TALLIES

User Requirements Document

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Scope

The goal of this project is the development of a Geant4-based class structure addressed to the direct calculation in Geant4 of specific tallies. The present project is focused on the development of fluence and dose tallies. However, the same structure could be further implemented in order to calculate other important parameters.
Fluence and dose calculations in the background studies in the LHC experiments are considered an important issue. In fact, the evaluation of the radiation level in the cavern and in the experimental setup during the experiment running is fundamental.
In addition, it is necessary to estimate the Single Event Upset (SEU) in the associated electronics, which can generate several problems in the measurements.
This document collects the user requirements of this application, listed in proper thematic domains.

Specific Requirements

1. Geometry and sensitive detector

UR1.1 The user shall be able to define a sensitive detector on a plane and cylindrical surface, giving the position, the dimensions and the number of voxels along each of the two surface coordinate axes, in a specified reference system.
Need: Essential
Priority: High
Stability: Stable
Clarity: Clear
Source: LHCb
Verifiability: Verifiable

Note: *Voxel* is defined as one of the calculation cells, in which the sensitive surface can be divided.

UR2.2 The user shall be able to discriminate the voxels, which compose the sensitive plane, and to associate the particle hits to each voxel.
Need: Useful
Priority: High
Stability: Stable
Clarity: Clear
Source: LHCb
Verifiability: Verifiable
Note: *Hit* is defined in terms of position, energy deposited and track length of the particle step in the voxel volume, at minimum.

3. Event

UR3.1 The user shall be able to detect the hits associated to each event and collect and maintain them in transient memory storage.
Need: Useful
Priority: Medium
Stability: Stable
Clarity: Clear
Source: LHCb (discussion with G. Corti)
Verifiability: Verifiable
Note:

UR3.2 The user shall be able to convert the hits collections in terms of particle fluences.
Need: Essential
Priority: Medium
Stability: Stable
Clarity: Clear
Source: LHCb (discussion with G. Corti)
Verifiability: Verifiable
Note: The *fluence* is defined as the number of particles passing through a surface. This is a scalar variable. Therefore, it does not consider the vector direction. It is typically expressed as particles/cm^2. The *flux* is defined as the fluence per time unit.

UR3.3 The user shall be able to redefine the hits collections in terms of particle doses.
Need: Essential
Priority: Medium
Stability: Stable
Clarity: Clear
Source: LHCb (discussion with G. Corti)
Verifiability: Verifiable

Note: The *dose* is defined as the energy released by a particle per mass unit. It is typically expressed as Gy, that is J/kg.

UR3.4 The user shall be able to distinguish the hits, depending on the particle type, which has generated them.
Need: Useful
Priority: Medium
Stability: Stable
Clarity: Clear
Source: LHCb
Verifiability: Verifiable
Note:

UR3.5 The user shall be able to evaluate the dose and fluence distribution on the chosen surface (see UR1.1).
Need: Useful
Priority: Medium
Stability: Stable
Clarity: Clear
Source: LHCb
Verifiability: Verifiable
Note:

UR3.6 The user shall be able to evaluate the differential spectra on the sensitive surface (see UR1.1).
Need: Useful
Priority: Medium
Stability: Stable
Clarity: Clear
Source: LHCb
Verifiability: Verifiable
Note:

4. Particles

UR4.1 The user shall be able to record the hits related to:
- charged hadrons (protons, pions, kaons);
- neutrons;
- electrons and positrons;
- gammas.

Need: Essential
Priority: Medium
Stability: Stable
Clarity: Clear
Source: LHCb (G. Corti)

Verifiability: Verifiable
Note:

5. Visualization

UR5.1 The user shall be able to visualize the geometrical setup defined for a run.
Need: Useful
Priority: Low
Stability:
Clarity: Clear
Source:
Verifiability: Verifiable
Note:

UR5.2 The user shall be able to visualize the particle tracks.
Need: Useful
Priority: Low
Stability:
Clarity: Clear
Source:
Verifiability: Verifiable
Note:

Constraint Requirements

UR A.1. The development platform shall be Linux and the compiler version should be supported by Geant4. Use of the LHCb software.
Need: Useful
Priority: Medium
Stability:
Clarity: Clear
Source:
Verifiability: Verifiable
Note:

UR A.2. The visualization systems supported should be one of the supported Geant4 packages.
Need: Useful
Priority: Low
Stability:
Clarity: Clear
Source:
Verifiability: Verifiable
Note: