

ATLAS Geometry on GPUs

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THE UNIVERSITY
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HSF Meeting

R&D on accelerators in Simulations - Bring your ideas

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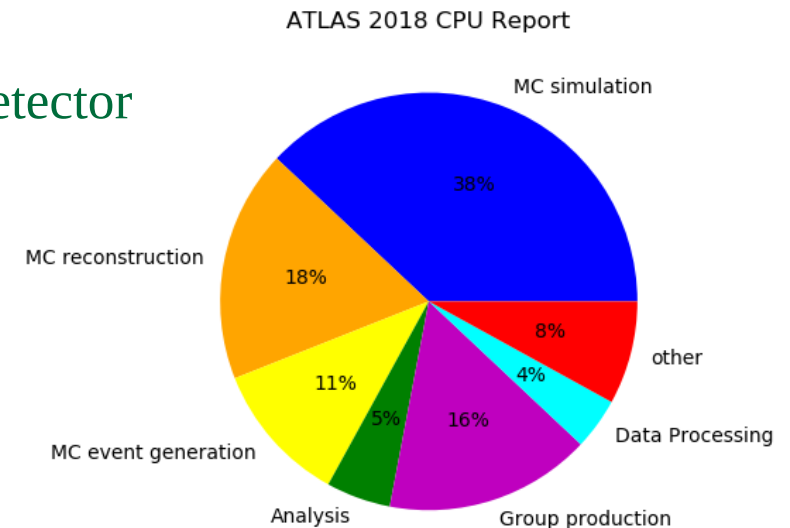
Project

- **Detector simulation consumes most CPU**
 - Many efforts have started to provide GPU accelerated particle transport
https://geant4.web.cern.ch/collaboration/task_force_rd
 - GPUs are becoming more prevalent at computing sites (particularly HPC centres)

- **Focus on electromagnetic calorimeter of the ATLAS detector**
 - Computationally dominant part of full Geant4 simulation
 - Relatively tractable number of processes

- **Implement EM Calorimeter geometry on GPU**

- We will start some R&D on how this could be done
- Study the current code in Athena
- Think also about alternative approaches (e.g. looking at tessellation, which GPUs handle very efficiently)



Challenges and Approach

- ATLAS calorimeter has accordion structure
 - Not implemented using standard G4 geometry primitives
- Geant4 is a large code base
 - many C++ features non trivial for porting to GPU in present form
 - Particle transport requires significant algorithmic modification beyond syntax conversion
- Working under the VecGeom umbrella
 - This is part of a larger R&D effort that examines how to use GPUs for particle transport in Geant4
 - Code was developed mainly with SIMD CPU execution as the target, but it was generically adaptable to both CPU and GPU execution ([Talk from Andrei](#))
 - Currently a demonstrator that does ray tracing through a HEP detector (eg. TrackML detector)
- Merge well with other R&D activities to make sure ATLAS is well integrated into the general geometry on GPU

Support

- Sinead Farrington and Graeme Stewart for the suggestions and start of project
- Andrei Gheata and Guilherme Amadio for VecGeom introduction
- **Suggested ideas:**
 - Tessellated geometry: Implement as triangles so that the geometry look-up is fast for each particle
 - Twisted geometry
- **Connection with industrial partners (currently Nvidia)**
 - Monthly mentorship from Nvidia solution architect (Paul Graham) and also engaged with other members who work with physicists to discuss projects (eg. SHIFT)
 - Training for Nvidia ambassador in CUDA programming
- Selected for the GPU hackathon in Sheffield to take place in July