

# HSF Physics Event Generator WG

<https://hepsoftwarefoundation.org/workinggroups/generators.html>

*IMO this is mainly:  
how to fit LHC event generation needs (required #events at the required precision)  
on our limited (CPU, GPU...) computing resources*

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*Thanks to all WG members for their work! I alone am to blame for any imprecisions or misunderstandings...*

12<sup>th</sup> LHCb Computing Workshop – 20<sup>th</sup> November 2019

<https://indico.cern.ch/event/831054>

# HSF Generators WG – timeline

- *Dec 2017*: Generators section in the HSF Community White Paper
  - Detailed standalone paper was not published (but draft still exists)
- *Nov 2018*: HSF Physics Event Generators computing workshop
  - LHCb contributions: Phil Ilten (LHCb, Pythia), Michal Kreps (EvtGen)
- *Dec 2018*: debriefing, set up an HSF Physics Event Generators WG
  - Conveners: AV, Josh McFayden, Stefan Hoeche, Steve Mrenna, Taylor Childers
- *Feb-Jul 2019*: seven WG meetings (<https://indico.cern.ch/category/8460>)
  - Around 5-15 participants (ATLAS, CMS, theorists) – see minutes
  - Group has been ~dormant for the last four months
  - *Suggestions and contributions from LHCb are welcome to improve WG activities!*
- *Nov 2019*: call for three new conveners (one-year term)
  - *Suggestions and nominations from LHCb are welcome!*

# Focus of discussions so far

- *ATLAS/CMS accounting* – fraction of WLCG CPU for generation now (Run2)
  - Gain better understanding if/where/why we already see a problem
  - Motivation: in Dec 2018, CMS reported ~1%, ATLAS reported ~14%
- *Generator comparison* – do ATLAS/CMS differ due to their generator choice?
  - CMS mainly uses MadGraph, ATLAS mainly uses Sherpa
  - Can we define standard setups to allow generator profiling and optimization?
- *GPUs* – what are the status and prospects for generators on GPUs (HPCs)?
- *Event sample sharing* – has been discussed for some ATLAS/CMS channels
- Wish list – my selection of some additional issues we should address
  - *Impact of negative weights* (NLO) – also discussed at the Les Houches workshop
  - *Projections for Run4* – higher precision (NNLO), faster detector simulation...
  - How can we enable *tighter cooperation of different communities* (experimentalists, theorists, software engineers, resource managers) around a set of shared goals?



# Generator comparison (WIP)

- Current estimate for GEN fraction of WLCG CPU: CMS ~5%, ATLAS ~12%
- MadGraph (CMS) vs. Sherpa (ATLAS) explains part of the difference, not all
  - The situation is different in different channels
  - The choice of some parameters is also important
- Latest update from the [March 2019 meeting](#) (details available on [overleaf](#)):

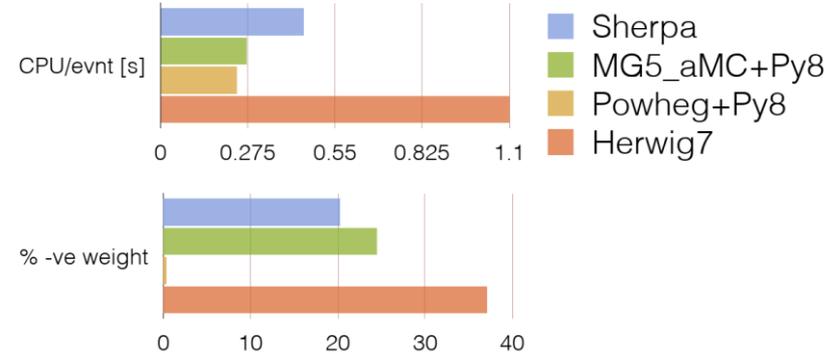


Figure 1: CPU per event and negative weight fraction for  $t\bar{t}$ @NLO.



Figure 2: CPU per event  $W \rightarrow e\nu + 0-4\text{jets}@LO$  (using pre-integration grids).

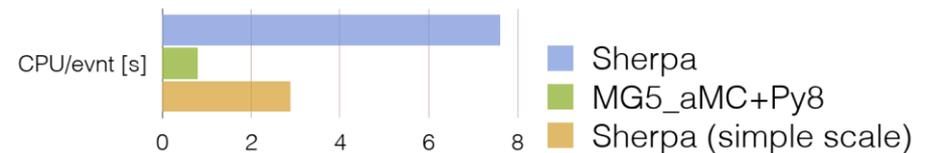


Figure 3: CPU per event  $W \rightarrow e\nu + 0-2\text{jets}@NLO$  (using pre-integration grids).

- WIP: prepare standalone recipes to reproduce and analyse these numbers

# Generators on GPUs (WIP)

- There are high expectations to port generators on GPUs
  - We may soon be offered computing time pledges on GPU-based HPCs
  - We now have ~no Grid workloads that we can run there: can we port generators?
- Reality check: GPU work on MadGraph in Japan dates back to 2008-2013
  - See [talk by J. Kanzaki](#) at HSF/OSG/WLCG Workshop in March 2019
- New: GPU work on MadGraph ongoing in Argonne
  - See [talk by K. Fielman](#) at HSF Generator WG in July 2019
  - A few other people may also be interested to contribute to this
  - We will certainly ask for an update on this work at an upcoming meeting

**PROSPECTS**

- End of summer:
  - Fully functional gVEGAS
  - Integration benchmarking
- After Summer:
  - Restore gBASES, gSPRING
  - Event generation benchmarking
- Much later:
  - GPU functionality fully integrated into MG5

ENERGY 11 Argonne

- Are you aware of (or interested in) porting other generators to GPUs?...

# Conclusions: event generation costs money

- Generator software sits at a complex crossroads
  - Many different communities with different goals / motivation and expertise
    - But in view of HL-LHC we should make sure that it does not fall in the crack!
  - Collaboration is essential: how to ensure it is mutually beneficial to all involved?
    - Too much for a single person: theoretical & experimental physics, software, computing
- In the HSF WG we concentrated on ATLAS and CMS so far
  - *But LHCb is very welcome to raise issues and offer contributions!* 😊
  - Hoping and assuming that doing this work in common is the right way

## Non-exhaustive list of *LHCb-specific questions*...

- What is the CPU fraction from GEN now?
- What is the projected GEN fraction in Run3/4?
- Which generator speedup would be most useful?
- Which generator on GPU would be most useful?
- Is there (will there be) a problem with negative weights?
- Is there (will there be) a problem with unweighting efficiency?

