

# TOPAS-nBio-dev (TOPAS v4.0)

## Regression testing (cf. TOPAS-nBio-dev (TOPAS v4.0))

José Ramos-Méndez, Naoki D. Kondo, and Thongchai A.M. Masilela

University of California San Francisco

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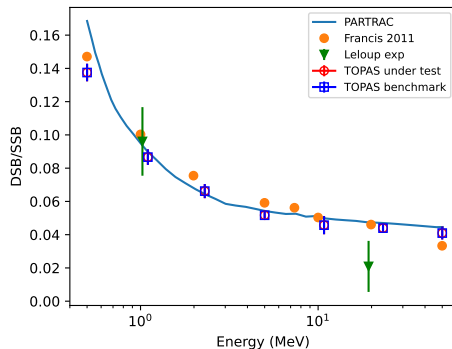
Nanodosimetry III: g4em-dna\_opt2

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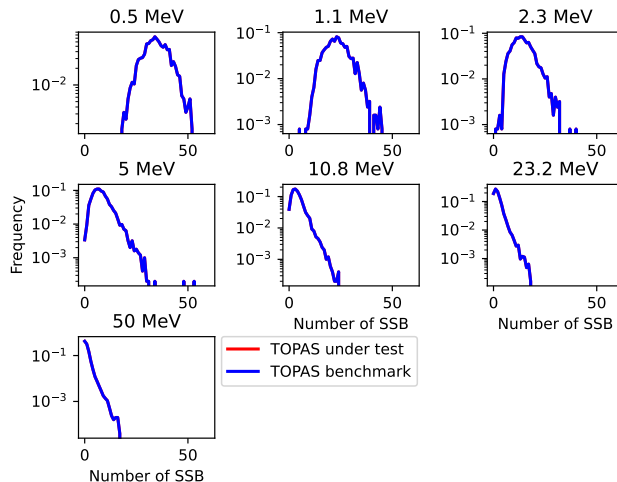
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SSBs as a function of DMSO: single pulse, low dose rate

# DBSCAN - TsEmDNAPhysics

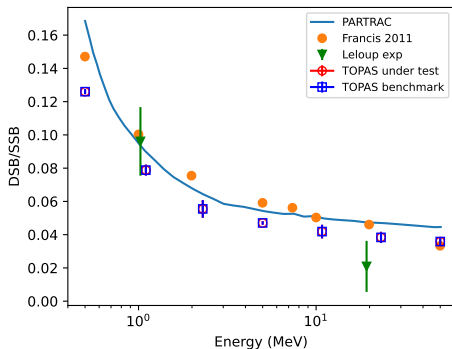


	TOPAS under test (s)	TOPAS benchmark (s)
Init.	0.0 +/- 0.0	0.0 +/- 0.0
Exec.	152.2 +/- 0.6	152.2 +/- 0.6
Final.	0.0 +/- 0.0	0.0 +/- 0.0

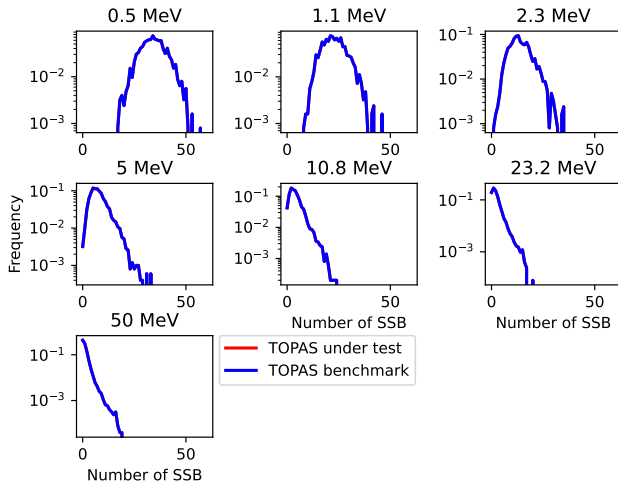


► Francis Z, Villagrasa C, Clairand I. Simulation of DNA damage clustering after proton irradiation using an adapted DBSCAN algorithm. *Comput Methods Programs Biomed.* 2011; 101(3):265-270. doi:10.1016/j.cmpb.2010.12.012

# DBSCAN - g4em-dna\_opt2

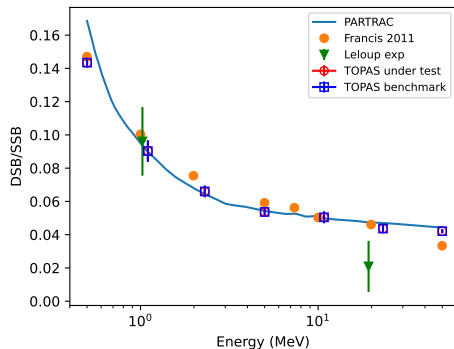


	TOPAS under test (s)	TOPAS benchmark (s)
Init.	0.0 +/- 0.0	0.0 +/- 0.0
Exec.	146.4 +/- 1.2	146.4 +/- 1.2
Final.	0.0 +/- 0.0	0.0 +/- 0.0

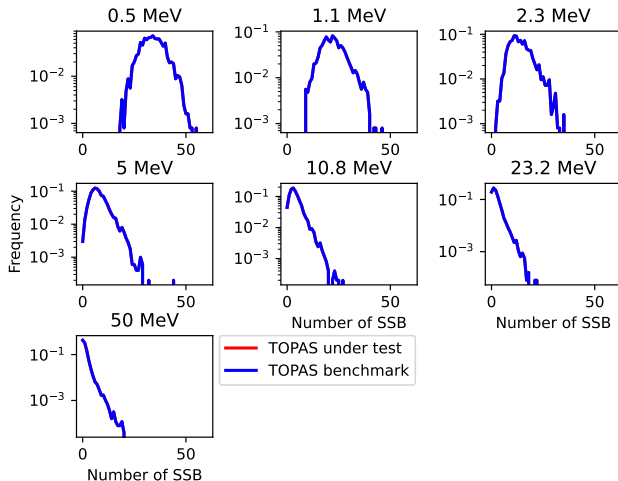


Francis Z, Villagrasa C, Clairand I. Simulation of DNA damage clustering after proton irradiation using an adapted DBSCAN algorithm. *Comput Methods Programs Biomed.* 2011; 101(3):265-270. doi:10.1016/j.cmpb.2010.12.012

# DBSCAN - g4em-dna\_opt4

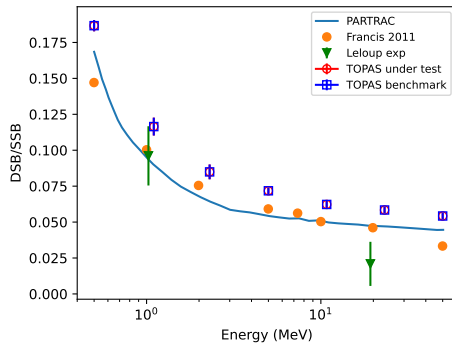


	TOPAS under test (s)	TOPAS benchmark (s)
Init.	0.0 +/- 0.0	0.0 +/- 0.0
Exec.	450.9 +/- 1.0	450.9 +/- 1.0
Final.	0.0 +/- 0.0	0.0 +/- 0.0

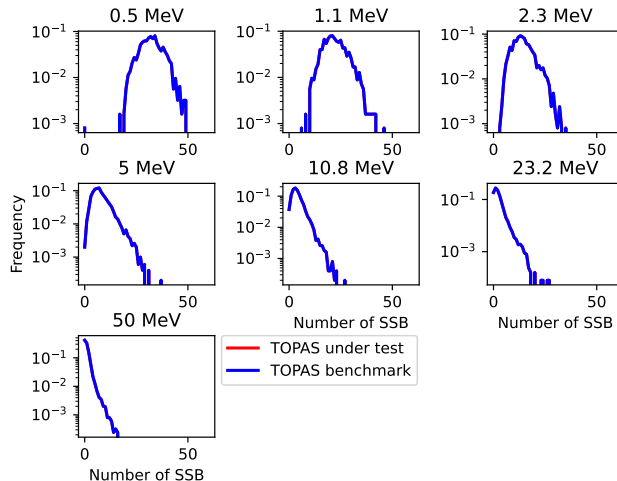


Francis Z, Villagrasa C, Clairand I. Simulation of DNA damage clustering after proton irradiation using an adapted DBSCAN algorithm. *Comput Methods Programs Biomed.* 2011; 101(3):265-270. doi:10.1016/j.cmpb.2010.12.012

# DBSCAN - g4em-dna\_opt6

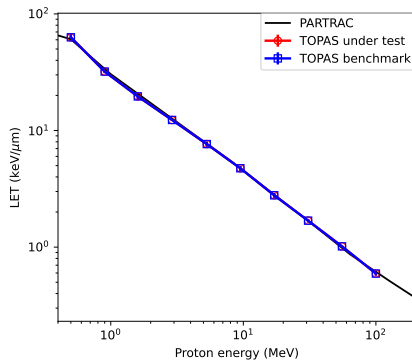


	TOPAS under test (s)	TOPAS benchmark (s)
Init.	0.0 +/- 0.0	0.0 +/- 0.0
Exec.	129.0 +/- 0.9	129.0 +/- 0.9
Final.	0.0 +/- 0.0	0.0 +/- 0.0

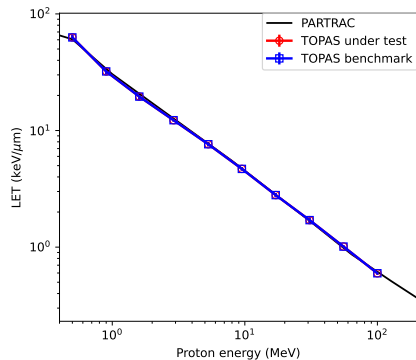


► Francis Z, Villagrasa C, Clairand I. Simulation of DNA damage clustering after proton irradiation using an adapted DBSCAN algorithm. *Comput Methods Programs Biomed.* 2011; 101(3):265-270. doi:10.1016/j.cmpb.2010.12.012

# LET I



	TOPAS under test (s)	TOPAS benchmark (s)
Init.	0.0 +/- 0.0	0.0 +/- 0.0
Exec.	264.0 +/- 1.4	264.0 +/- 1.4
Final.	0.0 +/- 0.0	0.0 +/- 0.0

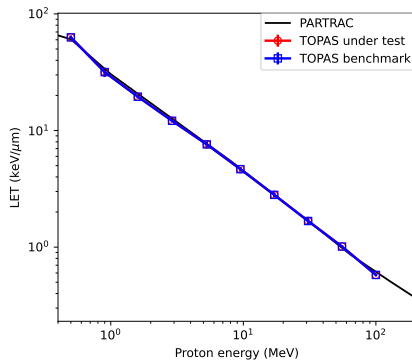


	TOPAS under test (s)	TOPAS benchmark (s)
Init.	0.0 +/- 0.0	0.0 +/- 0.0
Exec.	253.6 +/- 0.5	253.6 +/- 0.5
Final.	0.0 +/- 0.0	0.0 +/- 0.0

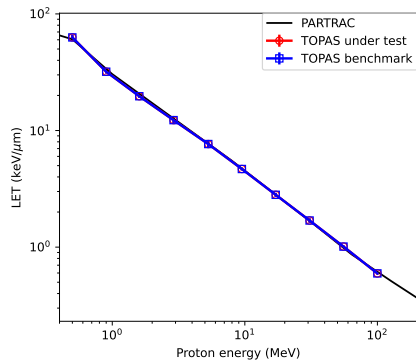
▶ LET as a function of proton energy for TsEmDNAPhysics (left) and g4em-dna\_opt2 (right).



# LET II



	TOPAS under test (s)	TOPAS benchmark (s)
Init.	0.0 +/- 0.0	0.0 +/- 0.0
Exec.	724.3 +/- 1.0	724.3 +/- 1.0
Final.	0.0 +/- 0.0	0.0 +/- 0.0

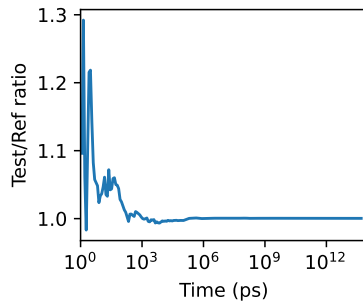
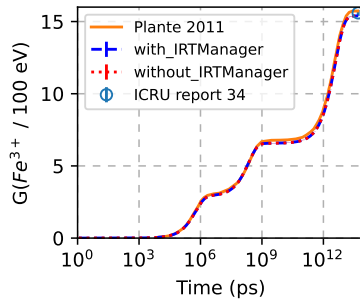


	TOPAS under test (s)	TOPAS benchmark (s)
Init.	0.0 +/- 0.0	0.0 +/- 0.0
Exec.	234.9 +/- 0.9	234.9 +/- 0.9
Final.	0.0 +/- 0.0	0.0 +/- 0.0

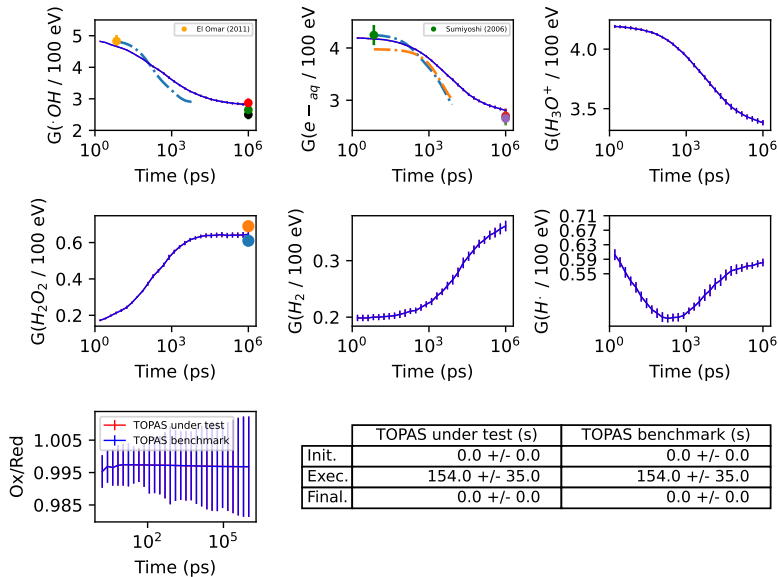
▶ LET as a function of proton energy for g4em-dna\_opt4 (left) and g4em-dna\_opt6 (right).

# Fricke: IRT

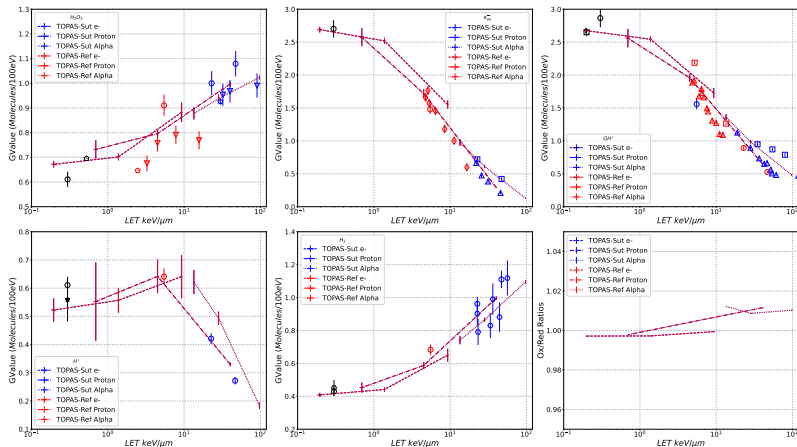
	with_IRTManager	without_IRTManager
Init. (s)	0.010 +/- 0.000	0.010 +/- 0.000
Exec. (s)	1262.560 +/- 22.274	1281.648 +/- 28.085
Final. (s)	0.006 +/- 0.005	0.006 +/- 0.005
Value (/100eV)	15.393 +/- 0.005	15.387 +/- 0.005



# G-value: step-by-step

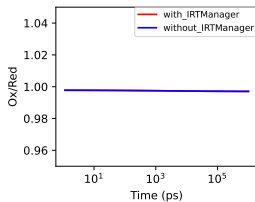
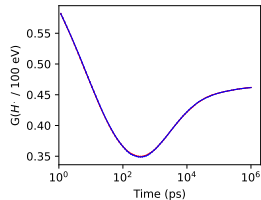
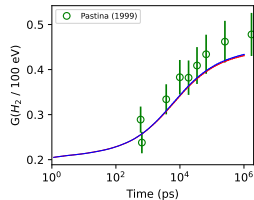
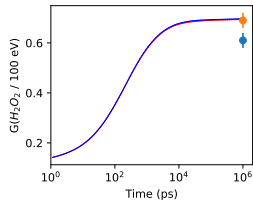
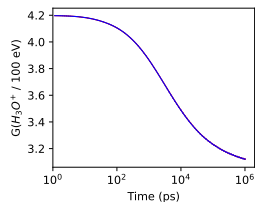
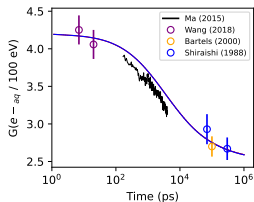
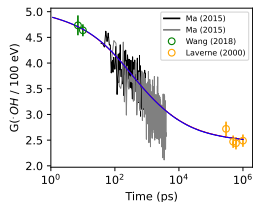


# G-value vs. LET: step-by-step



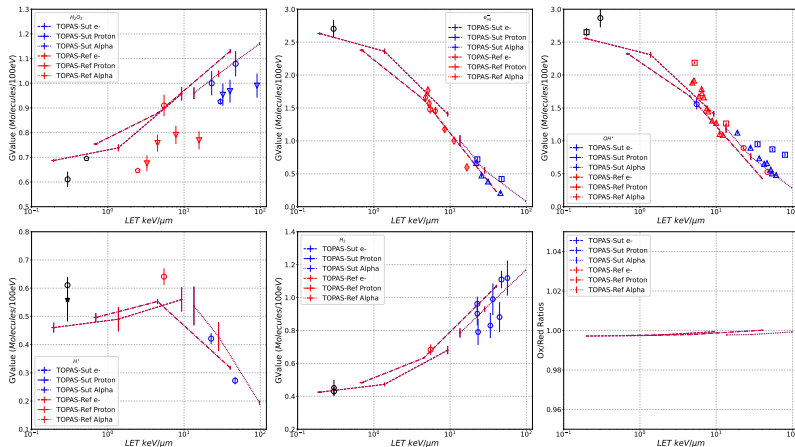
	TOPAS-Ref	TOPAS-Sut
Real	35918.750 +/- 564.408	35918.750 +/- 564.408
User	35895.032 +/- 564.205	35895.032 +/- 564.205
Sys	16.572 +/- 0.227	16.572 +/- 0.227

# G-value: IRT



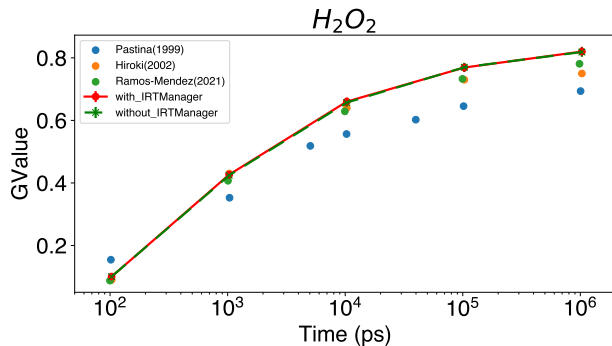
	with IRTManager (s)	without IRTManager (s)
Init.	0.010 +/- 0.000	0.010 +/- 0.000
Exec.	277.856 +/- 9.256	273.050 +/- 9.457
Final.	0.004 +/- 0.005	0.000 +/- 0.000

# G-value vs. LET: IRT



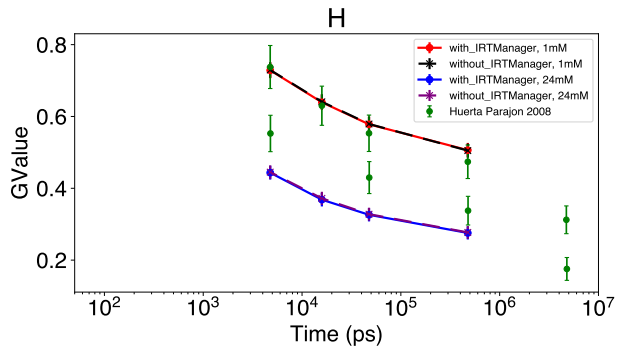
	TOPAS-Ref	TOPAS-Sut
Real	1365.454 +/- 23.439	1365.454 +/- 23.439
User	1090.800 +/- 23.443	1090.800 +/- 23.443
Sys	10.438 +/- 0.247	10.438 +/- 0.247

# G-value of $H_2O_2$ : IRT



	Reference	Under Test
Real (s)	0.0 +- 0.0	0.0 +- 0.0
User (s)	213.47 +- 1.17	182.19 +- 1.1
Sys (s)	0.0 +- 0.0	0.0 +- 0.0

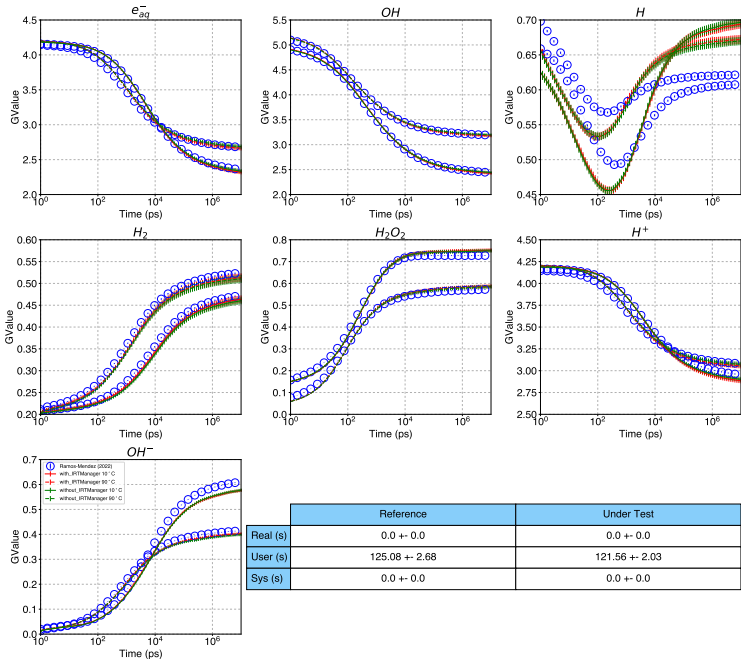
# G-value of H: IRT



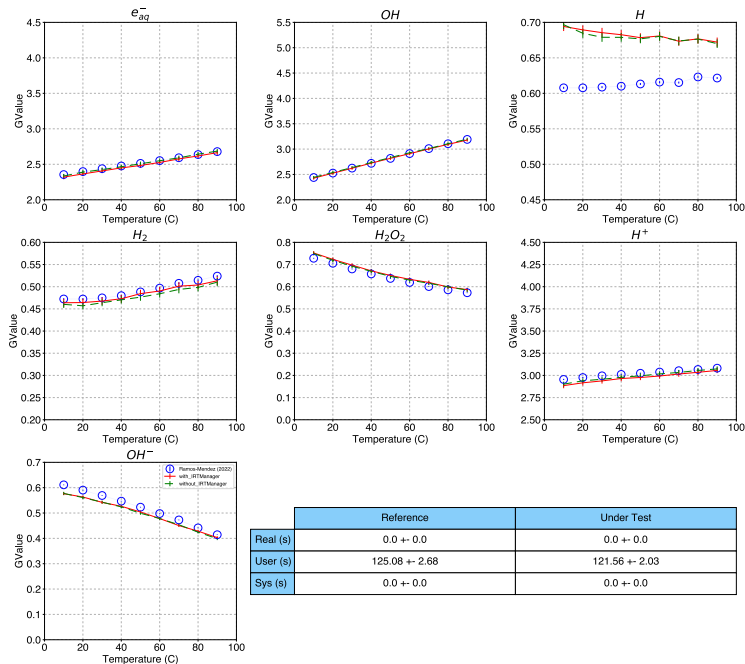
	Reference	Under Test
Real (s)	0.0 +- 0.0	0.0 +- 0.0
User (s)	572.38 +- 11.45	543.03 +- 21.58
Sys (s)	0.0 +- 0.0	0.0 +- 0.0



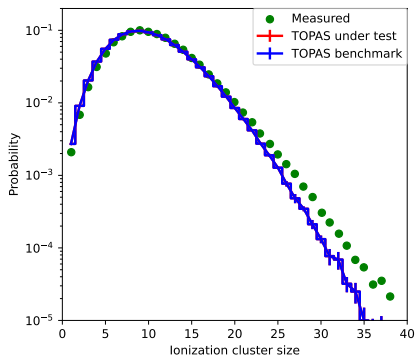
# G-value and Temperature I: IRT



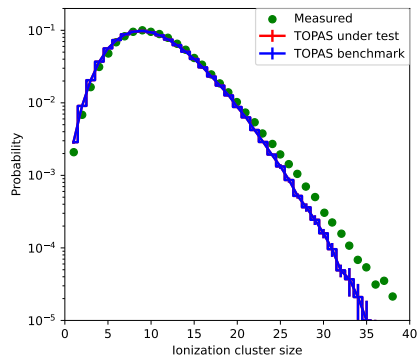
# G-value and Temperature II: IRT



# Nanodosimetry I: TsEmDNAPhysics and g4em-dna\_opt2



	TOPAS under test (s)	TOPAS benchmark (s)
Init.	0.0 +/- 0.0	0.0 +/- 0.0
Exec.	10342.3 +/- 25.4	10342.3 +/- 25.4
Final.	0.0 +/- 0.0	0.0 +/- 0.0

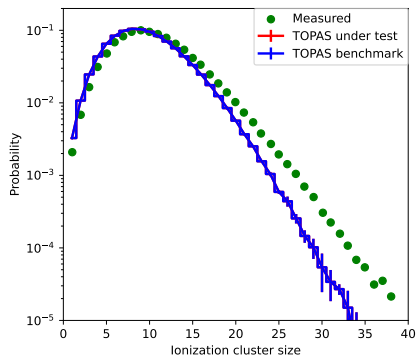


	TOPAS under test (s)	TOPAS benchmark (s)
Init.	0.0 +/- 0.0	0.0 +/- 0.0
Exec.	10082.1 +/- 49.3	10082.1 +/- 49.3
Final.	0.0 +/- 0.0	0.0 +/- 0.0

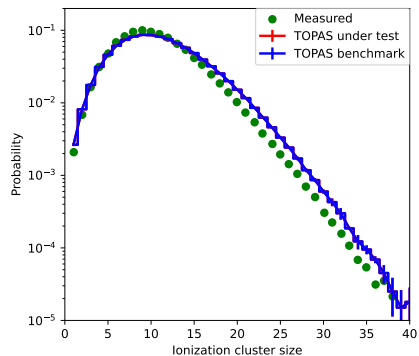


Conte V, Selva A, Colautti P, et al., Nanodosimetry: Towards a new concept of radiation quality. *Radiat Prot Dosimetry*. 2018;180(1-4):150-156. doi:10.1093/rpd/ncx175

# Nanodosimetry I: g4em-dna\_opt4 and g4em-dna\_opt6



	TOPAS under test (s)	TOPAS benchmark (s)
Init.	0.0 +/- 0.0	0.0 +/- 0.0
Exec.	8531.7 +/- 11.6	8531.7 +/- 11.6
Final.	0.0 +/- 0.0	0.0 +/- 0.0

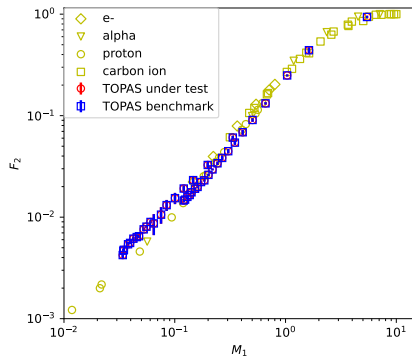


	TOPAS under test (s)	TOPAS benchmark (s)
Init.	0.0 +/- 0.0	0.0 +/- 0.0
Exec.	7789.4 +/- 37.9	7789.4 +/- 37.9
Final.	0.0 +/- 0.0	0.0 +/- 0.0

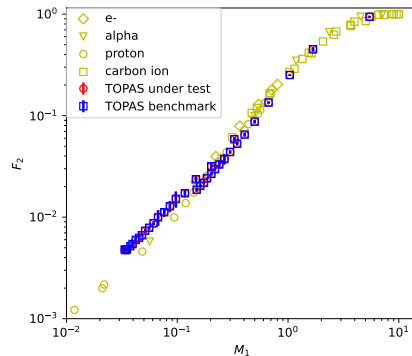


Conte V, Selva A, Colautti P, et al., Nanodosimetry: Towards a new concept of radiation quality. *Radiat Prot Dosimetry*. 2018;180(1-4):150-156. doi:10.1093/rpd/ncx175

# Nanodosimetry II: TsEmDNAPhysics and g4em-dna\_opt2



	TOPAS under test (s)	TOPAS benchmark (s)
Init.	0.0 +/- 0.0	0.0 +/- 0.0
Exec.	119.6 +/- 0.6	119.6 +/- 0.6
Final.	0.0 +/- 0.0	0.0 +/- 0.0

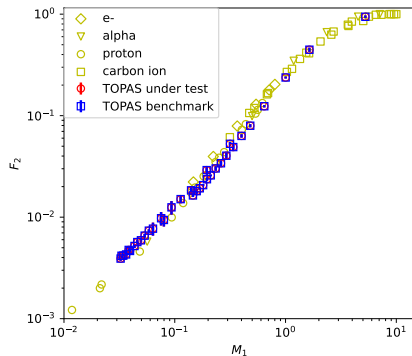


	TOPAS under test (s)	TOPAS benchmark (s)
Init.	0.0 +/- 0.0	0.0 +/- 0.0
Exec.	93.8 +/- 0.2	93.8 +/- 0.2
Final.	0.0 +/- 0.0	0.0 +/- 0.0

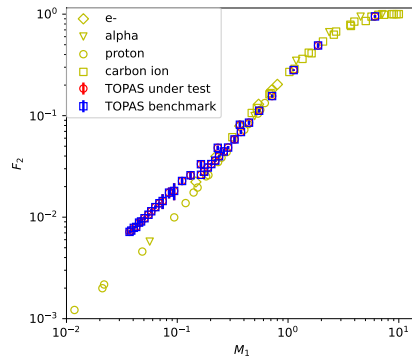


Conte V, Selva A, Colautti P, et al., Nanodosimetry: Towards a new concept of radiation quality. *Radiat Prot Dosimetry*. 2018;180(1-4):150-156. doi:10.1093/rpd/ncx175

# Nanodosimetry II: g4em-dna\_opt4 and g4em-dna\_opt6



	TOPAS under test (s)	TOPAS benchmark (s)
Init.	0.0 +/- 0.0	0.0 +/- 0.0
Exec.	1796.0 +/- 3.7	1796.0 +/- 3.7
Final.	0.0 +/- 0.0	0.0 +/- 0.0

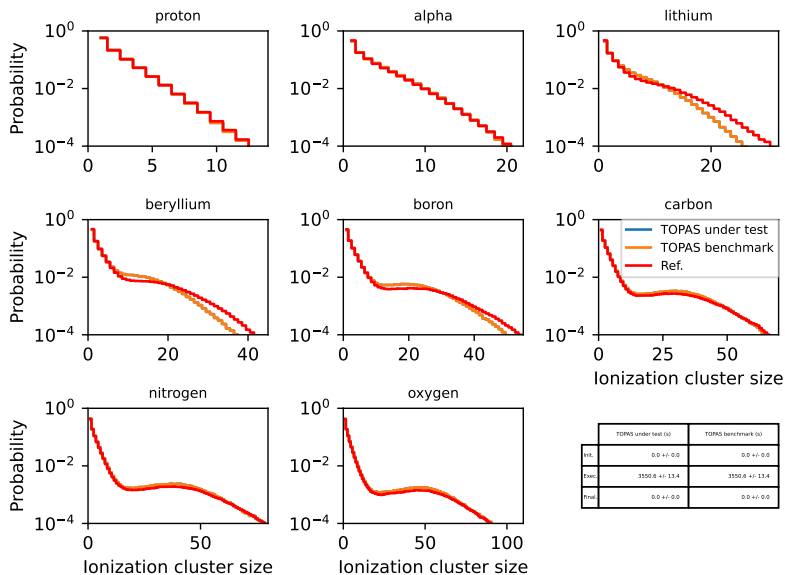


	TOPAS under test (s)	TOPAS benchmark (s)
Init.	0.0 +/- 0.0	0.0 +/- 0.0
Exec.	1312.8 +/- 5.1	1312.8 +/- 5.1
Final.	0.0 +/- 0.0	0.0 +/- 0.0



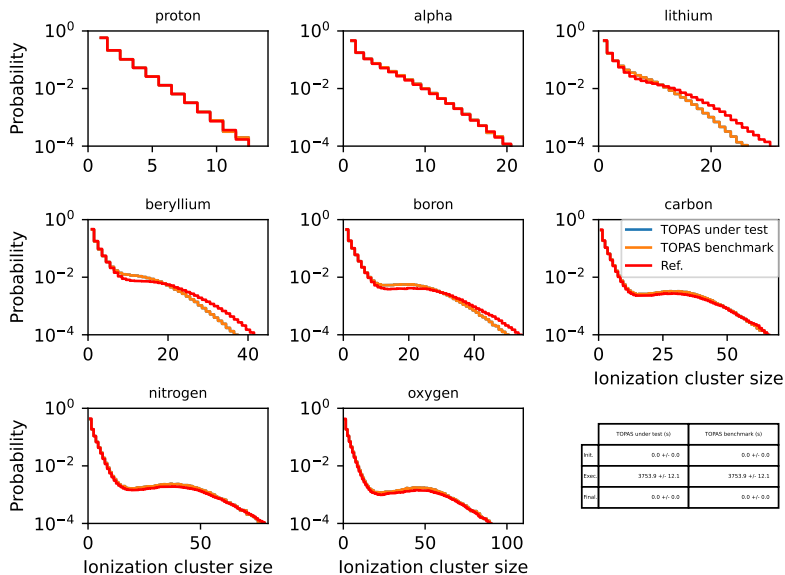
Conte V, Selva A, Colautti P, et al., Nanodosimetry: Towards a new concept of radiation quality. *Radiat Prot Dosimetry*. 2018;180(1-4):150-156. doi:10.1093/rpd/ncx175

# Nanodosimetry III: TsEmDNAPhysics



Ramos-Méndez J, Burigo LN, Schulte R, Chuang C, Faddegon B. Fast calculation of nanodosimetric quantities in treatment planning of proton and ion therapy. *Phys Med Biol.* 2018;63(23):235015. doi:10.1088/1361-6560/aaeeee

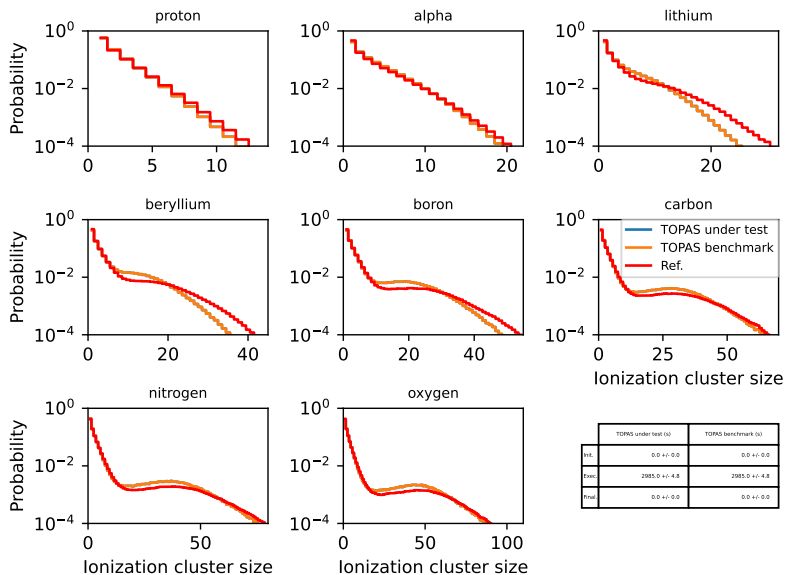
# Nanodosimetry III: g4em-dna\_opt2



Ramos-Méndez J, Burigo LN, Schulte R, Chuang C, Faddegon B. Fast calculation of nanodosimetric quantities in treatment planning of proton and ion therapy. *Phys Med Biol.* 2018;63(23):235015. doi:10.1088/1361-6560/aaeeee

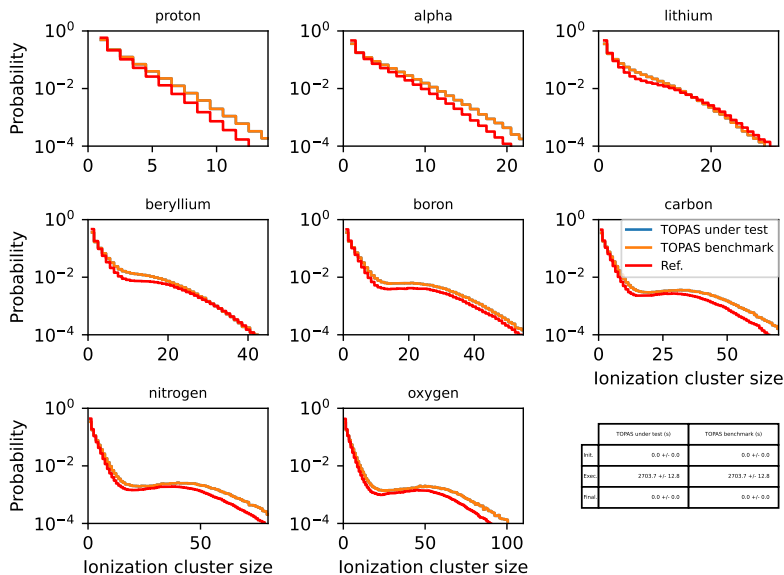


# Nanodosimetry III: g4em-dna\_opt4



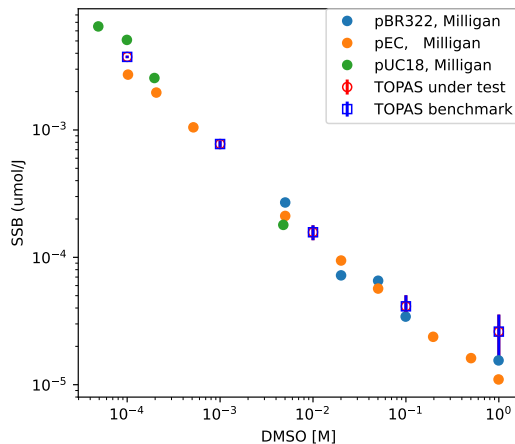
Ramos-Méndez J, Burigo LN, Schulte R, Chuang C, Faddegon B. Fast calculation of nanodosimetric quantities in treatment planning of proton and ion therapy. *Phys Med Biol.* 2018;63(23):235015. doi:10.1088/1361-6560/aaeeee

# Nanodosimetry III: g4em-dna\_opt6



► Ramos-Méndez J, Burigo LN, Schulte R, Chuang C, Faddegon B. Fast calculation of nanodosimetric quantities in treatment planning of proton and ion therapy. *Phys Med Biol.* 2018;63(23):235015. doi:10.1088/1361-6560/aaeeee

# SSBs as a function of DMSO: single pulse, low dose rate



	TOPAS under test (s)	TOPAS benchmark (s)
Init.	0.9 +/- 0.0	0.9 +/- 0.0
Exec.	24577.5 +/- 344.9	24577.5 +/- 344.9
Final.	0.0 +/- 0.0	0.0 +/- 0.0