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On the performance of the novel front-end electronics for the ATLAS BI RPC upgrade at HL-LHC developed in SiGe BiCMOS technology

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The High Luminosity phase of LHC will require a vast improvement of the ATLAS detector in terms of performance, since the entire apparatus will be operated in much harsher conditions. The BI project is one of the ATLAS Phase-2 upgrades, ensuring the demands coming from the physics for the next 20 years. In this framework, a novel dedicated Front-End electronics has been developed, which exploits a BJT-based preamplifier, a fast discriminator (minimum threshold achievable 1-2 fC) and a high resolution (<100ps) Time-To-Digital converter in SiGe BiCMOS technology, to vastly enhance the detector rate capability (1 order of magnitude with respect to the RPC currently installed in ATLAS). This front-end electronics is integrated for the first time within the detector faraday cage, largely reducing the effects of induced and self-induced noise, allowing a minimum effective charge threshold on the induced signal of 1-2 fC. The integration of the front-end electronics directly within the detector Faraday cage is also permitted by the low power consumption of 15 mW/ch. The RPC coupled with this novel front-end electronics represents a new generation of large area timing detectors, granting a record time resolution of 350 ps on a single gas gap of 1 mm and operated with the ATLAS standard gas mixture. The effect of the extremely low threshold has also an impact on the gas mixture, enabling the usage of eco-friendly gas mixtures which would not be usable elsewise.
The latest performance of this newly developed front-end electronics along with the results achieved with RPC detector coupled with it will be shown.

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