

Physics updates

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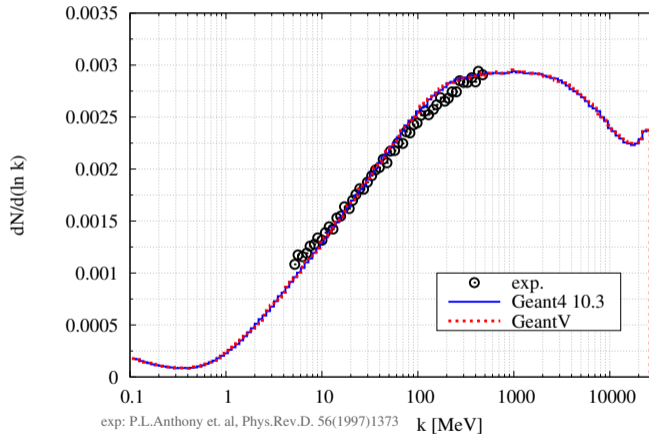
Recent important developments:

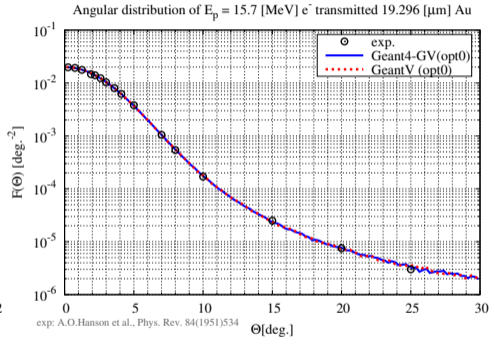
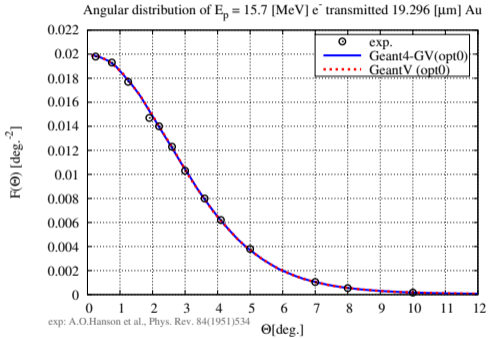
- **GEANT-242**: real-physics material description is used everywhere (`vecgeom::Material` is removed)
- **GEANT-174**: multiple Coulomb scattering model and the corresponding process has been implemented
- **GEANT-173**: msc is part of the default physics list (for e^-e^+ beyond ionisation and bremsstrahlung)
- incoherent scattering of photons (**GEANT-372**) and "low-energy" model to describe conversion of photons into e^-e^+ pair (**GEANT-317**) have also been implemented and they are included into the default physics list

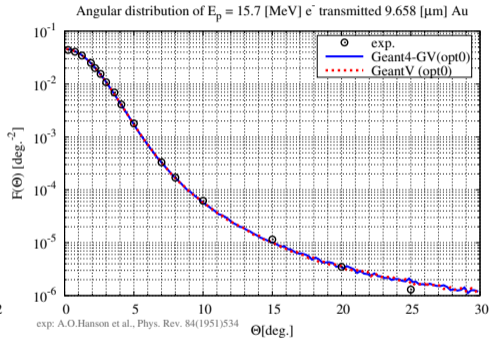
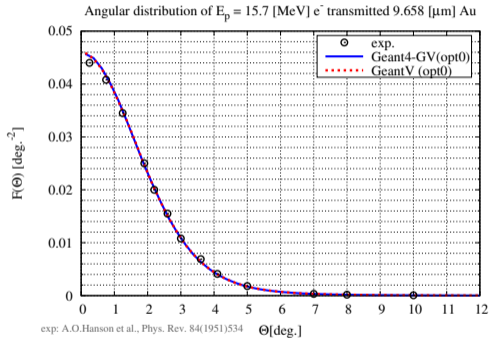
Current State

particle	processes	model(s)	
		GeantV	Geant4
e^-	ionisation	Møller [100eV-100TeV]	Møller [100eV-100TeV]
	bremsstrahlung	Seltzer-Berger [1keV-1GeV]	Seltzer-Berger [1keV-1GeV]
		Tsai (Bethe-Heitler) w. LPM. [1GeV-100TeV]	Tsai (Bethe-Heitler) w. LPM. [1GeV-100TeV]
Coulomb sc.	GS MSC model [100eV-100TeV]	GS MSC model [100eV-100MeV] Mixed model [100MeV-100TeV]	
e^+	ionisation	Bhabha [100eV-100TeV]	Bhabha [100eV-100TeV]
	bremsstrahlung	Seltzer-Berger [1keV-1GeV]	Seltzer-Berger [1keV-1GeV]
		Tsai (Bethe-Heitler) w. LPM. [1GeV-100TeV]	Tsai (Bethe-Heitler) w. LPM. [1GeV-100TeV]
	Coulomb sc.	GS MSC model [100eV-100TeV]	GS MSC model [100eV-100MeV] Mixed model [100MeV-100TeV]
annihilation	-	Heitler (2γ) [0-100TeV]	
γ	photoelectric	-	SANDIA par. [100eV-100TeV] + deEx.
	incoherent sc.	Klein-Nishina ⁺ [100eV-100TeV]	Klein-Nishina ⁺ [100eV-100TeV]
	e^-e^+ pair production	Bethe-Heitler ⁺ [100eV-100TeV]	Bethe-Heitler ⁺ [100eV-80GeV]
		-	Bethe-Heitler ⁺ w. LPM [80GeV-100TeV]
coherent sc.	-	Livermore	
+	energy loss fluct.	-	Urban

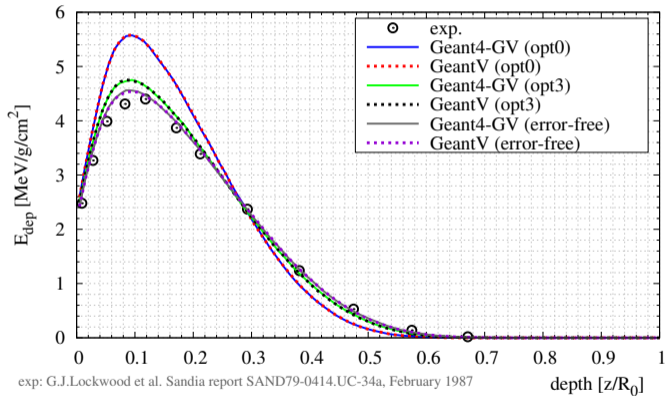
Photon energy distribution: $E_{el} = 25$ [GeV], Target: Pb, 0.15 [mm]



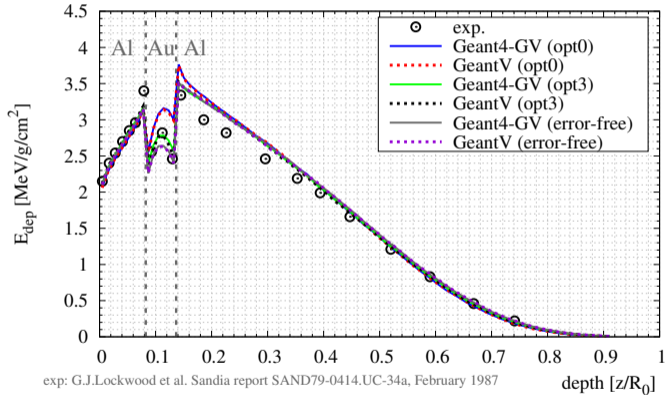




Energy deposit of $E_0 = 0.5$ [MeV] e^- in Mo as a function of the depth
(MSC $R_f=0.1$; cut = 0.02 [mm])



Energy deposit of $E_p = 1.0$ [MeV] e^- in Al[168.4 μ m]-Au[21.7 μ m]-Al[1.5904mm]
 as a function of the depth (MSC $R_f = 0.1$; cut = 100 [nm])



10^4 10 [GeV] e⁻ in ATLAS bar. simpl. cal. : 50 layers of [2.3 mm Pb + 5.7 mm lAr]; p.cut = 0.7 [mm]

e⁻/e⁺: ionisation, bremsstrahlung, msc; γ : Compton, conversion

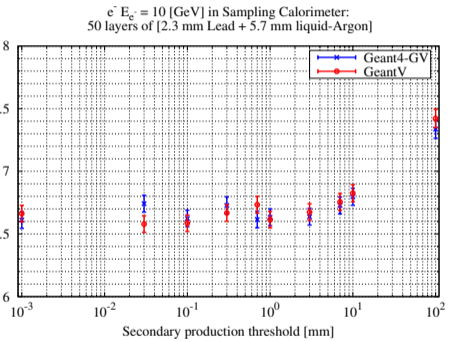
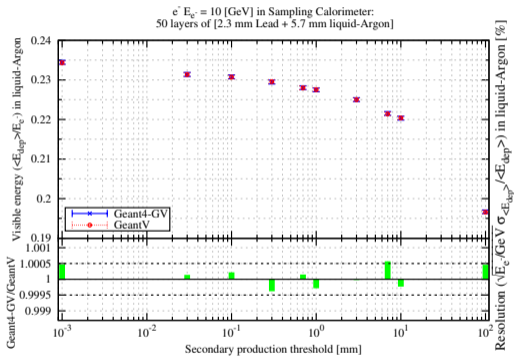
GeantV

Geant4

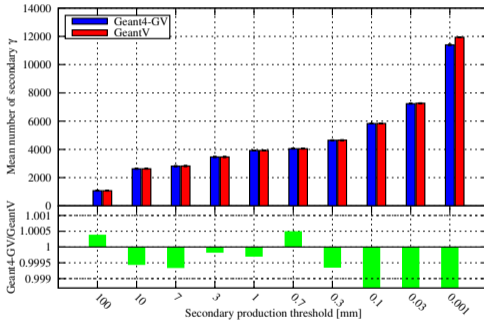
material	E _d [GeV]	rms [MeV]	tr.l. [m]	rms [cm]	E _d [GeV]	rms [MeV]	tr.l. [m]	rms [cm]
Pb	6.9224	69.148	5.0795	5.1165	6.9223	64.380	5.0800	4.7808
lAr	2.2800	48.549	10.599	24.774	2.2803	47.706	10.601	24.316

Mean number of :

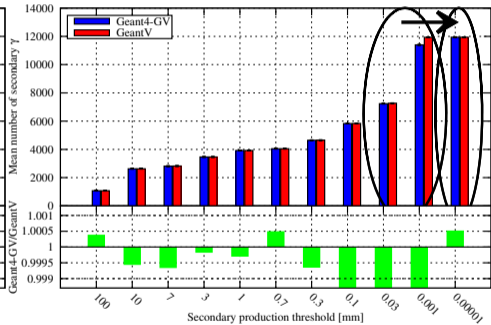
gamma	4045	4047
electron	100199	100233
positron	538.56	538.64
charged steps	120692	120712
neutral steps	527023	527231



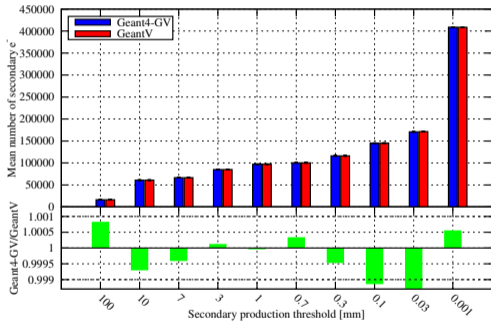
$e^+e^- E_{e^-} = 10$ [GeV] in Sampling Calorimeter:
50 layers of [2.3 mm Lead + 5.7 mm liquid-Argon]



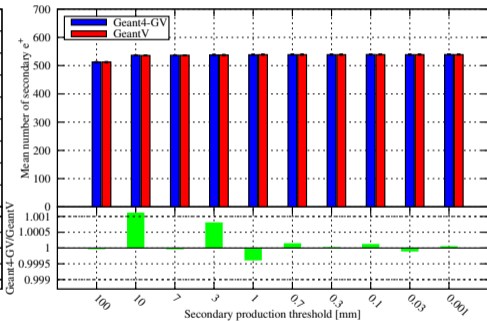
$e^+e^- E_{e^-} = 10$ [GeV] in Sampling Calorimeter:
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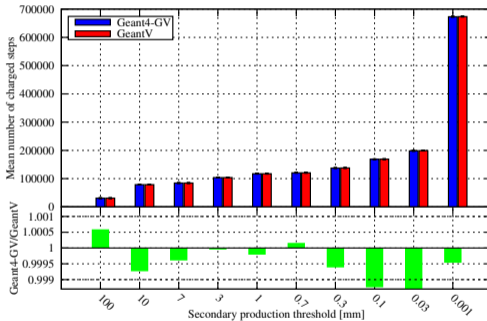
$e^+e^- E_{\text{c.m.}} = 10$ [GeV] in Sampling Calorimeter:
50 layers of [2.3 mm Lead + 5.7 mm liquid-Argon]



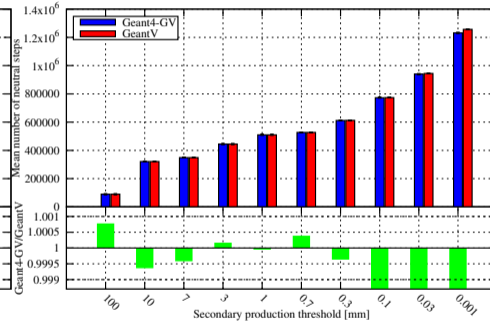
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$e^+e^- E_{\text{c}} = 10$ [GeV] in Sampling Calorimeter:
50 layers of [2.3 mm Lead + 5.7 mm liquid-Argon]



$e^+e^- E_{\text{c}} = 10$ [GeV] in Sampling Calorimeter:
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Physics to do:

- change from global lambda-table to optional per-process lambda tables (requires significant changes in the general physics framework)
- see the table regarding the [missing interactions/models](#)
- each (EM) model should provide option to use rejection based sampling beyond sampling tables

General to do:

- understand and resolve speed issue !
- navigation interface to compute safety (for displacement)
- **Error in <LinearPropagator>: track X from event Y stuck -> killing it** (boxes, no mag. f.!)
- clear separation of applications from the toolkit
- user interfaces, user interfaces, user interfaces