100 Ohm transmision line multi-strip multi-gap high counting rate RPC prototype *

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A basic structure for the inner zone of the CBM-TOF wall using multi-strip, multi-gap low resistivity glass RPCs showed excellent performance in terms of time resolution and efficiency [1] up to local counting rates of 10^5 particles/(cm^2·s) [2] and up to 10^4 particles/(cm^2·s) all over the counter surface [3]. The differential read-out of the RPC cells had 50 Ohm impedance and therefore using fast NINO amplifiers [4] of 100 Ohm input impedance, an impedance matching was required at the level of mother-boards. In order to circumvent this aspect and at the same time to have a solution for the higher granularity required for the most inner zones of the CBM-TOF, a new RPC prototype was designed and built. The strip structure of the readout and high voltage electrodes was decided based on APLAC simulations such to obtain a differential readout impedance as close as possible to 100 Ohm. The measured value of the glass permitivity was used in the simulation. The central read-out electrode was considered as a single layer strip structure sandwiched between two thin layers of FR4. For the standard structure of the RPC cells developed by us, [1], in order to obtain a 100 Ohm impedance for the transmission line, a pitch of 4.19 mm (2.16 mm strip width and 2.03 mm gap) is required.

The simulated signals on the anode and cathode electrodes read-out on 50 Ohm load resistors and the differential one can be seen in Fig. 1. They were obtained with APLAC injecting in the transmission line pulses of ± 1 V with a 100 ps rise time and 600 ps fall time through a 50 Ohm resistor.

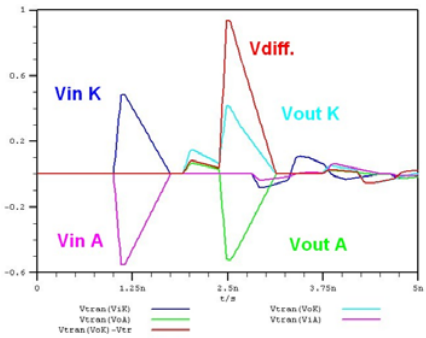

Figure 1: The signals on the anode and cathode electrodes and the differential one obtained with APLAC.

The active area of the new prototype is 283 x 200 mm^2. A photo of the assembled RPC structure on the back flange and closing box is presented in Fig.2 left. The PCB with the structure of the read-out electrodes can be seen on the right side of Fig. 2. The prototype based on such strip characteristics was built and the results in terms of the differential and the anode and cathode signals, respectively, obtained directly from the RPC with a ^{60}Co source can be followed in Fig. 3.

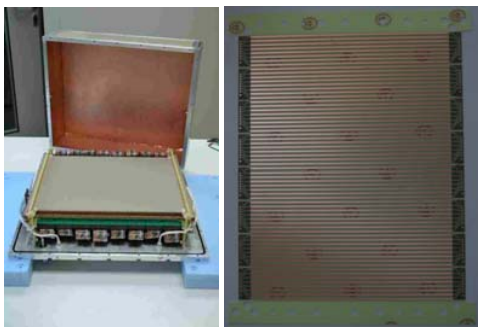

Figure 2: Left side: A photo of the assembled RPC structure on the back flange and closing box. Right side: the PCB with the structure of the read-out electrodes.

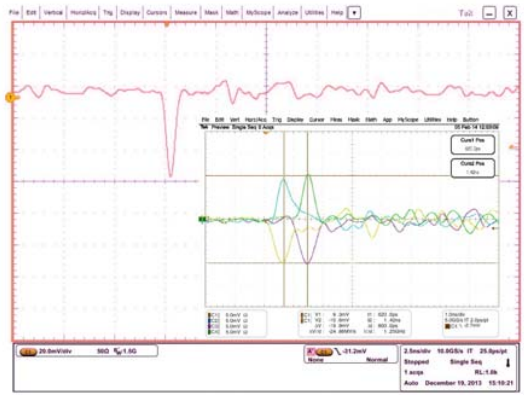

Figure 3: The differential and the anode and cathode signals at the two ends of a strip.

As can be seen, the APLAC predictions are rather well confirmed by the real signals delivered by the RPC.

Detailed cosmic ray tests are in progress and in-beam tests are foreseen in the near future.

References

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