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Usage of Machine Learning in CMS Level-1 Endcap Muon Trigger

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The Level-1 trigger of the CMS experiment at the LHC uses custom hardware processors to select up to 100 kHz of interesting events out of a possible 40 MHz. Correct measurement of the transverse momentum of particles is crucial to correctly identify which events to keep. This task is particularly challenging in the endcaps of the CMS experiment due to the non-uniform magnetic field, reduced bending of particle trajectories, and the large amount of collision backgrounds in regions close to the beam line. These challenging conditions provide an ideal problem for machine learning (ML) based solutions. This talk discusses the development and performance of ML based transverse momentum assignment methods at the CMS Level-1 Endcap Muon Track Finder (EMTF) for Run 3 of the LHC as well as the plans for the foreseen Phase 2 upgrade of the EMTF system. A new addition for Run 3 is the neural network based transverse momentum assignment to muons originating from displaced vertices. The displaced NN will complement the boosted decision tree (BDT) based momentum assignment which is optimized for prompt muons that has been in use since 2016. The Phase 2 upgrade of the EMTF will instead use two NNs implemented into FPGAs to handle prompt and displaced muons separately. These new displaced muon triggers will enable new phase spaces for the CMS experiment to search for long-lived particles (LLPs) that decay into muons which are predicted by many beyond the Standard Model (BSM) scenarios.

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