HSF Physics Generators

2021 Summary and Plans for 2022

20 January 2022

Overview

Summary of 2021

- General impression: Lots more attention in the community on generator software!
- Mostly spent on LHCC review of HL-LHC computing (2020-2021) and related documents
  - We had 7 meetings (HSF phys gen category in indico)
  - Talk at the LHCC review, 3 November 2021
  - "HL-LHC Computing Review Stage-2, Common Software Projects: Event Generators", [arXiv:2109.14938]
- "Challenges in Monte Carlo event generator software for High-Luminosity LHC", [Comput Softw Big Sci 5, 12 (2021)]
- Significant progress in e.g.
  - MadGraph4GPU, Speed improvements in e.g. Sherpa now in production, ATLAS vs CMS accounting, but to try to finish this off

Plans for 2022

- Snowmass document
- Expand into NP community (with Markus' help!)
- Also try to reach out more to the neutrino community.
- Go back to more "topical" meetings
  - Need to follow up on various things highlighted in CSBS paper and HL-LHC review
  - Also need to catch up a bit with more recently developments
  - Could also be useful to have a workshop?

Many thanks to Andrea!

Welcome to Markus!

Topics for 2022

- MC for EIC:
  - Report from previous MC4EIC WS, Contributions for Spring WS?
- Latest calculations and their CPU/negative weight performance
  - MiNNLO, ttbar NNLO calculations, Recent ATLAS V+jets paper [PMGR-2021-01]
- ATLAS/CMS/LHCb
  - CPU/Event accounting for central production, Sample sharing, Filtering inefficiencies for B-physics
- GPU/CPU vectorisation porting
  - Status from MG4GPU, Sherpa, other groups?
- Unweighting/resampling developments
  - Review of tools, integration into experiments and usage/viability for experiments
- ML tools
  - Get better overview of current usage of ML and work out what is genuinely useful for experiments
    - Phase-space Sampling improvements, Use in systematic uncertainties, GAN for event generation
- Benchmarking and validation
  - Docker image for using generators for benchmarking? Spack and CI for validation?
- Modular generator software framework
  - Is it feasible? How to initiate?

Topics for 2022

- Reports from other groups
  - SWIFTHEP/EXCALIBUR (UK), HEP-CCE (USA), Others?
- Training
  - Discuss with Training WG
  - Replacement for MCnet schools?
- More long-term/speculative topics to follow more closely
  - Julia
  - Quantum Computing for event generation

Back-ups

Miscellaneous recent papers of interest

- Style-based quantum generative adversarial networks for Monte Carlo events: https://arxiv.org/abs/2110.06933
- Unbiased Elimination of Negative Weights in Monte Carlo Samples: https://arxiv.org/pdf/2109.07851.pdf

Plans for 2022

- Snowmass White Paper on Event Generators
  - To highlight opportunities in event generator development that span several frontiers and experimental facilities, such as the LHC, next-generation neutrino experiments such as Dune and HyperK, Belle II, the EIC, the Forward Physics Facility, Heavy Ion experiments and future colliders.
  - Invited to prepare a contribution (~2 pages) on the *computing performance of event generators, with a focus on recent work in the HEP Software Foundation*.
  - MCnet collaboration will write an overview on efforts that are not covered under the HSF umbrella.
  - A first draft is almost ready.
  - Deadline March, 15th but aiming for a first draft by the end of January.