

Muon detector

1.0

Doxygen 1.8.13

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Gun	??
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run action	??
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??	
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src/muonDetectorConstruction.cc	
??	
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src/muonExtraPhysics.cc	??
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??	
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src/muonPrimaryGeneratorAction.cc	
mu- 150 MeV	??
src/muonRunAction.cc	
CSV	??
src/muonStepMax.cc	??
src/muonSteppingAction.cc	
??	
src/PMThit.cc	??
src/PMTSD.cc	
??	

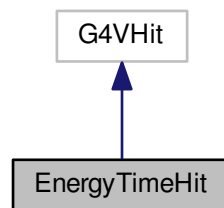
Chapter 4

4.1 EnergyTimeHit

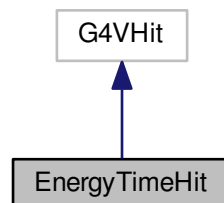
muon detector Hit

```
#include <EnergyTimeHit.hh>
```

EnergyTimeHit :



EnergyTimeHit :



Public

- void * [operator new](#) (size_t)
Memory allocation and de-allocation
- void [operator delete](#) (void *)
- void [SetDeltaEnergy](#) (G4double deltaE)
- void [SetTime](#) (G4double time)
- void [SetPosition](#) (G4ThreeVector pos)
- void [SetName](#) (G4String name)
- G4double [GetDeltaEnergy](#) () const
hit
- G4double [GetTime](#) () const
hit
- G4ThreeVector [GetPosition](#) () const
hit
- G4String [GetName](#) () const
hit

Private

- G4double [fDeltaEnergy](#)
- G4double [fTime](#)
- G4ThreeVector [fPosition](#)
- G4String [fname](#)

4.1.1

muon detector Hit

Hit

EnergyTimeHit.hh 19 .

4.1.2

4.1.2.1 [GetDeltaEnergy\(\)](#)

```
G4double EnergyTimeHit::GetDeltaEnergy ( ) const [inline]
```

hit

eventAction

EnergyTimeHit.hh 52 .

4.1.2.2 GetName()

```
G4String EnergyTimeHit::GetName ( ) const [inline]
hit
eventAction
EnergyTimeHit.hh 67 .
```

4.1.2.3 GetPosition()

```
G4ThreeVector EnergyTimeHit::GetPosition ( ) const [inline]
hit
eventAction
EnergyTimeHit.hh 62 .
```

4.1.2.4 GetTime()

```
G4double EnergyTimeHit::GetTime ( ) const [inline]
hit
eventAction
EnergyTimeHit.hh 57 .
```

4.1.2.5 operator delete()

```
void EnergyTimeHit::operator delete (
    void * aHit ) [inline]
EnergyTimeHit.hh 89 .
```

4.1.2.6 operator new()

```
void * EnergyTimeHit::operator new (
    size_t ) [inline]
```

Memory allocation and de-allocation

EnergyTimeHit.hh 80 .

4.1.2.7 SetDeltaEnergy()

```
void EnergyTimeHit::SetDeltaEnergy (
    G4double deltaE ) [inline]
```

<i>deltaE</i>	sensitiveProcessHit()step
---------------	---------------------------

EnergyTimeHit.hh 31 .

4.1.2.8 SetName()

```
void EnergyTimeHit::SetName (
    G4String name ) [inline]
```

logical Volume

<i>name</i>	sensitiveProcessHit()step
-------------	---------------------------

EnergyTimeHit.hh 47 .

4.1.2.9 SetPosition()

```
void EnergyTimeHit::SetPosition (
    G4ThreeVector pos ) [inline]
```

<i>pos</i>	sensitiveProcessHit()step
------------	---------------------------

EnergyTimeHit.hh 41 .

4.1.2.10 SetTime()

```
void EnergyTimeHit::SetTime (
    G4double time ) [inline]
```

<i>time</i>	sensitiveProcessHit()step
-------------	---------------------------

EnergyTimeHit.hh 36 .

4.1.3

4.1.3.1 fDeltaEnergy

```
G4double EnergyTimeHit::fDeltaEnergy [private]
```

EnergyTimeHit.hh 69 .

4.1.3.2 fname

```
G4String EnergyTimeHit::fname [private]
```

EnergyTimeHit.hh 72 .

4.1.3.3 fPosition

```
G4ThreeVector EnergyTimeHit::fPosition [private]
```

EnergyTimeHit.hh 71 .

4.1.3.4 fTime

```
G4double EnergyTimeHit::fTime [private]
```

EnergyTimeHit.hh 70 .

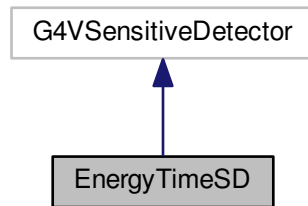
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- include/[EnergyTimeHit.hh](#)

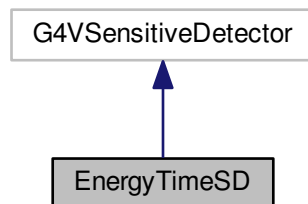
4.2 EnergyTimeSD

```
#include <EnergyTimeSD.hh>
```

EnergyTimeSD :



EnergyTimeSD :



Public

- [EnergyTimeSD](#) (G4String name)
hit collection
- void [Initialize](#) (G4HCofThisEvent *) override

Protected

- G4bool [ProcessHits](#) (G4Step *aStep, G4TouchableHistory *ROhist) override

Private

- [EnergyTimeHitsCollection](#) * [fHitsCollection](#) { nullptr }
 - G4int [fHitsCollectionId](#) { -1 }
- id = -1, id = -1 Hit*

4.2.1

EnergyTimeSD.hh 17 .

4.2.2**4.2.2.1 EnergyTimeSD()**

```
EnergyTimeSD::EnergyTimeSD (
    G4String name )
```

hit collection

energy_time

<i>name</i>	
-------------	--

EnergyTimeSD.cc 15 .

4.2.3**4.2.3.1 Initialize()**

```
void EnergyTimeSD::Initialize (
    G4HCofThisEvent * hcof ) [override]
```

id Hit

EnergyTimeSD.cc 49 .

4.2.3.2 ProcessHits()

```
G4bool EnergyTimeSD::ProcessHits (
    G4Step * aStep,
    G4TouchableHistory * ROhist ) [override], [protected]
```

muon

EnergyTimeSD.cc 23 .

4.2.4

4.2.4.1 fHitsCollection

```
EnergyTimeHitsCollection* EnergyTimeSD::fHitsCollection { nullptr } [private]
```

EnergyTimeSD.hh 41 .

4.2.4.2 fHitsCollectionId

```
G4int EnergyTimeSD::fHitsCollectionId { -1 } [private]
```

id = -1, id = -1 Hit

EnergyTimeSD.hh 45 .

:

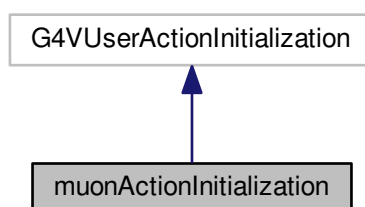
- [include/EnergyTimeSD.hh](#)
- [src/EnergyTimeSD.cc](#)

4.3 muonActionInitialization

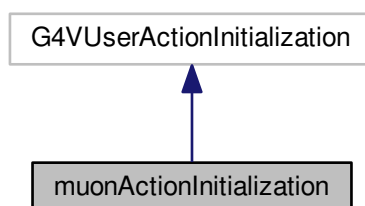
action

```
#include <muonActionInitialization.hh>
```

muonActionInitialization :



muonActionInitialization :



Public

- [muonActionInitialization](#) ()
construction
- virtual [~muonActionInitialization](#) ()
- virtual void [BuildForMaster](#) () const override
build
- virtual void [Build](#) () const override
build

4.3.1

action

muonActionInitialization.hh 15 .

4.3.2

4.3.2.1 `muonActionInitialization()`

```
muonActionInitialization::muonActionInitialization ( )
```

construction

[long description]

`muonActionInitialization.cc` 15 .

4.3.2.2 `~muonActionInitialization()`

```
muonActionInitialization::~~muonActionInitialization ( ) [virtual]
```

`muonActionInitialization.cc` 19 .

4.3.3

4.3.3.1 `Build()`

```
void muonActionInitialization::Build ( ) const [override], [virtual]
```

build

[muonPrimaryGeneratorAction](#), `runAction`, `eventAction`, `SteppingAction`

`muonActionInitialization.cc` 28 .

4.3.3.2 `BuildForMaster()`

```
void muonActionInitialization::BuildForMaster ( ) const [override], [virtual]
```

build

`muonActionInitialization.cc` 22 .

:

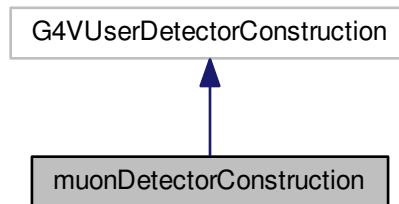
- `include/muonActionInitialization.hh`
- `src/muonActionInitialization.cc`

4.4 muonDetectorConstruction

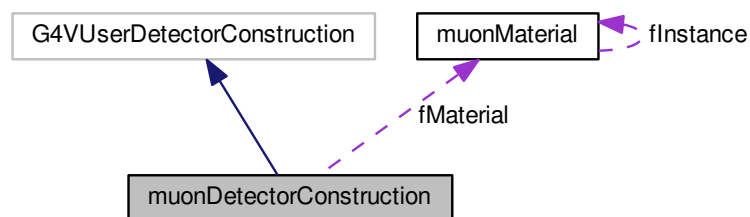
Detector Construction

```
#include <muonDetectorConstruction.hh>
```

muonDetectorConstruction :



muonDetectorConstruction :



Public

- [muonDetectorConstruction](#) ()
constructor
- virtual [~muonDetectorConstruction](#) ()
- virtual G4VPhysicalVolume * [Construct](#) () override
Detector construction
- void [Constructmuondetector](#) (G4LogicalVolume *world)
Construct muondetector
- void [ConstructPMT](#) (G4LogicalVolume *world)
Construct PMT
- void [ConstructReflection](#) (G4LogicalVolume *world, G4Trd *detector)
[brief description]
- void [ConstructSDandField](#) () override

Private

- G4double `c_light` = 2.99792458e+8 * m/s
- G4double `h_Planck` = 6.62606896e-34 * joule*s
- G4double `world_sizeXY` = 1*m
- G4double `world_sizeZ` = 0.2*m
- G4double `shape_x1` = 20./2.*mm
- G4double `shape_x2` = 20./2.*mm
- G4double `shape_y1` = 84./2.*mm
- G4double `shape_y2` = 143.5/2.*mm
- G4double `shape_z` = 338.5/2.0*mm
- G4double `phi` = 90.*deg
- G4RotationMatrix * `rotm`
- G4ThreeVector `pos1` = G4ThreeVector(0, 0, -15.*mm)
- G4ThreeVector `pos2` = G4ThreeVector(0., 0., 15.*mm)
- G4double `PMT_thick` = 1.0*mm
- G4double `PMT_x` = 20./2.*mm
- G4double `PMT_y` = 84./2.*mm
- G4ThreeVector `PMTpos1` = G4ThreeVector(340.5/2.0*mm, 0.0*cm, 15 *mm)
- G4ThreeVector `PMTpos2` = G4ThreeVector(340.5/2.0*mm, 0.0*cm, -15 *mm)
- G4double `rshape_x1` = 22./2.*mm
- G4double `rshape_x2` = 22./2.*mm
- G4double `rshape_y1` = 86./2.*mm
- G4double `rshape_y2` = 145.5/2.*mm
- G4double `rshape_z` = 340.5/2.0*mm
- G4ThreeVector `rpos1` = G4ThreeVector(-1.*mm, 0, -15.*mm)
- G4ThreeVector `rpos2` = G4ThreeVector(-1.*mm, 0., 15.*mm)
- G4bool `checkOverlaps` = true
- `muonMaterial` * `fMaterial`

4.4.1

Detector Construction

`muonDetectorConstruction.hh` 22 .

4.4.2

4.4.2.1 `muonDetectorConstruction()`

`muonDetectorConstruction::muonDetectorConstruction ()`

constructor

`muonDetectorConstruction.cc` 10 .

4.4.2.2 ~muonDetectorConstruction()

```
muonDetectorConstruction::~~muonDetectorConstruction ( ) [virtual]
```

muonDetectorConstruction.cc 15 .

4.4.3

4.4.3.1 Construct()

```
G4VPhysicalVolume * muonDetectorConstruction::Construct ( ) [override], [virtual]
```

Detector construction

define geometry

world physical volume

muonDetectorConstruction.cc 27 .

4.4.3.2 Constructmuondetector()

```
void muonDetectorConstruction::Constructmuondetector (
    G4LogicalVolume * world )
```

Construct muondetector

<i>world</i>	parent volume world logical volume, tree
--------------	--

muonDetectorConstruction.cc 53 .

4.4.3.3 ConstructPMT()

```
void muonDetectorConstruction::ConstructPMT (
    G4LogicalVolume * world )
```

Construct PMT

<i>world</i>	parent volume world logical volume, tree
--------------	--

muonDetectorConstruction.cc 114 .

4.4.3.4 ConstructReflection()

```
void muonDetectorConstruction::ConstructReflection (
    G4LogicalVolume * world,
    G4Trd * detector )
```

[brief description]

[long description]

<i>world</i>	parent volume world logical volume, tree
<i>detector</i>	muon detector

muonDetectorConstruction.cc 77 .

4.4.3.5 ConstructSDandField()

```
void muonDetectorConstruction::ConstructSDandField ( ) [override]
```

pmt(PMTSD) muon detector(EnergyTimeSD)

muonDetectorConstruction.cc 189 .

4.4.4

4.4.4.1 c_light

```
G4double muonDetectorConstruction::c_light = 2.99792458e+8 * m/s [private]
```

muonDetectorConstruction.hh 64 .

4.4.4.2 checkOverlaps

```
G4bool muonDetectorConstruction::checkOverlaps = true [private]
```

muonDetectorConstruction.hh 103 .

4.4.4.3 fMaterial

```
muonMaterial* muonDetectorConstruction::fMaterial [private]
```

muonDetectorConstruction.hh 105 .

4.4.4.4 h_Planck

```
G4double muonDetectorConstruction::h_Planck = 6.62606896e-34 * joule*s [private]
```

muonDetectorConstruction.hh 65 .

4.4.4.5 phi

```
G4double muonDetectorConstruction::phi = 90.*deg [private]
```

muonDetectorConstruction.hh 79 .

4.4.4.6 PMT_thick

```
G4double muonDetectorConstruction::PMT_thick = 1.0*mm [private]
```

muonDetectorConstruction.hh 89 .

4.4.4.7 PMT_x

```
G4double muonDetectorConstruction::PMT_x = 20./2.*mm [private]
```

muonDetectorConstruction.hh 90 .

4.4.4.8 PMT_y

```
G4double muonDetectorConstruction::PMT_y = 84./2.*mm [private]
```

muonDetectorConstruction.hh 90 .

4.4.4.9 PMTpos1

```
G4ThreeVector muonDetectorConstruction::PMTpos1 = G4ThreeVector(340.5/2.0*mm, 0.0*cm, 15 *mm)
[private]
```

muonDetectorConstruction.hh 91 .

4.4.4.10 PMTpos2

```
G4ThreeVector muonDetectorConstruction::PMTpos2 = G4ThreeVector(340.5/2.0*mm, 0.0*cm, -15 *mm)
[private]
```

muonDetectorConstruction.hh 92 .

4.4.4.11 pos1

```
G4ThreeVector muonDetectorConstruction::pos1 = G4ThreeVector(0, 0, -15.*mm) [private]
```

muonDetectorConstruction.hh 85 .

4.4.4.12 pos2

```
G4ThreeVector muonDetectorConstruction::pos2 = G4ThreeVector(0., 0., 15.*mm) [private]
```

muonDetectorConstruction.hh 86 .

4.4.4.13 rotm

```
G4RotationMatrix* muonDetectorConstruction::rotm [private]
```

```
:
```

```
=
```

```
new G4RotationMatrix(G4ThreeVector(std::cos(phi), 0., -std::sin(phi)),
G4ThreeVector(0., 1., 0.), G4ThreeVector( std::sin(phi), 0., std::cos(phi)))
```

muonDetectorConstruction.hh 80 .

4.4.4.14 rpos1

```
G4ThreeVector muonDetectorConstruction::rpos1 = G4ThreeVector(-1.*mm, 0, -15.*mm) [private]
```

muonDetectorConstruction.hh 100 .

4.4.4.15 rpos2

```
G4ThreeVector muonDetectorConstruction::rpos2 = G4ThreeVector(-1.*mm, 0., 15.*mm) [private]
```

muonDetectorConstruction.hh 101 .

4.4.4.16 rshape_x1

```
G4double muonDetectorConstruction::rshape_x1 = 22./2.*mm [private]
```

muonDetectorConstruction.hh 95 .

4.4.4.17 rshape_x2

```
G4double muonDetectorConstruction::rshape_x2 = 22./2.*mm [private]
```

muonDetectorConstruction.hh 96 .

4.4.4.18 rshape_y1

```
G4double muonDetectorConstruction::rshape_y1 = 86./2.*mm [private]
```

muonDetectorConstruction.hh 97 .

4.4.4.19 rshape_y2

```
G4double muonDetectorConstruction::rshape_y2 = 145.5/2.*mm [private]
```

muonDetectorConstruction.hh 98 .

4.4.4.20 rshape_z

```
G4double muonDetectorConstruction::rshape_z =340.5/2.0*mm [private]
```

```
muonDetectorConstruction.hh 99 .
```

4.4.4.21 shape_x1

```
G4double muonDetectorConstruction::shape_x1 = 20./2.*mm [private]
```

```
muonDetectorConstruction.hh 73 .
```

4.4.4.22 shape_x2

```
G4double muonDetectorConstruction::shape_x2 = 20./2.*mm [private]
```

```
muonDetectorConstruction.hh 74 .
```

4.4.4.23 shape_y1

```
G4double muonDetectorConstruction::shape_y1 =84./2.*mm [private]
```

```
muonDetectorConstruction.hh 75 .
```

4.4.4.24 shape_y2

```
G4double muonDetectorConstruction::shape_y2 =143.5/2.*mm [private]
```

```
muonDetectorConstruction.hh 76 .
```

4.4.4.25 shape_z

```
G4double muonDetectorConstruction::shape_z =338.5/2.0*mm [private]
```

```
muonDetectorConstruction.hh 77 .
```

4.4.4.26 world_sizeXY

```
G4double muonDetectorConstruction::world_sizeXY = 1*m [private]
muonDetectorConstruction.hh 69 .
```

4.4.4.27 world_sizeZ

```
G4double muonDetectorConstruction::world_sizeZ = 0.2*m [private]
muonDetectorConstruction.hh 69 .
```

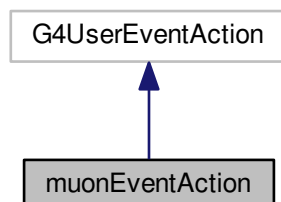
:

- [include/muonDetectorConstruction.hh](#)
- [src/muonDetectorConstruction.cc](#)

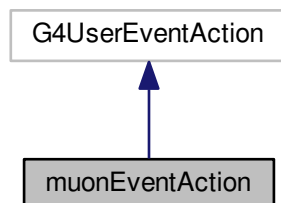
4.5 muonEventAction

Ntuple

```
#include <muonEventAction.hh>
muonEventAction :
```



muonEventAction :



Public

- [muonEventAction](#) ()
construction
- virtual [~muonEventAction](#) ()
- virtual void [EndOfEventAction](#) (const G4Event *anEvent) override
Ntuple

Private

- G4int [muondetectorEnId](#) { -1 }
- G4int [PMT_Id](#) {-1}

4.5.1

Ntuple

muonEventAction.hh 18 .

4.5.2

4.5.2.1 muonEventAction()

```
muonEventAction::muonEventAction ( )
```

construction

muonEventAction.cc 20 .

4.5.2.2 ~muonEventAction()

```
muonEventAction::~~muonEventAction ( ) [virtual]
```

muonEventAction.cc 23 .

4.5.3

4.5.3.1 EndOfEventAction()

```
void muonEventAction::EndOfEventAction (
    const G4Event * anEvent ) [override], [virtual]
```

Ntuple

id,

pmt hitcollection muon detector hitcollection

<i>anEvent</i>	[description]
----------------	---------------

PMT1' 1 PMT2 2 event id

muondetector1' 1 muondetector2 2 event id

muonEventAction.cc 29 .

4.5.4

4.5.4.1 muondetectorEnId

```
G4int muonEventAction::muondetectorEnId { -1 } [private]
```

muonEventAction.hh 34 .

4.5.4.2 PMT_Id

```
G4int muonEventAction::PMT_Id {-1} [private]
```

muonEventAction.hh 35 .

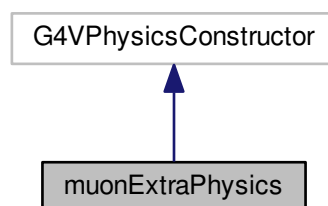
:

- [include/muonEventAction.hh](#)
- [src/muonEventAction.cc](#)

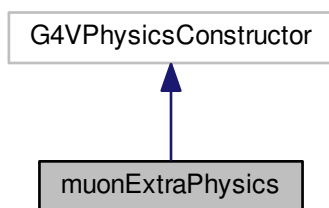
4.6 muonExtraPhysics

```
#include <muonExtraPhysics.hh>
```

muonExtraPhysics :



muonExtraPhysics :



Public

- [muonExtraPhysics](#) ()
- virtual [~muonExtraPhysics](#) ()
- virtual void [ConstructParticle](#) ()
- virtual void [ConstructProcess](#) ()

4.6.1

muonExtraPhysics.hh 10 .

4.6.2

4.6.2.1 muonExtraPhysics()

```
muonExtraPhysics::muonExtraPhysics ( )
```

muonExtraPhysics.cc 13 .

4.6.2.2 ~muonExtraPhysics()

```
muonExtraPhysics::~~muonExtraPhysics ( ) [virtual]
```

muonExtraPhysics.cc 17 .

4.6.3

4.6.3.1 ConstructParticle()

```
void muonExtraPhysics::ConstructParticle ( ) [virtual]
```

muonExtraPhysics.cc 19 .

4.6.3.2 ConstructProcess()

```
void muonExtraPhysics::ConstructProcess ( ) [virtual]
```

muonExtraPhysics.cc 23 .

:

- include/muonExtraPhysics.hh
- src/muonExtraPhysics.cc

4.7 muonMaterial

```
#include <muonMaterial.hh>
```

muonMaterial :



Public

- [muonMaterial](#) ()
construction fNistMan
- [~muonMaterial](#) ()
- G4Material * [GetMaterial](#) (const G4String)
nist
- G4Material * [Getfdetector](#) ()
detector
- G4Material * [GetfPMT](#) ()
PMT
- G4Material * [Getfreflect](#) ()
reflect
- G4Material * [GetfAir](#) ()
world -

Public

- static `muonMaterial` * `GetInstance` ()

Private

- void `CreateMaterials` ()

Private

- G4NistManager * `fNistMan`
- G4Material * `fdetector`
- G4Material * `fPMT`
- G4Material * `freflect`
- G4Material * `fAir`

Private

- static `muonMaterial` * `fInstance` =0

4.7.1

`muonMaterial.hh` 17 .

4.7.2

4.7.2.1 `muonMaterial()`

```
muonMaterial::muonMaterial ( )
```

construction `fNistMan`

`muonMaterial.cc` 13 .

4.7.2.2 `~muonMaterial()`

```
muonMaterial::~~muonMaterial ( )
```

`muonMaterial.cc` 21 .

4.7.3

4.7.3.1 CreateMaterials()

```
void muonMaterial::CreateMaterials ( ) [private]
```

fdetector fPMT freflect fAir

muonMaterial.cc 53 .

4.7.3.2 GetfAir()

```
G4Material* muonMaterial::GetfAir ( ) [inline]
```

world -

world

muonMaterial.hh 48 .

4.7.3.3 Getfdetector()

```
G4Material* muonMaterial::Getfdetector ( ) [inline]
```

detector

detector

muonMaterial.hh 33 .

4.7.3.4 GetfPMT()

```
G4Material* muonMaterial::GetfPMT ( ) [inline]
```

PMT

PMT

muonMaterial.hh 38 .

4.7.3.5 Getfreflect()

```
G4Material* muonMaterial::Getfreflect ( ) [inline]
```

reflect

reflect

muonMaterial.hh 43 .

4.7.3.6 GetInstance()

```
muonMaterial * muonMaterial::GetInstance ( ) [static]
```

muonMaterial.cc 27 .

4.7.3.7 GetMaterial()

```
G4Material * muonMaterial::GetMaterial (
    const G4String material )
```

nist

muonMaterial.cc 36 .

4.7.4

4.7.4.1 fAir

```
G4Material* muonMaterial::fAir [private]
```

muonMaterial.hh 66 .

4.7.4.2 fdetector

```
G4Material* muonMaterial::fdetector [private]
```

muonMaterial.hh 63 .

4.7.4.3 fInstance

```
muonMaterial * muonMaterial::fInstance =0 [static], [private]
```

muonMaterial.hh 59 .

4.7.4.4 fNistMan

```
G4NistManager* muonMaterial::fNistMan [private]
```

muonMaterial.hh 61 .

4.7.4.5 fPMT

```
G4Material* muonMaterial::fPMT [private]
```

muonMaterial.hh 64 .

4.7.4.6 freflect

```
G4Material* muonMaterial::freflect [private]
```

muonMaterial.hh 65 .

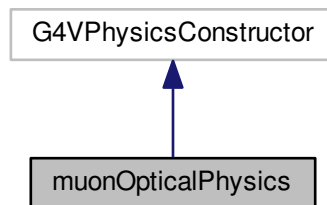
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- [include/muonMaterial.hh](#)
- [src/muonMaterial.cc](#)

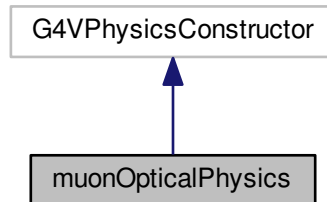
4.8 muonOpticalPhysics

```
#include <muonOpticalPhysics.hh>
```

```
muonOpticalPhysics :
```



```
muonOpticalPhysics :
```



Public

- [muonOpticalPhysics](#) (G4bool toggle=true)
- virtual [~muonOpticalPhysics](#) ()
- virtual void [ConstructParticle](#) ()
- virtual void [ConstructProcess](#) ()
- G4OpWLS * [GetWLSProcess](#) ()
- G4Cerenkov * [GetCerenkovProcess](#) ()
- G4Scintillation * [GetScintillationProcess](#) ()
- G4OpAbsorption * [GetAbsorptionProcess](#) ()
- G4OpRayleigh * [GetRayleighScatteringProcess](#) ()
- G4OpMieHG * [GetMieHGScatteringProcess](#) ()
- G4OpBoundaryProcess * [GetBoundaryProcess](#) ()
- void [SetNbOfPhotonsCerenkov](#) (G4int)

Private

- G4OpWLS * [fWLSProcess](#)
- G4Cerenkov * [fCerenkovProcess](#)
- G4Scintillation * [fScintProcess](#)
- G4OpAbsorption * [fAbsorptionProcess](#)
- G4OpRayleigh * [fRayleighScattering](#)
- G4OpMieHG * [fMieHGScatteringProcess](#)
- G4OpBoundaryProcess * [fBoundaryProcess](#)
- G4bool [fAbsorptionOn](#)

4.8.1

muonOpticalPhysics.hh 19 .

4.8.2

4.8.2.1 muonOpticalPhysics()

```
muonOpticalPhysics::muonOpticalPhysics (
    G4bool toggle = true )
```

muonOpticalPhysics.cc 8 .

4.8.2.2 ~muonOpticalPhysics()

```
muonOpticalPhysics::~~muonOpticalPhysics ( ) [virtual]
```

muonOpticalPhysics.cc 22 .

4.8.3

4.8.3.1 ConstructParticle()

```
void muonOpticalPhysics::ConstructParticle ( ) [virtual]
```

muonOpticalPhysics.cc 26 .

4.8.3.2 ConstructProcess()

```
void muonOpticalPhysics::ConstructProcess ( ) [virtual]
```

muonOpticalPhysics.cc 33 .

4.8.3.3 GetAbsorptionProcess()

```
G4OpAbsorption* muonOpticalPhysics::GetAbsorptionProcess ( ) [inline]
```

muonOpticalPhysics.hh 32 .

4.8.3.4 GetBoundaryProcess()

```
G4OpBoundaryProcess* muonOpticalPhysics::GetBoundaryProcess ( ) [inline]
```

muonOpticalPhysics.hh 35 .

4.8.3.5 GetCerenkovProcess()

```
G4Cerenkov* muonOpticalPhysics::GetCerenkovProcess ( ) [inline]
```

muonOpticalPhysics.hh 30 .

4.8.3.6 GetMieHGScatteringProcess()

```
G4OpMieHG* muonOpticalPhysics::GetMieHGScatteringProcess ( ) [inline]
```

muonOpticalPhysics.hh 34 .

4.8.3.7 GetRayleighScatteringProcess()

```
G4OpRayleigh* muonOpticalPhysics::GetRayleighScatteringProcess ( ) [inline]
```

muonOpticalPhysics.hh 33 .

4.8.3.8 GetScintillationProcess()

```
G4Scintillation* muonOpticalPhysics::GetScintillationProcess ( ) [inline]
```

muonOpticalPhysics.hh 31 .

4.8.3.9 GetWLSProcess()

```
G4OpWLS* muonOpticalPhysics::GetWLSProcess ( ) [inline]
```

muonOpticalPhysics.hh 29 .

4.8.3.10 SetNbOfPhotonsCerenkov()

```
void muonOpticalPhysics::SetNbOfPhotonsCerenkov (
    G4int maxNumber )
```

muonOpticalPhysics.cc 112 .

4.8.4

4.8.4.1 fAbsorptionOn

```
G4bool muonOpticalPhysics::fAbsorptionOn [private]
```

muonOpticalPhysics.hh 49 .

4.8.4.2 fAbsorptionProcess

```
G4OpAbsorption* muonOpticalPhysics::fAbsorptionProcess [private]
```

muonOpticalPhysics.hh 44 .

4.8.4.3 fBoundaryProcess

```
G4OpBoundaryProcess* muonOpticalPhysics::fBoundaryProcess [private]
```

muonOpticalPhysics.hh 47 .

4.8.4.4 fCerenkovProcess

```
G4Cerenkov* muonOpticalPhysics::fCerenkovProcess [private]
```

muonOpticalPhysics.hh 42 .

4.8.4.5 fMieHGScatteringProcess

```
G4OpMieHG* muonOpticalPhysics::fMieHGScatteringProcess [private]
```

muonOpticalPhysics.hh 46 .

4.8.4.6 fRayleighScattering

```
G4OpRayleigh* muonOpticalPhysics::fRayleighScattering [private]
```

muonOpticalPhysics.hh 45 .

4.8.4.7 fScintProcess

```
G4Scintillation* muonOpticalPhysics::fScintProcess [private]
```

muonOpticalPhysics.hh 43 .

4.8.4.8 fWLSPProcess

```
G4OpWLS* muonOpticalPhysics::fWLSPProcess [private]
```

muonOpticalPhysics.hh 41 .

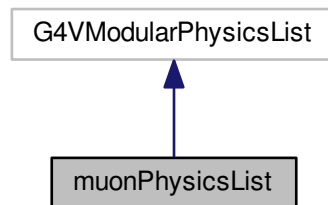
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- [include/muonOpticalPhysics.hh](#)
- [src/muonOpticalPhysics.cc](#)

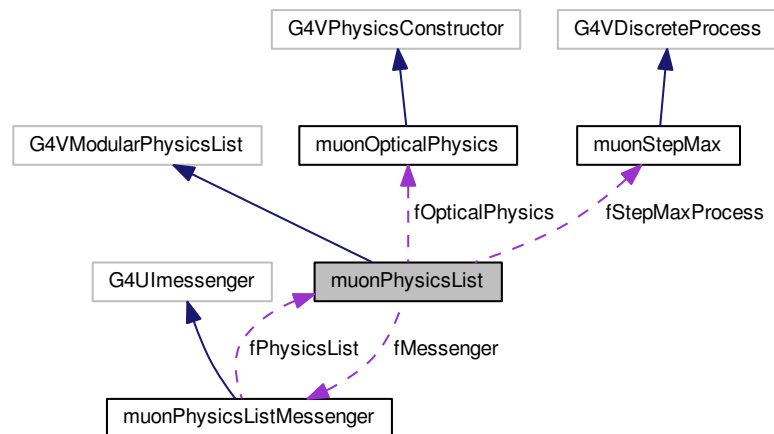
4.9 muonPhysicsList

```
#include <muonPhysicsList.hh>
```

```
muonPhysicsList :
```



```
muonPhysicsList :
```



Public

- `muonPhysicsList` (G4String)
- virtual `~muonPhysicsList` ()
- void `SetCuts` ()
- void `SetCutForGamma` (G4double)
- void `SetCutForElectron` (G4double)
- void `SetCutForPositron` (G4double)
- void `SetStepMax` (G4double)
- `muonStepMax * GetStepMaxProcess` ()
- void `AddStepMax` ()

- void [RemoveFromPhysicsList](#) (const G4String &)
Remove specific physics from physics list.
- void [ClearPhysics](#) ()
Make sure that the physics list is empty.
- virtual void [ConstructParticle](#) ()
- virtual void [ConstructProcess](#) ()
- void [SetAbsorption](#) (G4bool)
- void [SetNbOfPhotonsCerenkov](#) (G4int)
- void [SetVerbose](#) (G4int)

Private

- G4double [fCutForGamma](#)
- G4double [fCutForElectron](#)
- G4double [fCutForPositron](#)
- [muonStepMax](#) * [fStepMaxProcess](#)
- [muonOpticalPhysics](#) * [fOpticalPhysics](#)
- [muonPhysicsListMessenger](#) * [fMessenger](#)
- G4bool [fAbsorptionOn](#)
- G4VMPLData::G4PhysConstVectorData * [fPhysicsVector](#)

4.9.1

[muonPhysicsList.hh](#) 15 .

4.9.2

4.9.2.1 [muonPhysicsList\(\)](#)

```
muonPhysicsList::muonPhysicsList (
    G4String physName )
```

[muonPhysicsList.cc](#) 39 .

4.9.2.2 [~muonPhysicsList\(\)](#)

```
muonPhysicsList::~muonPhysicsList ( ) [virtual]
```

[muonPhysicsList.cc](#) 82 .

4.9.3

4.9.3.1 AddStepMax()

```
void muonPhysicsList::AddStepMax ( )
```

muonPhysicsList.cc 282 .

4.9.3.2 ClearPhysics()

```
void muonPhysicsList::ClearPhysics ( )
```

Make sure that the physics list is empty.

muonPhysicsList.cc 91 .

4.9.3.3 ConstructParticle()

```
void muonPhysicsList::ConstructParticle ( ) [virtual]
```

muonPhysicsList.cc 102 .

4.9.3.4 ConstructProcess()

```
void muonPhysicsList::ConstructProcess ( ) [virtual]
```

muonPhysicsList.cc 124 .

4.9.3.5 GetStepMaxProcess()

```
muonStepMax * muonPhysicsList::GetStepMaxProcess ( )
```

muonPhysicsList.cc 275 .

4.9.3.6 RemoveFromPhysicsList()

```
void muonPhysicsList::RemoveFromPhysicsList (
    const G4String & name )
```

Remove specific physics from physics list.

muonPhysicsList.cc 192 .

4.9.3.7 SetAbsorption()

```
void muonPhysicsList::SetAbsorption (
    G4bool toggle )
```

muonPhysicsList.cc 214 .

4.9.3.8 SetCutForElectron()

```
void muonPhysicsList::SetCutForElectron (
    G4double cut )
```

muonPhysicsList.cc 252 .

4.9.3.9 SetCutForGamma()

```
void muonPhysicsList::SetCutForGamma (
    G4double cut )
```

muonPhysicsList.cc 244 .

4.9.3.10 SetCutForPositron()

```
void muonPhysicsList::SetCutForPositron (
    G4double cut )
```

muonPhysicsList.cc 260 .

4.9.3.11 SetCuts()

```
void muonPhysicsList::SetCuts ( )
```

muonPhysicsList.cc 225 .

4.9.3.12 SetNbOfPhotonsCerenkov()

```
void muonPhysicsList::SetNbOfPhotonsCerenkov (
    G4int maxNumber )
```

muonPhysicsList.cc 301 .

4.9.3.13 SetStepMax()

```
void muonPhysicsList::SetStepMax (
    G4double step )
```

muonPhysicsList.cc 268 .

4.9.3.14 SetVerbose()

```
void muonPhysicsList::SetVerbose (
    G4int verbose )
```

muonPhysicsList.cc 308 .

4.9.4

4.9.4.1 fAbsorptionOn

```
G4bool muonPhysicsList::fAbsorptionOn [private]
```

muonPhysicsList.hh 59 .

4.9.4.2 fCutForElectron

```
G4double muonPhysicsList::fCutForElectron [private]
```

muonPhysicsList.hh 50 .

4.9.4.3 fCutForGamma

```
G4double muonPhysicsList::fCutForGamma [private]
```

muonPhysicsList.hh 49 .

4.9.4.4 fCutForPositron

```
G4double muonPhysicsList::fCutForPositron [private]
```

muonPhysicsList.hh 51 .

4.9.4.5 fMessenger

```
muonPhysicsListMessenger* muonPhysicsList::fMessenger [private]
```

muonPhysicsList.hh 57 .

4.9.4.6 fOpticalPhysics

```
muonOpticalPhysics* muonPhysicsList::fOpticalPhysics [private]
```

muonPhysicsList.hh 55 .

4.9.4.7 fPhysicsVector

```
G4VMPLData::G4PhysConstVectorData* muonPhysicsList::fPhysicsVector [private]
```

muonPhysicsList.hh 61 .

4.9.4.8 fStepMaxProcess

```
muonStepMax* muonPhysicsList::fStepMaxProcess [private]
```

muonPhysicsList.hh 53 .

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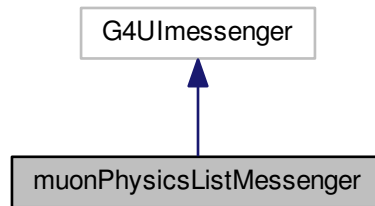
- [include/muonPhysicsList.hh](#)
- [src/muonPhysicsList.cc](#)

4.10 muonPhysicsListMessenger

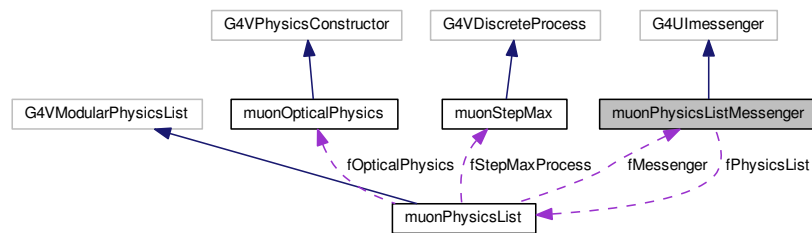
Provide control of the physics list and cut parameters

```
#include <muonPhysicsListMessenger.hh>
```

```
muonPhysicsListMessenger :
```



```
muonPhysicsListMessenger :
```



Public

- `muonPhysicsListMessenger` (`muonPhysicsList *`)
- virtual `~muonPhysicsListMessenger` ()
- virtual void `SetNewValue` (`G4UImessenger *`, `G4String`)

Private

- `muonPhysicsList *` `fPhysicsList`
- `G4UImessenger *` `fDirectory`
- `G4UImessenger *` `fDecayDirectory`
- `G4UImessenger *` `fSetAbsorptionCMD`
- `G4UImessenger *` `fVerboseCmd`
- `G4UImessenger *` `fCerenkovCmd`
- `G4UImessenger *` `fGammaCutCMD`

- G4UlcmdWithADoubleAndUnit * [fElectCutCMD](#)
- G4UlcmdWithADoubleAndUnit * [fPosCutCMD](#)
- G4UlcmdWithADoubleAndUnit * [fAllCutCMD](#)
- G4UlcmdWithADoubleAndUnit * [fStepMaxCMD](#)
- G4UlcmdWithAString * [fRemovePhysicsCMD](#)
- G4UlcmdWithoutParameter * [fClearPhysicsCMD](#)
- G4UlcmdWithoutParameter * [fListCMD](#)
- G4UlcmdWithoutParameter * [fPienuCMD](#)
- G4UlcmdWithoutParameter * [fPimunuCMD](#)

4.10.1

Provide control of the physics list and cut parameters

`muonPhysicsListMessenger.hh` 26 .

4.10.2

4.10.2.1 `muonPhysicsListMessenger()`

```
muonPhysicsListMessenger::muonPhysicsListMessenger (
    muonPhysicsList * pPhys )
```

`muonPhysicsListMessenger.cc` 19 .

4.10.2.2 `~muonPhysicsListMessenger()`

```
muonPhysicsListMessenger::~~muonPhysicsListMessenger ( ) [virtual]
```

`muonPhysicsListMessenger.cc` 112 .

4.10.3

4.10.3.1 `SetNewValue()`

```
void muonPhysicsListMessenger::SetNewValue (
    G4UICmd * command,
    G4String newValue ) [virtual]
```

`muonPhysicsListMessenger.cc` 137 .

4.10.4

4.10.4.1 fAllCutCMD

```
G4UICmdWithADoubleAndUnit* muonPhysicsListMessenger::fAllCutCMD [private]
```

muonPhysicsListMessenger.hh 50 .

4.10.4.2 fCerenkovCmd

```
G4UICmdWithAnInteger* muonPhysicsListMessenger::fCerenkovCmd [private]
```

muonPhysicsListMessenger.hh 45 .

4.10.4.3 fClearPhysicsCMD

```
G4UICmdWithoutParameter* muonPhysicsListMessenger::fClearPhysicsCMD [private]
```

muonPhysicsListMessenger.hh 54 .

4.10.4.4 fDecayDirectory

```
G4UIDirectory* muonPhysicsListMessenger::fDecayDirectory [private]
```

muonPhysicsListMessenger.hh 40 .

4.10.4.5 fDirectory

```
G4UIDirectory* muonPhysicsListMessenger::fDirectory [private]
```

muonPhysicsListMessenger.hh 39 .

4.10.4.6 fElectCutCMD

G4UIcmdWithADoubleAndUnit* muonPhysicsListMessenger::fElectCutCMD [private]

muonPhysicsListMessenger.hh 48 .

4.10.4.7 fGammaCutCMD

G4UIcmdWithADoubleAndUnit* muonPhysicsListMessenger::fGammaCutCMD [private]

muonPhysicsListMessenger.hh 47 .

4.10.4.8 fListCMD

G4UIcmdWithoutParameter* muonPhysicsListMessenger::fListCMD [private]

muonPhysicsListMessenger.hh 56 .

4.10.4.9 fPhysicsList

[muonPhysicsList](#)* muonPhysicsListMessenger::fPhysicsList [private]

muonPhysicsListMessenger.hh 37 .

4.10.4.10 fPienuCMD

G4UIcmdWithoutParameter* muonPhysicsListMessenger::fPienuCMD [private]

muonPhysicsListMessenger.hh 58 .

4.10.4.11 fPimunuCMD

G4UIcmdWithoutParameter* muonPhysicsListMessenger::fPimunuCMD [private]

muonPhysicsListMessenger.hh 59 .

4.10.4.12 fPosCutCMD

```
G4UIcmdWithADoubleAndUnit* muonPhysicsListMessenger::fPosCutCMD [private]
```

muonPhysicsListMessenger.hh 49 .

4.10.4.13 fRemovePhysicsCMD

```
G4UIcmdWithAString* muonPhysicsListMessenger::fRemovePhysicsCMD [private]
```

muonPhysicsListMessenger.hh 53 .

4.10.4.14 fSetAbsorptionCMD

```
G4UIcmdWithABool* muonPhysicsListMessenger::fSetAbsorptionCMD [private]
```

muonPhysicsListMessenger.hh 42 .

4.10.4.15 fStepMaxCMD

```
G4UIcmdWithADoubleAndUnit* muonPhysicsListMessenger::fStepMaxCMD [private]
```

muonPhysicsListMessenger.hh 51 .

4.10.4.16 fVerboseCmd

```
G4UIcmdWithAnInteger* muonPhysicsListMessenger::fVerboseCmd [private]
```

muonPhysicsListMessenger.hh 44 .

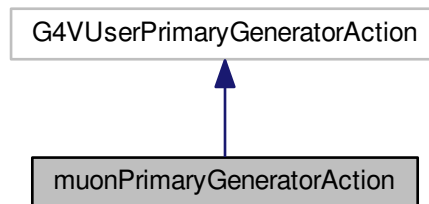
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- [include/muonPhysicsListMessenger.hh](#)
- [src/muonPhysicsListMessenger.cc](#)

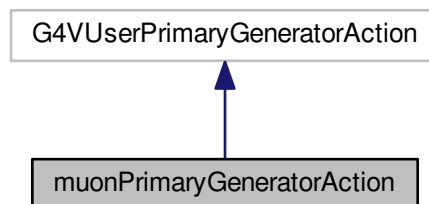
4.11 muonPrimaryGeneratorAction

```
#include <muonPrimaryGeneratorAction.hh>
```

muonPrimaryGeneratorAction :



muonPrimaryGeneratorAction :



Public

- [muonPrimaryGeneratorAction](#) ()
fParticleGun
- virtual [~muonPrimaryGeneratorAction](#) ()
- virtual void [GeneratePrimaries](#) (G4Event *anEvent) override
event fParticleGun
- const G4ParticleGun * [GetParticleGun](#) () const

Private

- G4ParticleGun * [fParticleGun](#)

4.11.1

muonPrimaryGeneratorAction.hh 17 .

4.11.2

4.11.2.1 muonPrimaryGeneratorAction()

```
muonPrimaryGeneratorAction::muonPrimaryGeneratorAction ( )
```

```
fParticleGun
```

```
mu- 0 0 -1 150 MeV
```

```
muonPrimaryGeneratorAction.cc 21 .
```

4.11.2.2 ~muonPrimaryGeneratorAction()

```
muonPrimaryGeneratorAction::~~muonPrimaryGeneratorAction ( ) [virtual]
```

```
muonPrimaryGeneratorAction.cc 41 .
```

4.11.3

4.11.3.1 GeneratePrimaries()

```
void muonPrimaryGeneratorAction::GeneratePrimaries (
    G4Event * anEvent ) [override], [virtual]
```

```
event fParticleGun
```

```
0 0 0.1m
```

```
muonPrimaryGeneratorAction.cc 47 .
```

4.11.3.2 GetParticleGun()

```
const G4ParticleGun* muonPrimaryGeneratorAction::GetParticleGun ( ) const [inline]
```

```
muonPrimaryGeneratorAction.hh 35 .
```

4.11.4

4.11.4.1 fParticleGun

```
G4ParticleGun* muonPrimaryGeneratorAction::fParticleGun [private]
```

```
muonPrimaryGeneratorAction.hh 37 .
```

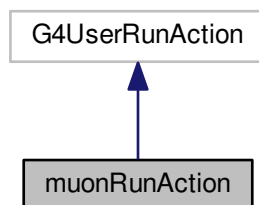
```
:
```

- [include/muonPrimaryGeneratorAction.hh](#)
- [src/muonPrimaryGeneratorAction.cc](#)

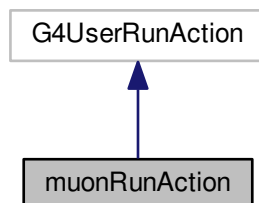
4.12 muonRunAction

```
#include <muonRunAction.hh>
```

```
muonRunAction :
```



```
muonRunAction :
```



Public

- `muonRunAction()`
muon_nt_detector.csv muon_nt_pmt.csv
- virtual `~muonRunAction()`
- virtual void `EndOfRunAction(const G4Run *run)`
event

4.12.1

muonRunAction.hh 20 .

4.12.2**4.12.2.1 muonRunAction()**

```
muonRunAction::muonRunAction ( )
```

```
muon_nt_detector.csv muon_nt_pmt.csv
```

```
muon_nt_pmt id = 1 muon_nt_detector id = 2
```

```
muonRunAction.cc 16 .
```

4.12.2.2 ~muonRunAction()

```
muonRunAction::~muonRunAction ( ) [virtual]
```

```
muonRunAction.cc 64 .
```

4.12.3

4.12.3.1 EndOfRunAction()

```
void muonRunAction::EndOfRunAction (
    const G4Run * run ) [virtual]
```

event

muonRunAction.cc 46 .

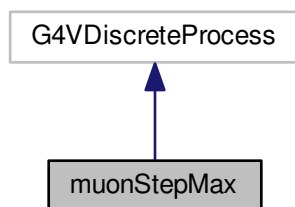
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- [include/muonRunAction.hh](#)
- [src/muonRunAction.cc](#)

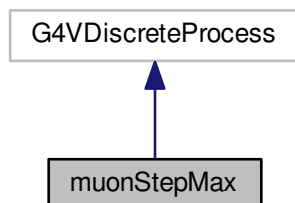
4.13 muonStepMax

```
#include <muonStepMax.hh>
```

muonStepMax :



muonStepMax :



Public

- [muonStepMax](#) (const G4String &processName="UserStepMax")
- [muonStepMax](#) (muonStepMax &)
- virtual [~muonStepMax](#) ()
- virtual G4bool [IsApplicable](#) (const G4ParticleDefinition &)
- void [SetStepMax](#) (G4double)
- G4double [GetStepMax](#) ()
- virtual G4double [PostStepGetPhysicalInteractionLength](#) (const G4Track &track, G4double previousStepSize, G4ForceCondition *condition)
- virtual G4VParticleChange * [PostStepDolt](#) (const G4Track &, const G4Step &)

Protected

- G4double [GetMeanFreePath](#) (const G4Track &, G4double, G4ForceCondition *)

Private

- [muonStepMax](#) & [operator=](#) (const [muonStepMax](#) &right)
- [muonStepMax](#) (const [muonStepMax](#) &)

Private

- G4double [fMaxChargedStep](#)

4.13.1

muonStepMax.hh 11 .

4.13.2**4.13.2.1 muonStepMax()** [1/3]

```
muonStepMax::muonStepMax (
    const G4String & processName = "UserStepMax" )
```

muonStepMax.cc 9 .

4.13.2.2 muonStepMax() [2/3]

```
muonStepMax::muonStepMax (
    muonStepMax & right )
```

muonStepMax.cc 23 .

4.13.2.3 ~muonStepMax()

```
muonStepMax::~~muonStepMax ( ) [virtual]
```

muonStepMax.cc 19 .

4.13.2.4 muonStepMax() [3/3]

```
muonStepMax::muonStepMax (
    const muonStepMax & ) [private]
```

4.13.3

4.13.3.1 GetMeanFreePath()

```
G4double muonStepMax::GetMeanFreePath (
    const G4Track & ,
    G4double ,
    G4ForceCondition * ) [protected]
```

muonStepMax.cc 65 .

4.13.3.2 GetStepMax()

```
G4double muonStepMax::GetStepMax ( ) [inline]
```

muonStepMax.hh 24 .

4.13.3.3 IsApplicable()

```
G4bool muonStepMax::IsApplicable (
    const G4ParticleDefinition & particle ) [virtual]
```

muonStepMax.cc 27 .

4.13.3.4 operator=()

```
muonStepMax& muonStepMax::operator= (
    const muonStepMax & right ) [private]
```

4.13.3.5 PostStepDoIt()

```
G4VParticleChange * muonStepMax::PostStepDoIt (
    const G4Track & aTrack,
    const G4Step & ) [virtual]
```

muonStepMax.cc 55 .

4.13.3.6 PostStepGetPhysicalInteractionLength()

```
G4double muonStepMax::PostStepGetPhysicalInteractionLength (
    const G4Track & track,
    G4double previousStepSize,
    G4ForceCondition * condition ) [virtual]
```

muonStepMax.cc 38 .

4.13.3.7 SetStepMax()

```
void muonStepMax::SetStepMax (
    G4double step )
```

muonStepMax.cc 34 .

4.13.4

4.13.4.1 fMaxChargedStep

```
G4double muonStepMax::fMaxChargedStep [private]
```

muonStepMax.hh 44 .

:

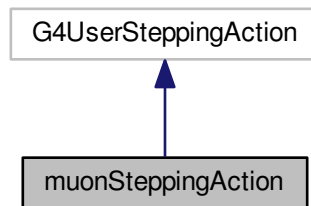
- [include/muonStepMax.hh](#)
- [src/muonStepMax.cc](#)

4.14 muonSteppingAction

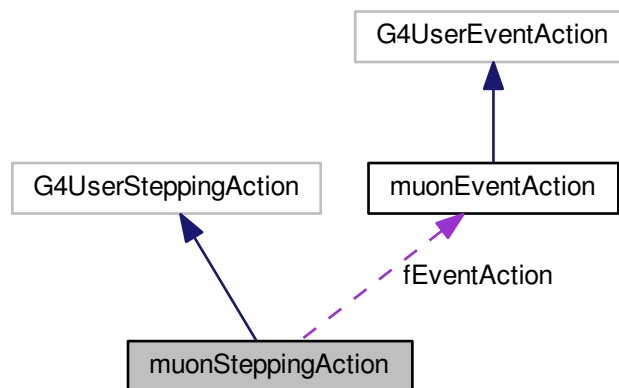
stepping action

```
#include <muonSteppingAction.hh>
```

muonSteppingAction :



muonSteppingAction :



Public

- [muonSteppingAction](#) ([muonEventAction](#) *eventAction)
- virtual [~muonSteppingAction](#) ()
- virtual void [UserSteppingAction](#) (const G4Step *)

Private

- [muonEventAction](#) * fEventAction

4.14.1

stepping action

muonSteppingAction.hh 18 .

4.14.2

4.14.2.1 muonSteppingAction()

```
muonSteppingAction::muonSteppingAction (
    muonEventAction * eventAction )
```

muonSteppingAction.cc 15 .

4.14.2.2 ~muonSteppingAction()

```
muonSteppingAction::~~muonSteppingAction ( ) [virtual]
```

muonSteppingAction.cc 19 .

4.14.3

4.14.3.1 UserSteppingAction()

```
void muonSteppingAction::UserSteppingAction (
    const G4Step * theStep ) [virtual]
```

muonSteppingAction.cc 27 .

4.14.4

4.14.4.1 fEventAction

```
muonEventAction* muonSteppingAction::fEventAction [private]
```

```
muonSteppingAction.hh 28 .
```

```
:
```

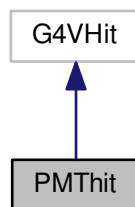
- [include/muonSteppingAction.hh](#)
- [src/muonSteppingAction.cc](#)

4.15 PMThit

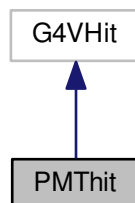
pmt Hit

```
#include <PMThit.hh>
```

PMThit :



PMThit :



Public

- void * [operator new](#) (size_t)
- void [operator delete](#) (void *)
- void [SetDeltaEnergy](#) (G4double deltaE)
- void [SetTime](#) (G4double time)
- void [SetPosition](#) (G4ThreeVector pos)
- void [SetName](#) (G4String name)
- G4double [GetDeltaEnergy](#) () const
- G4double [GetTime](#) () const
- G4ThreeVector [GetPosition](#) () const
- G4String [GetName](#) () const

Private

- G4double [fDeltaEnergy](#)
- G4double [fTime](#)
- G4ThreeVector [fPosition](#)
- G4String [fname](#)

4.15.1

pmt Hit

Hit

PMThit.hh 20 .

4.15.2

4.15.2.1 GetDeltaEnergy()

```
G4double PMThit::GetDeltaEnergy ( ) const [inline]
```

PMThit.hh 32 .

4.15.2.2 GetName()

```
G4String PMThit::GetName ( ) const [inline]
```

PMThit.hh 35 .

4.15.2.3 GetPosition()

```
G4ThreeVector PMThit::GetPosition ( ) const [inline]
```

PMThit.hh 34 .

4.15.2.4 GetTime()

```
G4double PMThit::GetTime ( ) const [inline]
```

PMThit.hh 33 .

4.15.2.5 operator delete()

```
void PMThit::operator delete (
    void * aHit ) [inline]
```

PMThit.hh 56 .

4.15.2.6 operator new()

```
void * PMThit::operator new (
    size_t ) [inline]
```

PMThit.hh 47 .

4.15.2.7 SetDeltaEnergy()

```
void PMThit::SetDeltaEnergy (
    G4double deltaE ) [inline]
```

PMThit.hh 27 .

4.15.2.8 SetName()

```
void PMThit::SetName (
    G4String name ) [inline]
```

PMThit.hh 30 .

4.15.2.9 SetPosition()

```
void PMThit::SetPosition (
    G4ThreeVector pos ) [inline]
```

PMThit.hh 29 .

4.15.2.10 SetTime()

```
void PMThit::SetTime (
    G4double time ) [inline]
```

PMThit.hh 28 .

4.15.3

4.15.3.1 fDeltaEnergy

```
G4double PMThit::fDeltaEnergy [private]
```

PMThit.hh 37 .

4.15.3.2 fname

```
G4String PMThit::fname [private]
```

PMThit.hh 40 .

4.15.3.3 fPosition

```
G4ThreeVector PMThit::fPosition [private]
```

PMThit.hh 39 .

4.15.3.4 fTime

```
G4double PMThit::fTime [private]
```

PMThit.hh 38 .

:

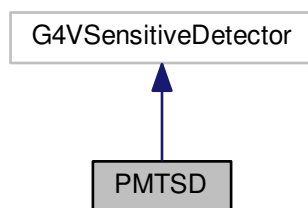
- include/PMThit.hh

4.16 PMTSD

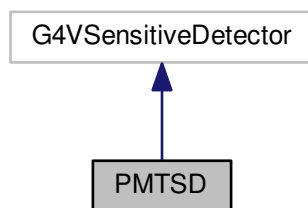
pmt

```
#include <PMTSD.hh>
```

PMTSD :



PMTSD :



Public

- [PMTSD](#) (G4String name)
- void [Initialize](#) (G4HCofThisEvent *) override

Protected

- G4bool [ProcessHits](#) (G4Step *aStep, G4TouchableHistory *ROhist) override

Private

- [pmtHitsCollection](#) * [fHitsCollection](#) { nullptr }
- G4int [fHitsCollectionId](#) { -1 }

4.16.1

pmt

PMTSD.hh 17 .

4.16.2**4.16.2.1 PMTSD()**

```
PMTSD::PMTSD (
    G4String name )
```

muon pmt pmt name/pmt_energy_time

<i>name</i>	pmt
-------------	-----

PMTSD.cc 21 .

4.16.3**4.16.3.1 Initialize()**

```
void PMTSD::Initialize (
    G4HCofThisEvent * hcof ) [override]
```

PMTSD.cc 84 .

4.16.3.2 ProcessHits()

```
G4bool PMTSD::ProcessHits (
    G4Step * aStep,
    G4TouchableHistory * ROhist ) [override], [protected]
```

PMTSD.cc 29 .

4.16.4

4.16.4.1 fHitsCollection

```
pmtHitsCollection* PMTSD::fHitsCollection { nullptr } [private]
```

PMTSD.hh 28 .

4.16.4.2 fHitsCollectionId

```
G4int PMTSD::fHitsCollectionId { -1 } [private]
```

PMTSD.hh 29 .

:

- [include/PMTSD.hh](#)
- [src/PMTSD.cc](#)

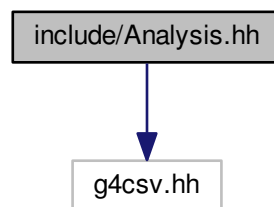
Chapter 5

5.1 include/Analysis.hh

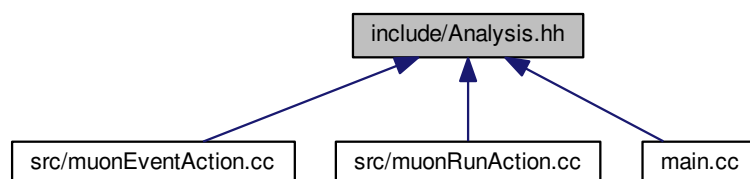
root csv

```
#include "g4csv.hh"
```

Analysis.hh (Include):



:



5.1.1

root csv

loyxin

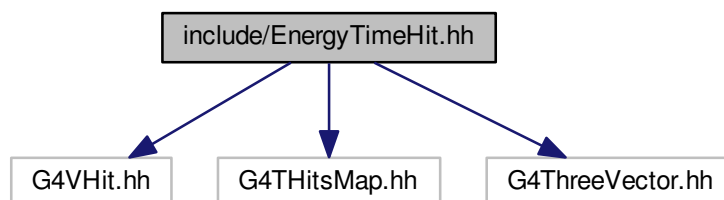
1.0

2017-09-10

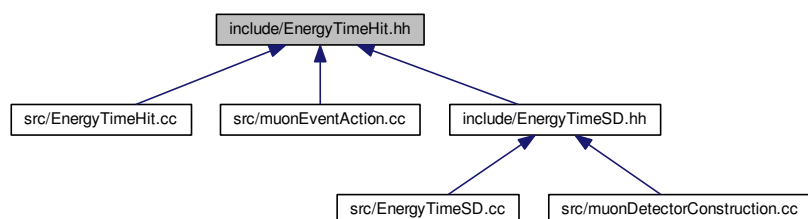
5.2 include/EnergyTimeHit.hh

muon detector Hit

```
#include <G4VHit.hh>
#include <G4THitsMap.hh>
#include <G4ThreeVector.hh>
EnergyTimeHit.hh (Include):
```



:



- class `EnergyTimeHit`
muon detector Hit
- using `EnergyTimeHitsCollection` = `G4THitsCollection`< `EnergyTimeHit` >
- `G4ThreadLocal G4Allocator`< `EnergyTimeHit` > * `hitAllocator`

5.2.1

muon detector Hit

Hit

loyxin

1.0

2017-09-10

5.2.2

5.2.2.1 `EnergyTimeHitsCollection`

using `EnergyTimeHitsCollection` = `G4THitsCollection`<`EnergyTimeHit`>

`EnergyTimeHit.hh` 76 .

5.2.3

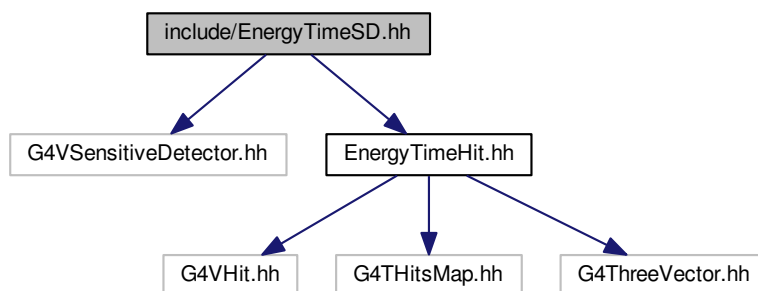
5.2.3.1 hitAllocator

```
G4ThreadLocal G4Allocator<EnergyTimeHit>* hitAllocator
```

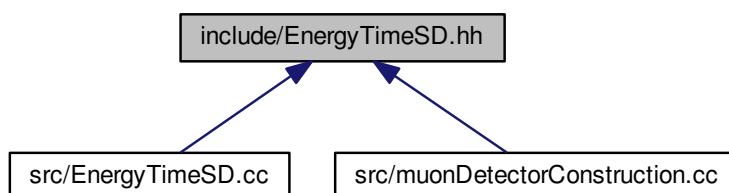
EnergyTimeHit.cc 9.

5.3 include/EnergyTimeSD.hh

```
#include <G4VSensitiveDetector.hh>
#include "EnergyTimeHit.hh"
EnergyTimeSD.hh (Include):
```



:



- class [EnergyTimeSD](#)

5.3.1

loyxin

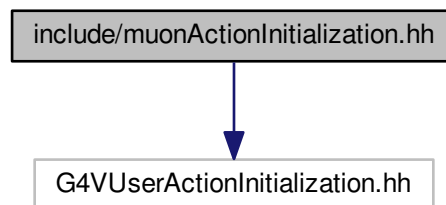
1.0

2017-09-10

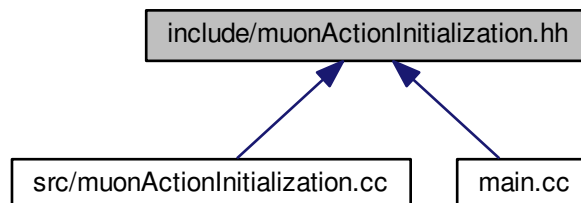
5.4 include/muonActionInitialization.hh

action

```
#include <G4VUserActionInitialization.hh>  
muonActionInitialization.hh (Include):
```



:



- class `muonActionInitialization`
action

5.4.1

action

loyxin

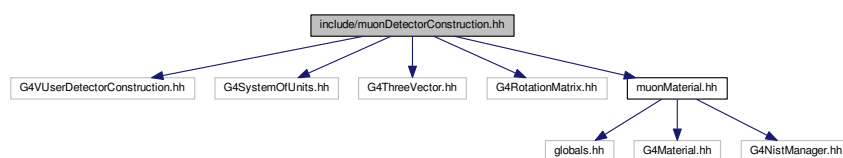
1.0

2017-09-10

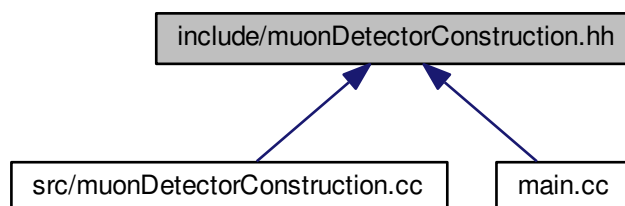
5.5 `include/muonDetectorConstruction.hh`

Detector Construction

```
#include <G4VUserDetectorConstruction.hh>
#include <G4SystemOfUnits.hh>
#include <G4ThreeVector.hh>
#include <G4RotationMatrix.hh>
#include "muonMaterial.hh"
muonDetectorConstruction.hh (Include):
```



:



- class `muonDetectorConstruction`
Detector Construction

5.5.1

Detector Construction

loyxin

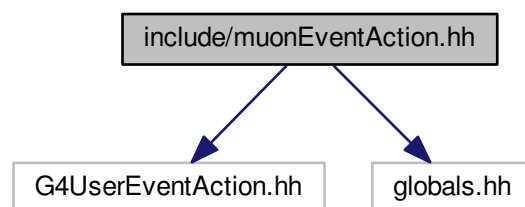
1.0

2017-09-10

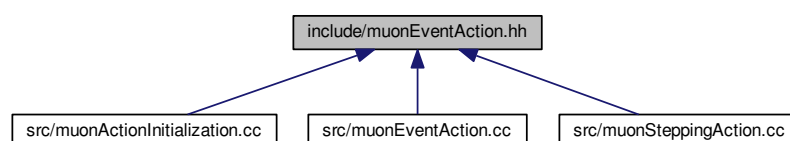
5.6 include/muonEventAction.hh

Event action Ntuple

```
#include <G4UserEventAction.hh>
#include <globals.hh>
muonEventAction.hh (Include):
```



:



- class `muonEventAction`
Ntuple

5.6.1

Event action Ntuple

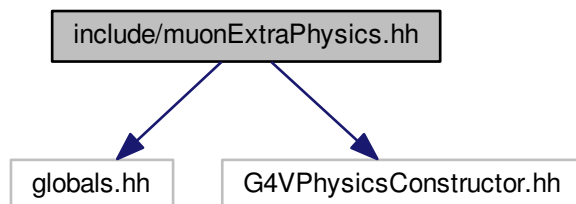
loyxin

1.0

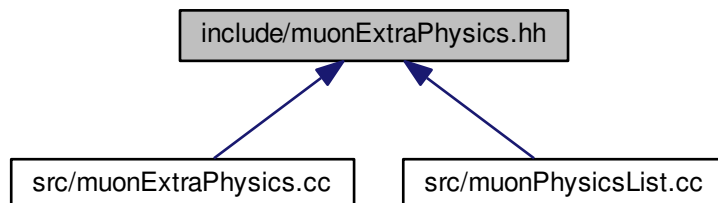
2017-09-10

5.7 include/muonExtraPhysics.hh

```
#include "globals.hh"  
#include "G4VPhysicsConstructor.hh"  
muonExtraPhysics.hh (Include):
```



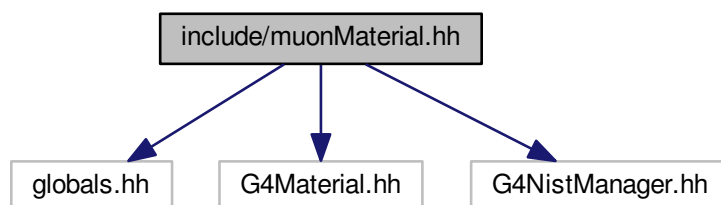
:



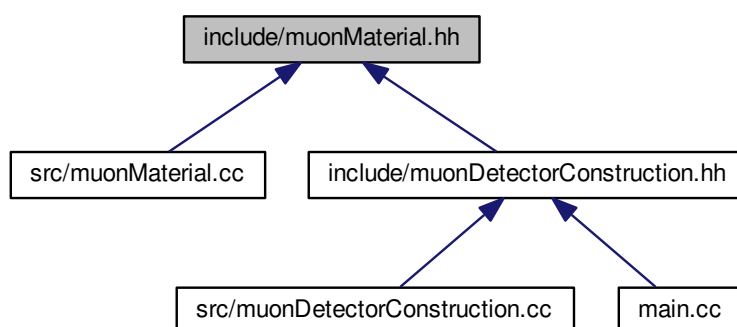
- class `muonExtraPhysics`

5.8 include/muonMaterial.hh

```
#include "globals.hh"  
#include "G4Material.hh"  
#include "G4NistManager.hh"  
muonMaterial.hh (Include):
```



:



- class `muonMaterial`

5.8.1

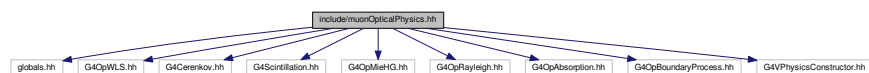
loyxin

1.0

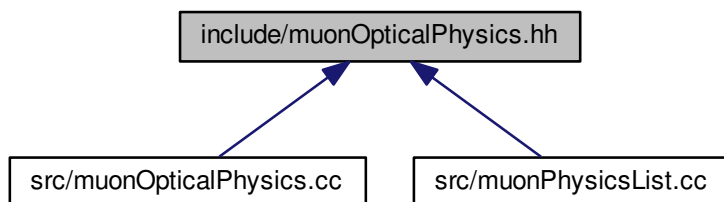
2017-09-10

5.9 include/muonOpticalPhysics.hh

```
#include "globals.hh"
#include "G4OpWLS.hh"
#include "G4Cerenkov.hh"
#include "G4Scintillation.hh"
#include "G4OpMieHG.hh"
#include "G4OpRayleigh.hh"
#include "G4OpAbsorption.hh"
#include "G4OpBoundaryProcess.hh"
#include "G4VPhysicsConstructor.hh"
muonOpticalPhysics.hh (Include):
```



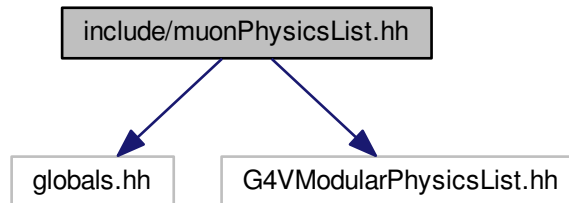
:



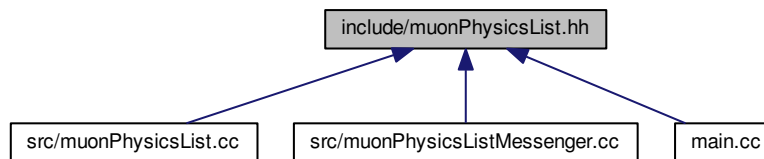
- class [muonOpticalPhysics](#)

5.10 include/muonPhysicsList.hh

```
#include "globals.hh"
#include "G4VModularPhysicsList.hh"
muonPhysicsList.hh (Include):
```



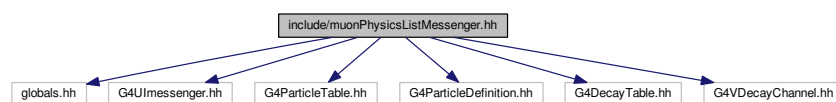
:



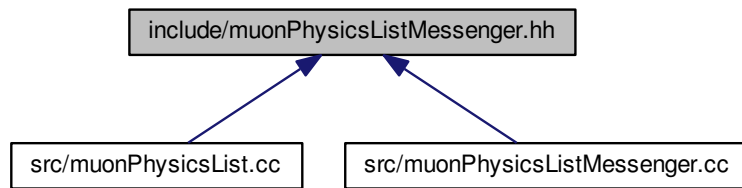
- class [muonPhysicsList](#)

5.11 include/muonPhysicsListMessenger.hh

```
#include "globals.hh"
#include "G4UImessenger.hh"
#include "G4ParticleTable.hh"
#include "G4ParticleDefinition.hh"
#include "G4DecayTable.hh"
#include "G4VDecayChannel.hh"
muonPhysicsListMessenger.hh (Include):
```



:



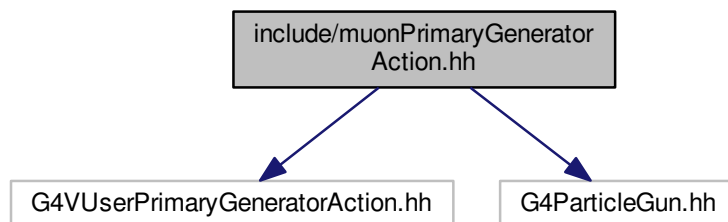
- class `muonPhysicsListMessenger`

Provide control of the physics list and cut parameters

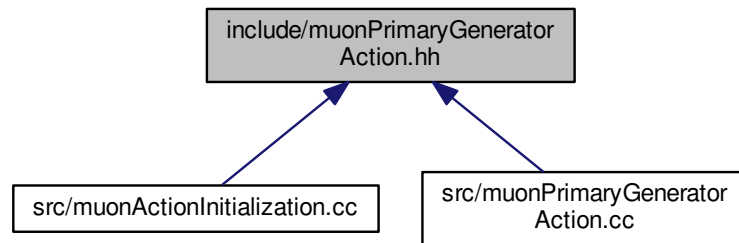
5.12 include/muonPrimaryGeneratorAction.hh

Gun

```
#include <G4VUserPrimaryGeneratorAction.hh>
#include <G4ParticleGun.hh>
muonPrimaryGeneratorAction.hh (Include):
```



:



- class `muonPrimaryGeneratorAction`

5.12.1

Gun

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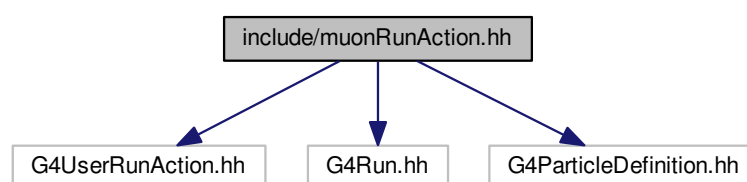
1.0

2017-09-10

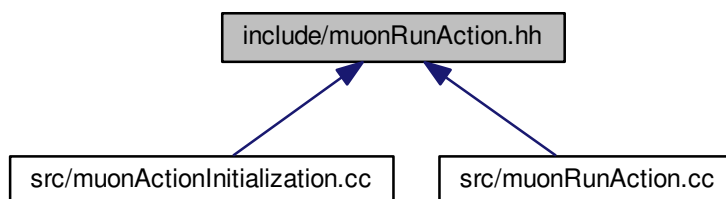
5.13 include/muonRunAction.hh

run action

```
#include <G4UserRunAction.hh>
#include <G4Run.hh>
#include <G4ParticleDefinition.hh>
muonRunAction.hh (Include):
```



:



- class [muonRunAction](#)

5.13.1

run action

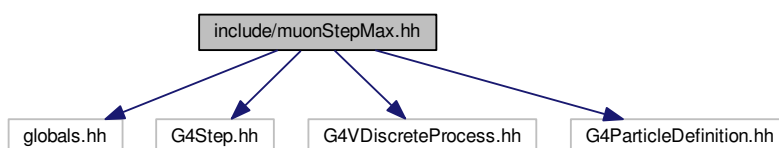
loyxin

1.0

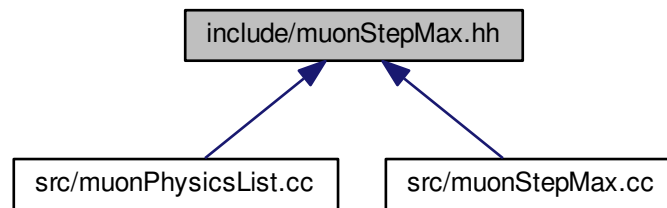
2017-09-10

5.14 include/muonStepMax.hh

```
#include "globals.hh"
#include "G4Step.hh"
#include "G4VDiscreteProcess.hh"
#include "G4ParticleDefinition.hh"
muonStepMax.hh (Include):
```



:

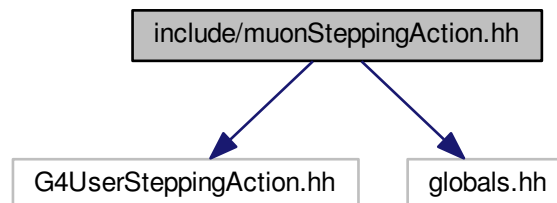


- class `muonStepMax`

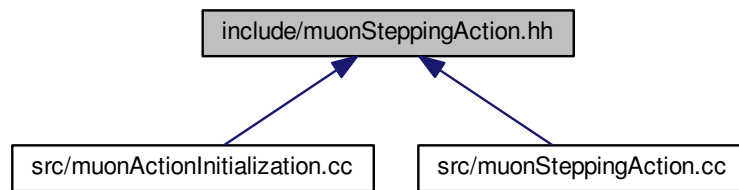
5.15 include/muonSteppingAction.hh

stepping action

```
#include <G4UserSteppingAction.hh>
#include <globals.hh>
muonSteppingAction.hh (Include):
```



:



- class `muonSteppingAction`
stepping action

5.15.1

stepping action

loyxin

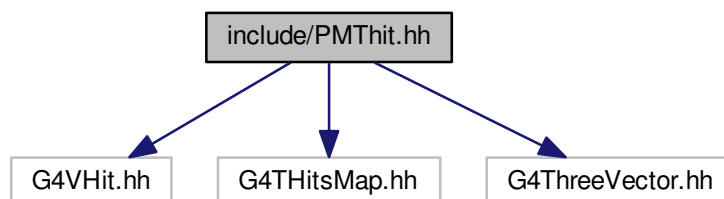
1.0

2017-09-10

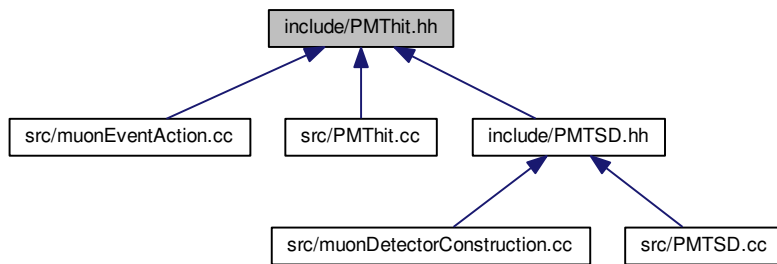
5.16 include/PMThit.hh

pmt Hit

```
#include <G4VHit.hh>
#include <G4THitsMap.hh>
#include <G4ThreeVector.hh>
PMThit.hh (Include):
```



:



- class `PMThit`
pmt Hit
- using `pmtHitsCollection` = `G4THitsCollection< PMThit >`
- `G4ThreadLocal G4Allocator< PMThit > * pmthitAllocat`

5.16.1

pmt Hit

Hit

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1.0

2017-09-10

5.16.2

5.16.2.1 pmtHitsCollection

```
using pmtHitsCollection = G4THitsCollection<PMThit>
PMThit.hh 43 .
```

5.16.3

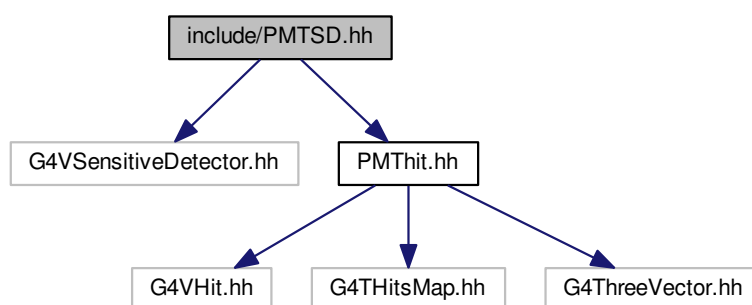
5.16.3.1 pmthitAllocat

```
G4ThreadLocal G4Allocator<PMThit>* pmthitAllocat
PMThit.cc 9 .
```

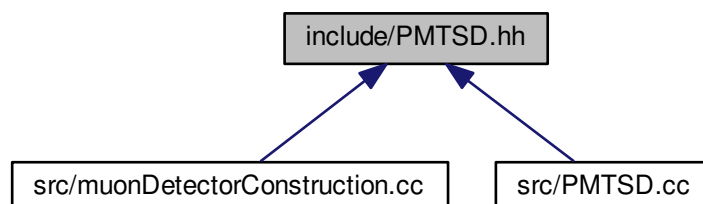
5.17 include/PMTSD.hh

pmt

```
#include <G4VSensitiveDetector.hh>
#include "PMThit.hh"
PMTSD.hh (Include):
```



:



- class **PMTSD**
 pmt

5.17.1

pmt

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1.0

2017-09-10

5.18 main.cc

main file

```
#include <G4RunManager.hh>
#include <G4UImanager.hh>
#include <G4VisExecutive.hh>
#include <G4UIExecutive.hh>
#include <G4ScoringManager.hh>
#include <G4String.hh>
#include <G4VUserPhysicsList.hh>
#include <Randomize.hh>
#include <vector>
#include "Analysis.hh"
#include "muonDetectorConstruction.hh"
#include "muonActionInitialization.hh"
#include "muonPhysicsList.hh"
```

main.cc (Include):



- `int main (int argc, char **argv)`
main function

5.18.1

main file

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-i runManager

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2017-09-10

5.18.2

5.18.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

main function

-i runManager

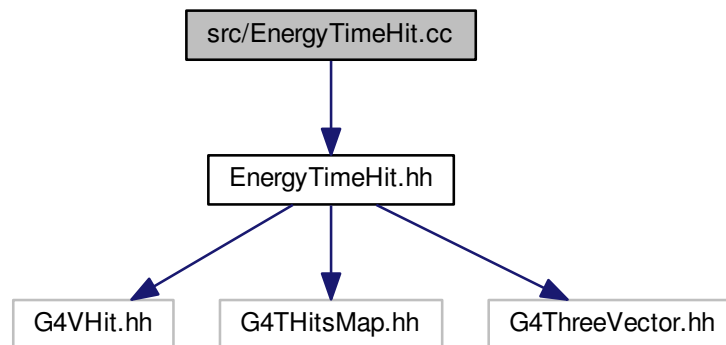
<i>argc</i>	
<i>argv</i>	

main.cc 51 .

5.19 src/EnergyTimeHit.cc

```
#include "EnergyTimeHit.hh"
```

EnergyTimeHit.cc (Include):



- `G4ThreadLocal G4Allocator< EnergyTimeHit > * hitAllocator = nullptr`

5.19.1

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5.19.2

5.19.2.1 hitAllocator

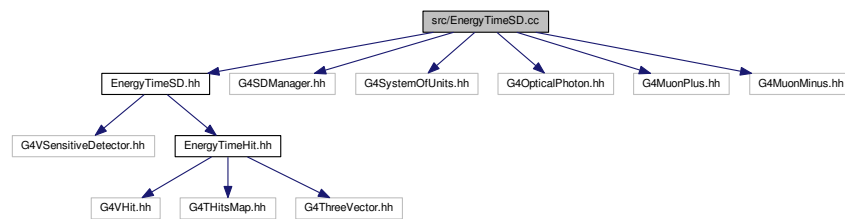
```
G4ThreadLocal G4Allocator<EnergyTimeHit>* hitAllocator = nullptr
```

EnergyTimeHit.cc 9 .

5.20 src/EnergyTimeSD.cc

```
#include "EnergyTimeSD.hh"
#include <G4SDManager.hh>
#include <G4SystemOfUnits.hh>
#include <G4OpticalPhoton.hh>
#include <G4MuonPlus.hh>
#include <G4MuonMinus.hh>
```

EnergyTimeSD.cc (Include):



5.20.1

muon name/energy_time

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5.21 src/muonActionInitialization.cc

action

```
#include "muonActionInitialization.hh"
#include "muonPrimaryGeneratorAction.hh"
#include "muonRunAction.hh"
#include "muonEventAction.hh"
#include "muonSteppingAction.hh"
```

muonActionInitialization.cc (Include):



5.21.1

action

runaction eventaction steppingaction primary generator

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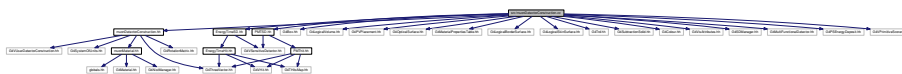
2017-09-10

5.22 src/muonDetectorConstruction.cc

```

#include "muonDetectorConstruction.hh"
#include <G4Box.hh>
#include <G4LogicalVolume.hh>
#include <G4PVPlacement.hh>
#include <G4OpticalSurface.hh>
#include <G4MaterialPropertiesTable.hh>
#include <G4LogicalBorderSurface.hh>
#include <G4LogicalSkinSurface.hh>
#include <G4Trd.hh>
#include <G4SubtractionSolid.hh>
#include <G4Colour.hh>
#include <G4VisAttributes.hh>
#include "EnergyTimeSD.hh"
#include "PMTSD.hh"
#include <G4SDManager.hh>
#include <G4MultiFunctionalDetector.hh>
#include <G4PSEnergyDeposit.hh>
#include <G4VPrimitiveScorer.hh>
muonDetectorConstruction.cc (Include):

```



5.22.1

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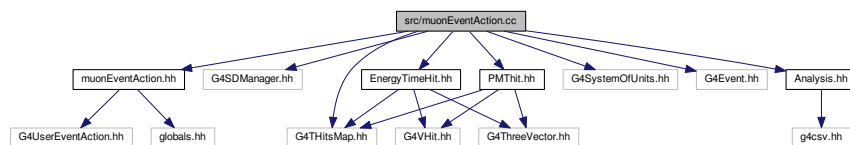
1.0

2017-09-10

5.23 src/muonEventAction.cc

CSV

```
#include "muonEventAction.hh"
#include <G4SDManager.hh>
#include <G4THitsMap.hh>
#include <G4SystemOfUnits.hh>
#include <G4Event.hh>
#include "Analysis.hh"
#include "EnergyTimeHit.hh"
#include "PMThit.hh"
muonEventAction.cc (Include):
```



5.23.1

CSV

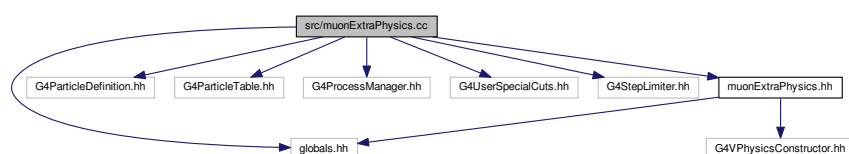
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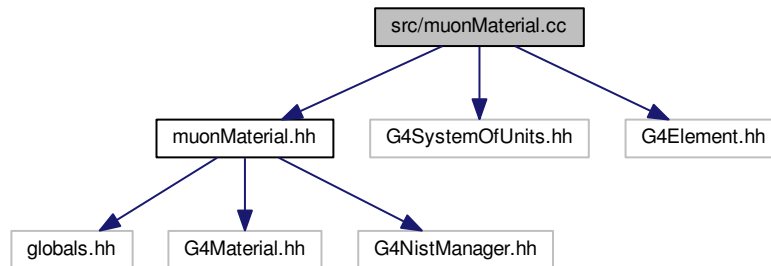
5.24 src/muonExtraPhysics.cc

```
#include "globals.hh"
#include "G4ParticleDefinition.hh"
#include "G4ParticleTable.hh"
#include "G4ProcessManager.hh"
#include "G4UserSpecialCuts.hh"
#include "G4StepLimiter.hh"
#include "muonExtraPhysics.hh"
muonExtraPhysics.cc (Include):
```



5.25 src/muonMaterial.cc

```
#include "muonMaterial.hh"
#include <G4SystemOfUnits.hh>
#include <G4Element.hh>
muonMaterial.cc (Include):
```



5.25.1

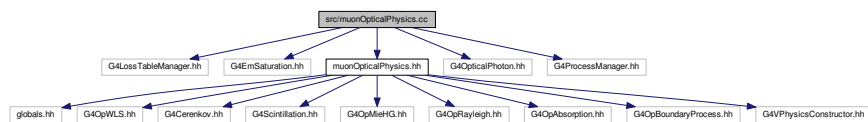
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1.0

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5.26 src/muonOpticalPhysics.cc

```
#include "G4LossTableManager.hh"
#include "G4EmSaturation.hh"
#include "muonOpticalPhysics.hh"
#include "G4OpticalPhoton.hh"
#include "G4ProcessManager.hh"
muonOpticalPhysics.cc (Include):
```



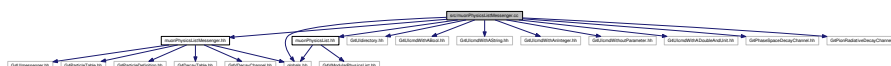
5.27 src/muonPhysicsList.cc

```
#include "muonPhysicsList.hh"
#include "muonPhysicsListMessenger.hh"
#include "muonExtraPhysics.hh"
#include "muonOpticalPhysics.hh"
#include "G4LossTableManager.hh"
#include "G4ProcessManager.hh"
#include "G4ParticleTypes.hh"
#include "G4ParticleTable.hh"
#include "FTFP_BERT.hh"
#include "QGSP_BERT_HP.hh"
#include "G4Gamma.hh"
#include "G4Electron.hh"
#include "G4Positron.hh"
#include "muonStepMax.hh"
#include "G4ProcessTable.hh"
#include "G4PionDecayMakeSpin.hh"
#include "G4DecayWithSpin.hh"
#include "G4DecayTable.hh"
#include "G4MuonDecayChannelWithSpin.hh"
#include "G4MuonRadiativeDecayChannelWithSpin.hh"
#include "G4RadioactiveDecayPhysics.hh"
#include "G4SystemOfUnits.hh"
muonPhysicsList.cc (Include):
```



5.28 src/muonPhysicsListMessenger.cc

```
#include "globals.hh"
#include "muonPhysicsListMessenger.hh"
#include "muonPhysicsList.hh"
#include "G4UIIdirectory.hh"
#include "G4UIcmdWithABool.hh"
#include "G4UIcmdWithAString.hh"
#include "G4UIcmdWithAnInteger.hh"
#include "G4UIcmdWithoutParameter.hh"
#include "G4UIcmdWithADoubleAndUnit.hh"
#include "G4PhaseSpaceDecayChannel.hh"
#include "G4PionRadiativeDecayChannel.hh"
muonPhysicsListMessenger.cc (Include):
```

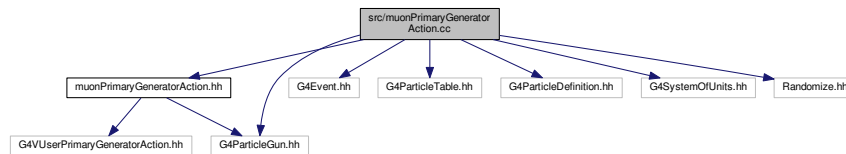


5.29 src/muonPrimaryGeneratorAction.cc

mu- 150 MeV


```
#include "muonPrimaryGeneratorAction.hh"
#include "G4Event.hh"
#include "G4ParticleGun.hh"
#include "G4ParticleTable.hh"
#include "G4ParticleDefinition.hh"
#include "G4SystemOfUnits.hh"
#include "Randomize.hh"
```

muonPrimaryGeneratorAction.cc (Include):



5.29.1

mu- 150 MeV

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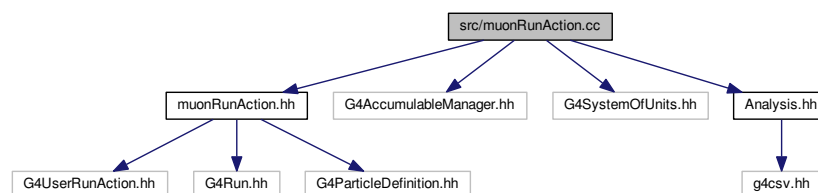
2017-09-10

5.30 src/muonRunAction.cc

CSV

```
#include "muonRunAction.hh"
#include <G4AccumulableManager.hh>
#include <G4SystemOfUnits.hh>
#include "Analysis.hh"
```

muonRunAction.cc (Include):



5.30.1

CSV

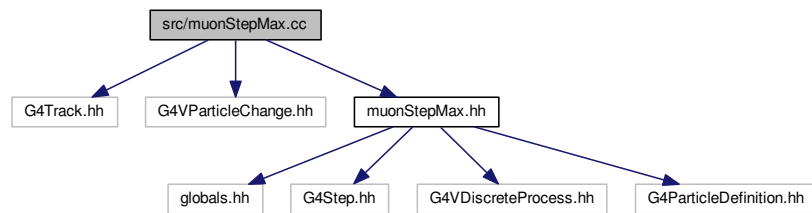
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5.31 src/muonStepMax.cc

```
#include "G4Track.hh"
#include "G4VParticleChange.hh"
#include "muonStepMax.hh"
muonStepMax.cc (Include):
```



5.32 src/muonSteppingAction.cc

```
#include "muonSteppingAction.hh"
#include "muonEventAction.hh"
#include "G4Step.hh"
#include "G4Event.hh"
#include <G4StepPoint.hh>
#include "globals.hh"
#include <G4Track.hh>
#include <G4AntiNeutrinoE.hh>
#include <G4VPhysicalVolume.hh>
#include <G4MuonMinus.hh>
muonSteppingAction.cc (Include):
```



5.32.1

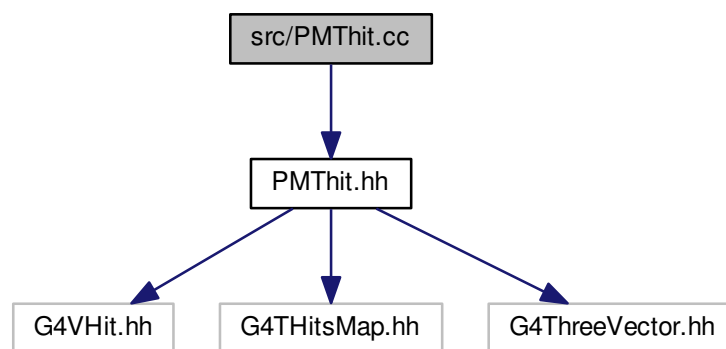
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5.33 src/PMThit.cc

```
#include "PMThit.hh"  
PMThit.cc (Include):
```



- `G4ThreadLocal G4Allocator< PMThit > * pmthitAllocat = nullptr`

5.33.1

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5.33.2

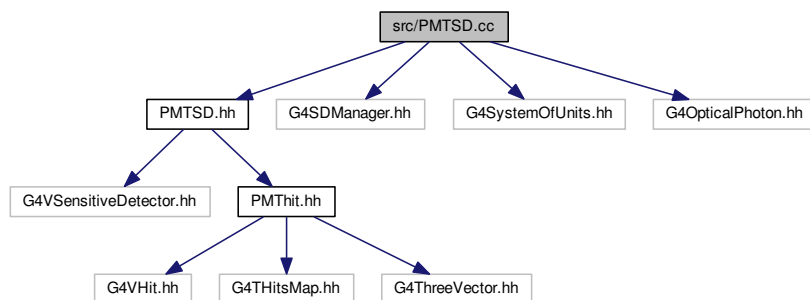
5.33.2.1 pmthitAllocat

```
G4ThreadLocal G4Allocator<PMThit>* pmthitAllocat = nullptr
```

PMThit.cc 9 .

5.34 src/PMTSD.cc

```
#include "PMTSD.hh"
#include <G4SDManager.hh>
#include <G4SystemOfUnits.hh>
#include <G4OpticalPhoton.hh>
PMTSD.cc (Include):
```



5.34.1

```
muon pmt pmt name/pmt_energy_time
```

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1.0

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