

Julia for Phenomenology and Event Generators

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Julia for HEP Mini-workshop
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Some HEP developments...

- **Statistical analysis tools**

- O. Schulz, Cornelius-G, L. Hauertmann, et al. (2021). bat/BAT.jl: v2.0.5 (v2.0.5). Zenodo.
<https://doi.org/10.5281/zenodo.5348846>
- LsqFitLsqFit.jl package:
<https://github.com/JuliaNLSolvers/LsqFit.jl>

- **Readers for the ROOT File Format**

- T. Gal. UnROOT.jl. <https://github.com/tamasgal/UnROOT.jl>
- O. Schulz, A. Lusiani. UpROOT.jl.
<https://github.com/JuliaHEP/UpROOT.jl>

- **Interface to data from the PDG**

- T. Gal, J. Schumann. Corpuscles.jl.
<https://github.com/JuliaPhysics/Corpuscles.jl>

Some HEP developments...

- **Lattice QCD**

- **A. Tomiya. LatticeQCD.jl.**

- <https://github.com/akio-tomiya/LatticeQCD.jl>

- **There's more...**

- <https://github.com/JuliaHEP>

- **Some papers**

- **LHCb Collaboration. Roel Aaij (Nikhef, Amsterdam) et al. Observation of excited Ω_c^0 baryons in $\Omega_b^- \rightarrow \Xi_c^+ K^- \pi^-$ decays. e-Print: 2107.03419 [hep-ex]**

- **Stanitzki, M., Strube, J. Performance of Julia for High Energy Physics Analyses. Comput Softw Big Sci 5, 10 (2021). <https://doi.org/10.1007/s41781-021-00053-3>**

- **Bimann, S., Erdmann, J., Grunwald, C. et al. Constraining top-quark couplings combining top-quark and B decay observables. Eur. Phys. J. C 80, 136 (2020). <https://doi.org/10.1140/epjc/s10052-020-7680-9>**

Ideas/Questions that could be addressed

- One language for all: Julia version of Madgraph, Whizard, Pythia, Herwig, Sherpa...? **Advantages and benefits: high performance and readability of the codes...?**
- Algorithms to improve capabilities of Madgraph, Whizard, Pythia, Herwig, Sherpa...
 - **Julia interfaces for event generators with no speed issues**
 - **Symbolic calculation with Julia; interface of Julia and Mathematica; Mathematica vs Julia notebooks**
- Implementing GPU kernels to improve performance on future clusters
- Quicker prototyping of algorithms, since no need to wait for compilation after each change
- Ability to run events in notebooks and get quick feedback on distributions
- **“The main item missing from the eco-system for carrying out a PhD-level physics analysis is an implementation of HEP-specific likelihood fitting codes”**. Stanitzki, M., Strube, J.