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Graph Neural Networks for a Deep-learning based Full Event Interpretation (DFEI) at the LHCb trigger

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In a decade from now, the Upgrade II of LHCb experiment will face an instantaneous luminosity ten times higher than in the current Run 3 conditions. This will bring LHCb to a new era, with huge event sizes and typically several signal heavy-hadron decays per event. The trigger scope will shift from deciding 'which events are interesting?'to 'which parts of the event are interesting?'. To allow for an inclusive, automatic and accurate multi-signal selection per event, we propose evolving from the current signal-based trigger to a Deep-learning based Full Event Interpretation (DFEI) approach. We have designed the first prototype for the DFEI algorithm, leveraging the power of Graph Neural Networks (GNN). The algorithm takes as input the final-state particles and has a two-folded goal: select the sub-set of particles originated in heavy-hadron decays, and reconstruct the decay chains in which they were produced. In this talk, we describe the design and development of this prototype, and discuss the latest performance studies on simulation, as well as the requirements for an eventual integration in the Real Time Analysis (RTA) system of LHCb.

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