



PRELIMINARY Update on validation test of Geant4 electron backscattering simulation over geant4-10-02-cand-03

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WORK IN PROGRESS

Preliminary analysis

Production and data analysis

● Production with Geant4 10.2-cand-03

- Same mass model as in previous reports
- Same physics configuration options as in previous reports
- Additional physics configuration option using G4eSingleCoulombScattering (*M. Tacconi et al., MI-Bicocca*)
- Smooth production, no apparent problems encountered so far

● Data analysis: as usual, GoF + categorical

- At this stage automated GOF analysis only, no further detailed investigation yet
- Categorical analysis in progress

Efficiency **PRELIMINARY**

Fraction of test cases with p-value>0.01 from GoF tests of compatibility with experiment (*Anderson-Darling*)

		10.1p02	10.2c3 Molière	10.2c3 PWA
<20 keV	GS (<i>uSPlus</i>)		0.57 ± 0.04	0.15 ± 0.03
	GSBRF	0.35 ± 0.04	0.38 ± 0.04	0.39 ± 0.04
	GSERF (<i>uS</i>)		0.32 ± 0.04	0.44 ± 0.04
	G4EmStandardPhysicsGS		0.58 ± 0.04	
20-100 keV	GS (<i>uSPlus</i>)		0.18 ± 0.04	0.17 ± 0.03
	GSBRF	0.49 ± 0.05	0.46 ± 0.05	0.44 ± 0.05
	GSERF (<i>uS</i>)		0.49 ± 0.05	0.51 ± 0.05
	G4EmStandardPhysicsGS		0.18 ± 0.04	
>100 keV	GS (<i>uSPlus</i>)		0.52 ± 0.06	0.61 ± 0.06
	GSBRF	0.95 ± 0.03	0.61 ± 0.06	0.57 ± 0.06
	GSERF (<i>uS</i>)		0.63 ± 0.06	0.52 ± 0.06
	G4EmStandardPhysicsGS		0.54 ± 0.06	

In progress

- Configurations other than Goudsmit-Saunderson ones
 - Productions done, no time yet to look at the results in detail
- Categorical analysis
 - To establish the significance of observed differences in compatibility with experiment
- Attempt to extend the experimental data sample
 - Motivation: reduce the uncertainties on efficiency (*if possible*)
 - So far: confirmation of the stability of the results
- Additional physics configurations?
 - Suggestions are welcome

Pre-packaged Em PhysicsConstructors

Efficiency = fraction of test cases with p-value>0.01
from GoF tests of compatibility with experiment (*Anderson-Darling*)

PRELIMINARY

PhysicsConstructor	Version	<20 keV	20-100 keV	>100 keV
G4EmLivermorePhysics	10.1p02	0.13 ± 0.03	0.29 ± 0.04	0.61 ± 0.06
	10.2-cand03	0.11 ± 0.03	0.24 ± 0.04	0.61 ± 0.06
G4EmStandardPhysics	10.1p02	0.13 ± 0.03	0.13 ± 0.04	0.71 ± 0.06
	10.2-cand03	0.08 ± 0.03	0.19 ± 0.03	0.86 ± 0.05
G4EmStandardPhysics_option1	10.1p02	<0.03	<0.01	0.41 ± 0.06
	10.2-cand03	<0.03	<0.01	0.39 ± 0.06
G4EmStandardPhysics_option2	10.1p02	<0.03	<0.01	0.41 ± 0.06
	10.2-cand03	<0.03	<0.01	0.39 ± 0.06
G4EmStandardPhysics_option3	10.1p02	0.21 ± 0.03	0.14 ± 0.03	0.68 ± 0.06
	10.2-cand03	0.17 ± 0.03	0.19 ± 0.04	0.75 ± 0.06
G4EmStandardPhysics_option4	10.1p02	0.23 ± 0.03	0.21 ± 0.04	0.73 ± 0.06
	10.2-cand03	0.10 ± 0.03	0.24 ± 0.04	0.66 ± 0.06
G4EmStandardPhysics_WVI	10.1p02	0.45 ± 0.04	0.46 ± 0.04	0.82 ± 0.05
	10.2-cand03	0.36 ± 0.04	0.47 ± 0.05	0.82 ± 0.05
G4EmStandardPhysics_SS	10.1p02	0.46 ± 0.04	0.51 ± 0.05	0.82 ± 0.05
	10.2-cand03	0.35 ± 0.04	0.53 ± 0.05	0.82 ± 0.05
G4EmStandardPhysics_GS	10.1p02			
	10.2-cand03	0.58 ± 0.04	0.18 ± 0.04	0.54 ± 0.06

Categorical analysis

NOTE: concerns
backscattering fraction
observable **ONLY**

PRELIMINARY

Significance $\alpha = 0.01$

Is **GSBRF** in **10.2** equivalent to GSBRF in **10.1p02**
w.r.t. compatibility with experiment?

NO

p-value_{Boschloo} = 0.000009

- *Pearson χ^2*
- *Suissa-Schuster*
- *Boschloo*

Is G4EmStandardPhysics**GS**_{10.2} equivalent to **G4EmStandardPhysics**_{10.2}
w.r.t. compatibility with experiment?

NO

p-value_{Boschloo} = 0.0002

Categorical analysis

PRELIMINARY

Is **G4EmStandardPhysicsOpt3**_{10.2} equivalent to **G4EmStandardPhysics**_{10.2}
w.r.t. compatibility with experiment?

Yes

p-value_{Boschloo} = 0.18

Is **G4EmStandardPhysicsOpt4**_{10.2} equivalent to **G4EmStandardPhysics**_{10.2}
w.r.t. compatibility with experiment?

Yes

p-value_{Boschloo} = 0.02

Is **G4EmLivermorePhysics**_{10.2} equivalent to **G4EmStandardPhysics**_{10.2}
w.r.t. compatibility with experiment?

NO

p-value_{Boschloo} = 0.004

Categorical analysis PRELIMINARY

One-sided tests

H_0 : equivalent compatibility with experiment

H_1 : greater compatibility with experiment

Is G4EmStandardPhysicsOpt4_{10.2} better than **G4EmStandardPhysics**_{10.2}
w.r.t. compatibility with experiment?

NO

p-value_{Boschloo} = 0.009

Is G4EmLivermorePhysics_{10.2} better than **G4EmStandardPhysics**_{10.2}
w.r.t. compatibility with experiment?

NO

p-value_{Boschloo} = 0.002

G4eSingleCoulombScattering

- Contacted the author (*M. Tacconi*) to confirm correct usage
- Thanks to the author for the information
 - Range of applicability: > 200 keV, “medium light” target elements
 - As in test58
 - As in TestEm5
- Preliminary: no backscattering observed
 - All reflected electrons registered in the backward detector are secondary electrons