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AdePT - Enabling GPU electromagnetic transport with Geant4

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An important alternative for boosting the throughput of simulation applications is to take advantage of accelerator hardware, by making general particle transport simulation for high-energy physics (HEP) single-instruction-multiple-thread (SIMT) friendly. This challenge is not yet resolved due to difficulties in mapping the complexity of Geant4 components and workflow to the massive parallelism features exposed by graphics processing units (GPU). The AdePT project is one of the R&D initiatives tackling this limitation and exploring GPUs as potential accelerators for offloading part of the CPU simulation workload. Our main target is the implementation of a complete electromagnetic shower transport engine working on the GPU. A first development phase, allowed us to verify our GPU prototype against the Geant4 simulation for both simplified and complex setups, and to test different Geant4 integration strategies. We have simplified the integration procedure of AdePT as an external library in both standalone applications and experimental frameworks through standard Geant4 mechanisms. The project's current main focus is to provide solutions for the main performance bottlenecks identified so far: inefficient geometry modeling for the GPUs, and a suboptimal CPU-GPU scheduling strategy. We will present the most recent results and conclusions of our work, focusing on the hybrid Geant4-AdePT use case.

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