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Monte Carlo reweighting for efficient hadronization parameter uncertainty estimation

As the community transitions to the HL-LHC era, high-statistics simulations become increasingly important for precision phenomenological hypothesis testing. Reweighting Monte Carlo samples can increase the effective computational efficiency of simulation by allowing an ensemble of generated events to be reinterpreted as though it were obtained using different input parameters. Each stage of the simulation process requires specialized knowledge and attention to effectively and efficiently implement reweighting techniques.

We here present our recent work (arXiv:2308.13459) implementing such a technique in the hadronization stage of collider-event predictions. The method is based on a Monte Carlo-veto algorithm and extends previous work on uncertainty estimates in parton showers to the Lund string-fragmentation model. We observe significant speed-ups in generation time, and this work enables a robust exploration of the uncertainties arising from the choice of input model parameters, an important step when determining the sensitivities of precision physics measurements.

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