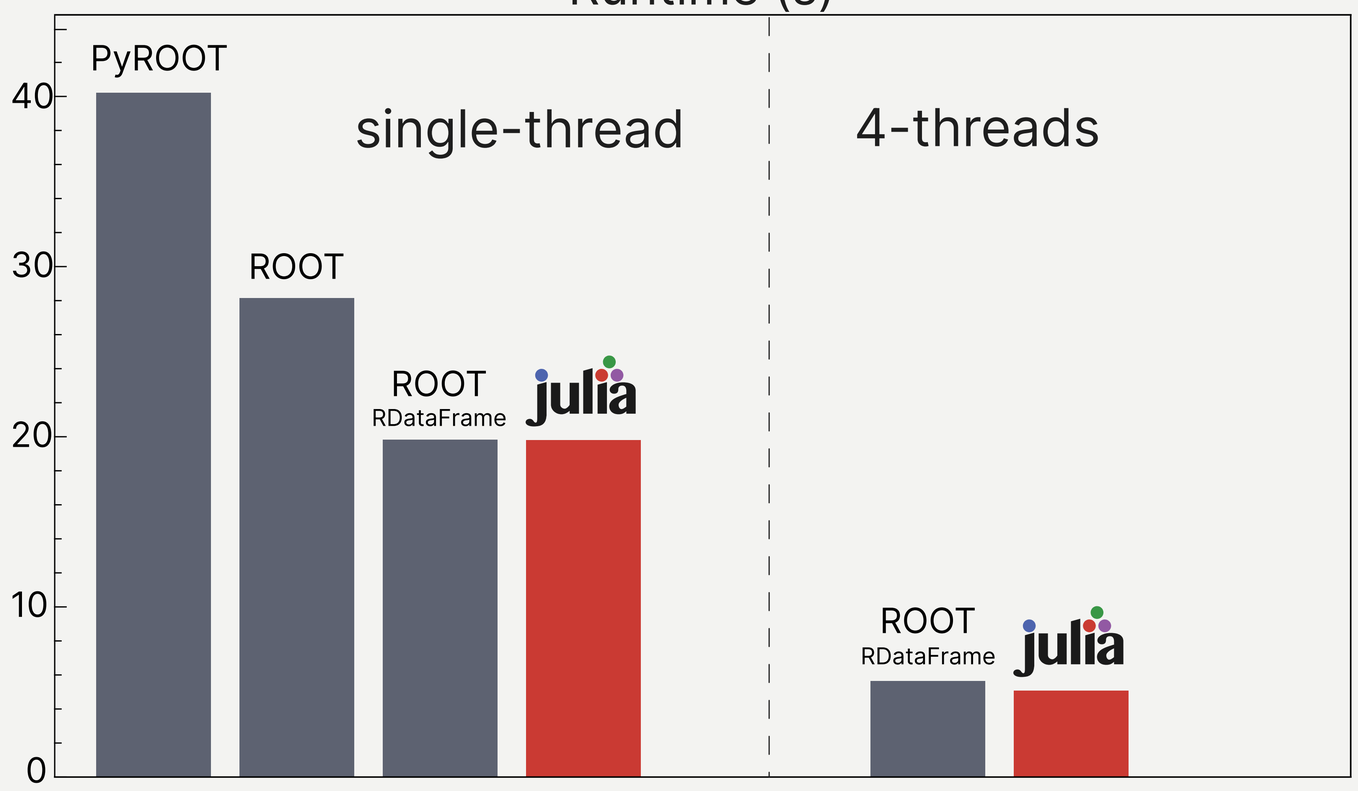
julia, a programming language that makes your HEP workflow read like Python but run like C++

DEV Jerry Ling [1], Tamás Gál [2], Oliver Schulz [3], Jan Strube [4] https://orcid.org/0000-0002-3359-0380

Runtime‡(s)



Example Code Snippet

For-loop style

```
@threads for event in myTree
    hist = Hist1D(Float64; bins = 70:5:110)
    best_mass = Inf
    Z_m = 91.2 #GeV
    for i in idxs, j in (i+1):last(idxs)
        LV_i = lep_tlvs[i]
        PID_i = lep_pids[i]
        # require Opposite particle ID
        PID_i != -lep_pids[j] && continue
        m_tmp = mass(LV_i + lep_tlvs[j])
        if abs(m_tmp-Z_m) < abs(best_mass-Z_m)
            best_mass = m_tmp
        end
    end
    ...
    push!(hist, best_mass)
end
```

Query style

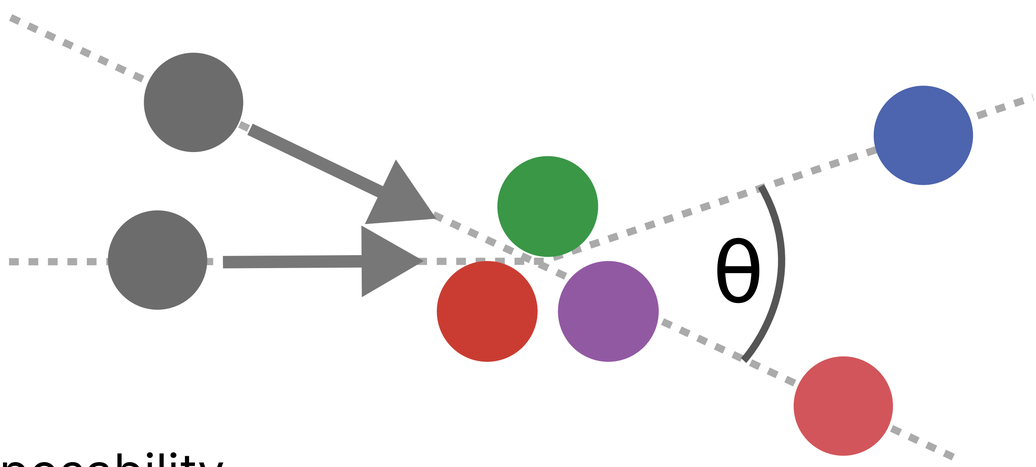
```
using Query, DataFrames

@from event in myTree begin
    @let Njets = length(event.Jet_pt)
    @where Njets > 6
    @let Njets40 = sum(evt.Jet_pt .> 40)
    @select {Njets, Njets40, event.MET_pt}
    @collect DataFrame
end
```

Digital Poster

http://cern.ch/go/vhR6

Benefits for HEP

- Dev → Production
- Min. Time-to-Insight
- Exact Reproducibility
- Auto Differentiation
- No Language Barrier
- High Reusability & Composability

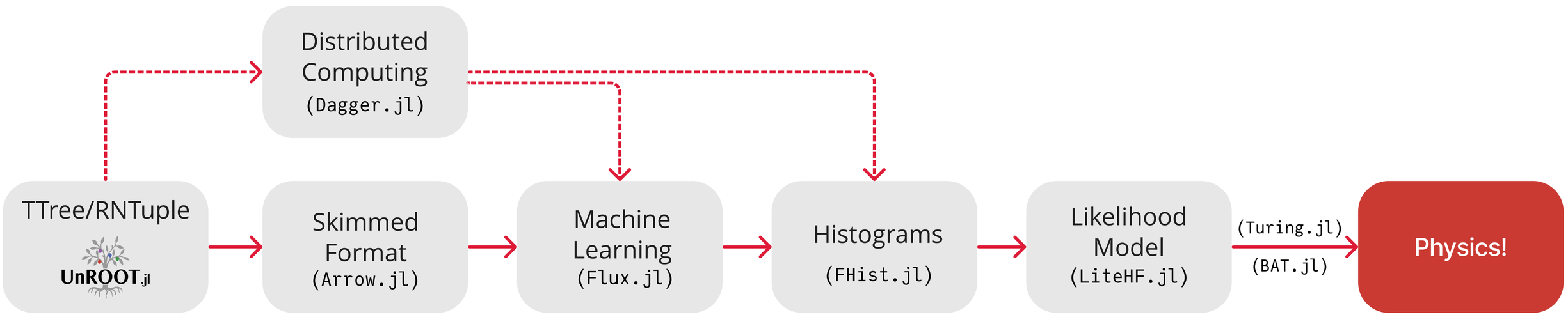


Language Features

- High-level Syntax
- Native GPU Support
- Built-in Pkg Manager
- Multiple Dispatch†
- In & Out of Core Parallelism
- JIT Compile

Maintained by juliaHEP

- UnROOT.jl: Pure Julia .root file reading library that is fast, lazy, parallelizable for columnar and per-event workload.
- FHist.jl: Optimized histogram library that comes with error-aware arithmetics and is thread-safe.
- LiteHF.jl: Binned statistical analysis library that leverages automatic differentiation and is compatible with HistFactory spec.



1 Harvard University / ATLAS Collaboration, jling@harvard.edu
2 Erlangen Centre for Astroparticle Physics, tamas.gal@fau.de
3 Max Planck Institute for Physics Munich, oschulz@mpp.mpg.de
4 Pacific Northwest National Laboratory, jan.strube@pnnl.gov

†: S. Karpinski, The Unreasonable Effectiveness of Multiple Dispatch
‡: https://github.com/Moelf/UnROOT_RDataFrame_MiniBenchmark

HARVARD UNIVERSITY