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Studies of gas gaps current density in the ATLAS RPC detector during 2018 data taking at Large Hadron Collider

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The ATLAS Resistive Plate Chamber (RPC) detector is a tracking trigger, used to primarily select high momentum muons in the ATLAS barrel region ($|\eta| < 1.05$) at the 40 MHz collision rate, and to provide muons azimuthal coordinates. The RPC system consists of about 3700 gas volumes covering a sensitive surface of about 4000 m^2 . It is arranged in three concentric double layers distributed on a radial distance of about 5m and operating at approximately 0.5 Tesla toroidal magnetic field. RPCs provide 6 points along the muon track with a space-time resolution of about $1 \text{ cm}^2 \times 1 \text{ ns}$. This work studies systematically gas gaps current as a function of the electric field applied on the gas, and environmental parameters both without/with the LHC beam induced background and up to an instantaneous luminosity $L_{\text{inst}} = 2 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ (twice larger the design LHC luminosity). These measurements have been used to study the RPC working condition and to extrapolate the detector response to High Luminosity LHC regime with $L_{\text{inst}} = 7.5 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$.

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