Contribution ID: **15** Type: **Oral**

Efficient precision simulation of processes with many-jet final states at the LHC

Wednesday 13 March 2024 15:10 (20 minutes)

The success of the LHC physics programme relies heavily on high-precision calculations. However, the increased computational complexity for high-multiplicity final states has been a growing cause for concern, with the potential to evolve into a debilitating bottleneck in the foreseeable future. We present a flexible and efficient approach for the simulation of collider events with multi-jet final states for both leading and next-to-leading order QCD calculations. The technique is based on an improved parton-level event file format with efficient scalable data handling. We validate the proposed framework using a range of processes, including Higgs boson plus multi-jet production with up to seven jets, and demonstrate its use in both the Sherpa and Pythia event generators, paving the way towards economically and ecologically sustainable event generation in the high-luminosity era.

Significance

We propose a new event file format akin to the Les Houches Event format but based on the HDF5 library, lending itself very well to HPC applications, including GPU-accelerated Monte Carlo event generators.

References

https://arxiv.org/abs/2309.13154

Experiment context, if any

The work is relevant for ATLAS and CMS but was done outside of the experiments and hence doesn't require involvement the respective publication boards.

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Session Classification: Track 3: Computations in Theoretical Physics: Techniques and Methods

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