

GEANT-4 GPU Port:

User Manual

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1 Revision History

All major edits to this document will be recorded in the table below.

Table 1: Revision History

Description of Changes	Author	Date
Initial draft of document	Matt	2016-02-26

2 List of Figures

Table #	Title
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3 Definitions and Acronyms

Table 2: Definitions and Acronyms

Term	Description
GEANT-4	open-source software toolkit used to simulate the passage of particles through matter
GEANT4-GPU	GEANT-4 with computations running on the GPU.
G4-STORK	(Geant-4 STOchastic Reactor Kinetics), fork of GEANT-4 developed by McMaster's Engineering Physics department to simulate McMaster's nuclear reactor
GPU	graphics processing unit, well-suited to parallel computing tasks
CPU	computer processing unit, general computer processor well-suited to serial tasks
CUDA	parallel computing architecture for general purpose programming on GPU, developed by NVIDIA
FAQ	Frequently Asked Questions

4 Introduction

4.1 Purpose

4.2 Scope

4.3 Background

4.4 Document Overview

This Document goes over how to install and run GEANT4-GPU. As well as software and hardware required for GEANT4-GPU to be installed and run. Instructions on how to install the required software are also included in this document. Following the installation section, is a section on creating and running simulations using GEANT4-GPU. There is a troubleshooting section as well as a FAQ in case you run into any problems installing or running GEANT4-GPU.

5 Legal Information

6 Installation

6.1 Required Hardware

6.2 Required Software

6.3 Supported Operating Systems

6.4 Installation Instructions

7 Execution

7.1 Creating a Simulation

7.2 Running the Simulation

8 Porting Other Geant4 Modules to CUDA

8.1 Layout of Source Files

8.2 CMake Changes

8.3 Interfacing with Existing Code

8.4 Lessons Learned

9 Troubleshooting

9.1 Installation

- Ensure path names are correct, check for spaces in pathnames
- The DCMMAKE_INSTALL_PREFIX in step 4 of installing GEANT-4 has two paths. Make sure they are separated by a space.
- make sure your operating system is supported
- Newer versions of Clang (included with Xcode 7) have been know to cause problems. Download Xcode 6 and uninstall Xcode 7 if this is the case.

9.2 Running the Simulation

- Ensure that your graphics card is a NVidia card with Compute Capability 3.0.

9.3 FAQ

What is GEANT-4?

Many physics researchers use GEANT-4 to learn about how particles interact with a specific environment. It is a toolkit (i.e. library) that uses the Monte Carlo model, meaning each particle's properties are calculated independently according to certain probabilities. It runs all those calculations, and provides output

Why will running the simulations on a GPU improve the performance?

GPU's contain a large amount of cores that can perform calculations much more quickly than a CPU if the problem is well-suited to parallelization. GEANT-4 runs relatively simple calculations on millions of particles, and each particle is completely independent of the others. This is exactly that sort of well-suited problem, and stands to see large performance gains.

Where can I find more information about GEANT-4?

Cern has an entire website full of information for GEANT-4.
geant4.web.cern.ch/geant4/index.shtml

Helpful Pages:

- Download page for Geant4 source code as well as Data files
geant4.web.cern.ch/geant4/support/download.shtml
- Getting Started
geant4.web.cern.ch/geant4/support/gettingstarted.shtml
- Installation Guide for geant4 (does not include CUDA)
geant4.web.cern.ch/geant4/UserDocumentation/UsersGuides/InstallationGuide/html/index.html

10 Appendix

10.1 Recommendations for Integration of Geant4 and CUDA

10.2 Future of Geant4-GPU