Update on Vectorised Propagation in Magnetic Field

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Overview

Expected delivery
December 15, 2017

Recent progress

Biggest risks
Complex 'logic' to deal with divergence
between 'lanes' of vectors

Structure of Field Propagation Module

- **Field** - concrete magnetic field of setup (e.g. Uniform, Interpolated)

- **Equation** of Motion: 'encodes' Lorentz force for charged particle in EM field

- **Stepper**: Specific (embedded) Runge-Kutta method, estimates endpoint & error of an integration step. (~Agnostic of equation.)

- **Driver**: Ensures integration within given error(s). Redoes a step if error is too large, or not finished; estimates 'next' step size for

Starting point

- Created sequential version based on my Geant4 classes, as adapted by Josh (GSoC 2012) to use templated classes (field, equation & stepper)

- First vector versions developed by Ananya, Nov 2015 - March 2017

  - Based directly on Vc

  - Simplified CMS field

  - Prototype 'Driver'

Progress - Preparation

- As starting point, adapted sequential classes to recent master

  - Field, Equation, Stepper, Driver

- Followed repeated changes to key classes holding data
  (GeantTrackVec) and those steering the work

  - First refactoring into WorkLoadManager

  - Move FieldPropagationHandler (v3) - simpler, due to Andrei

Progress - Move to (new) VecCore

- Andrei adapted to new VecCore, simplified

  - Field & Equation - no base class

- Key methods templated on type of data

  - template <typename Real_v> => to use as double or Double_v

- This approach was started by Ananya (in her 2nd 'version' Feb '16)

Recent progress

- Adapted CashKarp 5th order Runge Kutta stepper

  - Straightforward, using Ananya's prototype

  - 'Flexible' - applicable for 1 or many tracks

- Driver - adapted from Ananya's prototype

  - Not straightforward - unfinished and 'broken'

  - complex logic, required many fixes, rewriting

```
using GvEquationType   = MagFieldEquation<Field_Type>;

using StepperType = CashKarp<GvEquationType,Nposmom>;  // The Runge Kutta Stepper

auto myStepper = new StepperType(gvEquation);

auto vectorDriver =

   new SimpleIntegrationDriver<StepperType,Nposmom> (hStepMin,

                               myStepper,  N=6, verbose);
```

Next steps

Further testing - driver vs sequential & G4

Integration in FieldPropagationHandler

Implementation and algorithm improvement

Attention areas
- Maintain correctness while revising driver
- Coping with different regimes

Goals for next (3) weeks

1. Improved testing & first benchmarking

2. First integration in tracking

3. Profiling and first improvement in implementation