Karlsruhe Institute of Technology

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Institute of Experimental Particle Physics

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BMBF FSP-CMS

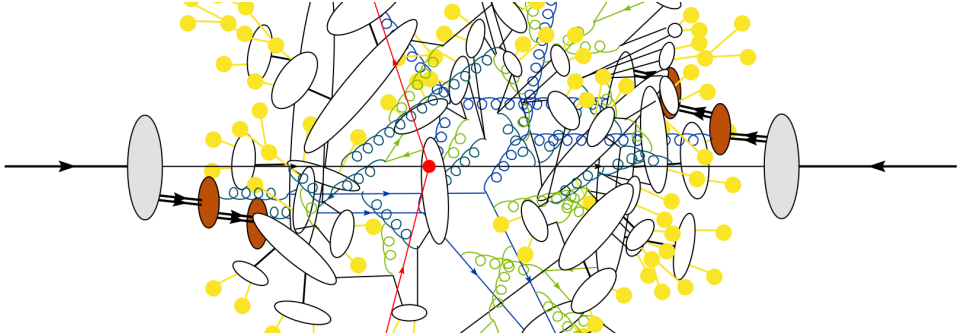
MC-Run: Scalable MC Event Generation and Analysis

tCSC lightning talk

Maximilian Horzela, **Cedric Verstege** | 12 June 2024

Why do we need this tool?

- Comparison with accurate theoretical predictions
  (e.g. PDF fits, mass & coupling “measurements”, . . .)
- Different Event Generators and Settings



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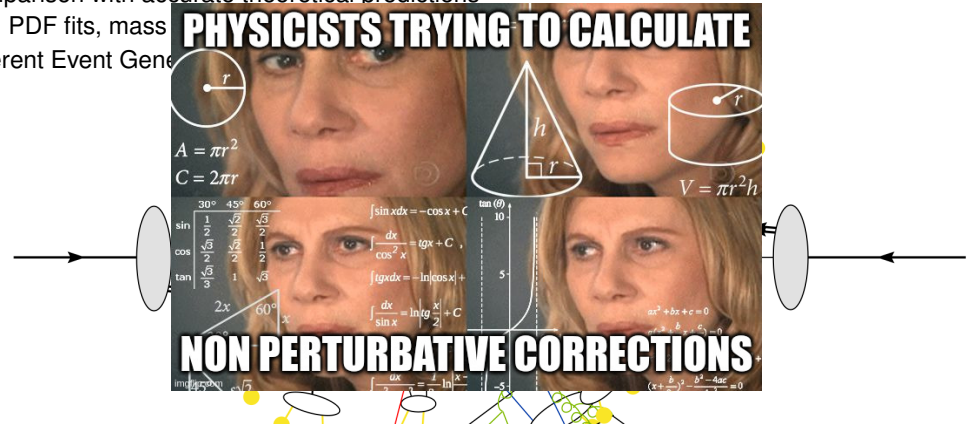

Why do we need another Framework for MC Production?

Goal: Derive generator level observables at high precision in finite time!

- High precision requires large numbers of events
  - Computationally expensive
  - → Lightweight
  - → Scalable
- MC generation is a complex effort → Use community standards

	Lightweight	Scalable	Automated	Standardized
Standalone Simulation	✓	✗	✗	✓
CMS SW	✗	✓	✗	✗
MC-Run	✓	✓	✓	✓

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Why do we need another Framework for MC Production?

Physicists

Smashing Particles

Setting up and writing good software

Goal: finite time!

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  - Computationally
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  - → Scalable
- MC generation is a c

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Standalone Simulatio
CMS SW
MC-Run

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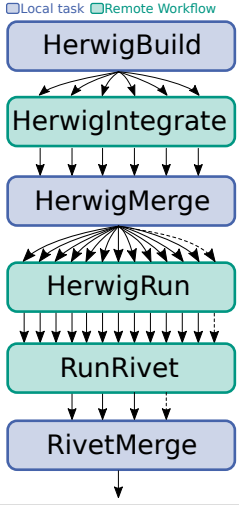
Framework for MC-Production and Analysis

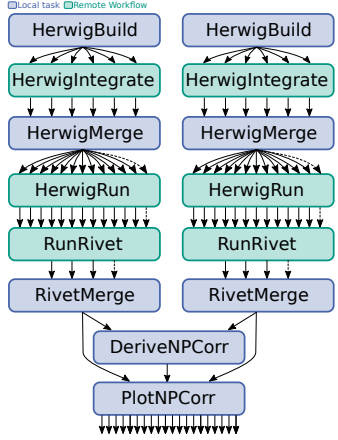
- Generate and analyse MC events using MCnet standards
  - lightweight, reproducible & consistent
- Modular workflow implemented in LAW
  - Complex workflow
  - Pick what you want to run
  - → Configure, start, lean back
- What you need:
  - CVMFS → Herwig7, Sherpa and Rivet
  - Grid Storage
  - GFAL2
  - HTCondor



Framework for Derivation of NP- and EWK-Corrections

- Automatically generate non-perturbative (NP) and electroweak (EWK) corrections and plots
- What you need to do:
  - Configure parameters
    Specify analysis objects/observables, physics process, ...
  - **Specify nominator and denominator**, e.g.

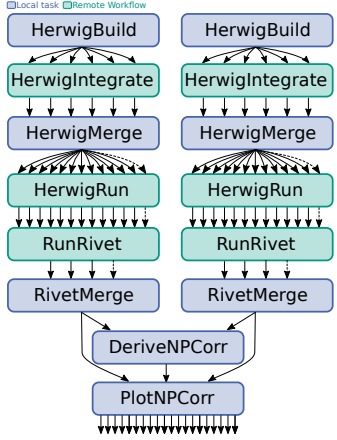
$$\text{NP corr.} = \frac{\text{ME} \otimes \text{PS} \otimes \text{Had.} \otimes \text{MPI}}{\text{ME} \otimes \text{PS}}$$



Benefit of the Workflow Manager

- You could manually execute each individual step → no benefit
- **Better:** just start the last step with full config in `luigi.cfg`

```
law run PlotNPCorr --campaign Dijets_LO --mc-generator
herwig --mc-setting-full withNP --mc-setting-partial
NPoff
```



Benefit of the Workflow Manager

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```
law run PlotNP
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```
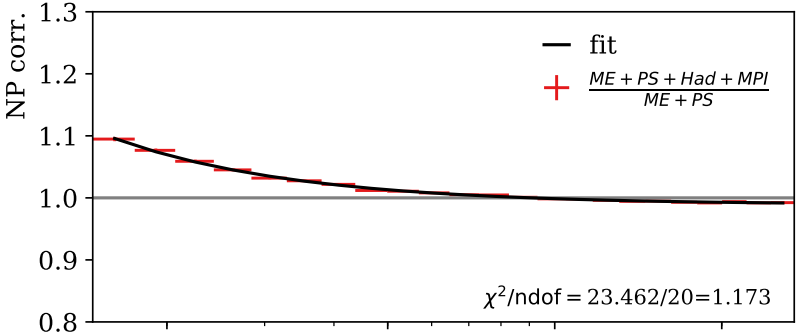
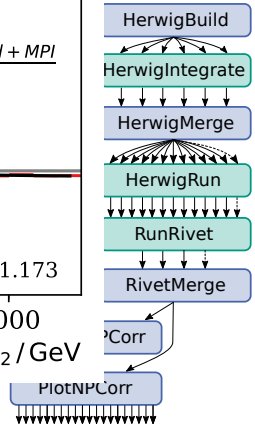
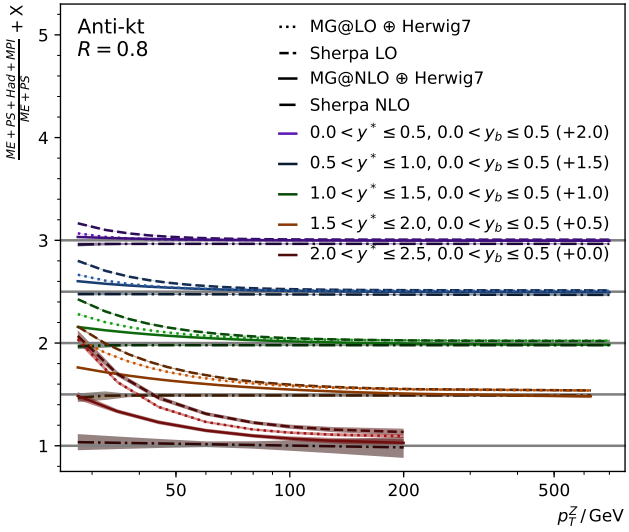



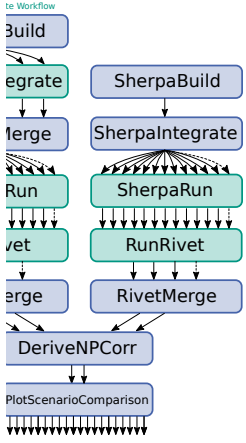


Extend the Workflow Manager

- Modularly extend th
  plotting tasks
- E.g. `PlotScenario(`
  NP-corrections for r

```
law run PlotScenarioC
'["LHC-LO-ZplusJet","
'["herwig","sherpa"]'
--mc-setting-partial M
```





Conclusions

- Lightweight, scalable, automated, and standardized MC event generation and analysis with MC-Run

→ NP corrections for Z+jet for four samples at local resources: $\mathcal{O}(10^9$ events) at $\mathcal{O}(10^3$ cores) in $\mathcal{O}$(days)

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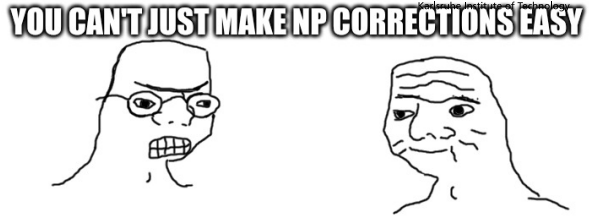

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