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Workshop on Software Challenges in MC Generators for HL-LHC (MCSW2018)

The High Luminosity Large Hadron Collider (HL-LHC), which is scheduled to begin data taking in 2026, will deliver to ATLAS and CMS approximately 30 times more data than the LHC has so far produced. This increase in the number of collision events and their increased complexity due to higher pile-up will require significant improvements in the software needed to reconstruct and analyse both real and simulated event data. This is because the total amount of available computing resources will be limited by more or less constant operational budgets, while the benefits of technological advances in new computer architectures can only be fully exploited by new software paradigms. These issues have been analysed in detail in the [Community White Paper](#) (CWP) published by the HEP Software Foundation (HSF) in 2017.

At the same time, the full exploitation of the HL-LHC physics program will only be possible if the precision of theoretical predictions matches that reached by the experimental measurements. New calculations at the next-to-next-to-leading-order (NNLO) level will be needed, which not only requires breakthroughs in theoretical models and calculations, but also implies that the processing time needed to generate one unweighted Monte Carlo (MC) event will significantly increase. The number of unweighted simulated events that need to be generated by MC techniques will also increase by one order of magnitude. Moreover, as in the case of the LHC experiment frameworks, most of the available MC generator software has not yet been optimized for modern computer architectures. It is therefore essential to review the status of physics generators, to understand which software improvements are needed if any and how they could be implemented and funded, with the final goal of making sure that the computing resources required by MC event generation to achieve the necessary theoretical precision at HL-LHC remain affordable within the available budgets. This analysis would represent a natural extension of that already initiated within the CWP process, which led to the preparation of the detailed [Generator and Theory WG Chapter for the CWP](#).

For these reasons, we propose to hold a *Workshop on Software Challenges in MC Generators for HL-LHC*.

The Workshop should take place before the upcoming LHCC review of software and computing for HL-LHC in early 2019. Taking into account other constraints, we could aim for early December 2018.

The appropriate location has not yet been identified.

The Workshop should aim to bring together all relevant communities: the community of theorists and MC generators authors to start with, but also those responsible for MC generator software and productions in the experiments, as well as computing engineers with the relevant software and architecture expertise. A program committee reflecting this diversity should be set up.

The deliverables of the workshop should include the following, which could be documented in a final report:

- A better shared understanding of the current usage of MC generators in the experiments.
- An assessment of the theoretical precisions that are needed in different physics processes in order to ensure the full exploitation of the HL-LHC physics potential.

- A first estimate of the computing resources that would be needed for generating the required numbers of MC events at HL-LHC, and a first evaluation of possible measures needed to alleviate these computing resources, if any (e.g. weighted events, common cross-experiment generation...).
- A review of the readiness of MC generators to exploit modern computer architectures (vectorization, multi-core, HPCs, GPUs...) and an estimate of the work needed to improve in this area.
- A shared vision of how a concrete collaboration between the different communities on these issues could be implemented, and possibly funded.