NE697: Introduction to Geant4

C++ Geant4 Intro

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Today's Agenda

- Administrative items?
- exampleB1 detailed breakdown
- Running exampleB1 on the server with VSCode
- Time to get B1 running + to work on Assignment 4

Assignment 4

- Expand MC1D
  - New interaction: “scattering”, skip 1 unit
  - 5 command-line args instead of 3
    - Scatter probability (skip one unit)
    - Start position on the track
  - Isotropic source – particles can go either direction (50/50)
  - Update .csv to contain type of interaction (“a”, “s”, or “e” (end of the track))

Geant4 Resources

- Application Developer's Guide
  - https://geant4-userdoc.web.cern.ch/UsersGuides/ForApplicationDeveloper/html/index.html
  - **Read this!!!**
- Doxygen documentation (source code browsing)
  - https://geant4.kek.jp/Reference/
- Examples
  - https://geant4-userdoc.web.cern.ch/Doxygen/examples_doc/html/index.html

Geant4: RunAction

- Used for Run management
- Functions called at the start and stop of a Run
- Allows us to provide a custom Run object (inherits from G4Run)
- Note “const G4Run*”: cannot change Run objects in these functions!
  - Reminder, same as G4Run const*
- We’ll revisit the Run objects later

Public Member Functions

	G4UserRunAction ()
virtual	**~G4UserRunAction** ()
virtual **G4Run** *	**GenerateRun** ()
virtual void	**BeginOfRunAction** (const **G4Run** *aRun)
virtual void	**EndOfRunAction** (const **G4Run** *aRun)
virtual void	**SetMaster** (**G4bool** val=true)
G4bool	**IsMaster** () const

Protected Attributes

G4bool	**isMaster**

Geant4: EventAction

- Used for Event management
- Functions called at the start and stop of an Event
- Often used for printing periodic updates (event number)
- EndOfEventAction() historically used for getting Event hit information (now done in Run::RecordEvent())

Public Member Functions

	G4UserEventAction ()
virtual	**~G4UserEventAction** ()
virtual void	**SetEventManager** (**G4EventManager** *value)
virtual void	**BeginOfEventAction** (const **G4Event** *anEvent)
virtual void	**EndOfEventAction** (const **G4Event** *anEvent)

Geant4: PrimaryGeneratorAction

- Sets the primary particle properties for the G4Event
  - Which, how many, position, direction, energy, etc
- GeneratePrimaries() is usually a pass-through to a particle gun's GeneratePrimaryVertex()
- G4GeneralParticleSource (GPS) built-in option

Public Member Functions

	G4VUserPrimaryGeneratorAction ()
virtual	**~G4VUserPrimaryGeneratorAction** ()
virtual void	**GeneratePrimaries** (**G4Event** *anEvent)=0

Geant4: DetectorConstruction

Public Member Functions

	G4VUserDetectorConstruction ()
virtual	~G4VUserDetectorConstruction ()
virtual G4VPhysicalVolume *	Construct ()=0
virtual void	ConstructSDandField ()
virtual void	CloneSD ()
virtual void	CloneF ()
void	RegisterParallelWorld (G4VUserParallelWorld *)
G4int	ConstructParallelGeometries ()
void	ConstructParallelSD ()
G4int	GetNumberOfParallelWorld () const
G4VUserParallelWorld *	GetParallelWorld (G4int i) const

- Interface for providing geometry to Geant4
- Also handles SensitiveDetectors (more on this later)
- Parallel geometries (I've never used these)
- Construct() returns your top level simulation physical volume ("world")

Geant4: Physics Lists

- We can define what physics we want, how we want
- We usually want to use the physics we all know* and love
- Most people 1) copy from a similar example and then modify or 2) use a built-in
- Completely dependent on details of the use case

Public Member Functions

	G4VUserPhysicsList ()
virtual	~G4VUserPhysicsList ()
	G4VUserPhysicsList (const G4VUserPhysicsList &)
G4VUserPhysicsList &	operator= (const G4VUserPhysicsList &)
virtual void	ConstructParticle ()=0
void	Construct ()
virtual void	ConstructProcess ()=0
void	UseCoupledTransportation (G4bool vl=true)
virtual void	SetCuts ()
void	SetDefaultCutValue (G4double newCutValue)
G4double	GetDefaultCutValue () const
void	BuildPhysicsTable ()
void	PreparePhysicsTable (G4ParticleDefinition *)
void	BuildPhysicsTable (G4ParticleDefinition *)
G4bool	StorePhysicsTable (const G4String &directory=".")
G4bool	IsPhysicsTableRetrieved () const
G4bool	IsStoredInAscii () const
const G4String &	GetPhysicsTableDirectory () const
void	SetPhysicsTableRetrieved (const G4String &directory="")
void	SetStoredInAscii ()
void	ResetPhysicsTableRetrieved ()
void	ResetStoredInAscii ()
void	DumpList () const
void	DumpCutValuesTable (G4int flag=1)
void	DumpCutValuesTableIfRequested ()
void	SetVerboseLevel (G4int value)
G4int	GetVerboseLevel () const
void	SetCutsWithDefault ()
void	SetCutValue (G4double aCut, const G4String &pname)
G4double	GetCutValue (const G4String &pname) const
void	SetCutValue (G4double aCut, const G4String &pname, const G4String &rname)
void	SetParticleCuts (G4double cut, G4ParticleDefinition *particle, G4Region *region=0)
void	SetParticleCuts (G4double cut, const G4String &particleName, G4Region *region=0)
void	SetCutsForRegion (G4double aCut, const G4String &rname)
void	ResetCuts ()
void	SetApplyCuts (G4bool value, const G4String &name)
G4bool	GetApplyCuts (const G4String &name) const
void	RemoveProcessManager ()
void	AddProcessManager (G4ParticleDefinition *newParticle, G4ProcessManager *newManager=0)
void	CheckParticleList ()
void	DisableCheckParticleList ()
G4int	GetInstanceID () const
virtual void	InitializeWorker ()
virtual void	TerminateWorker ()

Lab Time

- Questions, discussion, time to get started on B1/A4