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Novel ideas for CMS L1 trigger in HL-LHC using RPC ultimate timing performance

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The CMS RPC system has been upgraded for Phase-2 with two major projects. First is the comprehensive redesign of the Link System connecting the Front-End Boards (FEBs) of existing CMS RPC chambers to the trigger processors, which leads to fully exploit the intrinsic time resolution of 1.6 ns. Second is the extension of the pseudorapidity coverage by adding new chambers from $|\eta| = 1.9$ to 2.4. The newly assembled chambers utilize Improved Resistive Plate Chambers (iRPC) technology, enabling signal readout from both ends of the strip for 2-dimensional hit reconstruction. Equipped with advanced electronics, iRPCs deliver hit timing with a 500ps resolution, facilitating the development of precise Time of Flight triggers.

Given the vital role of RPC in CMS experiment, specifically upgraded to cope with high luminosity and high event pile up expected in the upcoming High-Luminosity Large Hadron Collider (HL-LHC) phase, we will discuss novel trigger algorithms and advanced offline analysis techniques. We aim at improving the detection efficiency of Long-lived particles (LLPs) offering a tantalizing glimpse into new physics, potentially providing clues about dark matter, supersymmetry, and other beyond-the-Standard-Model theories. The focus will be on particles that either decay into Standard Model muons in the detector's outer layers or are inherently muon-like heavy stable charged particles. The ultimate time resolution performance of existing RPCs and iRPCs will enhance the discovery potential of our searches in CMS for new physics.

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