR photons from ionization energy loss on the particle track. A pipe filled with helium was used to minimize absorption losses over the 1.3 m distance between the radiator and the drift chamber.

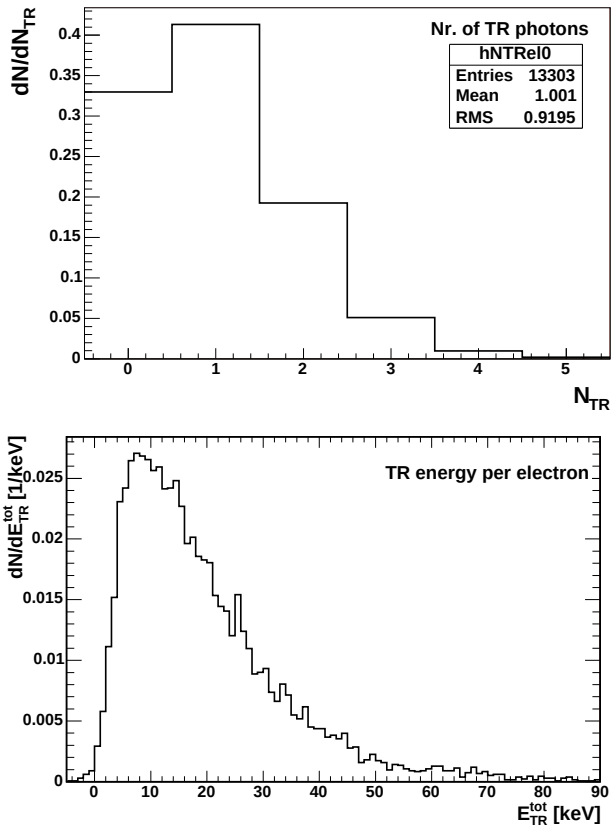

Figure 1: Top panel: Distribution of the number of photons detected in the drift chamber at a momentum of 8 GeV/c for the standard sandwich radiator. Bottom panel: Spectrum of TR energy deposited in the detector.

Fig. 1 shows the distribution of the number of photons detected in the drift chamber and the energy spectrum of these photons for electrons of momentum 8 GeV/c for the standard sandwich radiator of the final ALICE TRD chambers. The distribution of the number of photons is roughly Poissonian with a mean of one photon in the detector. Fig. 2 shows the mean number of photons detected in the drift chamber and the mean energy deposit per electron as a function of momentum for different radiator configurations: The standard sandwich radiator, a plexiglas dummy, a regular foil radiator and radiators composed of either pure fibers or pure foam (which are both components of the ALICE TRD sandwich radiator). Both the largest average number of photons and the highest energy deposit per electron are observed using the regular radiator. However, we also identify photons in the detector with only the dummy radiator. Their significant number can not be explained by bremsstrahlung. Whether this effect is due to a beam contamination or beam interaction with the helium pipe housing remains to be clarified.

The measurement of the properties of TR are essential also for comparison with and verification of simulation routines.

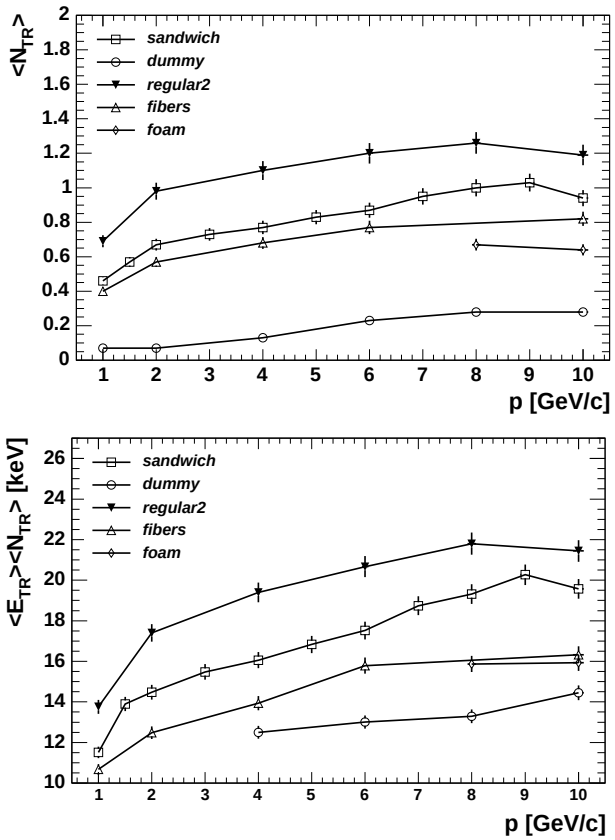

Figure 2: Mean number of photons detected in the drift chamber (top panel) and most probable energy deposit per photon (bottom panel) as a function of momentum for all radiator configurations.

References

[1] ALICE Transition Radiation Detector Technical Design Report, ALICE TDR 9, CERN/LHCC 2001-021.

[2] O. Busch et al., Nucl. Instr. Meth. Phys. Res. A 525 (2004) 153.