ExaTEPP: EXAscale science for Theoretical and Experimental Particle Physics

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V. Alexandrov[1], E. Alexandrova[1], E. Bennett[2], D. Costanzo[3], L. DelDebbio[4], P. Heywood[3], J. Lenz[2], B. Lucini[2], B. Morgan[5], P. Richmond[3]

1. Hartree Centre, 2. Swansea University, 3. University of Sheffield, 4. University of Edinburgh, 5. Warwick University

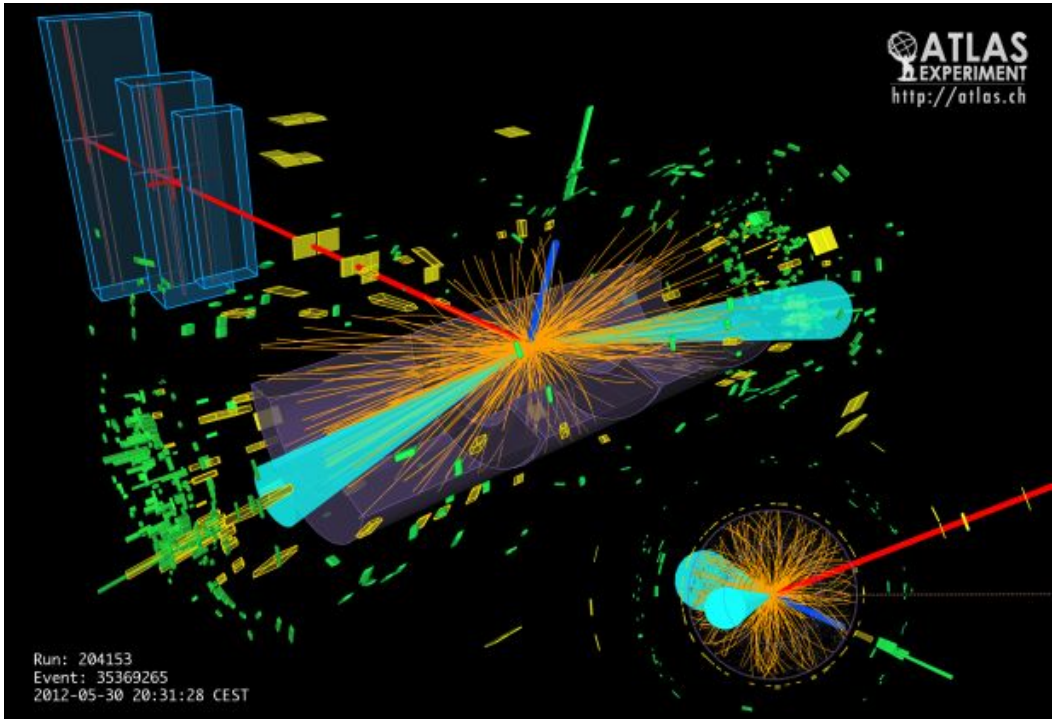
Particle Physics, studying fundamental phenomena

Fundamental physics is studied by observing interaction between particles at high energy

For example the Large Hadron Collider at CERN

Computing needed to:

- Process and analyse vast amounts of data (~EByte)
- Build theoretical models with precision of 1 ppb (or better)
- Simulate the interaction of particles with matter (the detector)

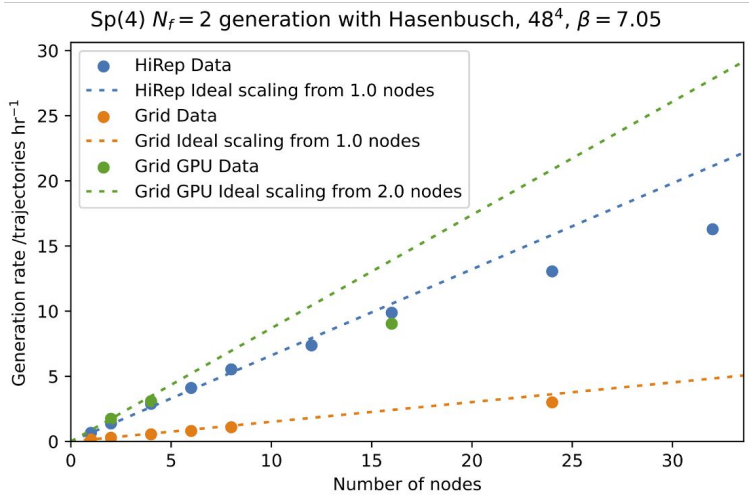


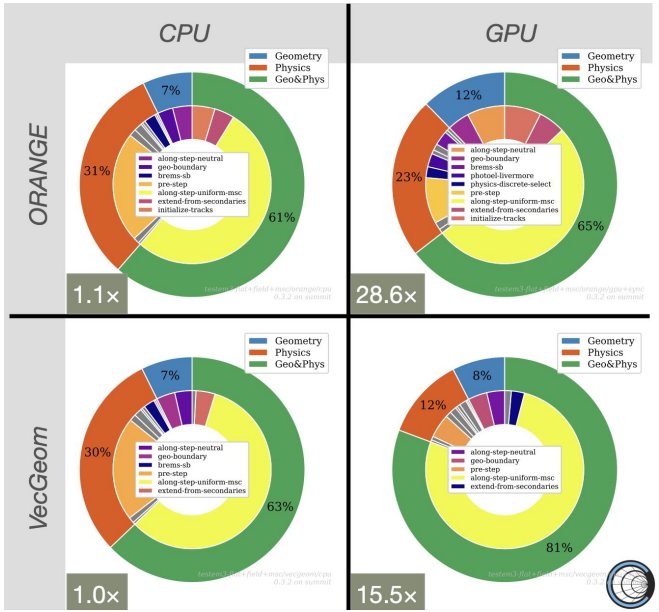
ExaTEPP: Project status

- A collaboration between experiment and theory
  - Part of the ExCALIBUR high-priority use cases phase 2
  - Well connected with international partners (e.g. ECP in the US, CERN, etc)
- As international collaboration particle physics computing is already at the exascale
  - Blueprint technologies for other sciences (e.g data management, shared computational bottlenecks with LLM when model gets out of node)
  - Probing test case for most advanced computer architectures
- WP1: Training and knowledge exchange (Hartree Centre)
  - Interaction with industry. Training led by the Hartree Centre (using the Centre training portal)
  - Workshops and collaboration with external partners (e.g. ECP, CERN, …)
- WP2: Simulation
  - Simulate the behaviour of quarks using lattice field theory
  - Simulate the transport of particles through detector systems as part of the Geant4 collaboration
- WP3: Benchmarking
  - Performance metrics to evaluate different/new hardware
  - Evaluation tools for future procurements

Current challenges

- Detector simulation. Most time spent navigating geometry.
  - Moving from solid to surfaces shows an improvement on the GPU





- Optimised Lattice Field Theory software with improved performance portability and demanding but performant strong scaling
- Our benchmark approach enables us to evaluate the most performing architectures and to assess their suitability for the specific workloads.