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Multi-particle reconstruction in the High Granularity Calorimeter using object condensation and graph neural networks

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The high-luminosity upgrade of the LHC will come with unprecedented physics and computing challenges. One of these challenges is the accurate reconstruction of particles in events with up to 200 simultaneous proton-proton interactions. The planned CMS High Granularity Calorimeter offers fine spatial resolution for this purpose, with more than 6 million channels, but also poses unique challenges to reconstruction algorithms aiming to reconstruct individual particle showers. In this contribution, we propose an end-to-end machine-learning method that performs clustering, classification, and energy and position regression in one step while staying within memory and computational constraints. We employ GravNet, a graph neural network, and an object condensation loss function to achieve this task. Additionally, we propose a method to relate truth showers to reconstructed showers by maximising the energy weighted intersection over union using maximal weight matching. Our results show the efficiency of our method and highlight a promising research direction to be investigated further.

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