GEANT-4 GPU Port:

Design Document

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Contents

1 Introduction

1.1 Purpose

The purpose of GEANT4-GPU is to reduce the computation times of particle simulations.

1.2 Description

The project aims to improve the computation times of GEANT4 particle simulations by running simulations on the GPU. GEANT4-GPU will allow users to build GEANT4 with an enable GPU acceleration option. Our implementation will be available on Mac, Linux and Windows operating systems with NVIDIA graphics cards. GEANT4-GPU must be able to do particle simulations much faster than running the simulations on a GEANT4 build that runs entirely on the CPU.

1.3 Scope

The scope of GEANT4-GPU will be limited to Engineering Physics simulations; particularly those that make use of the NeutronHPVector class.

Revision History

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

Table 1: Revision History

Description of Changes	**Author**	**Date**
Set up sections and filled out Introduction section	Matthew	2015-12-15

2 Anticipated and unlikely changes

2.1 Likely Changes

2.2 Unlikely Changes

3 Module Hierarchy

4 Connection between requirements and design

5 Traceability matrices

5.1 Note About G4 variables

Geant4 uses it's own version of the standard variables (G3int, G4bool, G4double, etc). These variables behave exactly like their non G4 counterparts. These G4 variables were implemented as a standard.

6 MIS of NeutronHPDataPoint

6.1 Interface Syntax

Routine Name	Input	Output	Exceptions
G4NeutronHPDataPoint			
G4NeutronHPDataPoint	G4double, G4double		
operator(REVISE THIS)	G4NeutronHPDataPoint		
GetEnergy		G4double	
GetXsection		G4double	
SetEnergy	G4double		
SetXsection	G4double		
GetX		G4double	
GetY		G4double	
SetX	G4double		
SetY	G4double		
SetData	G4double, G4double		

6.2 Exported Access Programs

6.3 Interface Semantics

6.3.1 State Variables

energy : G4Double
xSec : G4Double

6.3.2 Environment Variables

There are no environment variables for this Module.

6.3.3 Assumption

6.3.4 Access Program Semantics

7 MIS of NeutronHPVector

7.1 Interface Syntax

Routine Name	Input	Output	Exceptions
G4NeutronHPVector			
G4NeutronHPVector	G4int		
SetVerbose	G4int		
Times	G4double		
SetPoint	G4int, G4NeutronHPDataPoint		
SetData	G4int, G4double,G4double		
SetX	G4int, G4double		
SetEnergy	G4int, G4double		
SetY	G4int, G4double		
SetXsec	G4int, G4double		
GetEnergy	G4int	G4double	
GetXsec	G4int	G4double	
GetXsec	G4double	G4double	
GetXsec	G4double,G4int	G4double	
GetX	G4int	G4double	
GetY	G4double	G4double	
GetY	G4int	G4double	
GetVectorLength		G4int	
GetPoint	G4int	const G4NeutronHPDataPoint &	
Hash			
ReHash			
InitInterpolation	istream		
Init	istream,G4int, G4double, G4double		
Init	istream, G4double,G4double		
ThinOut	G4double		
SetLabel	G4double		
GetLabel		G4double	
CleanUp			

Routine Name	Input	Output	Exceptions
Sample		G4double	
Debug		G4double *	
Merge	G4NeutronHPVector *, G4NeutronHPVector *		
Merge	G4InterpolationScheme, G4double, G4NeutronHPVector *, G4NeutronHPVector *		
SampleLin		G4double	
IntegrateAndNormalise			
Integrate			
GetIntegral		G4double	
SetInterpolation-Manager	const G4InterpolationManager &		
SetInterpolation-Manager	G4InterpolationManager &		
G4Interpolation-Manager		const G4Interpolation-Manager &	
SetScheme	G4int,const G4InterpolationScheme &		
GetScheme	G4int	G4InterpolationScheme	
GetMeanX		G4double	
GetBlocked		vector<G4double>	
GetBuffered		vector<G4double>	
Get15percentBorder		G4double	
Get50percentBorder		G4double	
Check	G4int		
IsBlocked	G4double	G4bool	

7.2 Exported Access Programs

7.3 Interface Semantics

7.3.1 State Variables

G4NeutronHPInterPolator : theLin
totalIntegral : G4double
G4NeutronHPDataPoint * : theData
G4InterpolationManager : theManager
G4double * : theIntegral
G4int : nEntries
G4int : nPoints
G4double : label
G4NeutronInterpolator : theInt
G4int : Verbose
G4int : isFreed
G4NeutronHPHash : theHash
G4double : maxValue
vector¡G4double¿ : theBlocked
vector ¡G4double¿ : theBuffered
G4double : the15percentBorderCash
G4double : the50percentBorderCash

7.3.2 Environment Variables

There are no environment variables for this Module.

7.3.3 Assumption

7.3.4 Access Program Semantics

8 MIS of CMake Files

8.1 Interface Syntax

8.2 Exported Access Programs

8.3 Interface Semantics

8.3.1 State Variables

useCuda : Bool

8.3.2 Environment Variables

NeutronHPVectorGPU.cu : cuda file with GPU code

8.3.3 Assumption

8.3.4 Access Program Semantics