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Reconstruction, performance and physics opportunities with long-lived particles with lifetime exceeding 100 ps at LHCb

Unstable long-lived particles with lifetime above 100 picoseconds occur in the Standard Model (SM) and show up in many of their extensions. They are, however, challenging to reconstruct and trigger at the LHC due to their very displaced decay vertices that often are located outside the vertex locator systems. The new fully software-based trigger system of the LHCb experiment for Run 3 onwards consists of two stages, HLT1 and HLT2, the first one enabling the detector reconstruction to be performed in real time with high performance on Graphic Processor Units (GPUs), the second providing also in real time offline-quality resolution of the reconstructed objects. This trigger opens the possibility to develop new algorithms, which can be decisive for enhancing the reconstruction of Λ and K^0 s hadrons and finding new particles with lifetimes ranging from about 100 picoseconds to tens of nanoseconds. This talk discusses the efforts and challenges of these developments, detector performance studies using Run 2 and Run 3 data, and the opportunities opened for the LHCb physics program within and beyond the SM.

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