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Fast b-tagging at the high-level trigger of the ATLAS experiment

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The exceptional challenges in data acquisition faced by experiments at the LHC demand extremely robust trigger systems. The ATLAS trigger, after a fast hardware data processing step, uses software-based selections referred to as the High-Level-Trigger (HLT). Jets originating from b-quarks (b-jets) are produced in many interesting fundamental interactions, making them a key signature in a broad spectrum of processes, such as Standard Model HH⟶4b. Trigger selections including b-jets require track reconstruction which is computationally expensive and could overwhelm the HLT farm. To cope with the real-time constraints and enhance the physics reach of the collected data, a fast neural-network-based b-tagger was introduced for the start of Run-3 (https://arxiv.org/abs/2306.09738). This low-precision filter runs after the hardware trigger and before the remaining HLT reconstruction. It relies on the negligible cost of neural-network inference as compared to track reconstruction, and the cost reduction from limiting tracking to specific detector regions. In the case of HH⟶4b, the filter lowers the input rate to the remaining HLT by a factor of five at the small cost of reducing the overall signal efficiency by roughly 2%. The proposed talk will present this method, which has tremendous potential for application at the HL-LHC, including in the low latency hardware trigger and in use cases beyond heavy flavour tagging.

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