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Triggering long-lived particles in HL-LHC and the challenges in the first stage of the trigger system

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Triggering long-lived particles (LLPs) at the first stage of the trigger system is very crucial in LLP searches to ensure that we do not miss them at the very beginning. The future High Luminosity runs of the Large Hadron Collider will have an increased number of pile-up events per bunch crossing. There will be major upgrades in hardware, firmware and software sides, like tracking at level-1 (L1). The L1 trigger menu will also be modified to cope with pile-up and maintain the sensitivity to physics processes. In our study we found that the usual level-1 triggers, mostly meant for triggering prompt particles, will not be very efficient for LLP searches in the 140 pile-up environment of HL-LHC, thus pointing to the need to include dedicated L1 triggers in the menu for LLPs. We consider the decay of the LLP into jets and develop dedicated jet triggers using the track information at L1 to select LLP events. We show in our work that these triggers give promising results in identifying LLP events with moderate trigger rates.

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