



# **Excalibur-HEP: “EMCuda” Test bench of secondary generation and handling on GPUs**

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# Overview

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- Excalibur-HEP: 15 month project in UK funded under [UKRI Excalibur High Priority Use Cases Phase 1](#)
  - *UK funding for HEP Simulation expected to continue after*
- Includes work package on simulation, focussing on use of GPUs
- Here discuss one idea/topic:
  - *Clear issue on efficiently using GPUs for simulation is differing particle types and secondary generation.*
  - *Develop “Fisher-Price” test benches to explore algorithms/techniques/limitations on/of GPUs (or rather SIMT) for this problem.*
  - *Enumerate issues found to identify “go/no-go” areas for further development*

# The “Fisher-Price” Model

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- *No geometry/transport - but provide “stubs” for where the calls would occur*
- *Toy particles/physics: “e+/e-/g”, continuous energy loss, scatter, compton/pair*
- *Start one particle on GPU*
  - *“Step” until it is killed by some threshold*
  - *“Score” energy losses*
  - *Key item: when secondaries are generated, how to handle/schedule them on the device?*
  - *Key item: how best to hand back info to host (“hits/scores”, maybe, particles we can’t handle like hadrons)?*
- *Extraordinarily simple, but that’s the idea: to focus on the SIMT aspects, challenges, scaling for this type of MC*

# Summary

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- Aware this retreads some existing ground/work
  - *What's known already?*
  - *Are there promising areas to focus on?*
  - *What could we learn from other fields?*
- Aim is not a full implementation, but a series of test benches to clearly identify traps and pitfalls
- This is also to allow exploration/comparison of using “portable APIs”
  - *Initially use CUDA to implement*
  - *Then try porting to oneAPI/Alpaka etc and compare performance*