

## Physics Parameters for Radiation Therapy Applications

### 1) Standard EM Physics list

Use the “Standard Physics List option 3” configuration available in :

\$G4INSTALL/source/physics\_lists/builders/src/G4EmStandardPhysics\_option3.cc

Particle	Process
<b>gamma</b>	G4PhotoElectric
	G4ComptonScattering
	G4GammaConversion
	G4RayleighScattering

Particle	Process	Parameters		
		MSC model	Urban93	default
<b>e-</b>	G4eMultipleScattering	Step Limit Type		fUseDistanceToBoundary <b>default = fUseSafety</b>
		Range Factor		0.04 default
		Geom Factor		2.5 default
		Skin		1 default
		Step Function		dRR 0.2 default
	G4eIonisation	fR		0.1 mm <b>default = 1mm</b>
		Linear Loss Limit		0.01 default
	G4eBremsstrahlung	---		

Particle	Process	Parameters		
		MSC model	Urban93	default
<b>e+</b>	G4eMultipleScattering	Step Limit Type		fUseDistanceToBoundary <b>default = fUseSafety</b>
		Range Factor		0.04 default
		Geom Factor		2.5 default
		Skin		1 default
		Step Function		dRR 0.2 default
	G4eIonisation	fR		0.1 mm <b>default = 1mm</b>
		Linear Loss Limit		0.01 default
	G4eBremsstrahlung	---		
G4eplusAnnihilation	---			

ElectroMagnetic option	Value	
Min Energy	100 eV	default
Max Energy	10 TeV	default
dE/dx table binning	220	<b>default = 84</b>
Lambda table binning	220	<b>default = 84</b>

## 2) User Limits

✓ ALWAYS use Random Energy Deposition

✓ Recommended Values:

User Limit	Continuous Phantom	Voxelized Phantom
Cut	<1/50 dosel size	<1/20 dosel size
Maximum Step Size	<1/50 dosel size	None

## 3) References

L Maigne, Y Perrot, D R Schaart, D Donnarieix, V Breton, "GATE/GEANT4 validation for mono-energetic electron dose point kernels and pencil beam kernels between 15 keV and 20 MeV", *Phys. Med. Biol.* 56 (2011) 811-827.

## 4) GATE implementation

```
#####
# Physics #
#####

/gate/physics/addProcess PhotoElectric
/gate/physics/processes/PhotoElectric/setModel StandardModel

/gate/physics/addProcess Compton
/gate/physics/processes/Compton/setModel StandardModel

/gate/physics/addProcess GammaConversion
/gate/physics/processes/GammaConversion/setModel StandardModel

/gate/physics/addProcess ElectronIonisation
/gate/physics/processes/ElectronIonisation/setModel StandardModel e-
/gate/physics/processes/ElectronIonisation/setModel StandardModel e+

/gate/physics/addProcess Bremsstrahlung e-
/gate/physics/addProcess Bremsstrahlung e+
/gate/physics/processes/Bremsstrahlung/setModel StandardModel e-
/gate/physics/processes/Bremsstrahlung/setModel StandardModel e+

/gate/physics/addProcess PositronAnnihilation e+

/gate/physics/addProcess eMultipleScattering e+
/gate/physics/addProcess eMultipleScattering e-

/gate/physics/processes/eMultipleScattering/setGeometricalStepLimiterType e- distanceToBoundary
/gate/physics/processes/eMultipleScattering/setGeometricalStepLimiterType e+ distanceToBoundary

/gate/physics/setEMin 0.1 keV
/gate/physics/setEMax 10 GeV
/gate/physics/setDEDX Binning 220
/gate/physics/setLambda Binning 220

/gate/physics/processList Enabled
/gate/physics/processList Initialized

#####
# Cuts #
#####

/gate/physics/Gamma/SetCutInRegion patient 1.0 mm
/gate/physics/Electron/SetCutInRegion patient 1.0 mm
/gate/physics/processes/ElectronIonisation/setStepFunction e- 0.2 0.1 mm
```

```
#####  
# Step Max #  
#####
```

```
/gate/physics/SetMaxStepSizeInRegion patient 0.02 mm  
/gate/physics/ActivateStepLimiter e-
```