

# SWIFT-HEP

## Plan and next phase

21 November 2023

# Project timeline - SWIFT-HEP

Making good progress on all fronts.

- Recruitment was the biggest challenge
- Covid impact at the start...
- Successfully developed as a community project
- 50% posts worked well, despite the difficulties to set them up
- Relatively LHC-centric

We received funding for SWIFT-HEP 1.5

- Costed to maintain a flat level of effort: 4.5 FTE for 18 months (largely people currently in post)

Costs are going up (salary and overheads)

Project now costs £500k/year

## WP0: Management

Proj leader  
 Dep proj leader  
 D0.1: TDR Contributions  
 D0.2: Define Phase-2

## WP1: Data Management

D1.1: Setup UK data lake  
 D1.2: Implement QoS info  
 D1.3: Rec on data access  
 D1.4: Analysis Facility  
 D1.5: Pilot log system  
 D1.6: Middle size VOs  
 D1.7: DIRAC load manag  
 D1.7: DIRAC high lvl cmds

## WP2: Event Generators

D2.1: Profiling report  
 D2.2: Optimise LHAPDF  
 D2.3: Gen code optimisation  
 D2.4: Pythia8 biased hadr  
 D2.5: Pythia8 color recon  
 D2.6: EvtGen modernisation

## WP3: Simulation

D3.1: EMCuda prototype  
 D3.2: EMCuda validation  
 D3.3: Geant4 Optiks exmpl

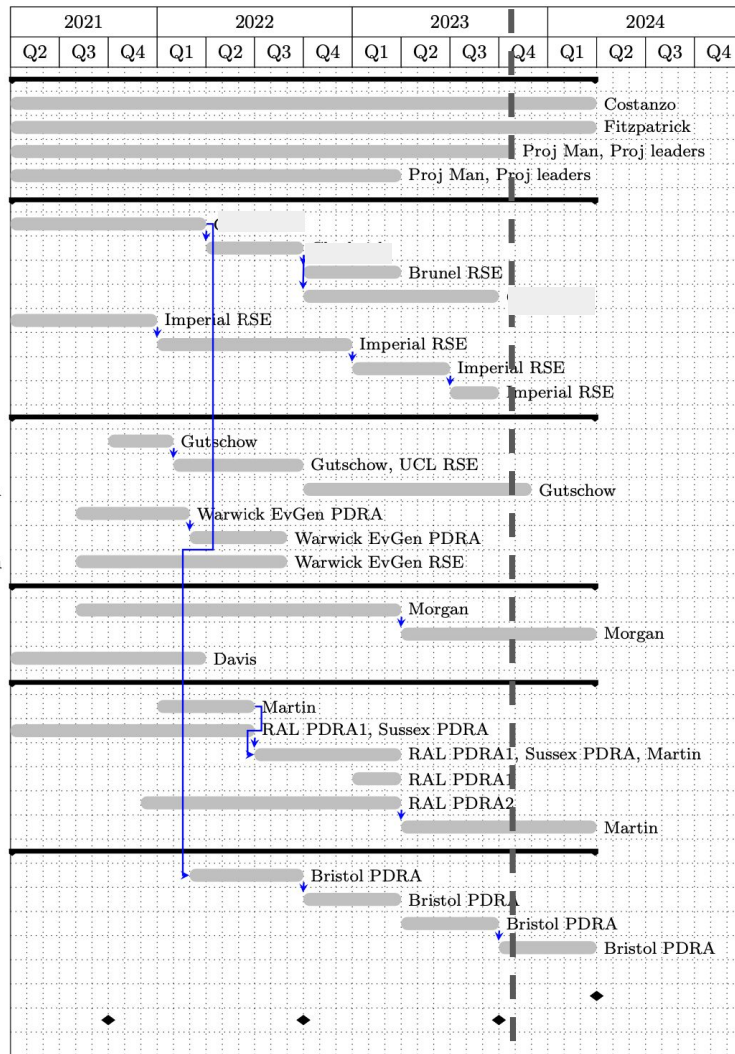
## WP4: Reco Trigger

D4.1: Report on benchm  
 D4.2: FPGA prot deploy  
 D4.3: FPGA prot benchm  
 D4.4: OneAPI report  
 D4.5: FasTras in OneAPI  
 D4.6: FasTras benchm

## WP5: Analysis Systems

D5.1: Oper UK data lake  
 D5.2: Caching mechanism  
 D5.3: Per-site Optim  
 D5.4: Workload schedule

Final report  
 Workshops



## SWIFT-HEP #2:

- We need to keep growing. We need a ramp rather than a step (e.g. plan for £1M/year from Oct 25)
- We should maintain the “community” aspects of the project
- Many posts or fractions of posts at many universities.
  - Hard to manage
  - Facilitates communication across experiments and across groups
  - Leverages resources from other projects
- Work package leaders need to be funded by the project at around 10% for the work they are doing
- Currently no brief from STFC on how to proceed
  - Science board(s) structure is evolving
  - Nevertheless, we should prepare a 2-page document with a high-level description of where we are going. This is the topic of this workshop

# SWIFT-HEP 2 - Where we are going

- Does the current WP structure work well?
  - It was designed to roughly match the HSF organisation
  - Development vs deployment (The LHC will be deploying HL-LHC software in the next phase)
- What are we missing?
  - Start to think about future colliders, also how do we link with the DRD initiative?
  - Sustainability - Better software means less compute power
  - Sustainability - Software life cycle is a few decades
  - Training and user experience. This is rather low-level in phase-1
  - ....
- We need to remain part of a wider international ecosystem
  - Focus on a few challenges that are part of our expertise
  - Integrate with other national initiatives (GridPP, IRIS, excalibur, HPCs, ... )

# Data management, workflow management and analysis systems

- Currently WP1 and WP5. Several aspects are linked together
- Data management: increase of our space footprint (disk and tape)
  - Quality of service: important to optimise costs and carbon footprint
  - Some data needs to be served very quickly (e.g. analysis)
  - Some data can take longer to be delivered (e.g. a planned simulation campaign)
- Workflow management and analysis
  - Large experiment production systems have efficient mechanisms in place
  - Smaller collaborations and users/group of users may still find this challenging
  - Integration with resources such as GridPP or IRIS
  - Users training and onboarding is essential (A good system is a system that is used)
- Workflow management of hybrid CPU/GPU payloads on GridPP
  - E.g. Celeritas/AdePT. But also GPU intense payloads (e.g. Sherpa)
- View analysis as part of the “user experience”
  - Would this make it simpler to explain in the proposal?
  - Would it further foster collaboration between different teams

- Currently WP2
- Requires work with the event generator developers
  - Higher order corrections and better physics performance
  - Software development needed to achieve this efficiently
- Optimisation and performance improvements still possible
  - Increase in requirements from the experiments
  - More compute vs better software (though we probably need both!)
- What infrastructure can we deliver/maintain in the future years
  - HepMC and other interface work
  - Work towards parallelism (?)
  - Can/should we take on some work on neutrino event generators?

- Currently WP3
  - Very focused on GPU developments
  - EM showers and geometry (AdePT, Celeritas)
  - Optical photon propagation (Optics, Mitsuba, ...)
- Shift from development to deployment and optimisation
  - Either on GPU or other platforms
- The UK contribution to Geant4 is still rather small and fragmented
  - More effort, more communication, and training
  - Requires discussion with other communities (e.g. medical, accelerators, space, ...)
  - What contribution could we take on Geant4?
- Interest in the UK in fast and parametrised simulations
  - This will be the majority of the simulation run at the LHC
  - Is there generic work we could support?

# Reconstruction and triggers

- Interest in tracking, matching the interest in hardware
  - In particular in the area of online/realtime tracking
  - Development of triggers (and trigger level analysis) on GPU/FPGAs (access more and more of our collision data)
- Interest in AI techniques for “particle flow”
  - Both at colliders and non-collider experiments
- A lot of work in this area is experiment specific
  - Where are the commonalities and how can we exploit them?



# Benchmarking, platform development

- Hardware evolution is increasingly fast
- Running on multiple platforms is going to be really important
  - E.g. recent developments on ARM. Multiple GPU vendors, etc.
  - How do we benchmark different platforms?
  - How do we make sure we get the best performance of the machine we use?
  - How do we monitor energy consumption of our jobs? And carbon footprint?

# Training and user experience

- In phase 1 we had a small budget for it
  - Which wasn't used during covid, as nobody really wanted yet another week of zoom training!
  - We had a C++ training last summer
- We should persuade STFC of the need of a “computing school” as part of their training offer
  - Or provide this as MOOCs
- Is this in the SWIFT-HEP remit? Or should we retain the HEP specific training (ROOT, Geant4, analysis, ...)

# The plan for phase 2

- This is the beginning of a long discussion
- I'll collect these thoughts and other ideas from this workshop in a document
  - Invite people to comment, contribute, criticise, ...
  - "Usual" etiquette. You can
    - Write your thoughts (provide your name)
    - Comment on something written by others (use comment feature or add text)
    - Do not delete other people's text
    - Email threads may (or may not) start from there
  - Then collect and tidy up to send to STFC
- Proposed timeline
  - Open the document this week
  - Circulate until 15 Dec (before XMas)
  - Tidy up and prepare early in the new year