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Performance of the BIS78 RPC detectors: a new concept of electronics and detector integration for high-rate and fast timing large size RPCs

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The reduction of the average charge per count in the gas along with the capability to discriminate very small avalanche signals, can allow an efficient and long-term Resistive Plate Chamber detector operation, in high radiation background environment. This goal has been reached during the R&D program of the BIS78 ATLAS upgrade project, through the deep integration of a fast (100 ps peaking time) and sensitive (as small as 100 μV threshold) Front-End electronics (FE) with a very large size detector structure. This innovative RPC integration concept pivots on a newly conceived faraday cage, embedding the readout strips and the FE, tightly wrapped around a 1 mm gas gap RPC with 1.2 mm thick electrodes, as a fully independent singlet structure.
We studied the performance of BIS78 production triplet chambers, made of 3 independent singlets of 2 m2, each providing a 2D+time information, showing a minimum threshold achievable of 2pC of average charge per count produced inside the gas gap.
We show that these chambers grant a record combined performance of better than 95% single gap efficiency, time resolution of 350 ps and ~10 kHz/cm^2 rate capability.

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