# GEANT-4 GPU Port:

**Design Document: Detailed Design**

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# 1 Introduction

## 1.1 Revision History

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

Table 1: Revision History

| Description of Changes | Author | Date |
|---|---|---|
| Set up sections and filled out Introduction section | Matthew | 2015-12-15 |
| Added some more sections, renamed current ones | Stuart | 2016-01-08 |

## 1.2 Document Structure & Template

The design documentation for the project is based off of templates from WHAT TEMPLATES??????, and is broken into two main documents.

The system architecture document details the system architecture, including an overview of the modules that make up the system, analysis of aspects that are likely and unlikely to change, reasoning behind the high-level decisions, and a table showing how each requirement is addressed in the proposed design.

This detailed design document covers the specifics of several key modules in the project. For each module, an MIS is given fully detailing the interface of the module. Then, the methods for handling errors within the module are discussed, and finally the main algorithms and data structures used by the module are presented.

## 1.3 List of Tables



## 1.4 Note About G4 variables

Geant4 uses its own basic types for standard C++ types (G4int, G4bool, G4double, etc). These types are currently just `typedefs` to the respective type as defined in the system libraries.

# 2 NeutronHPDataPoint

## 2.1 MIS (Module Interface Specification)

### 2.1.1 Interface Syntax

Table 2: NeutronHPDataPoint – 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 | | |

### 2.1.2 Exported Access Programs

### 2.1.3 Interface Semantics

### 2.1.4 State Variables

- energy : G4Double
- xSec : G4Double

### 2.1.5 Environment Variables

There are no environment variables for this Module.

#### 2.1.6 Assumption

#### 2.1.7 Access Program Semantics

### 2.2 Error Handling

### 2.3 Key Algorithms

# 3 G4NeutronHPVector

## 3.1 MIS (Module Interface Specification)

### 3.1.1 Interface Syntax

Table 3: G4NeutronHPVector – 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,<br>G4double, G4double | | |
| Init | istream,<br>G4double,G4double | | |
| ThinOut | G4double | | |
| SetLabel | G4double | | |
| GetLabel | | G4double | |
| CleanUp | | | |
| Sample | | G4double | |
| Debug | | G4double * | |
| Merge | G4NeutronHPVector *,<br>G4NeutronHPVector * | | |
| Merge | G4InterpolationScheme, | | |
| | G4double, | | |
| | G4NeutronHPVector *, | | |
| | G4NeutronHPVector * | | |
| SampleLin | | G4double | |
| IntegrateAndNormalise | | | |
| Integrate | | | |
| GetIntegral | | G4double | |
| SetInterpolationManager | const<br>G4InterpolationManager<br>& | | |
| SetInterpolationManager | G4InterpolationManager<br>& | | |
| G4InterpolationManager | | const<br>G4InterpolationManager<br>& | |
| SetScheme | G4int,const<br>G4InterpolationScheme<br>& | | |
| GetScheme | G4int | G4InterpolationScheme | |
| GetMeanX | | G4double | |
| GetBlocked | | vector<G4double> | |
| GetBuffered | | vector<G4double> | |
| Get15percentBorder | | G4double | |
| Get50percentBorder | | G4double | |
| Check | G4int | | G4Hadronic-<br>Exception |
| IsBlocked | G4double | G4bool | |

### 3.1.2 Exported Access Programs

### 3.1.3 Interface Semantics

### 3.1.4 State Variables

- G4NeutronHPInterPolator : theLine
- 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

### 3.1.5 Environment Variables

There are no environment variables for this Module.

#### 3.1.6 Assumption

#### 3.1.7 Access Program Semantics

### 3.2 Error Handling

### 3.3 Key Algorithms

## 4 CMake Files

### 4.1 MIS (Module Interface Specification)

#### 4.1.1 Interface Syntax

Table 4: CMake Files – interface syntax

| Routine Name | Input | Output | Exceptions |
|---|---|---|---|

#### 4.1.2 Exported Access Programs

#### 4.1.3 Interface Semantics

#### 4.1.4 State Variables

- useCuda : Bool

#### 4.1.5 Environment Variables

- NeutronHPVectorGPU.cu : cuda file with GPU code

#### 4.1.6 Assumption

#### 4.1.7 Access Program Semantics

### 4.2 Error Handling

### 4.3 Key Algorithms