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Title: Validation Testing of Pulse Height Variance Reduction in MCNP

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memorandum

Computational Analysis and Simulation (X-3)
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Verification Testing of Pulse Height Variance Reduction in MCNP

A new feature of MCNP5 (v. 1.50) is the capability to use variance reduction with pulse height tallies (PHTVR). Unlike other MCNP tallies, pulse height tallies depend upon knowledge of the entire particle history from its creation at the source to the termination of all progeny. Implementing this feature required the construction of particle history "trees" that keep track of all physical, variance reduction, and termination events and the associated weight changes[1,2]. The memo presents the results of validation testing of the pulse height variance reduction technique.

Three test problems were created to test the MCNP variance reduction methods and physical processes for the pulse height tally. These problems were initially executed in analog mode until the relative errors were a tenth of a percent or less. These calculations were then repeated using several variance reduction techniques. Special attention was given to position annihilation and double fluorescence processes in conjunction with dxtran spheres. Energy spectra were compared for both track-length and pulse height tallies between the analog and variance reduction runs.

The following variance reduction techniques are available with pulse height tallies.

- Geometry splitting
- Energy splitting
- Time splitting
- Weight Window
- Exponential Transform
- Forced Collision
- DXTRAN
- DXC
- Source Biasing
- Weight Cutoff
- Implicit Capture

All of these variance reduction techniques, some separately and some combined with others, were tested with pulse height tallies. In addition Russian roulette was turned off for several tests using the new VAR card.

Problem 1: Ge sphere Next To a U / O Stacked Cylinder

The first problem is a stacked cylinder (60 cm diameter x 100 cm tall) consisting of U238 (ρ = 2.0 g/cm^3) and O16 (ρ = 0.0012 g/cm^3) sections. A 14-cm diameter germanium sphere (ρ = 5.3 g/cm^3) is located 50 cm from the axis of the cylinder at a height of 55 cm. An isotropic photon source is located 0.01 cm below the base of the cylinder. A drawing of the problem is provided in Figure 1.

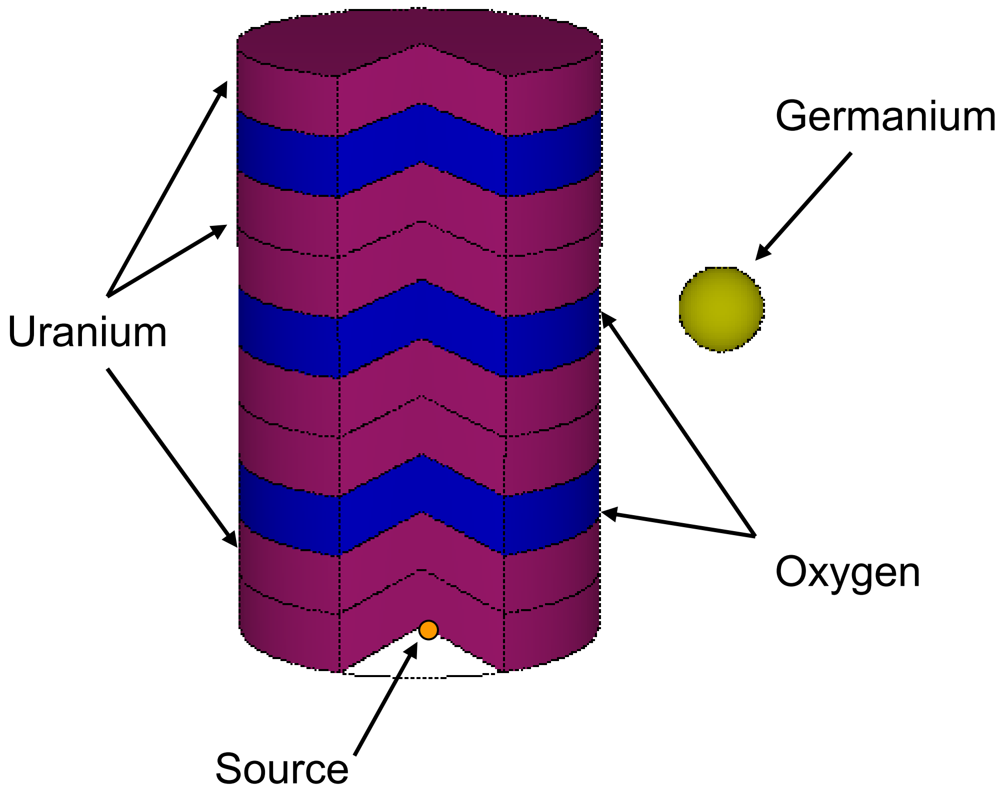


Figure 1. Drawing of the stacked cylinder problem

This problem was run in three different modes:

- 5 MeV photon source, photon only mode
- 5 MeV photon source, coupled photon-electron mode
- 200 MeV photon source, coupled photon-electron mode

Three tallies were scored to test the PHTVR method

1. Track length tally (F4) in the germanium sphere
2. Pulse height tally (F8) in the germanium sphere
3. Pulse height tally (F8) in the cylindrical sections

The implementation of the various variance reduction methods is summarized in Table 1. Note that the variance reduction methods were not set to optimize the results, but to challenge the PHTVR. As an additional test, the test problem was executed in analog mode with the PHTVR method turned on.

Table 1. Variance Reduction Implementation for Problem 1

Variance Reduction Method	Implementation*
Geometry splitting	`imp:p,e 1 2.4 1.9 2.5 5.1 6.3 4.9 4 2.5 6.3 2r 0`
Energy splitting	`esplt:p .75 4.5 1.2 2 .35 0.52 1.4 .1` `esplt:e .75 4.5 2 2 .5 .5`
Time splitting	`tsplt:p 2.5 1  1 .3 .5 .1`

Weight Window
Cell Based
Mesh Based
	Both types of weight windows were created by using one iteration of the weight window generator. The energy bins of the weight windows are:
	`wwe:p 0.4 0.6 2 4 4.9`
	`wwe:e 0.5 1 3 10`
	
	The mesh geometry is:
	`mesh geom rzt origin = -1 -501 0 axs 0 1 0 vec 1 0 1`
	`ref 0 0 0`
	`imesh 5 13 22 31 50 56 100 505`
	`jmesh 500 605 1010 jints 1 7 1`
	`kmesh 1 kints 4`

Exponential Transform	Used only in the uranium cells
	`ext:p .6v1 .5v2 0 .4v4 .2v5 0 .2v7 .3v8 0 .5v10`
	`0 0 0`
	`vect v1 1 1 0    v2 50 45 0    v4 50 15 0`
	`v5 50 15 0  v7 50 -15 0  v8 50 -25 0`
	`v10 50 -35 0`

Forced Collision	Used only in the oxygen cells `fcl:p 0 0 -1 0 0 1 0 0 1 0 0 0 0`

DXTRAN	Located around the germanium cell
	`dxt:p 50 55 0 7.1 7.1`
	`dd2 0.1 5e99` or `dd2 0 5e99`

Source Biasing	`sdef pos 0 -.01 0 par=p erg=5  dir=d1 vec=0 1 0`
	`si1 -1 0 0.707106781 0.920504853 1`
	`sb1 0 1 1 1 1`
	`sp1 0 0.5 0.353553391 0.106699036 0.039747573`

Weight Cutoff, Implicit Capture	Default values (`cut:p  2j -0.5 -0.25`)
Russian Roulette	On or off (`var RR=off`)

*Note: Cells 1-10 are make up the cylinder, starting at the base. Cell 11 is the germanium sphere.

5 MeV photon source, photon only

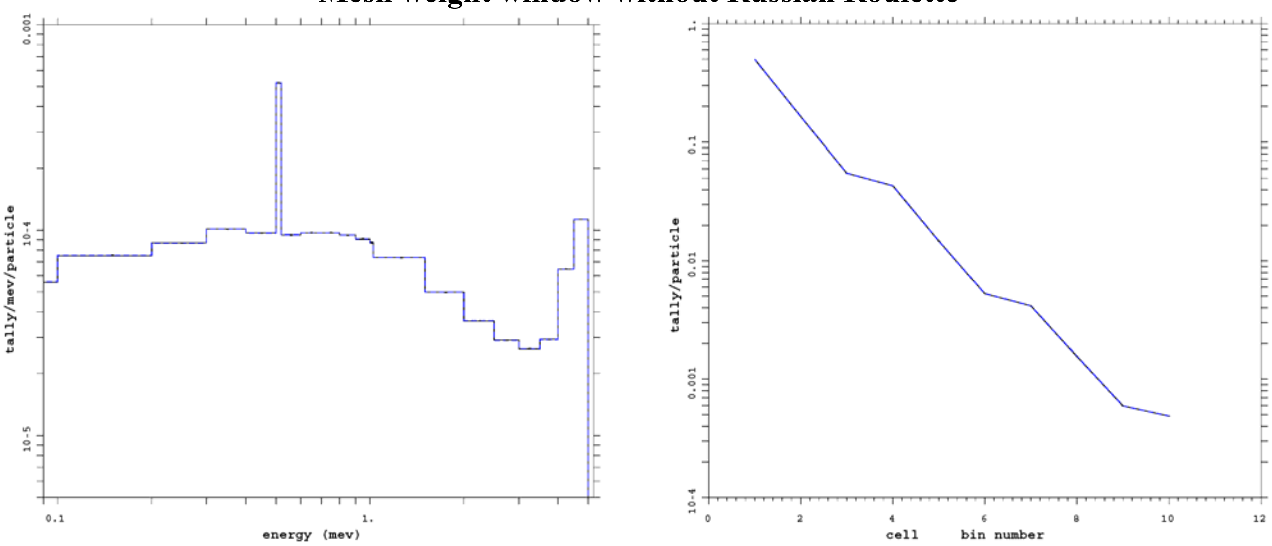
Forty-one tests were run in this mode. The tests were executed long enough to achieve small relative errors for the track-length tally in the germanium sphere in a reasonable length of time. The highest relative error of the tally was 0.0019; the median was 0.0004.

The variance reduction tally results were plotted and compared to the analog results. Based on an examination of the plots, the energy spectra were given three grades:

- Exact: The tally plot results matched the analog results exactly
- Acceptable: Although the tally results did not match exactly, they are within the expected uncertainties of the physics and cross sections used in MCNP
- Poor: The results did not agree.

Figures 2 though 4 provide examples of the three grades. In all cases, the blue line represents the analog results.

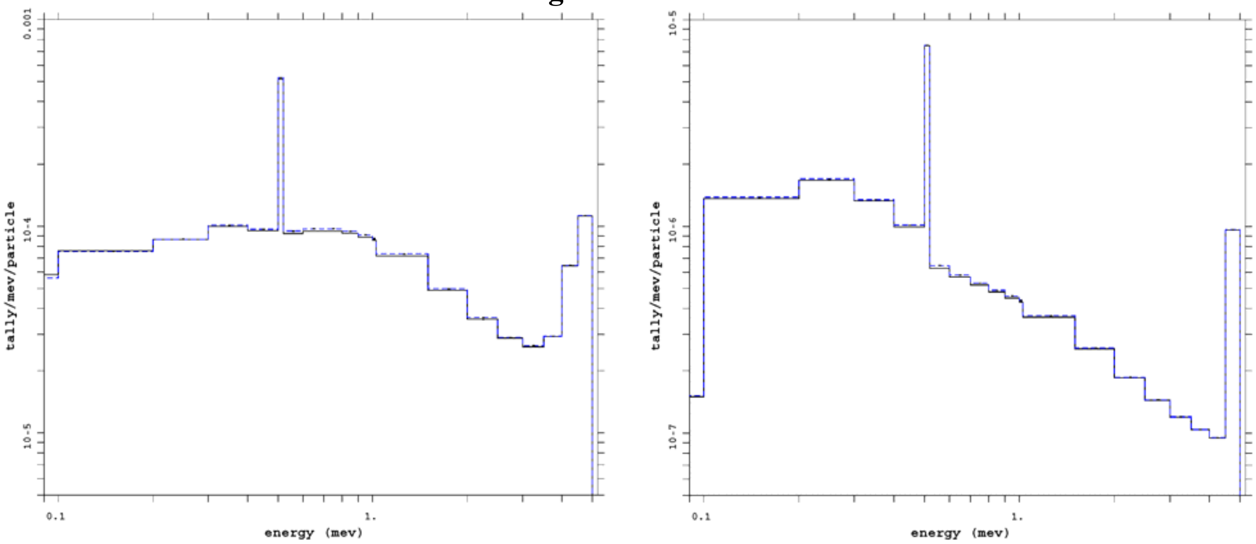
Figure 2: Exact Grade Example
Mesh weight window without Russian Roulette



a) Pulse height energy spectrum in the germanium sphere

b) Total pulses in the uranium/oxygen cells of the cylinder

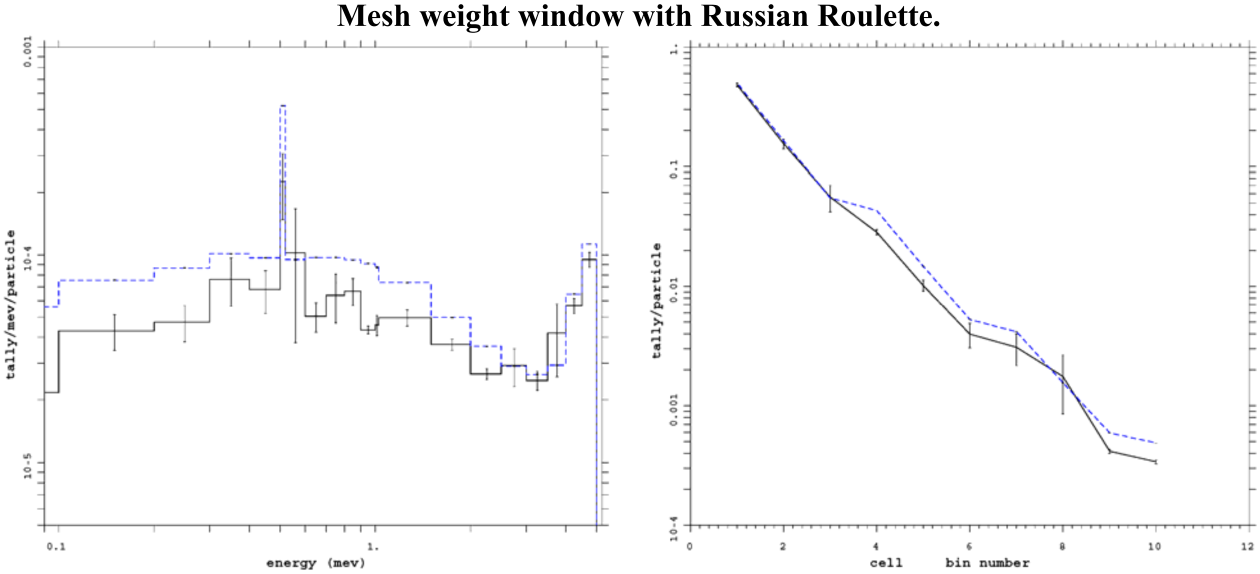
Figure 3: Acceptable Grade Example
DXTRAN and mesh weight window without Russian Roulette



a) Track-length energy spectrum in the germanium sphere

b) Pulse height energy spectrum in the germanium sphere

Figure 4: Poor Grade Example
Mesh weight window with Russian Roulette.



a) Pulse height energy spectrum in the germanium sphere

b) Total pulses in the uranium/oxygen cells of the cylinder

Table 2 summarizes the results for these runs. The Tests Failed column lists the number of the ten statistical tests that failed for the tally. Results are listed in order of the number of statistical tests failed for the pulse height tally in the germanium sphere.

Table 2. 5 MeV Photon Source – Photon Only Mode Results Summary

Run Number	Variance Reduction Technique*	Sphere Track Length tally		Sphere Pulse Height Tally		Total Pulses in the Cylinder sections
		Spectra Grade	Tests Failed	Spectra Grade	Tests Failed	
1	dxt dxtran roulette off	acceptable	1	acceptable	0	exact
2	imp	exact	0	exact	0	exact
3	imp dxt noRR	acceptable	1	acceptable	0	exact
4	imp noRR	exact	0	exact	0	exact
5	imp tsplt noRR	exact	0	exact	0	exact
6	mesh dxt noRR	acceptable	0	acceptable	0	exact
7	mesh ext fcl noRR	exact	1	exact	0	exact
8	mesh noRR	exact	0	exact	0	exact
9	analog	exact	0	exact	0	exact
10	analog with PHTVR	exact	0	exact	0	exact
11	sb	exact	1	exact	0	exact
12	cell dxt noRR	acceptable	0	acceptable	0	exact
13	cell noRR	exact	0	exact	0	exact
14	dxt	acceptable	1	acceptable	1	exact
15	dxt ext fcl tsplt noRR	acceptable	0	acceptable	1	exact
16	imp dxt	acceptable	2	acceptable	1	exact
17	imp esplt noRR	exact	1	exact	1	exact
18	imp ext fcl wc	exact	0	exact	1	exact
19	imp dxt ext fcl wc	acceptable	2	acceptable	1	exact
20	mesh dxt ext fcl wc	acceptable	0	poor	1	poor
21	imp dxt sb noRR	acceptable	0	acceptable	1	exact
22	cell ext fcl noRR	exact	1	exact	1	exact
23	imp esplt	exact	0	poor	2	exact
24	imp tsplt	exact	2	acceptable	2	exact
25	mesh ext fcl wc	exact	2	poor	2	poor
26	imp ext fcl sb wc	exact	0	exact	2	exact
27	cell dxt ext fcl wc	acceptable	0	poor	2	poor
28	cell dxt ext fcl noRR	acceptable	1	acceptable	2	exact
29	mesh	exact	1	poor	3	poor
30	mesh dxt ext fcl noRR	acceptable	1	acceptable	3	exact
31	dxt sb	acceptable	5	acceptable	3	exact
32	cell	exact	0	poor	3	poor
33	ext fcl wc	exact	0	exact	4	exact
34	dxt esplt ext fcl noRR	acceptable	0	acceptable	4	exact
35	dxt ext fcl tsplt wc	acceptable	7	poor	4	exact
36	imp ext fcl noRR	exact	0	exact	4	exact
37	cell ext fcl wc	exact	0	poor	4	poor
38	dxt ext fcl wc	acceptable	7	acceptable	5	exact
39	mesh dxt	acceptable	0	poor	6	poor

Run Number	Variance Reduction Technique*	Sphere Track Length tally		Sphere Pulse Height Tally		Total Pulses in the Cylinder sections
		Spectra Grade	Tests Failed	Spectra Grade	Tests Failed	
40	cell dxt	acceptable	0	poor	6	poor
41	dxt esplt ext fcl wc	acceptable	1	poor	7	poor
42	imp dxt ext fcl noRR	acceptable	3	acceptable	7	exact

*Meaning of abbreviations:
imp – geometry splitting
cell – cell based weight window
mesh – mesh based weight window
dxt – dxtran
esplt – energy splitting
ext – exponential transform
fcl – forced collision
sb – source biasing
tsplt – time splitting
wc – weight cutoff (values -0.50 -0.25)
noRR – Russian roulette off

Plots of the test results compared to the analog results are provided in the Appendices.

- Appendix A.1.i contains the track length tally plots in the sphere
- Appendix A.1.ii contains the pulse height tally plots in the sphere
- Appendix A.1.iii contains the plots of the total pulses in the cells of the cylinder.

Discussion of the results

Track length tallies: Despite not always passing the ten statistical checks, the track length tallies for all the variance reduction techniques either matched exactly or were within the acceptable range as compared to the analog results. The acceptable results all involve dxtran spheres. This is not unexpected, since in photon only problems, a thick-target-bremsstrahlung model is used to create bremsstrahlung photons. This model assumes that the bremsstrahlung photons have the same direction as the electron that creates them. DXTRAN, however, uses a specific formula to sample for the angle of the photon relative to the direction of the electron. (See Chap. 2, Section 3.7 of the MCNP manual, p. 2-78).

For the tallies that missed only one of the ten checks, all of the missed checks involved either the slope of the tail of the PDF (7 tallies), or the trend in either the mean (2 tallies) or the figure of merit (3 tallies).

Pulse height tallies: Only 11 of the 40 runs using variance reduction passed the ten statistical checks. Like the track length tallies, all of the tallies that missed only one check involved either the slope of the tail of the PDF (6 tallies), or a trend in either the mean (1 tally) or the figure of merit (2 tallies) was detected.

Even though not all of the statistical tests were passed, 29 of the test runs matched exactly or were within an acceptable range as compared to the analog results. All of the variance reduction runs that did not match the analog run included Russian roulette. Russian roulette affects the pulse height tally in two ways. First it increases the variance of the tally. Second, it reduces the number of nonzero history scores for the tally. For example consider the run that uses a mesh weight window with DXTRAN (Run 32). The scoring efficiency for the track length tally is 0.23 while the scoring efficiency of the pulse height tally is only 0.03. All of the runs which had the ratio of the number of rouletted particles to the number of source particles greater than 1.5 had poor pulse height tally results. All of the runs with Russian roulette turned off matched the analog results. In addition, for all of the failed runs, the tallies were al least 300 times less efficient than the analog case.

5 MeV photon source, coupled photons – electrons problem

A total of 36 problems were tested in this mode. For these runs, several default values were changed to speed up the calculations and to test other features of MCNP. These changes are:

- the energy cutoff was set to 0.09 MeV for both photons and electrons.
- the density of the U238 sections was reduced to 1.1 g/cm^3
- the upper energy limit for detailed photon physics treatment was lowered to 4.5 MeV
- Unless otherwise noted, the weight cutoff/implicit capture values were set at 5e-9 2.5e-9.

Because the photon simple physics treatment is not analog, the pulse height tally spectra were compared to results for which PHTVR was activated but no variance reduction was used.

As before, the individual tests were run for up to several days of CPU time. The highest relative error for the track-length tally was 0.0021. Most of the relative errors were less than 0.0010. Table 3 summarized the tests and their results. They are listed in order of the number of statistical tests the pulse height tally failed.

Table 3. Summary of Coupled photon-electron runs – 5 MeV Photon Source

Run Number	Variance Reduction Technique*	Sphere Track Length tally		Sphere Pulse Height Tally		Total Pulses in the Cylinder Sections
		Spectra Grade	Tests failed	Spectra Grade	Tests failed	
1	cell dxt noRR	exact	3	acceptable	0	exact
2	cell esplt noRR	exact	1	exact	0	exact
3	cell dxt ext fcl noRR	exact	1	exact	0	exact
4	ext fcl wc	exact	0	acceptable	0	exact
5	imp	exact	0	acceptable	0	exact
6	def wc	exact	0	acceptable	0	exact
7	imp esplt	exact	1	acceptable	0	exact
8	imp dxt ext fcl noRR	exact	1	exact	0	exact
9	no variance reduction	exact	0	poor	0	poor
10	cell ext fcl noRR	exact	0	acceptable	1	exact
11	dxt	exact	1	acceptable	1	exact
12	dxt dxtran roulette off	exact	1	acceptable	1	exact
13	imp dxt noRR	exact	2	exact	1	exact
14	imp esplt noRR	exact	0	exact	1	exact
15	imp ext fcl wc	exact	0	acceptable	1	exact
16	imp ext fcl noRR	exact	0	exact	1	exact
17	imp noRR	exact	0	exact	1	exact
18	mesh dxt noRR	exact	1	exact	1	exact

Run Number	Variance Reduction Technique*	Sphere Track Length tally		Sphere Pulse Height Tally		Total Pulses in the Cylinder Sections
		Spectra Grade	Tests failed	Spectra Grade	Tests failed	
19	mesh dxt ext fcl noRR	exact	1	exact	1	exact
20	mesh noRR	exact	1	exact	1	exact
21	no variance reduction with PHTVR	exact	0	exact	1	exact
22	cell dxt	exact	1	poor	2	poor
23	imp dxt ext fcl wc	exact	2	acceptable	2	exact
24	mesh ext fcl noRR	exact	0	exact	2	exact
25	imp dxt	exact	1	acceptable	3	exact
26	mesh dxt	acceptable	7	poor	3	poor
27	cell	exact	1	poor	4	poor
28	cell esplt	exact	3	poor	4	poor
29	mesh dxt ext fcl wc	exact	1	poor	4	poor
30	cell dxt ext fcl wc	exact	1	poor	5	poor
31	mesh	exact	4	poor	5	poor
32	cell ext fcl wc	exact	0	poor	6	poor
33	cell ext fcl def wc	exact	0	poor	6	poor
34	mesh ext fcl wc	exact	4	poor	7	poor

*Meaning of abbreviations:
imp – geometry splitting
cell – cell based weight window
mesh – mesh based weight window
def wc – default weight cutoffs (-0.50 -0.25)
dxt – dxtran
esplt – energy splitting
ext – exponential transform
fcl – forced collision
wc – weight cutoff (values 5e-9 2.5e-9)
noRR – Russian roulette off

Plots of the test results compared to the no variance reduction with PHTVR results are provided in the Appendices:

- Appendix A.2.i contains the track length tally plots in the sphere
- Appendix A.2.ii contains the pulse height tally plots in the sphere
- Appendix A.2.iii contains the plots of the total pulses in the cells of the cylinder

Discussion of the results

Track length tallies: As in the photon only problem, the track length tallies for all the variance reduction techniques either matched exactly or were within the acceptable range as compared to the analog results. Also as before, the acceptable results only involve tallies which use a dxtran sphere. The MCNP developers suspect that these differences are due to an inconsistency between the coherent sampling interpolation schemes used for dxtran and non-dxtran particles. There are plans to further investigate these discrepancies.

For the tallies that missed only one of the ten checks, all of the missed checks involved either the slope of the tail of the PDF (9), or the trend of either the mean (2 tallies) or the figure of merit (2 tallies). For

Run 26, which failed 7 of the statistical tests, most of the failures can be attributed to one very large history score that occurred during the run.

Pulse height tallies: Only 9 of the 40 runs passed all 10 statistical checks, while another 12 missed only one. Like the track length tallies, all of the tallies that missed only one check involved either the slope of the tail of the PDF (7 tallies), or the trend of the mean (2 tallies) or the figure of merit (3 tallies). The no variance reduction run using the PHTVR method missed the random trending of the figure of merit test. Examining the tally fluctuation chart, although the figure of merit was constantly decreasing, the average decrease in the last half of the problem was only 0.03%.

All the pulse height tallies that failed one or less of the statistical tests matched the analog results. As before, only runs using weight windows with Russian roulette did not match the analog results. In fact, most of the runs that failed the 5 MeV photon-only problem also failed this one. The only exception is the combined geometry and energy splitting run.

200 MeV photon source, coupled photon-electron mode

A total of 32 problems were tested in this mode. Several default values were changed in these runs:

- the energy cutoff was set to 0.09 MeV for both photons and electrons.
- the density of the U238 sections was reduced to 1.1 g/cm^3
- the upper energy limit for detailed photon physics treatment was increased to 600 MeV; simple photon physics was not used in this problem.
- Unless otherwise noted, for weight cutoff/implicit capture, the values were 5e-9 2.5e-9.

The individual tests were run for up to several days of CPU time. The highest relative error for the track-length tally was 0.013. Most of the relative errors were less than 0.003. Table 4 summarizes the tests and their results. They are listed in order of the number of statistical tests the pulse height tally failed.

Table 4. Summary of Coupled photon-electron runs – 200 MeV Photon Source

Run Number	Variance Reduction Technique*	Track length tally		Pulse Height tally		Total Pulses in the Cylinder Sections
		Spectra Grade	Tests failed	Spectra Grade	Tests failed	
1	analog	--	0	--	0	--
2	analog with PHTVR	exact	0	exact	0	exact
3	wc	exact	0	exact	0	exact
4	cell noRR	exact	0	exact	0	exact
5	imp noRR	exact	0	exact	0	exact
6	cell esplt noRR	exact	0	exact	1	exact
7	imp esplt noRR	exact	0	exact	1	exact
8	mesh dxt ext fcl noRR	exact	1	poor	2	poor
9	ext fcl wc	exact	1	poor	3	poor

Run Number	Variance Reduction Technique*				Track length tally		Pulse Height tally		Total Pulses in the Cylinder Sections
					Spectra Grade	Tests failed	Spectra Grade	Tests failed	
10		dxt	ext fcl	wc	exact	0	poor	3	poor
11	imp	dxt	ext fcl	noRR	acceptable	2	poor	3	poor
12	cell		ext fcl	wc	exact	2	poor	4	poor
13	cell		ext fcl	def wc	exact	1	poor	4	poor
14	cell	dxt	ext fcl	wc	exact	0	poor	4	poor
15		dxt		def wc	acceptable	1	acceptable	4	exact
16	imp			def wc	exact	0	poor	4	poor
17	cell	esplt			exact	2	poor	5	poor
18	cell	dxt	ext fcl	wc noRR	acceptable	0	poor	5	poor
19	cell		ext fcl	wc noRR	acceptable	0	poor	5	poor
20	imp	dxt		def wc	acceptable	2	poor	5	poor
21	mesh				exact	1	poor	5	poor
22	imp		ext fcl	wc	exact	0	poor	6	poor
23	imp	dxt	ext fcl	wc	acceptable	0	poor	6	poor
24	mesh	dxt		noRR	acceptable	5	acceptable	6	exact
25	cell	dxt		def wc	exact	1	poor	7	poor
26	cell	dxt		noRR	acceptable	1	acceptable	7	exact
27		dxt without dxtran roulette		def wc	acceptable	6	acceptable	7	exact
28	imp	dxt		noRR	acceptable	1	acceptable	7	exact
29	imp	esplt		def wc	exact	0	poor	7	poor
30	cell				exact	1	poor	8	poor
31	mesh	dxt			acceptable	1	poor	8	poor
32	mesh	dxt	ext fcl	wc	exact	0	poor	8	poor

*Meaning of abbreviations:
- imp – geometry splitting
- cell – cell based weight window
- mesh – mesh based weight window
- def wc – default weight cutoffs (-0.50 -0.25)
- dxt – dxtran
- esplt – energy splitting
- ext – exponential transform
- fcl – forced collision
- wc – weight cutoff (values 5e-9 2.5e-9)
- noRR – Russian roulette off

Plots of the test results compared to the analog results are provided in the Appendices:
- Appendix A.3.i contains the track length tally plots in the sphere
- Appendix A.3.ii contains the pulse height tally plots in the sphere
- Appendix A.3.iii contains the plots of the total pulses in the cells of the cylinder

Discussion of the results

Track length tallies: Once again, track length tallies for all the variance reduction techniques either matched exactly or were within the acceptable range as compared to the analog results. As before, acceptable results only involve the tallies which use a dxtran sphere.

The tallies that missed only one of the ten checks failed either the PDF slope test (2 tallies), the figure of merit trend test (2), or the variance of the variance trend test (1 tally).

Pulse height tallies: Only 6 of the 32 runs passed all 10 statistical checks, and only one run failed only one test.

All the pulse height tallies that failed one or less of the statistical tests matched the analog results. As before, runs using weight windows with Russian roulette did not match the analog results. In addition, all the tests the used the exponential transform and forced collisions failed. These runs likely failed because the exponential transform causes the tree branch weights to change at every collision. This in turn causes large variances in the pulse height tallies. All but one of the exponential transform runs had variances of the variance 0.2 or greater, with one above 0.8. All the runs which did not match the analog results missed two or more of the statistical tests.

Problem 2: Uranium Sphere Surrounded By a Uranium Shell

The second test problem was designed to test double fluorescence with dxtran spheres. The use of pulse height variance reduction with DXTRAN affects MCNP in two ways. First, both dxtran double fluorescence photons need to be produced. Second, the two nondxtran photons can interact with the dxtran sphere in one of four ways:

1. Neither photon hits the dxtran sphere
2. Only the first photon hits the dxtran sphere
3. Only the second photon hits the dxtran sphere
4. Both photons hit the dxtran sphere.

All four possibilities must be considered by the PHTVR method.

The geometry for this problem is shown in Figure 5. A large (diameter = 150 cm) U238 sphere (density = 10 g/cm^3) is surrounded by a 1-cm thick low density U238 shell (density=0.003 g/cm^3). Source particles are created on the inner surface of the shell, directed outward. With a large dxtran sphere surrounding the inner sphere, it becomes likely that both fluorescence photons created from a collision in the shell will be scattered towards the sphere.

This problem was run in both photon only and photon-election modes.

- Photon only mode
    - Source energies: 0.05, 0.2, and 2.75 MeV.
    - Bremsstrahlung was turned off; thus only fluorescence photons were created for the source energies below 1 MeV.
- Photon-electron mode

- Electron source energies: 0.2 MeV and 2.75 MeV
- Knock-on electron production was turned off
- The newest straggling model was used (`dbcn 17j 2`)

For each source, problems were run using the following variance reduction techniques.

- Analog
- Analog with PHTVR
- Forced collisions in the uranium shell and weight cutoffs (`cut:p 2j 1e-4 5e-5`)
- Dxtran around the inner sphere
- Dxtran around the sphere, forced collisions in the shell, and weight cutoffs (`cut:p 2j 1e-4 5e-5`)

Track length and pulse height tallies were taken of the uranium sphere.

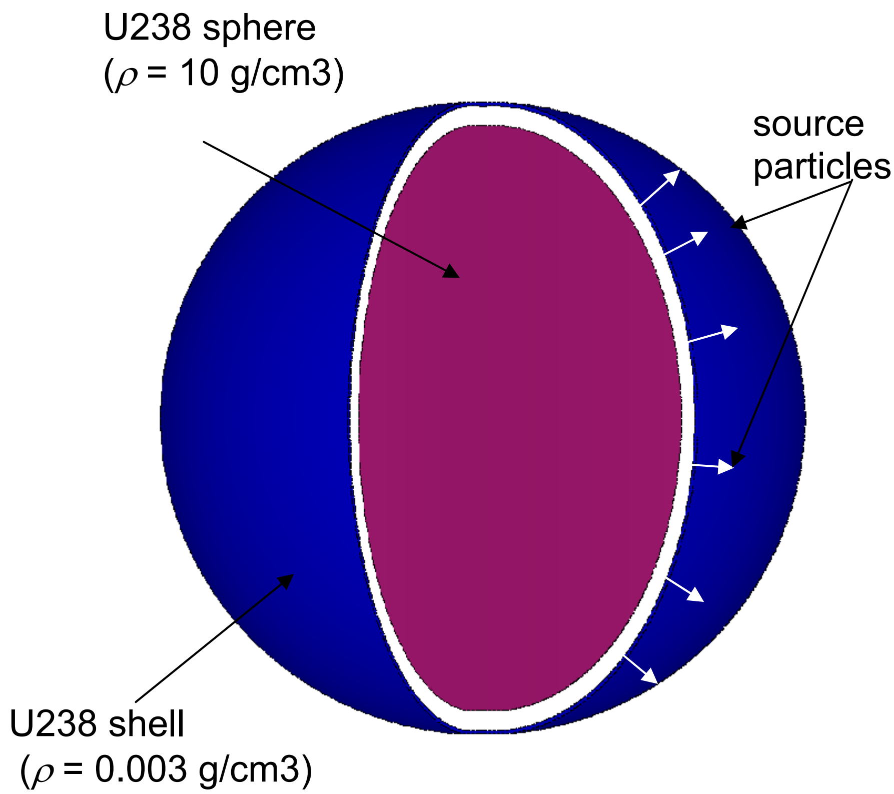


Figure 5: Geometry of the uranium sphere surrounded by a uranium shell

Results: In all cases, both the track-length tallies and the pulse height spectrums runs using variance reduction matched the analog results. The pulse height tally results are impressive in how all the resonance peaks match the analog cases. Plots of the pulse height tally spectra are contained in Appendix B.

Problem 3: Collinear dxtran spheres

The third problem was designed to test the treatment of annihilation photons with dxtran spheres. With PHTVR and DXTRAN, both annihilation photons dxtran particles are created and tracked. However, the annihilation photon that is traveling away from the dxtran sphere only scores for the pulse height tallies. The other tallies ignore this photon.

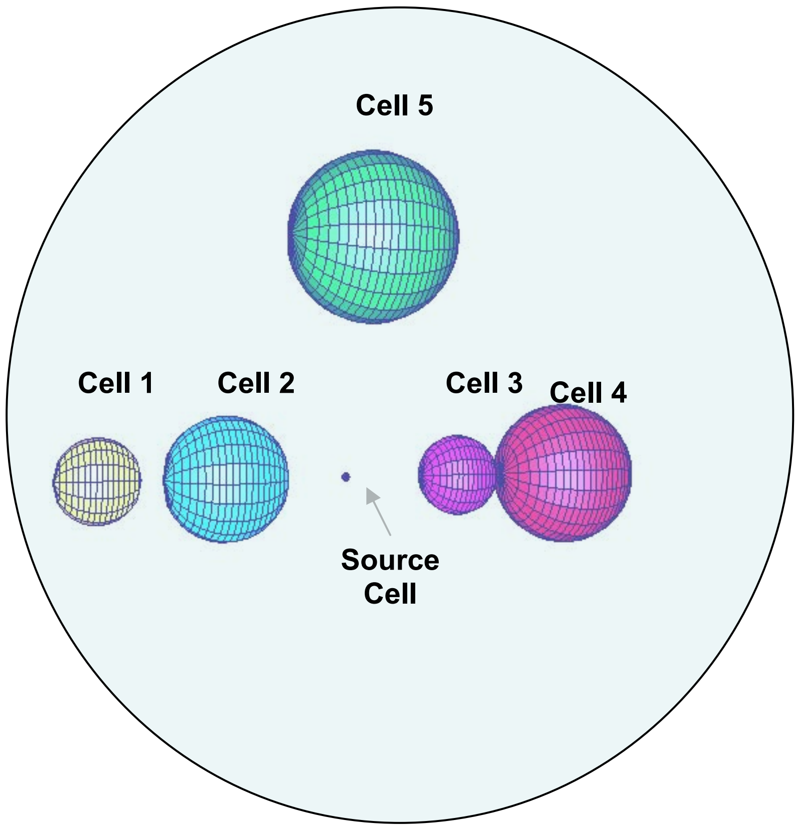


Figure 6: Geometry of the collinear dxtran sphere problem

The problem consists of four spheres in a row, with a fifth sphere off to the side. A 0.0011 MeV positron is started in the source cell, which immediately decays into two annihilation photons. Dxtran spheres are sometimes placed around the five spheres. Figure 6 is a drawing of this problem, and Table 5 describes each of the cells.

Table 5 Cell Geometry Description for the Collinear Dxtran Spheres Problem

Cell	x	y	z	Diameter (cm)	Material	Density (g/cm^3)
1	0	-60	0	10	U238	1.7
2	0	-30	0	15	U238	0.7
3	0	30	0	10	U238	0.7
4	0	60	0	18	U238	1.7
5	0	0	60	20	U238	1.7
Source	0	0	0	10^{-6}	Pb208	12

Surrounding the spheres is N14 with density 0.003 g/cm^3.

This problem was run using variance reduction techniques and in analog mode. The variance reduction techniques used are:

- Fractional forced collisions
- Dxtran sphere only around cell 1
- Dxtran sphere only around cell 4
- Dxtran spheres around cells 1-5
- Dxtran spheres around cells 1-5 with fractional forced collisions
- Five dxtran spheres around cells 1-5 with DXC cards
- Analog using the PHTVR method

Table 6 lists the values of the forced collision and DXC cards.

Table 6 Forced Collisions and DXC Card Parameters

		Cell 1	Cell 2	Cell 3	Cell 4	Cell 5	Source cell	Nitrogen cell	Outside cell
Forced Collision Values		0.25	1	-1	-0.25	0	0	0.25	0
DXC card values	dxc1	1	0.43	0.8	0.9	0.8	0.87	0.9	1
	dxc2	1	0.8	1	0.2	0.45	0.5	0.4	1
	dxc3	0.9	1	0.74	0.97	0.8	0.3	0.2	1
	dxc4	1	1	0.5	0.7	0.7	0.9	0.4	1
	dxc5	0.3	0.5	0.4	0.6	0.1	0.4	1	1

Track-length and pulse height tallies were scored for the five spheres.

Plots of the test results compared to the analog results are provided in Appendix C:

- Appendix C.1.i contains the track length tally plots in the spheres
- Appendix C.2.ii contains the pulse height tally plots in the spheres

Discussion of the results

Track length tallies: The track length tallies for all the runs and all the spheres matched exactly except for Cell 1. For this cell, only the analog run using the PHTVR method matched the purely analog results. The results for the other tests were acceptable, but did not match exactly; most of the discrepancy was in the spectra below 0.01 MeV.

Pulse Height tallies: The analysis of the pulse height tallies is divided into three energy ranges

Below 0.01 MeV: Although the results in this energy range are acceptable, most of the results do not match the analog results exactly. The worse case is for Cell 1, which is not surprising, considering that the Cell 1 track length tallies did not match the analog results either. For the other cells, the run using forced collisions only matched well with the analog results. All the runs for which a dxtran sphere surrounded the cell did not match as well. Most of the DXTRAN pulse height tallies in this energy range had higher errors than the analog results.

0.01 MeV – 0.511 MeV: In this energy range, there is good agreement with the analog results for all the variance reduction techniques.

Above 0.511 MeV: In this region, the results with five dxtran spheres did not match up with the analog results for all the cells except for Cell 1 (this cell had too few counts above 0.511 MeV to provide any conclusions). The worst cases were Cells 4 and 5, for which the DXTRAN results are noticeably higher than the analog results. However, the spectra in this energy range are several orders of magnitude lower than the lower energy results, and the relative errors in this region are on the order of 0.1.

Conclusions

Based on these tests, the following conclusions can be reached:

- The pulse height tally variance reduction method works as expected.
- There are some cases in which PHTVR does not work well
    - problems having a lot of roulette
    - exponential transform with high energy particles
- In those cases that PHTVR does not match the analog results
    - not all of the ten statistical tests are passed
    - the errors in the energy spectra are typically high
    - the calculations are inefficient.
- Multiple dxtran spheres should be used with caution
- In coupled electron-photon problems, the differences seen between dxtran and nondxtran results are possibly caused by an inconsistency between the coherent sampling interpolation schemes used for dxtran and non-dxtran particles

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[1] T. Booth, "Monte Carlo Variance Reduction Approaches for Non-Boltzmann Tallies", LA-12433 (1992)
[2] T. Booth, "Pulse Height Tally Variance Reduction in MCNP", LA-13955 (2004)

Appendix A.1.i

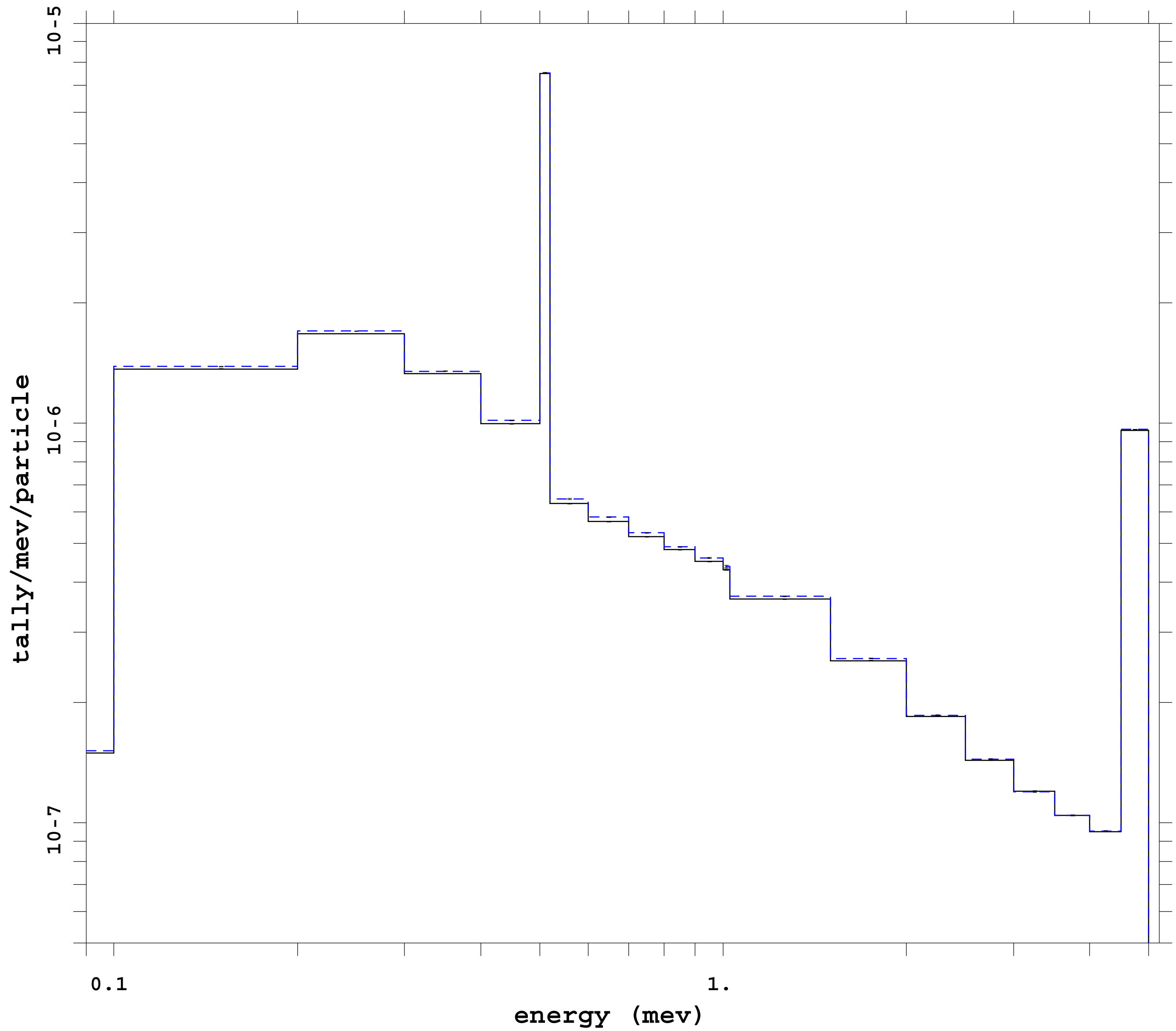
Problem 1
Ge sphere Next To a U / O Stacked Cylinder

Plots of the track length tally spectra in the germanium sphere

Plots are in order of the run number listed in Table 2. The variance reduction methods used are listed in the plot title; the graph label contains the run number.

Ep = 5 MeV   Photon only

Var Red: dxt dxtran roulette off



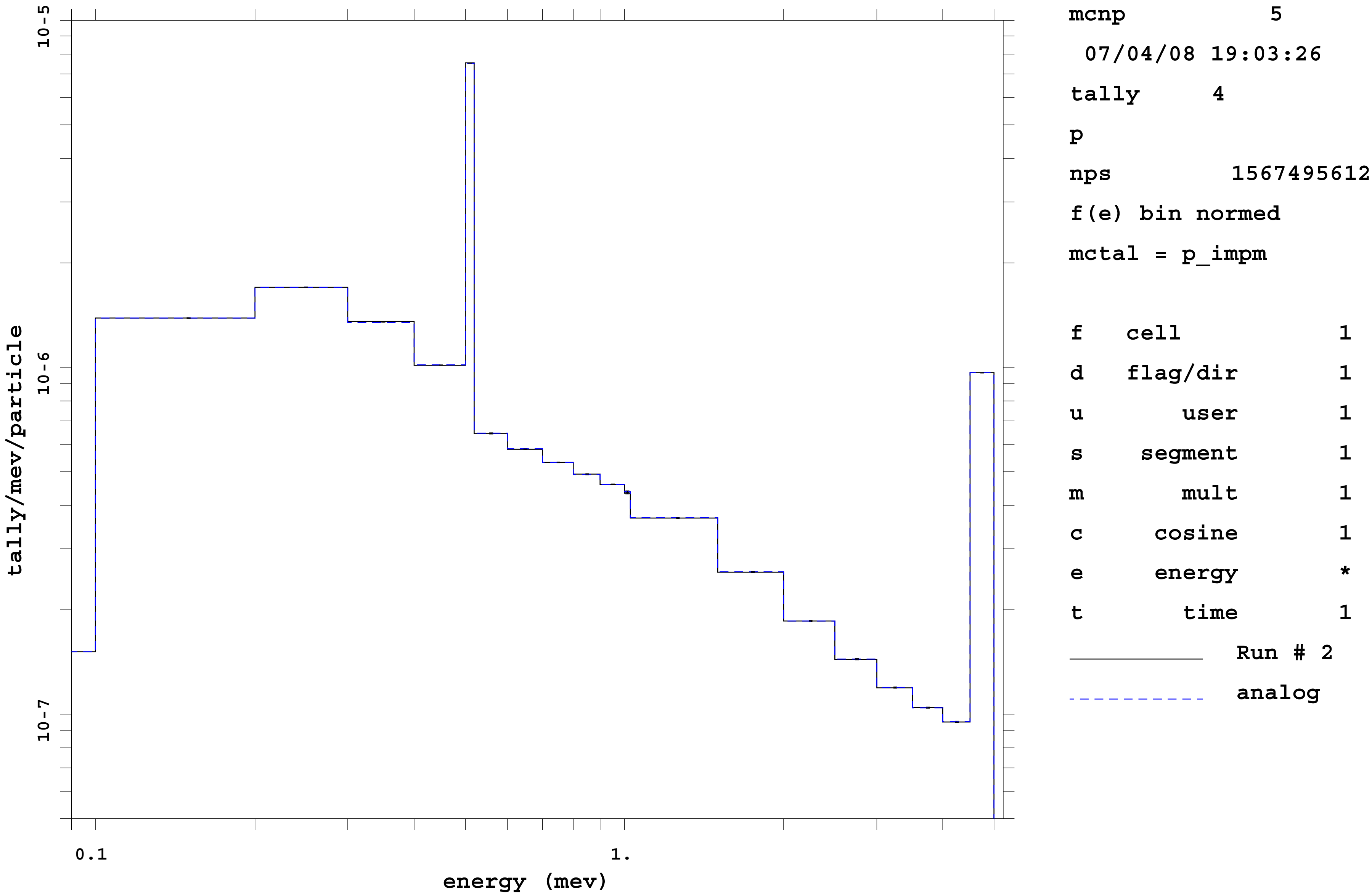
mcnp 5
07/04/08 19:03:17
tally 4
p
nps 1405032704
f(e) bin normed
mctal = p_dxt_dd0m

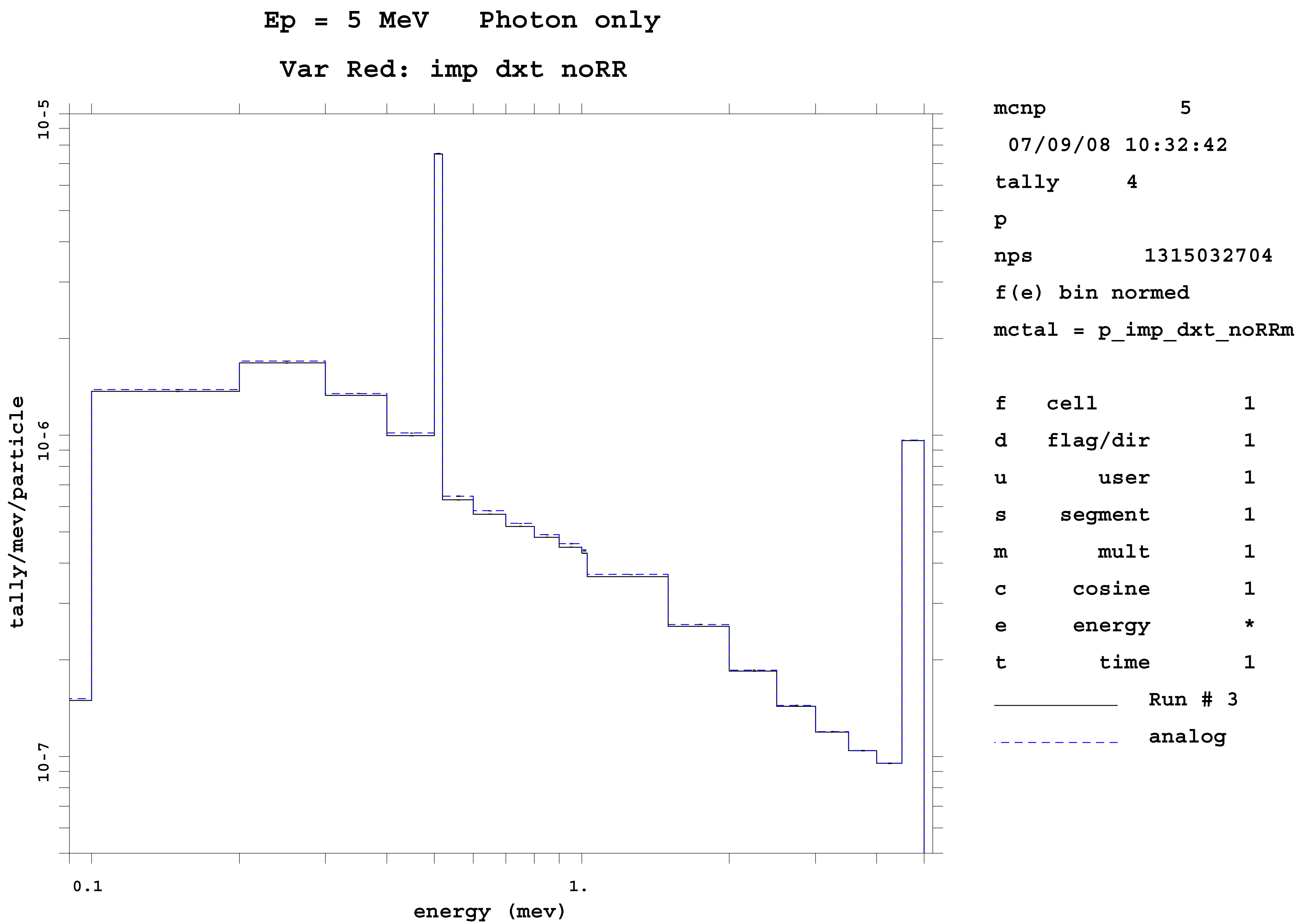
f	cell	1
d	flag/dir	1
u	user	1
s	segment	1
m	mult	1
c	cosine	1
e	energy	*
t	time	1

——— Run # 1
- - - analog

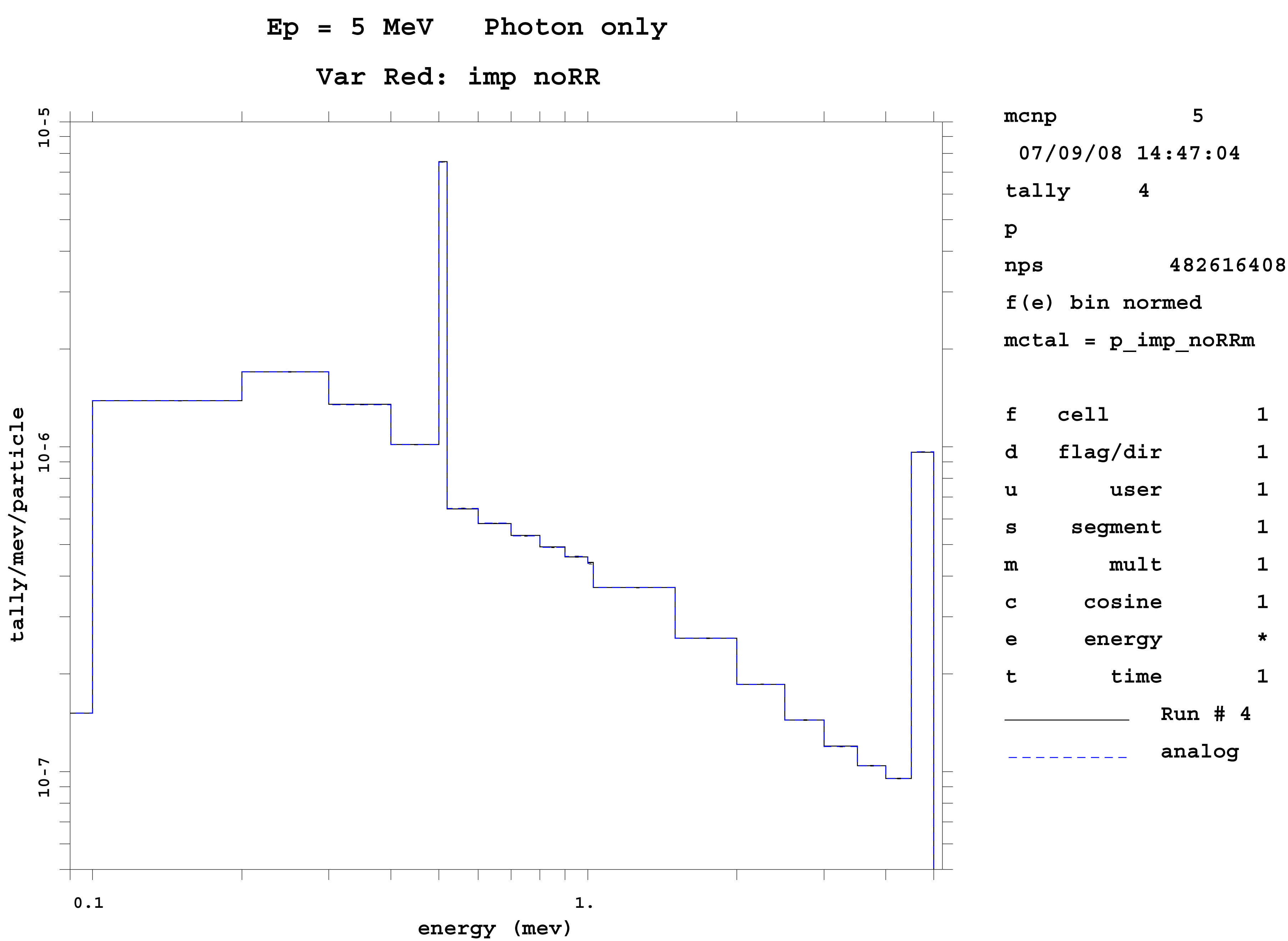
Ep = 5 MeV   Photon only

Var Red: imp



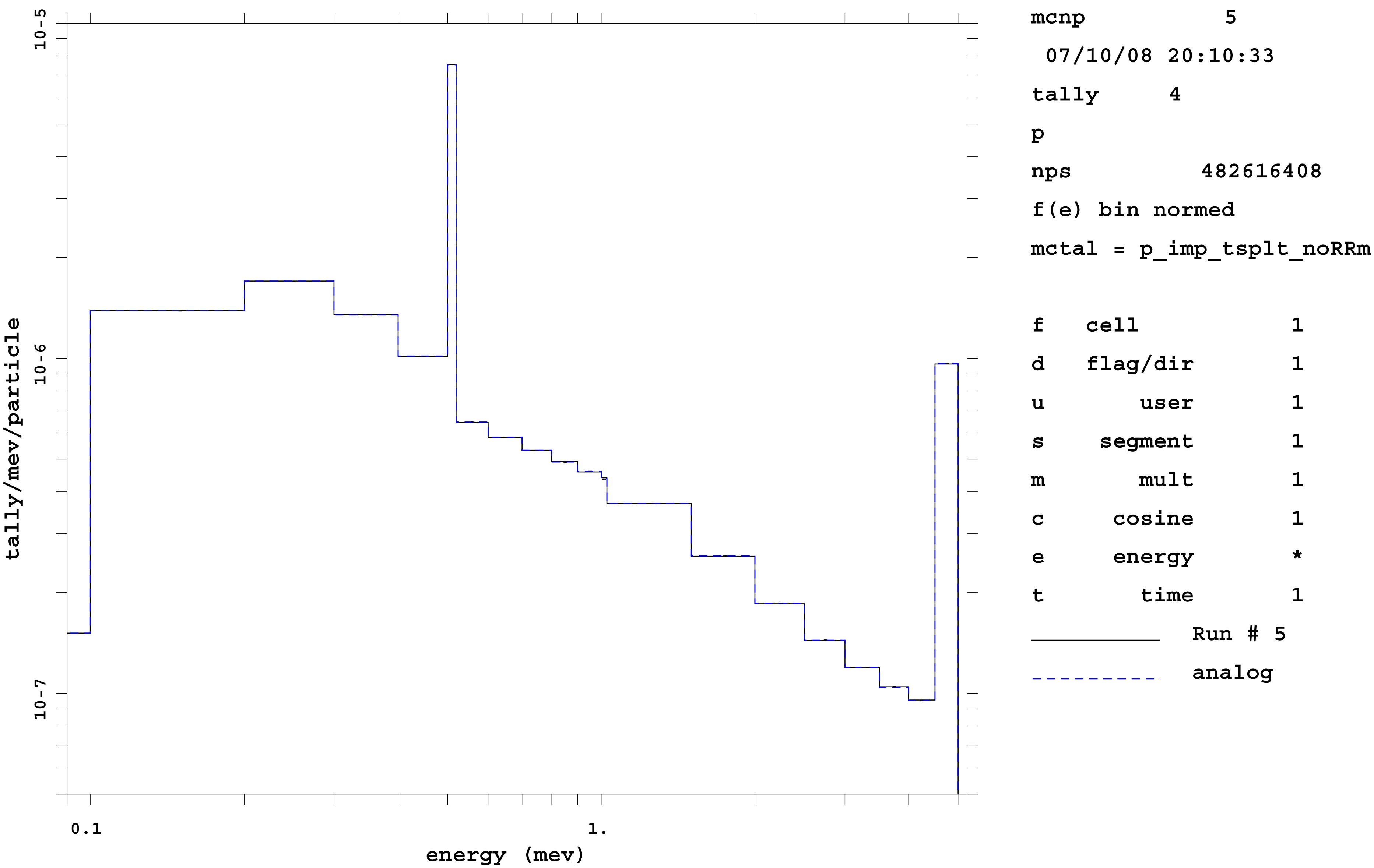


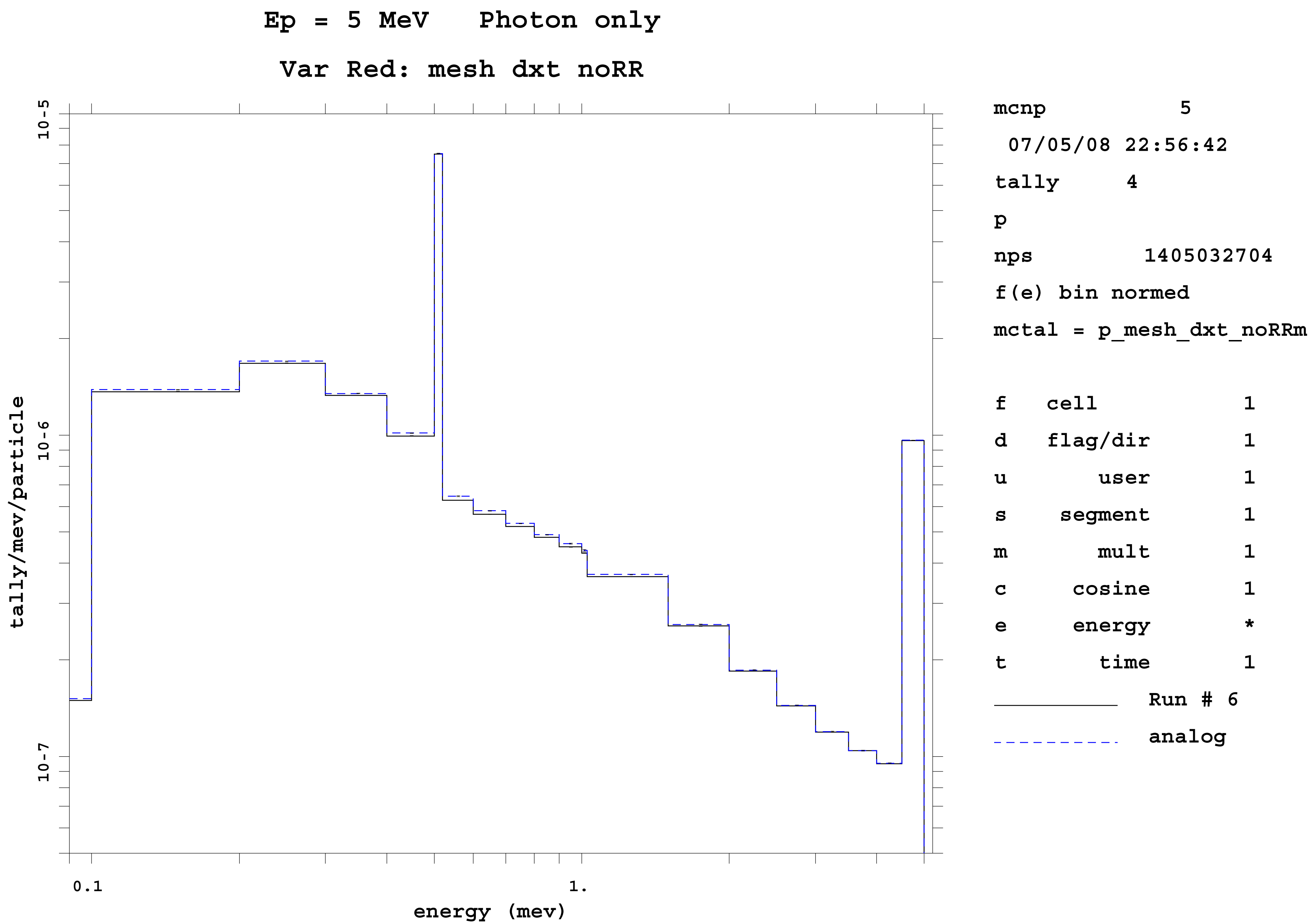
Ep = 5 MeV Photon only
Var Red: imp dxt noRR
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/09/08 10:32:42
tally 4
p
nps 1315032704
f(e) bin normed
mctal = p_imp_dxt_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 3
analog


Ep = 5 MeV Photon only
Var Red: imp noRR
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/09/08 14:47:04
tally 4
p
nps 482616408
f(e) bin normed
mctal = p_imp_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 4
analog

Ep = 5 MeV   Photon only

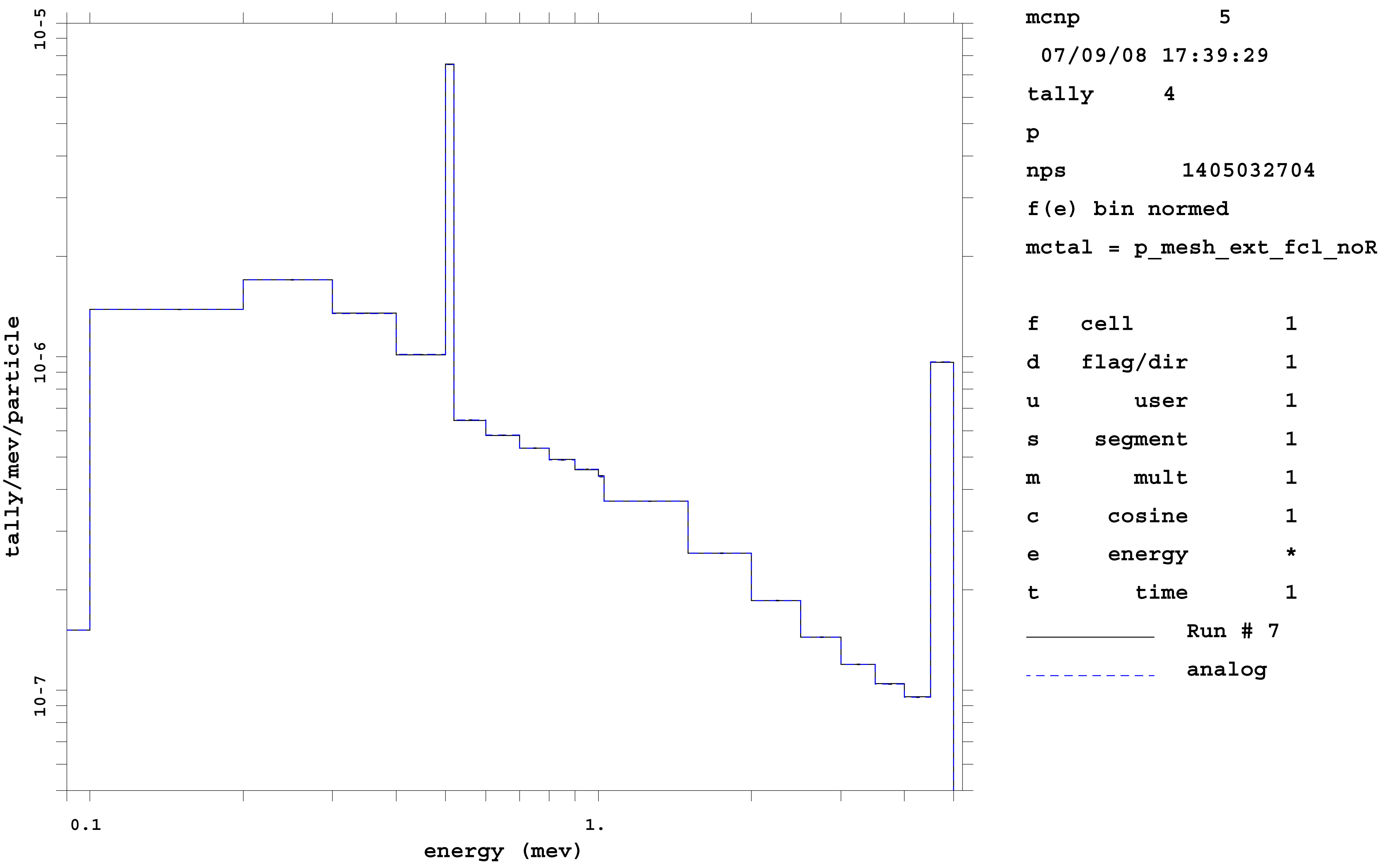
Var Red: imp tsplt noRR

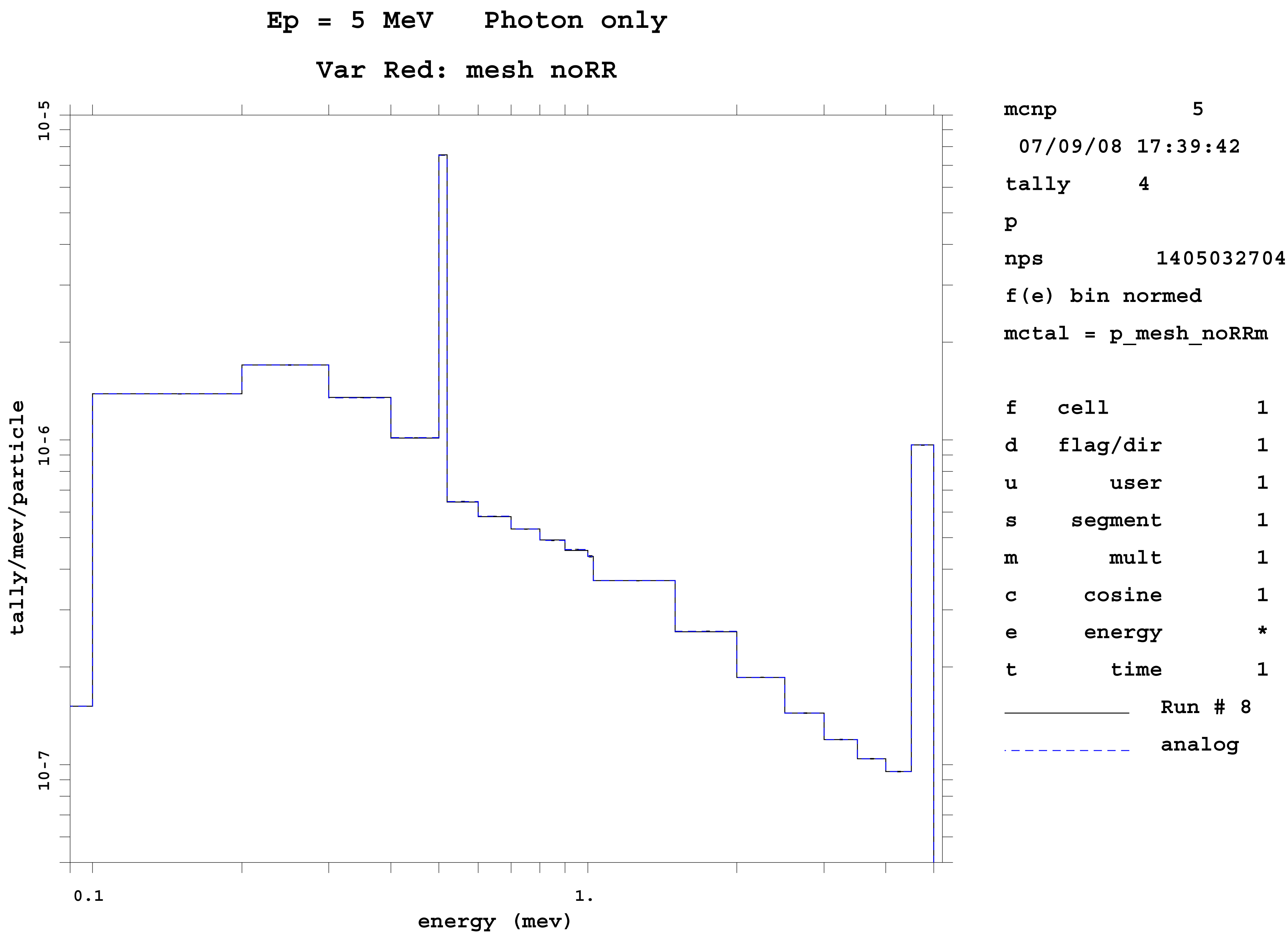



Ep = 5 MeV Photon only
Var Red: mesh dxt noRR
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/05/08 22:56:42
tally 4
p
nps 1405032704
f(e) bin normed
mctal = p_mesh_dxt_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 6
analog

Ep = 5 MeV   Photon only

Var Red: mesh ext fcl noRR

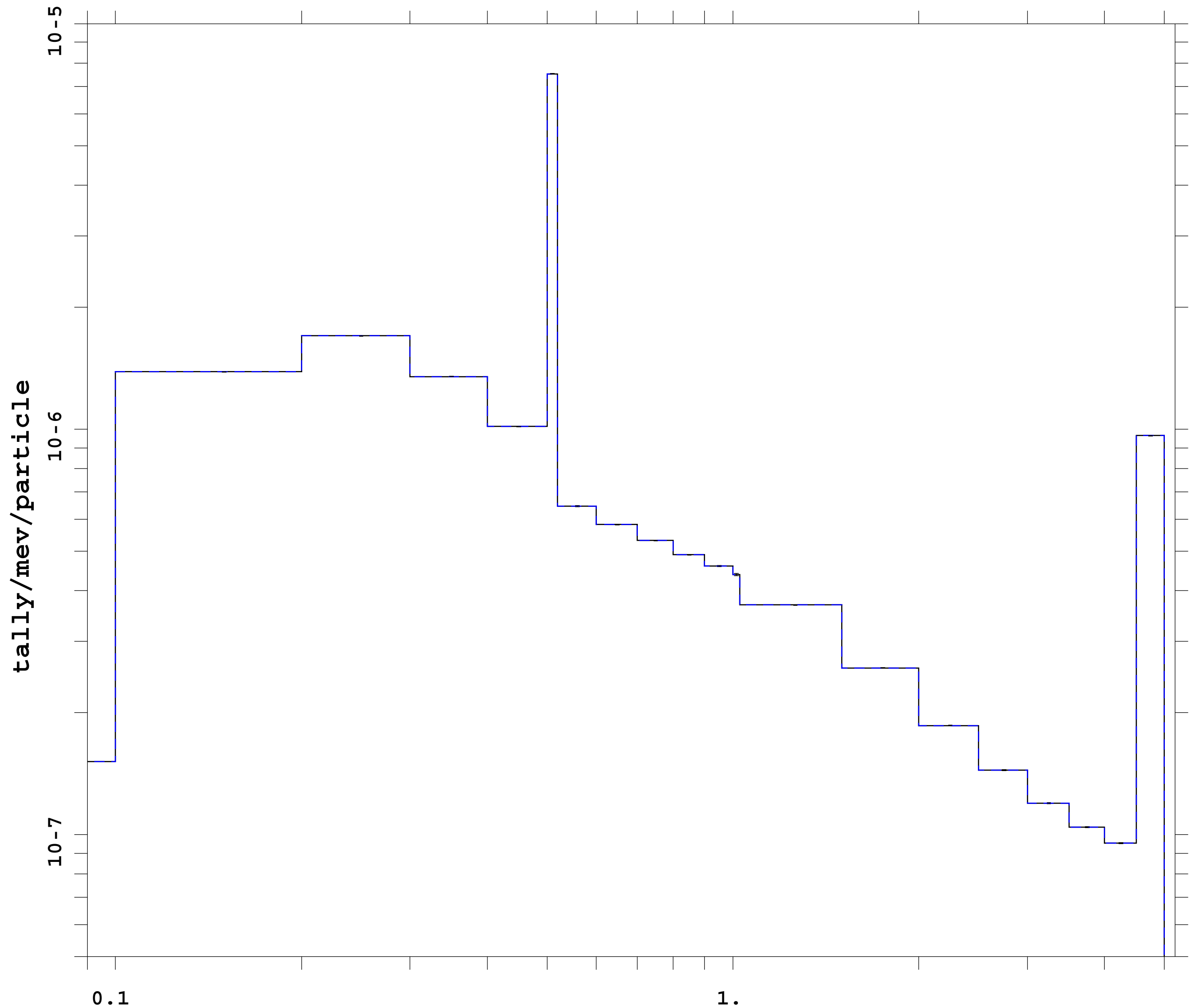




Ep = 5 MeV Photon only
Var Red: mesh noRR
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/09/08 17:39:42
tally 4
p
nps 1405032704
f(e) bin normed
mctal = p_mesh_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 8
analog

Ep = 5 MeV Photon only

Var Red: analog



mcnp 5
07/04/08 21:29:41
tally 4
p
nps 1265359408
f(e) bin normed
mctal = p_noVRm

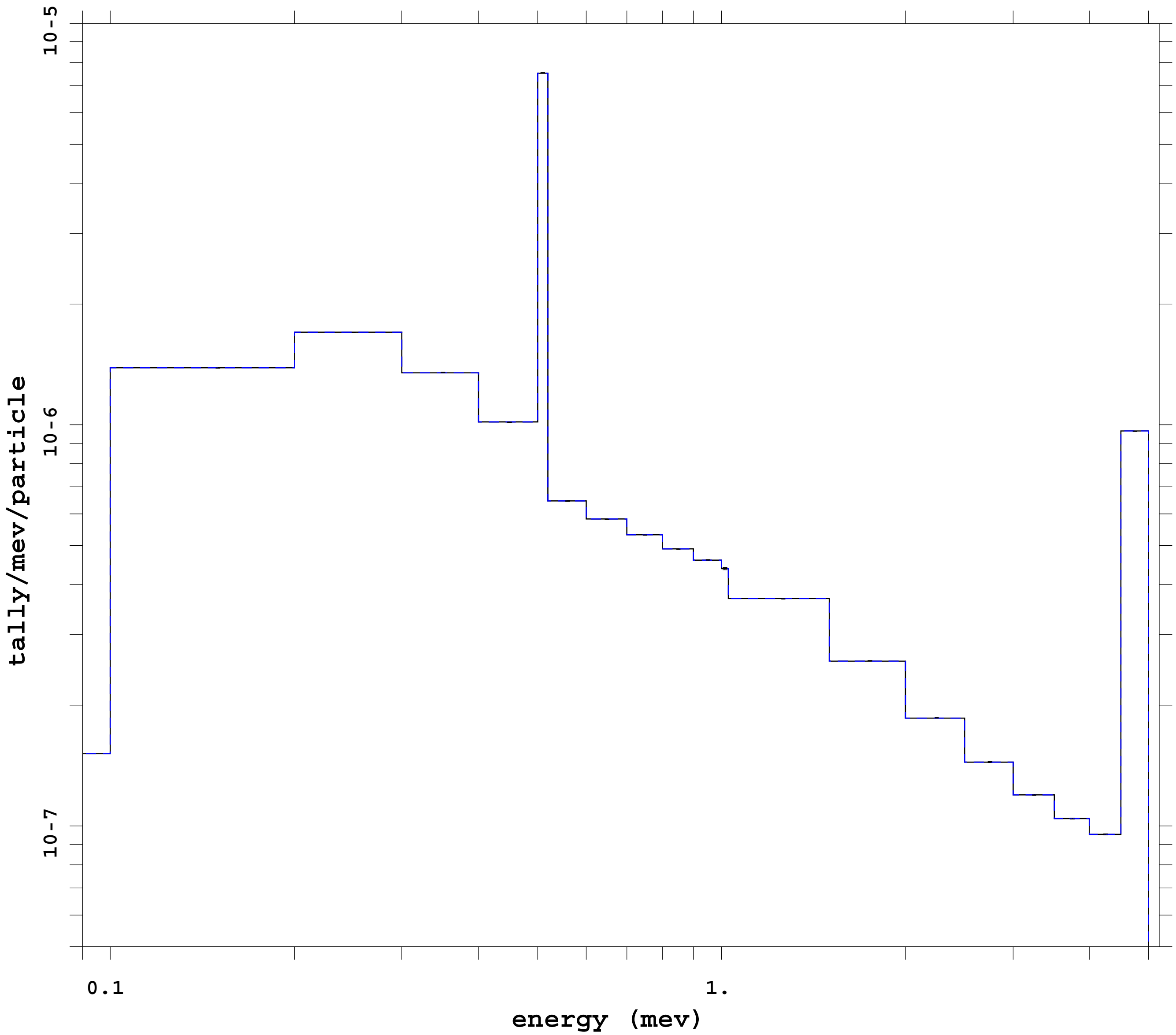
f	cell	1
d	flag/dir	1
u	user	1
s	segment	1
m	mult	1
c	cosine	1
e	energy	*
t	time	1

——— Run # 9

- - - - analog

Ep = 5 MeV   Photon only

Var Red: anlog using PHTVR



mcnp 5

07/04/08 21:14:40

tally 4

p

nps 1265359408

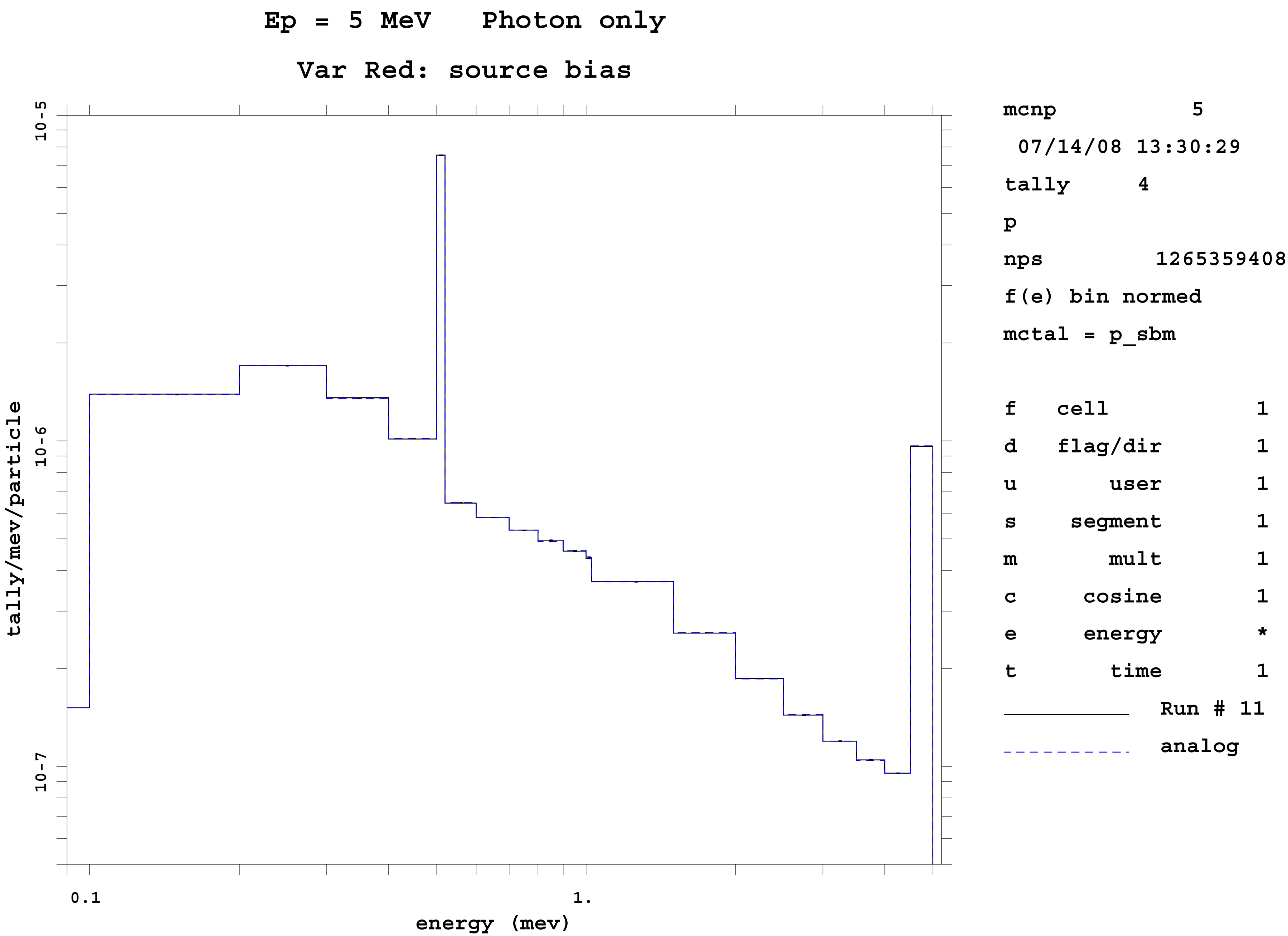
f(e) bin normed

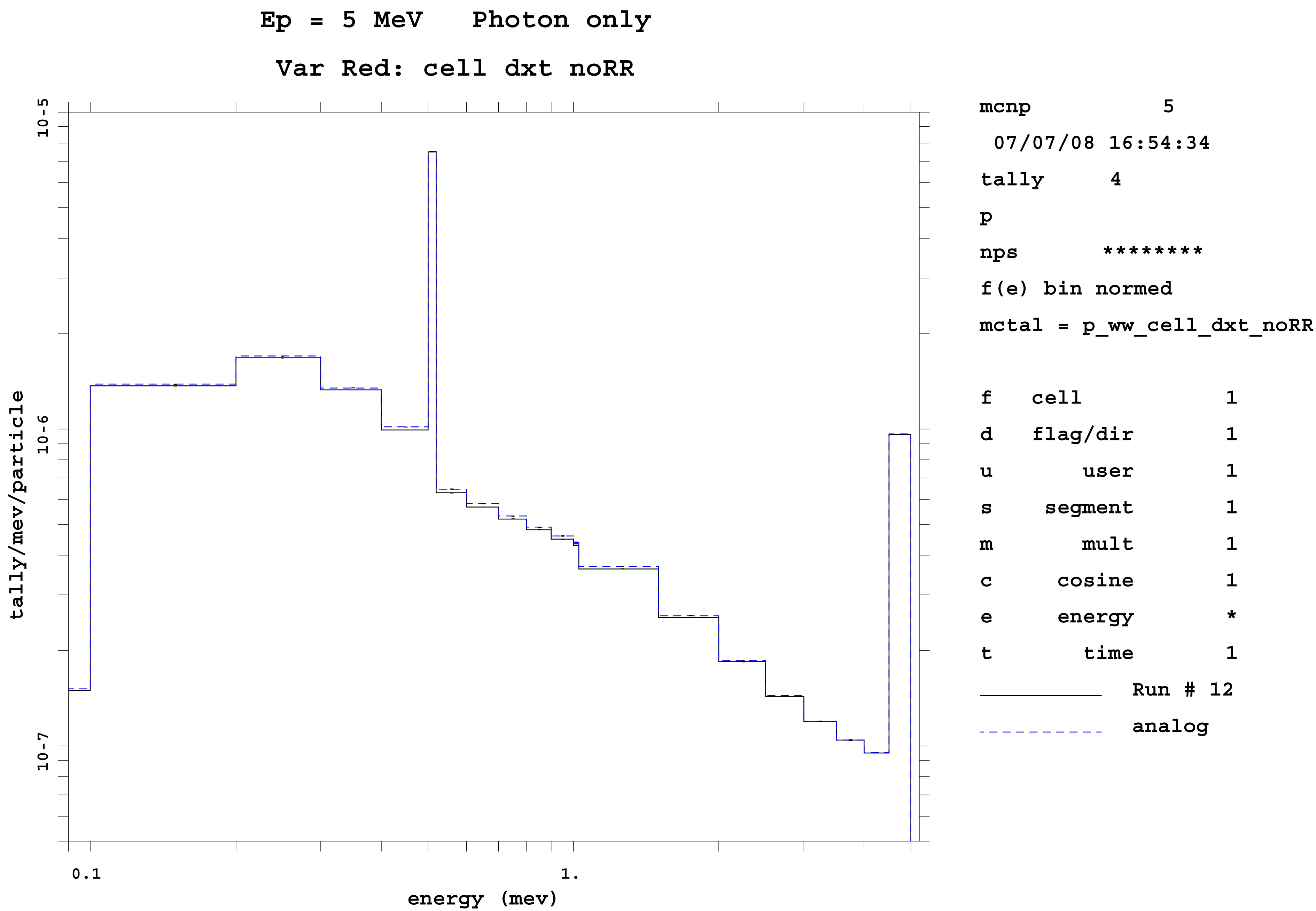
mctal = p_noVR_PHTVRm

f	cell	1
d	flag/dir	1
u	user	1
s	segment	1
m	mult	1
c	cosine	1
e	energy	*
t	time	1

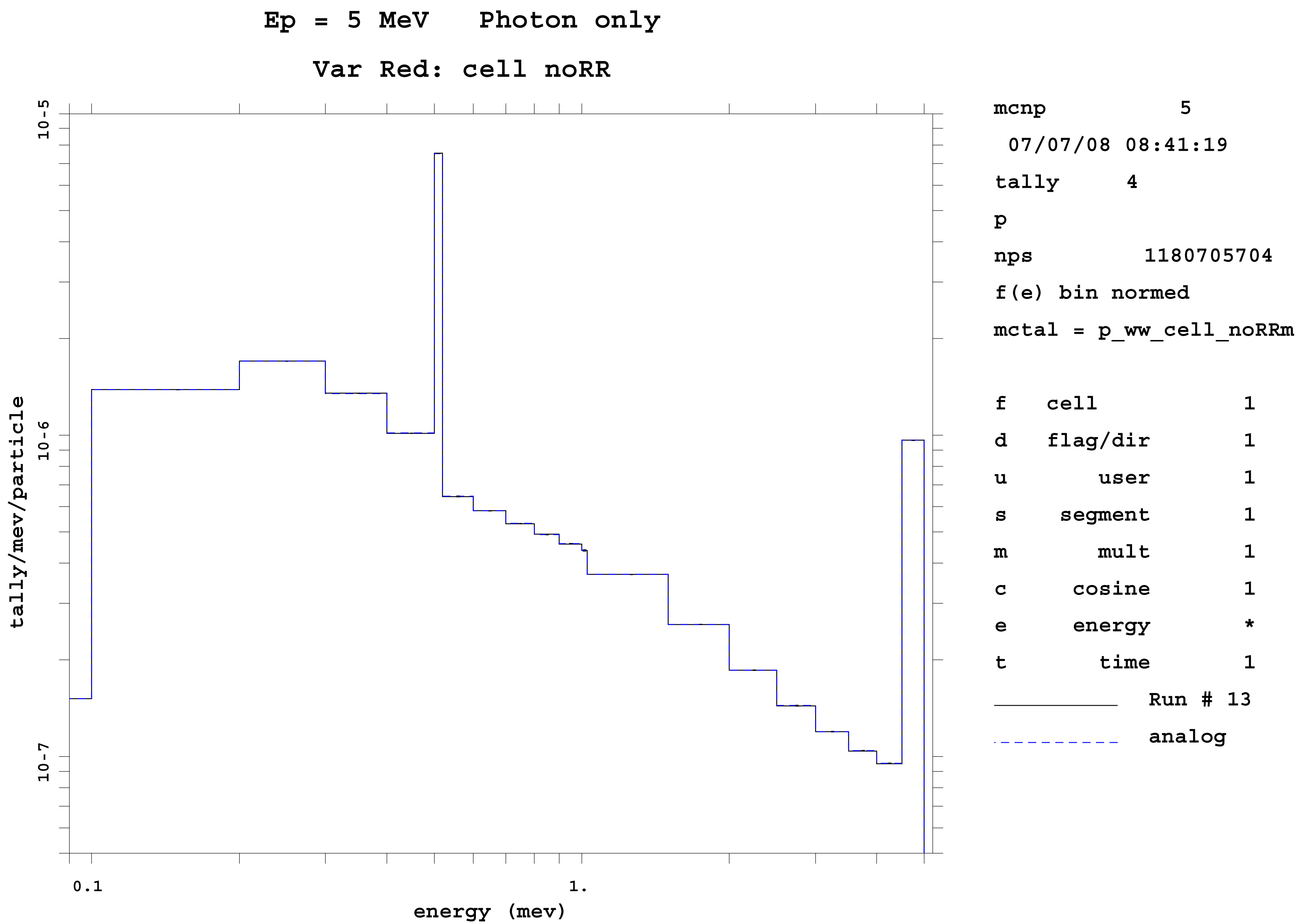
Run # 10

analog

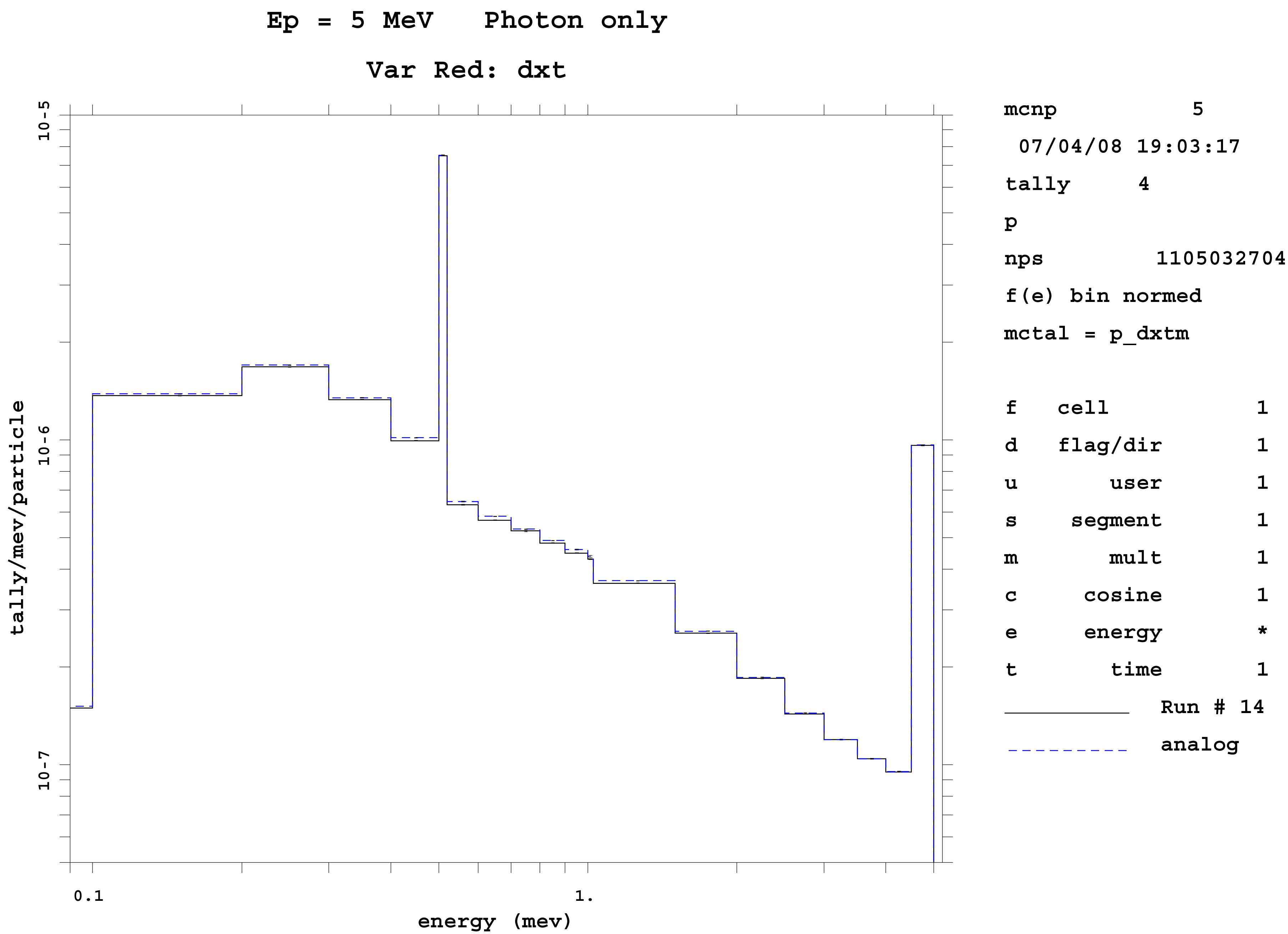

Ep = 5 MeV Photon only
Var Red: source bias
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/14/08 13:30:29
tally 4
p
nps 1265359408
f(e) bin normed
mctal = p_sbm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 11
analog



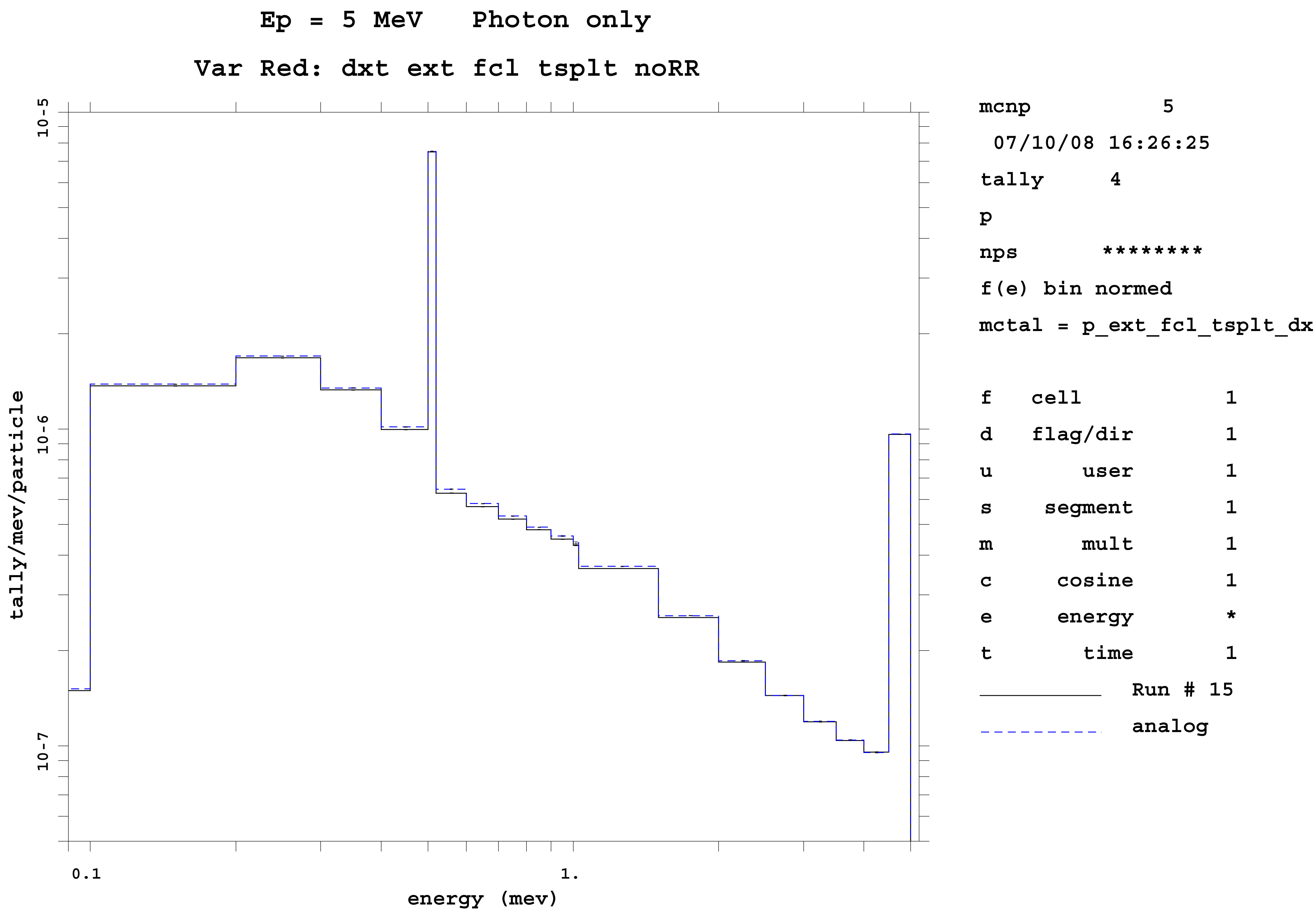
Ep = 5 MeV Photon only
Var Red: cell dxt noRR
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 16:54:34
tally 4
p
nps ********
f(e) bin normed
mctal = p_ww_cell_dxt_noRR
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 12
analog



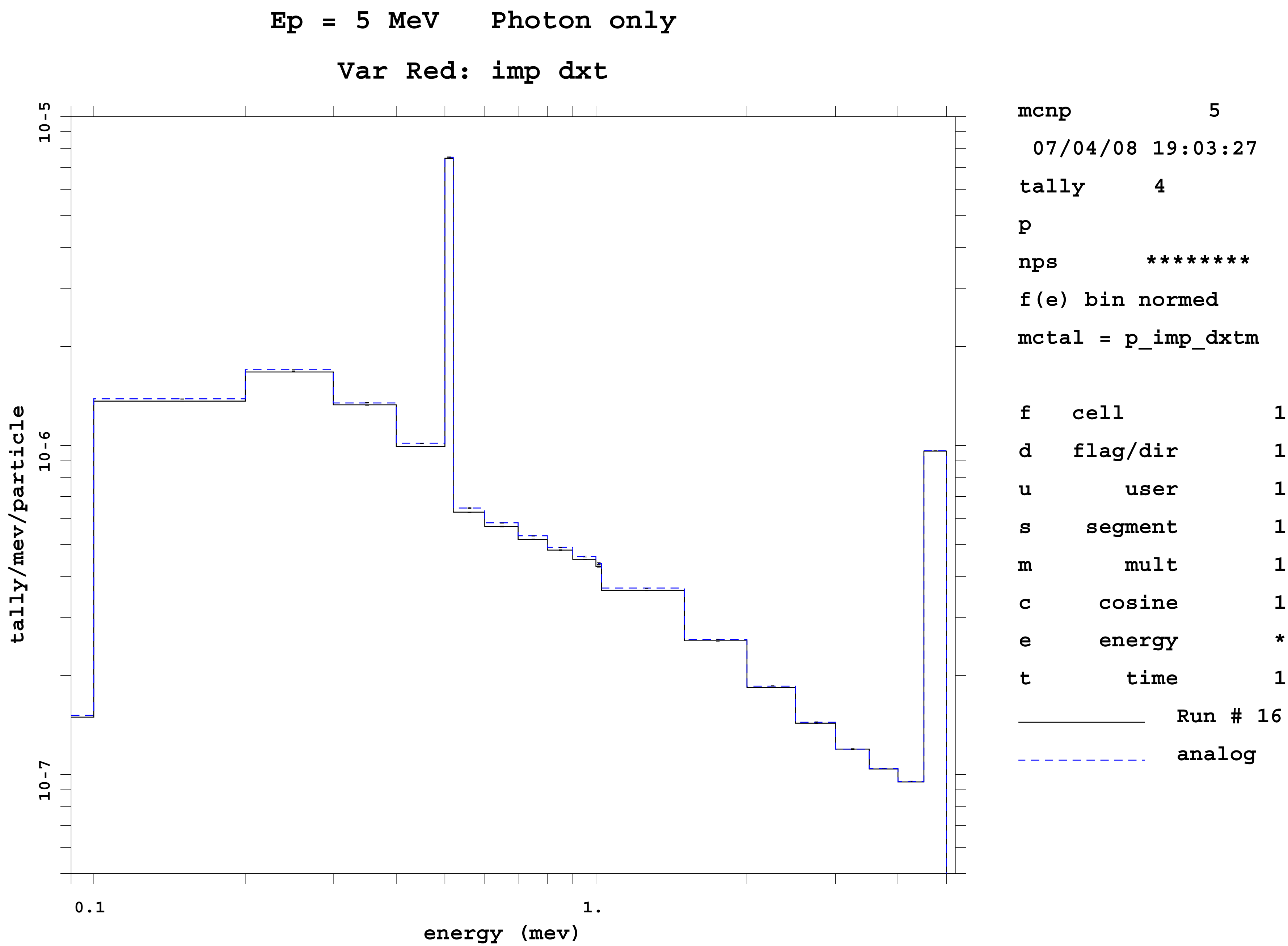
Ep = 5 MeV Photon only
Var Red: cell noRR
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 08:41:19
tally 4
p
nps 1180705704
f(e) bin normed
mctal = p_ww_cell_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 13
analog



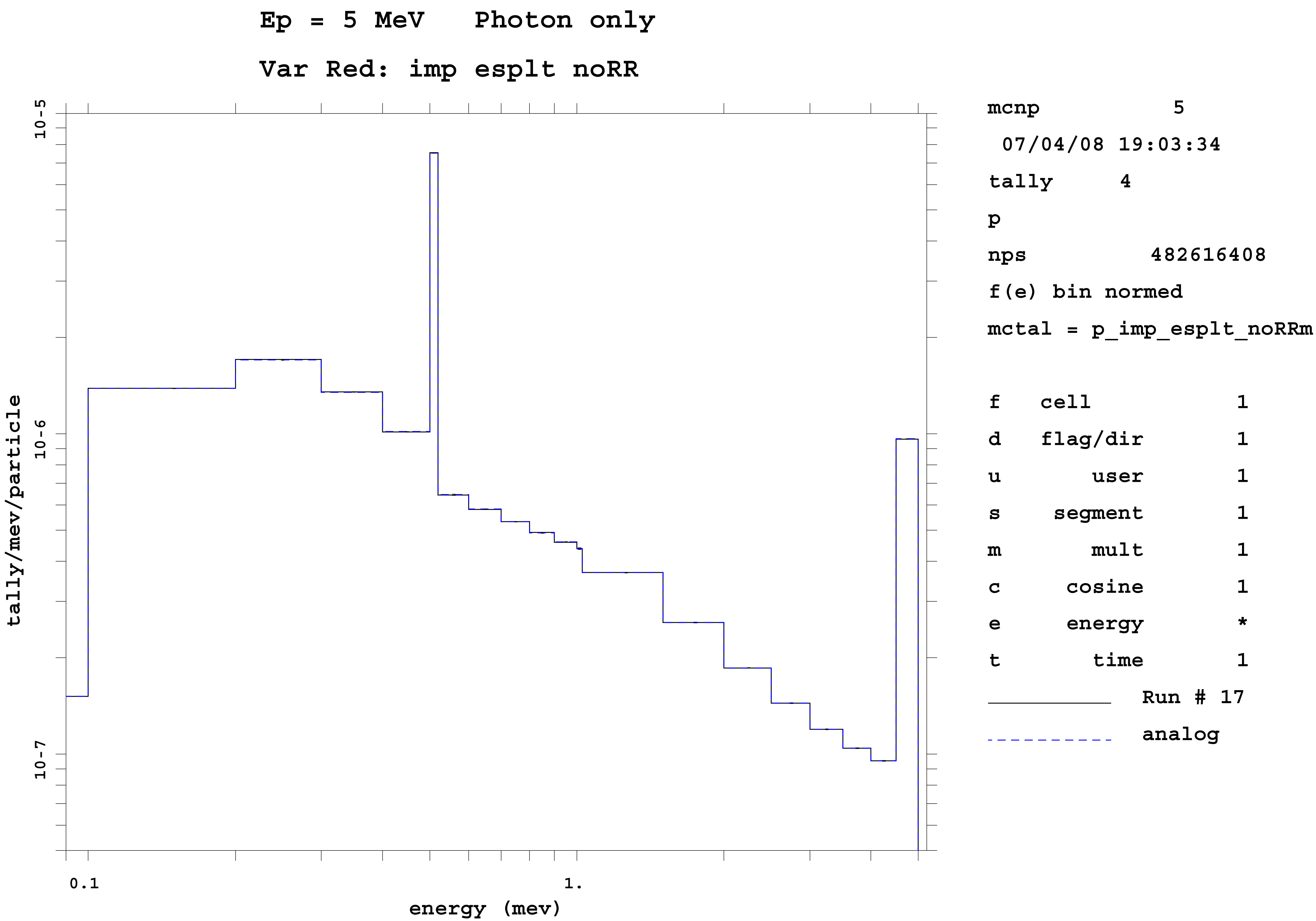
Ep = 5 MeV Photon only
Var Red: dxt
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/04/08 19:03:17
tally 4
p
nps 1105032704
f(e) bin normed
mctal = p_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 14
analog

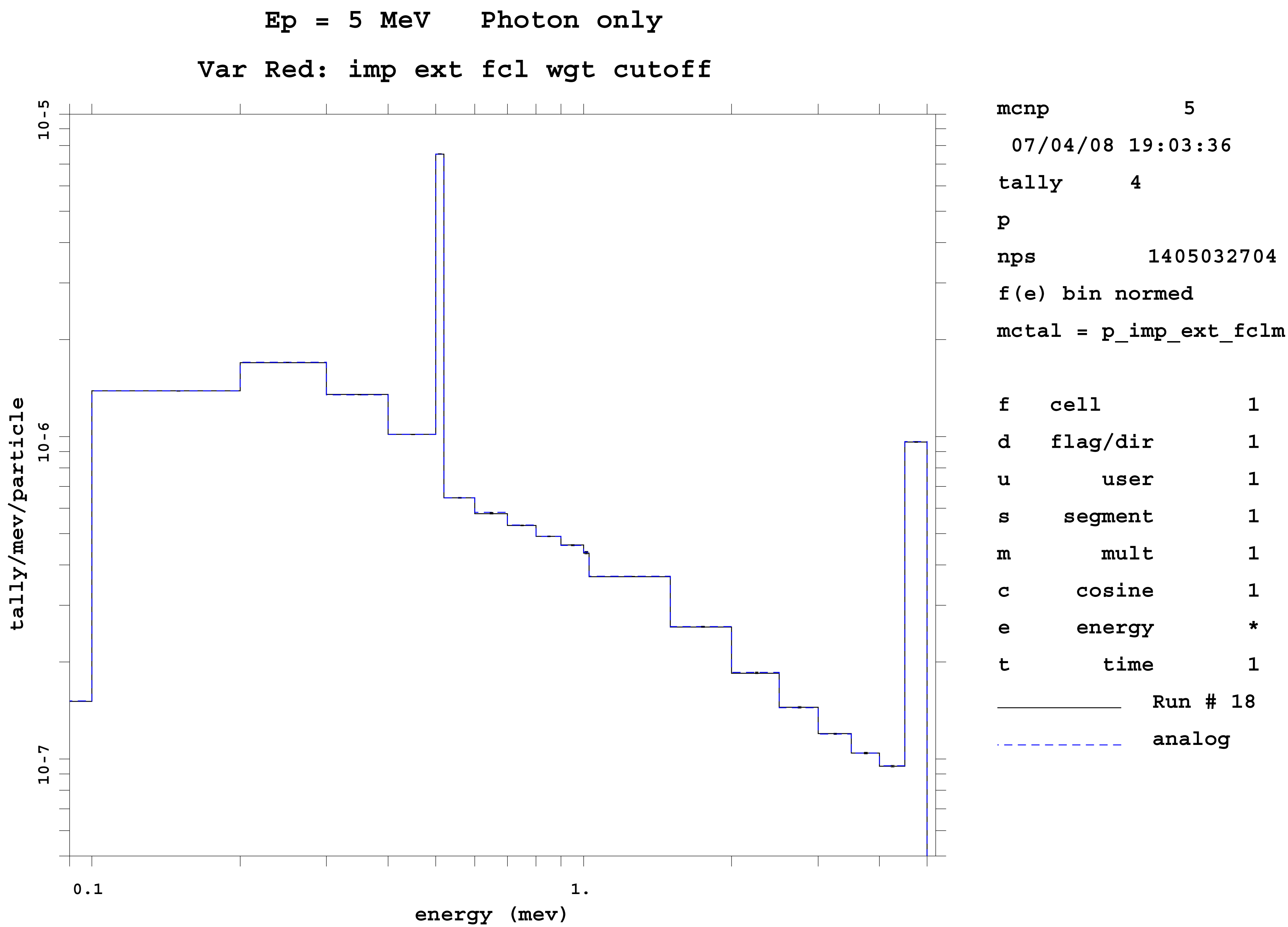


Ep = 5 MeV Photon only
Var Red: dxt ext fcl tsplt noRR
tally/mev/particle
10-5
10-6
10-7
0.1
1.
energy (mev)
mcnp 5
07/10/08 16:26:25
tally 4
p
nps ********
f(e) bin normed
mctal = p_ext_fcl_tsplt_dx
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 15
analog



Ep = 5 MeV Photon only
Var Red: imp dxt
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/04/08 19:03:27
tally 4
p
nps ********
f(e) bin normed
mctal = p_imp_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 16
analog

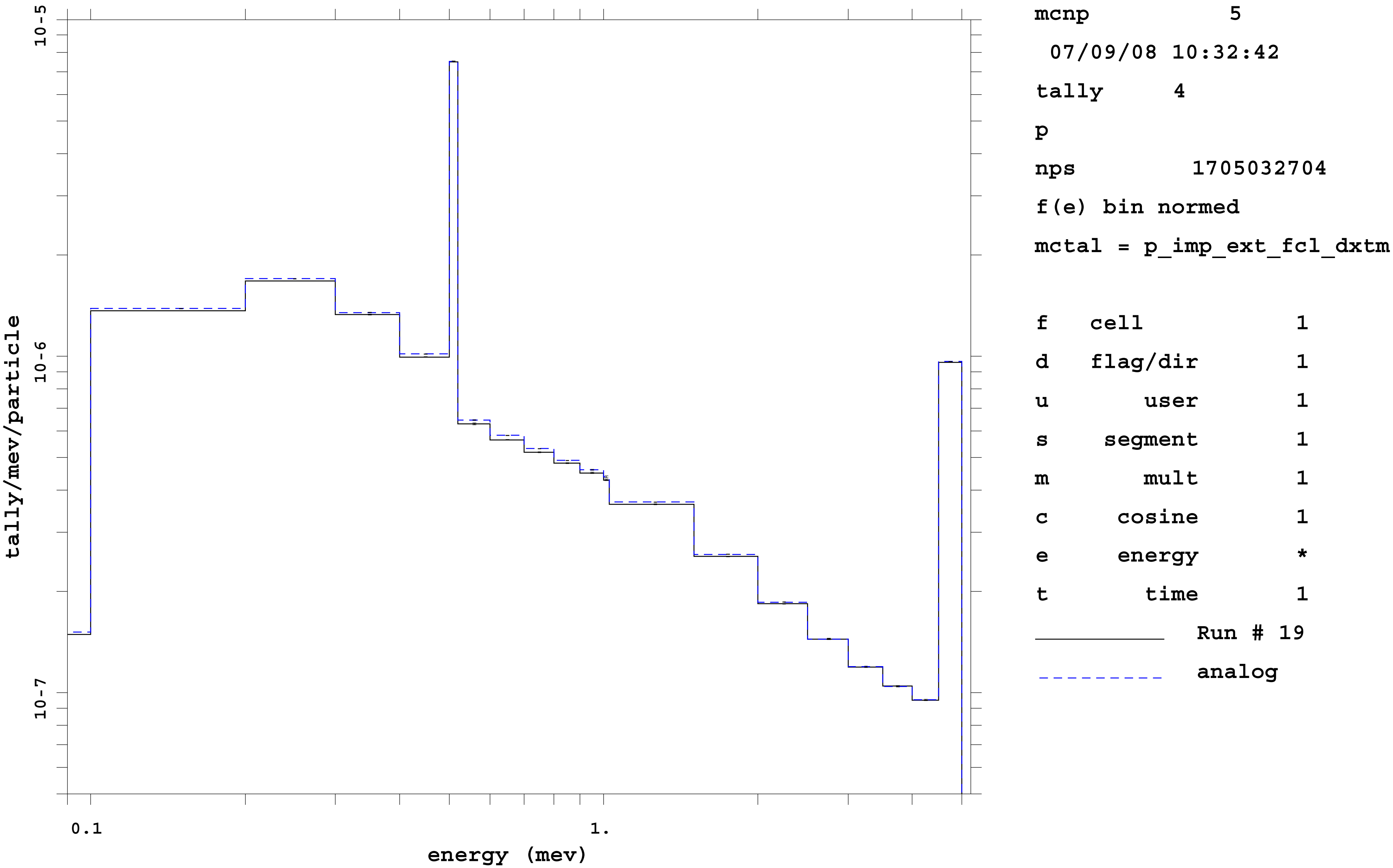

Ep = 5 MeV Photon only
Var Red: imp esplt noRR
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/04/08 19:03:34
tally 4
p
nps 482616408
f(e) bin normed
mctal = p_imp_esplt_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 17
analog

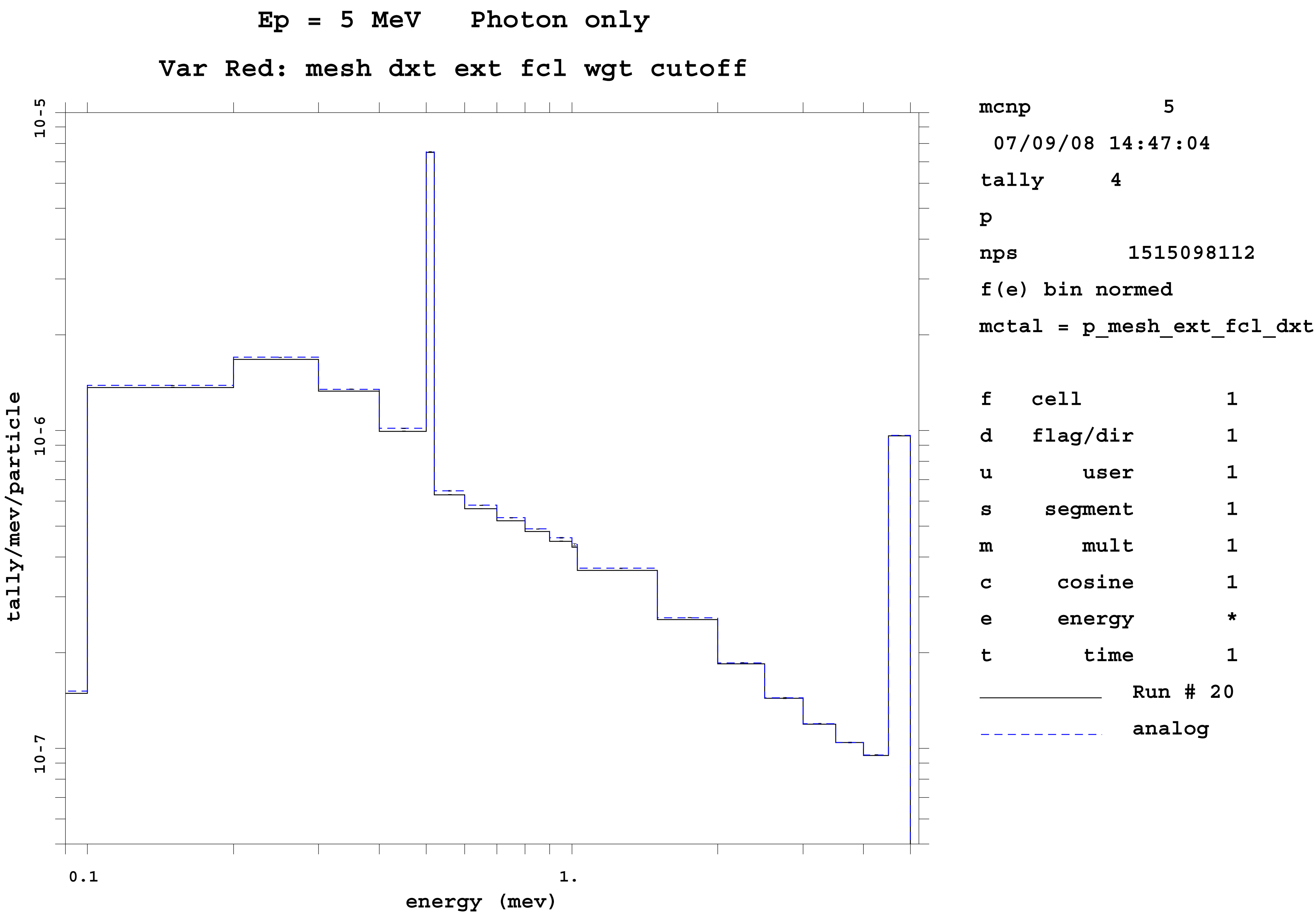


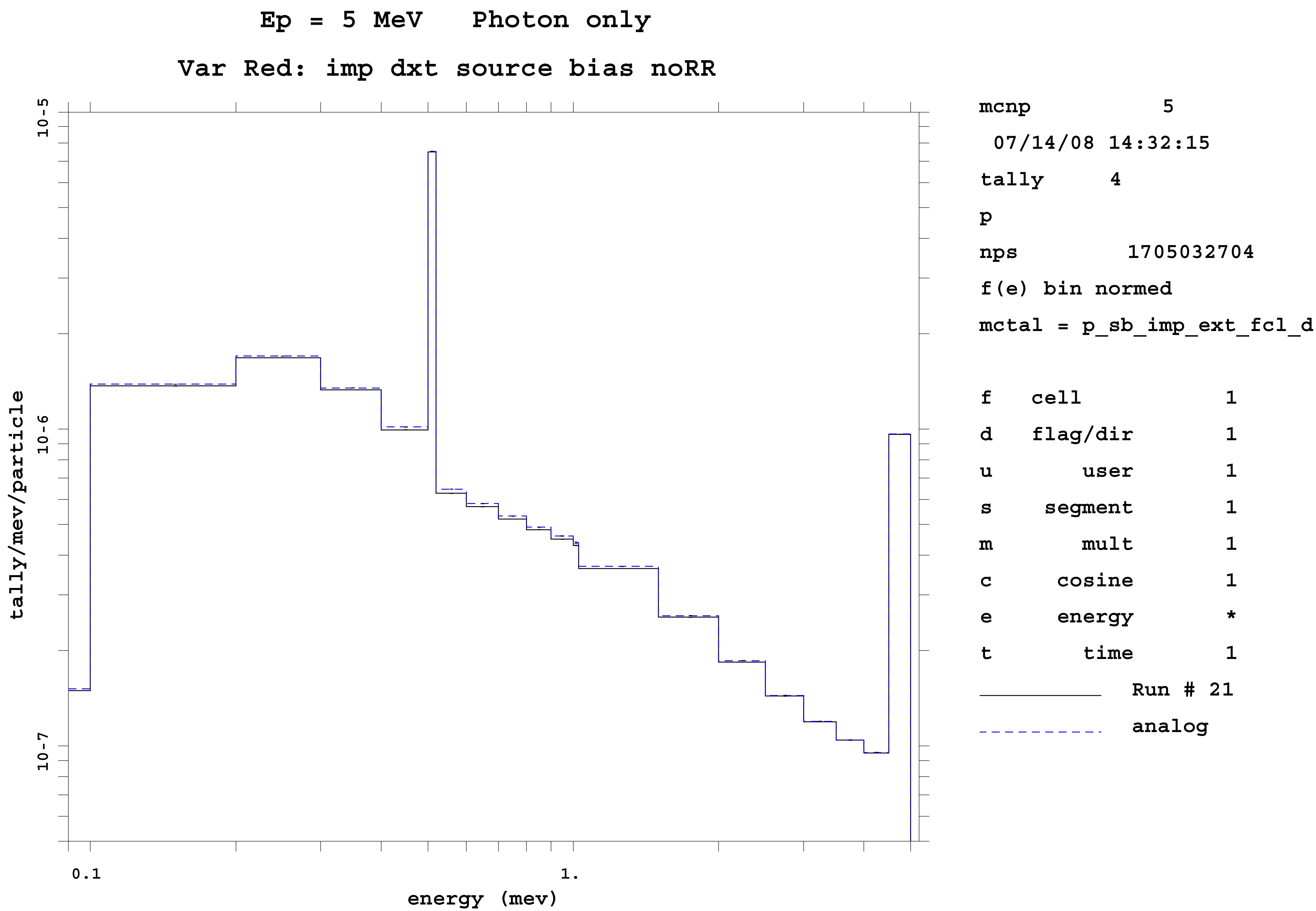
Ep = 5 MeV Photon only
Var Red: imp ext fcl wgt cutoff
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/04/08 19:03:36
tally 4
p
nps 1405032704
f(e) bin normed
mctal = p_imp_ext_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 18
analog

Ep = 5 MeV   Photon only

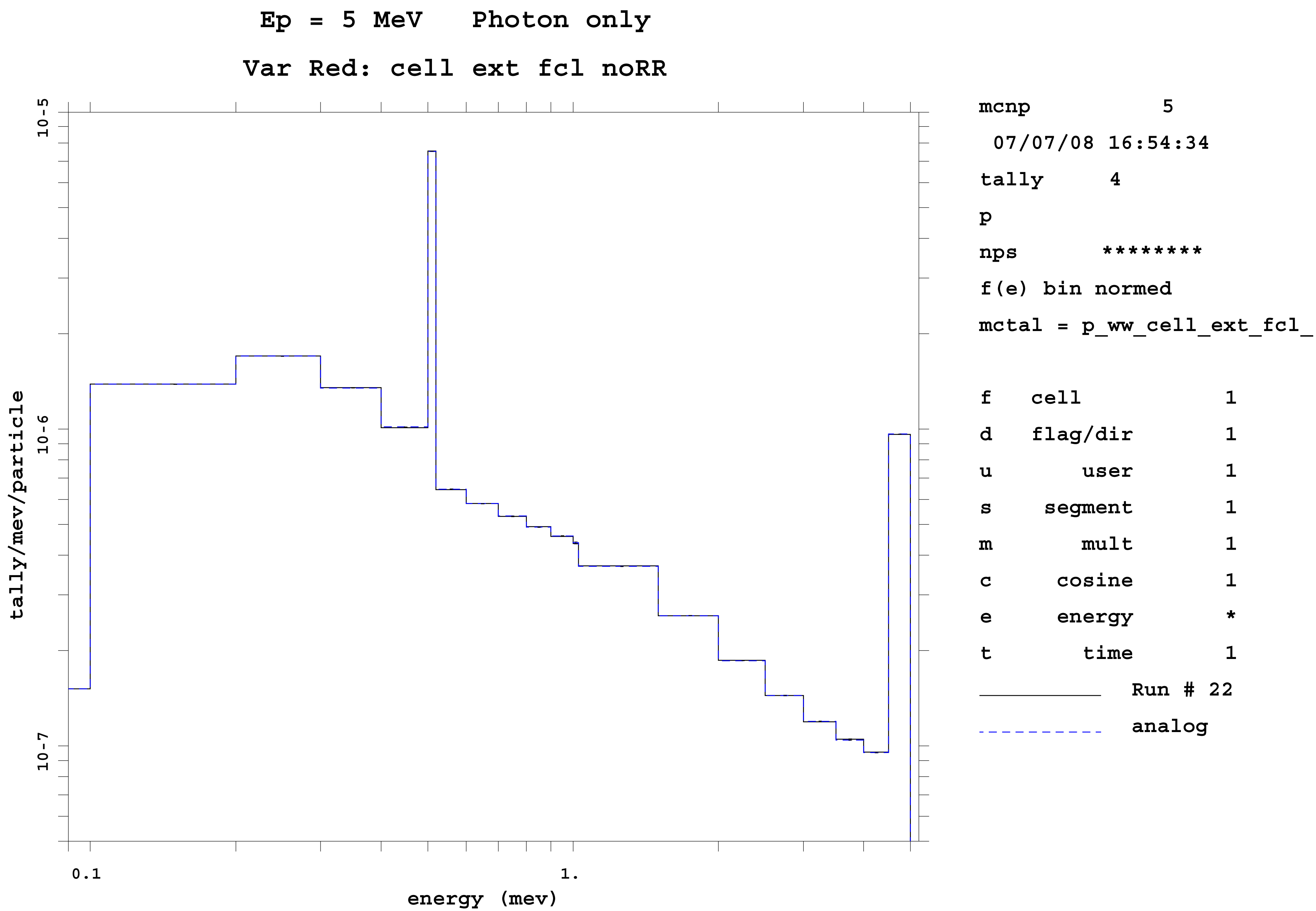
Var Red: imp dxt ext fcl wgt cutoff



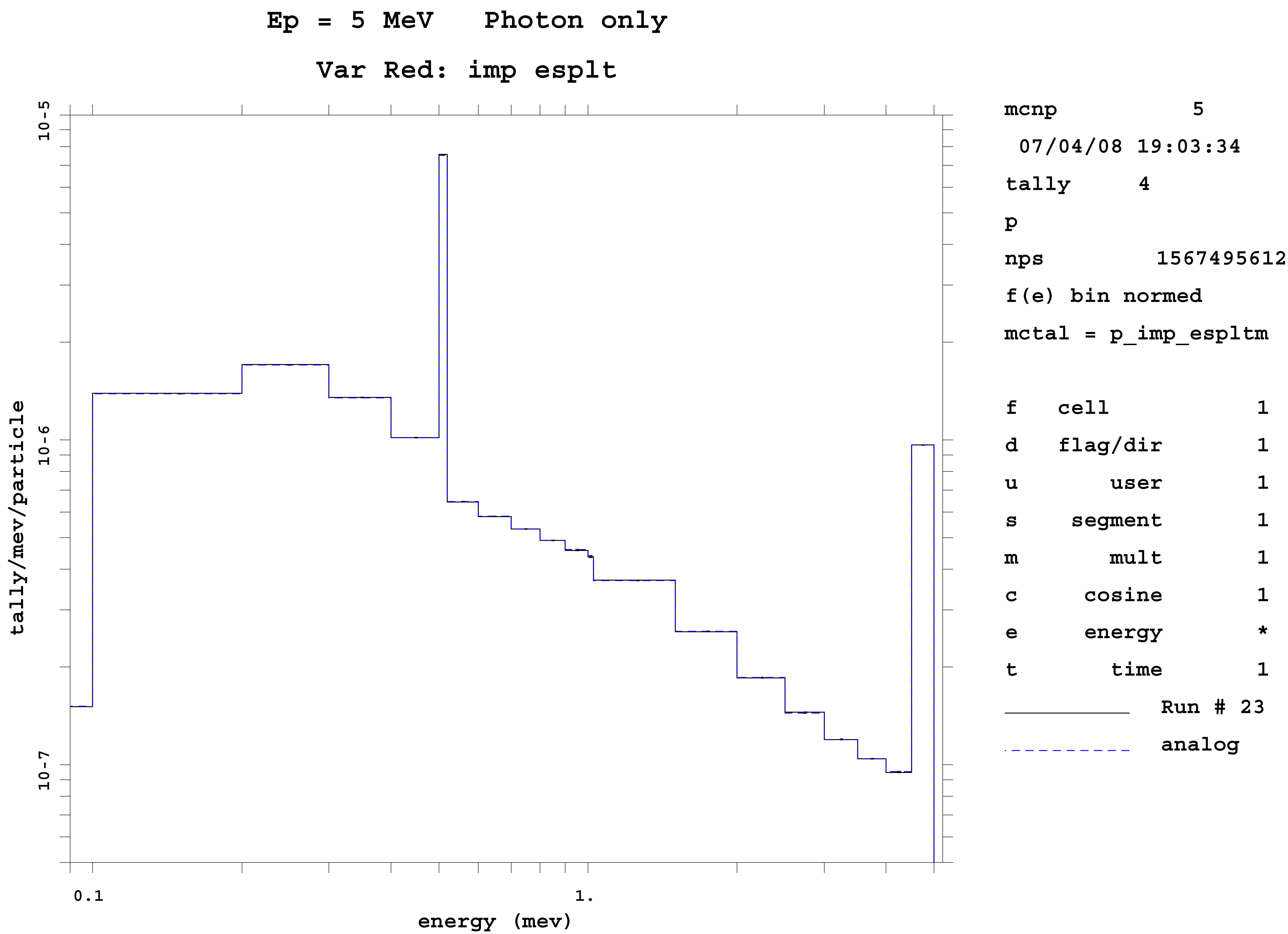

Ep = 5 MeV Photon only
Var Red: mesh dxt ext fcl wgt cutoff
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/09/08 14:47:04
tally 4
p
nps 1515098112
f(e) bin normed
mctal = p_mesh_ext_fcl_dxt
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 20
analog



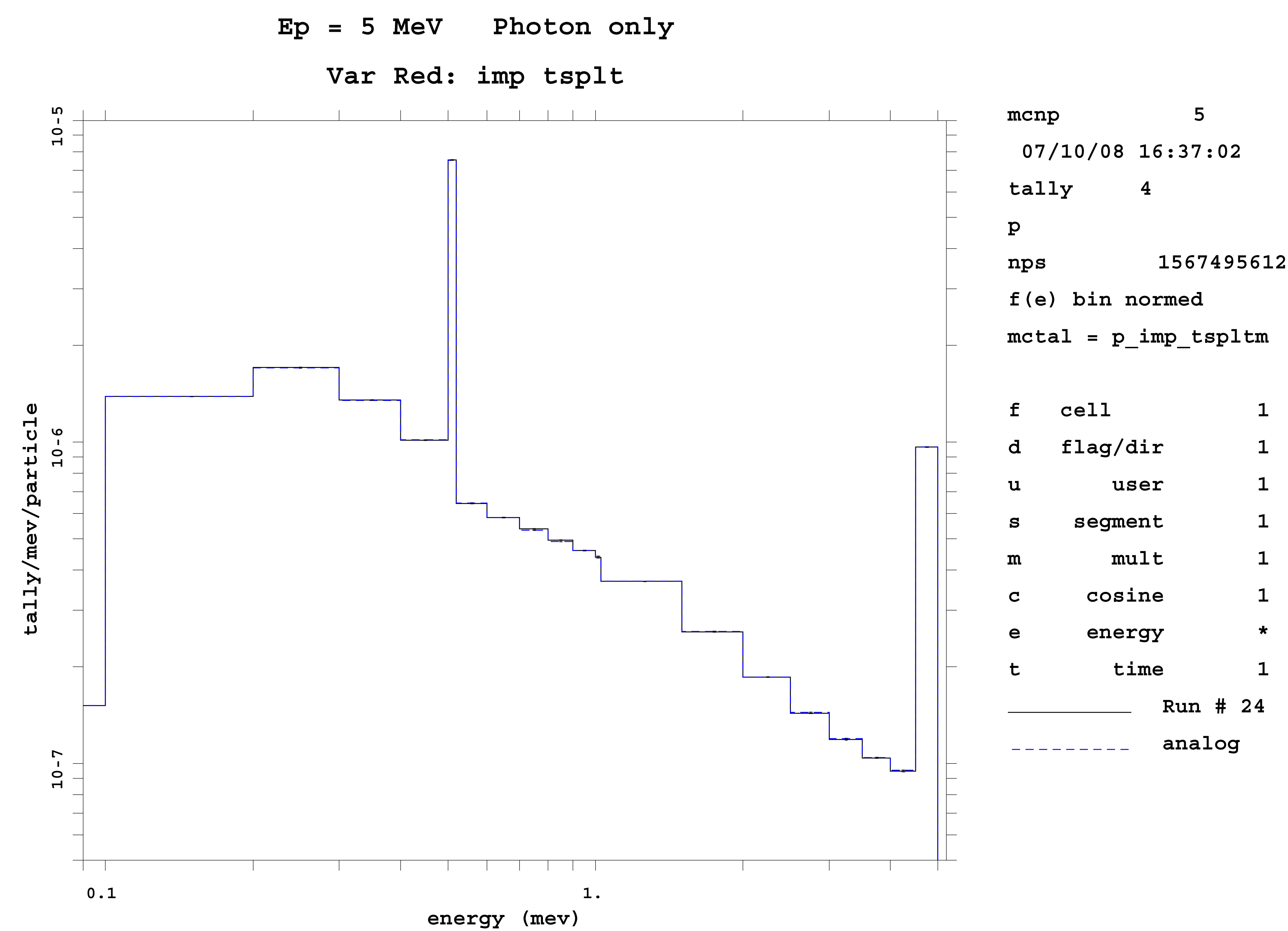
Ep = 5 MeV Photon only
Var Red: imp dxt source bias noRR
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/14/08 14:32:15
tally 4
p
nps 1705032704
f(e) bin normed
mctal = p_sb_imp_ext_fcl_d
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 21
analog

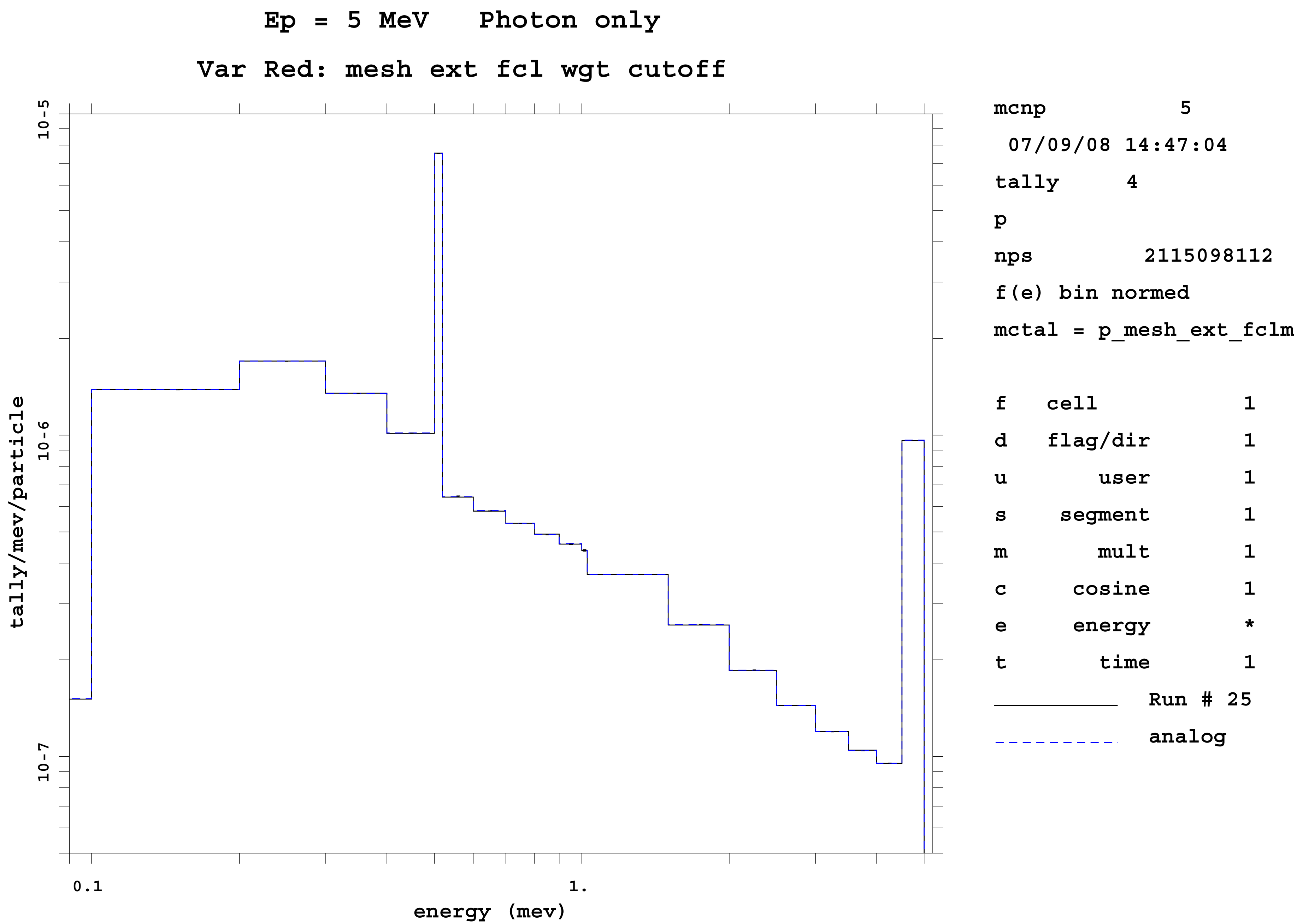


Ep = 5 MeV Photon only
Var Red: cell ext fcl noRR
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 16:54:34
tally 4
p
nps ********
f(e) bin normed
mctal = p_ww_cell_ext_fcl_
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 22
analog

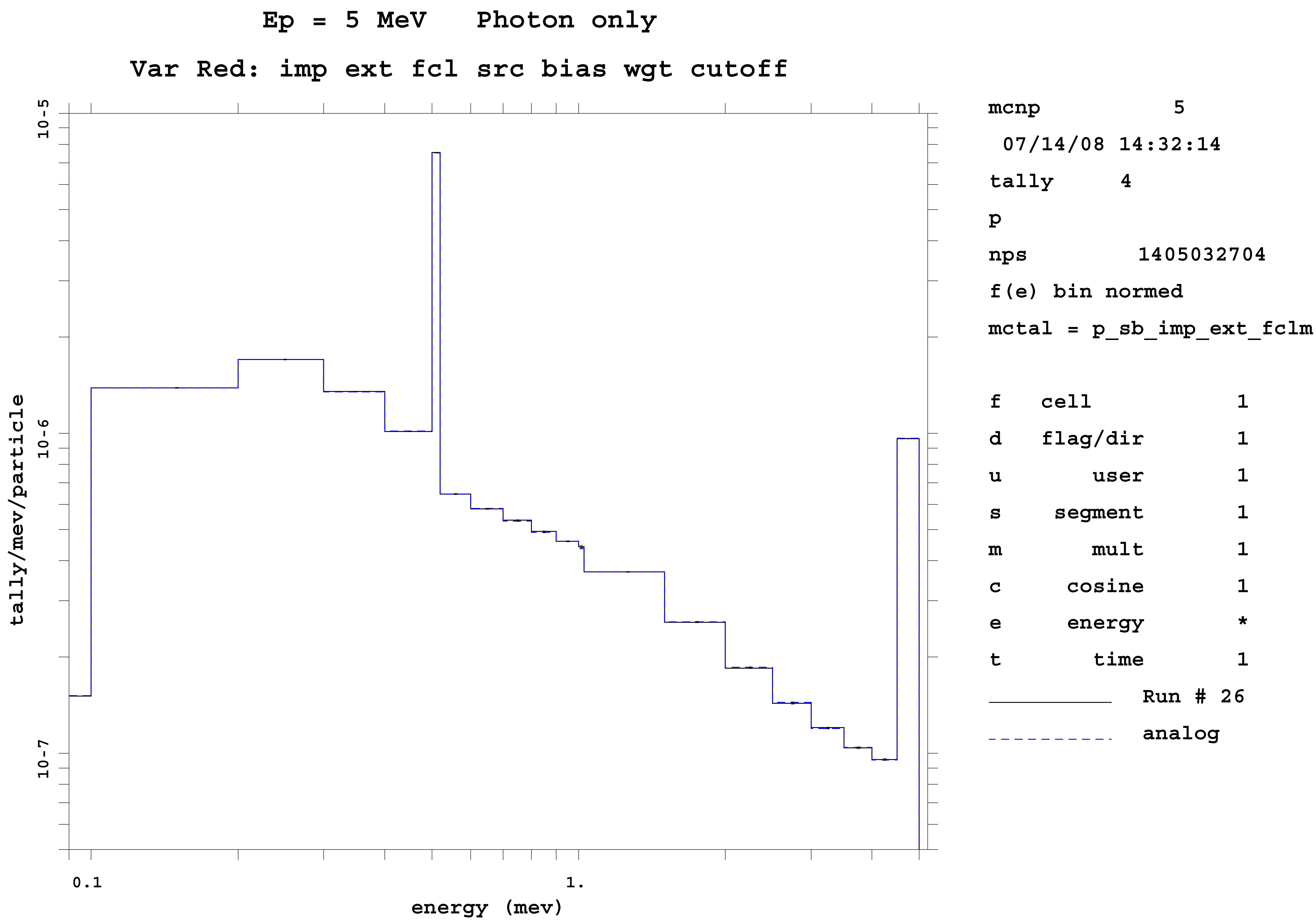


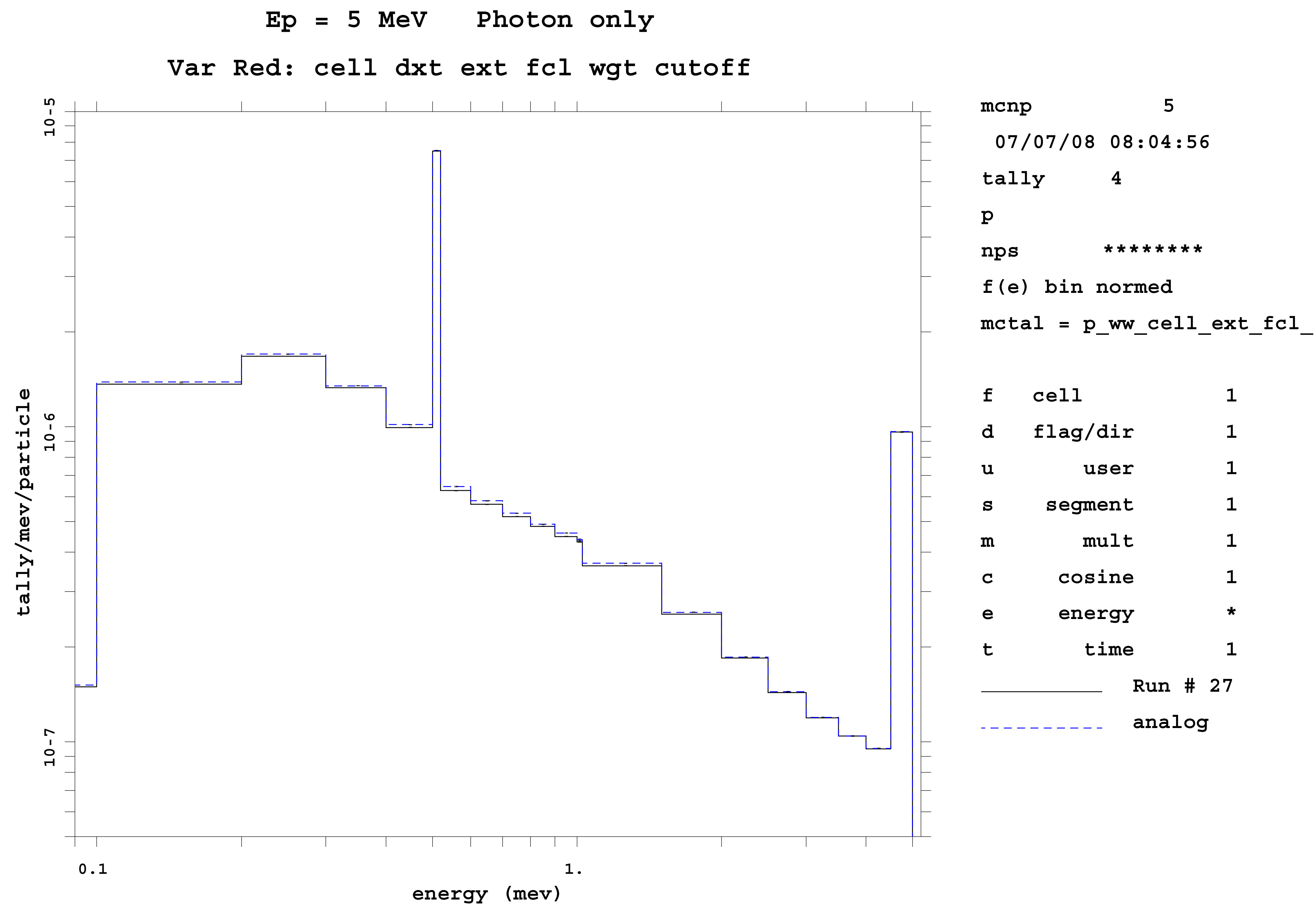
Ep = 5 MeV   Photon only
Var Red: imp espl t
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/04/08 19:03:34
tally 4
p
nps 1567495612
f(e) bin normed
mctal = p_imp_espltm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 23
analog


Ep = 5 MeV Photon only
Var Red: imp tsplt
tally/mev/particle
10-5
10-6
10-7
0.1
1.
energy (mev)
mcnp 5
07/10/08 16:37:02
tally 4
p
nps 1567495612
f(e) bin normed
mctal = p_imp_tspltm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 24
analog

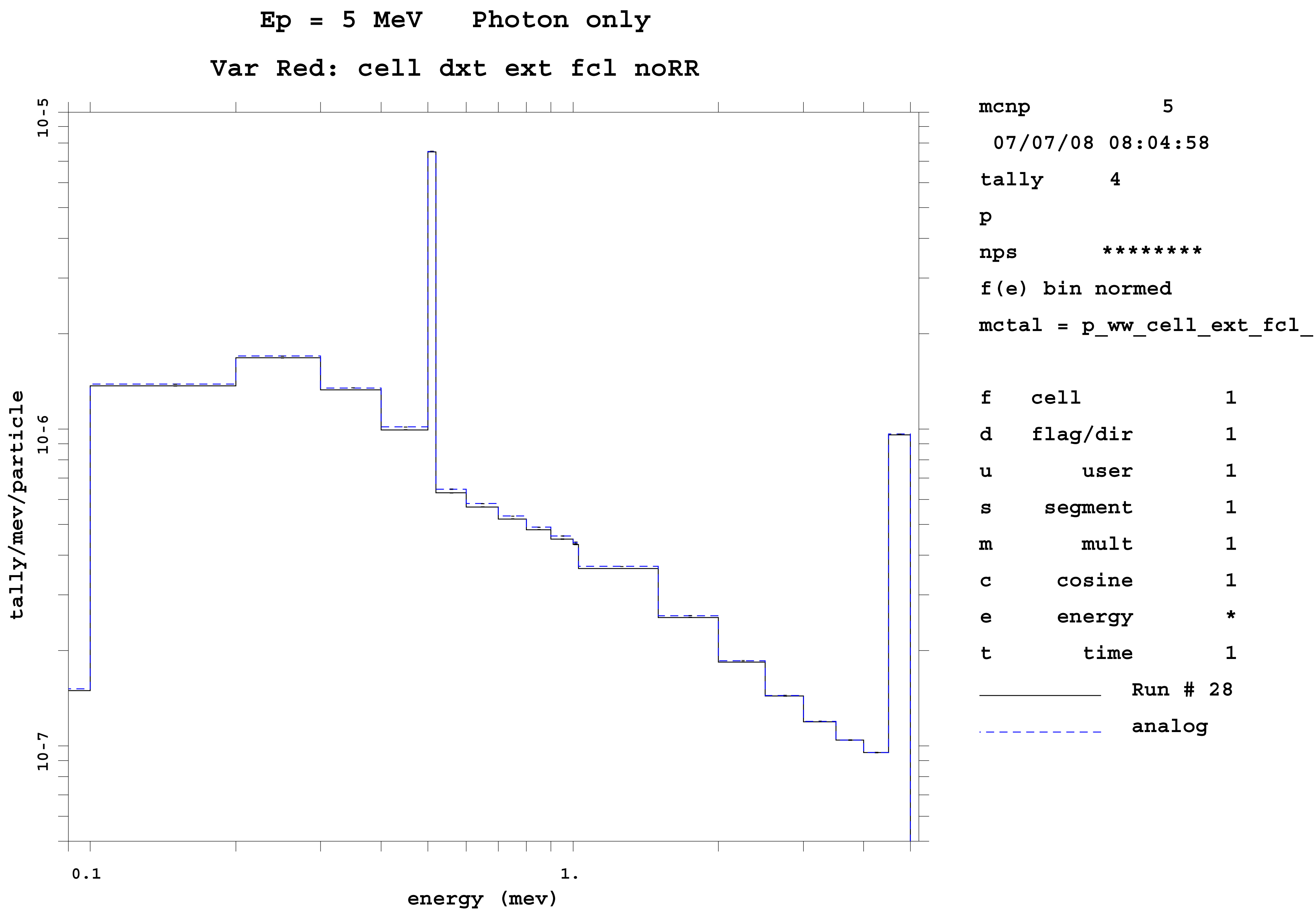


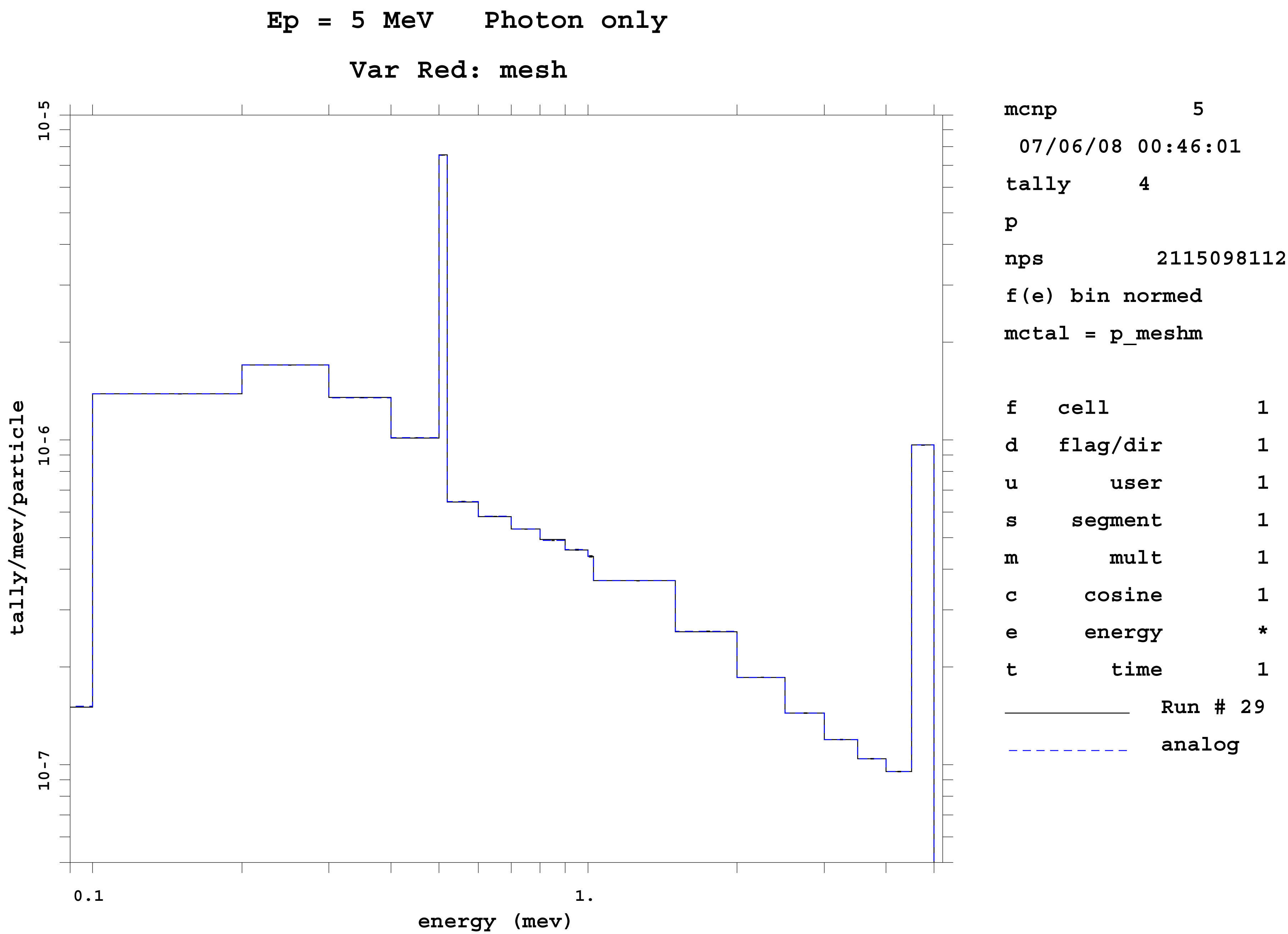
Ep = 5 MeV Photon only
Var Red: mesh ext fcl wgt cutoff
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/09/08 14:47:04
tally 4
p
nps 2115098112
f(e) bin normed
mctal = p_mesh_ext_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 25
analog


Ep = 5 MeV Photon only
Var Red: imp ext fcl src bias wgt cutoff
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/14/08 14:32:14
tally 4
p
nps 1405032704
f(e) bin normed
mctal = p_sb_imp_ext_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 26
analog

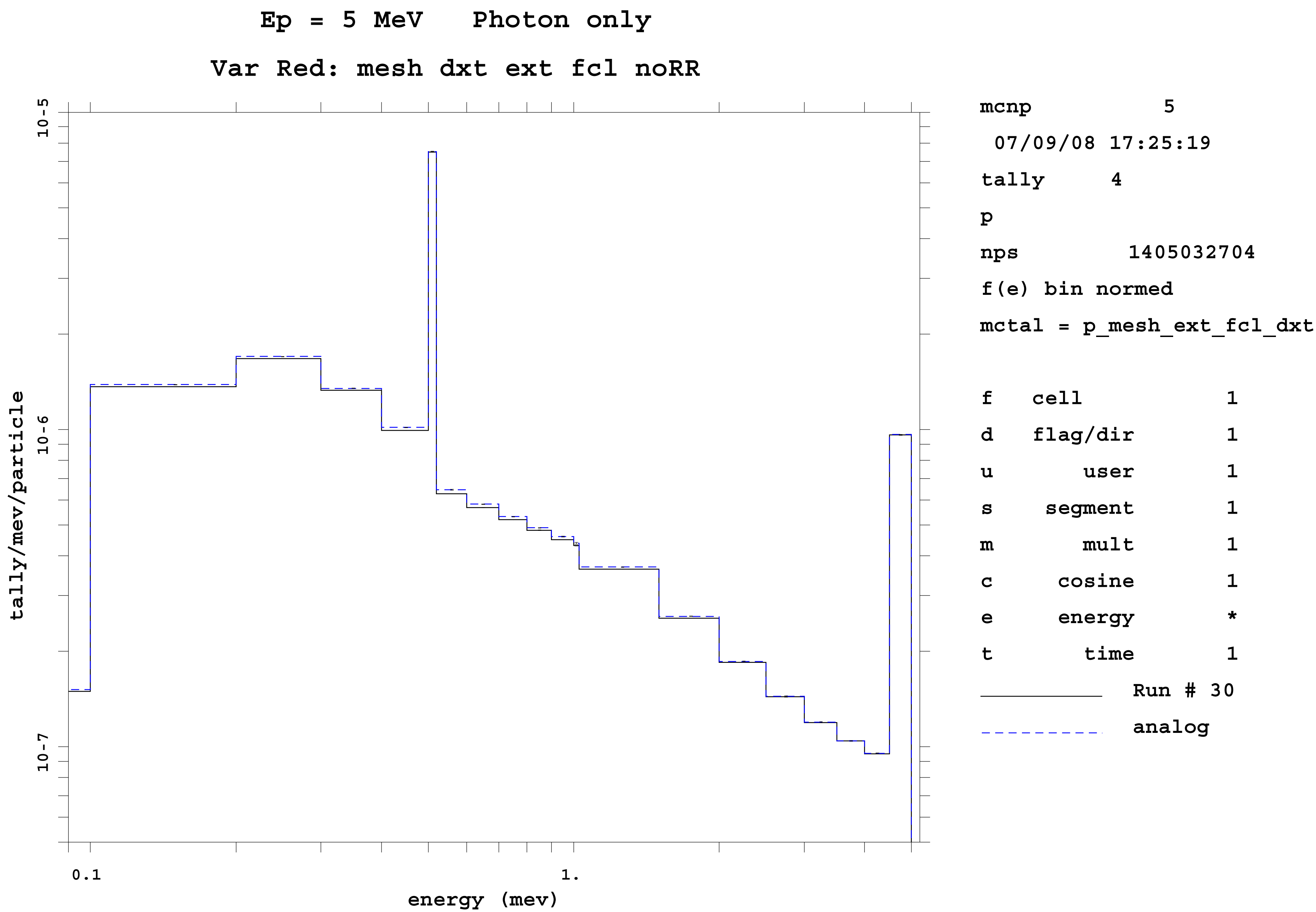


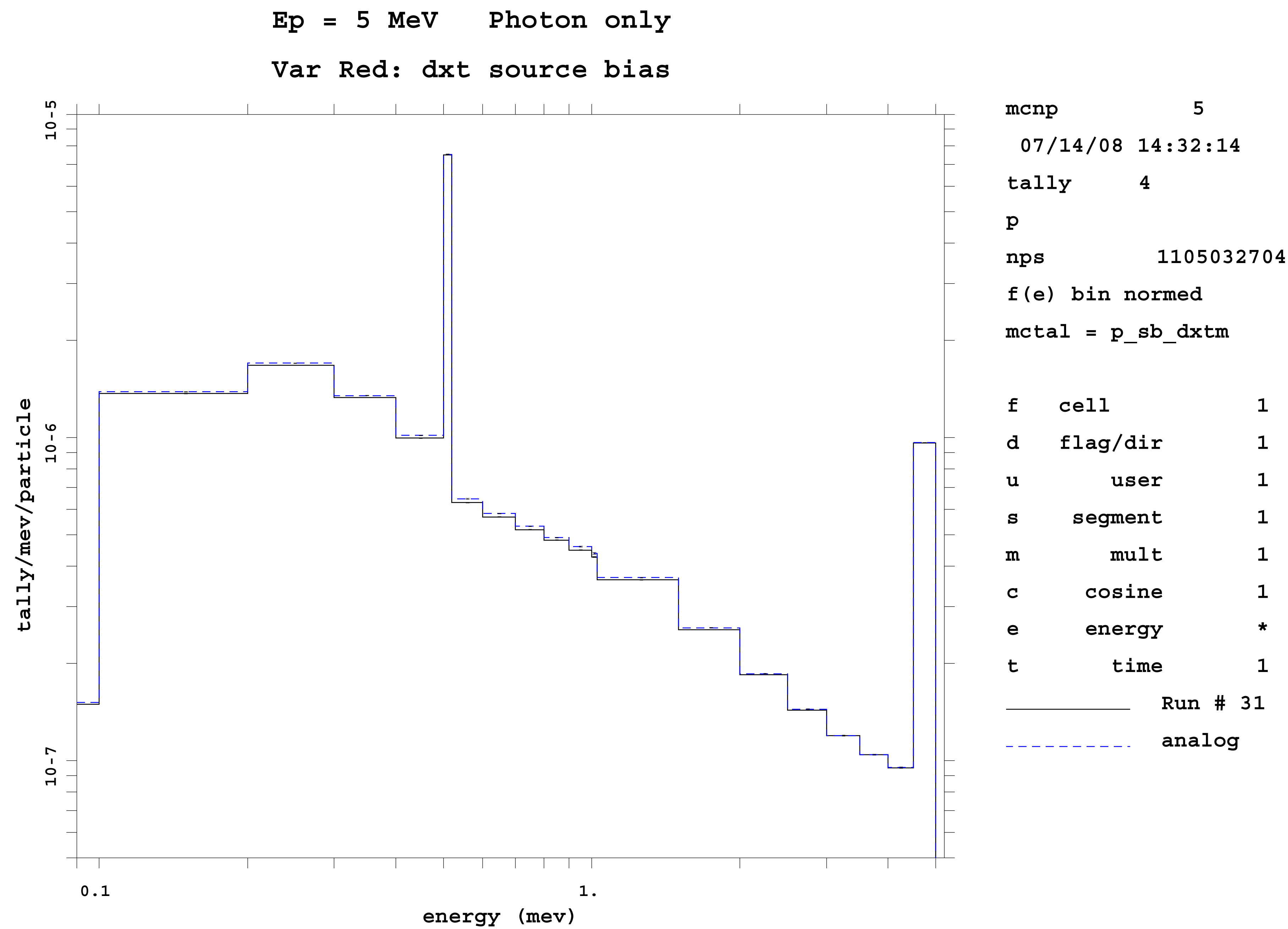
Ep = 5 MeV Photon only
Var Red: cell dxt ext fcl wgt cutoff
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 08:04:56
tally 4
p
nps ********
f(e) bin normed
mctal = p_ww_cell_ext_fcl_
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 27
analog


Ep = 5 MeV Photon only
Var Red: cell dxt ext fcl noRR
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 08:04:58
tally 4
p
nps ********
f(e) bin normed
mctal = p_ww_cell_ext_fcl_
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 28
analog



Ep = 5 MeV Photon only
Var Red: mesh
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/06/08 00:46:01
tally 4
p
nps 2115098112
f(e) bin normed
mctal = p_meshm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 29
analog

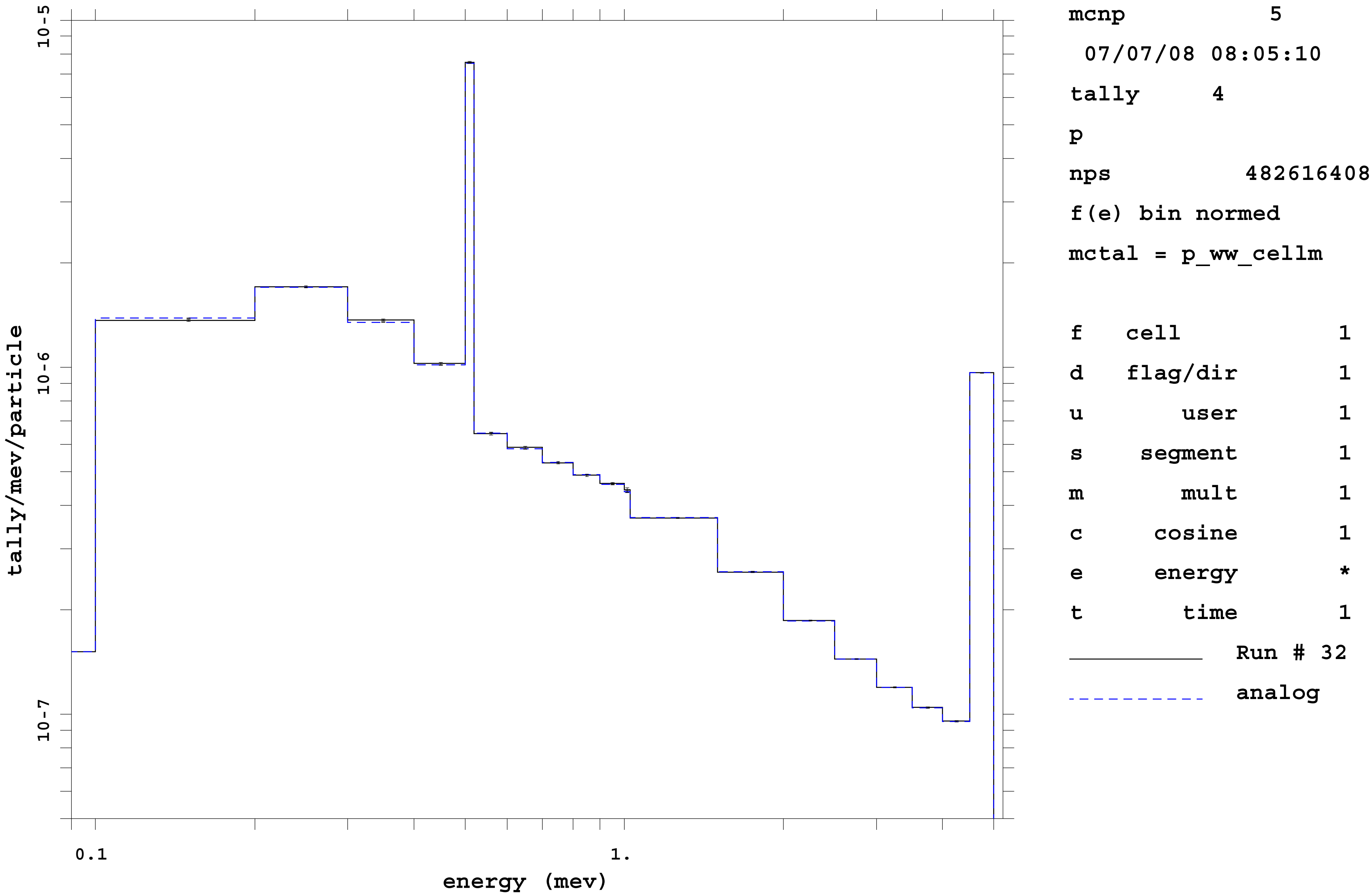

Ep = 5 MeV Photon only
Var Red: mesh dxt ext fcl noRR
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/09/08 17:25:19
tally 4
p
nps 1405032704
f(e) bin normed
mctal = p_mesh_ext_fcl_dxt
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 30
analog

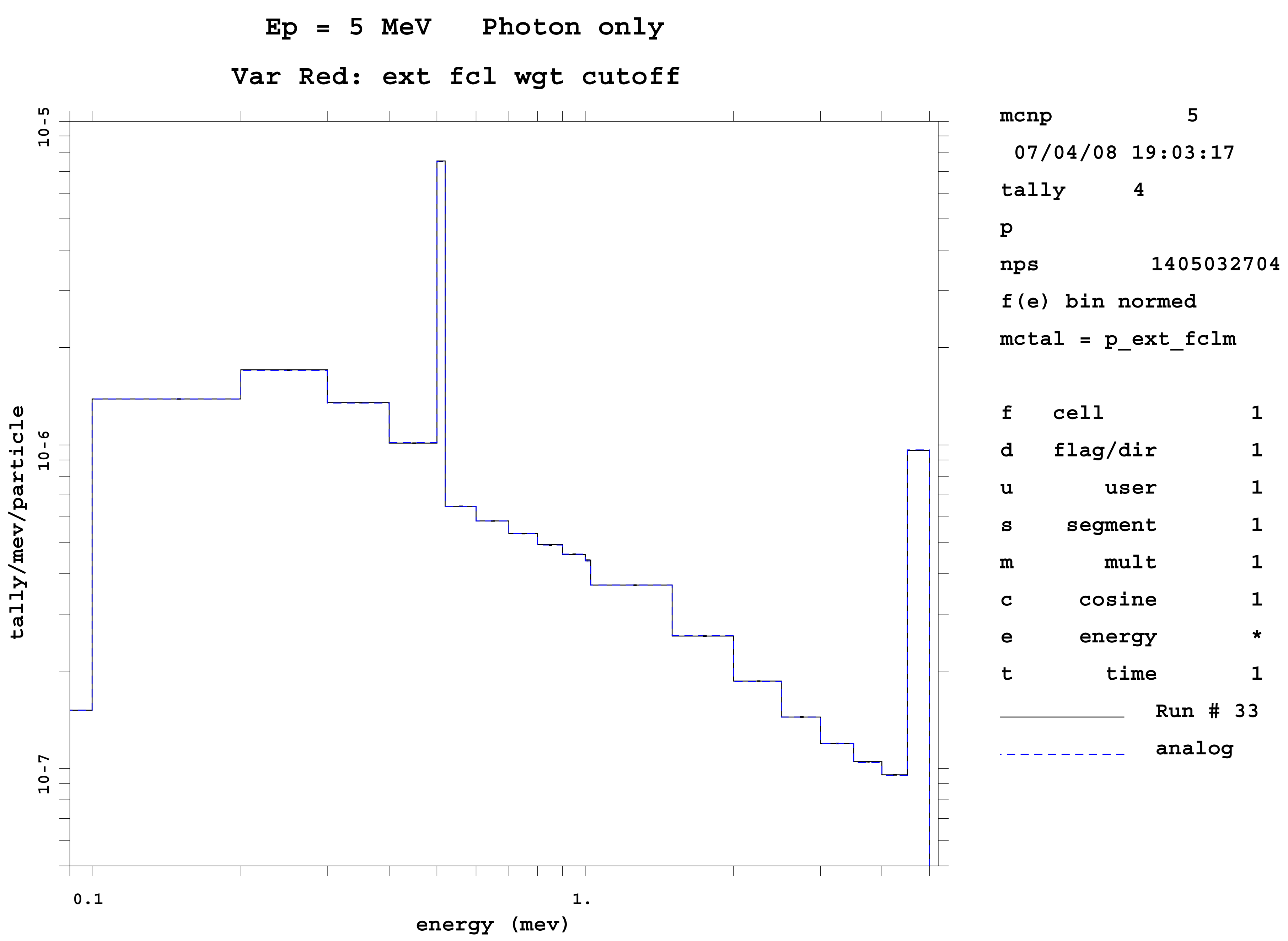


Ep = 5 MeV   Photon only
Var Red: dxt source bias
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/14/08 14:32:14
tally 4
p
nps 1105032704
f(e) bin normed
mctal = p_sb_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 31
analog

Ep = 5 MeV   Photon only

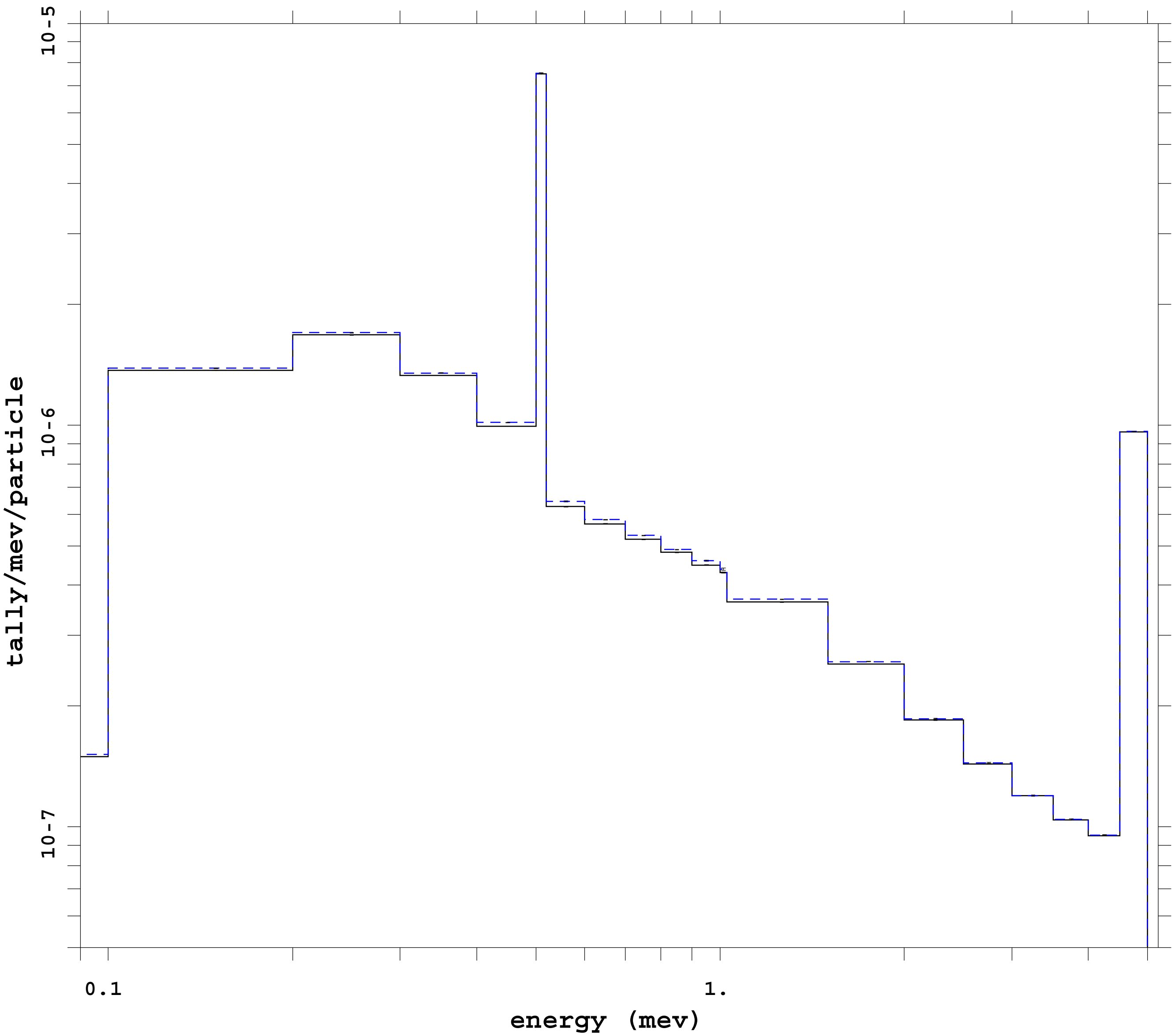
Var Red: cell




Ep = 5 MeV Photon only
Var Red: ext fcl wgt cutoff
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/04/08 19:03:17
tally 4
p
nps 1405032704
f(e) bin normed
mctal = p_ext_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 33
analog

Ep = 5 MeV   Photon only

Var Red: dxt esplt ext fcl noRR



mcnp 5

07/04/08 19:03:25

tally 4

p

nps ********

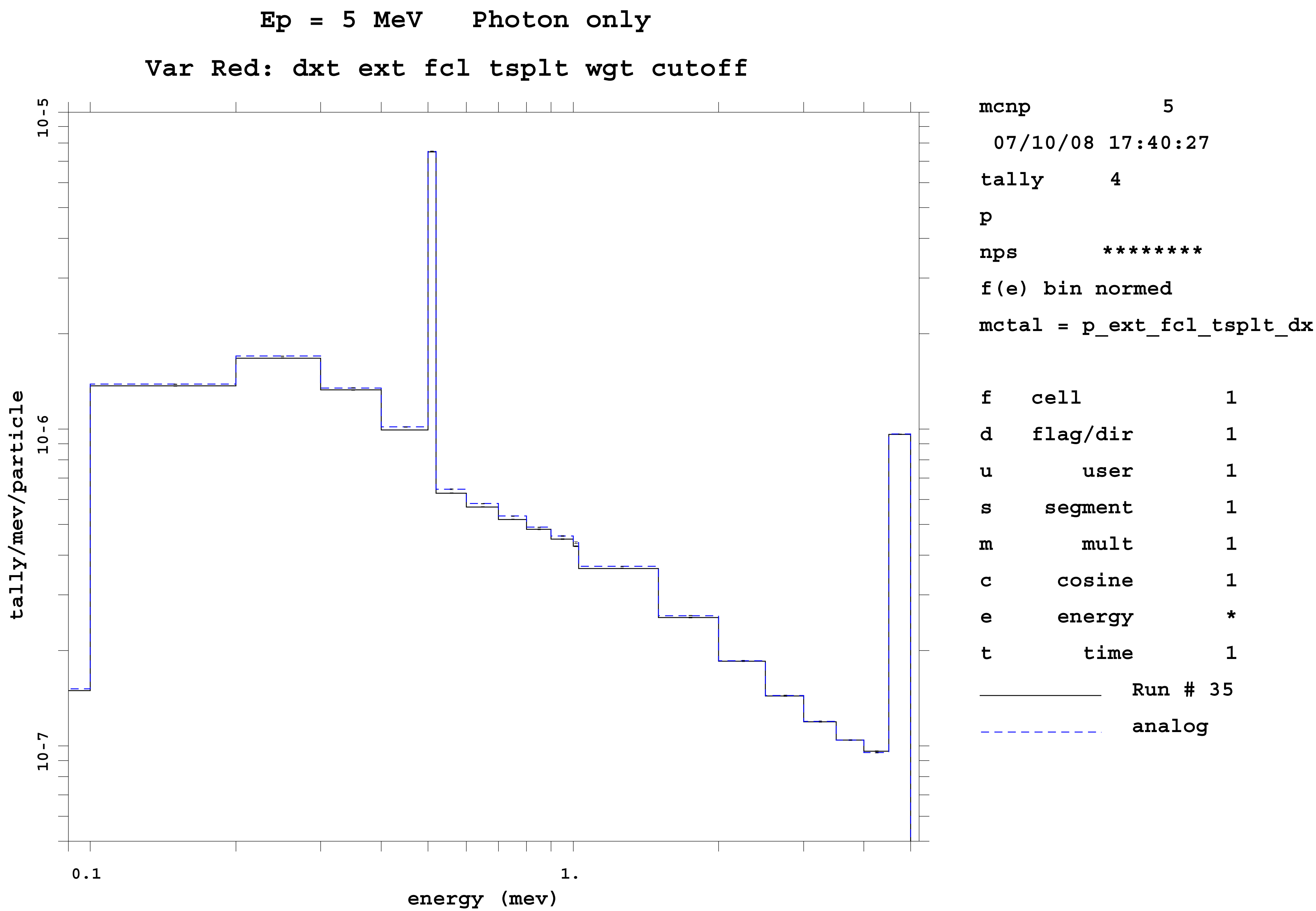
f(e) bin normed

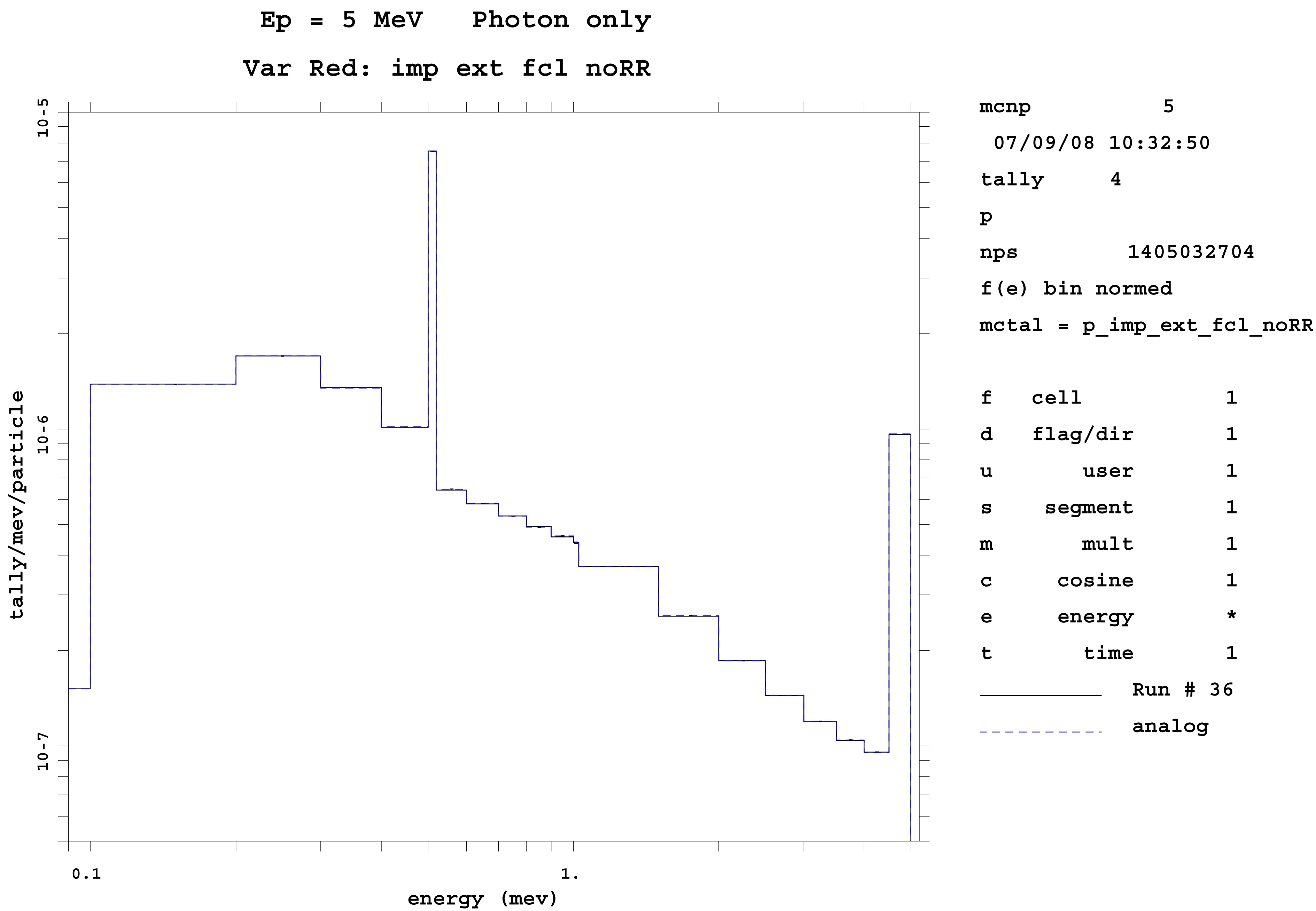
mctal = p_ext_fcl_esplt_dx

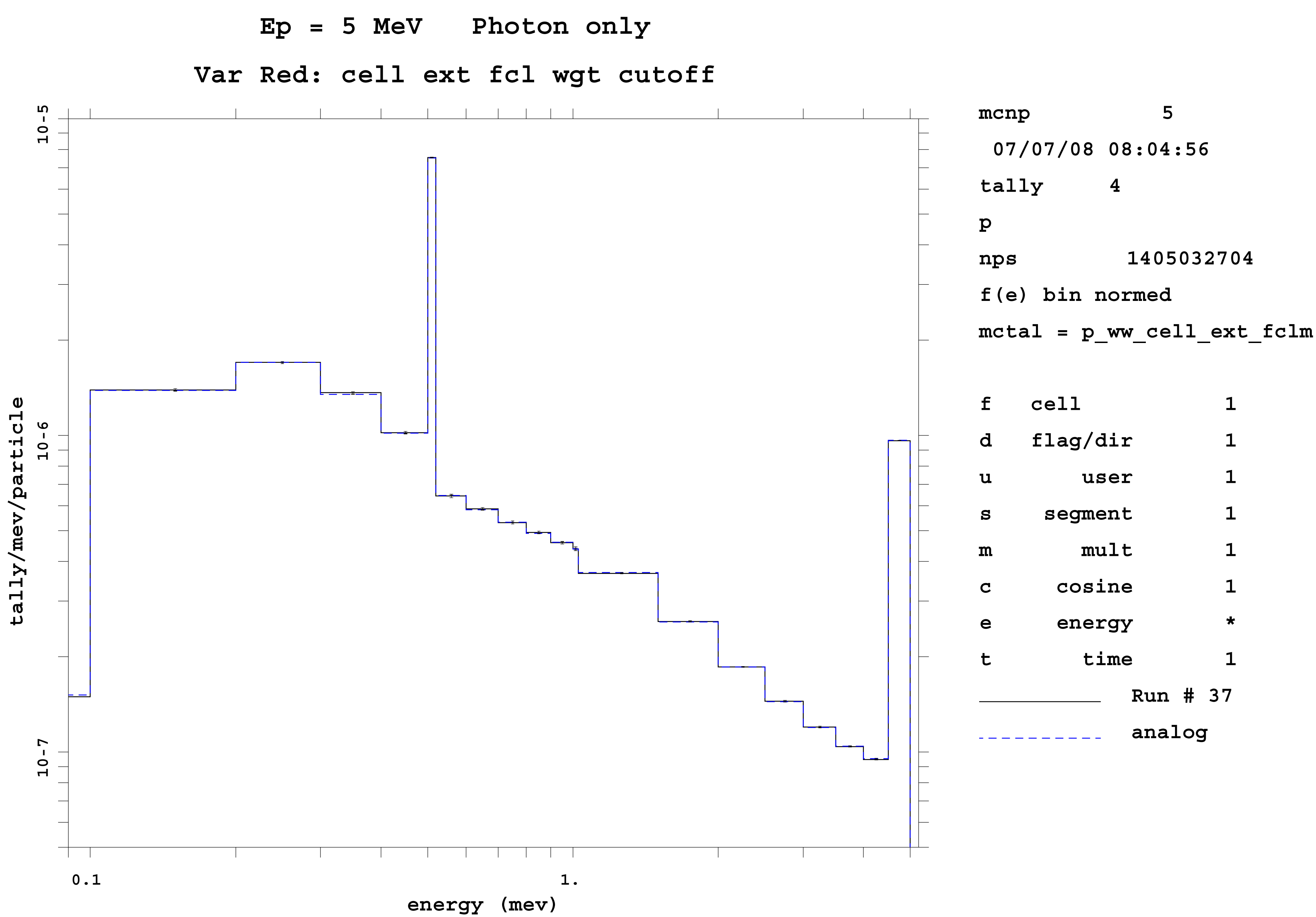
f	cell	1
d	flag/dir	1
u	user	1
s	segment	1
m	mult	1
c	cosine	1
e	energy	*
t	time	1

——— Run # 34

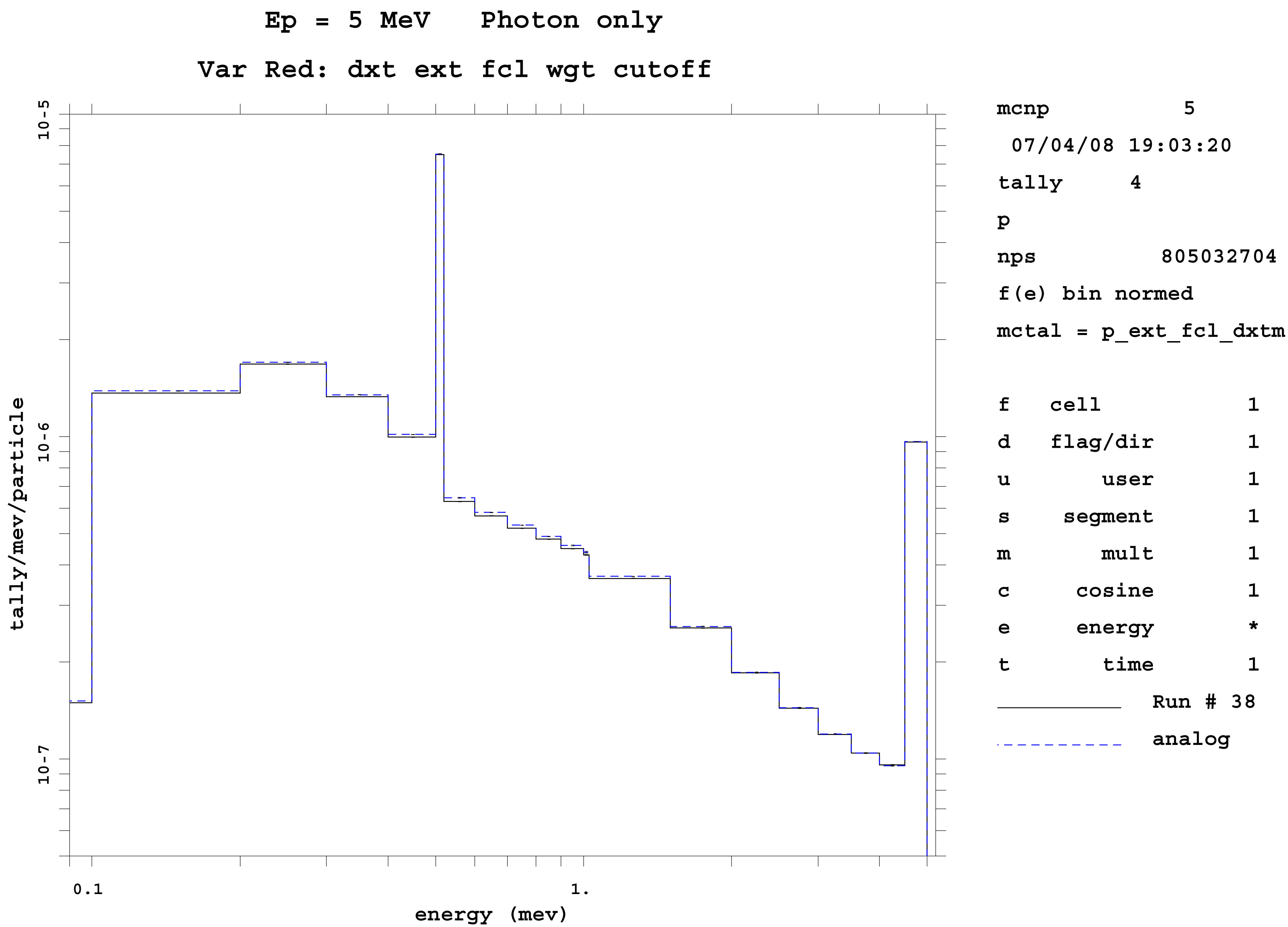
- - - analog

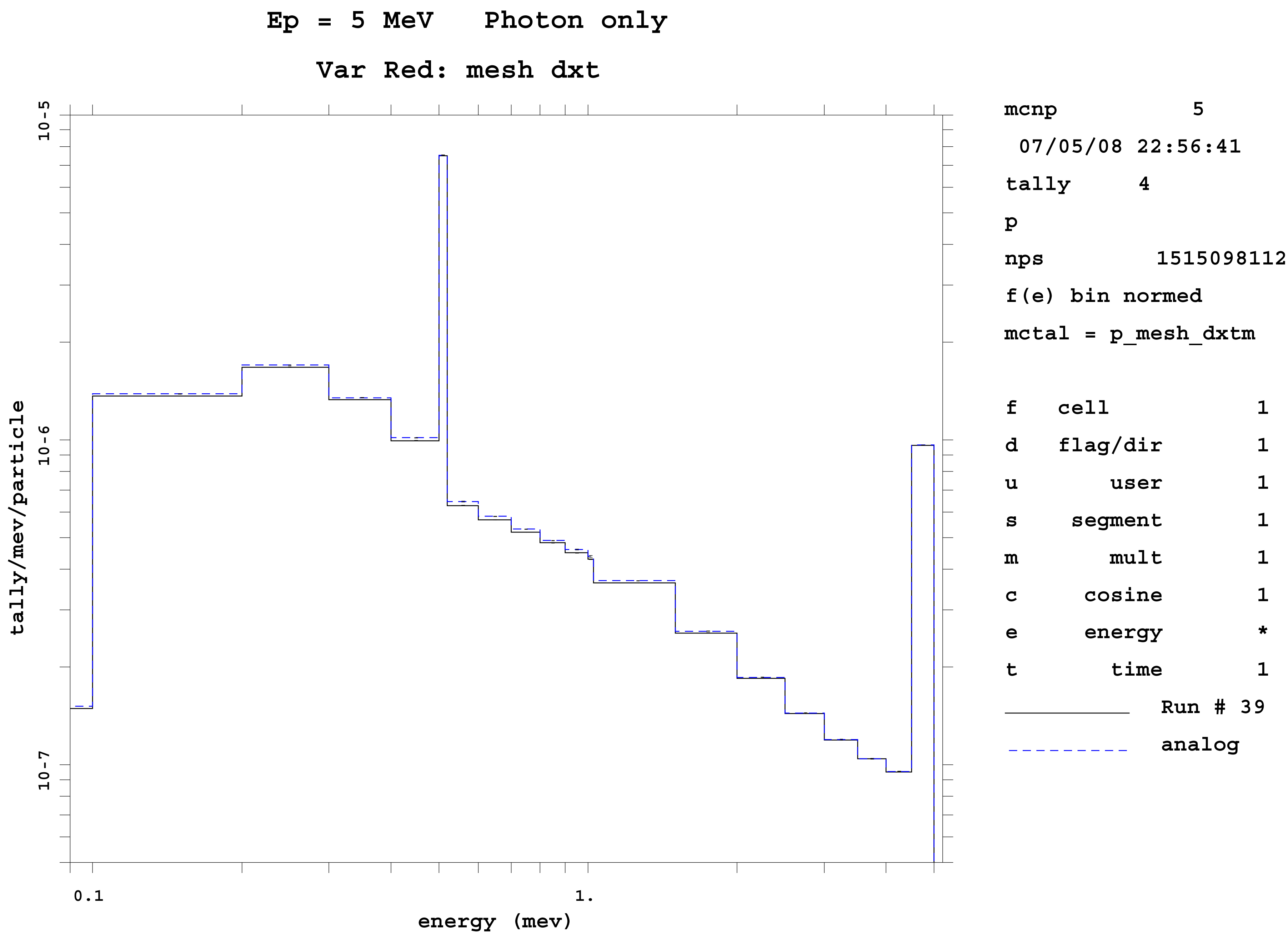

Ep = 5 MeV Photon only
Var Red: dxt ext fcl tsplt wgt cutoff
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/10/08 17:40:27
tally 4
p
nps ********
f(e) bin normed
mctal = p_ext_fcl_tsplt_dx
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 35
analog


Ep = 5 MeV Photon only
Var Red: imp ext fcl noRR
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/09/08 10:32:50
tally 4
p
nps 1405032704
f(e) bin normed
mctal = p_imp_ext_fcl_noRR
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 36
analog

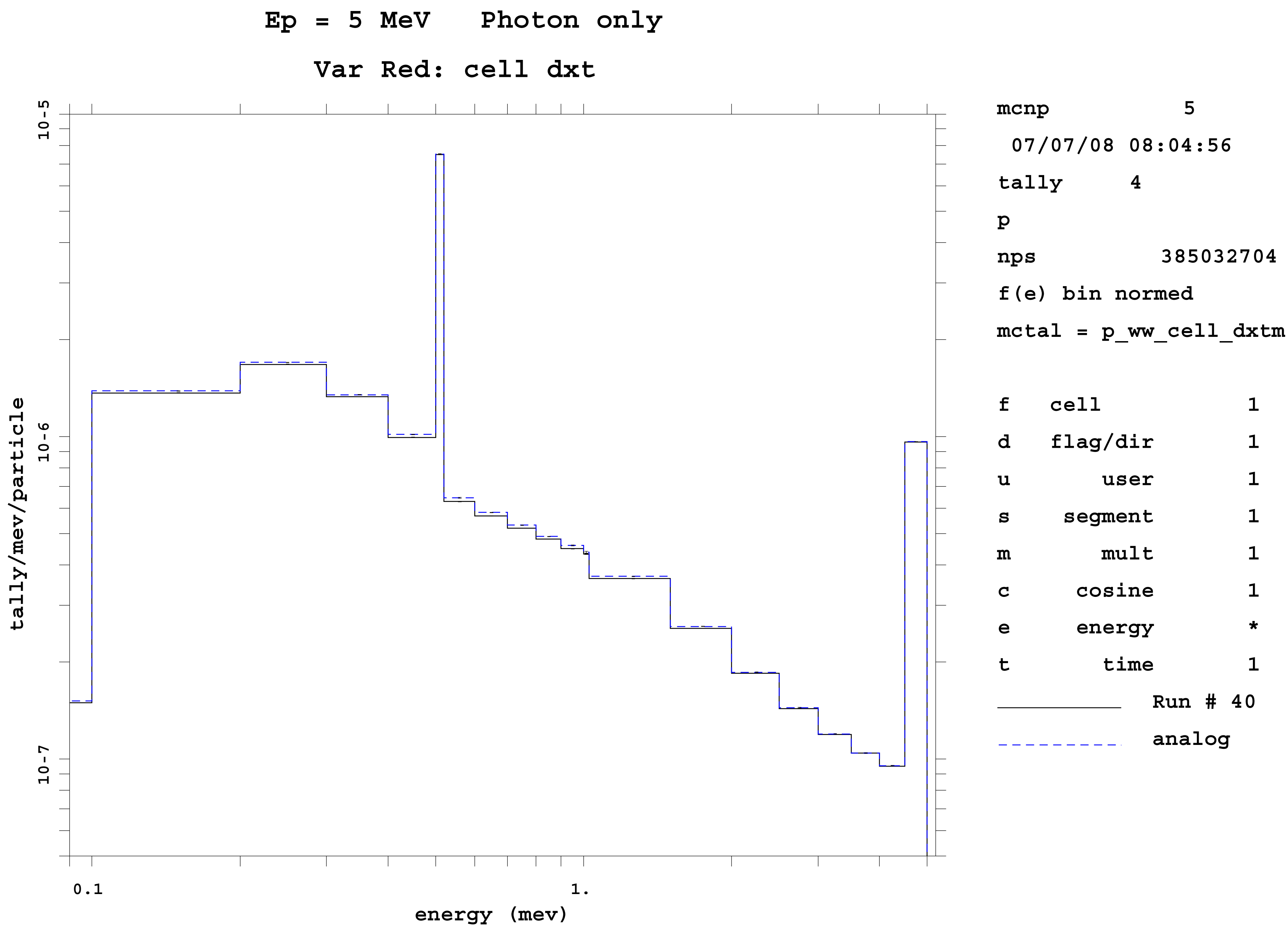


Ep = 5 MeV Photon only
Var Red: cell ext fcl wgt cutoff
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 08:04:56
tally 4
p
nps 1405032704
f(e) bin normed
mctal = p_ww_cell_ext_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 37
analog

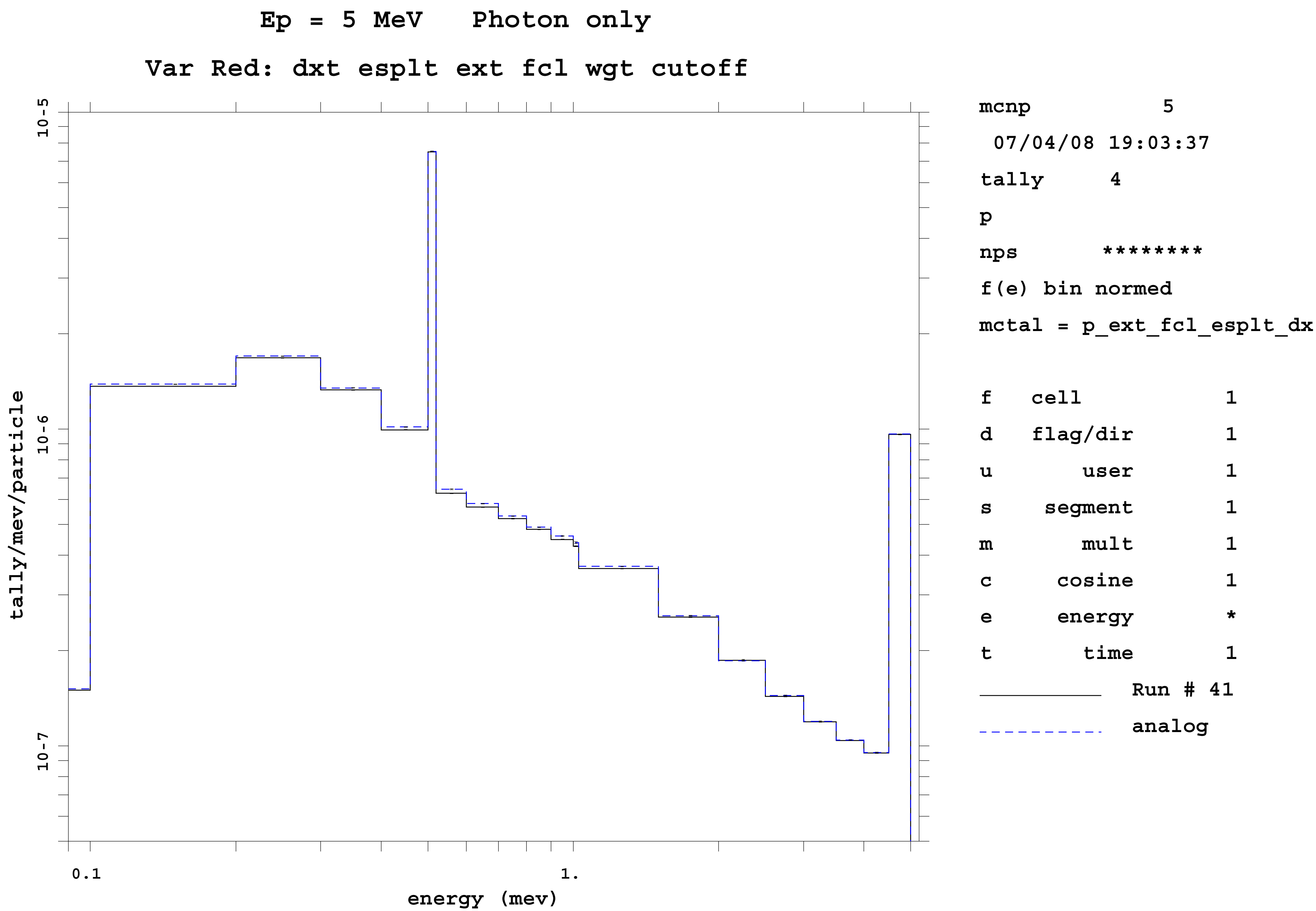

Ep = 5 MeV Photon only
Var Red: dxt ext fcl wgt cutoff
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/04/08 19:03:20
tally 4
p
nps 805032704
f(e) bin normed
mctal = p_ext_fcl_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 38
analog



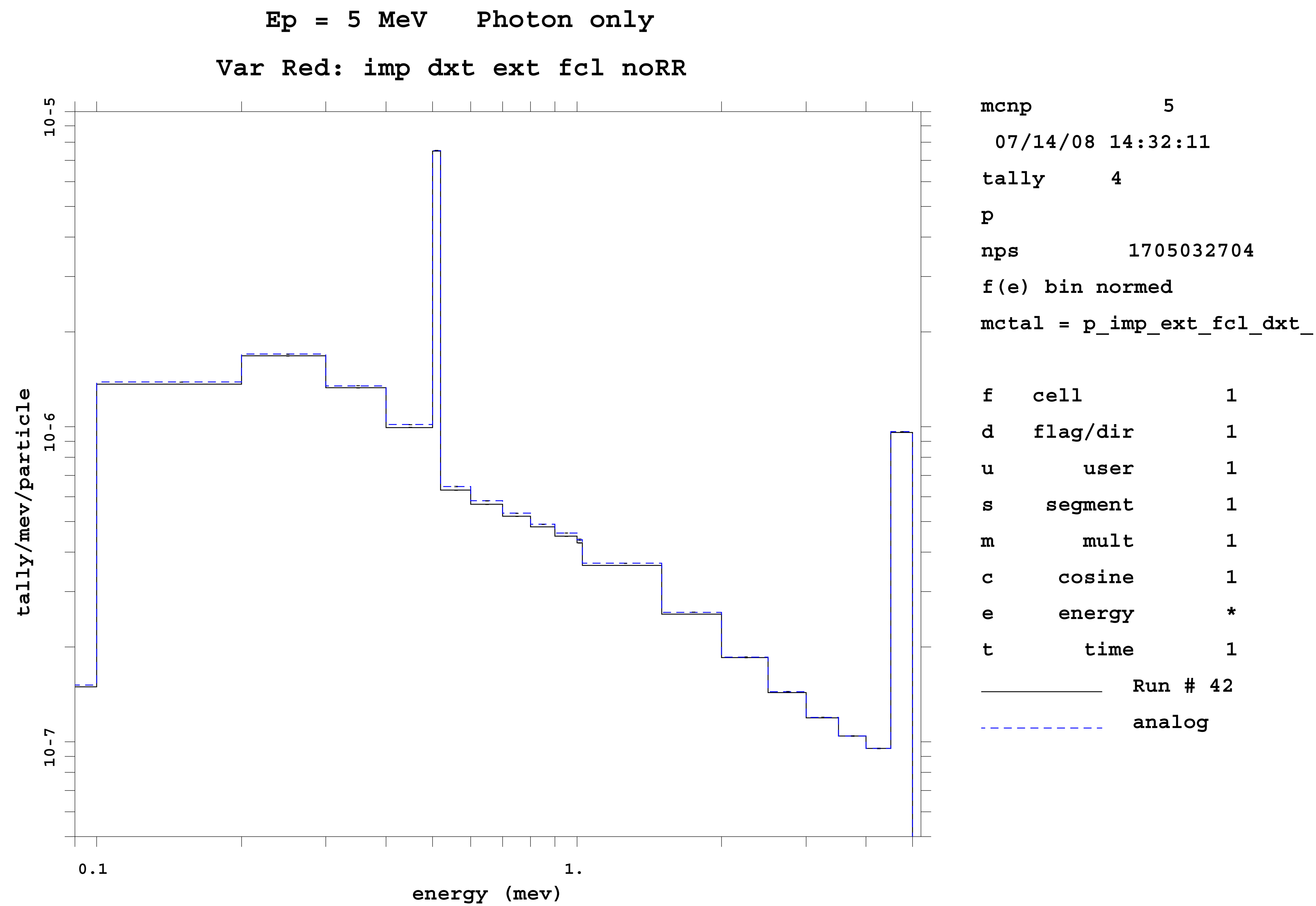
Ep = 5 MeV Photon only
Var Red: mesh dxt
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/05/08 22:56:41
tally 4
p
nps 1515098112
f(e) bin normed
mctal = p_mesh_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 39
analog



Ep = 5 MeV   Photon only
Var Red: cell dxt
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 08:04:56
tally 4
p
nps 385032704
f(e) bin normed
mctal = p_ww_cell_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 40
analog



Ep = 5 MeV Photon only
Var Red: dxt esplt ext fcl wgt cutoff
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/04/08 19:03:37
tally 4
p
nps ********
f(e) bin normed
mctal = p_ext_fcl_esplt_dx
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 41
analog

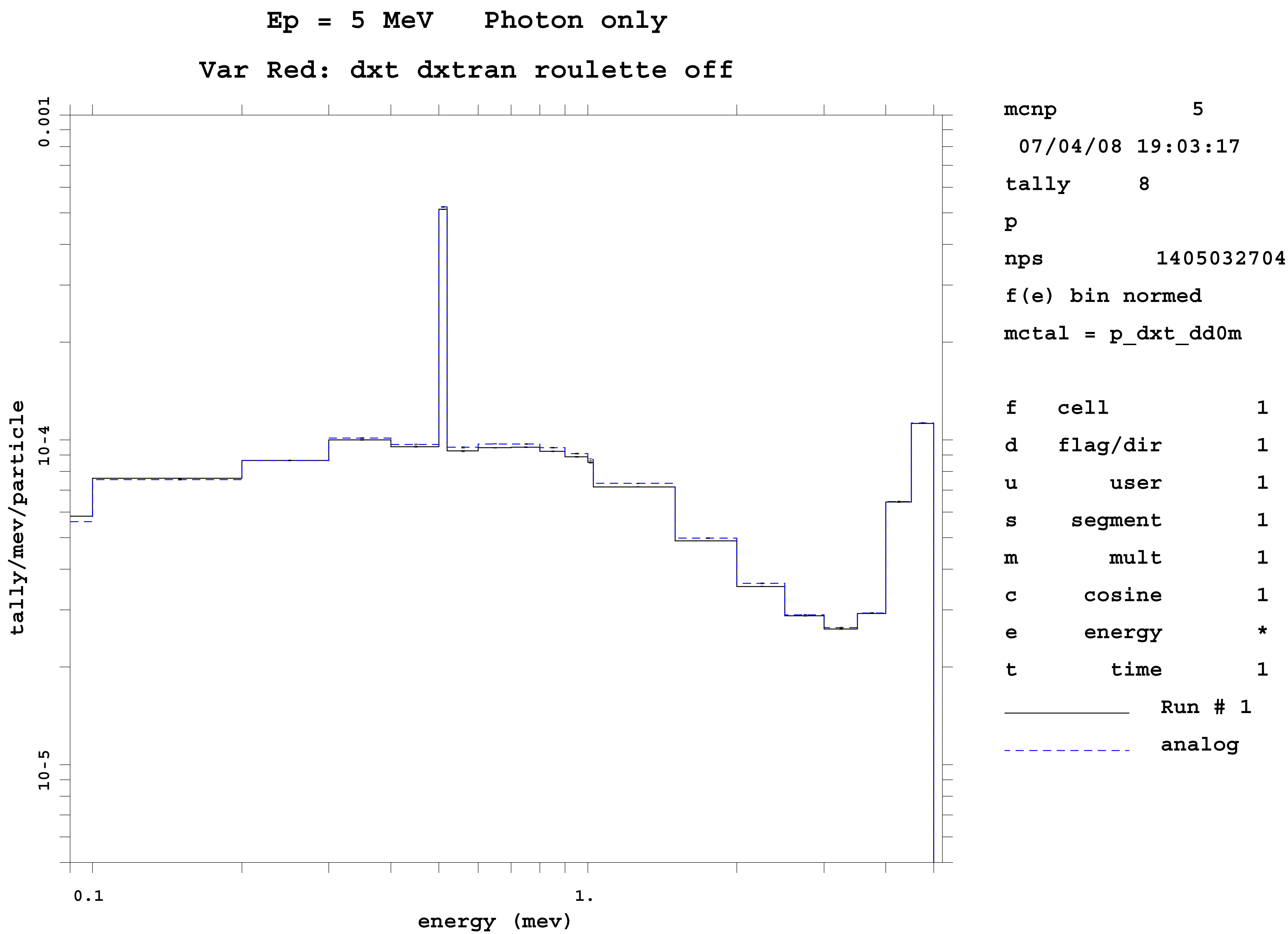

Ep = 5 MeV Photon only
Var Red: imp dxt ext fcl noRR
10-5
10-6
10-7
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/14/08 14:32:11
tally 4
p
nps 1705032704
f(e) bin normed
mctal = p_imp_ext_fcl_dxt_
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 42
analog

Appendix A.1.ii

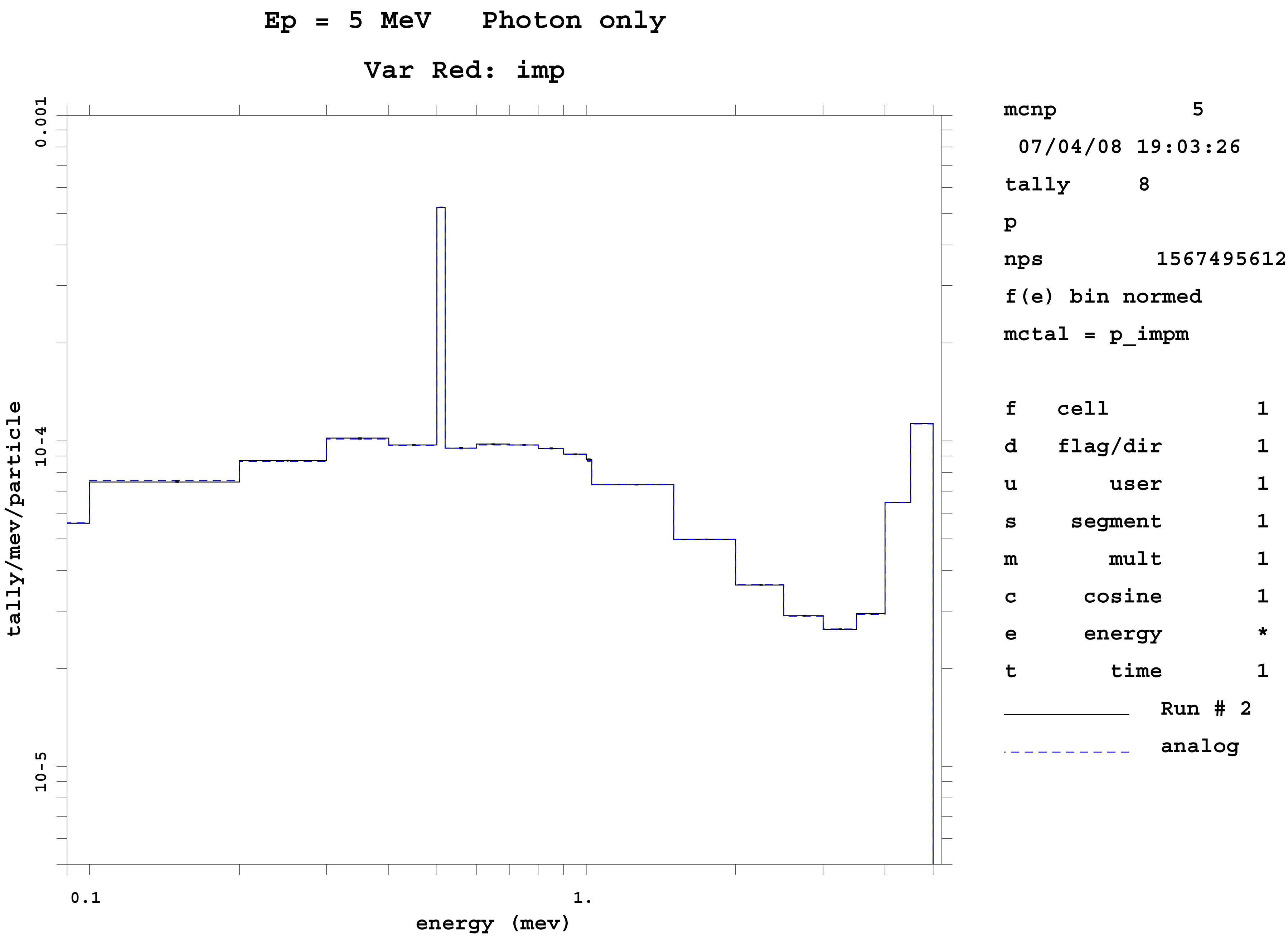
Problem 1
Ge sphere Next To a U / O Stacked Cylinder Problem

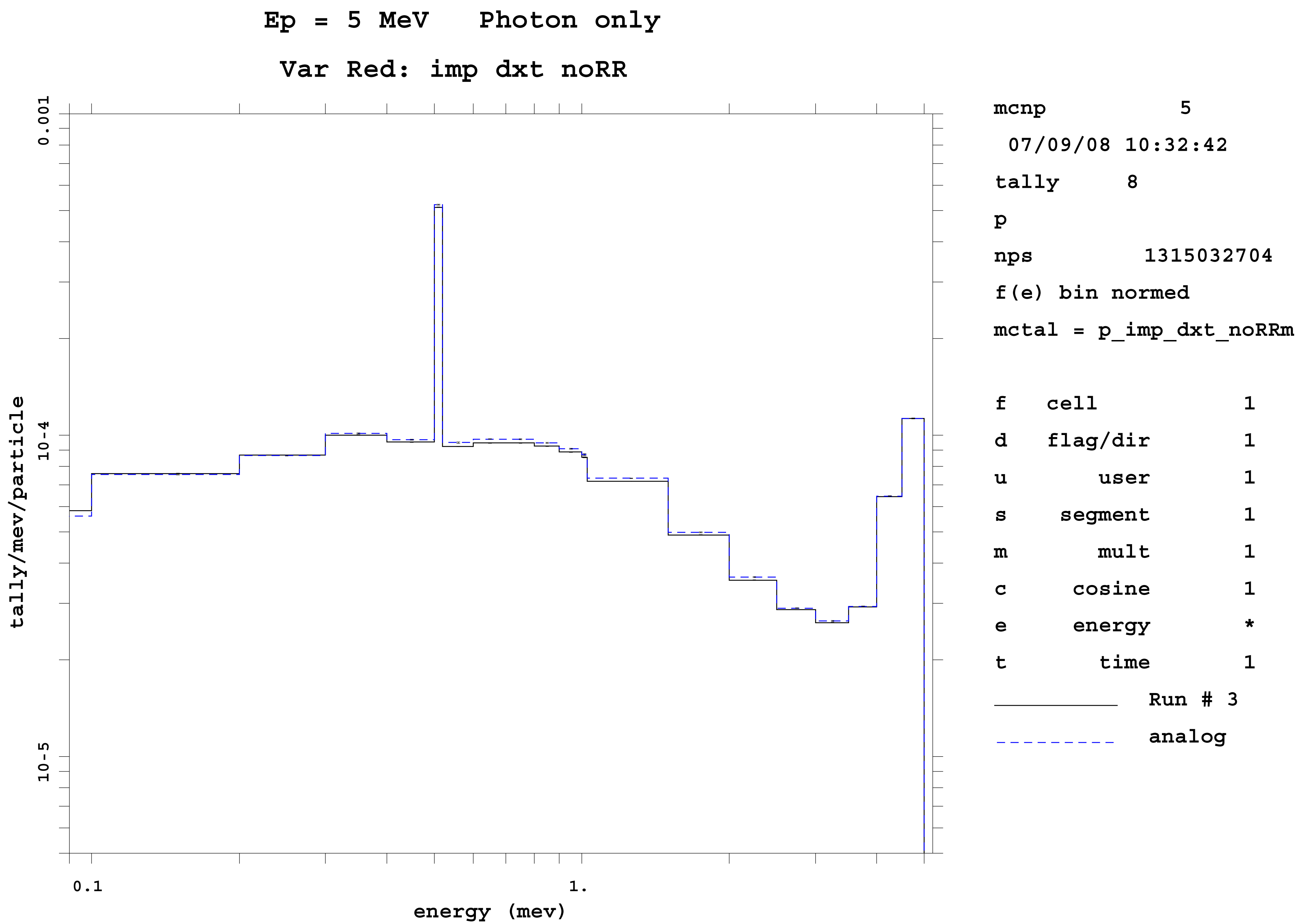
Plots of the pulse height tally spectra in the germanium sphere

Plots are in order of the run number listed in Table 2. The variance reduction methods used are listed in the plot title; the graph label contains the run number.



Ep = 5 MeV Photon only
Var Red: dxt dxtran roulette off
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/04/08 19:03:17
tally 8
p
nps 1405032704
f(e) bin normed
mctal = p_dxt_dd0m
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 1
analog

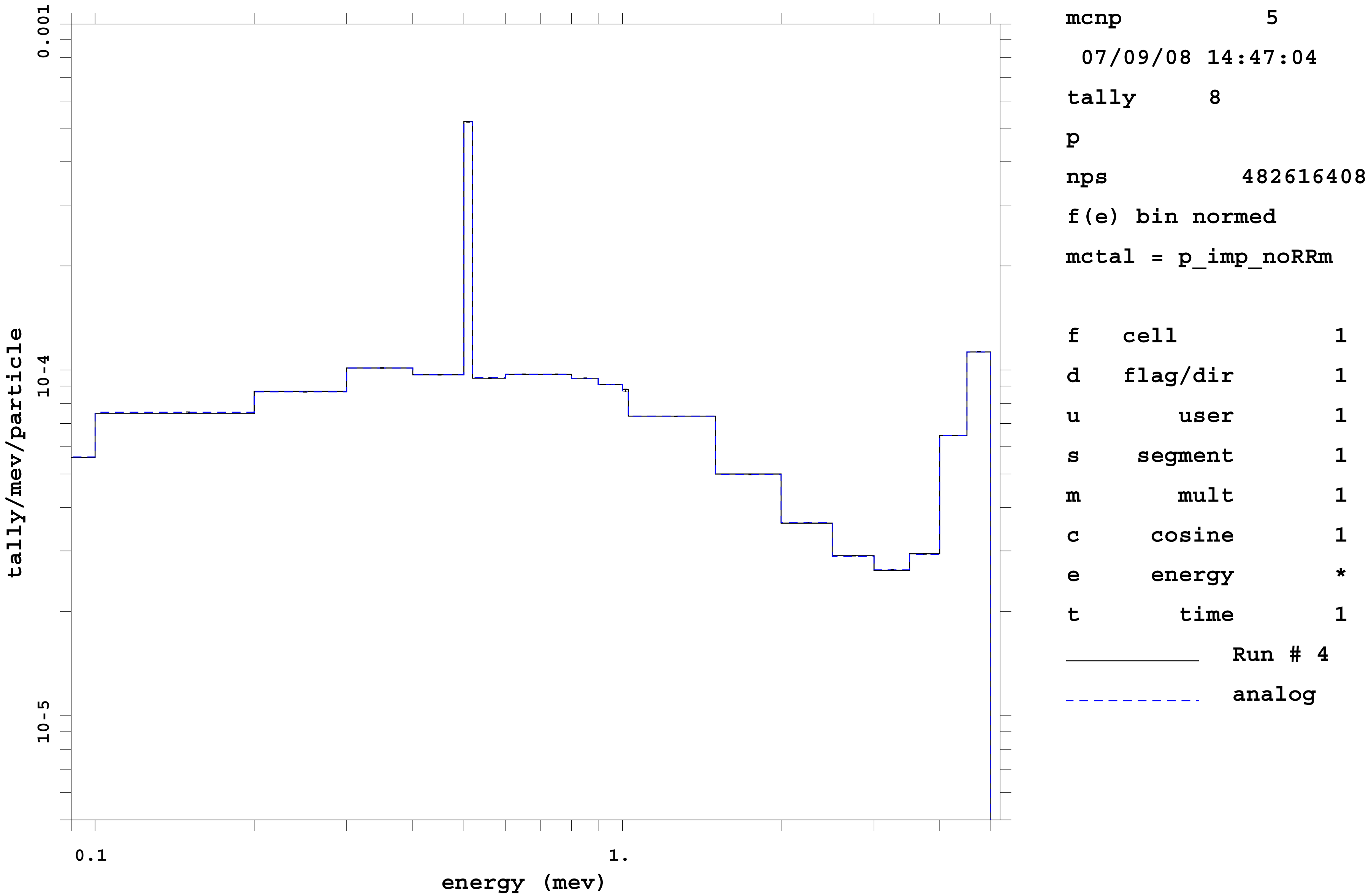

Ep = 5 MeV   Photon only
Var Red: imp
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/04/08 19:03:26
tally 8
p
nps 1567495612
f(e) bin normed
mctal = p_impm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 2
analog

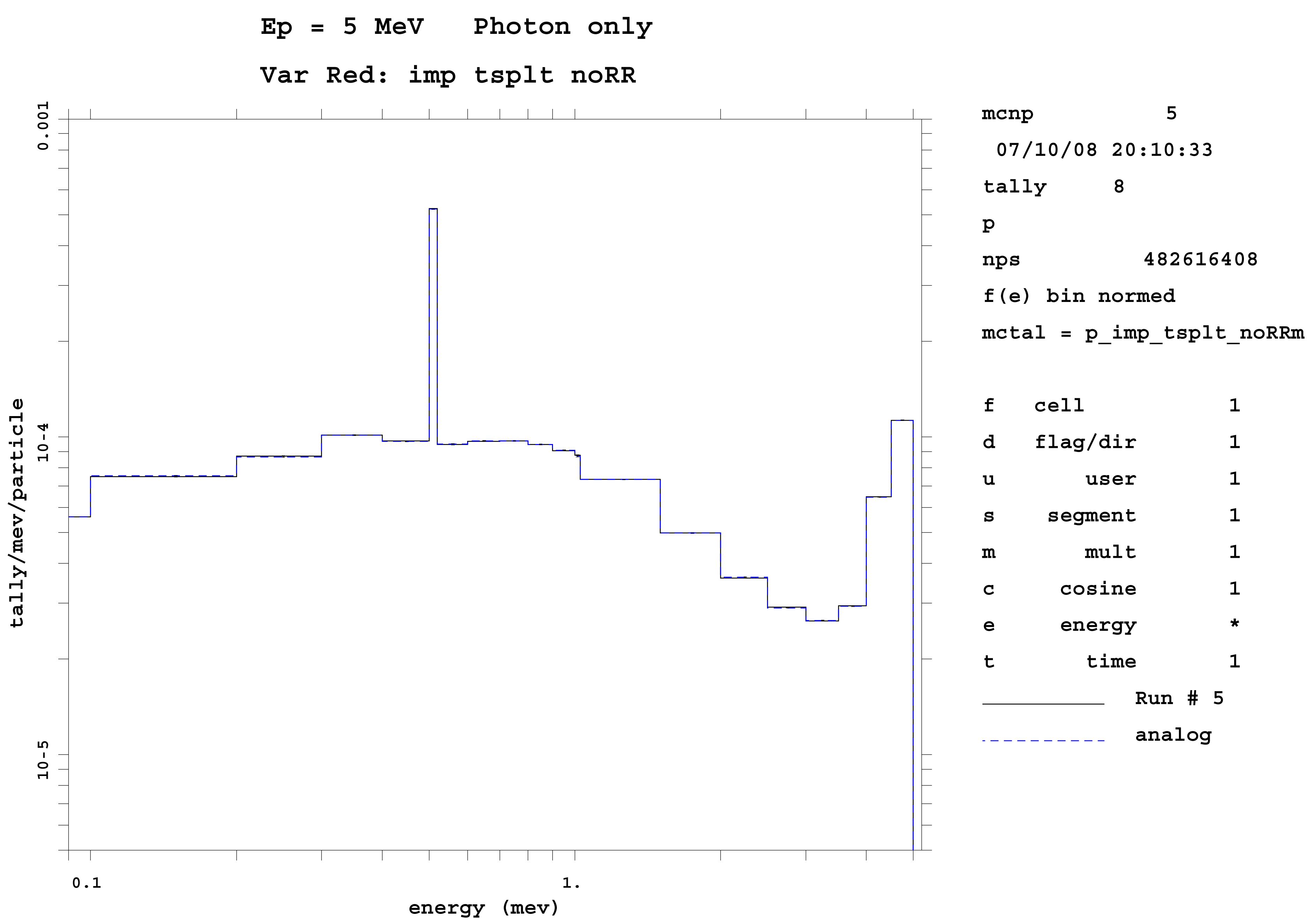


Ep = 5 MeV Photon only
Var Red: imp dxt noRR
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/09/08 10:32:42
tally 8
p
nps 1315032704
f(e) bin normed
mctal = p_imp_dxt_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 3
analog

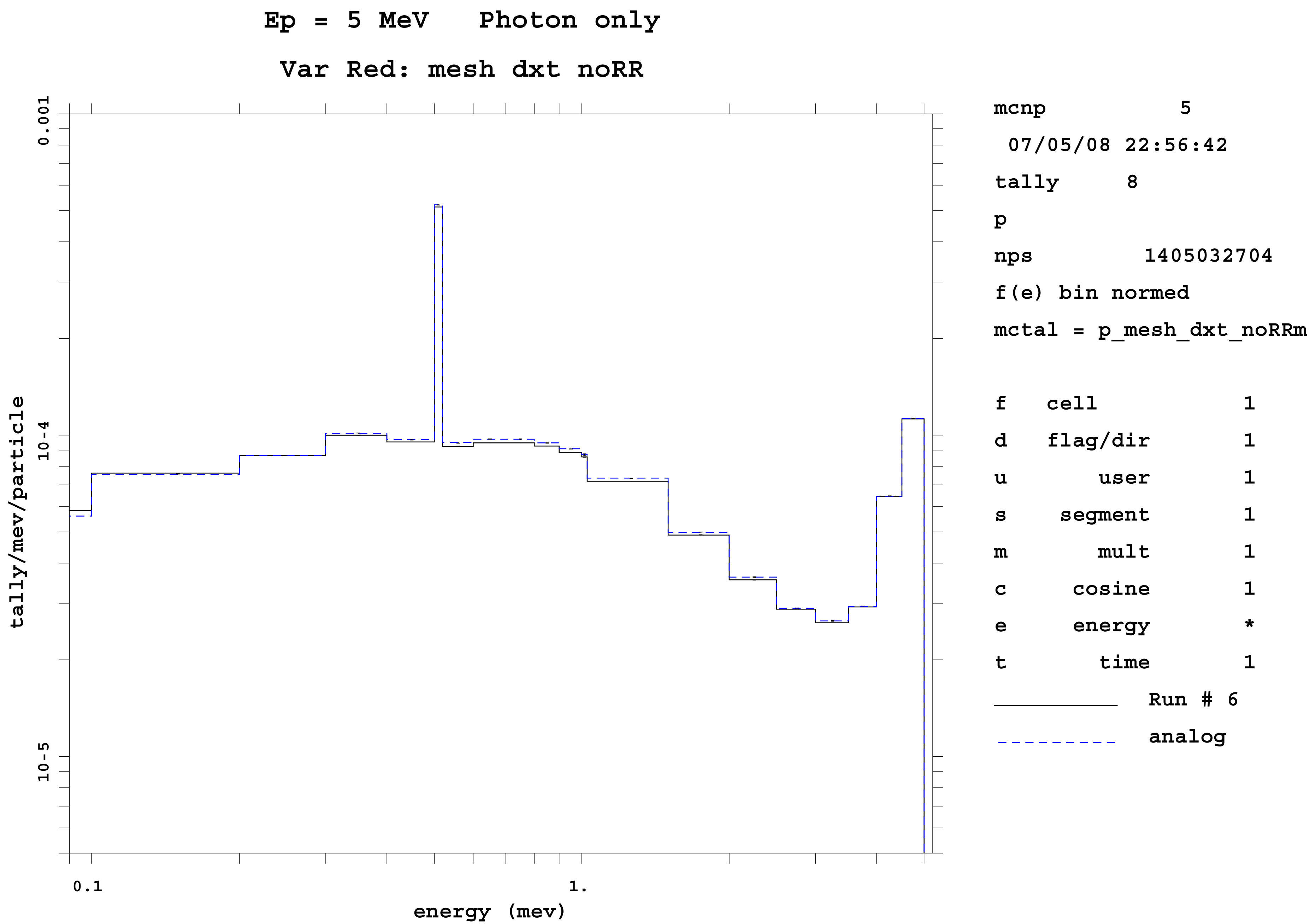
Ep = 5 MeV   Photon only

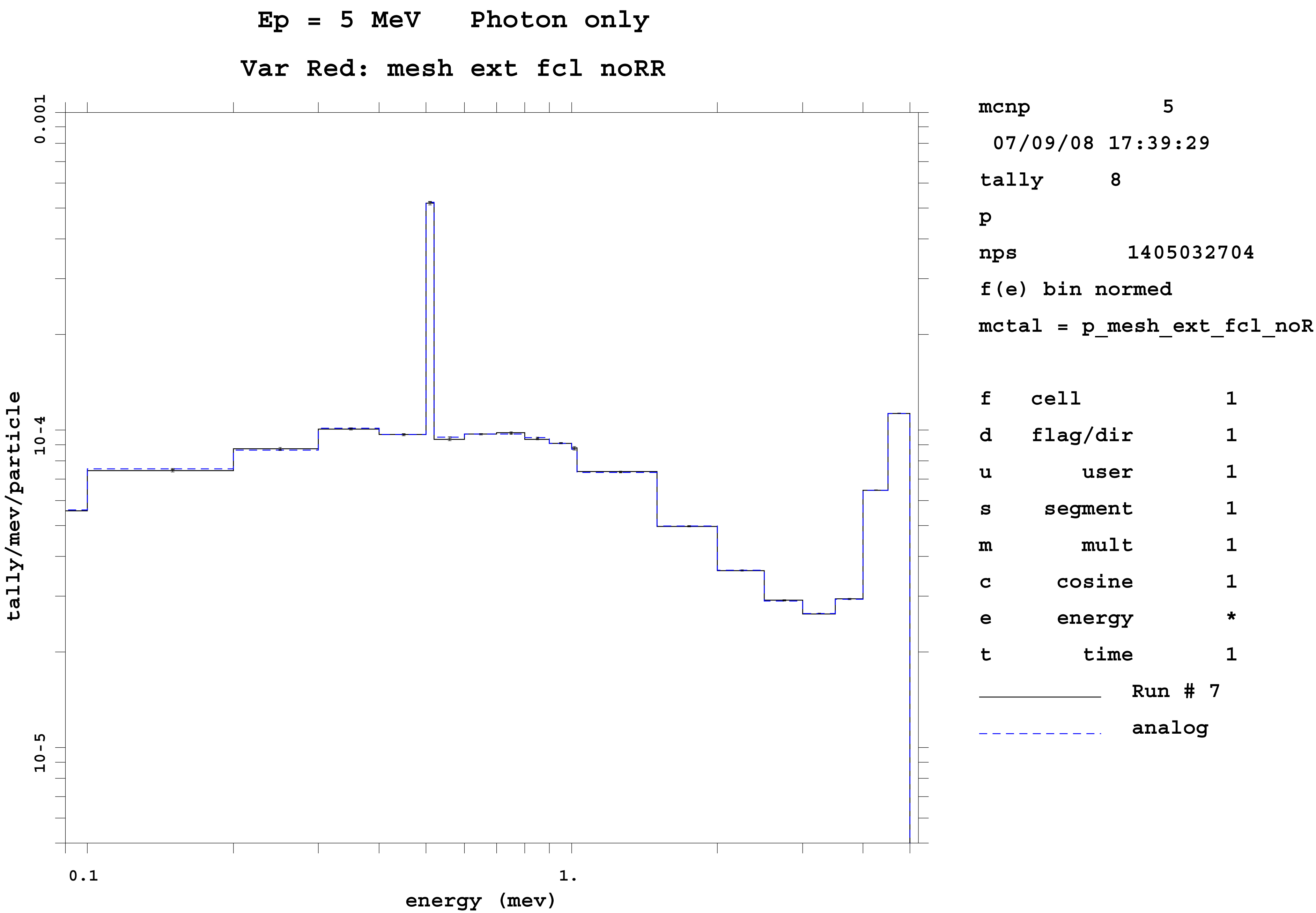
Var Red: imp noRR



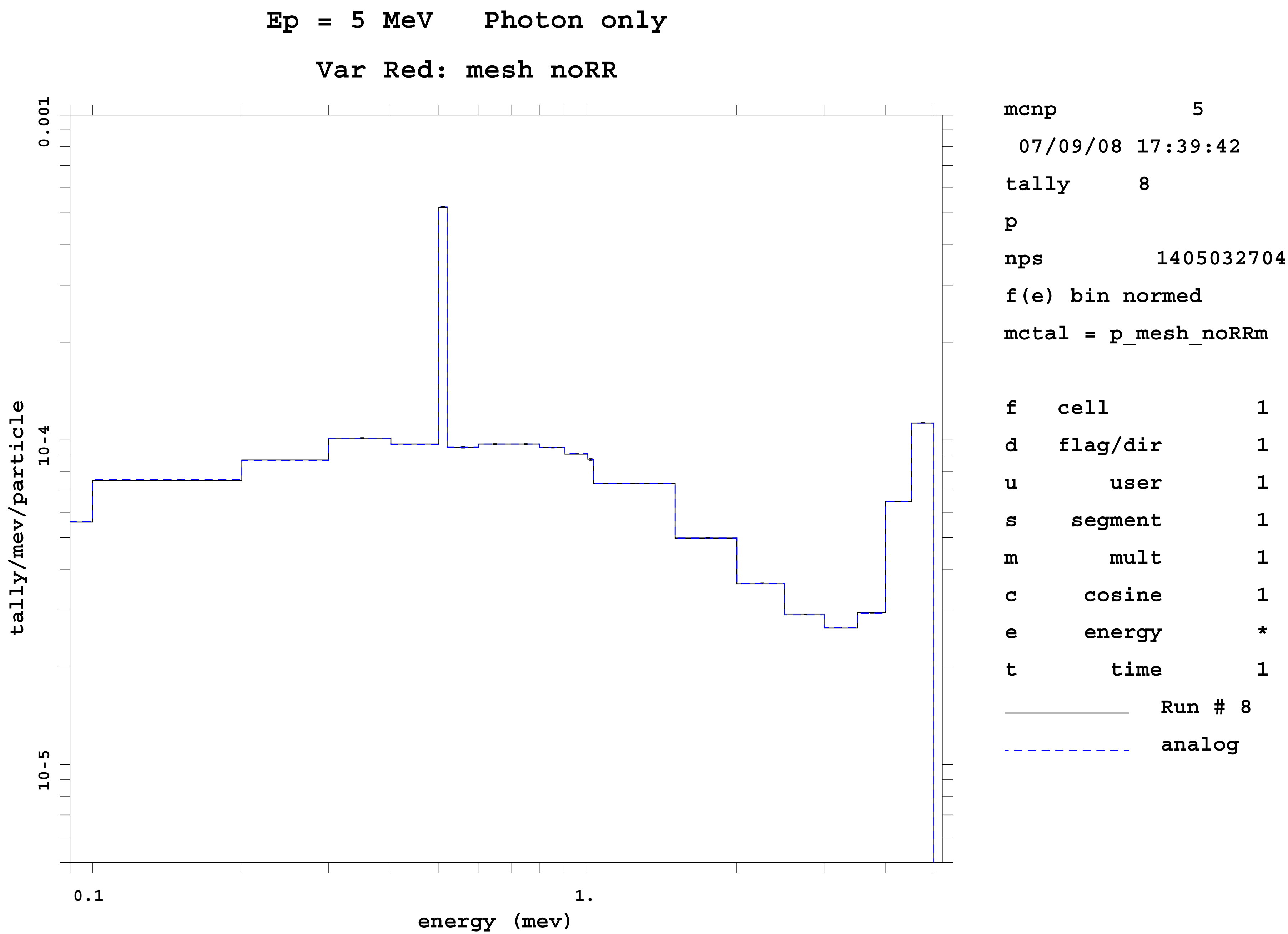


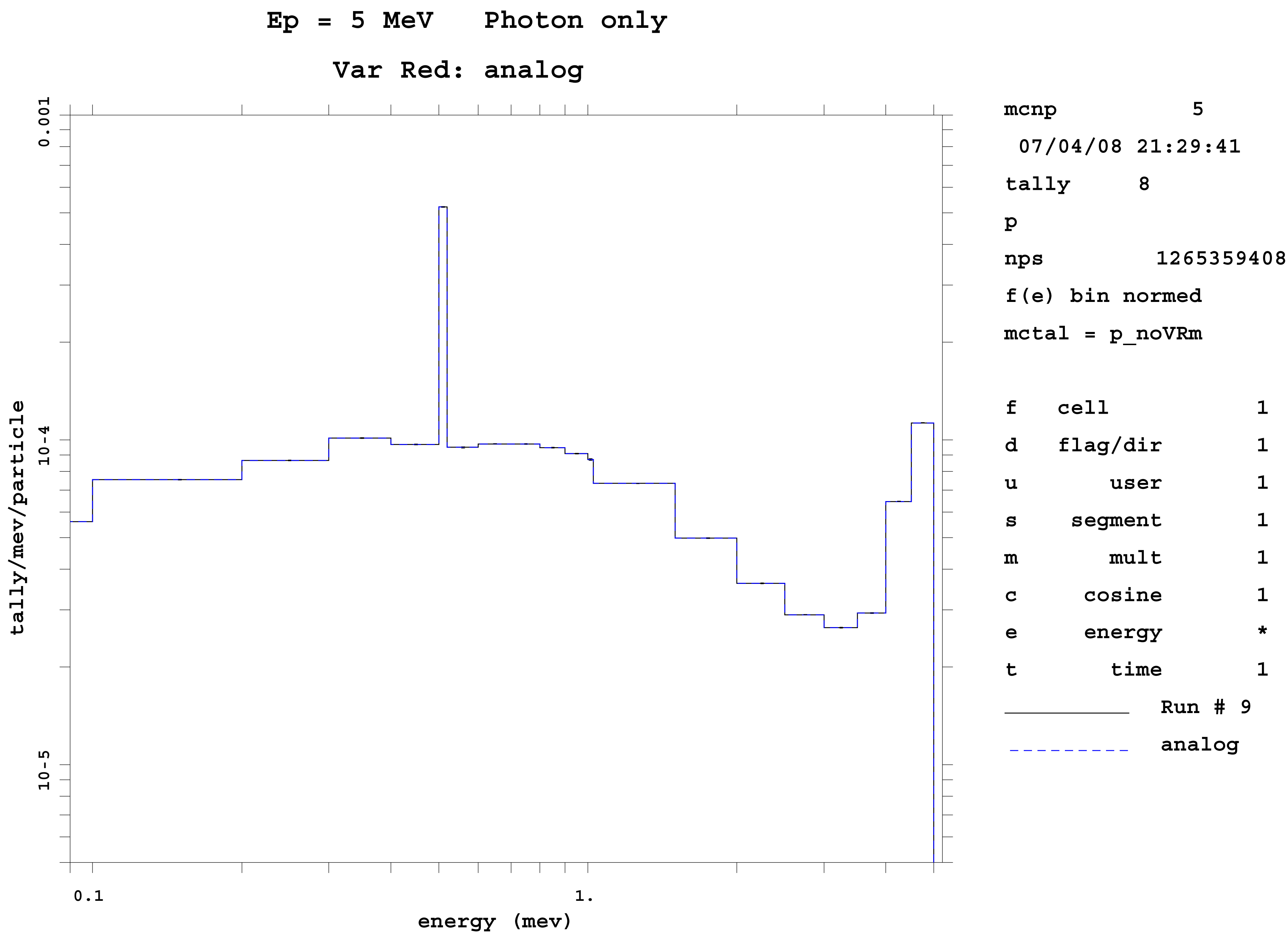
Ep = 5 MeV Photon only
Var Red: imp tsplt noRR
tally/mev/particle
0.001
10-4
10-5
0.1
1.
energy (mev)
mcnp 5
07/10/08 20:10:33
tally 8
p
nps 482616408
f(e) bin normed
mctal = p_imp_tsplt_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 5
analog


Ep = 5 MeV Photon only
Var Red: mesh dxt noRR
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/05/08 22:56:42
tally 8
p
nps 1405032704
f(e) bin normed
mctal = p_mesh_dxt_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 6
analog

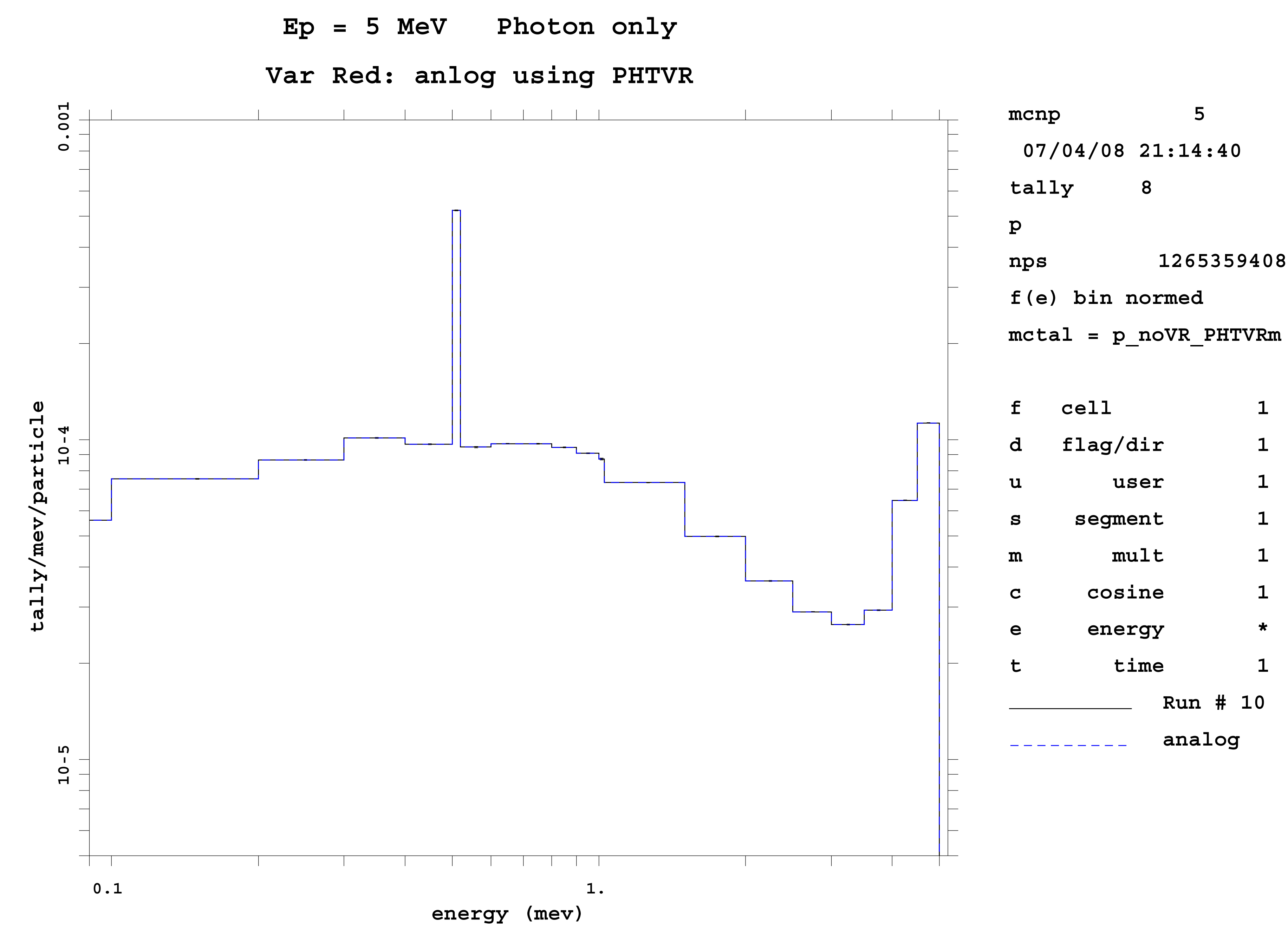


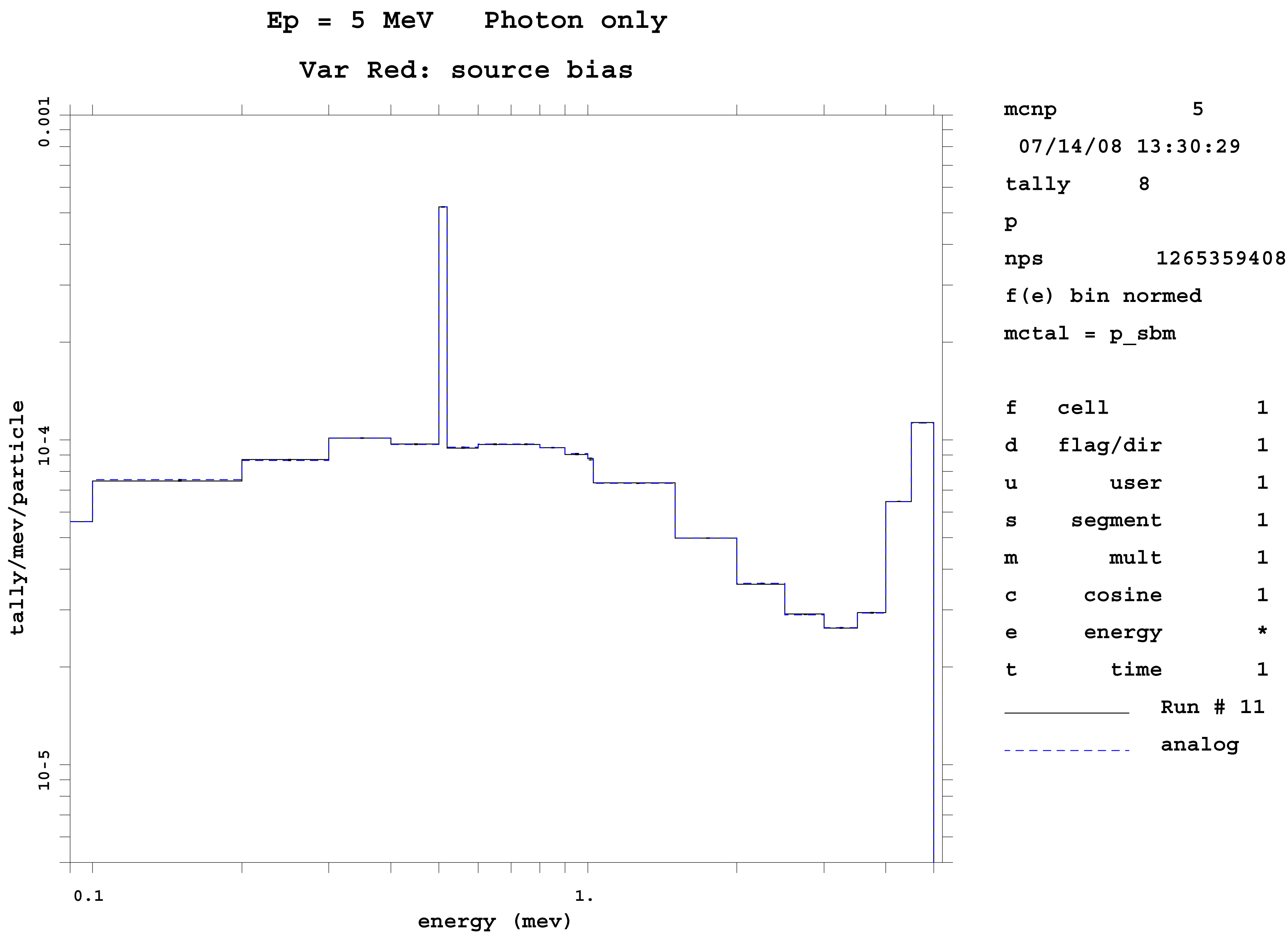
Ep = 5 MeV Photon only
Var Red: mesh ext fcl noRR
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/09/08 17:39:29
tally 8
p
nps 1405032704
f(e) bin normed
mctal = p_mesh_ext_fcl_noR
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 7
analog


Ep = 5 MeV Photon only
Var Red: mesh noRR
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/09/08 17:39:42
tally 8
p
nps 1405032704
f(e) bin normed
mctal = p_mesh_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 8
analog

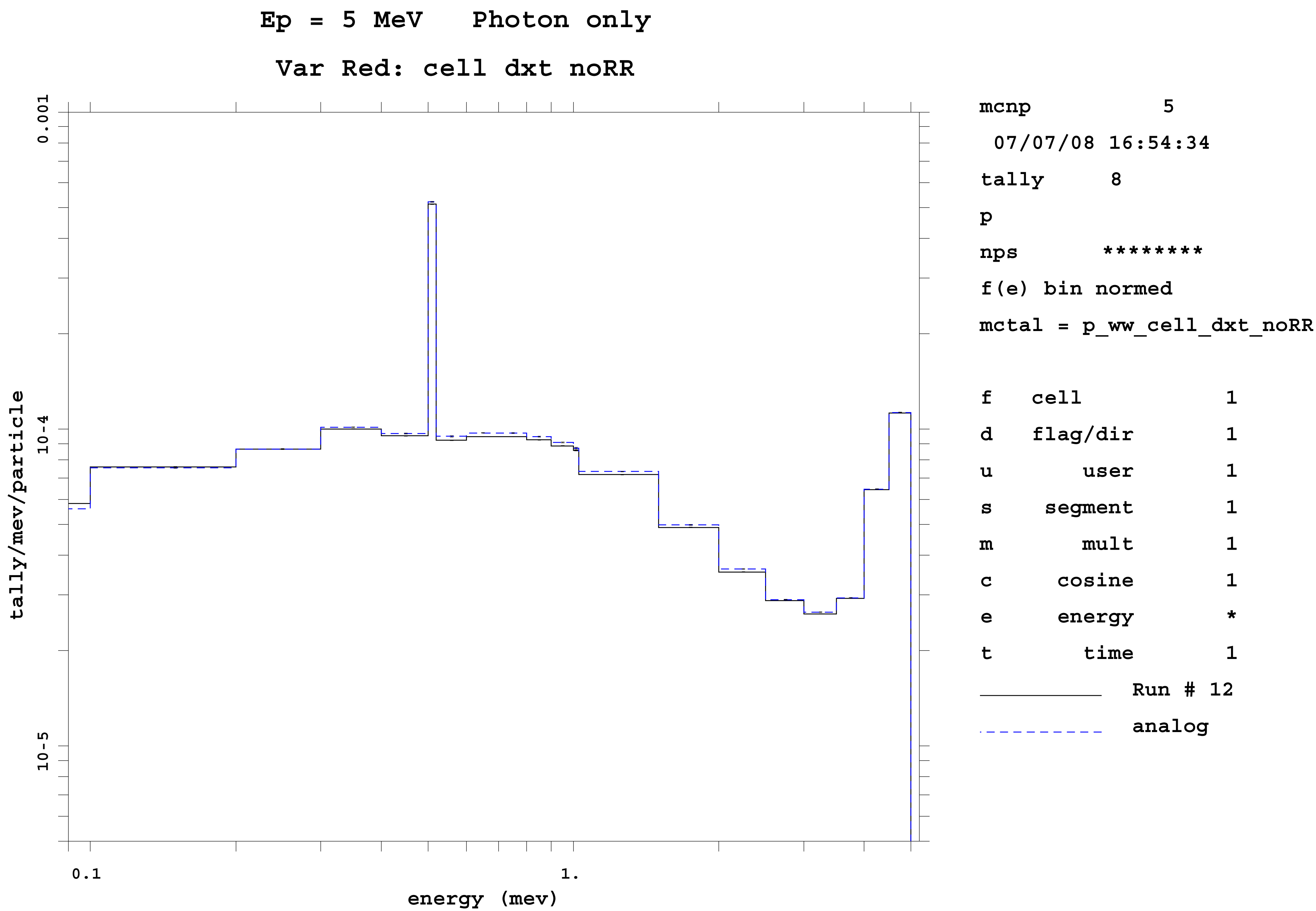


Ep = 5 MeV Photon only
Var Red: analog
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/04/08 21:29:41
tally 8
p
nps 1265359408
f(e) bin normed
mctal = p_noVRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 9
analog

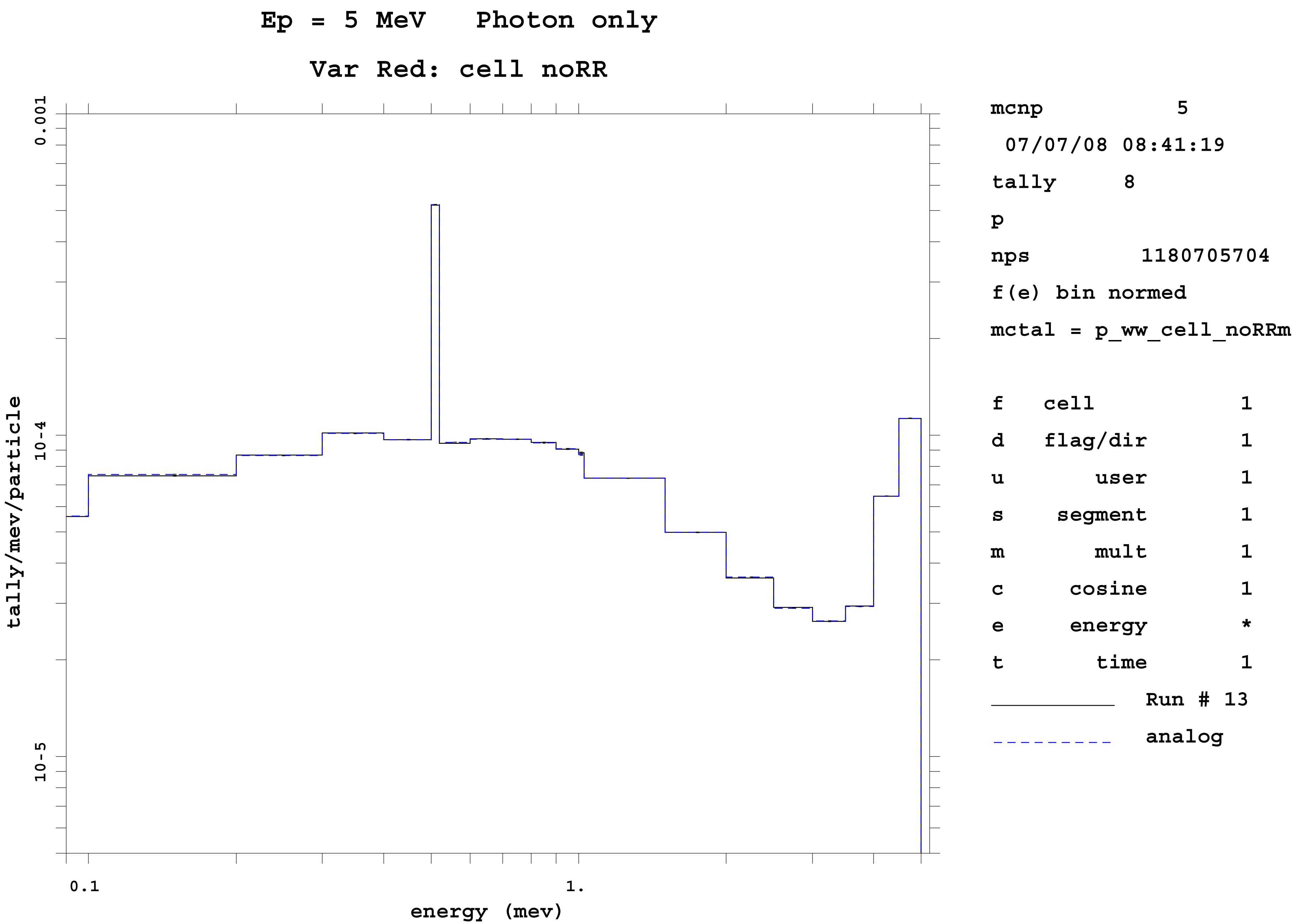

Ep = 5 MeV Photon only
Var Red: anlog using PHTVR
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/04/08 21:14:40
tally 8
p
nps 1265359408
f(e) bin normed
mctal = p_noVR_PHTVRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 10
analog

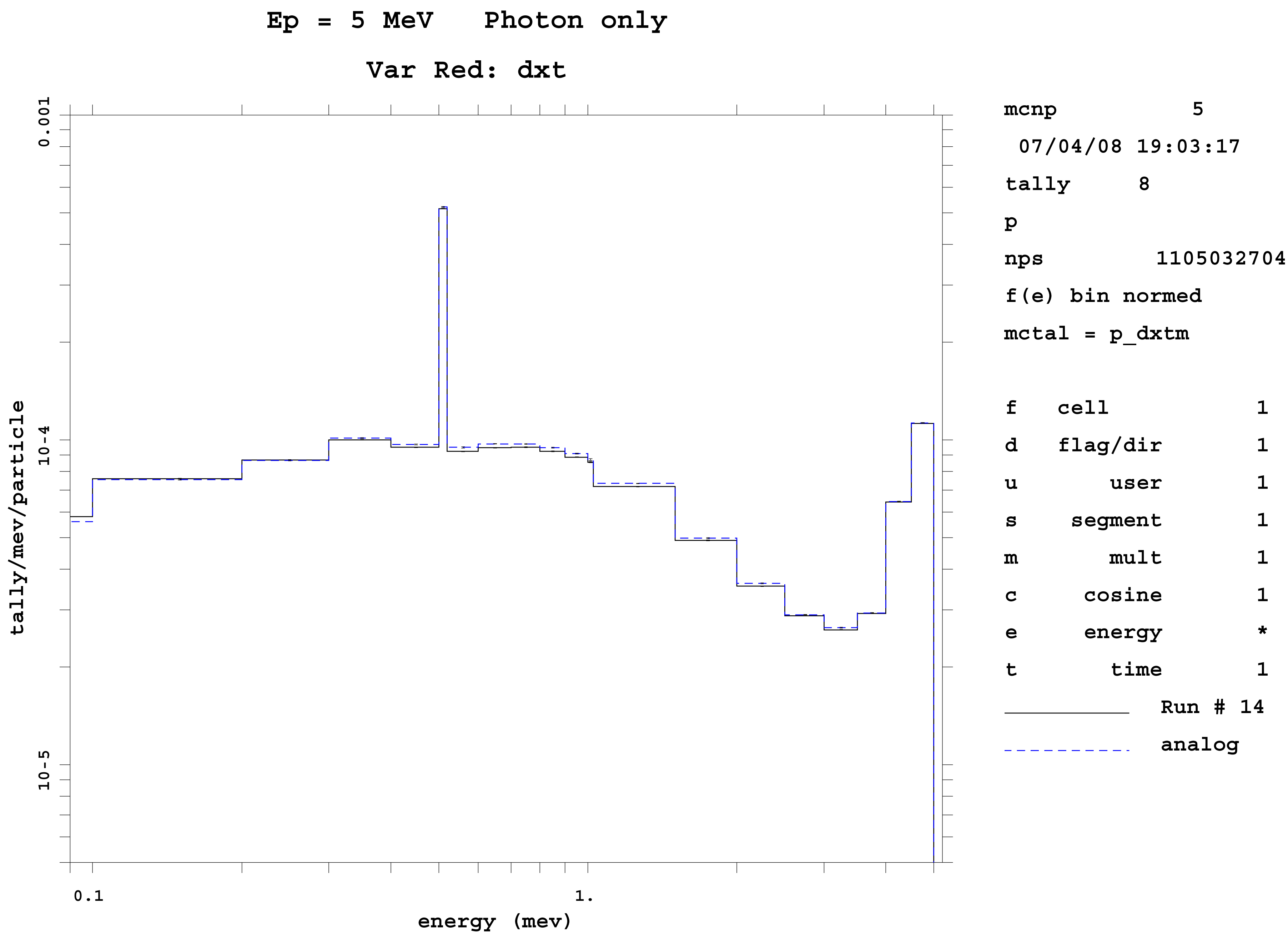


Ep = 5 MeV Photon only
Var Red: source bias
tally/mev/particle
0.001
10-4
10-5
0.1
1.
energy (mev)
mcnp 5
07/14/08 13:30:29
tally 8
p
nps 1265359408
f(e) bin normed
mctal = p_sbm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 11
analog

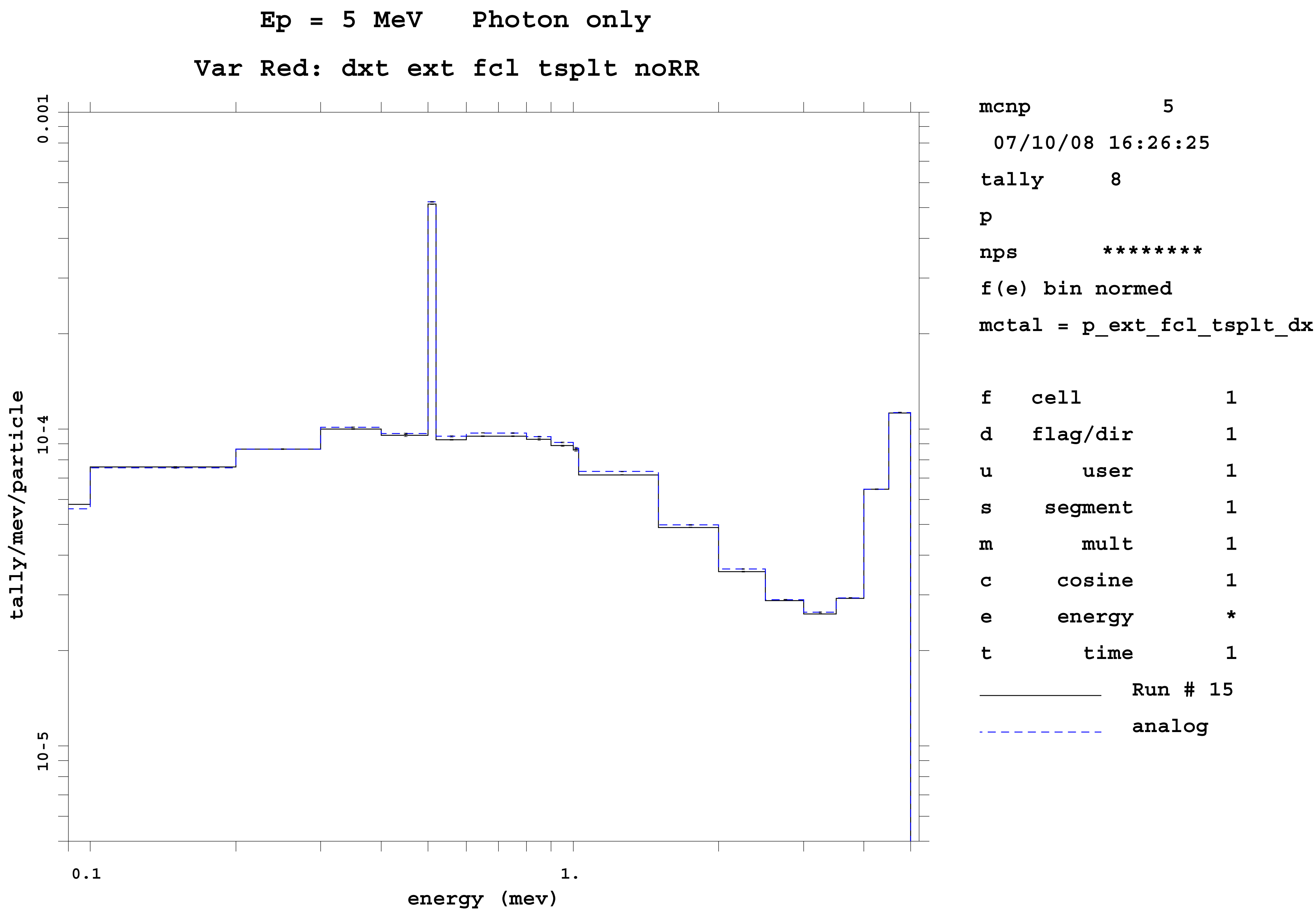


Ep = 5 MeV Photon only
Var Red: cell dxt noRR
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 16:54:34
tally 8
p
nps ********
f(e) bin normed
mctal = p_ww_cell_dxt_noRR
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 12
analog

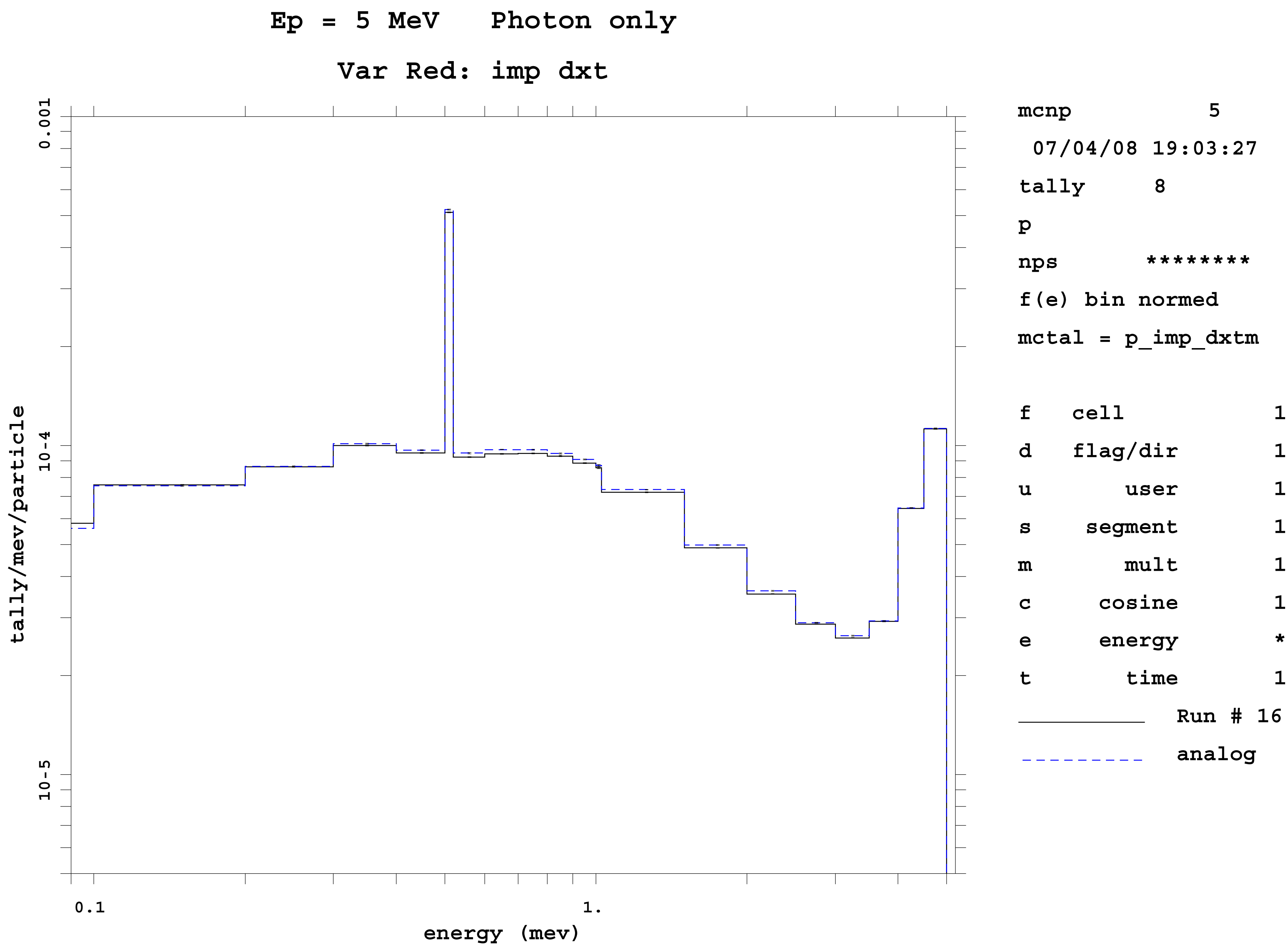

Ep = 5 MeV Photon only
Var Red: cell noRR
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 08:41:19
tally 8
p
nps 1180705704
f(e) bin normed
mctal = p_ww_cell_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 13
analog



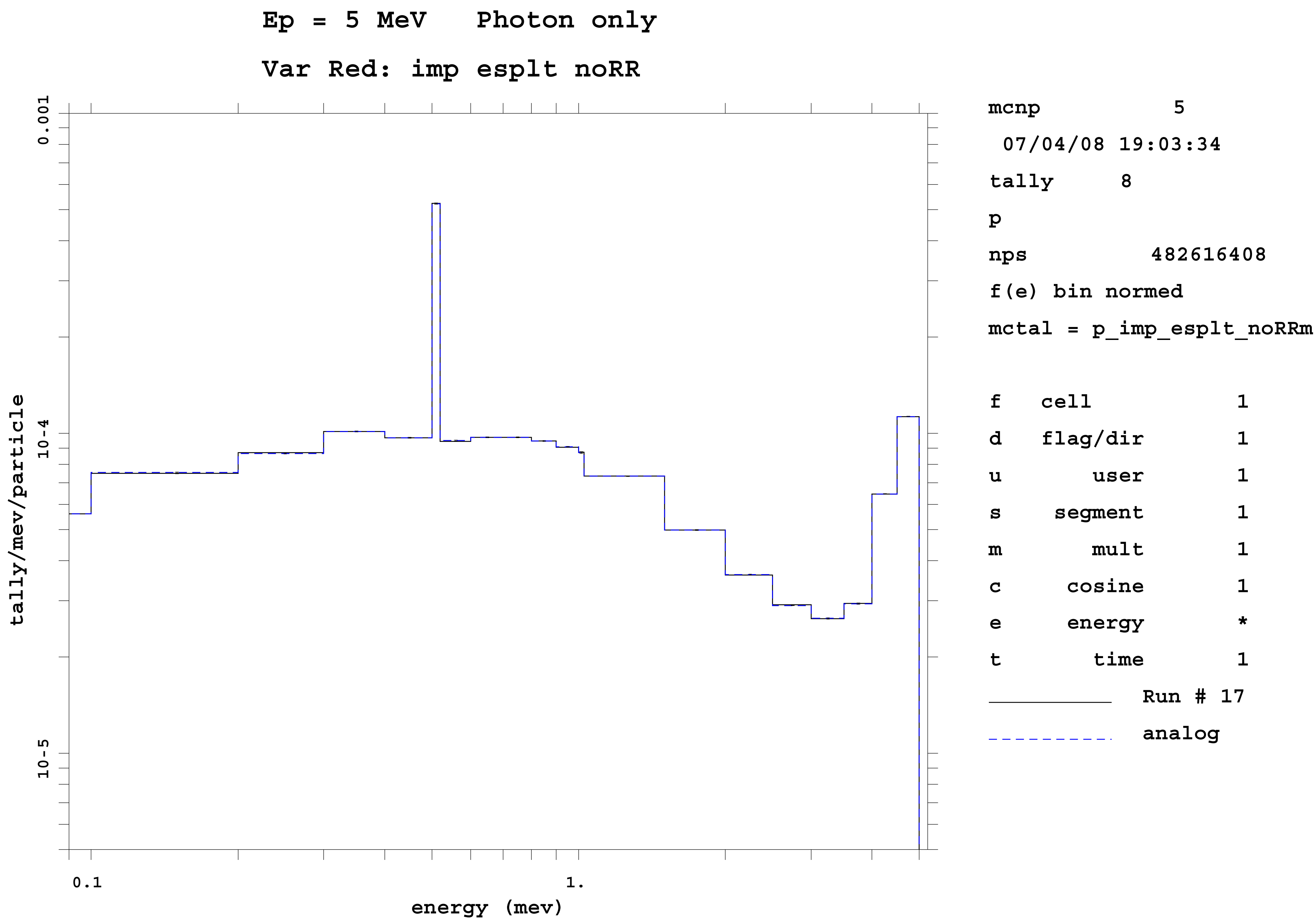
Ep = 5 MeV   Photon only
Var Red: dxt
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/04/08 19:03:17
tally 8
p
nps 1105032704
f(e) bin normed
mctal = p_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 14
analog



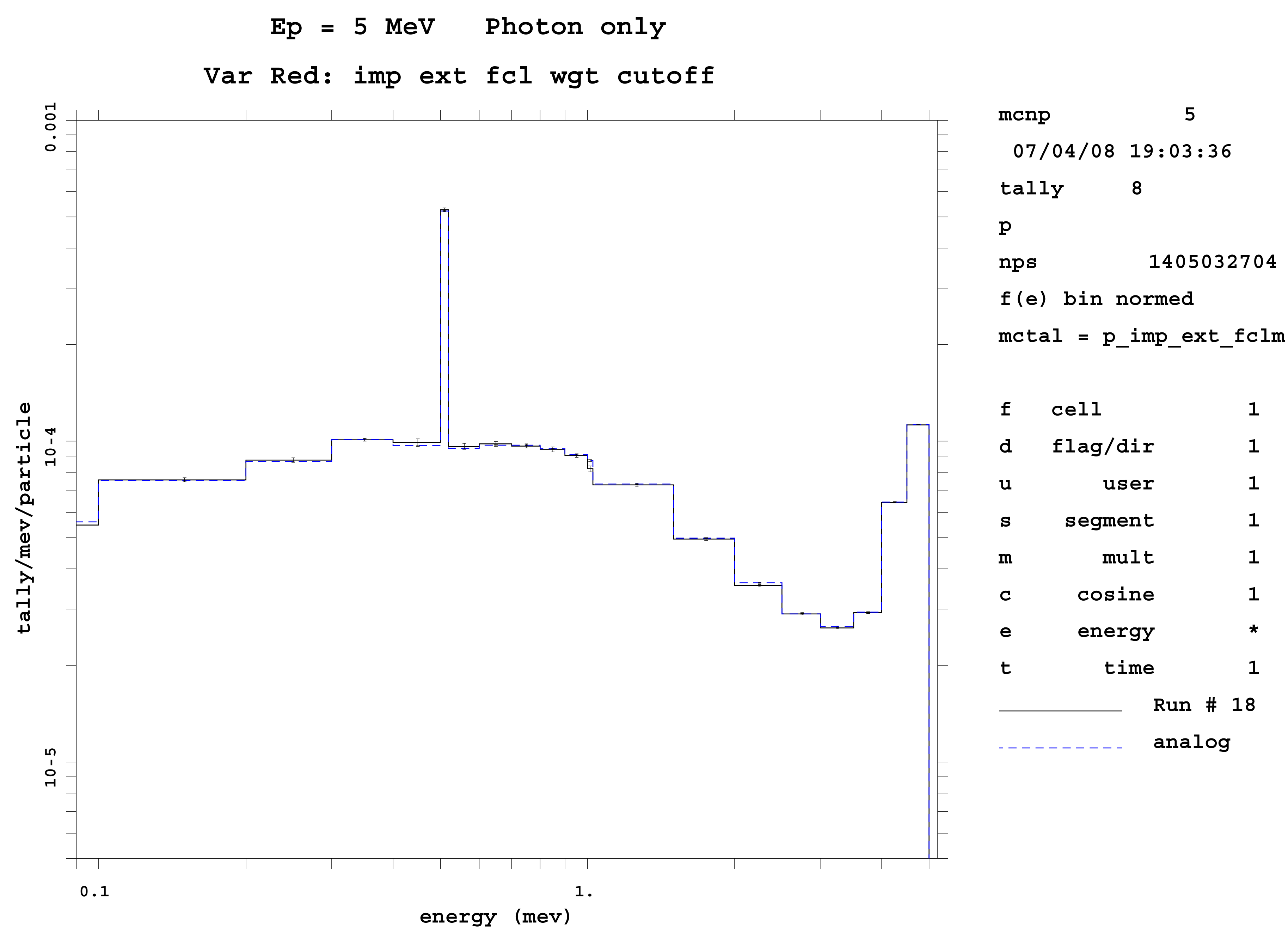
Ep = 5 MeV Photon only
Var Red: dxt ext fcl tsplt noRR
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/10/08 16:26:25
tally 8
p
nps ********
f(e) bin normed
mctal = p_ext_fcl_tsplt_dx
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 15
analog



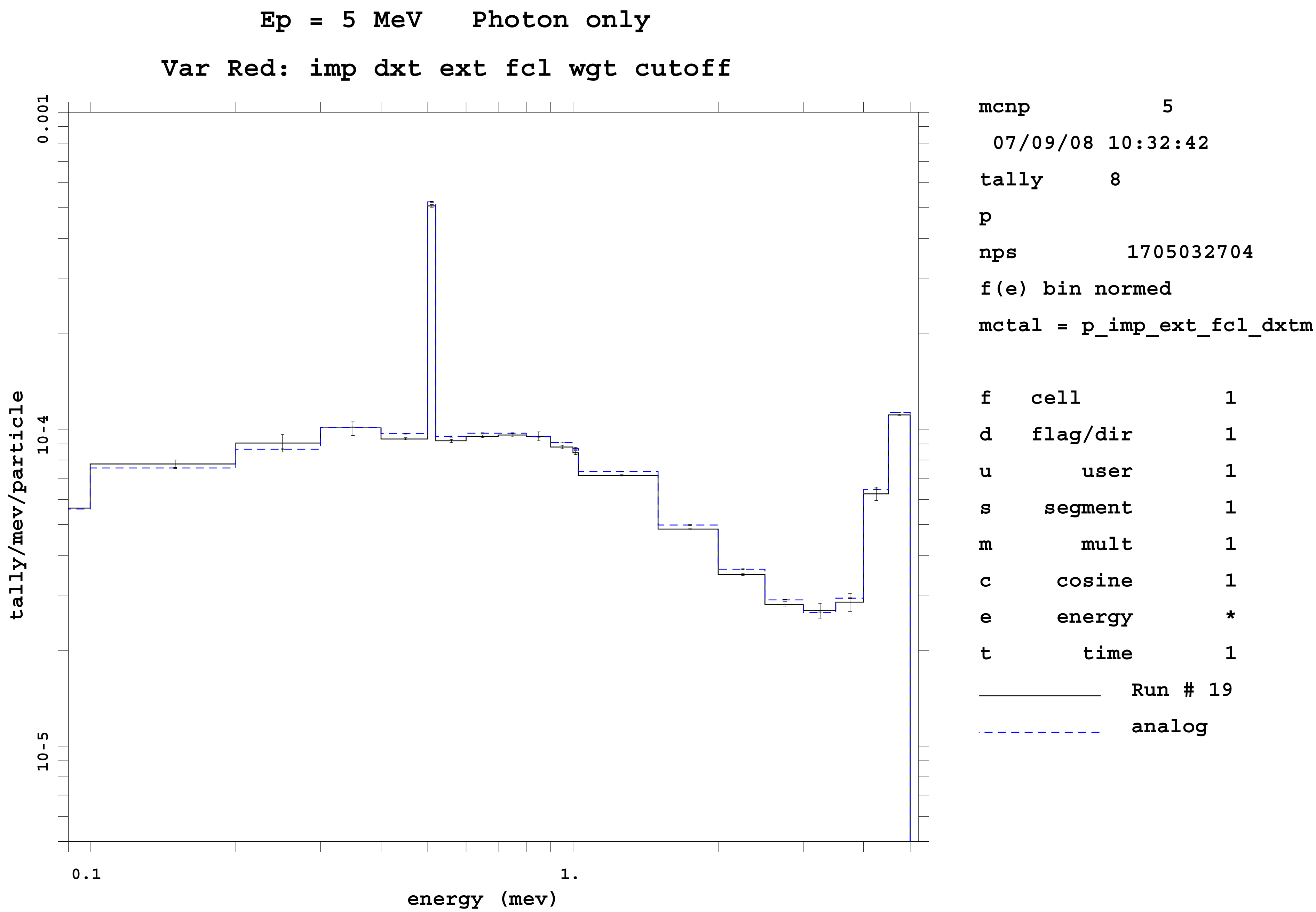
Ep = 5 MeV   Photon only
Var Red: imp dxt
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/04/08 19:03:27
tally 8
p
nps ********
f(e) bin normed
mctal = p_imp_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 16
analog

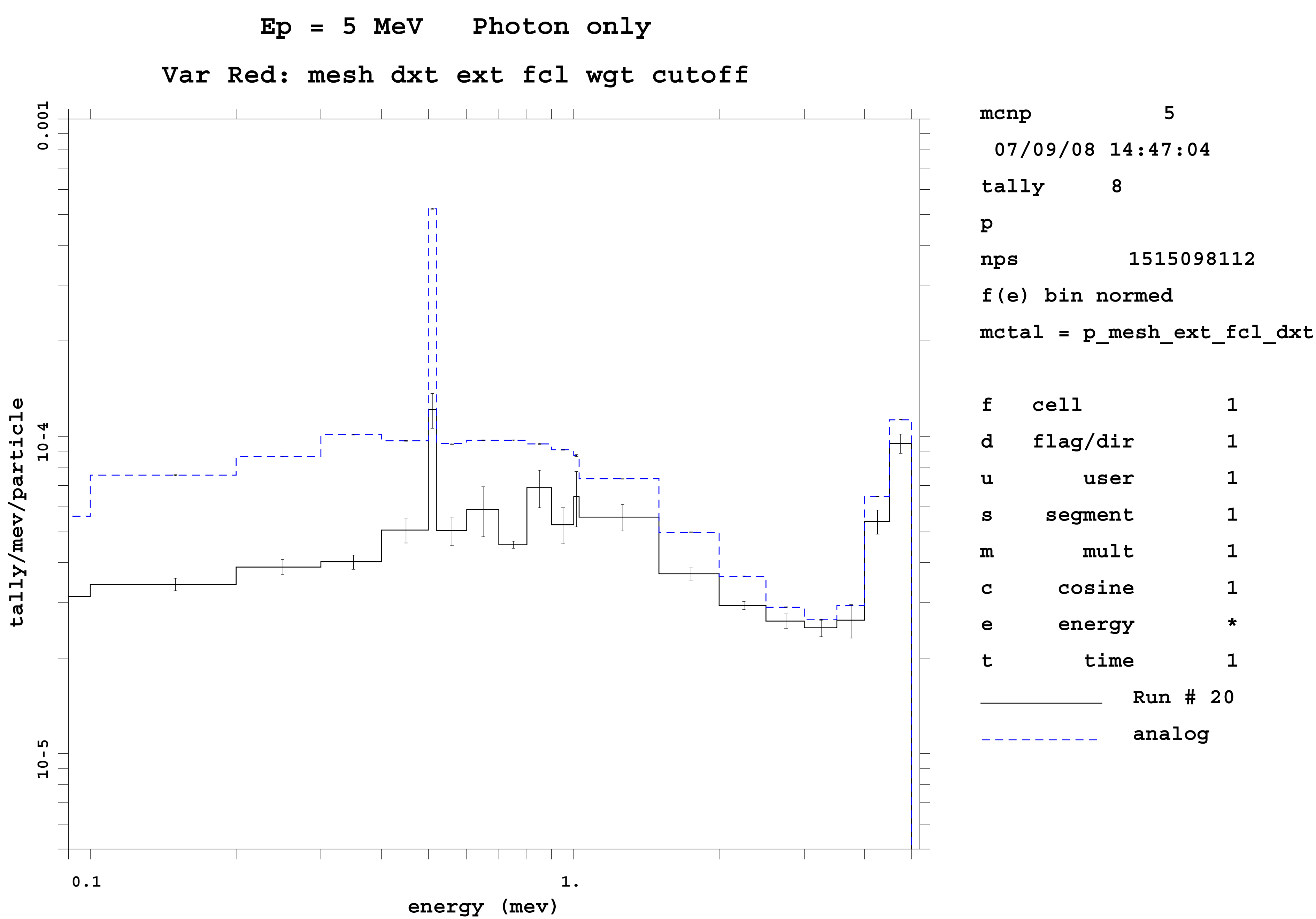


Ep = 5 MeV Photon only
Var Red: imp esplt noRR
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/04/08 19:03:34
tally 8
p
nps 482616408
f(e) bin normed
mctal = p_imp_esplt_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 17
analog

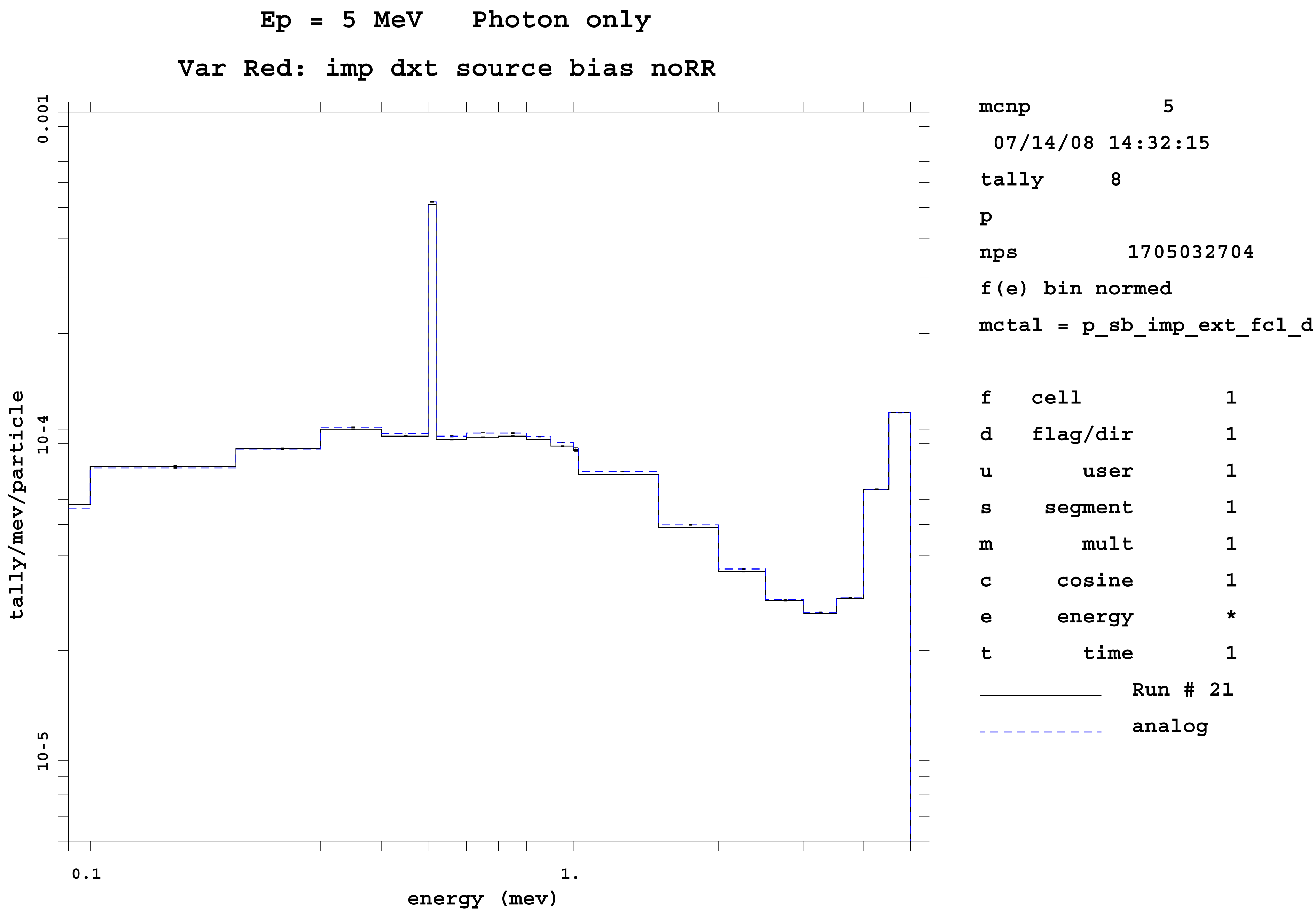


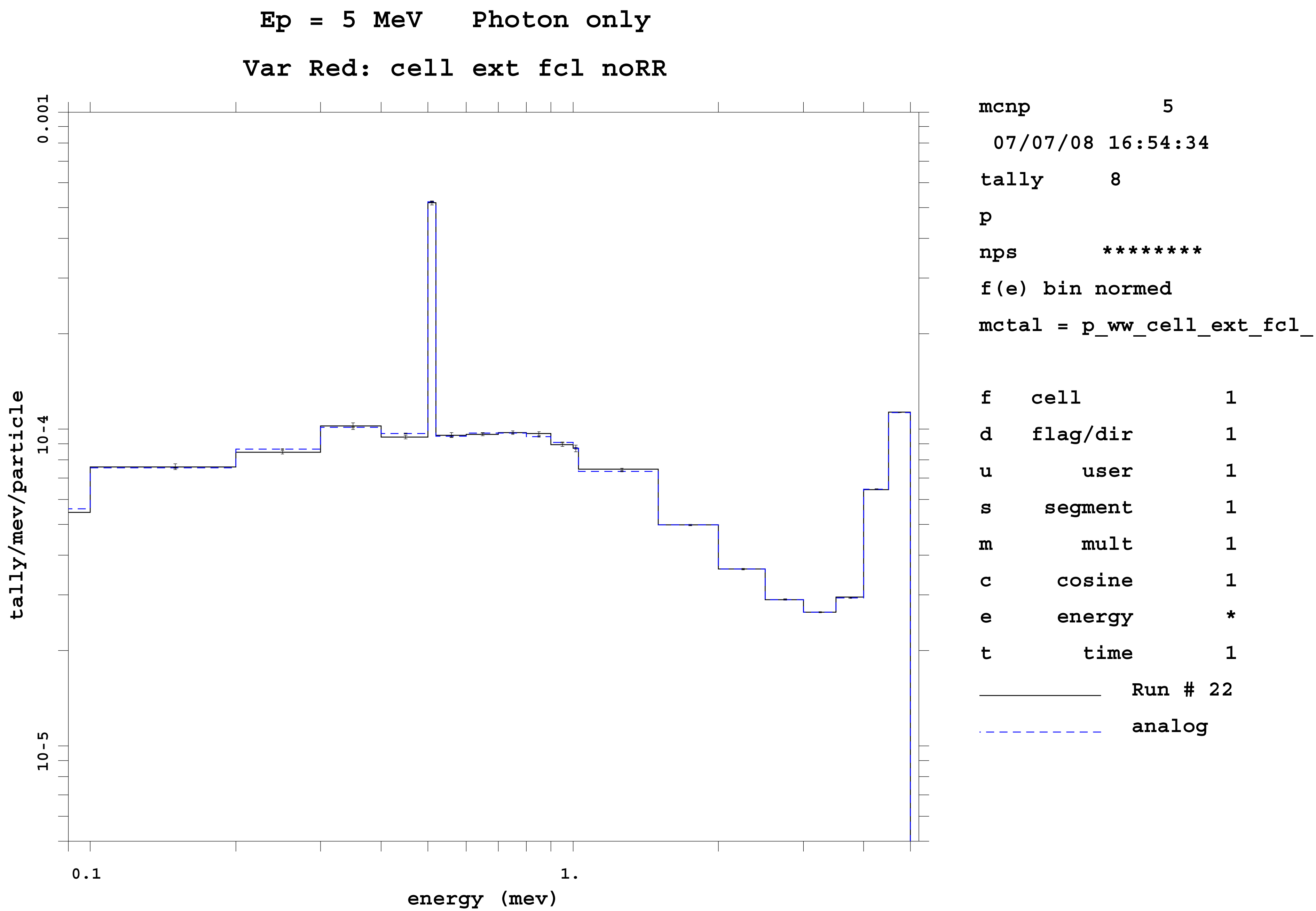
Ep = 5 MeV Photon only
Var Red: imp ext fcl wgt cutoff
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/04/08 19:03:36
tally 8
p
nps 1405032704
f(e) bin normed
mctal = p_imp_ext_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 18
analog


Ep = 5 MeV Photon only
Var Red: imp dxt ext fcl wgt cutoff
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/09/08 10:32:42
tally 8
p
nps 1705032704
f(e) bin normed
mctal = p_imp_ext_fcl_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 19
analog

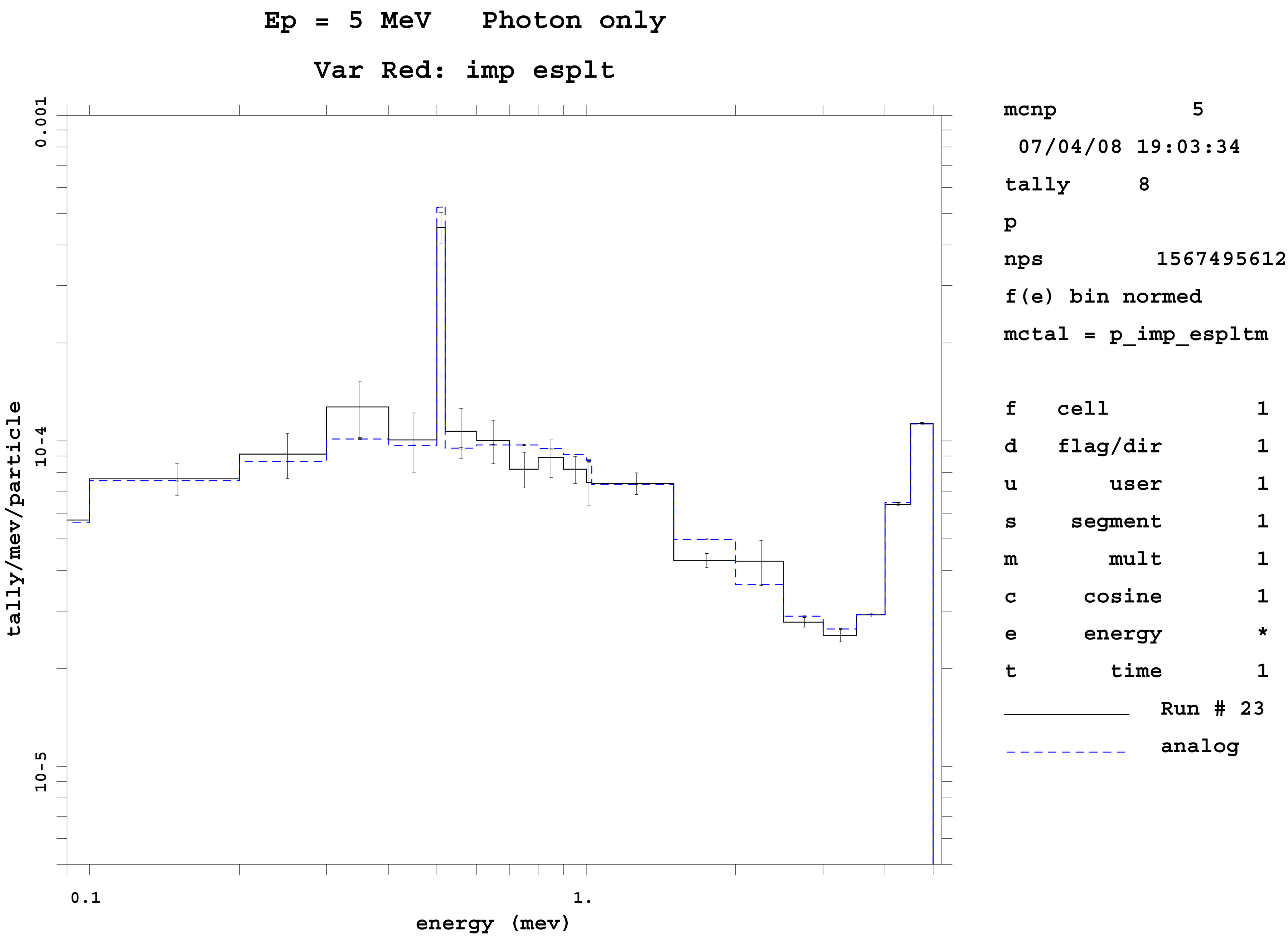


Ep = 5 MeV Photon only
Var Red: mesh dxt ext fcl wgt cutoff
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/09/08 14:47:04
tally 8
p
nps 1515098112
f(e) bin normed
mctal = p_mesh_ext_fcl_dxt
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 20
analog

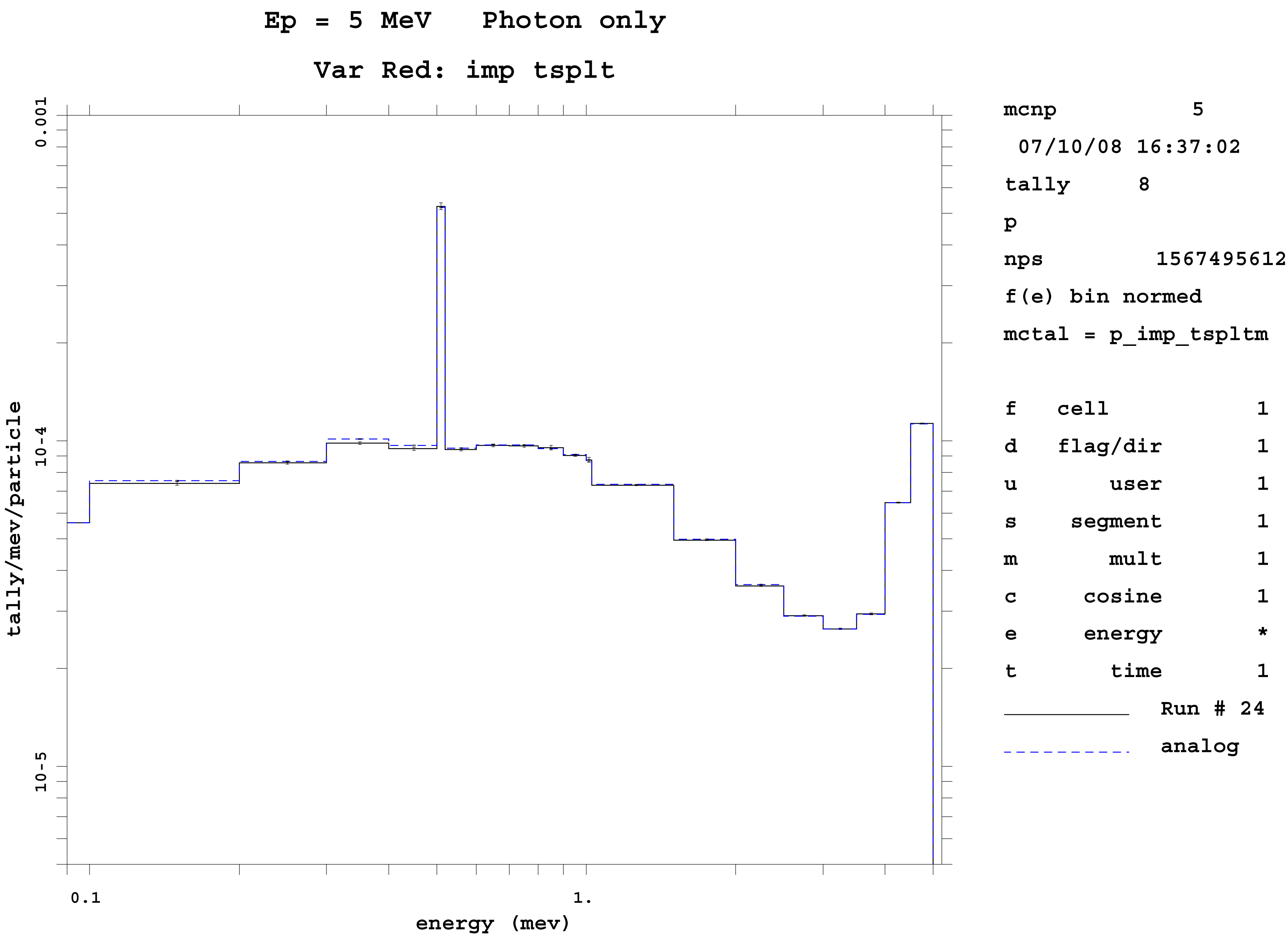

Ep = 5 MeV Photon only
Var Red: imp dxt source bias noRR
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/14/08 14:32:15
tally 8
p
nps 1705032704
f(e) bin normed
mctal = p_sb_imp_ext_fcl_d
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 21
analog

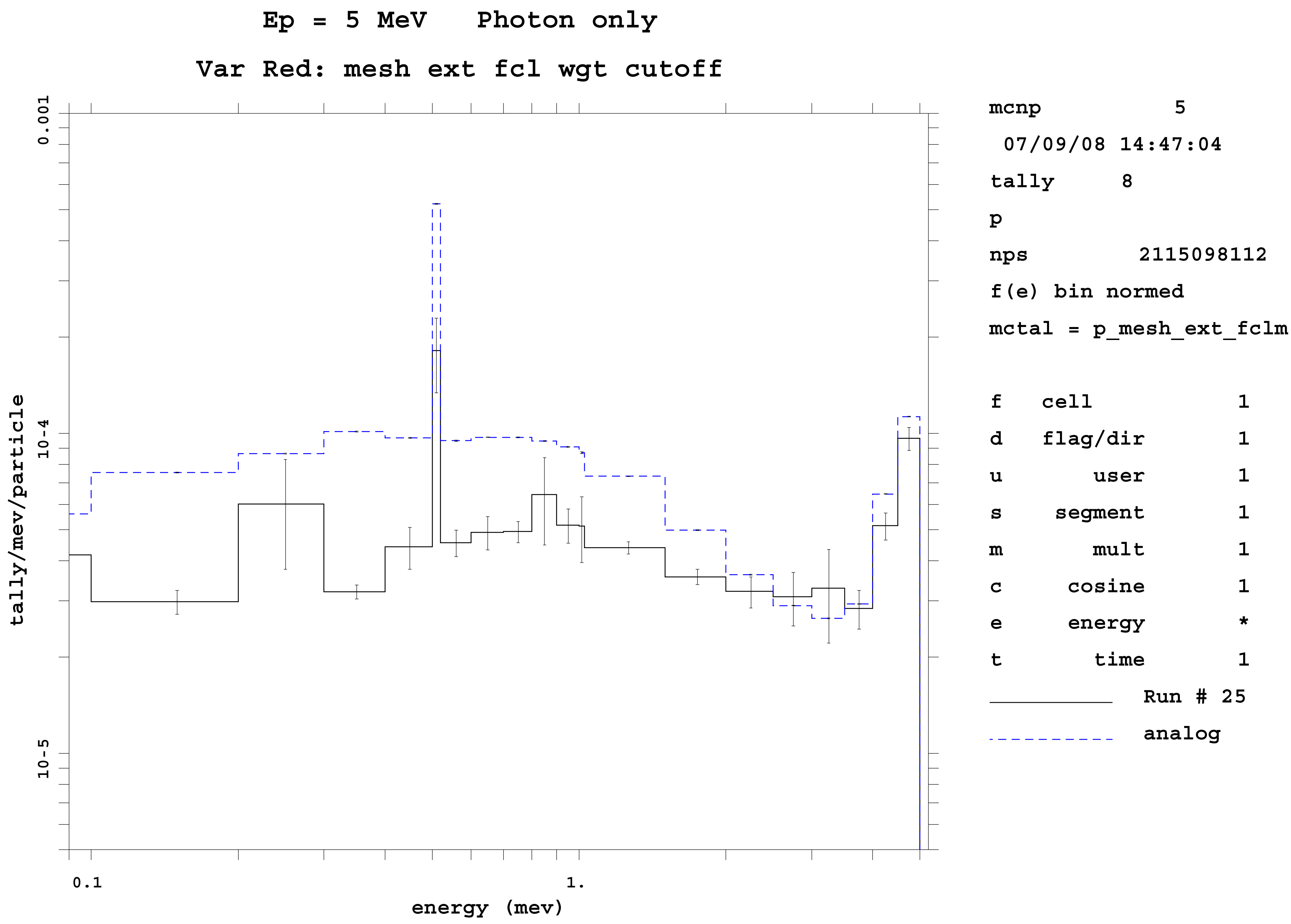


Ep = 5 MeV Photon only
Var Red: cell ext fcl noRR
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 16:54:34
tally 8
p
nps ********
f(e) bin normed
mctal = p_ww_cell_ext_fcl_
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 22
analog

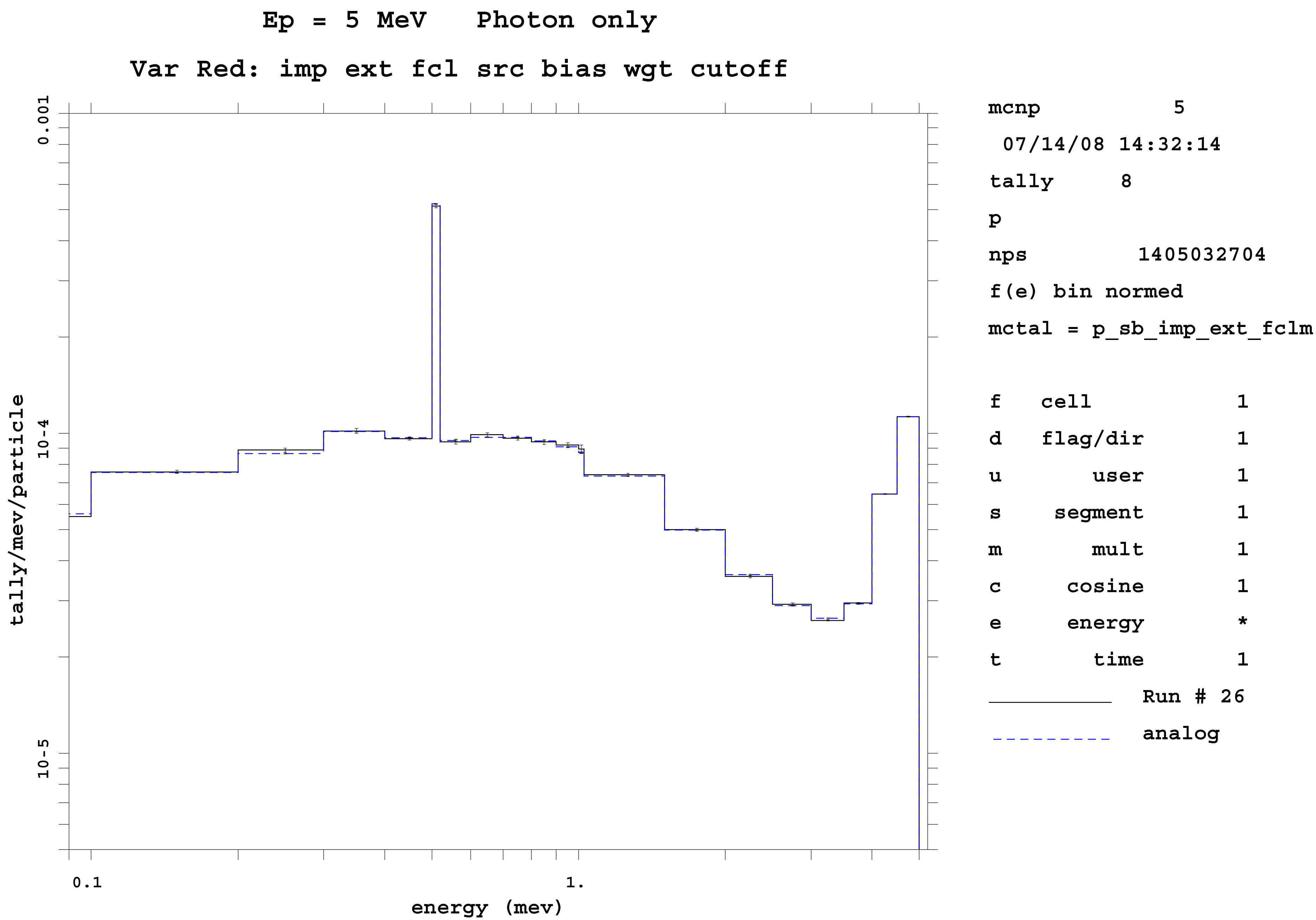


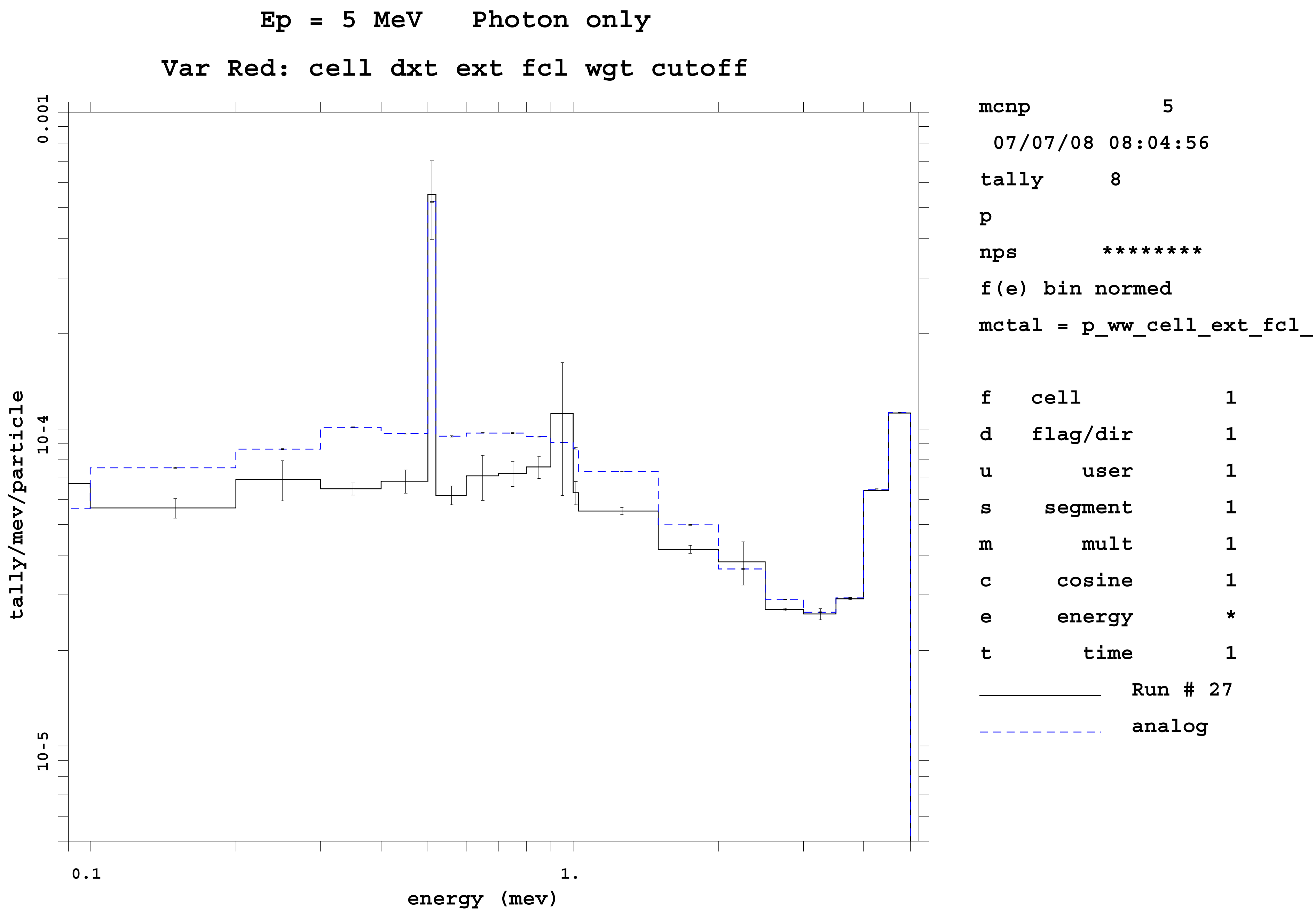
Ep = 5 MeV Photon only
Var Red: imp espltt
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/04/08 19:03:34
tally 8
p
nps 1567495612
f(e) bin normed
mctal = p_imp_espltm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 23
analog

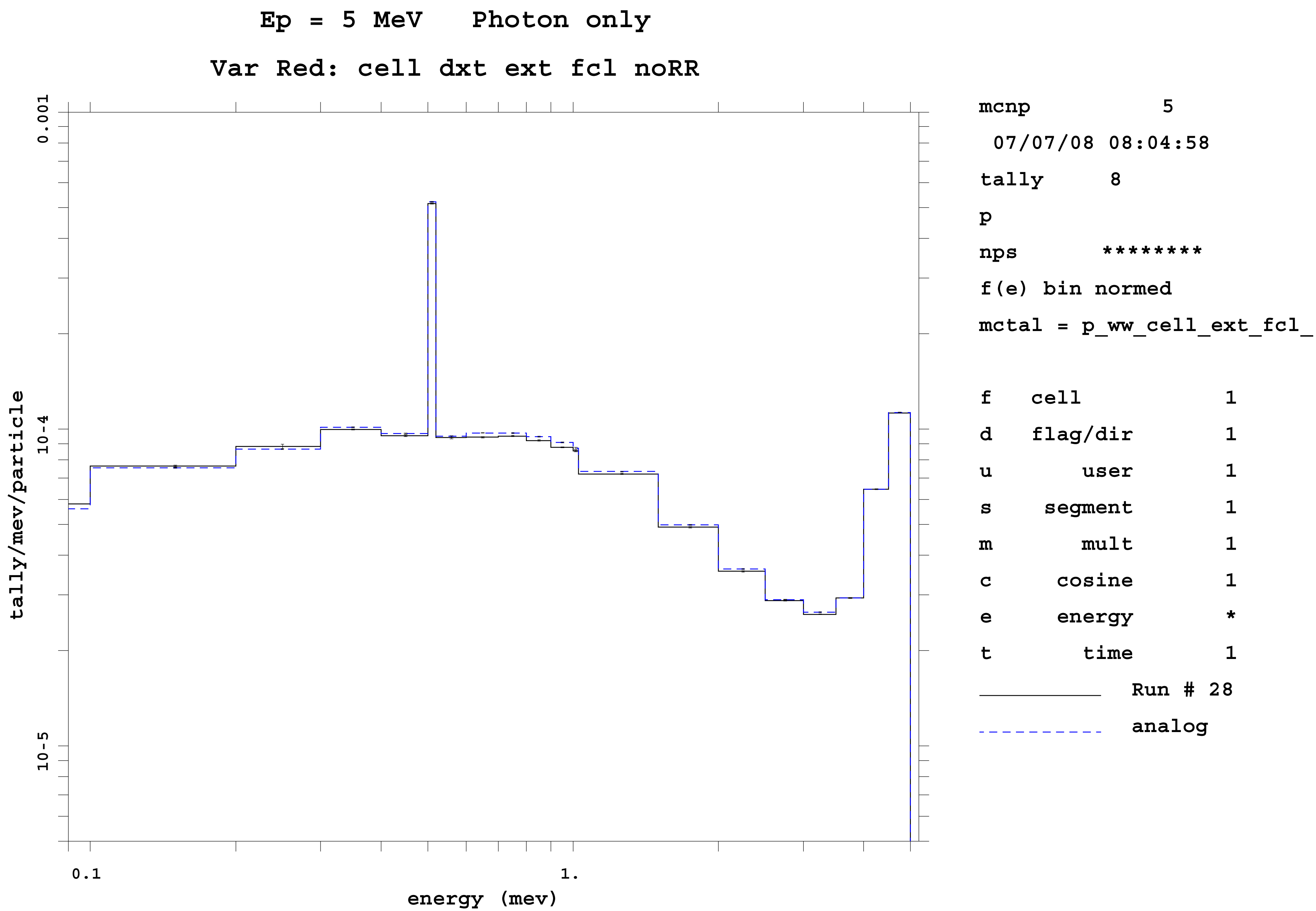

Ep = 5 MeV Photon only
Var Red: imp tsplt
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/10/08 16:37:02
tally 8
p
nps 1567495612
f(e) bin normed
mctal = p_imp_tspltm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 24
analog

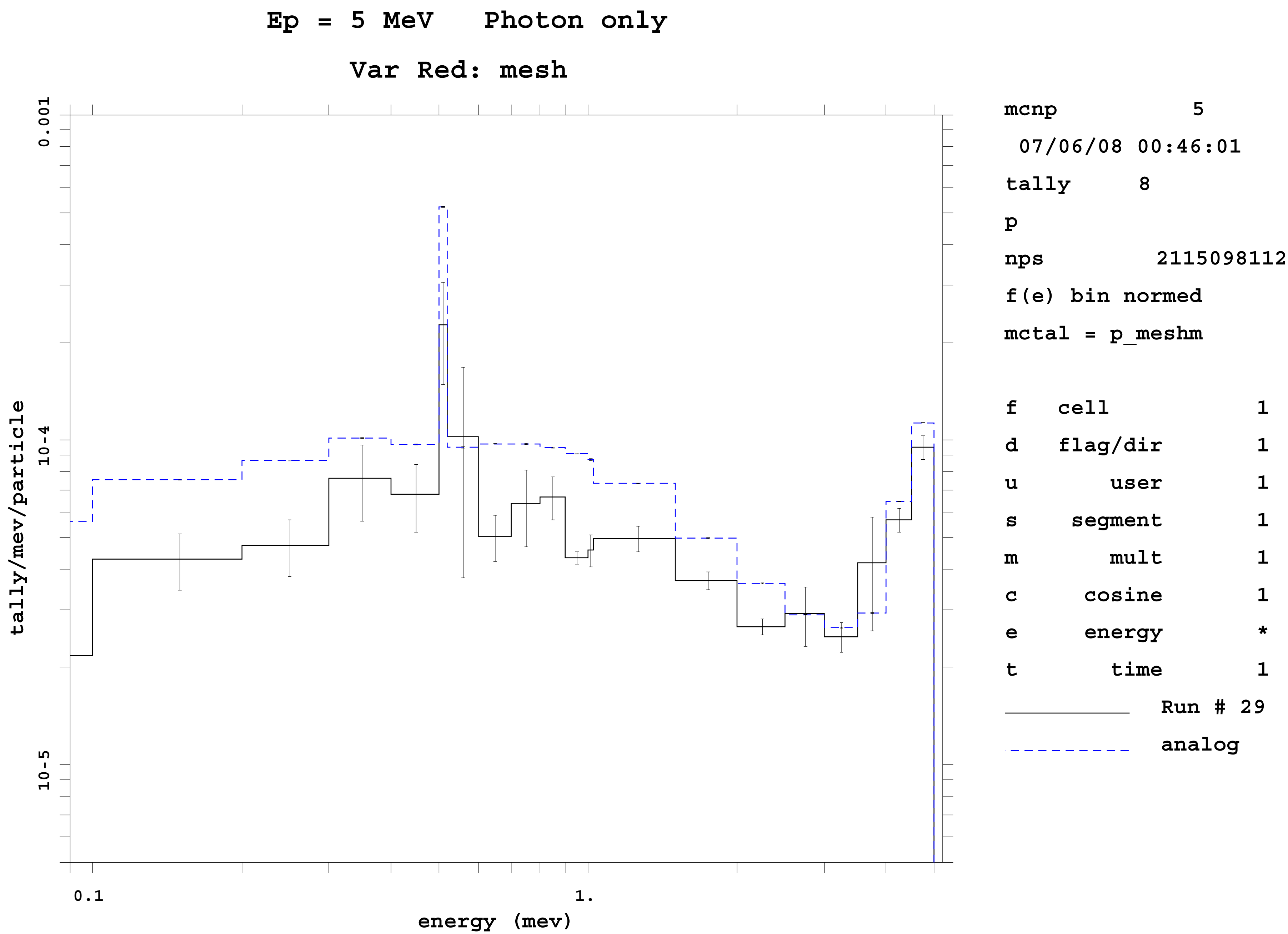


Ep = 5 MeV Photon only
Var Red: mesh ext fcl wgt cutoff
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/09/08 14:47:04
tally 8
p
nps 2115098112
f(e) bin normed
mctal = p_mesh_ext_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 25
analog

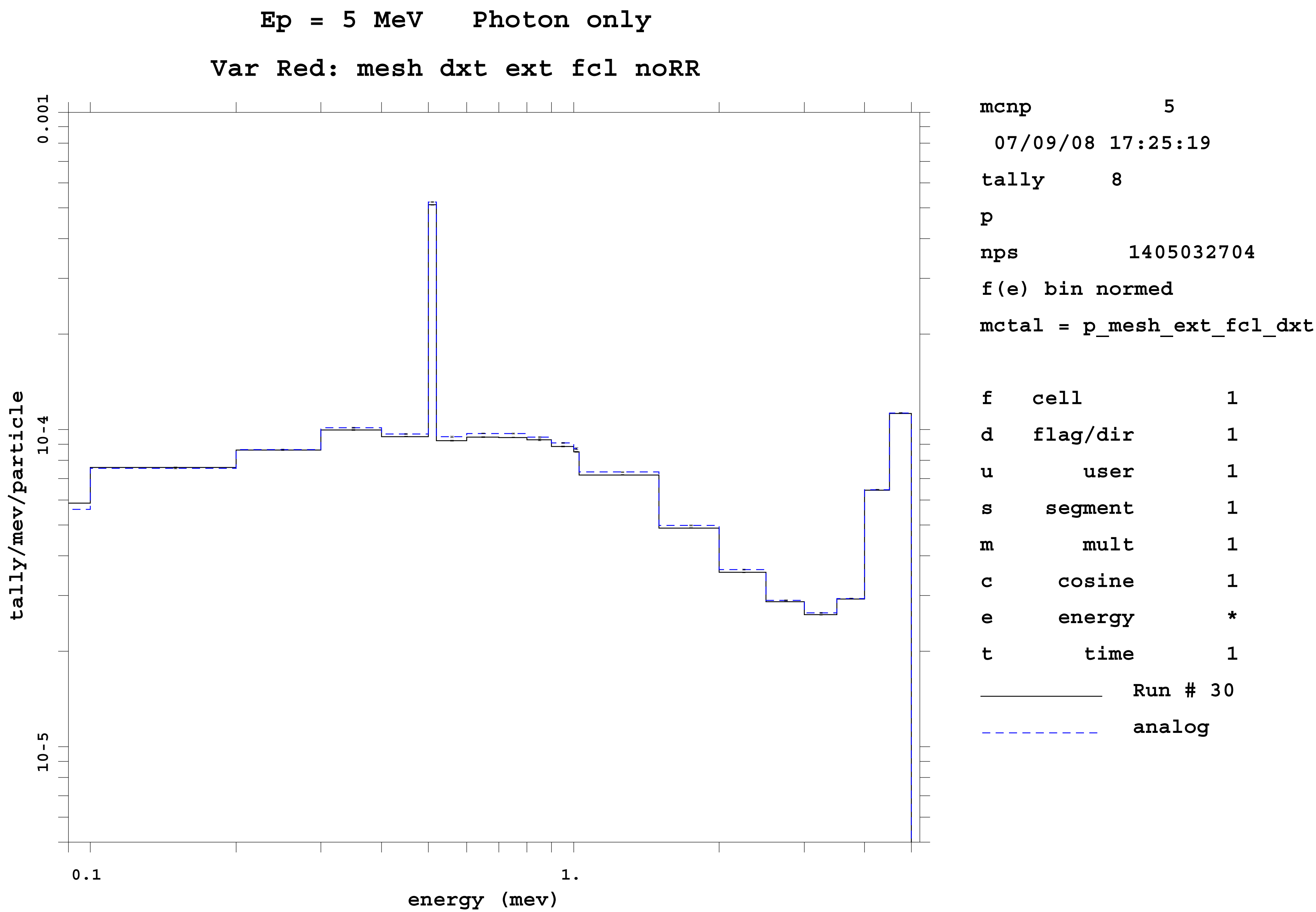

Ep = 5 MeV Photon only
Var Red: imp ext fcl src bias wgt cutoff
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/14/08 14:32:14
tally 8
p
nps 1405032704
f(e) bin normed
mctal = p_sb_imp_ext_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 26
analog

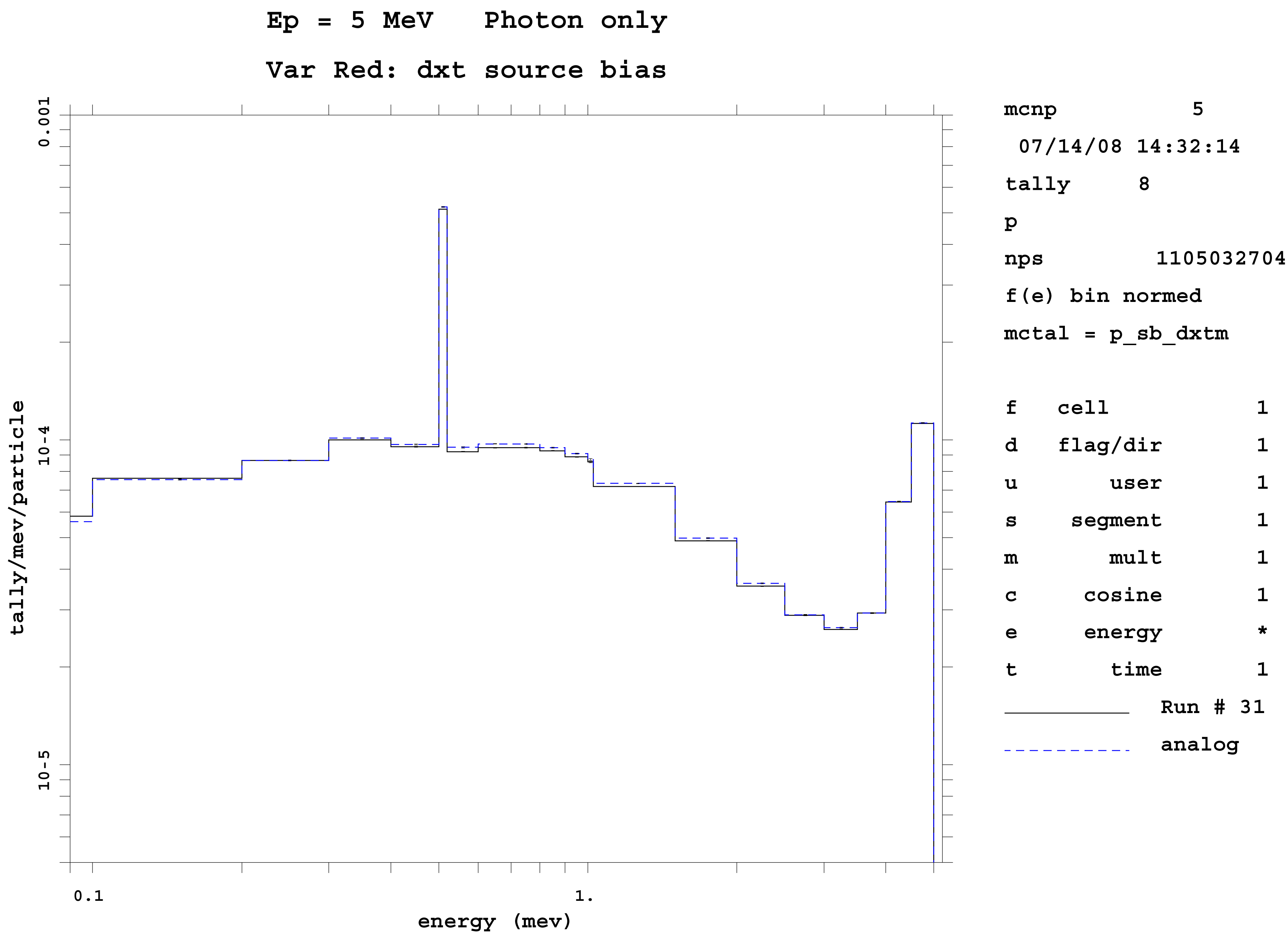

Ep = 5 MeV Photon only
Var Red: cell dxt ext fcl wgt cutoff
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 08:04:56
tally 8
p
nps ********
f(e) bin normed
mctal = p_ww_cell_ext_fcl_
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 27
analog


Ep = 5 MeV Photon only
Var Red: cell dxt ext fcl noRR
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 08:04:58
tally 8
p
nps ********
f(e) bin normed
mctal = p_ww_cell_ext_fcl_
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 28
analog

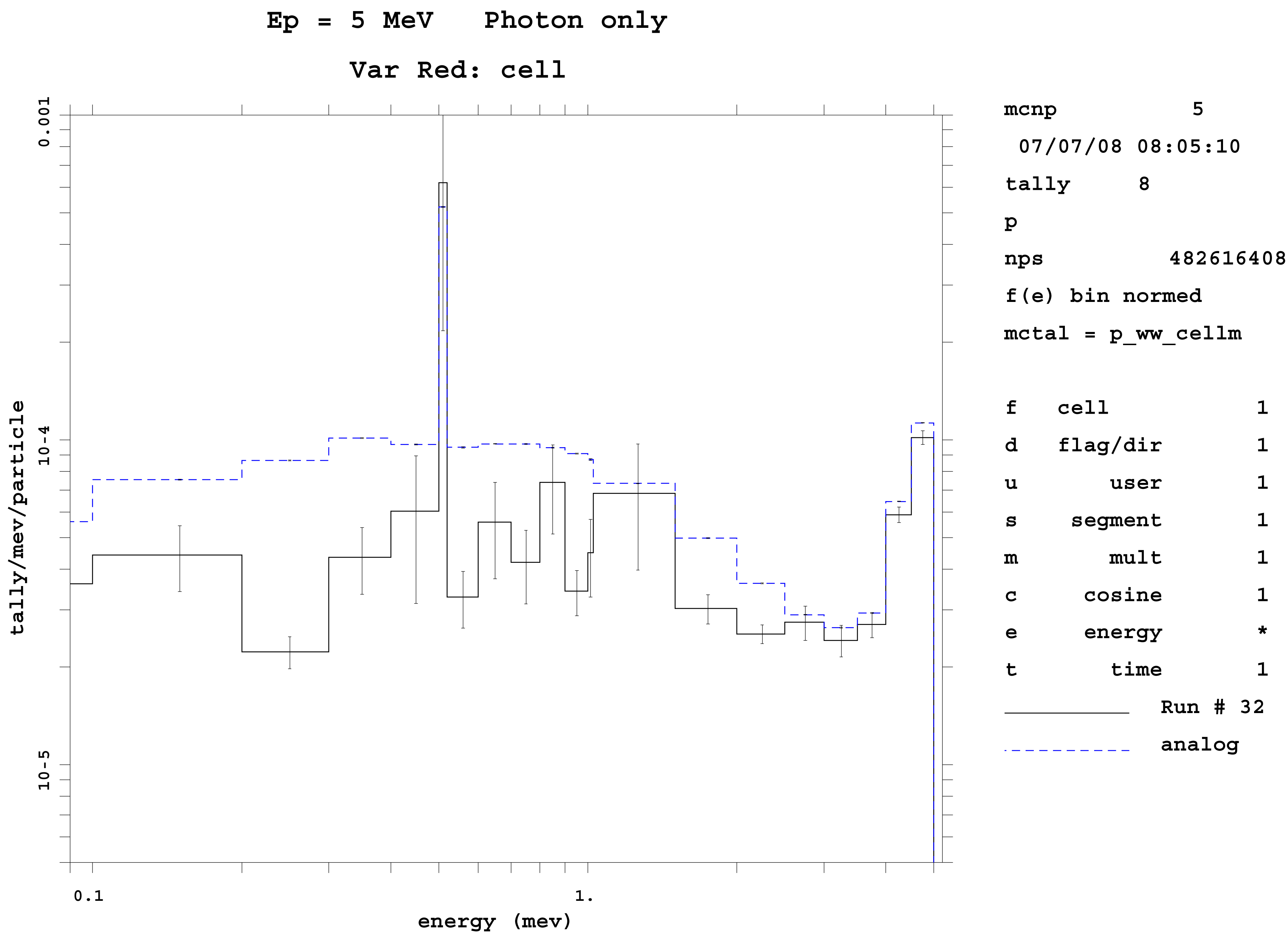


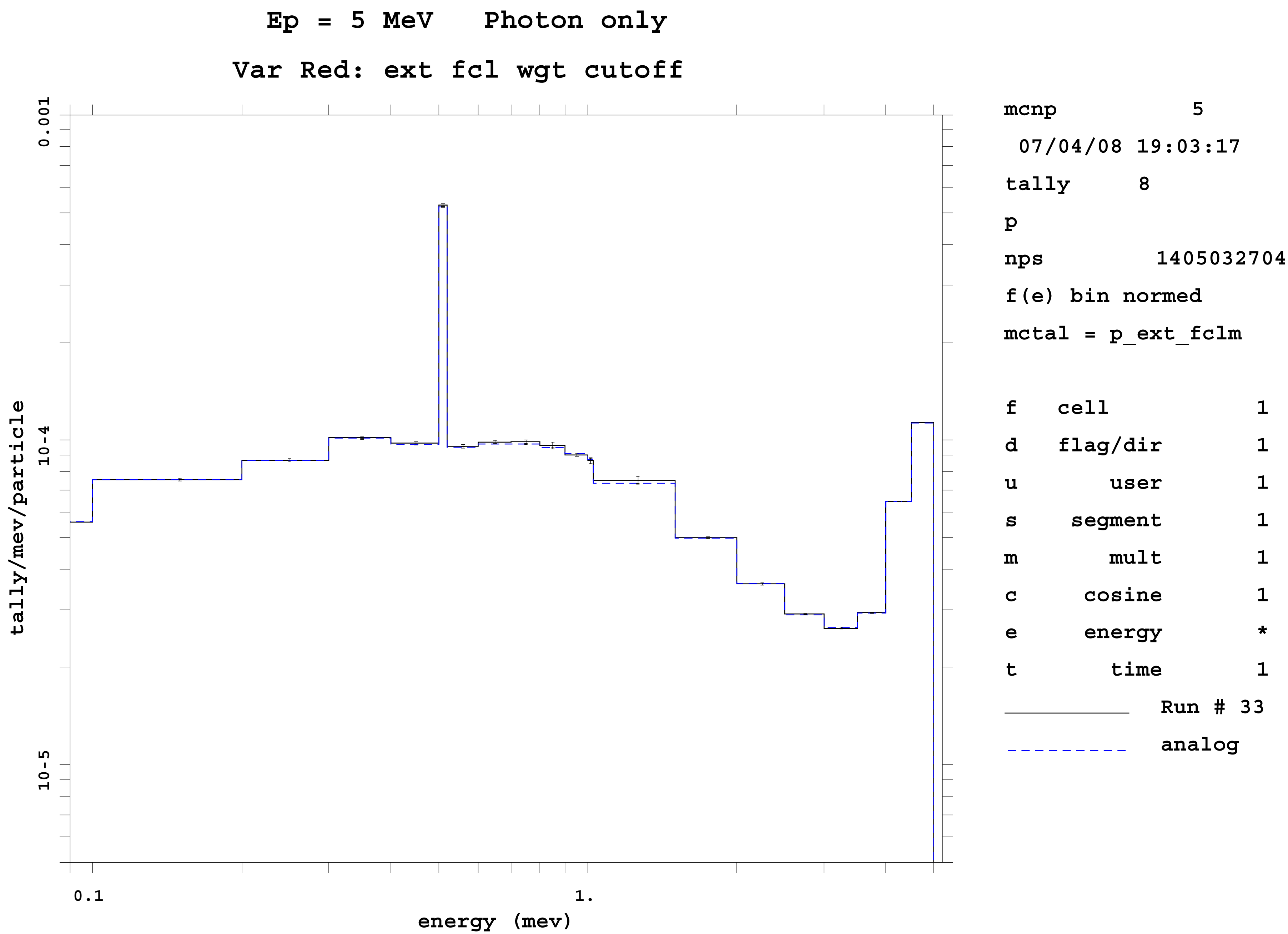
Ep = 5 MeV Photon only
Var Red: mesh
tally/mev/particle
0.001
10-4
10-5
0.1
1.
energy (mev)
mcnp 5
07/06/08 00:46:01
tally 8
p
nps 2115098112
f(e) bin normed
mctal = p_meshm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 29
analog

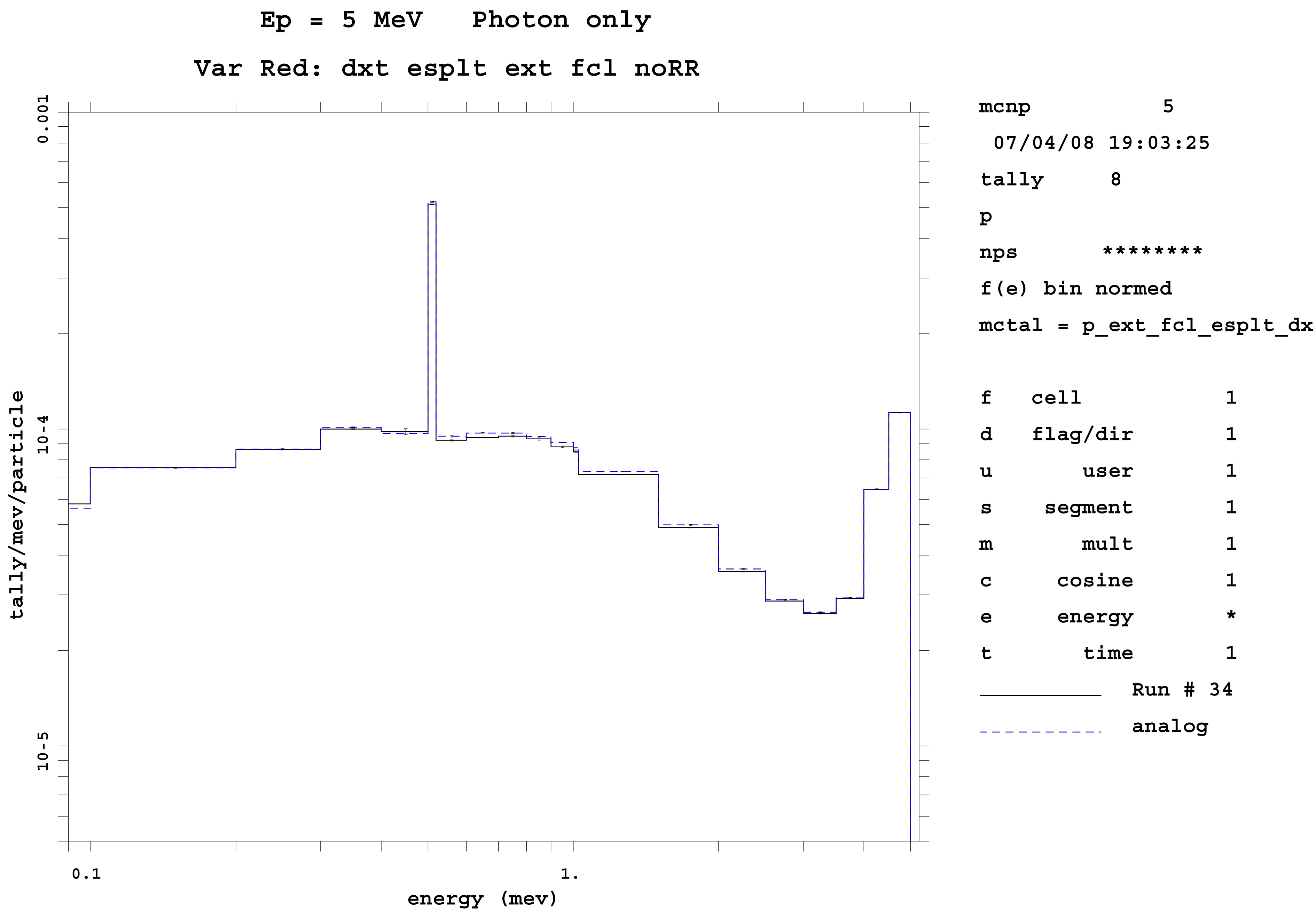

Ep = 5 MeV Photon only
Var Red: mesh dxt ext fcl noRR
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/09/08 17:25:19
tally 8
p
nps 1405032704
f(e) bin normed
mctal = p_mesh_ext_fcl_dxt
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 30
analog



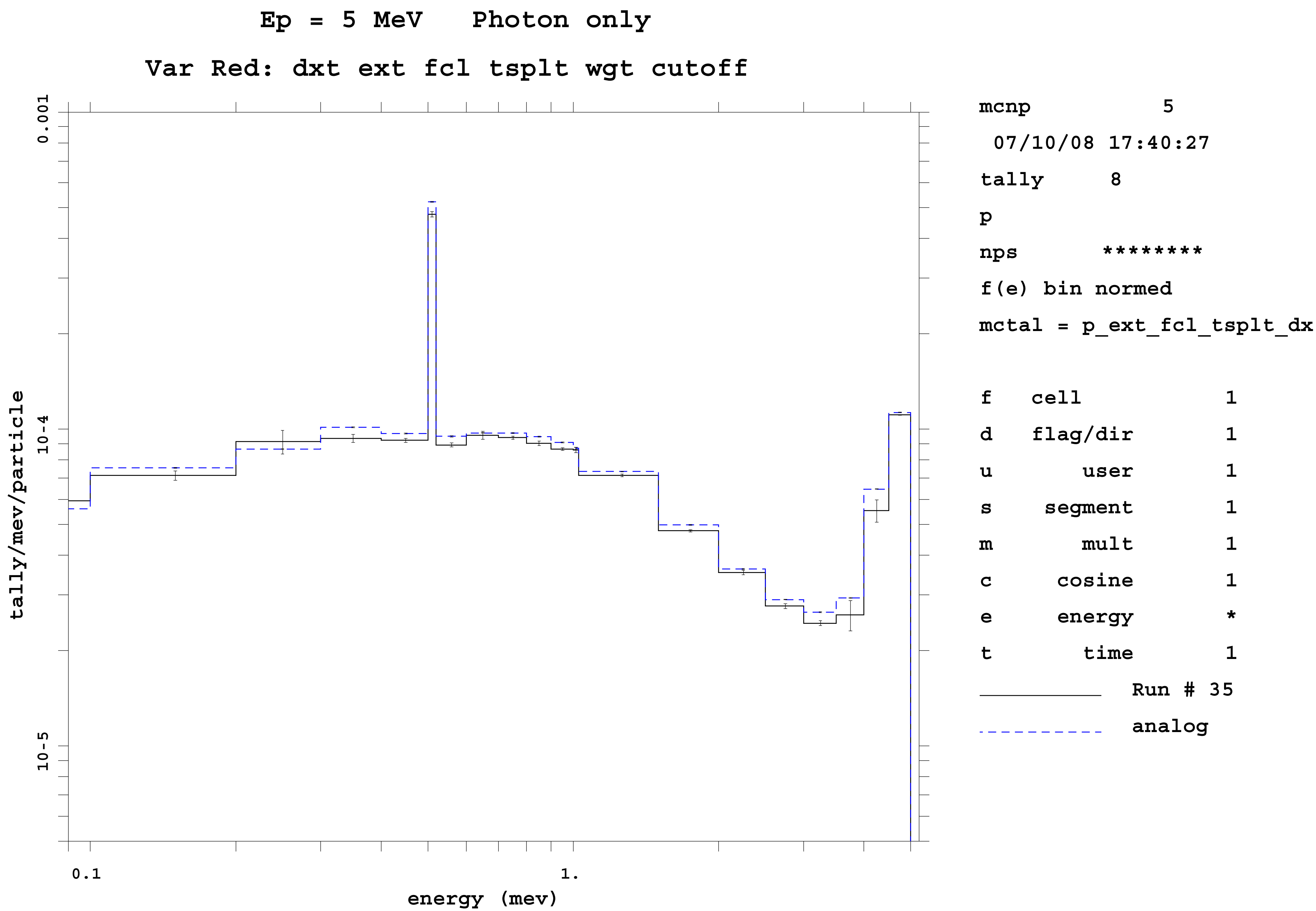
Ep = 5 MeV Photon only
Var Red: dxt source bias
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/14/08 14:32:14
tally 8
p
nps 1105032704
f(e) bin normed
mctal = p_sb_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 31
analog


Ep = 5 MeV Photon only
Var Red: cell
tally/mev/particle
0.001
10-4
10-5
0.1
1.
energy (mev)
mcnp 5
07/07/08 08:05:10
tally 8
p
nps 482616408
f(e) bin normed
mctal = p_ww_cellm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 32
analog

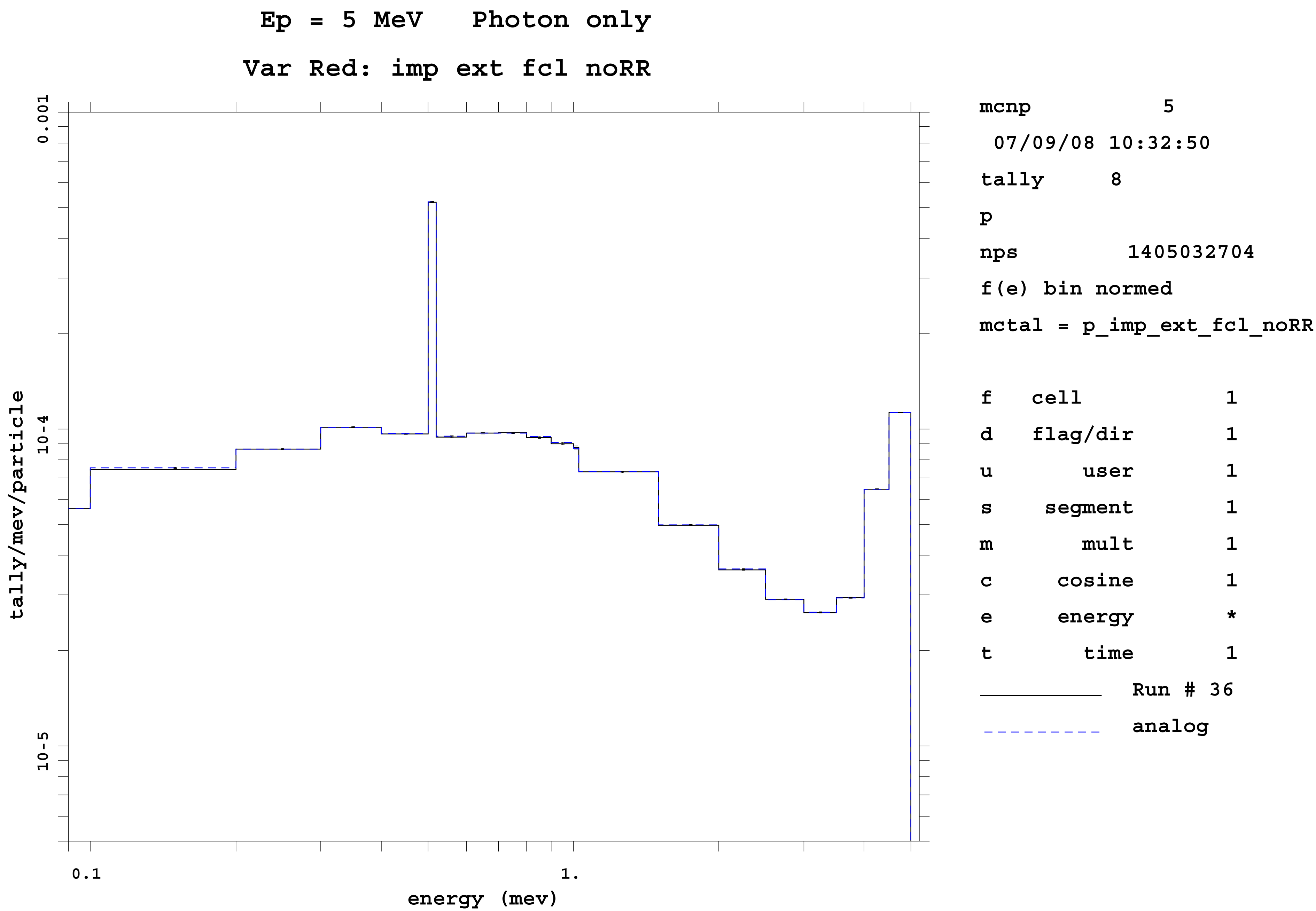

Ep = 5 MeV Photon only
Var Red: ext fcl wgt cutoff
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/04/08 19:03:17
tally 8
p
nps 1405032704
f(e) bin normed
mctal = p_ext_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 33
analog

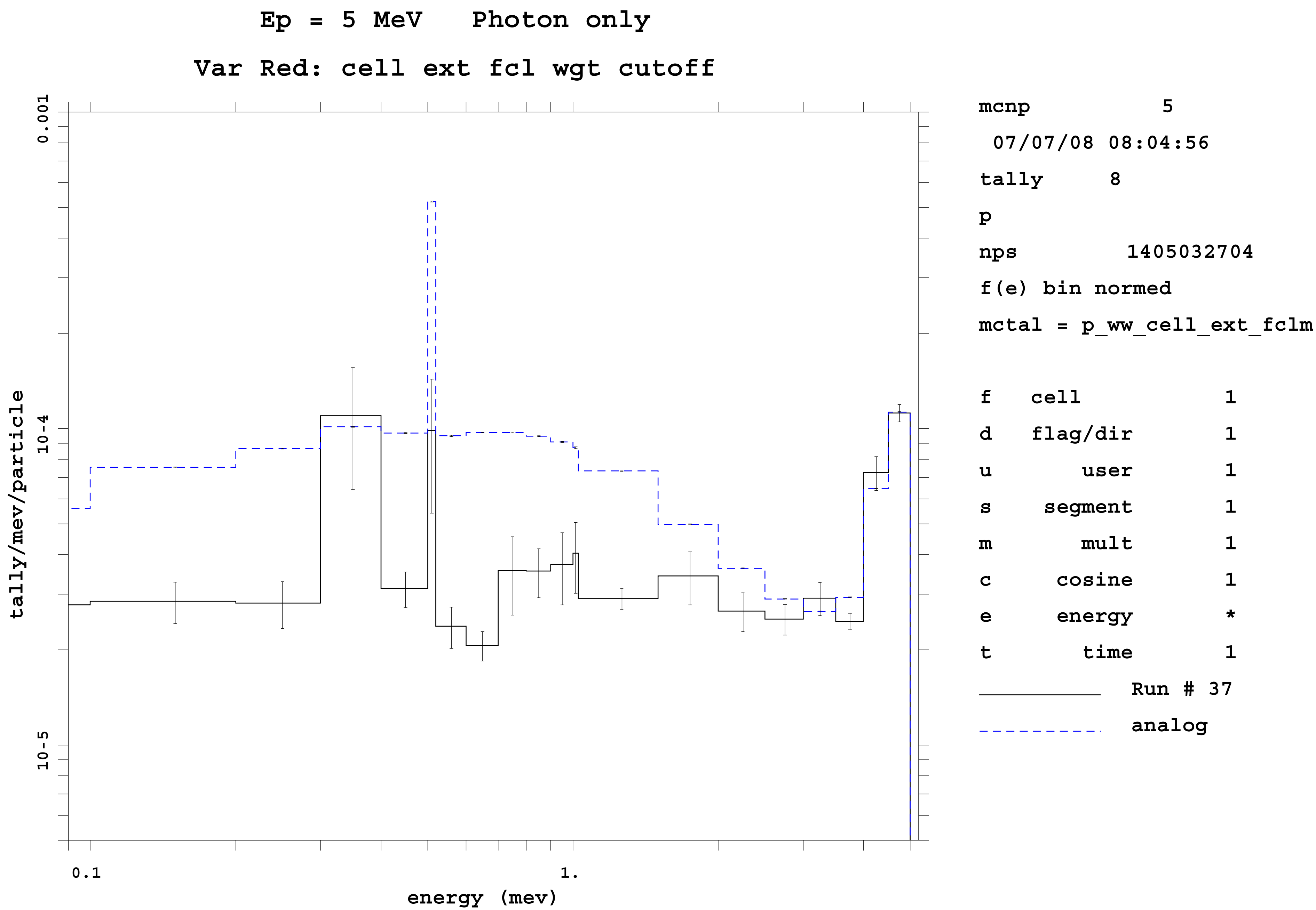


Ep = 5 MeV Photon only
Var Red: dxt esplt ext fcl noRR
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/04/08 19:03:25
tally 8
p
nps ********
f(e) bin normed
mctal = p_ext_fcl_esplt_dx
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 34
analog

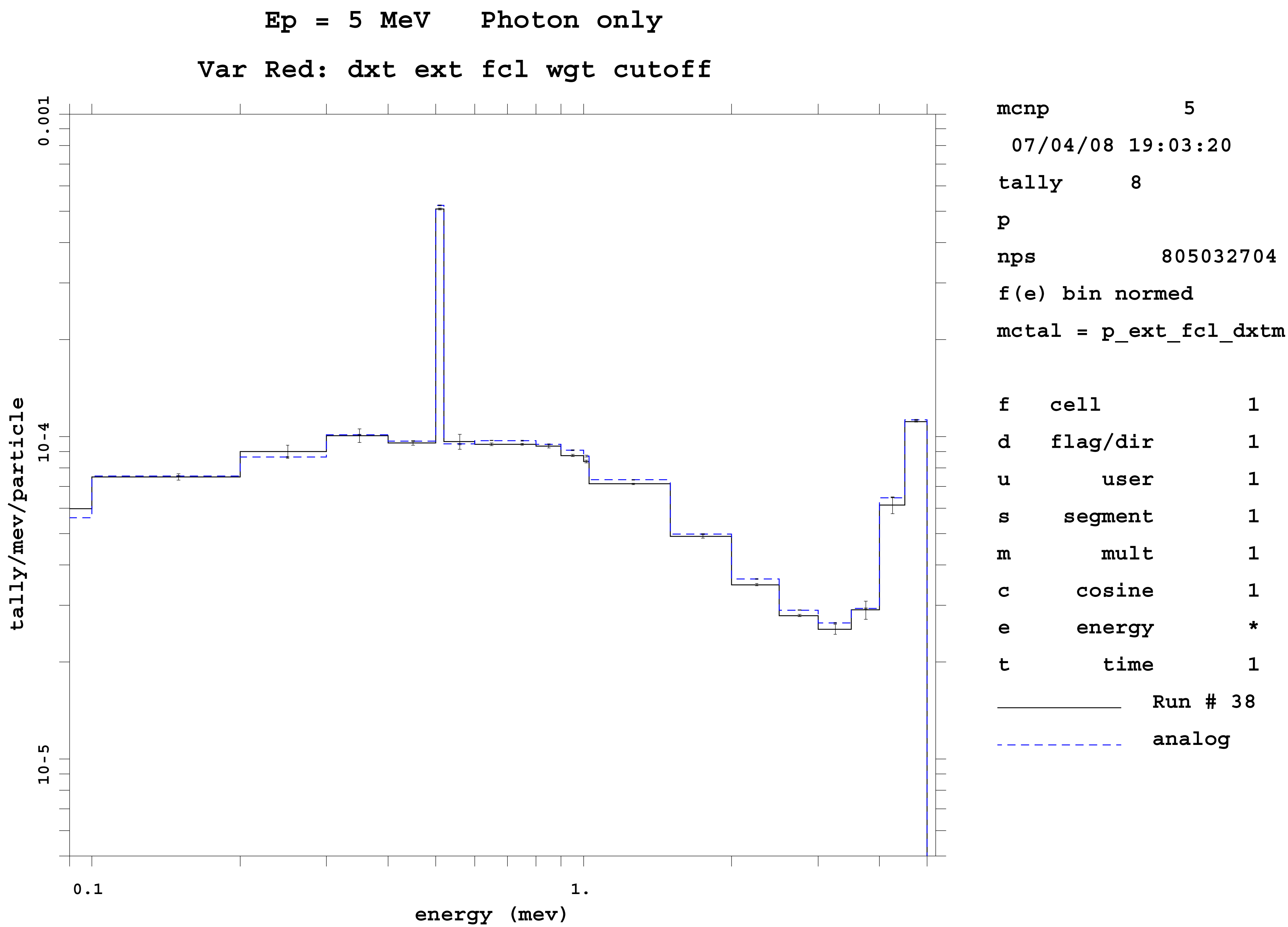


Ep = 5 MeV Photon only
Var Red: dxt ext fcl tsplt wgt cutoff
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/10/08 17:40:27
tally 8
p
nps ********
f(e) bin normed
mctal = p_ext_fcl_tsplt_dx
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 35
analog

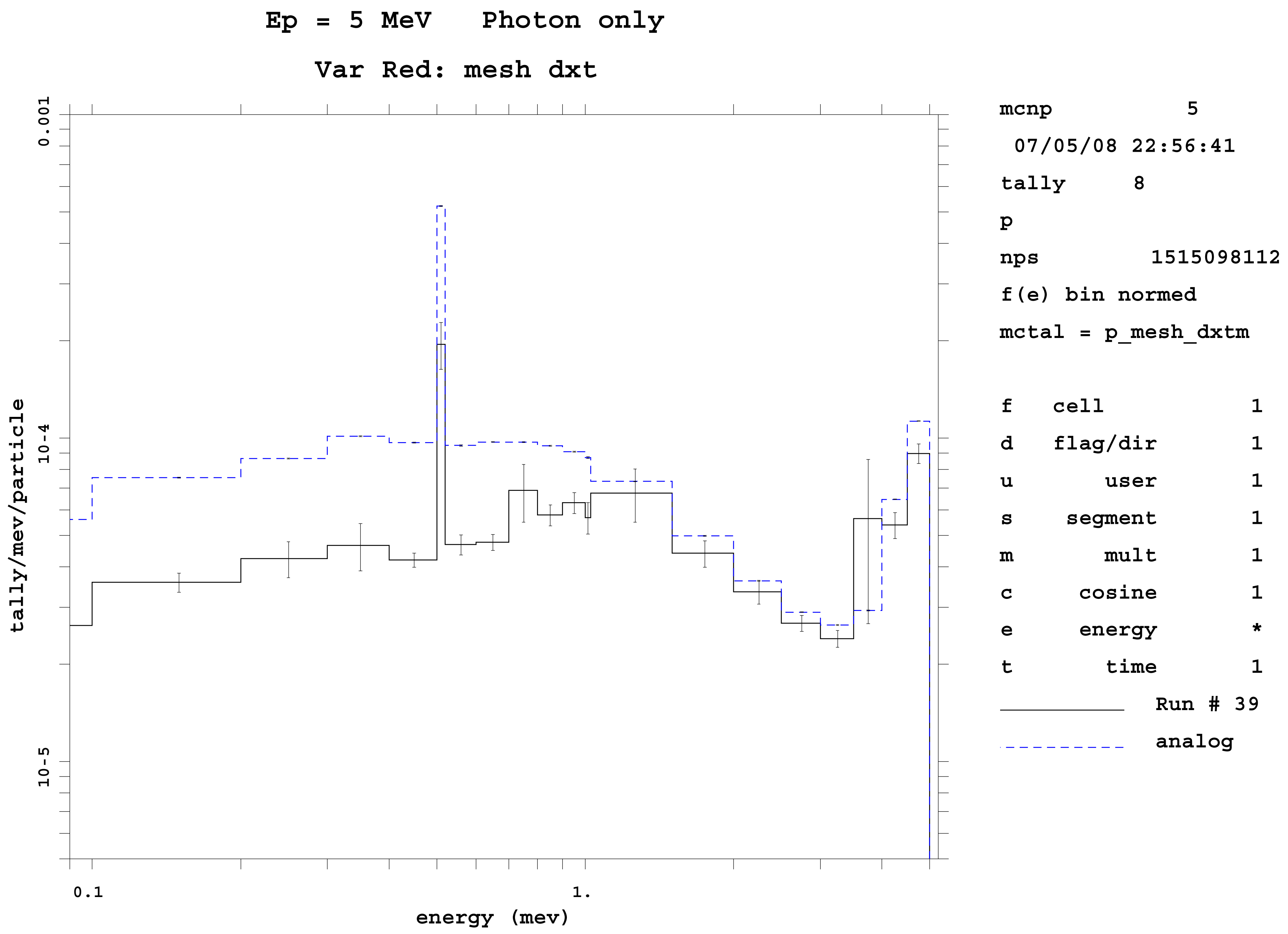

Ep = 5 MeV   Photon only
Var Red: imp ext fcl noRR
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/09/08 10:32:50
tally 8
p
nps 1405032704
f(e) bin normed
mctal = p_imp_ext_fcl_noRR
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 36
analog



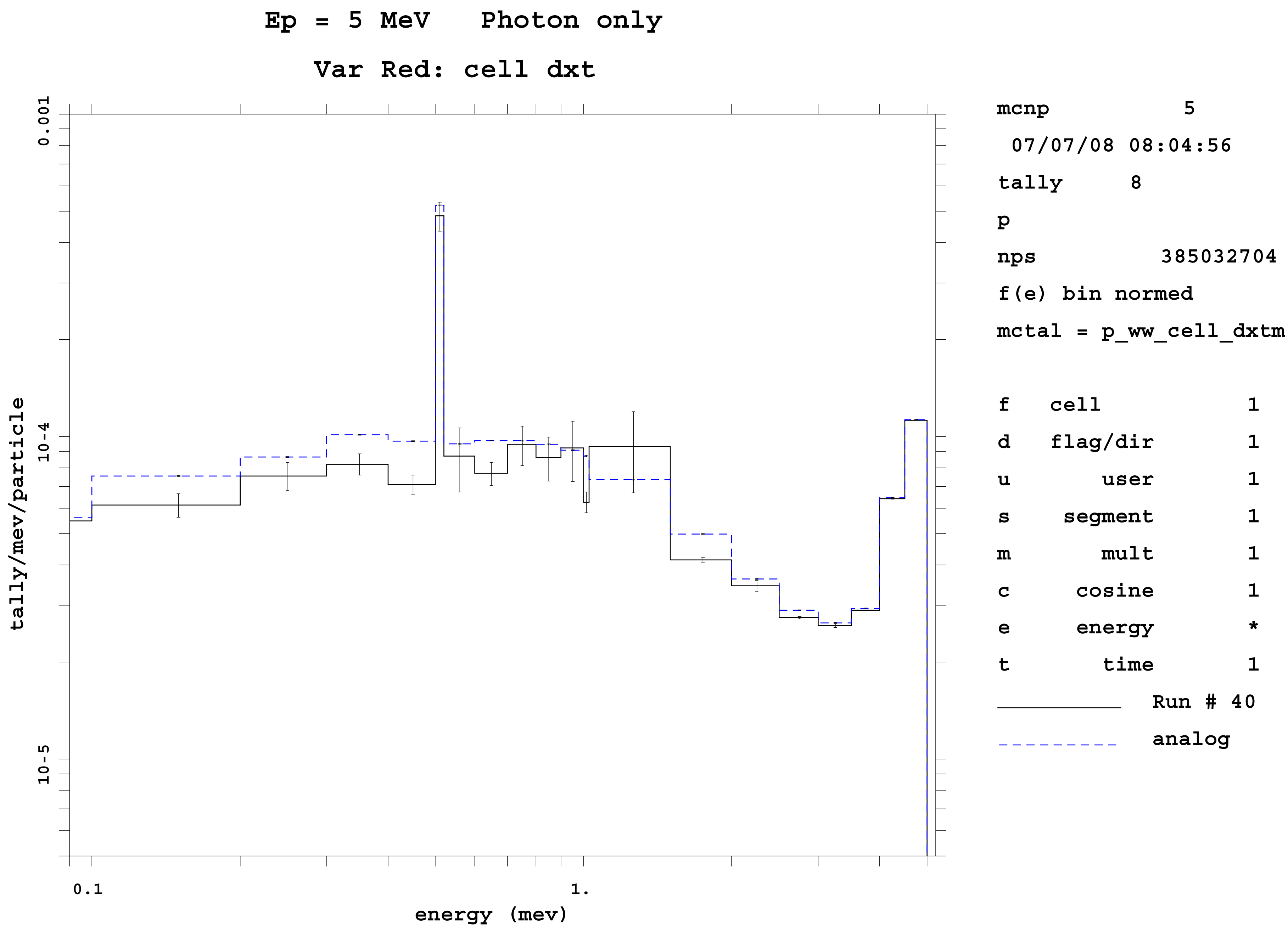
Ep = 5 MeV Photon only
Var Red: cell ext fcl wgt cutoff
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 08:04:56
tally 8
p
nps 1405032704
f(e) bin normed
mctal = p_ww_cell_ext_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 37
analog



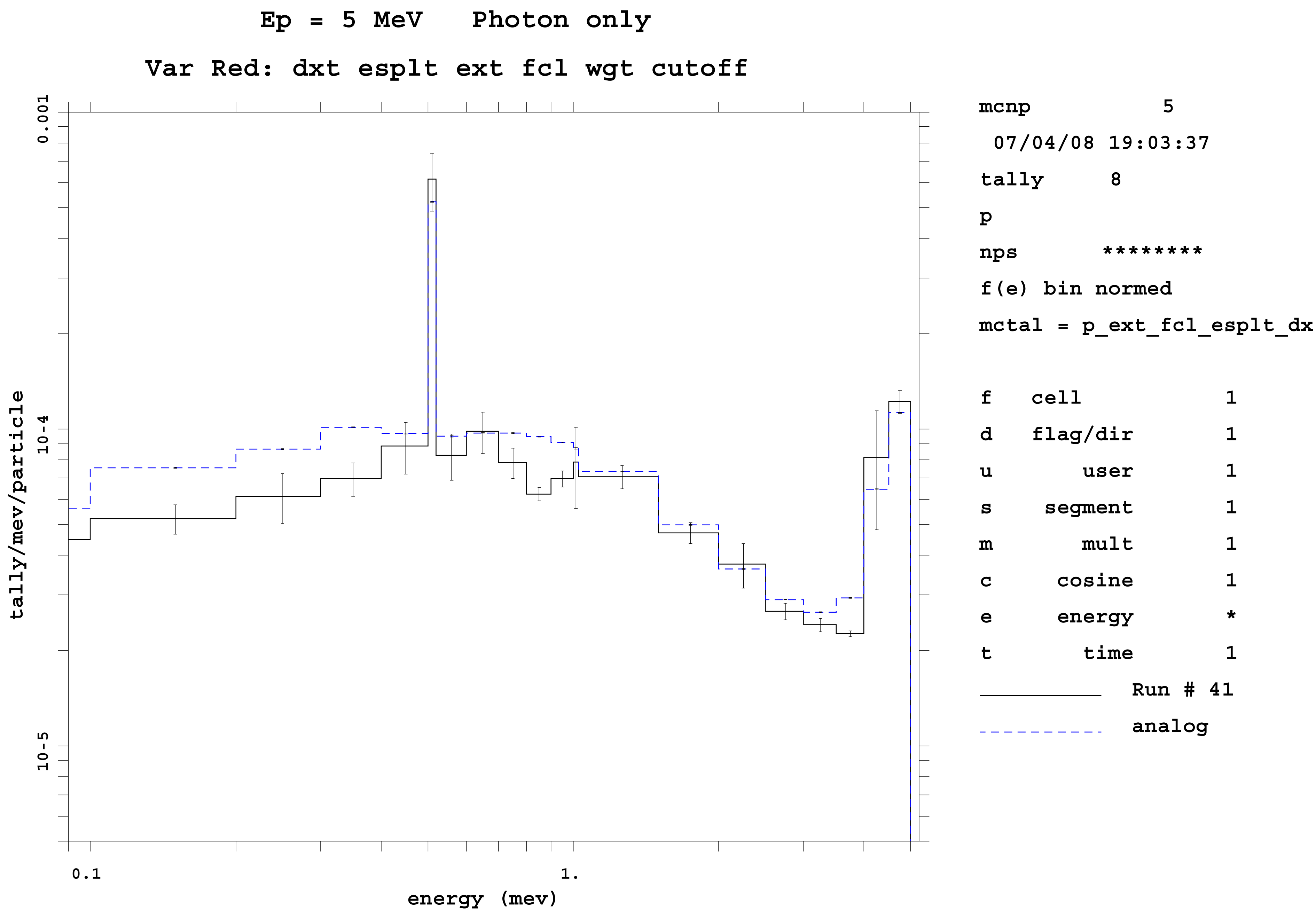
Ep = 5 MeV   Photon only
Var Red: dxt ext fcl wgt cutoff
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/04/08 19:03:20
tally 8
p
nps 805032704
f(e) bin normed
mctal = p_ext_fcl_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 38
analog

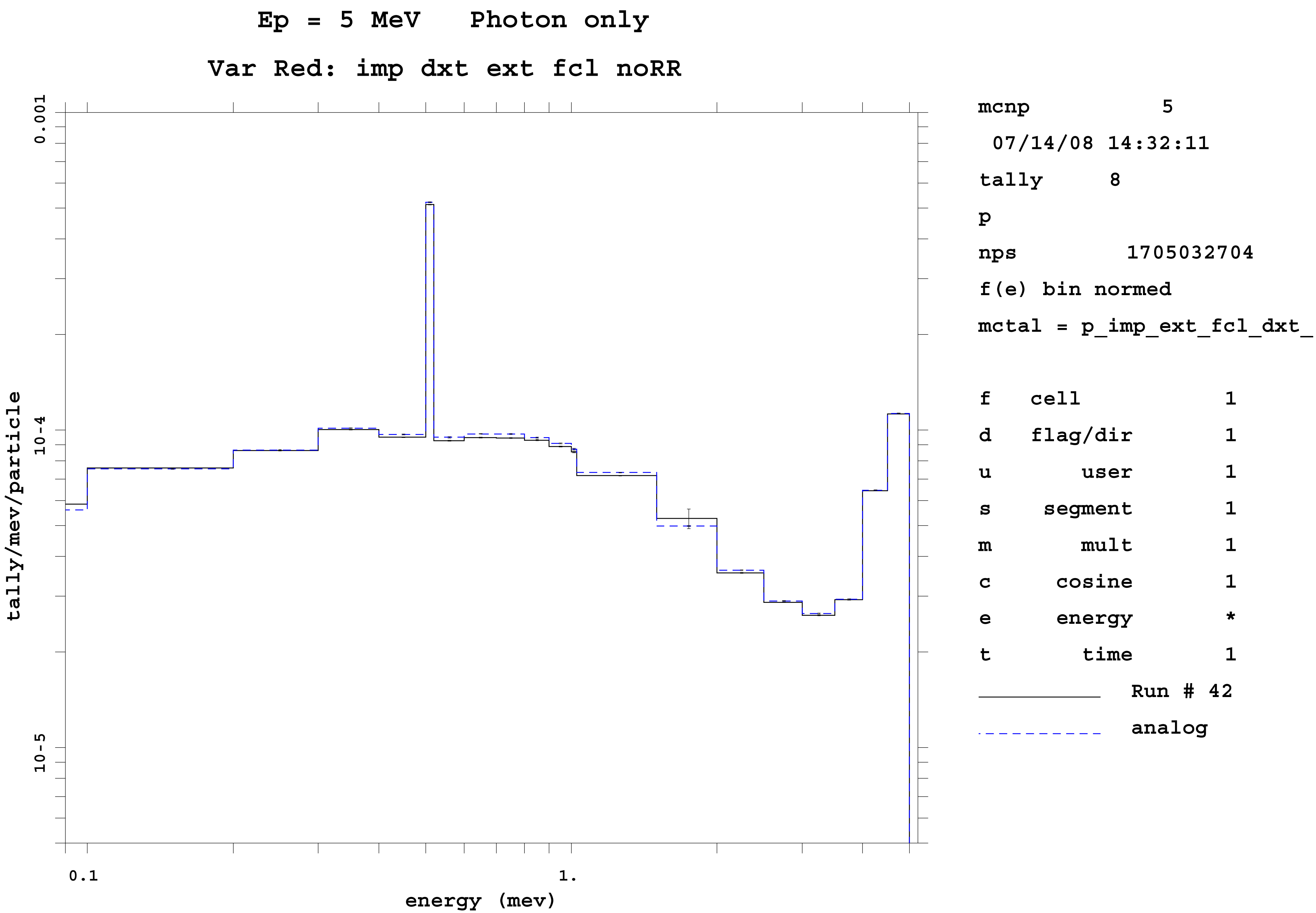


Ep = 5 MeV Photon only
Var Red: mesh dxt
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/05/08 22:56:41
tally 8
p
nps 1515098112
f(e) bin normed
mctal = p_mesh_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 39
analog



Ep = 5 MeV Photon only
Var Red: cell dxt
tally/mev/particle
0.001
10-4
10-5
0.1
1.
energy (mev)
mcnp 5
07/07/08 08:04:56
tally 8
p
nps 385032704
f(e) bin normed
mctal = p_ww_cell_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 40
analog


Ep = 5 MeV   Photon only
Var Red: dxt esplt ext fcl wgt cutoff
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/04/08 19:03:37
tally 8
p
nps ********
f(e) bin normed
mctal = p_ext_fcl_esplt_dx
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 41
analog



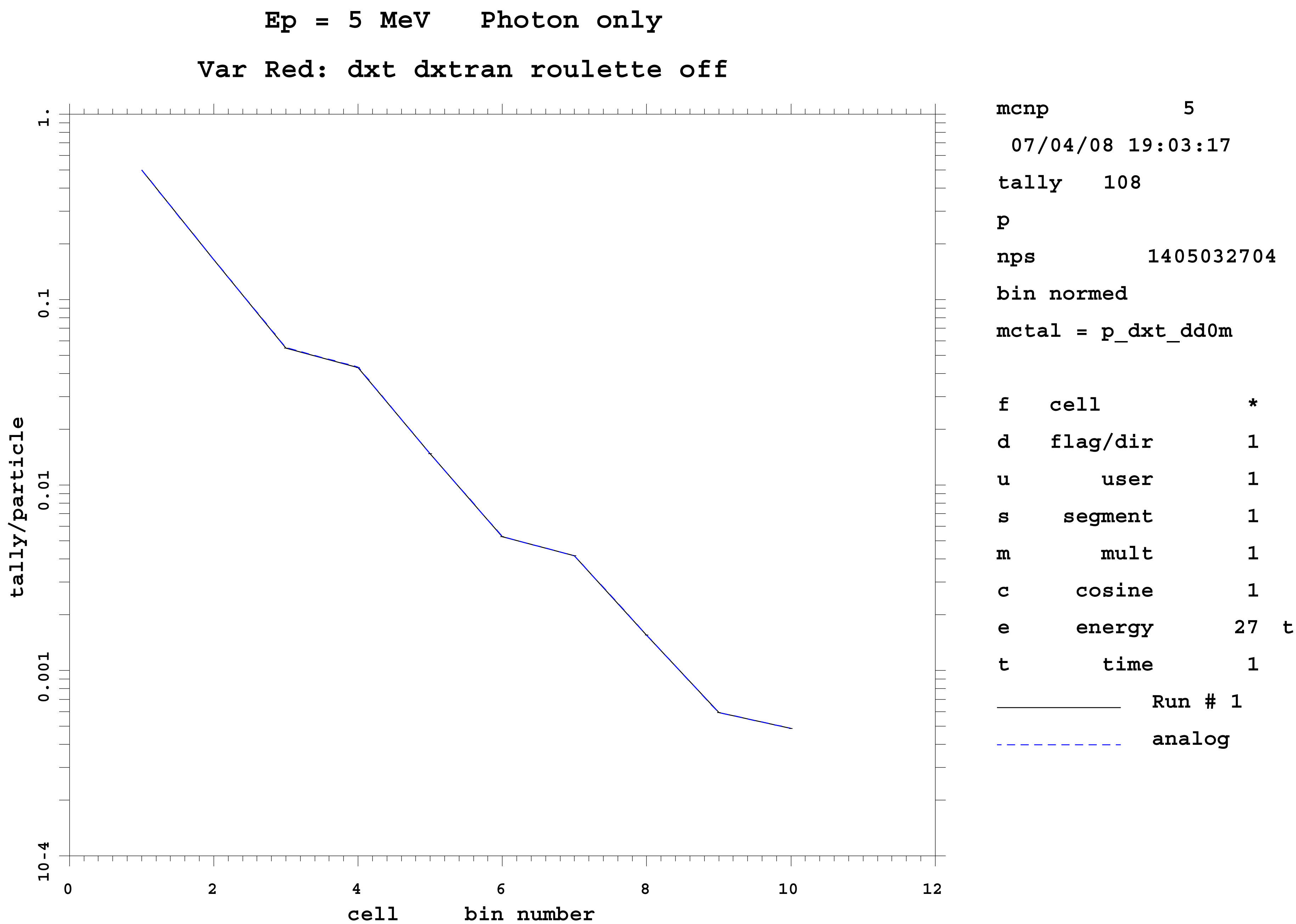
Ep = 5 MeV Photon only
Var Red: imp dxt ext fcl noRR
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/14/08 14:32:11
tally 8
p
nps 1705032704
f(e) bin normed
mctal = p_imp_ext_fcl_dxt_
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 42
analog

Appendix A.1.iii

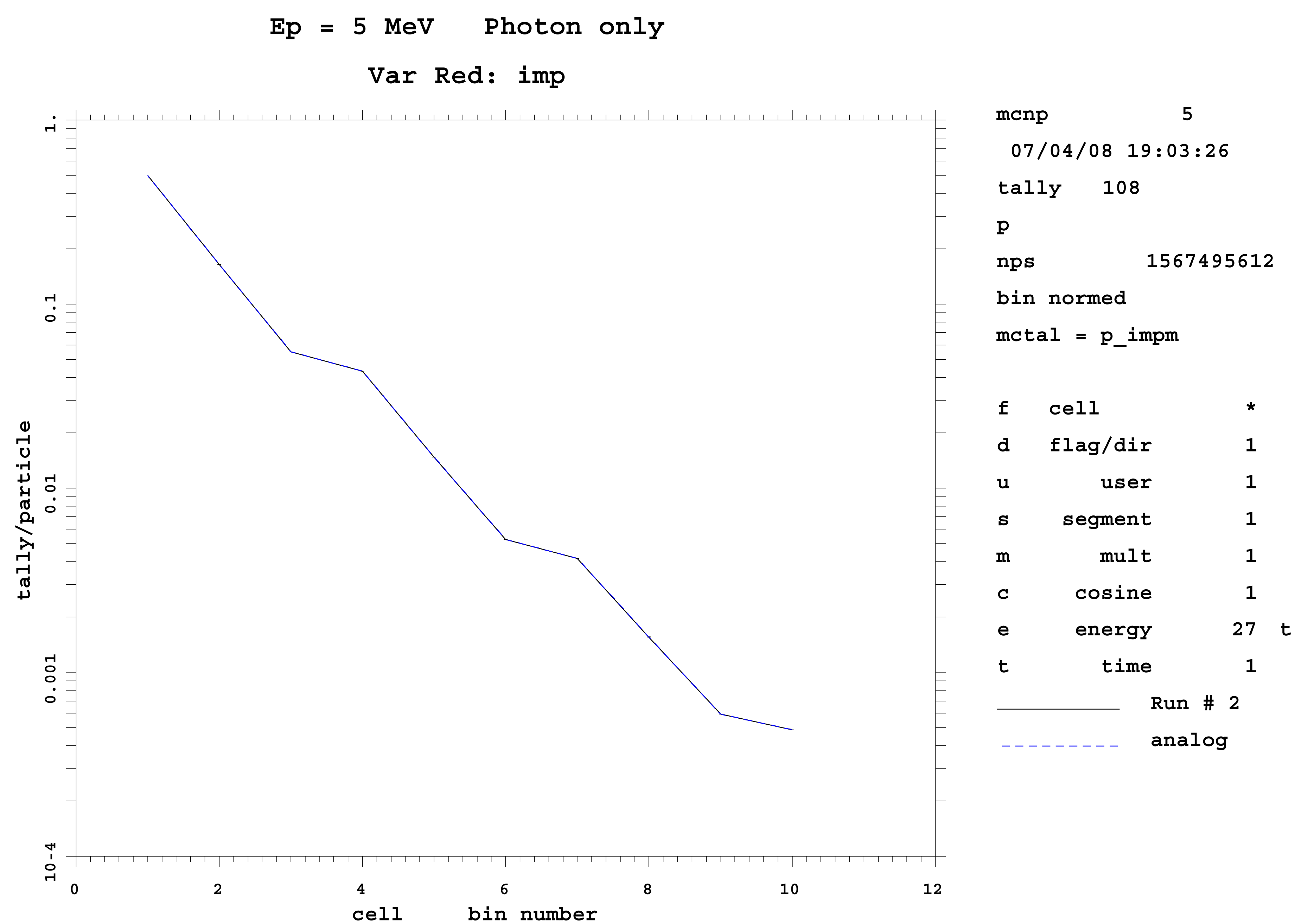
Problem 1
Ge sphere Next To a U / O Stacked Cylinder Problem

Plots of the total pulses in the sections of the cylinder

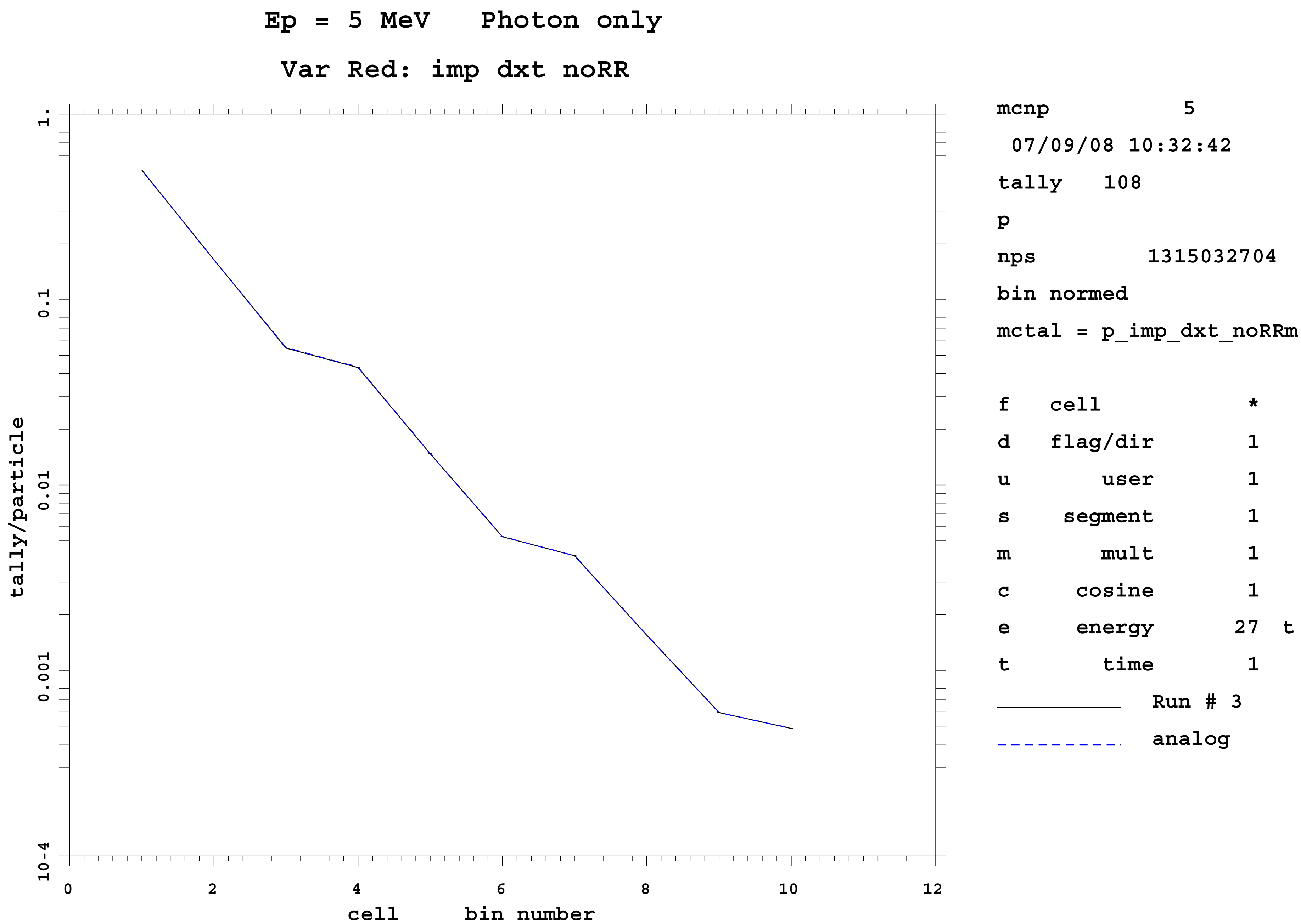
Plots are in order of the run number listed in Table 2. The variance reduction methods used are listed in the plot title; the graph label contains the run number.



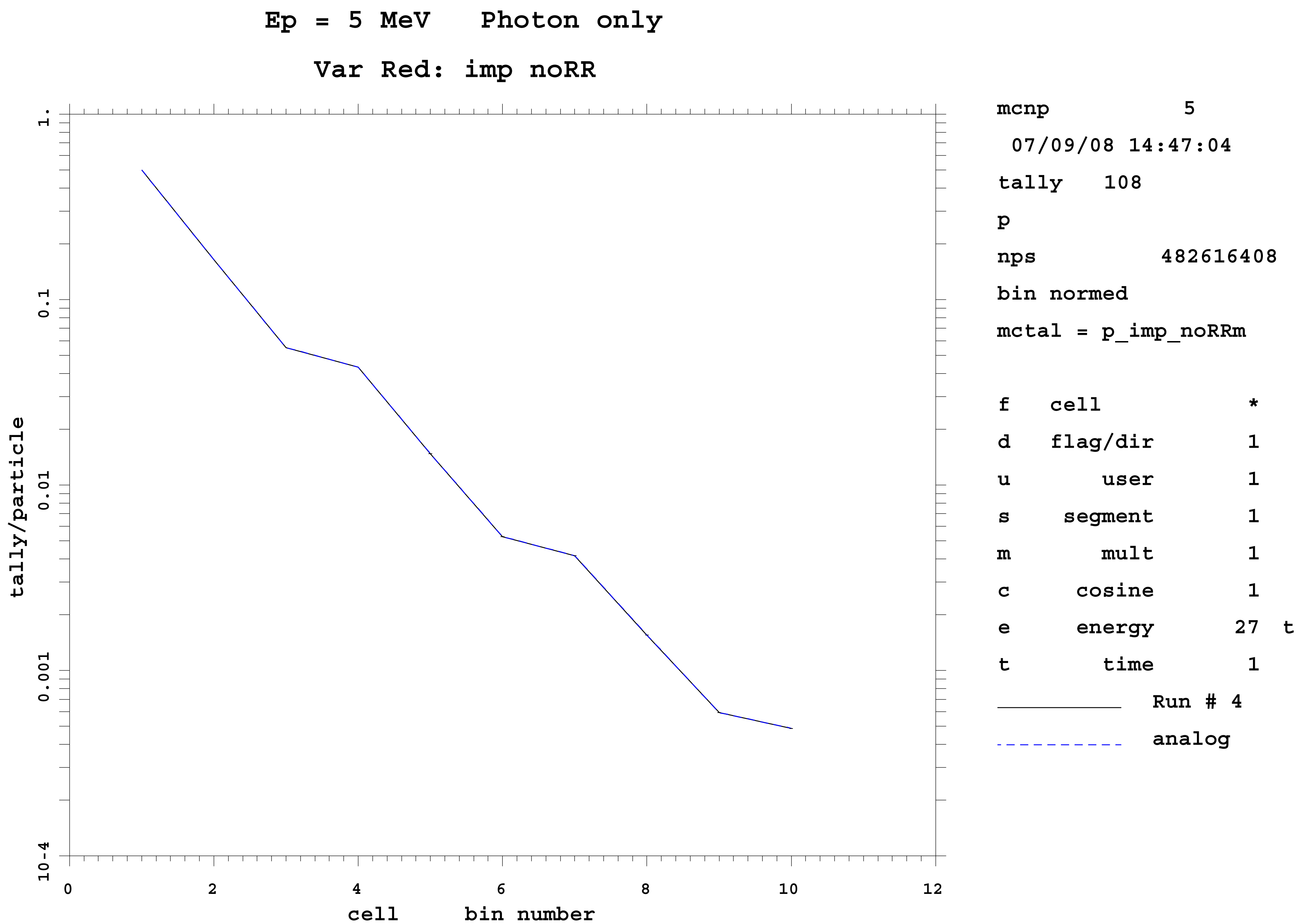
Ep = 5 MeV Photon only
Var Red: dxt dxtran roulette off
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/04/08 19:03:17
tally 108
p
nps 1405032704
bin normed
mctal = p_dxt_dd0m
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 1
analog



Ep = 5 MeV   Photon only
Var Red: imp
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell   bin number
mcnp 5
07/04/08 19:03:26
tally 108
p
nps 1567495612
bin normed
mctal = p_impm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 2
analog



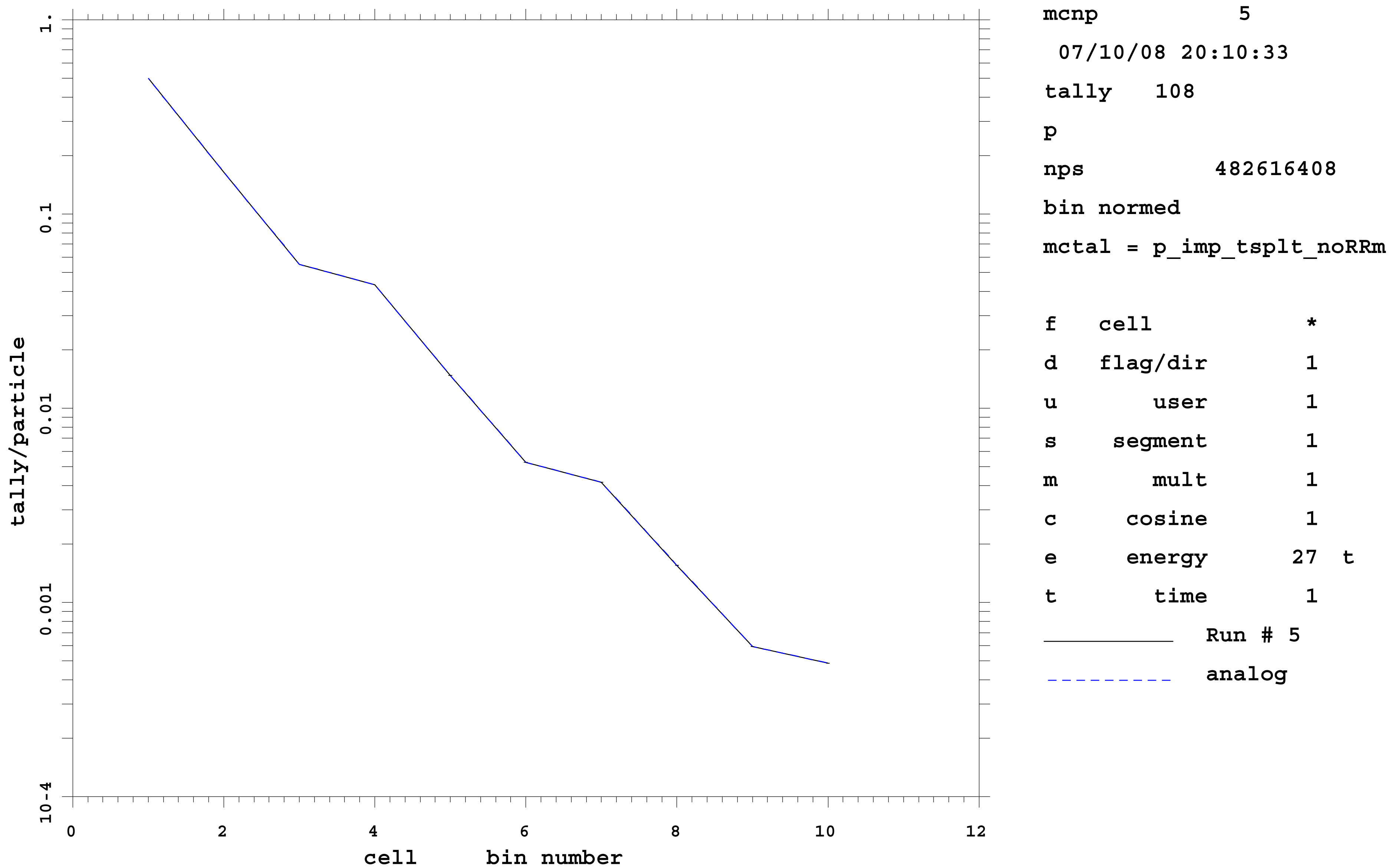
Ep = 5 MeV Photon only
Var Red: imp dxt noRR
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/09/08 10:32:42
tally 108
p
nps 1315032704
bin normed
mctal = p_imp_dxt_noRRm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 3
analog

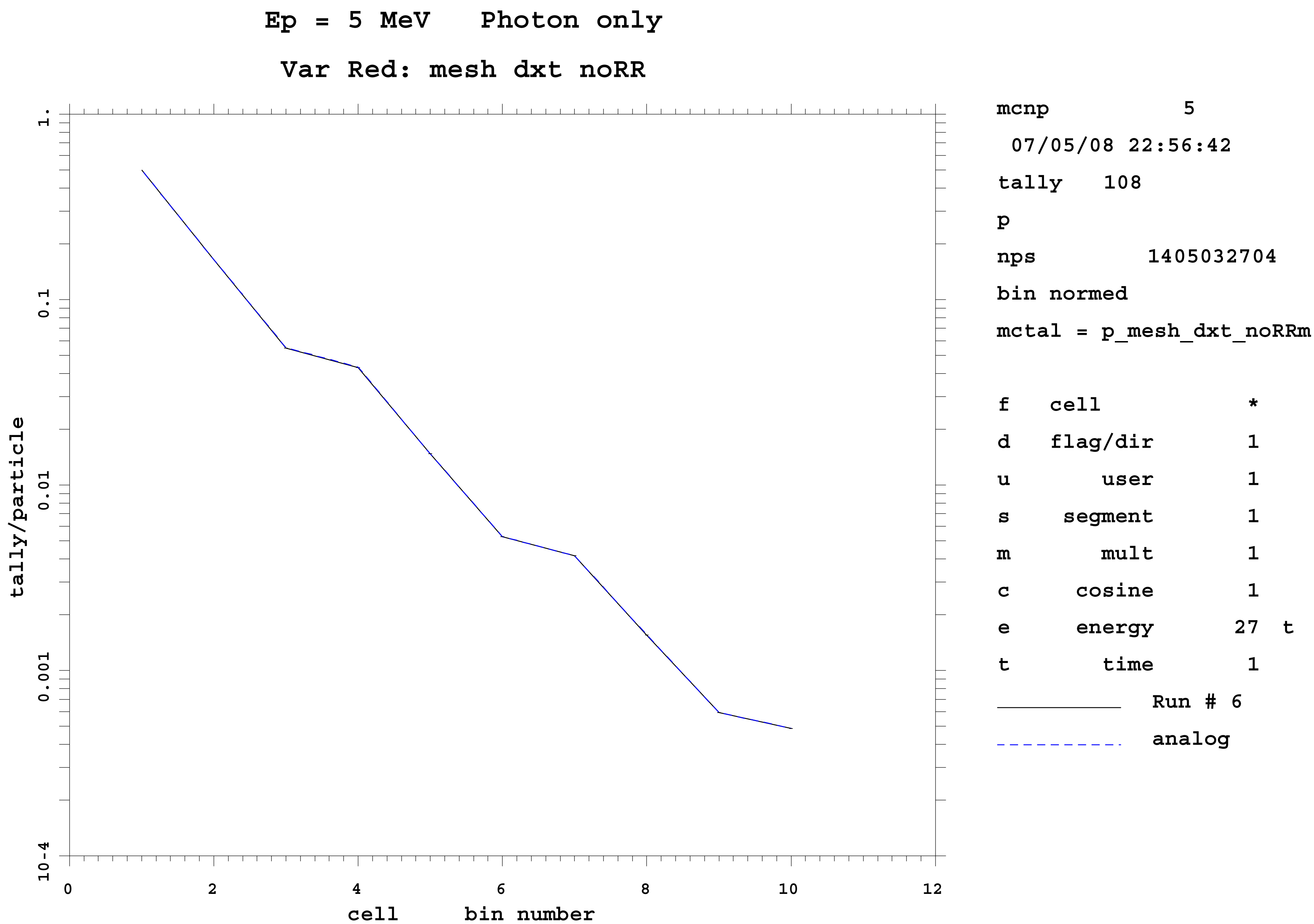


Ep = 5 MeV Photon only
Var Red: imp noRR
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/09/08 14:47:04
tally 108
p
nps 482616408
bin normed
mctal = p_imp_noRRm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 4
analog

Ep = 5 MeV Photon only

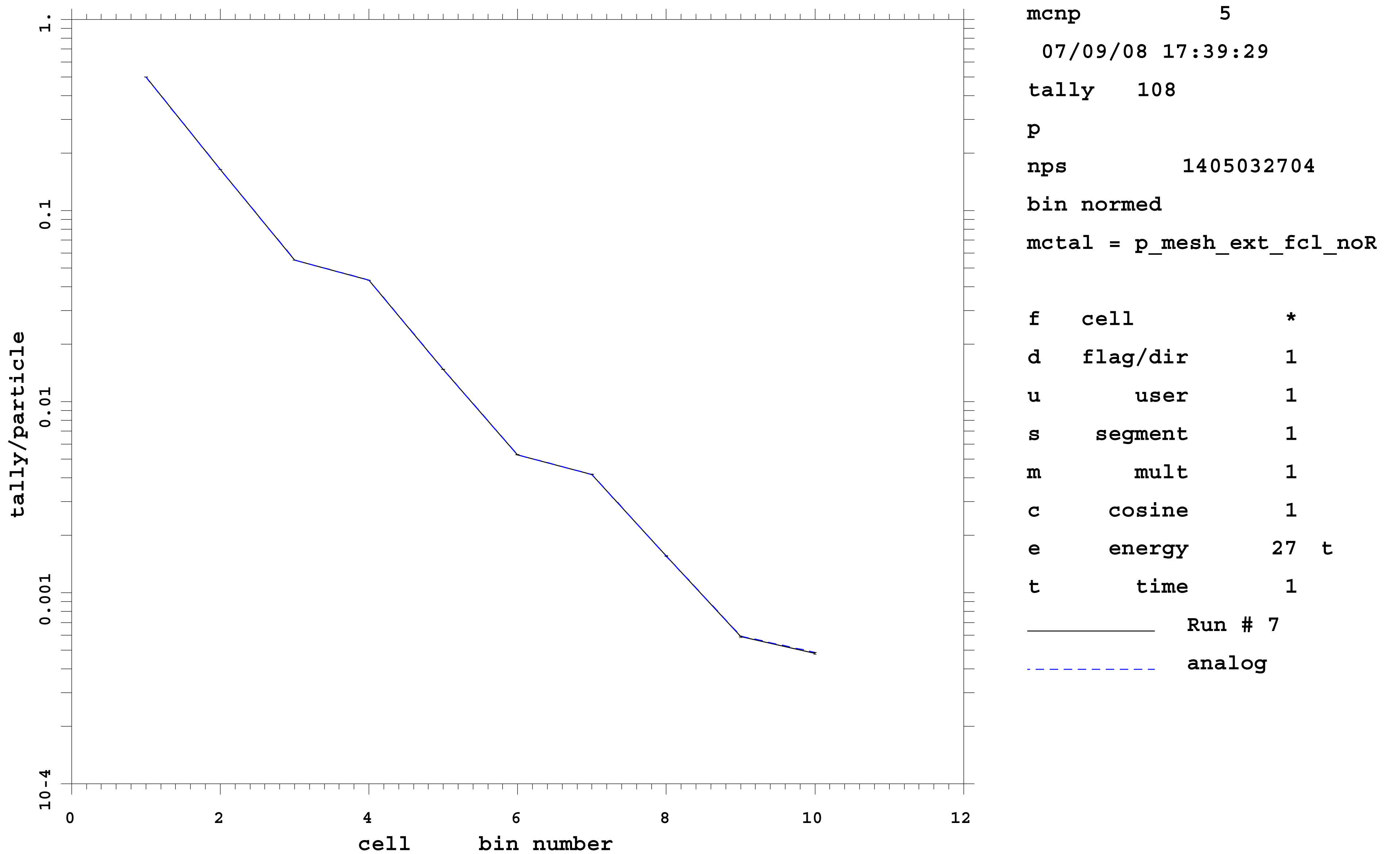
Var Red: imp tsplt noRR

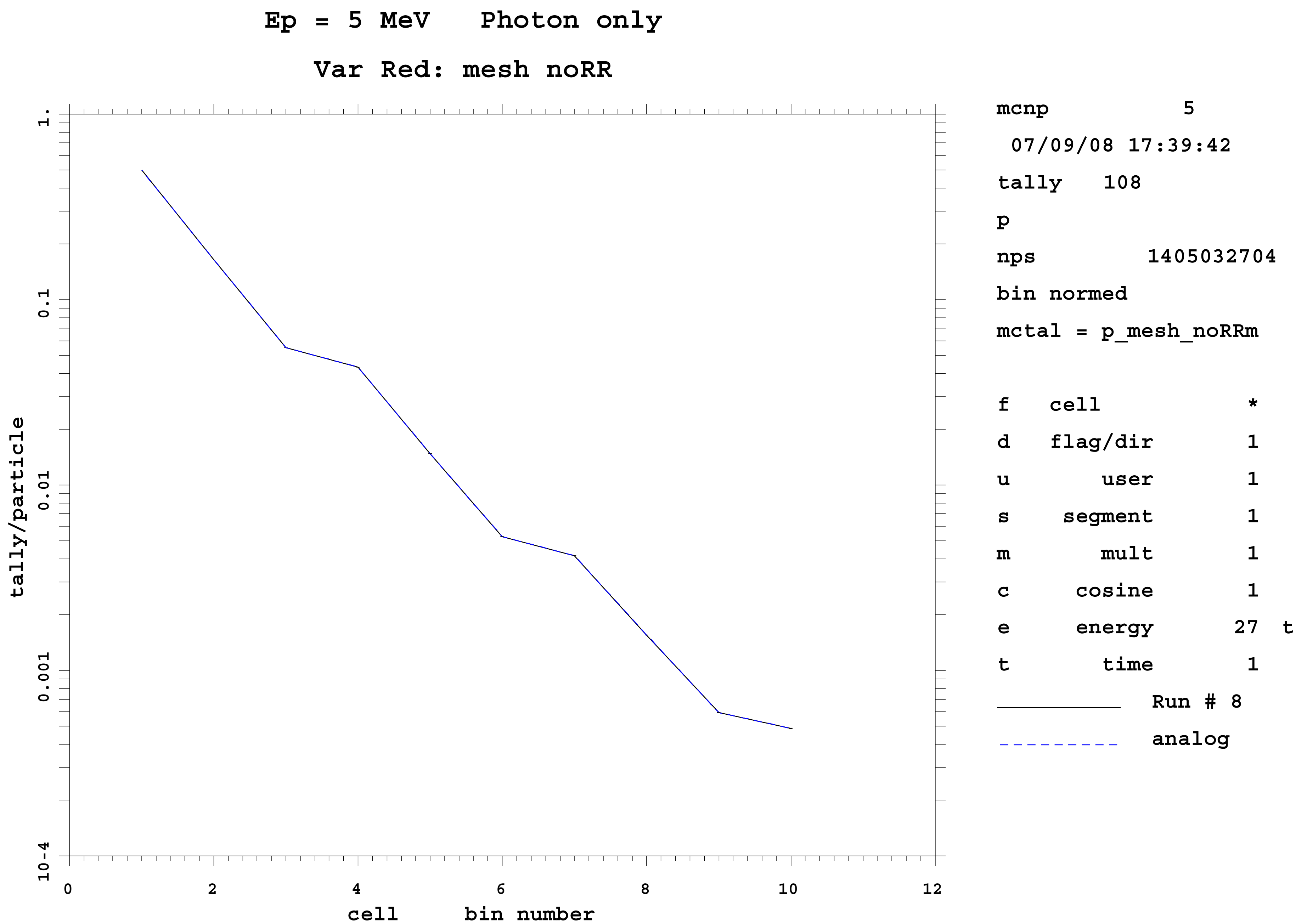


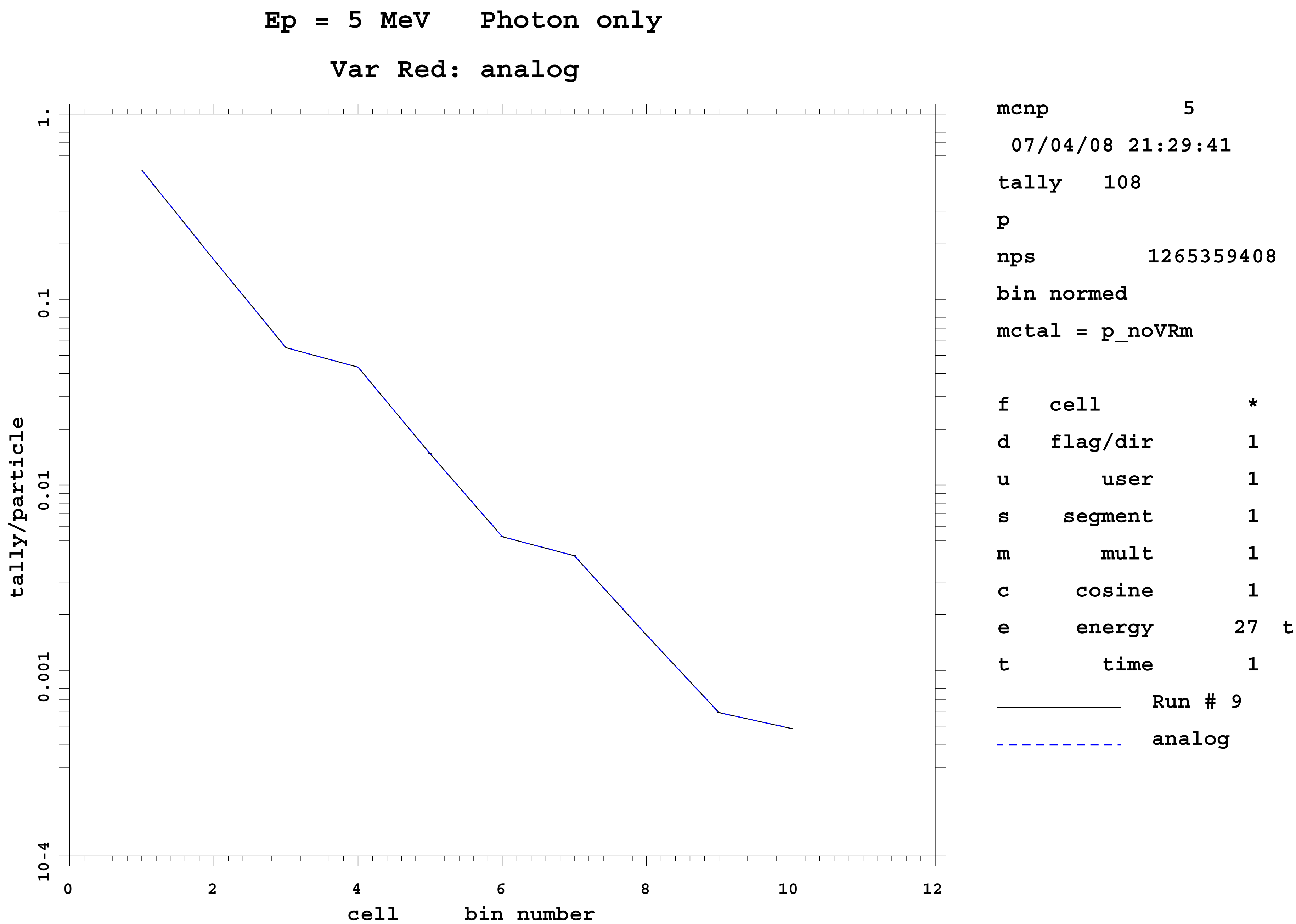

Ep = 5 MeV   Photon only
Var Red: mesh dxt noRR
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell   bin number
mcnp 5
07/05/08 22:56:42
tally 108
p
nps 1405032704
bin normed
mctal = p_mesh_dxt_noRRm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 6
analog

Ep = 5 MeV   Photon only

Var Red: mesh ext fcl noRR

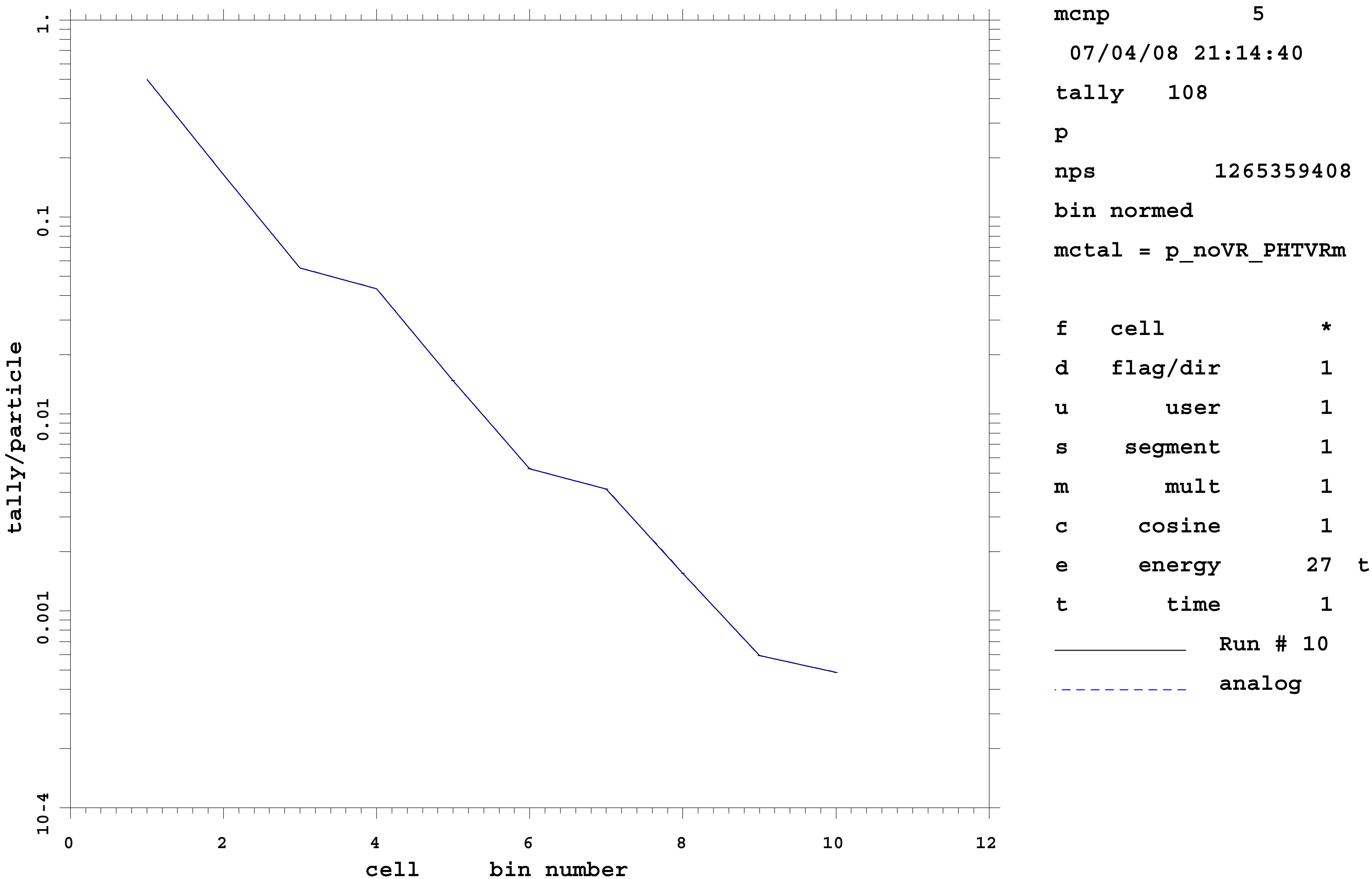


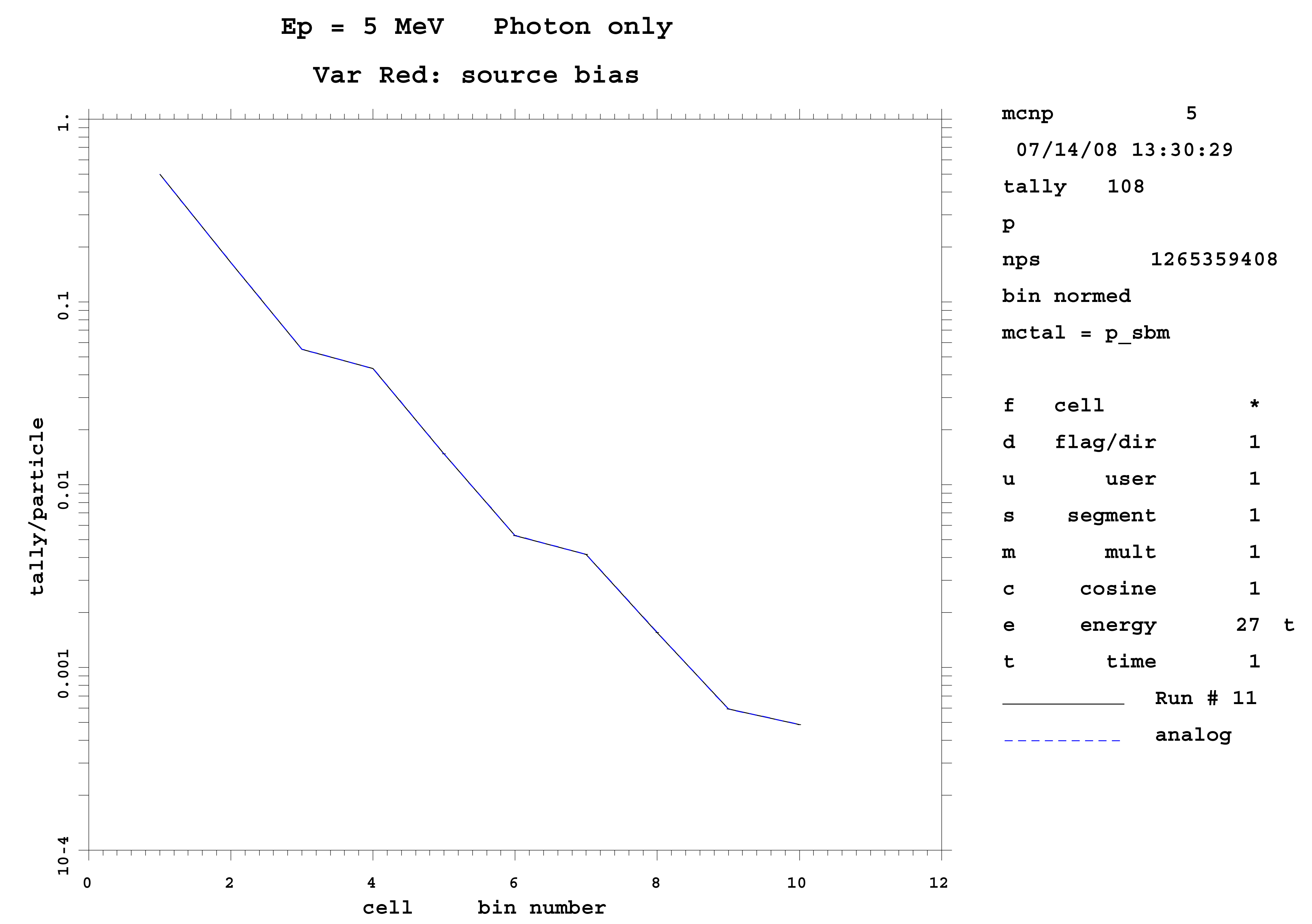

Ep = 5 MeV Photon only
Var Red: mesh noRR
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/09/08 17:39:42
tally 108
p
nps 1405032704
bin normed
mctal = p_mesh_noRRm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 8
analog


Ep = 5 MeV Photon only
Var Red: analog
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/04/08 21:29:41
tally 108
p
nps 1265359408
bin normed
mctal = p_noVRm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 9
analog

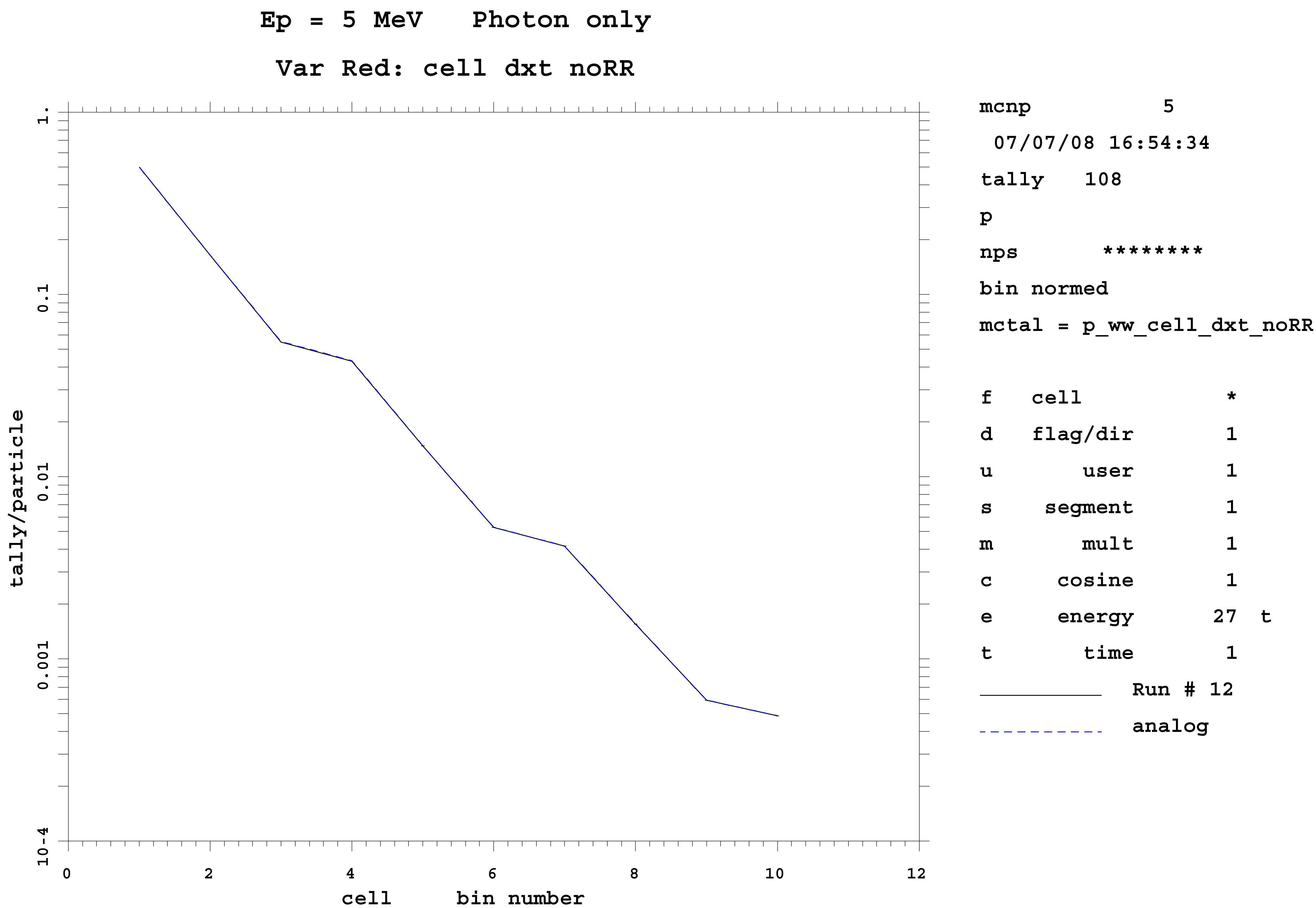
Ep = 5 MeV   Photon only

Var Red: anlog using PHTVR

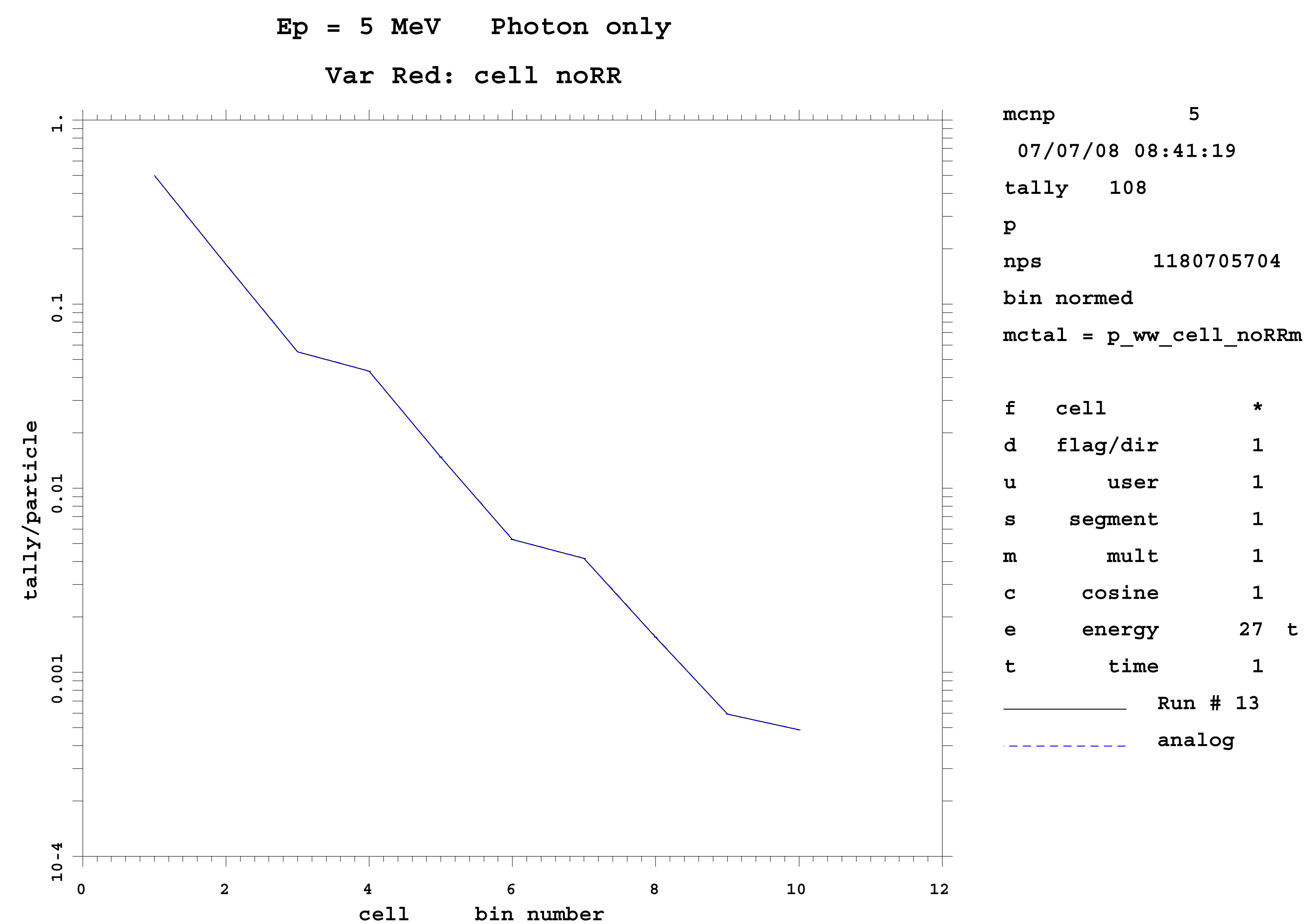




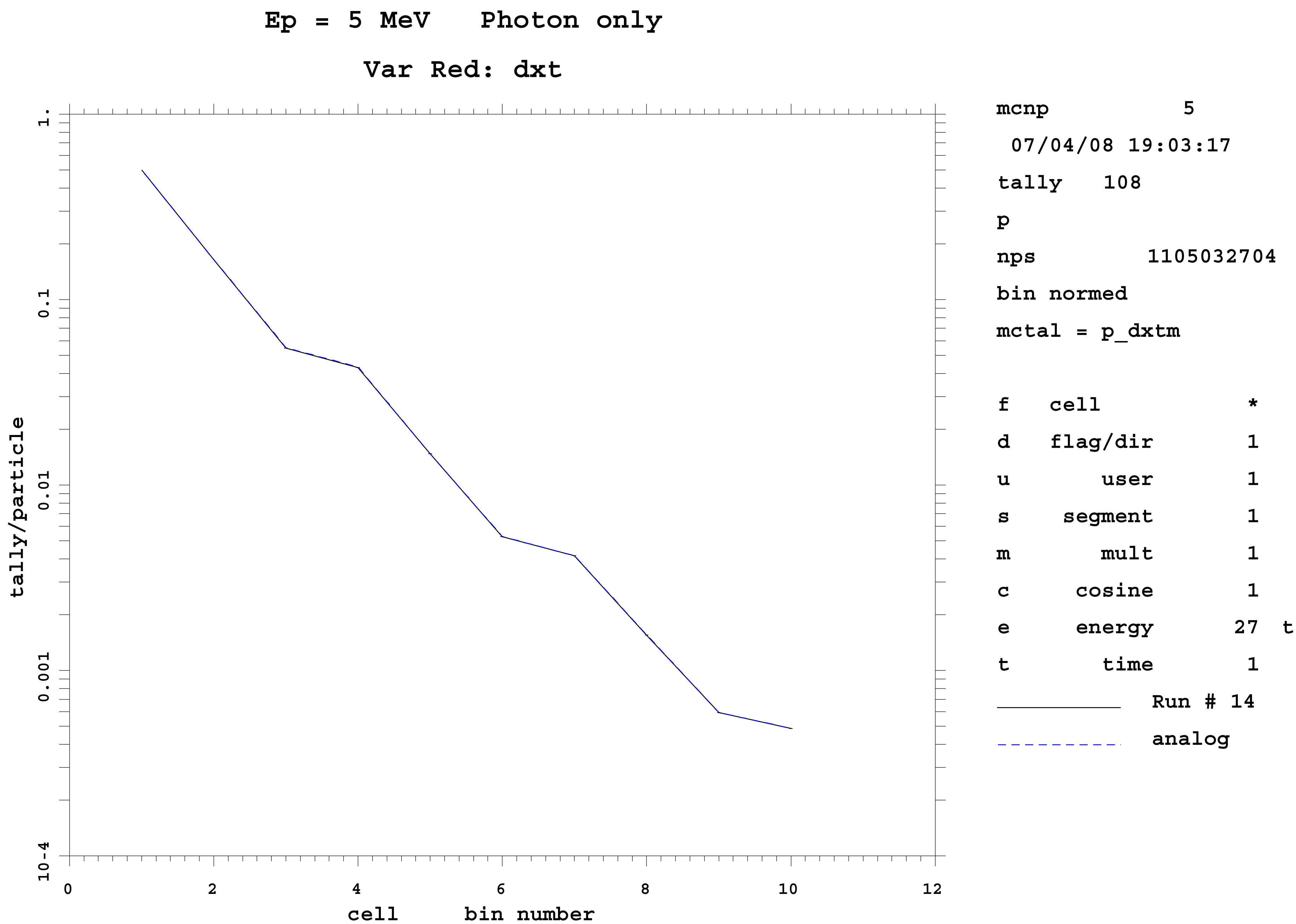
Ep = 5 MeV Photon only
Var Red: source bias
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/14/08 13:30:29
tally 108
p
nps 1265359408
bin normed
mctal = p_sbm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 11
analog

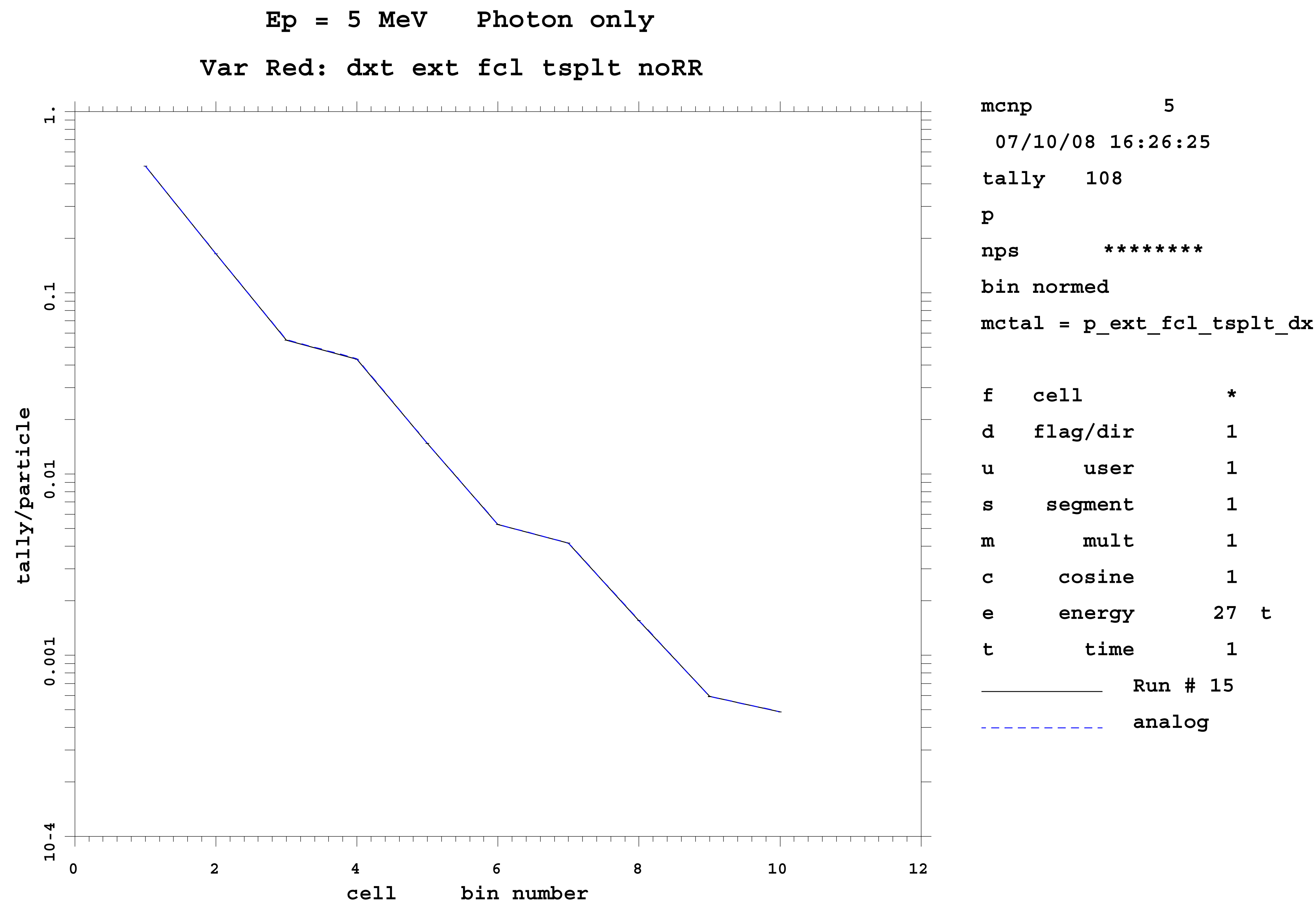


Ep = 5 MeV Photon only
Var Red: cell dxt noRR
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/07/08 16:54:34
tally 108
p
nps ********
bin normed
mctal = p_ww_cell_dxt_noRR
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 12
analog

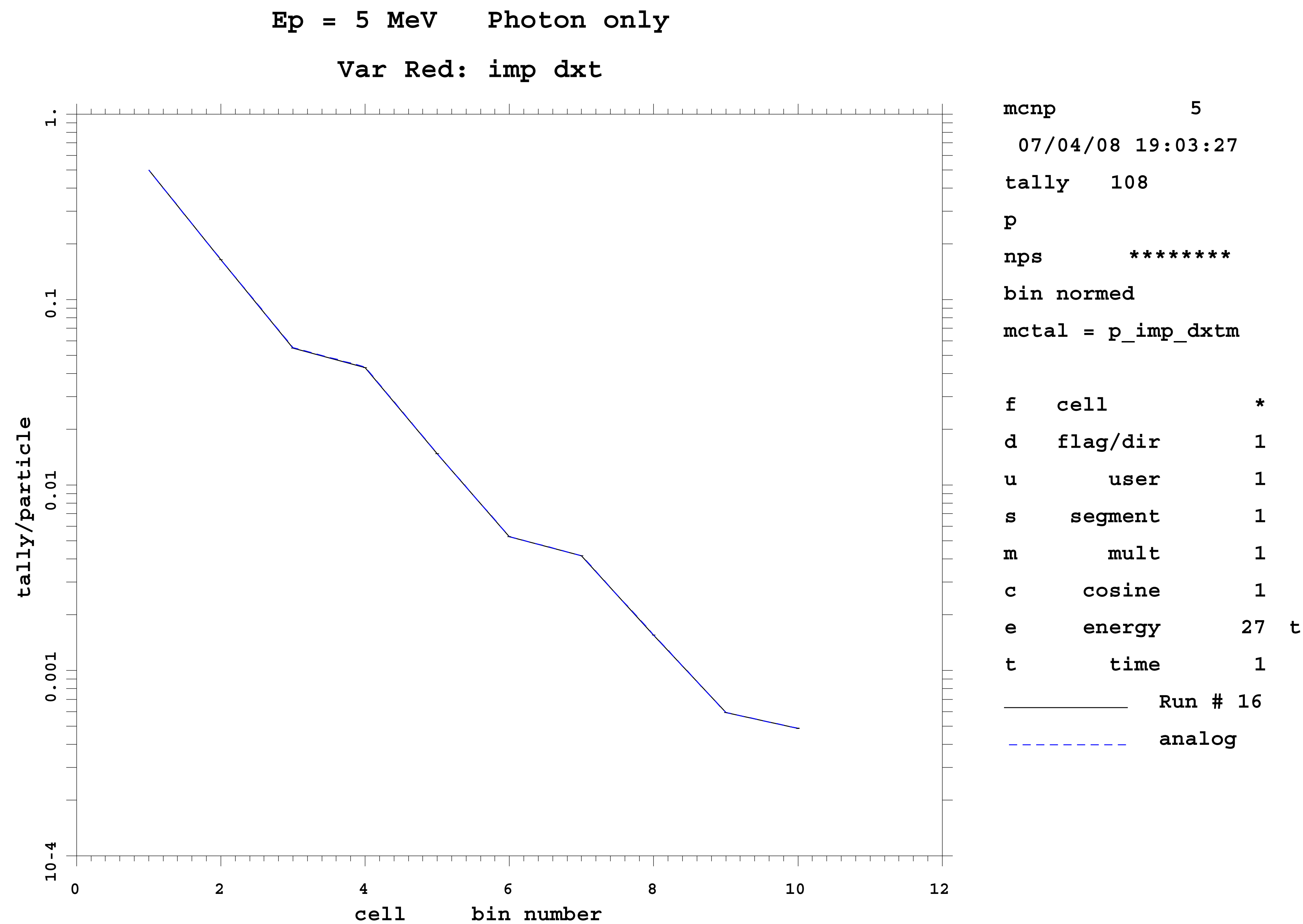


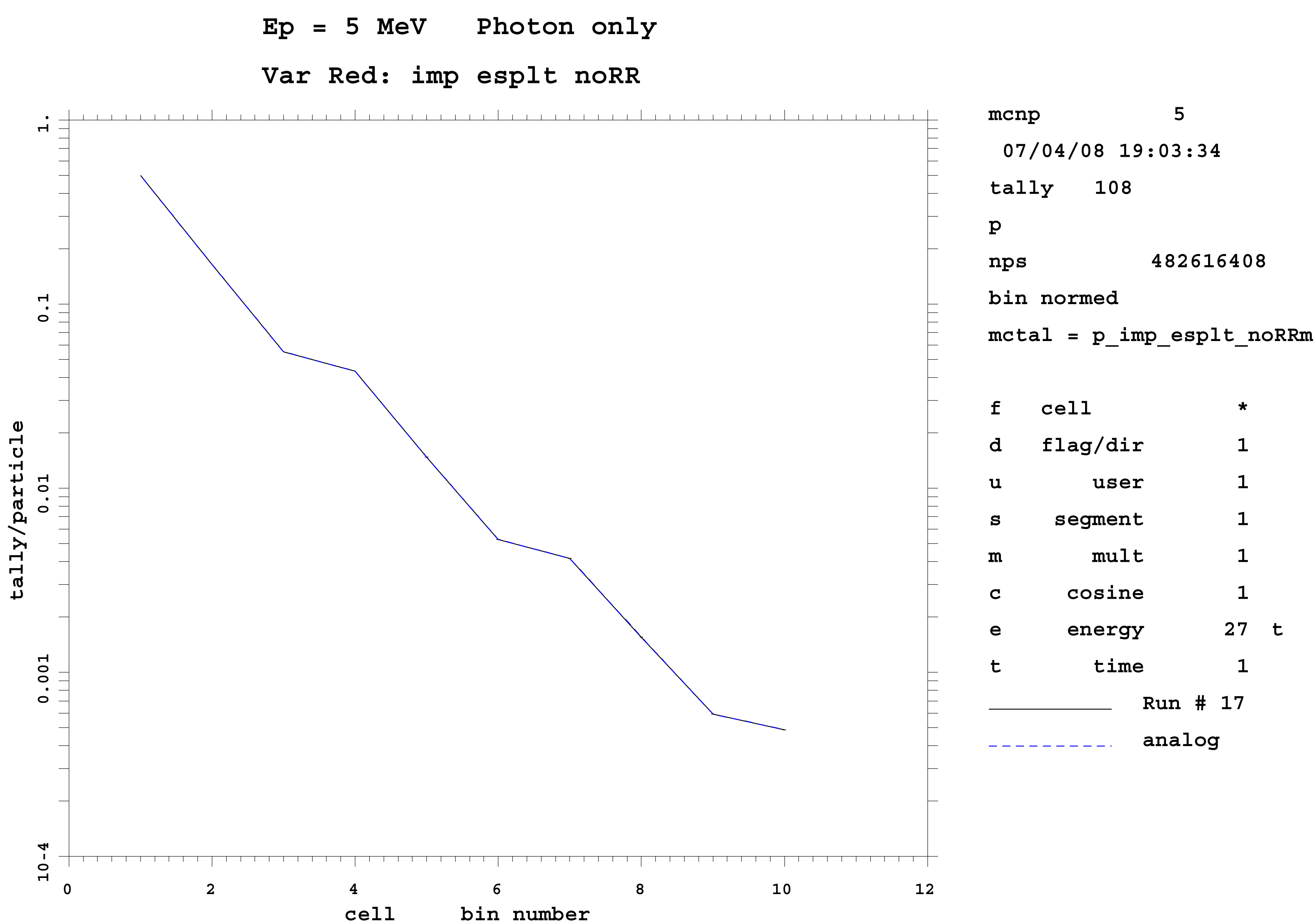
Ep = 5 MeV   Photon only
Var Red: cell noRR
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell   bin number
mcnp   5
07/07/08 08:41:19
tally   108
p
nps   1180705704
bin normed
mctal = p_ww_cell_noRRm
f   cell   *
d   flag/dir   1
u   user   1
s   segment   1
m   mult   1
c   cosine   1
e   energy   27 t
t   time   1
Run # 13
analog


Ep = 5 MeV Photon only
Var Red: dxt
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/04/08 19:03:17
tally 108
p
nps 1105032704
bin normed
mctal = p_dxtm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 14
analog

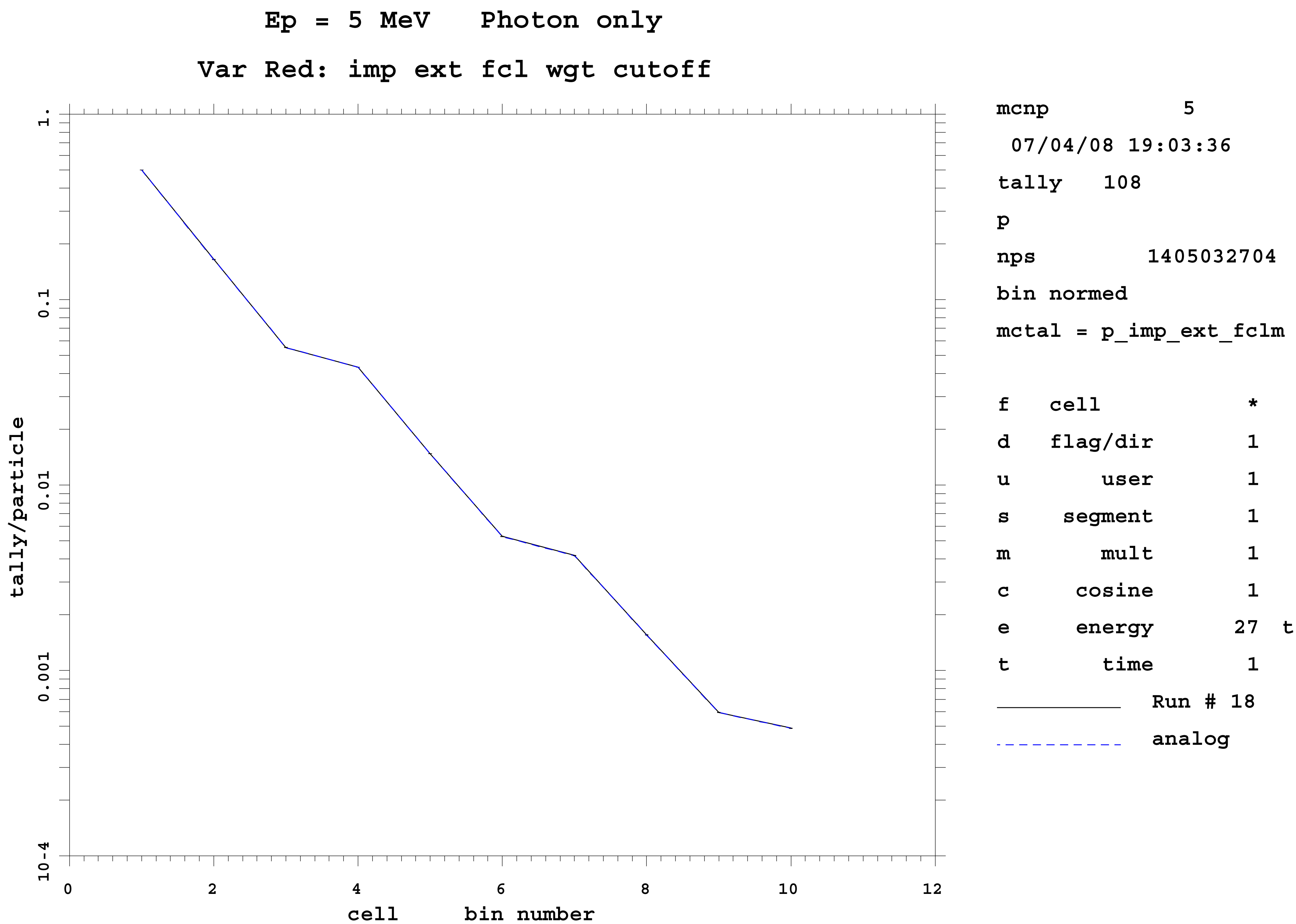


Ep = 5 MeV Photon only
Var Red: dxt ext fcl tsplt noRR
1.
0.1
0.01
0.001
10-4
tally/particle
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/10/08 16:26:25
tally 108
p
nps ********
bin normed
mctal = p_ext_fcl_tsplt_dx
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 15
analog

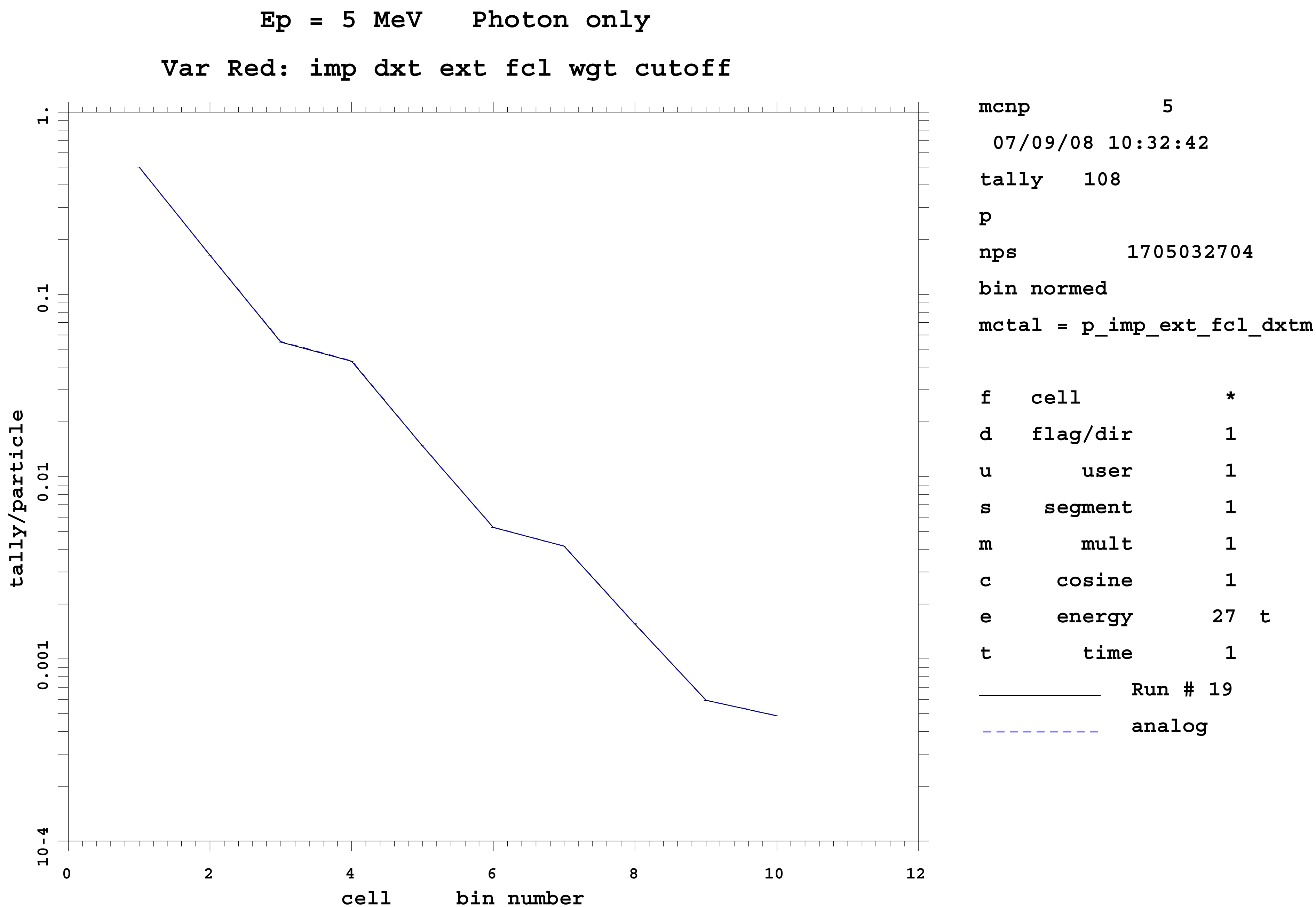

Ep = 5 MeV Photon only
Var Red: imp dxt
1.
0.1
0.01
0.001
10-4
tally/particle
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/04/08 19:03:27
tally 108
p
nps ********
bin normed
mctal = p_imp_dxtm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 16
analog

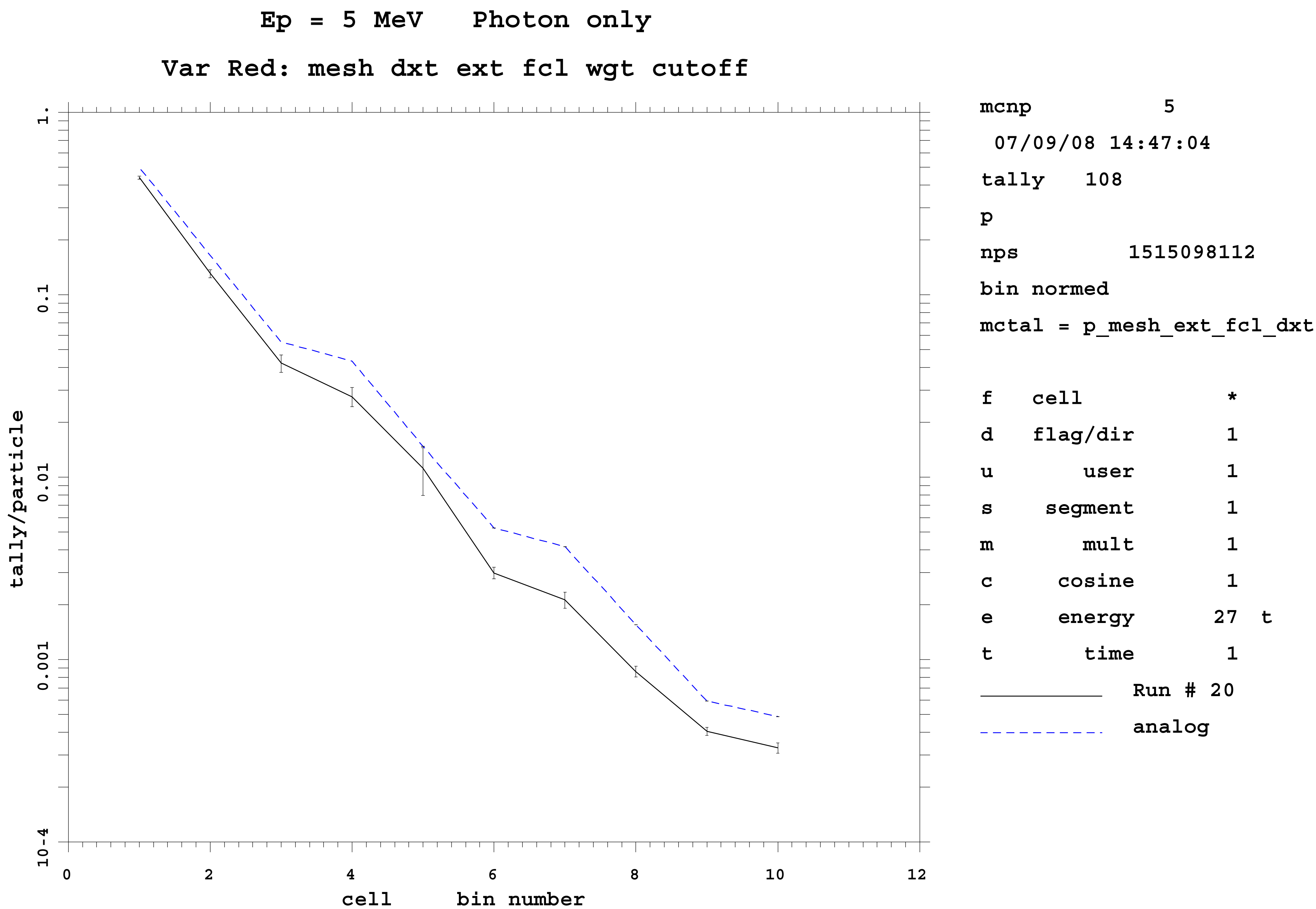


Ep = 5 MeV Photon only
Var Red: imp esplt noRR
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/04/08 19:03:34
tally 108
p
nps 482616408
bin normed
mctal = p_imp_esplt_noRRm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 17
analog

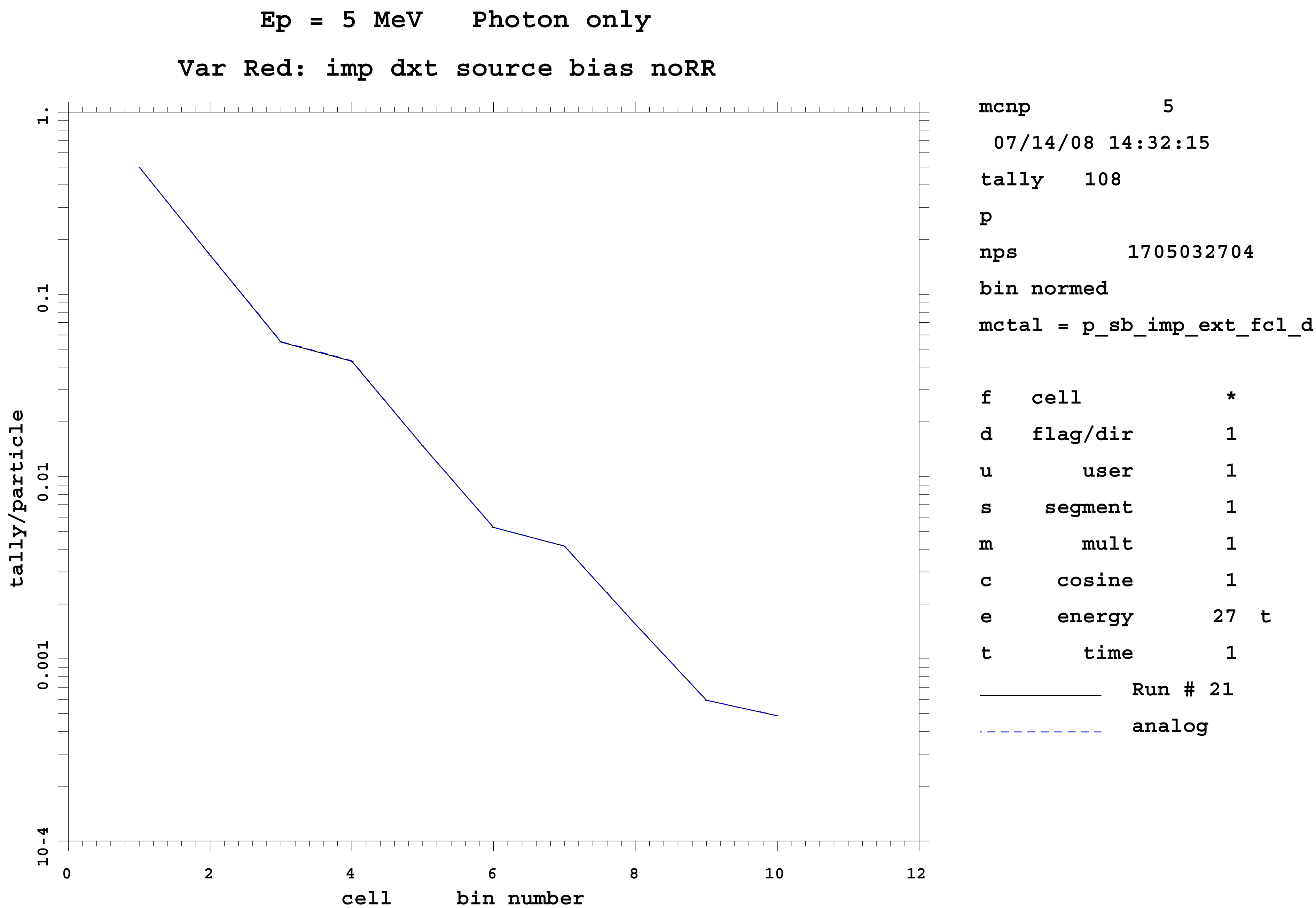


Ep = 5 MeV Photon only
Var Red: imp ext fcl wgt cutoff
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/04/08 19:03:36
tally 108
p
nps 1405032704
bin normed
mctal = p_imp_ext_fclm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 18
analog

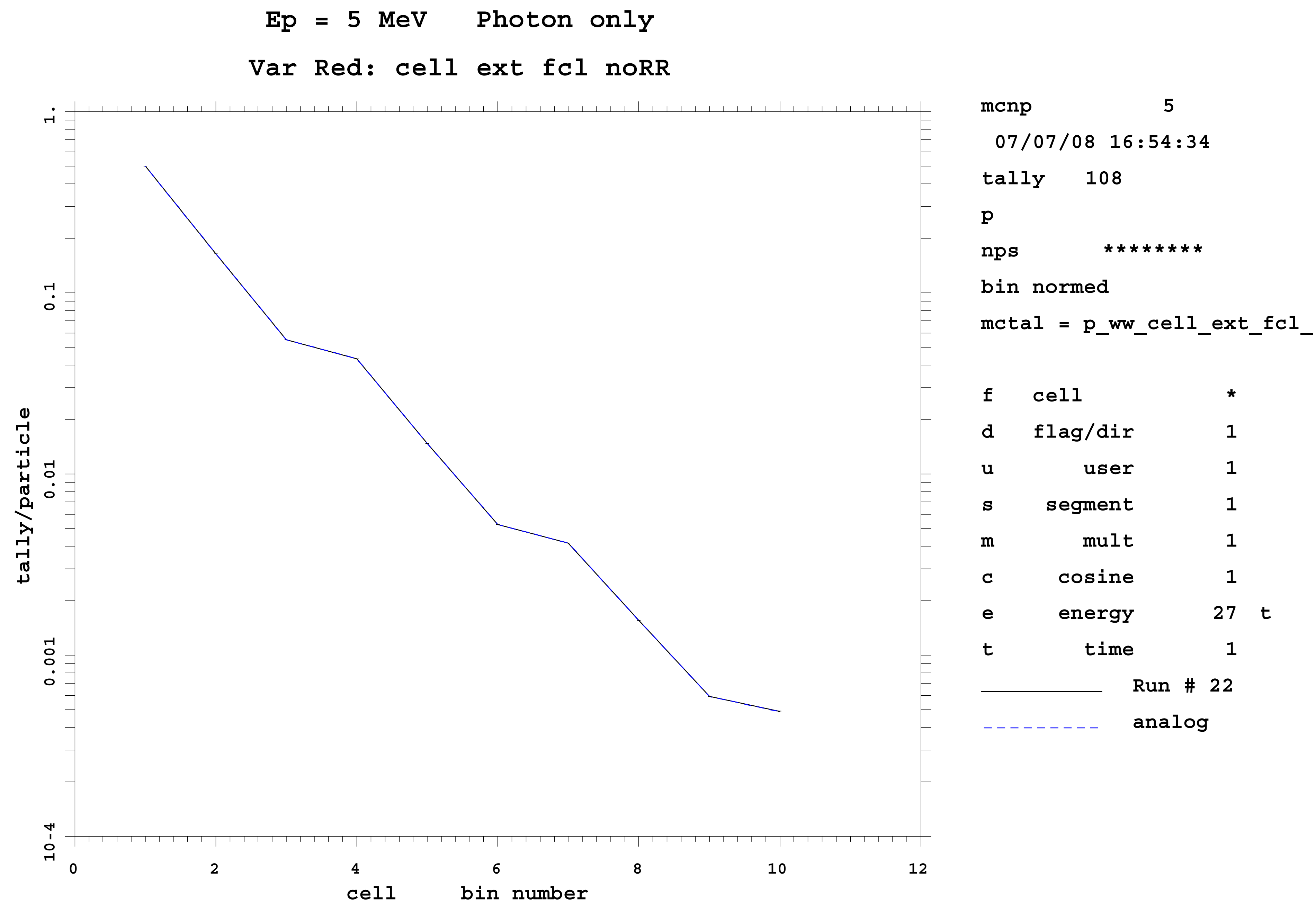

Ep = 5 MeV   Photon only
Var Red: imp dxt ext fcl wgt cutoff
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell   bin number
mcnp   5
07/09/08 10:32:42
tally   108
p
nps   1705032704
bin normed
mctal = p_imp_ext_fcl_dxtm
f   cell   *
d   flag/dir   1
u   user   1
s   segment   1
m   mult   1
c   cosine   1
e   energy   27 t
t   time   1
Run # 19
analog

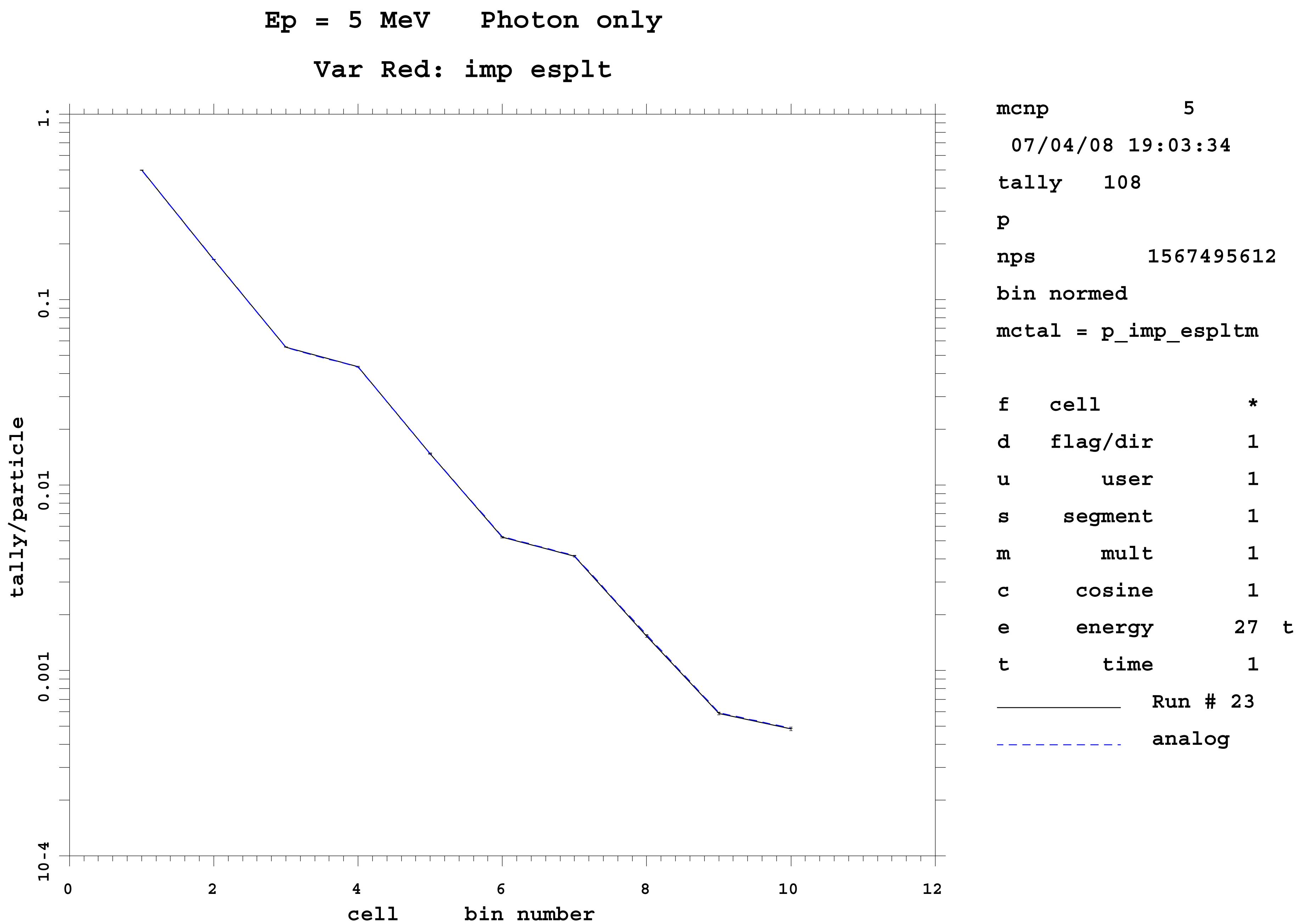


Ep = 5 MeV Photon only
Var Red: mesh dxt ext fcl wgt cutoff
mcnp 5
07/09/08 14:47:04
tally 108
p
nps 1515098112
bin normed
mctal = p_mesh_ext_fcl_dxt
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 20
analog
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number



Ep = 5 MeV   Photon only
Var Red: imp dxt source bias noRR
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell   bin number
mcnp 5
07/14/08 14:32:15
tally 108
p
nps 1705032704
bin normed
mctal = p_sb_imp_ext_fcl_d
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 21
analog

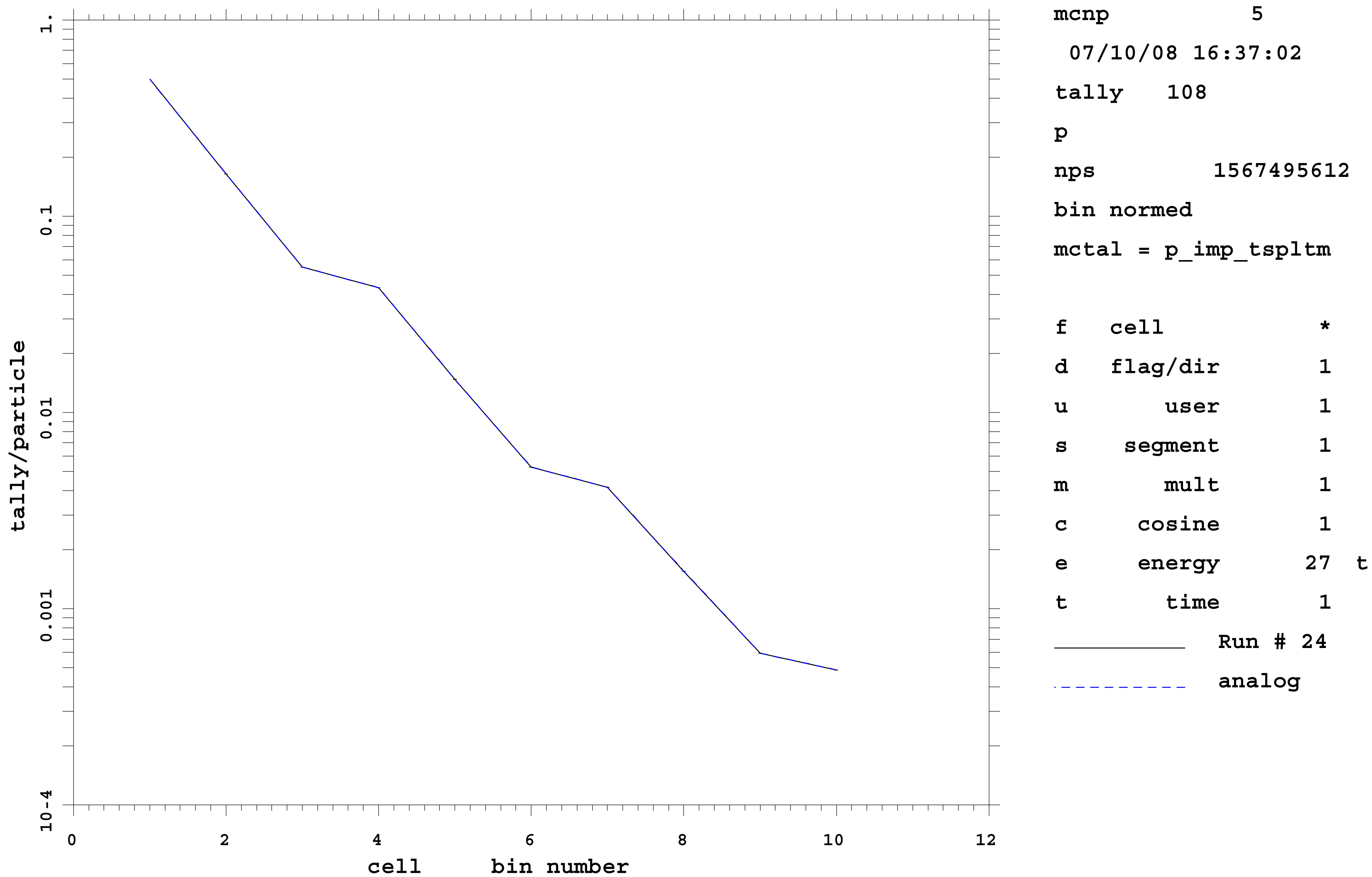

Ep = 5 MeV Photon only
Var Red: cell ext fcl noRR
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/07/08 16:54:34
tally 108
p
nps ********
bin normed
mctal = p_ww_cell_ext_fcl_
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 22
analog



Ep = 5 MeV   Photon only
Var Red: imp esplt
1.
0.1
0.01
0.001
10-4
tally/particle
0
2
4
6
8
10
12
cell   bin number
mcnp   5
07/04/08 19:03:34
tally   108
p
nps   1567495612
bin normed
mctal = p_imp_espltm
f   cell   *
d   flag/dir   1
u   user   1
s   segment   1
m   mult   1
c   cosine   1
e   energy   27 t
t   time   1
Run # 23
analog

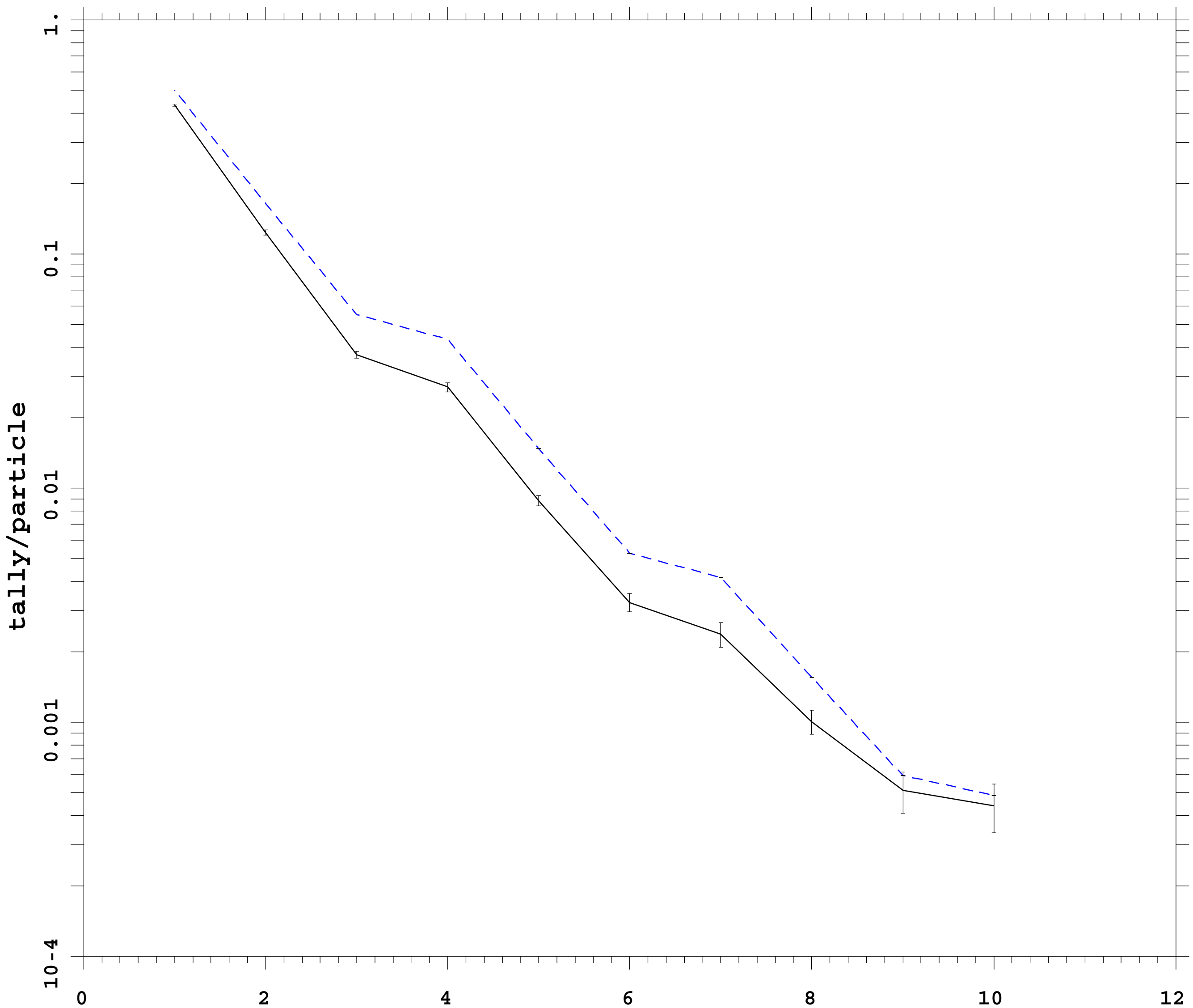
Ep = 5 MeV   Photon only

Var Red: imp tsplt



Ep = 5 MeV   Photon only

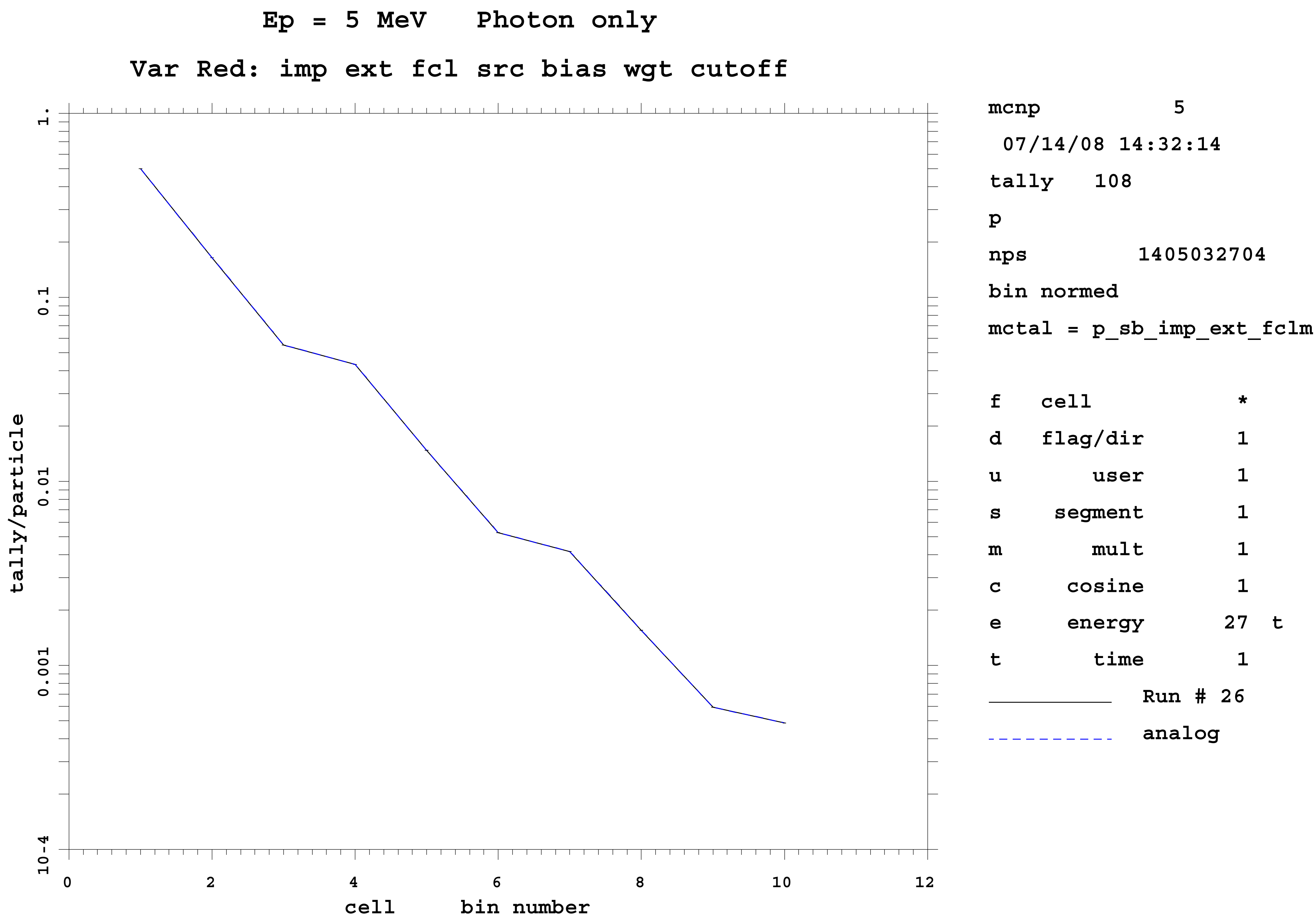
Var Red: mesh ext fcl wgt cutoff



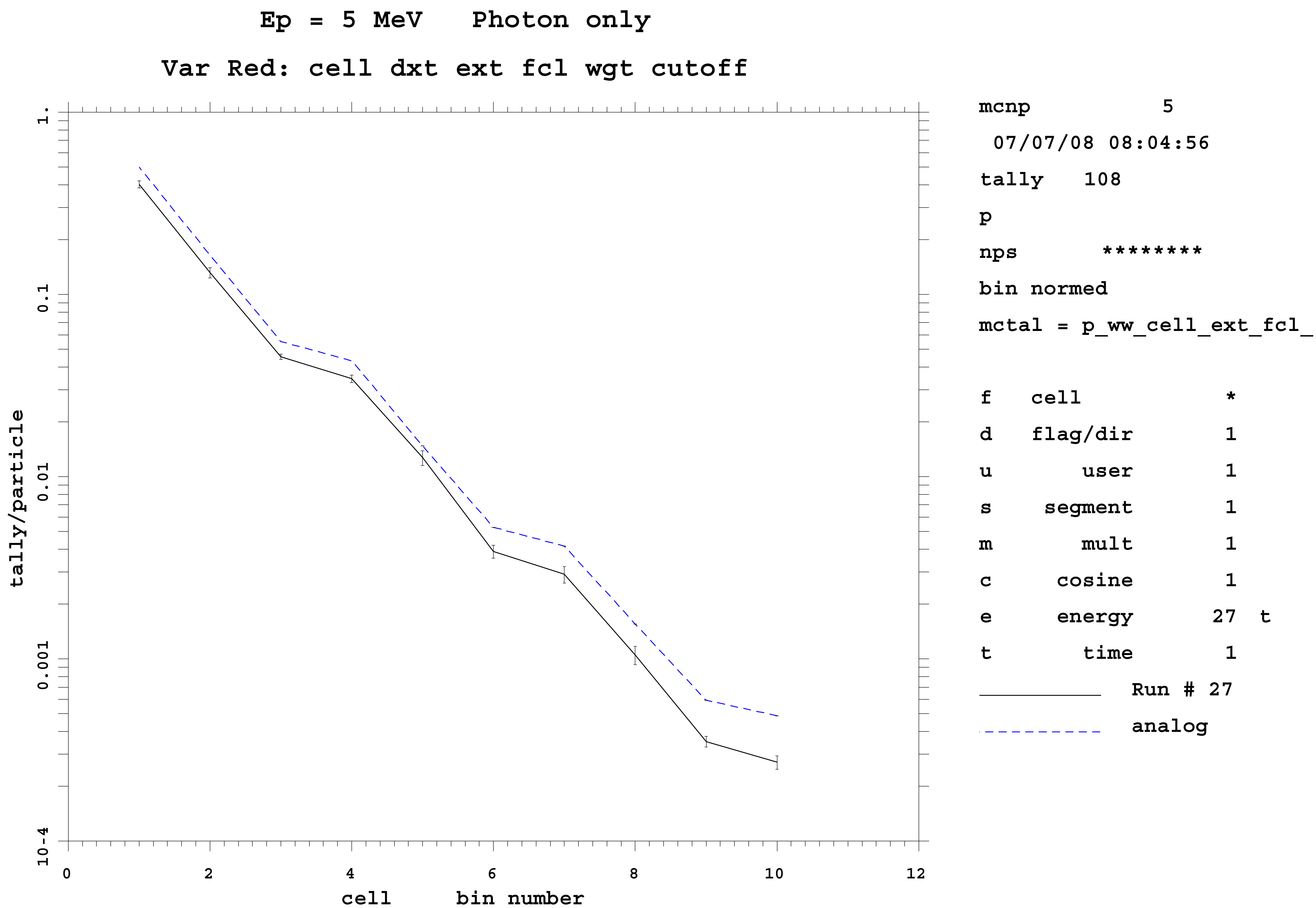
mcnp 5
07/09/08 14:47:04
tally 108
p
nps 2115098112
bin normed
mctal = p_mesh_ext_fclm

f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1

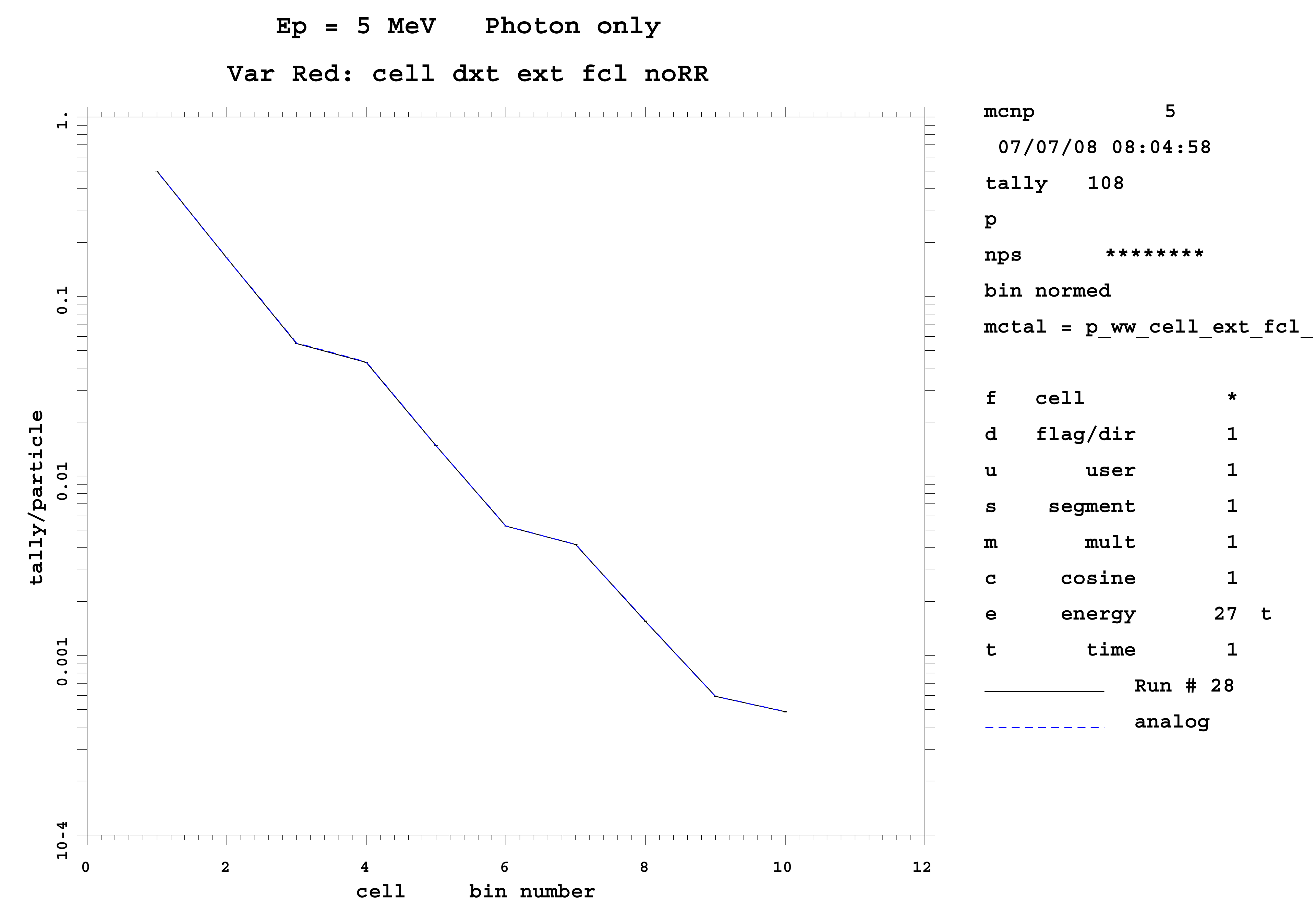
Run # 25
analog



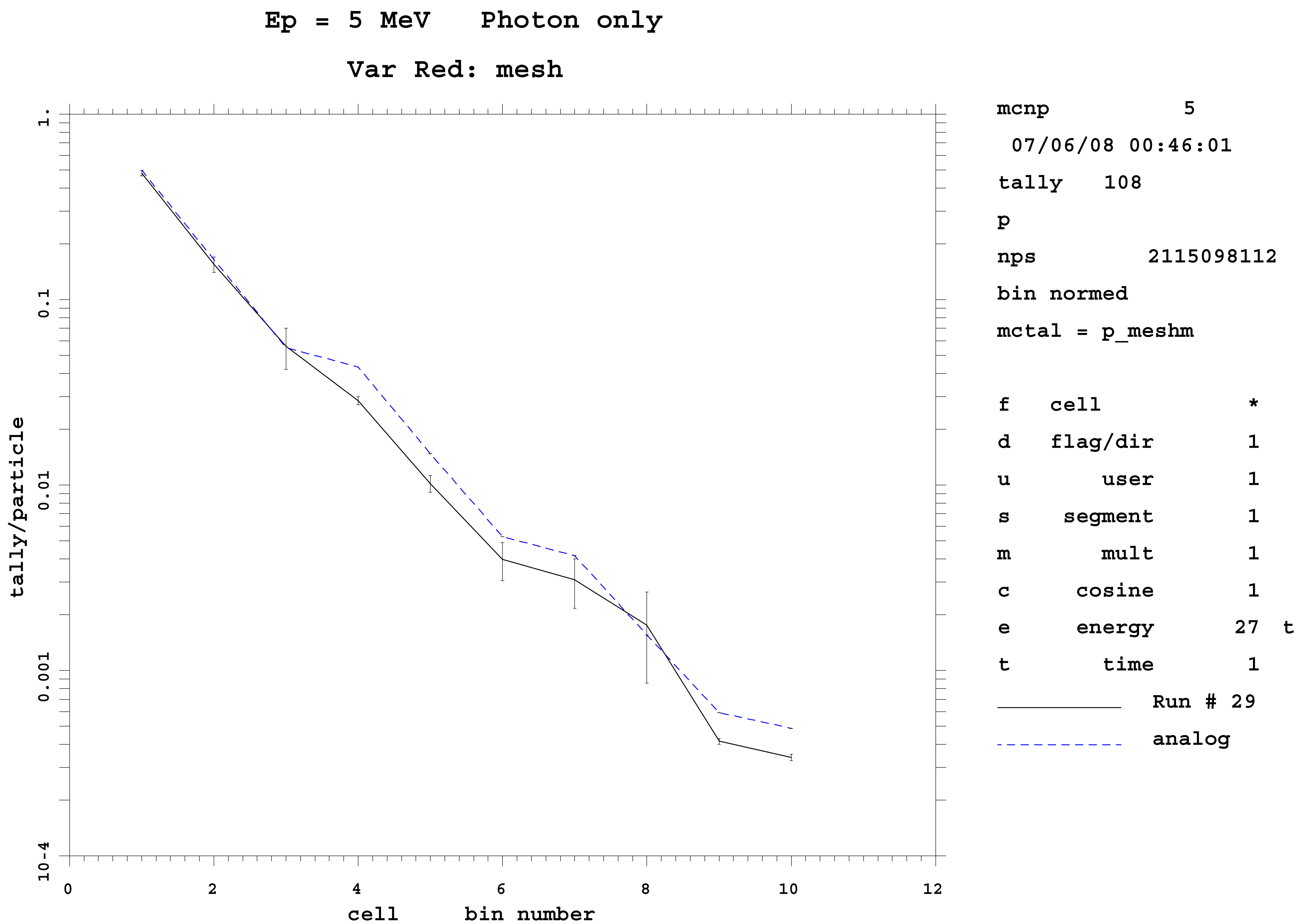
Ep = 5 MeV Photon only
Var Red: imp ext fcl src bias wgt cutoff
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/14/08 14:32:14
tally 108
p
nps 1405032704
bin normed
mctal = p_sb_imp_ext_fclm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 26
analog



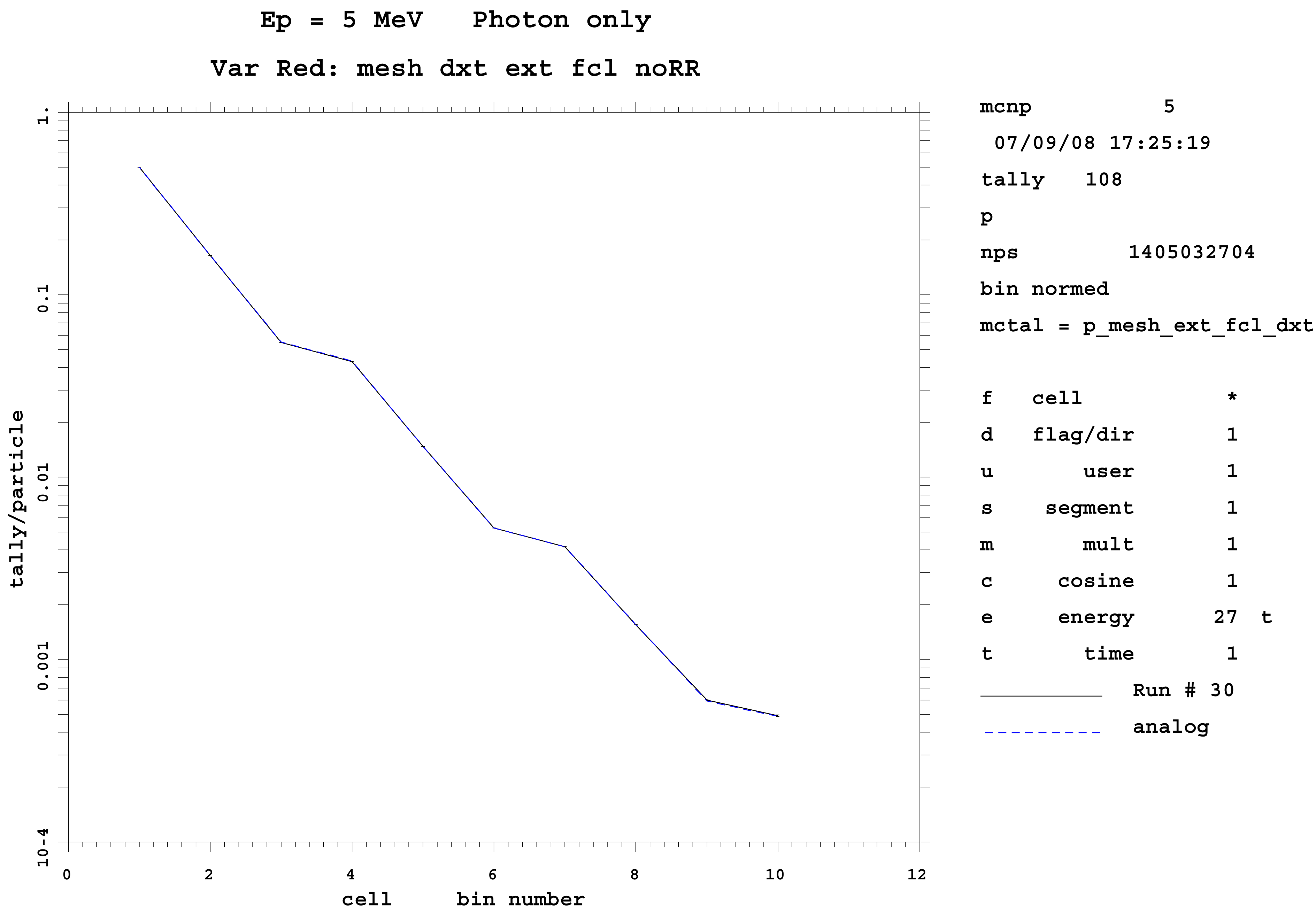
Ep = 5 MeV Photon only
Var Red: cell dxt ext fcl wgt cutoff
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/07/08 08:04:56
tally 108
p
nps ********
bin normed
mctal = p_ww_cell_ext_fcl_
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 27
analog



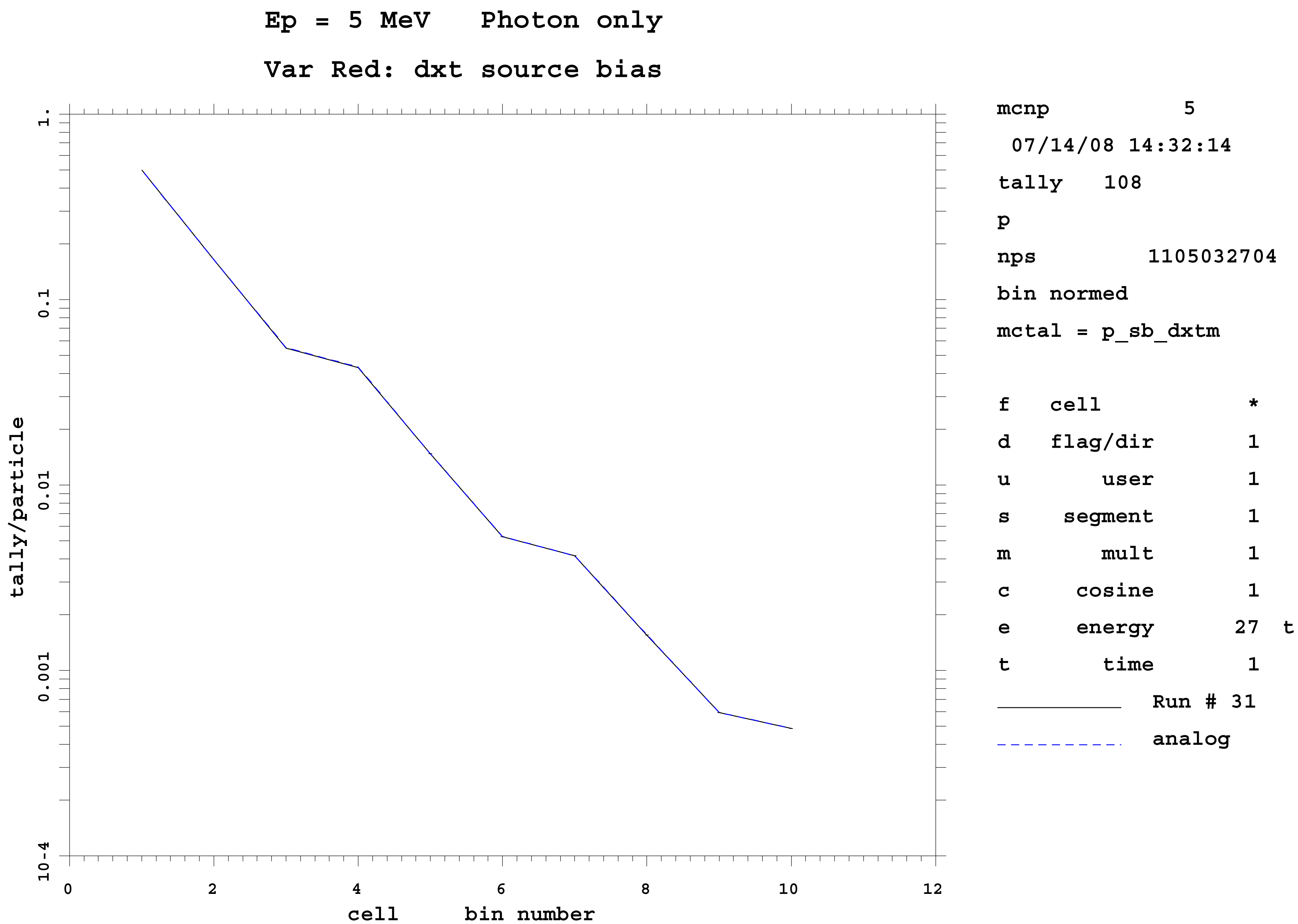
Ep = 5 MeV   Photon only
Var Red: cell dxt ext fcl noRR
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell   bin number
mcnp   5
07/07/08 08:04:58
tally   108
p
nps   ********
bin normed
mctal = p_ww_cell_ext_fcl_
f   cell   *
d   flag/dir   1
u   user   1
s   segment   1
m   mult   1
c   cosine   1
e   energy   27 t
t   time   1
Run # 28
analog



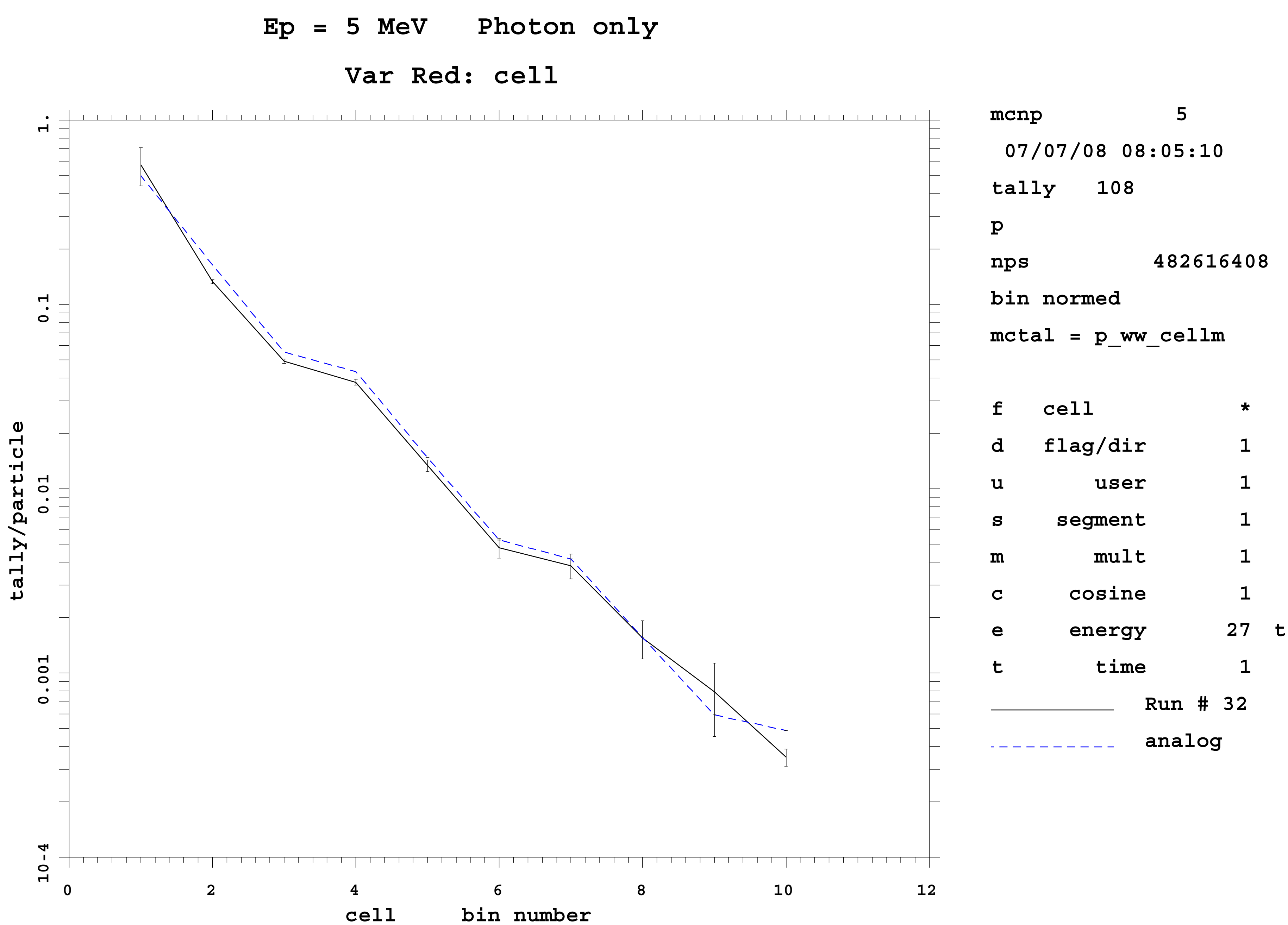
Ep = 5 MeV   Photon only
Var Red: mesh
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell   bin number
mcnp   5
07/06/08 00:46:01
tally 108
p
nps   2115098112
bin normed
mctal = p_meshm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 29
analog



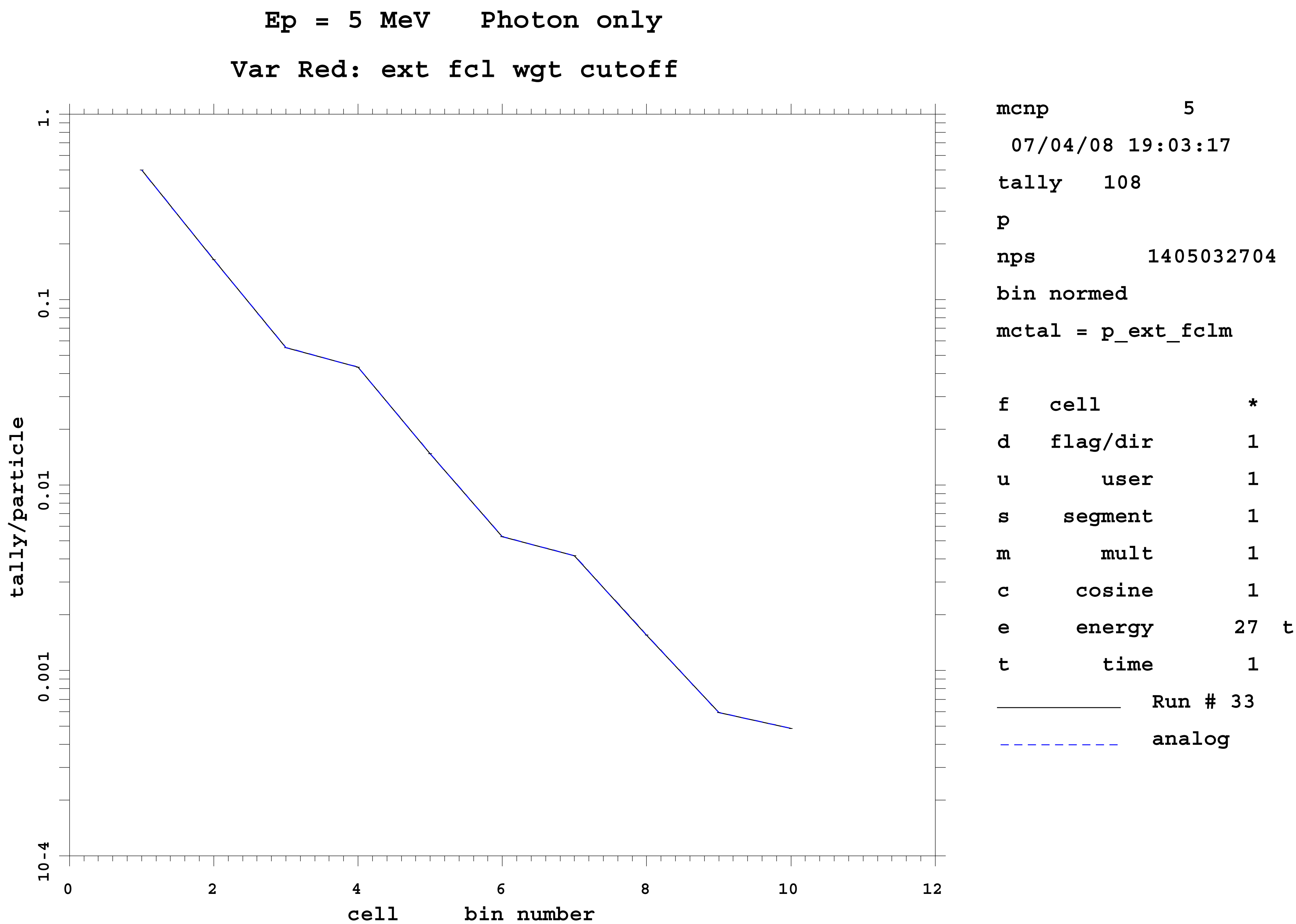
Ep = 5 MeV Photon only
Var Red: mesh dxt ext fcl noRR
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/09/08 17:25:19
tally 108
p
nps 1405032704
bin normed
mctal = p_mesh_ext_fcl_dxt
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 30
analog

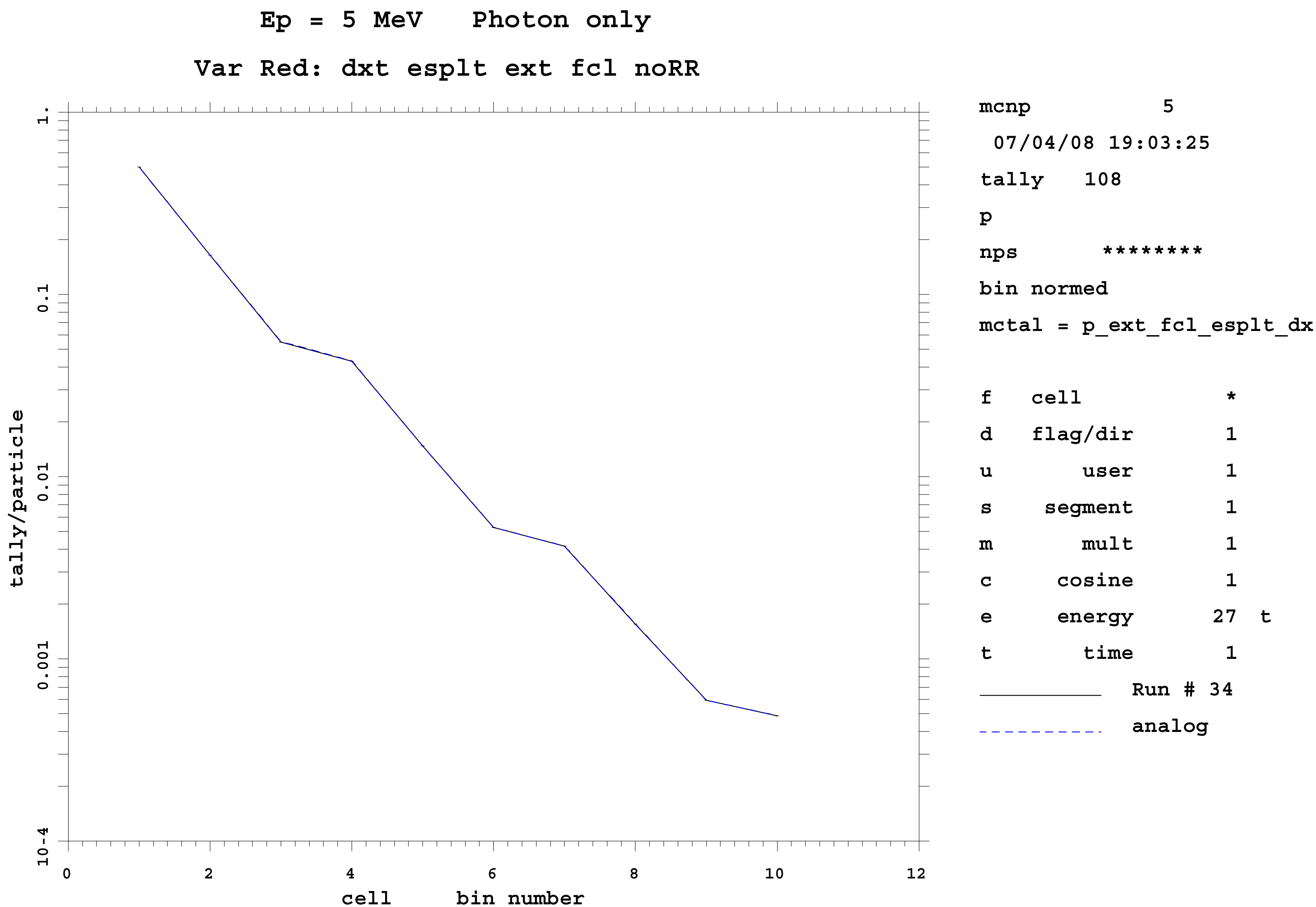


Ep = 5 MeV Photon only
Var Red: dxt source bias
mcnp 5
07/14/08 14:32:14
tally 108
p
nps 1105032704
bin normed
mctal = p_sb_dxtm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 31
analog
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number



Ep = 5 MeV Photon only
Var Red: cell
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/07/08 08:05:10
tally 108
p
nps 482616408
bin normed
mctal = p_ww_cellm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 32
analog

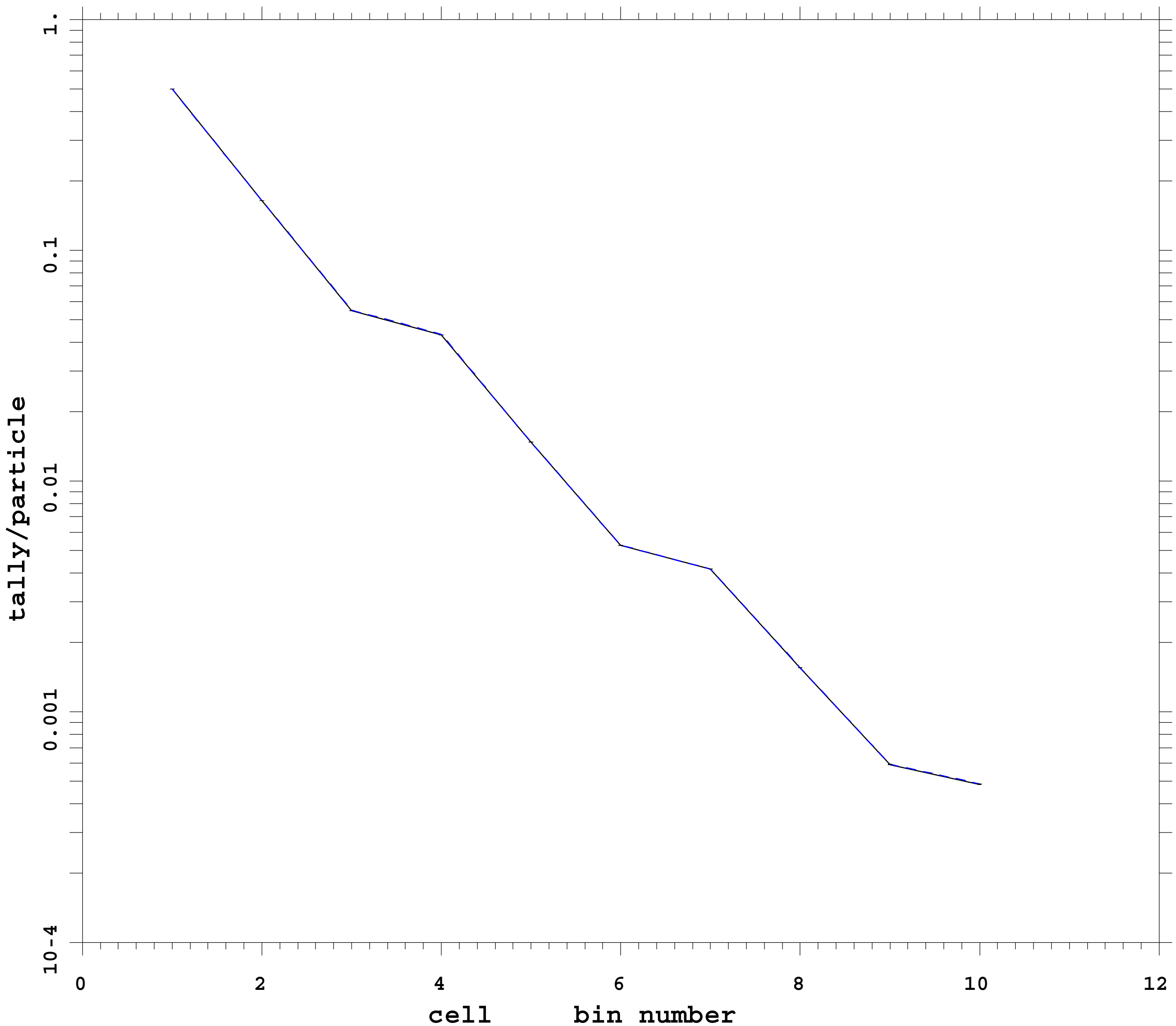

Ep = 5 MeV Photon only
Var Red: ext fcl wgt cutoff
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/04/08 19:03:17
tally 108
p
nps 1405032704
bin normed
mctal = p_ext_fclm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 33
analog



Ep = 5 MeV Photon only
Var Red: dxt esplt ext fcl noRR
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/04/08 19:03:25
tally 108
p
nps ********
bin normed
mctal = p_ext_fcl_esplt_dx
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 34
analog

Ep = 5 MeV   Photon only

Var Red: dxt ext fcl tsplt wgt cutoff

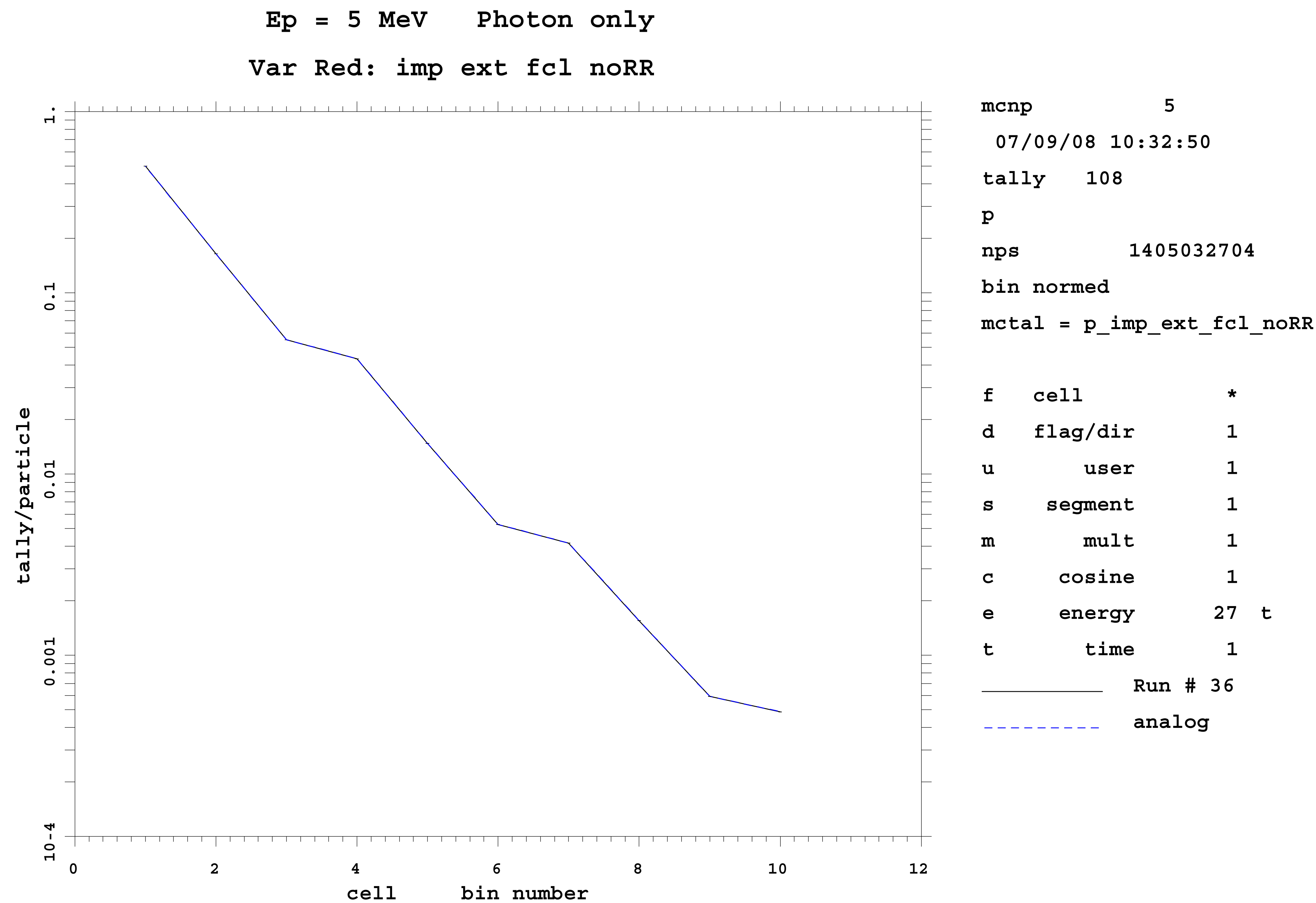


mcnp 5
07/10/08 17:40:27
tally 108
p
nps ********
bin normed
mctal = p_ext_fcl_tsplt_dx

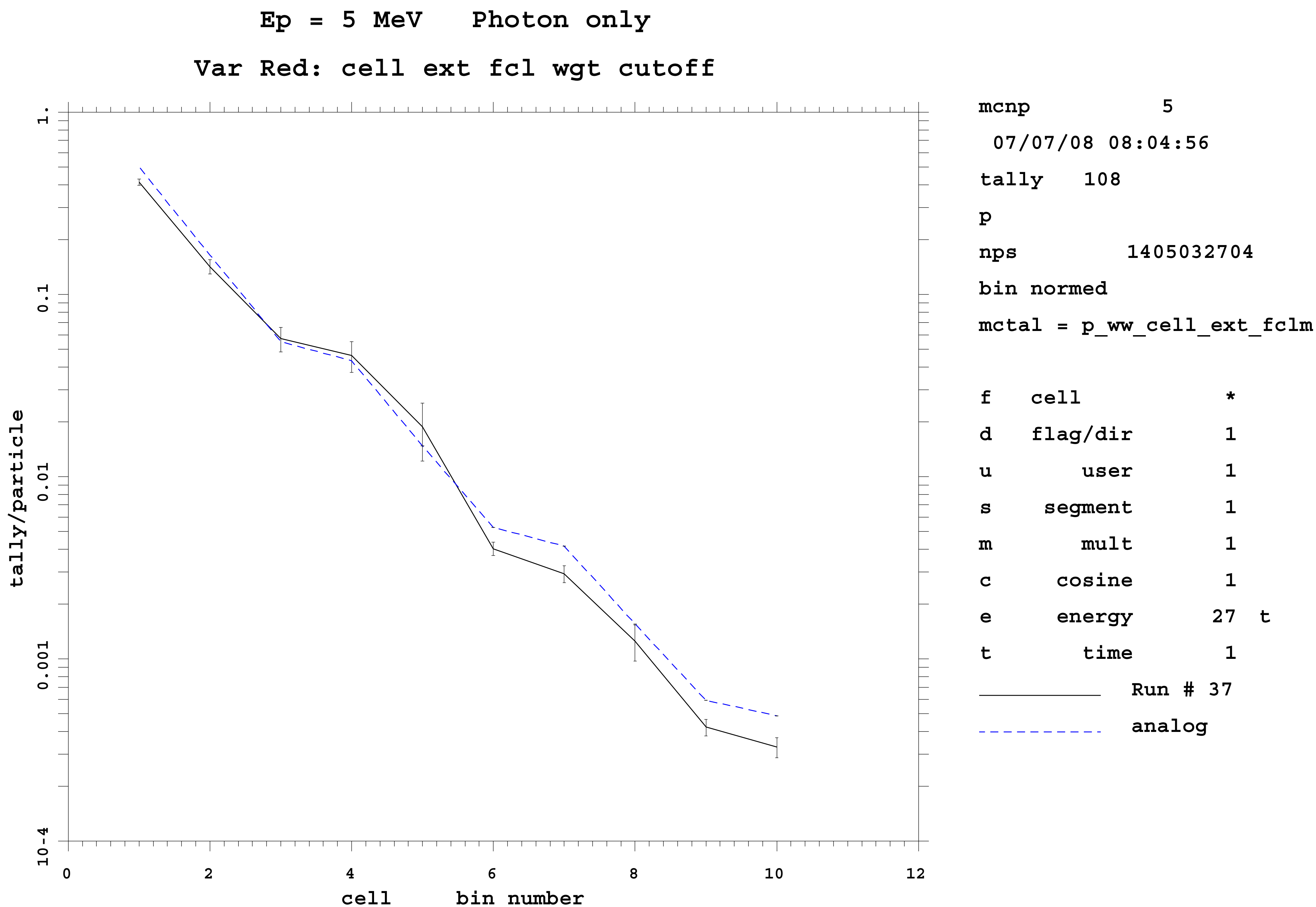
f	cell	*	
d	flag/dir	1	
u	user	1	
s	segment	1	
m	mult	1	
c	cosine	1	
e	energy	27	t
t	time	1	

Run # 35

analog

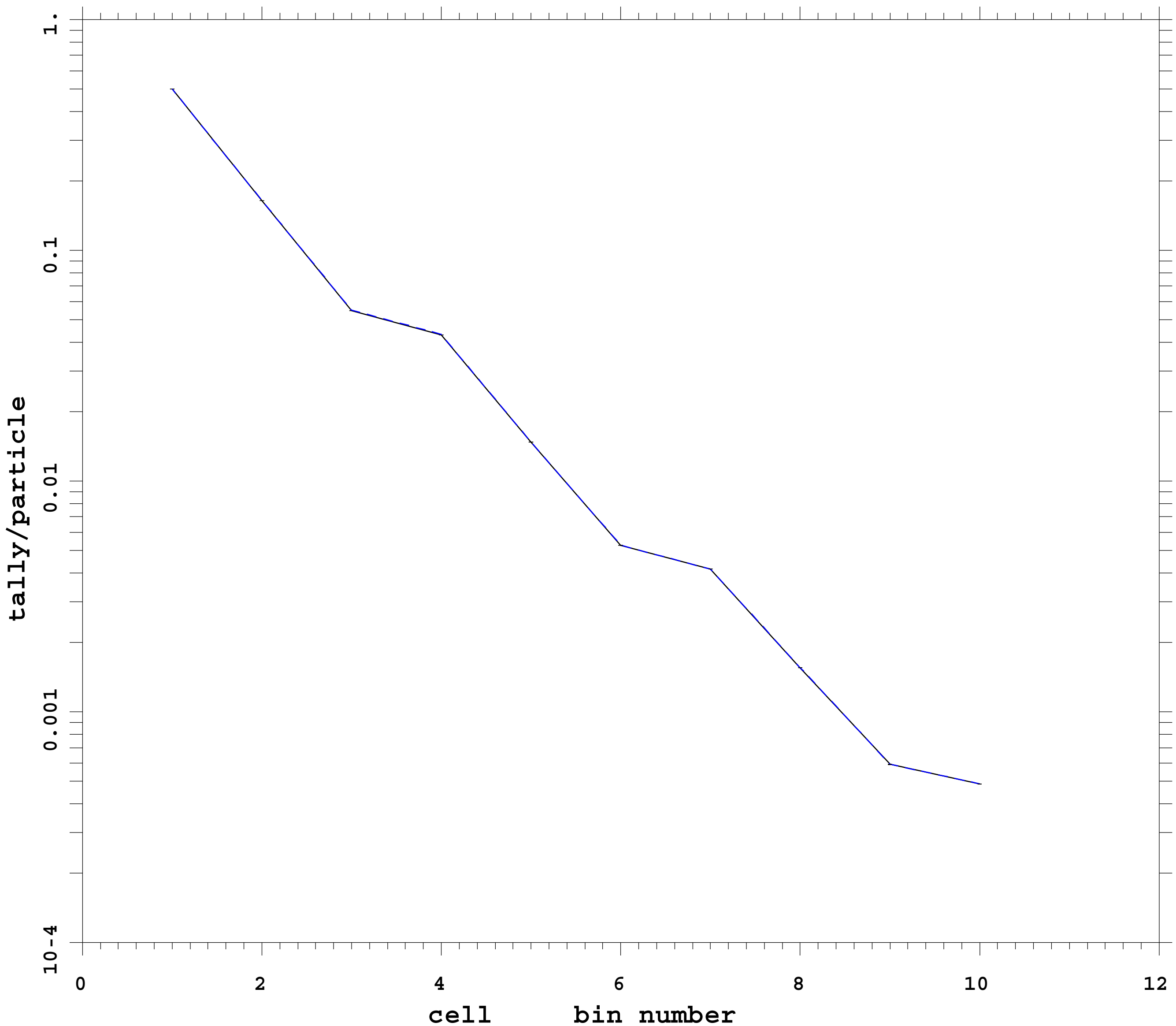


Ep = 5 MeV Photon only
Var Red: imp ext fcl noRR
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/09/08 10:32:50
tally 108
p
nps 1405032704
bin normed
mctal = p_imp_ext_fcl_noRR
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 36
analog


Ep = 5 MeV Photon only
Var Red: cell ext fcl wgt cutoff
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/07/08 08:04:56
tally 108
p
nps 1405032704
bin normed
mctal = p_ww_cell_ext_fclm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 37
analog

Ep = 5 MeV   Photon only

Var Red: dxt ext fcl wgt cutoff

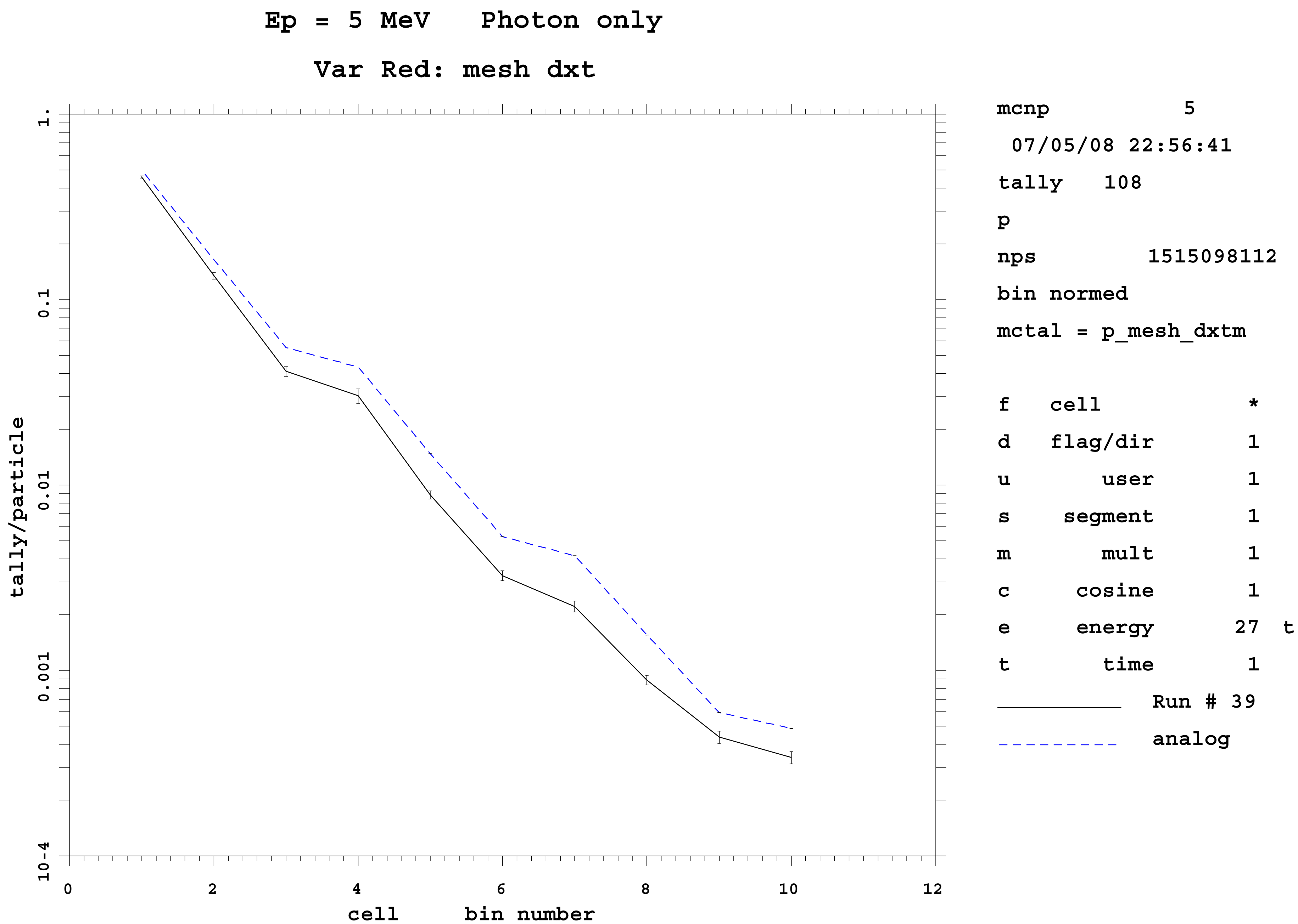


mcnp 5
07/04/08 19:03:20
tally 108
p
nps 805032704
bin normed
mctal = p_ext_fcl_dxtm

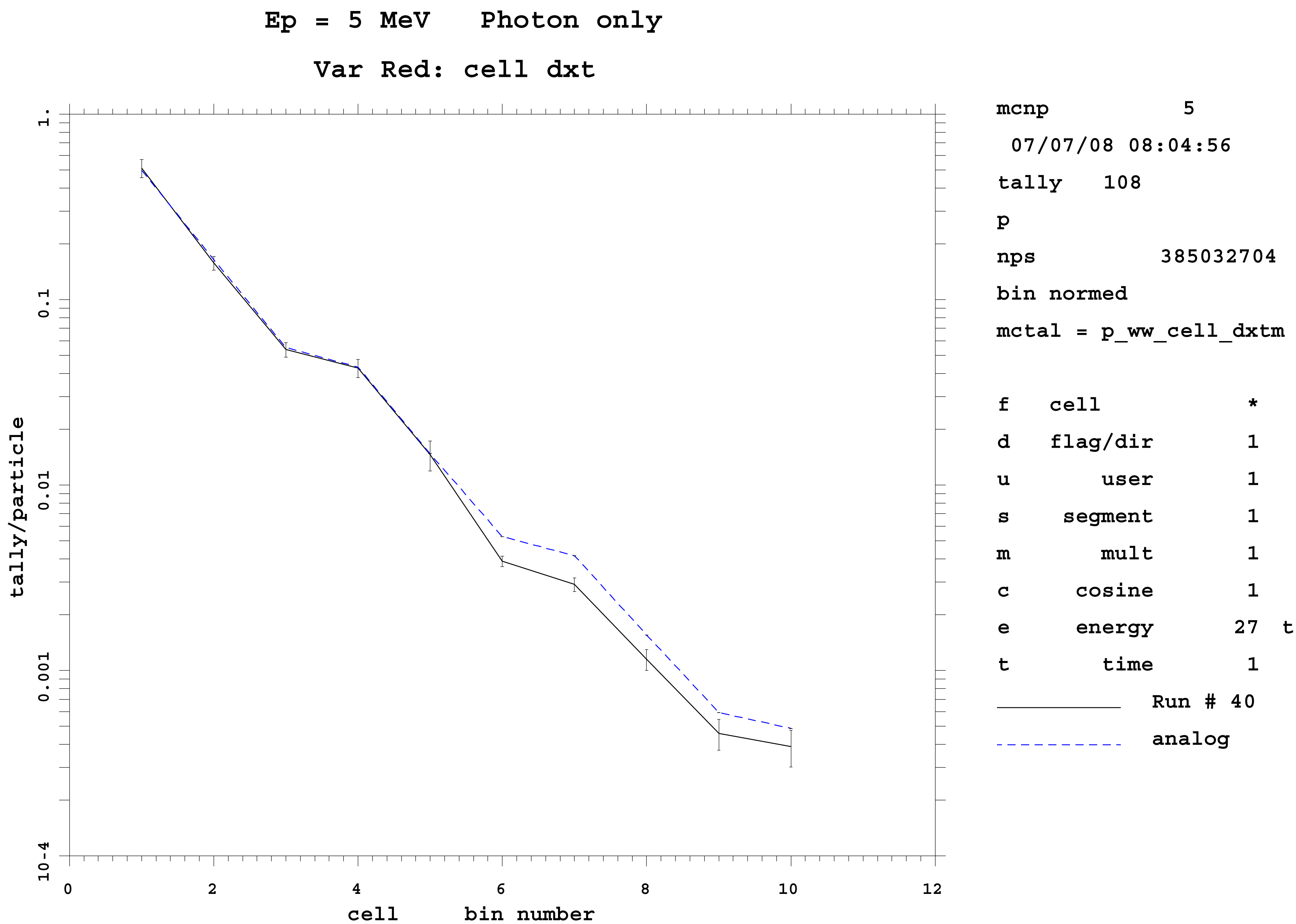
f	cell	*
d	flag/dir	1
u	user	1
s	segment	1
m	mult	1
c	cosine	1
e	energy	27 t
t	time	1

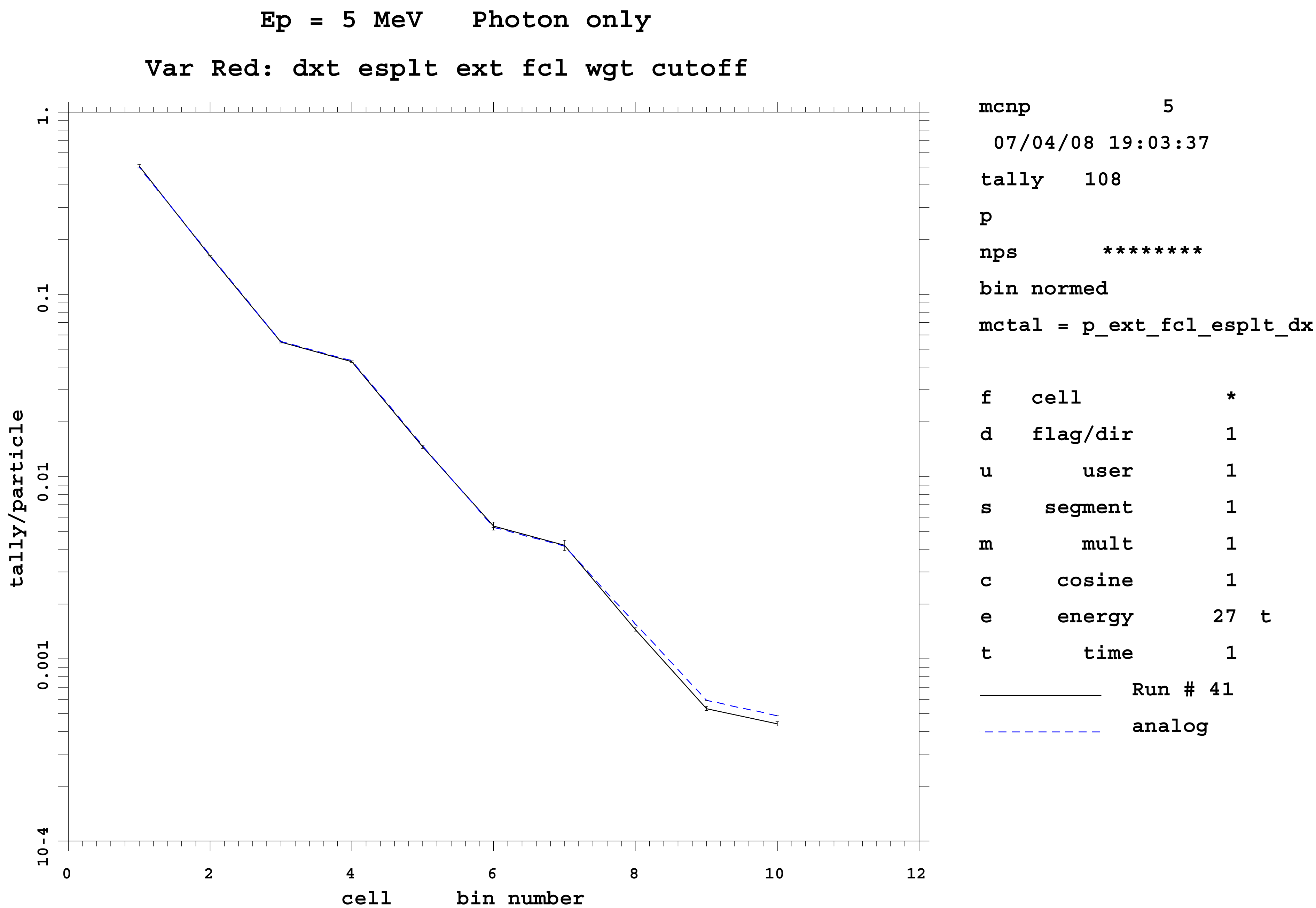
Run # 38

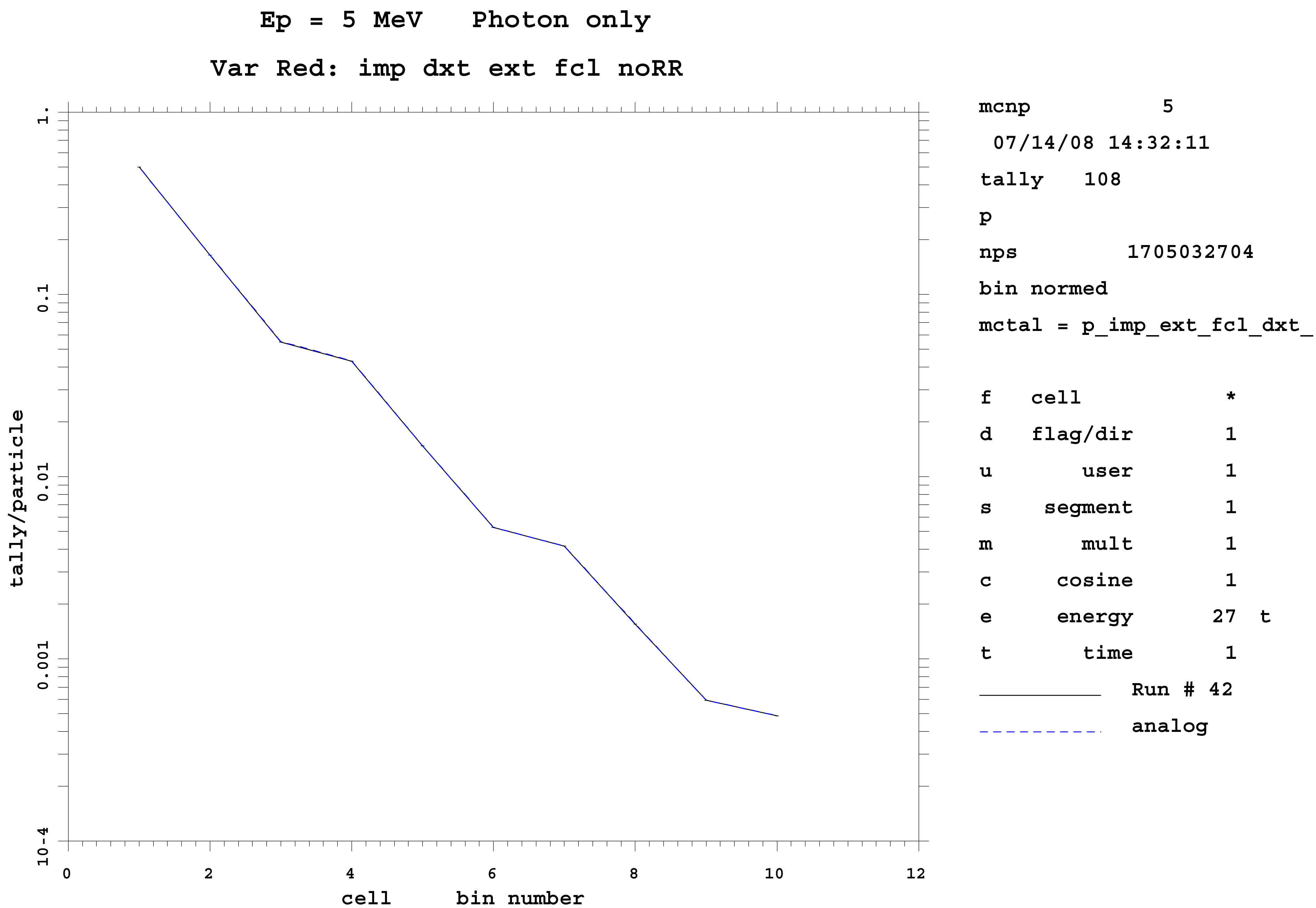
analog



Ep = 5 MeV Photon only
Var Red: mesh dxt
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/05/08 22:56:41
tally 108
p
nps 1515098112
bin normed
mctal = p_mesh_dxtm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 39
analog


Ep = 5 MeV Photon only
Var Red: cell dxt
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/07/08 08:04:56
tally 108
p
nps 385032704
bin normed
mctal = p_ww_cell_dxtm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 40
analog


Ep = 5 MeV   Photon only
Var Red: dxt esplt ext fcl wgt cutoff
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell   bin number
mcnp 5
07/04/08 19:03:37
tally 108
p
nps ********
bin normed
mctal = p_ext_fcl_esplt_dx
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 41
analog

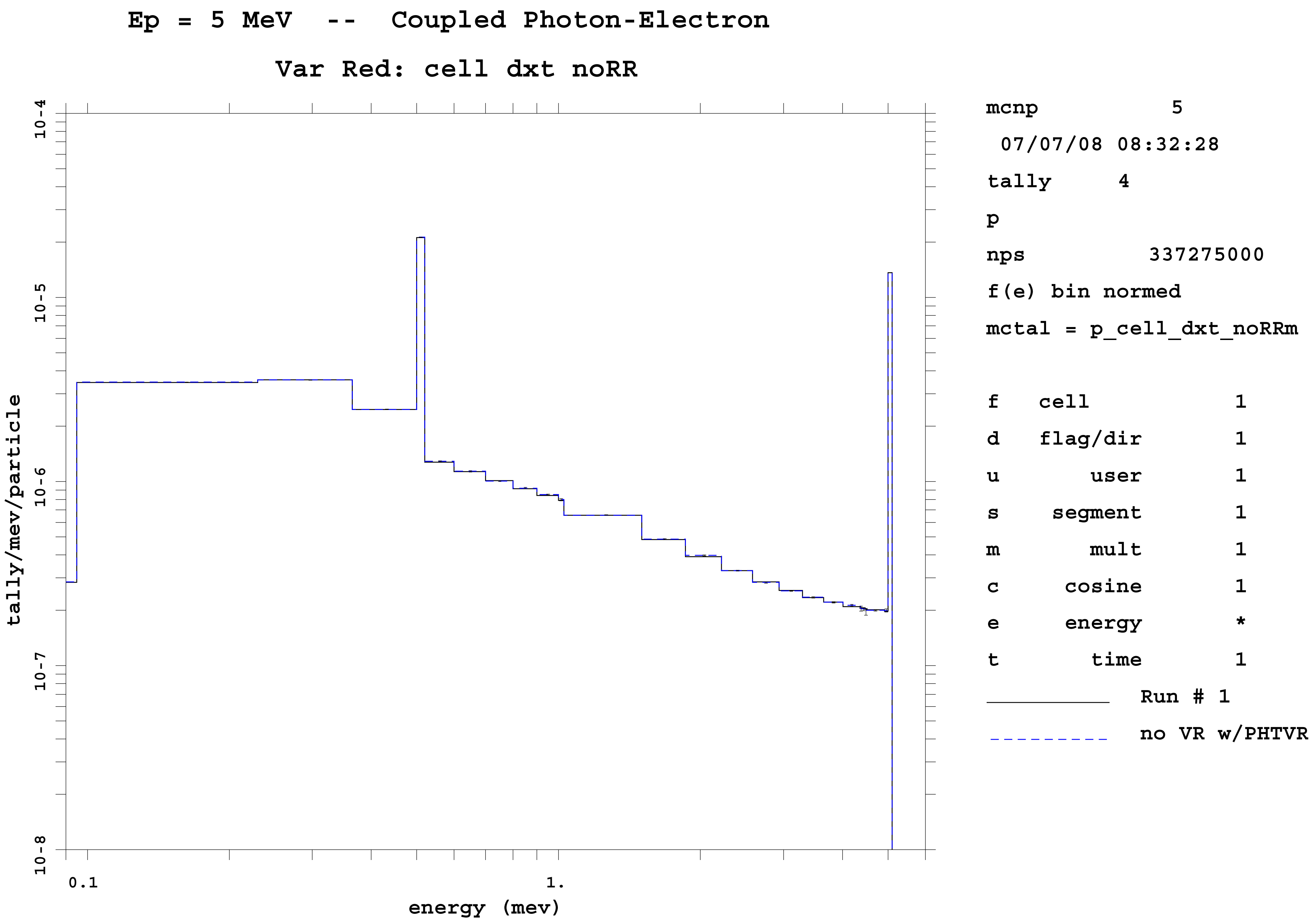

Ep = 5 MeV Photon only
Var Red: imp dxt ext fcl noRR
tally/particle
1.
0.1
0.01
0.001
10-4
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/14/08 14:32:11
tally 108
p
nps 1705032704
bin normed
mctal = p_imp_ext_fcl_dxt_
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 27 t
t time 1
Run # 42
analog

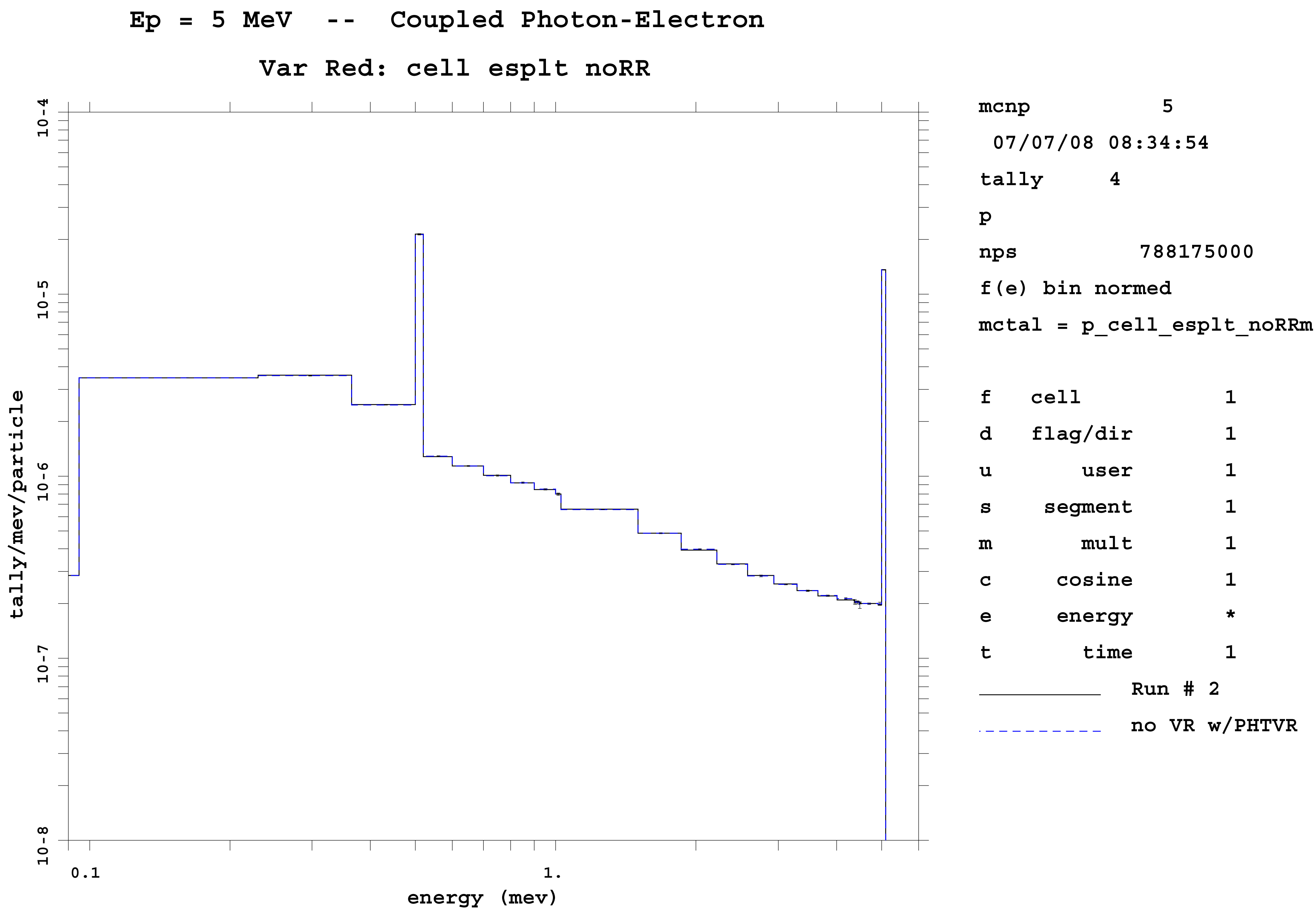
Appendix A.2.i

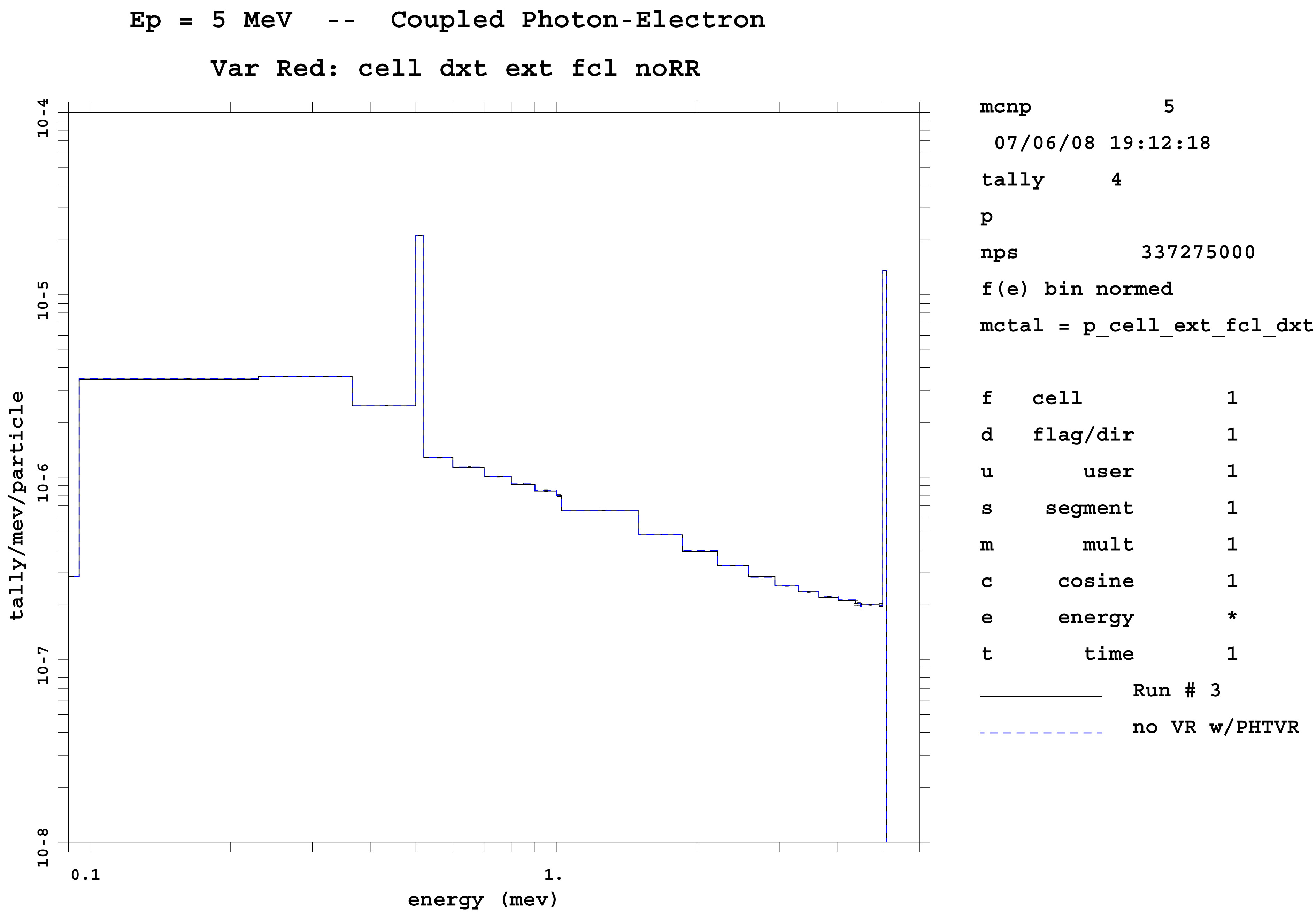
Problem 1
Ge sphere Next To a U / O Stacked Cylinder Problem

Plots of the track length tally spectra in the germanium sphere

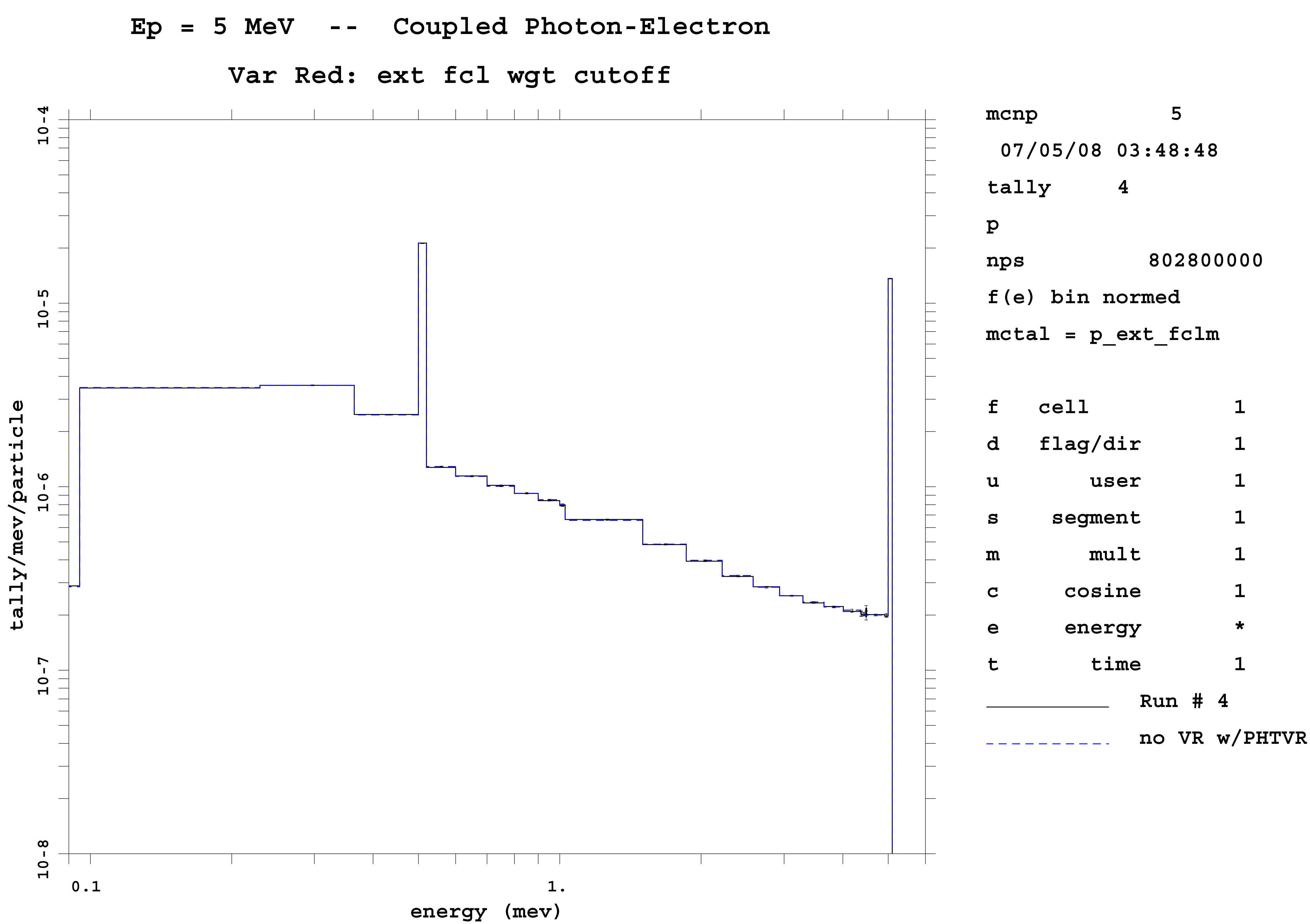
Plots are in order of the run number listed in Table 3. The variance reduction methods used are listed in the plot title; the graph label contains the run number.

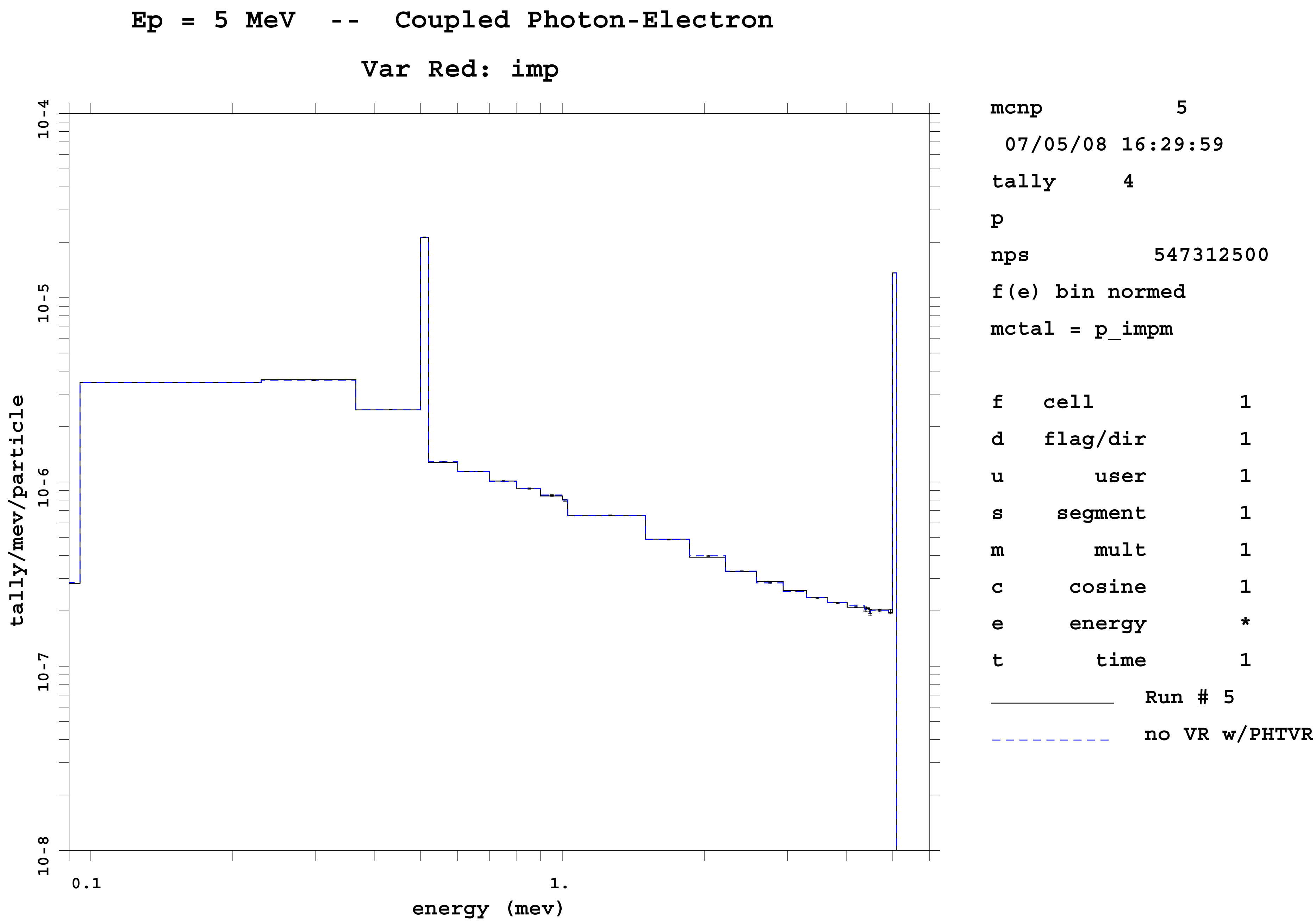

Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell dxt noRR
tally/mev/particle
10-4
10-5
10-6
10-7
10-8
0.1
1.
energy (mev)
mcnp 5
07/07/08 08:32:28
tally 4
p
nps 337275000
f(e) bin normed
mctal = p_cell_dxt_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 1
no VR w/PHTVR


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell esplt noRR
10-4
10-5
10-6
10-7
10-8
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 08:34:54
tally 4
p
nps 788175000
f(e) bin normed
mctal = p_cell_esplt_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 2
no VR w/PHTVR

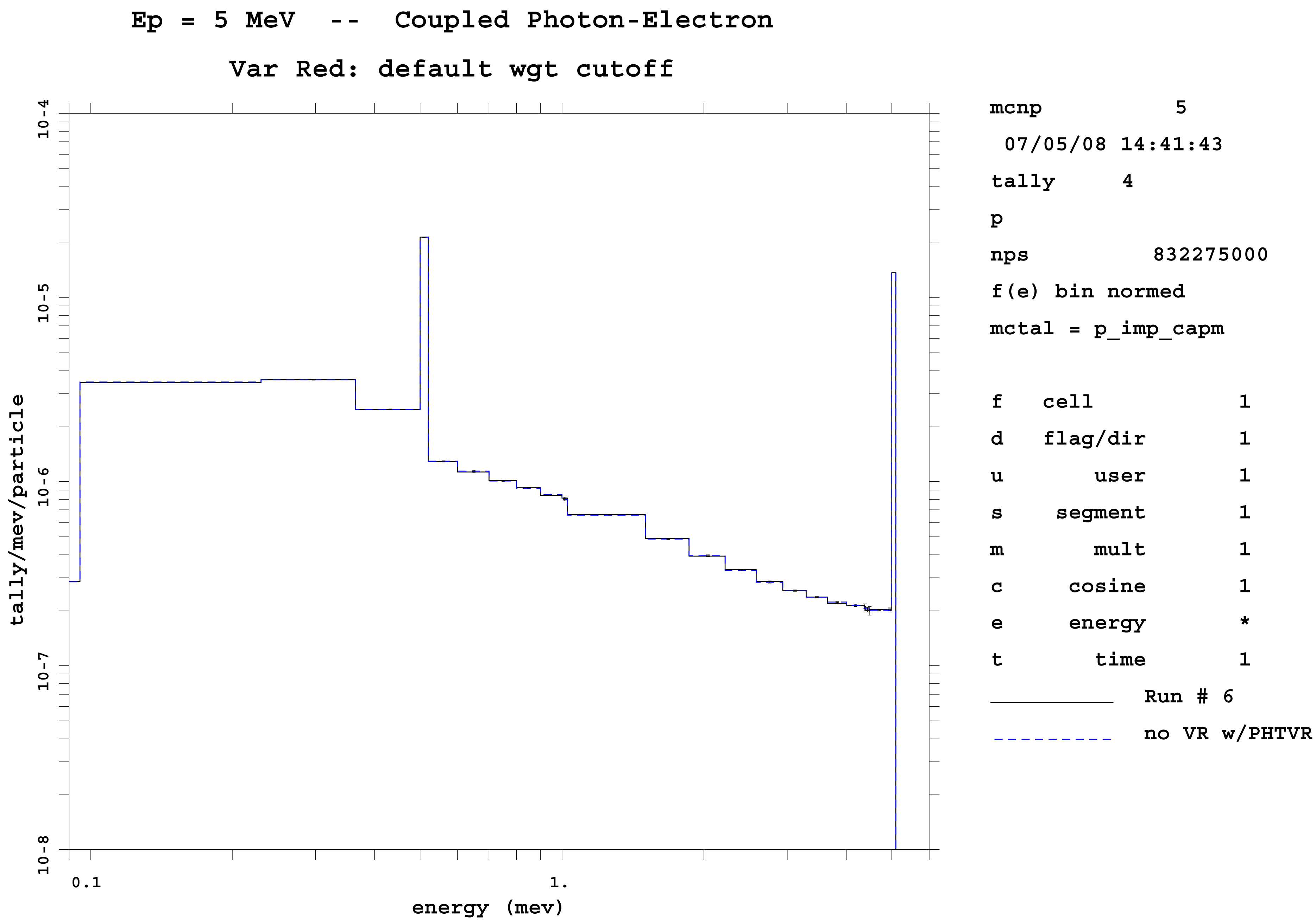


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell dxt ext fcl noRR
10-4
10-5
10-6
10-7
10-8
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/06/08 19:12:18
tally 4
p
nps 337275000
f(e) bin normed
mctal = p_cell_ext_fcl_dxt
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 3
no VR w/PHTVR

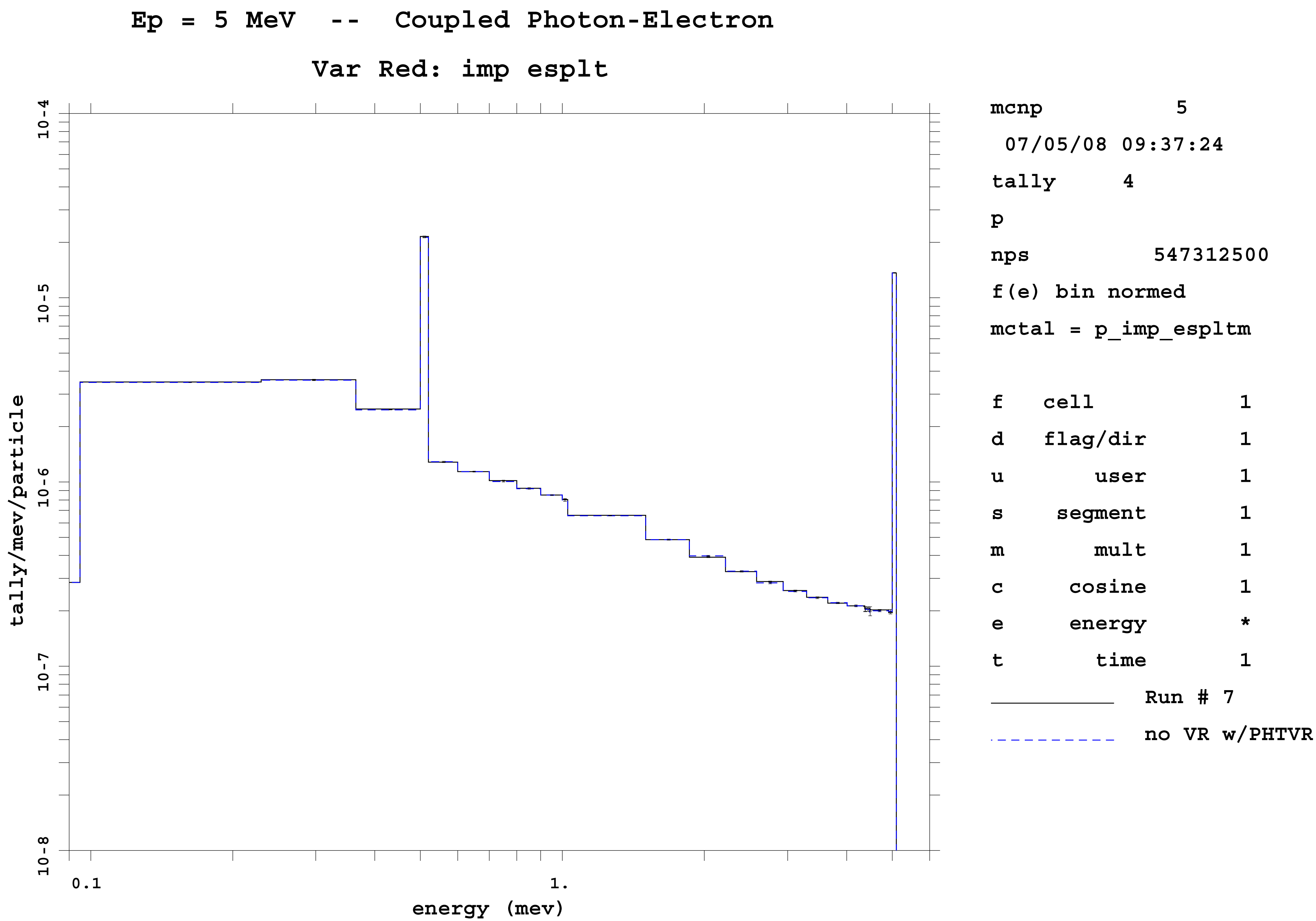

Ep = 5 MeV -- Coupled Photon-Electron
Var Red: ext fcl wgt cutoff
10-4
10-5
10-6
10-7
10-8
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/05/08 03:48:48
tally 4
p
nps 802800000
f(e) bin normed
mctal = p_ext_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 4
no VR w/PHTVR



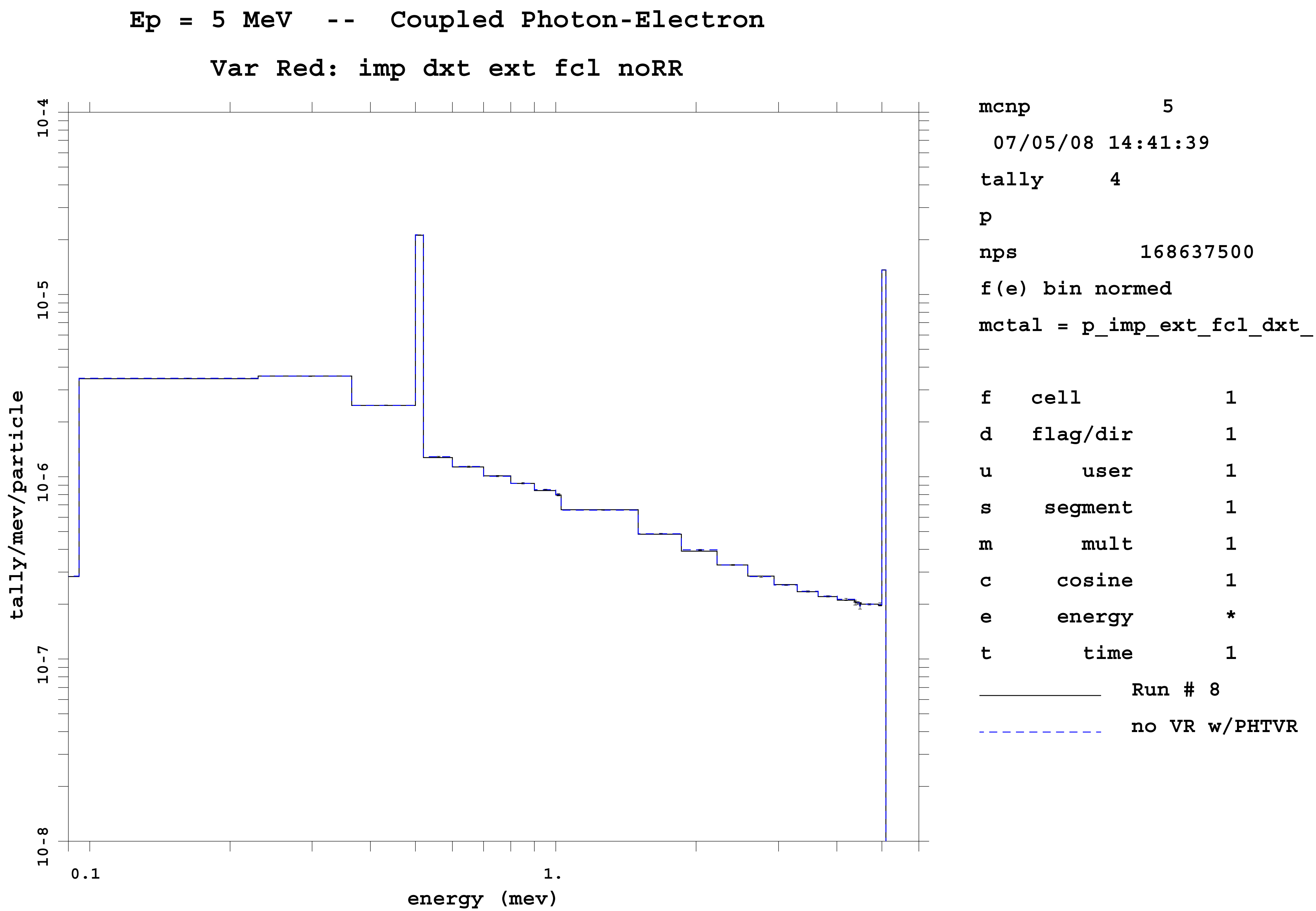
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp
tally/mev/particle
10-4
10-5
10-6
10-7
10-8
0.1
1.
energy (mev)
mcnp 5
07/05/08 16:29:59
tally 4
p
nps 547312500
f(e) bin normed
mctal = p_impm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 5
no VR w/PHTVR



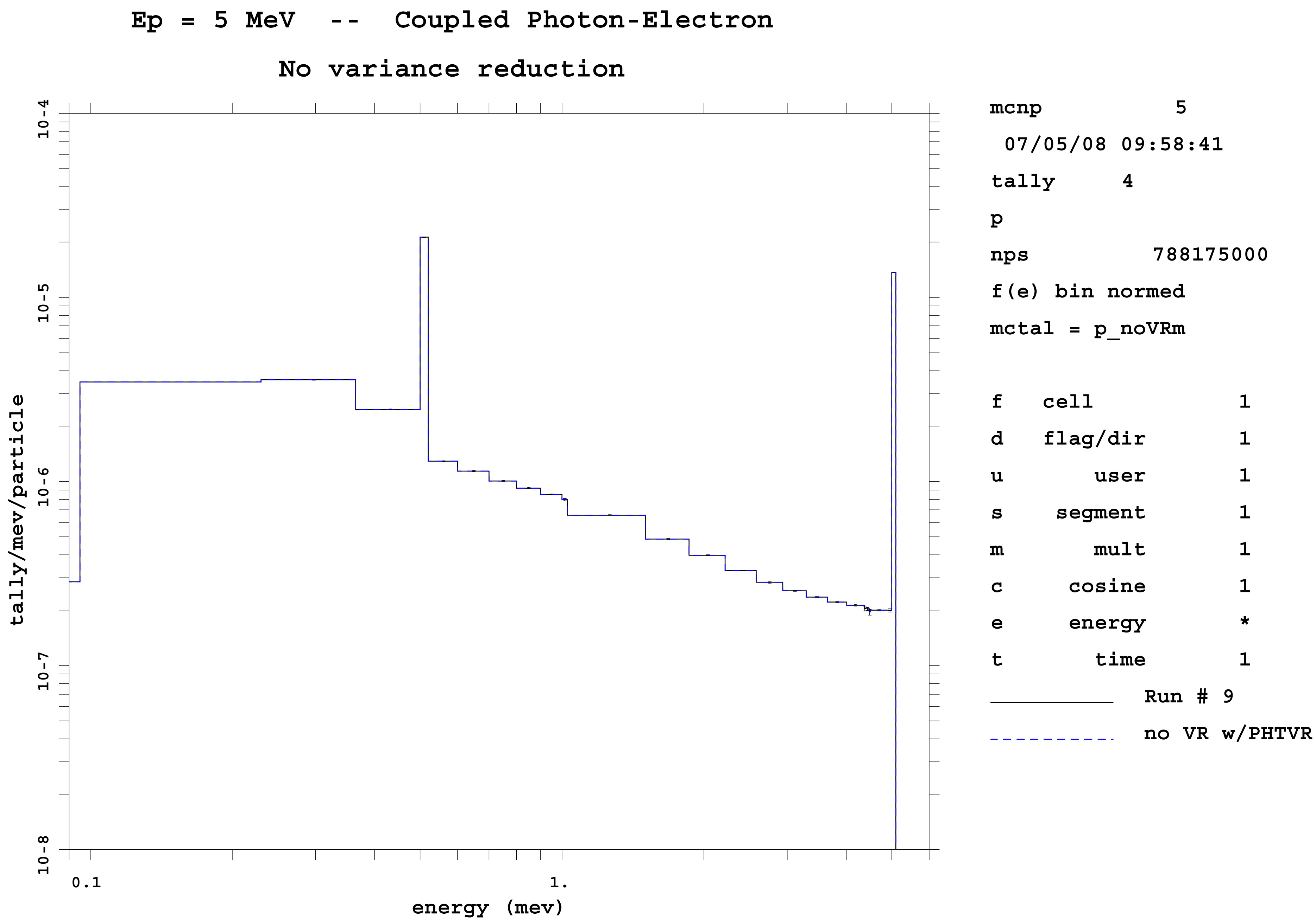
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: default wgt cutoff
tally/mev/particle
10-4
10-5
10-6
10-7
10-8
0.1
1.
energy (mev)
mcnp 5
07/05/08 14:41:43
tally 4
p
nps 832275000
f(e) bin normed
mctal = p_imp_capm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 6
no VR w/PHTVR

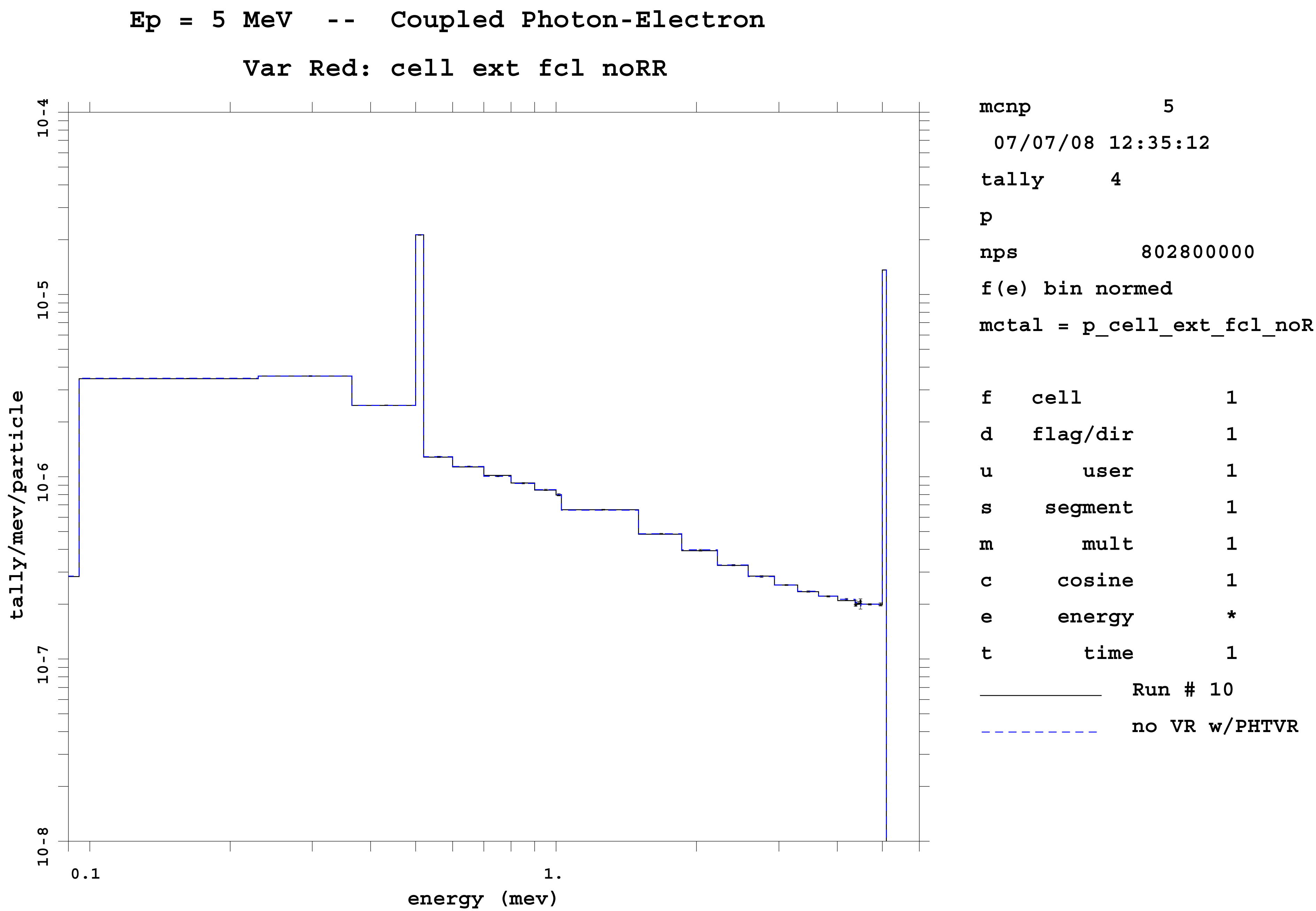


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp esplt
10-4
10-5
10-6
10-7
10-8
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/05/08 09:37:24
tally 4
p
nps 547312500
f(e) bin normed
mctal = p_imp_espltm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 7
no VR w/PHTVR

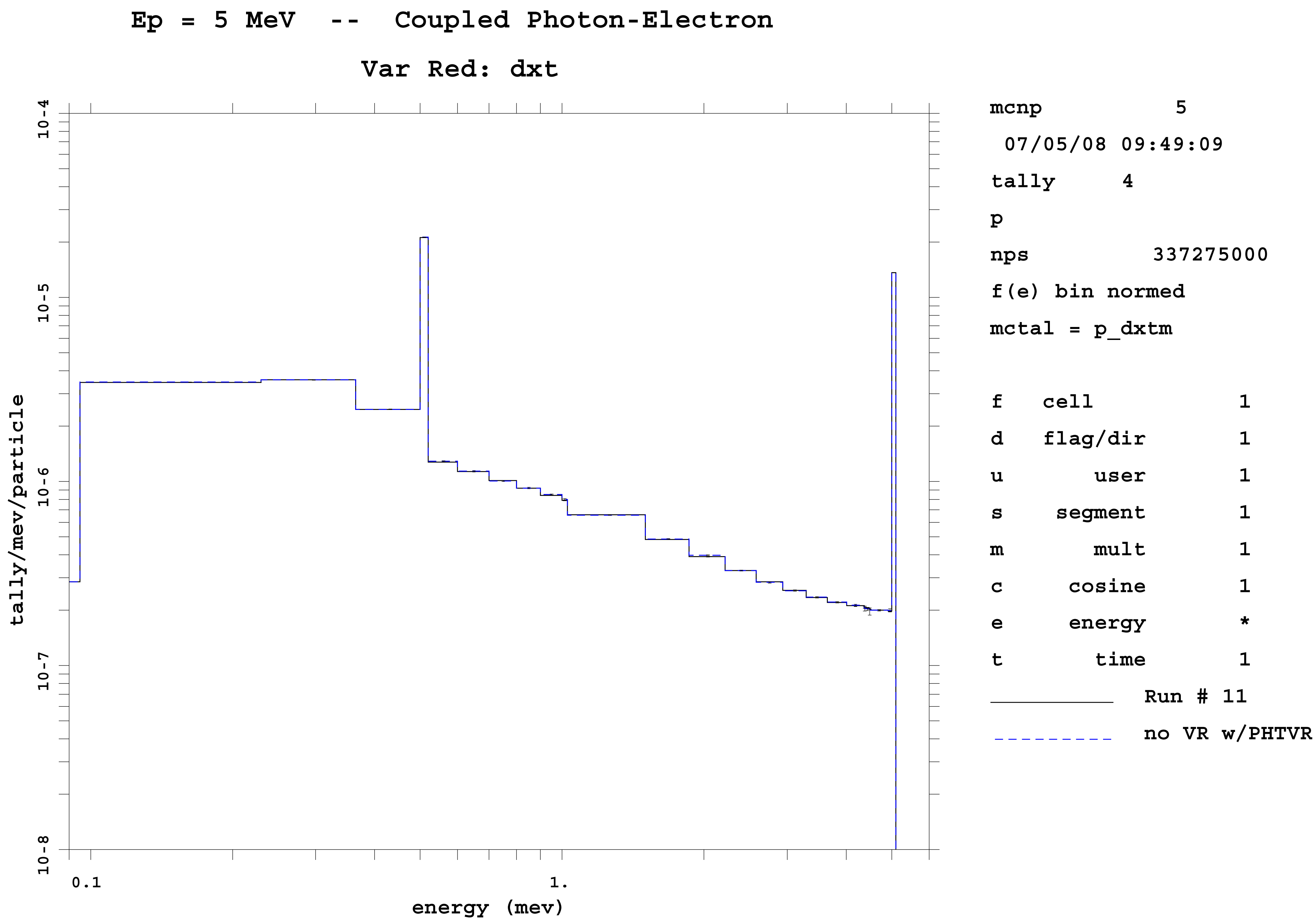


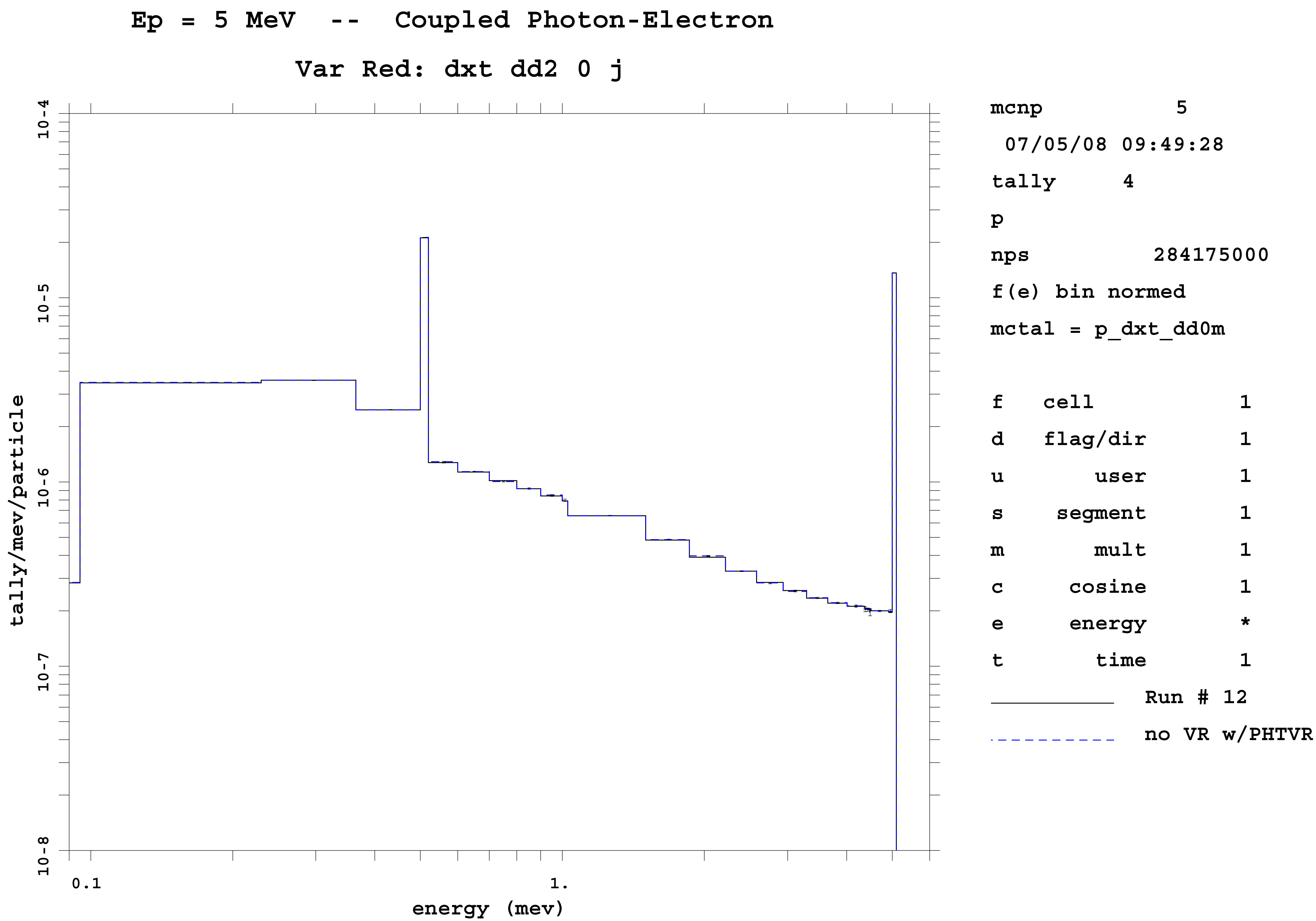
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp dxt ext fcl noRR
10-4
10-5
10-6
10-7
10-8
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/05/08 14:41:39
tally 4
p
nps 168637500
f(e) bin normed
mctal = p_imp_ext_fcl_dxt_
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 8
no VR w/PHTVR


Ep = 5 MeV -- Coupled Photon-Electron
No variance reduction
10-4
10-5
10-6
10-7
10-8
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/05/08 09:58:41
tally 4
p
nps 788175000
f(e) bin normed
mctal = p_noVRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 9
no VR w/PHTVR

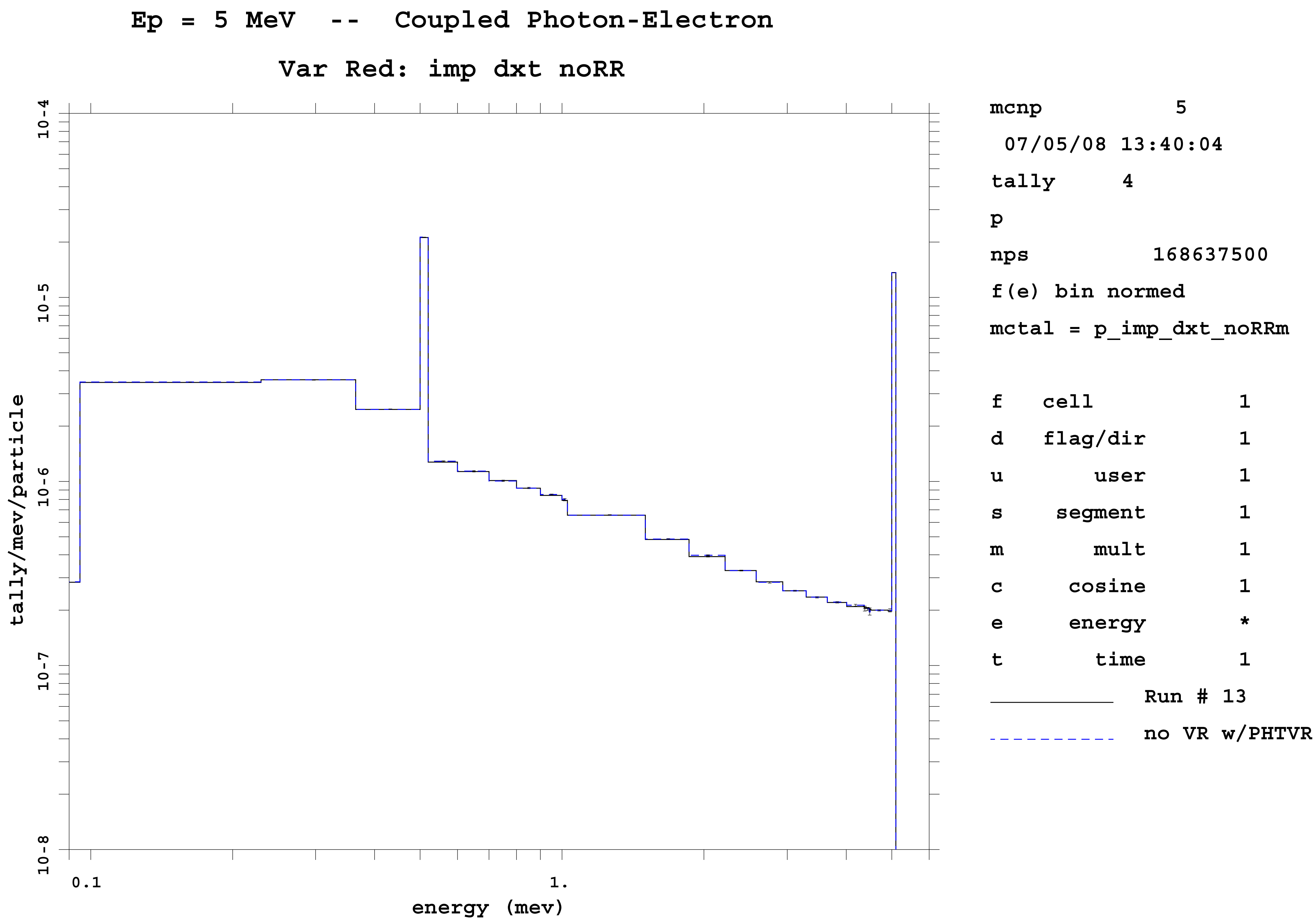


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell ext fcl noRR
10-4
10-5
10-6
10-7
10-8
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 12:35:12
tally 4
p
nps 802800000
f(e) bin normed
mctal = p_cell_ext_fcl_noR
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 10
no VR w/PHTVR


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: dxt
tally/mev/particle
10-4
10-5
10-6
10-7
10-8
0.1
1.
energy (mev)
mcnp 5
07/05/08 09:49:09
tally 4
p
nps 337275000
f(e) bin normed
mctal = p_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 11
no VR w/PHTVR



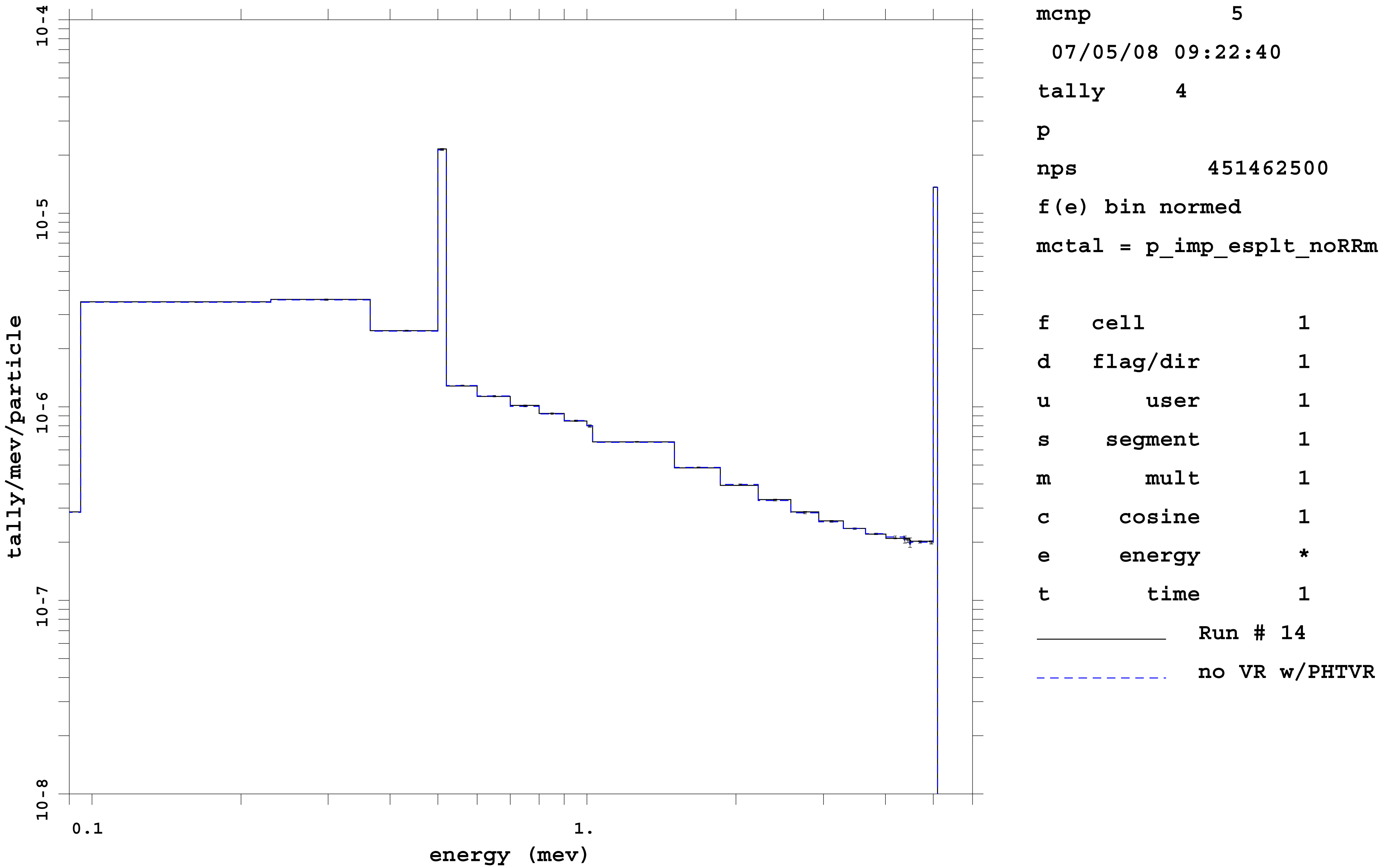
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: dxt dd2 0 j
10-4
10-5
10-6
10-7
10-8
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/05/08 09:49:28
tally 4
p
nps 284175000
f(e) bin normed
mctal = p_dxt_dd0m
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 12
no VR w/PHTVR

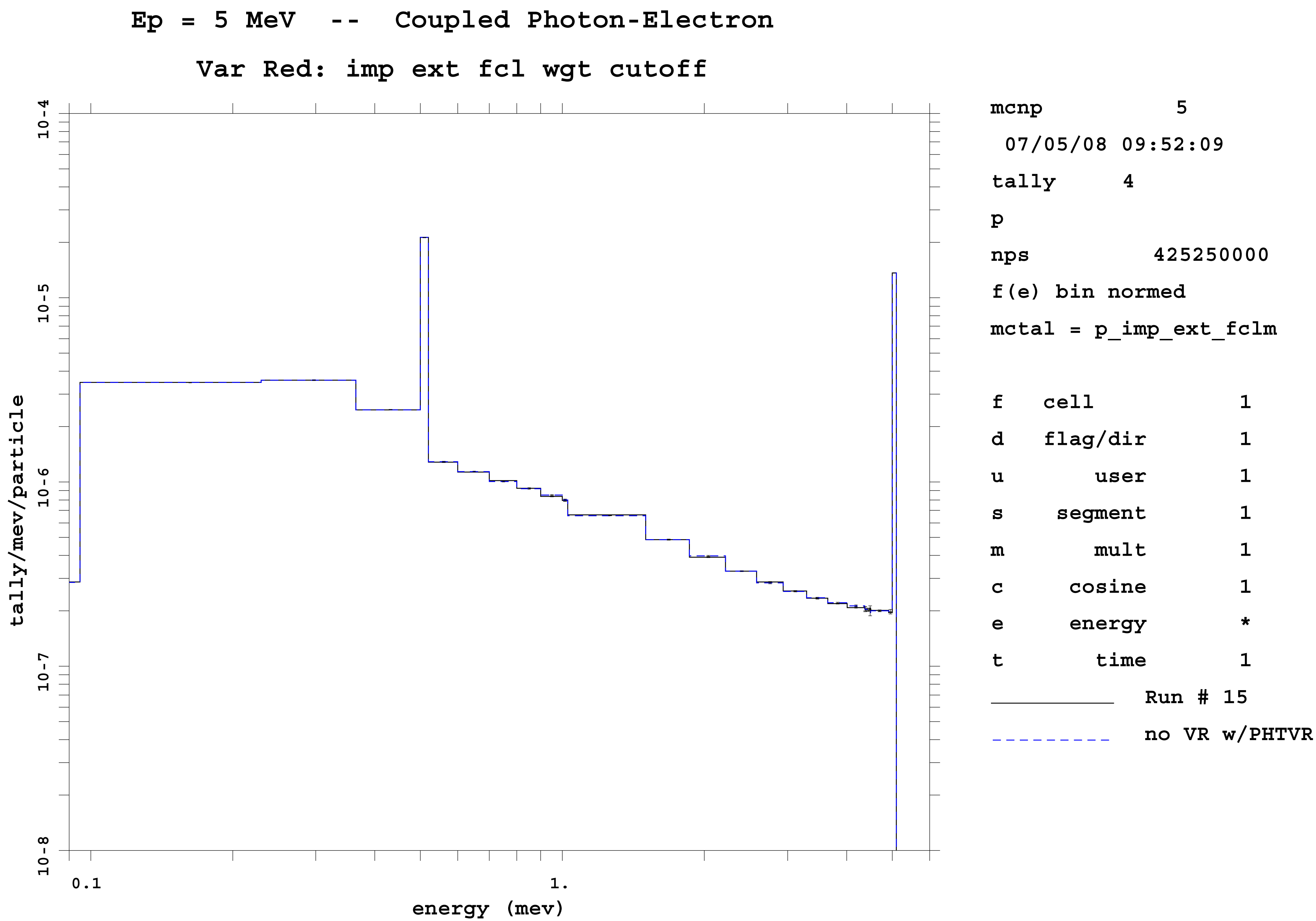


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp dxt noRR
10-4
10-5
10-6
10-7
10-8
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/05/08 13:40:04
tally 4
p
nps 168637500
f(e) bin normed
mctal = p_imp_dxt_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 13
no VR w/PHTVR

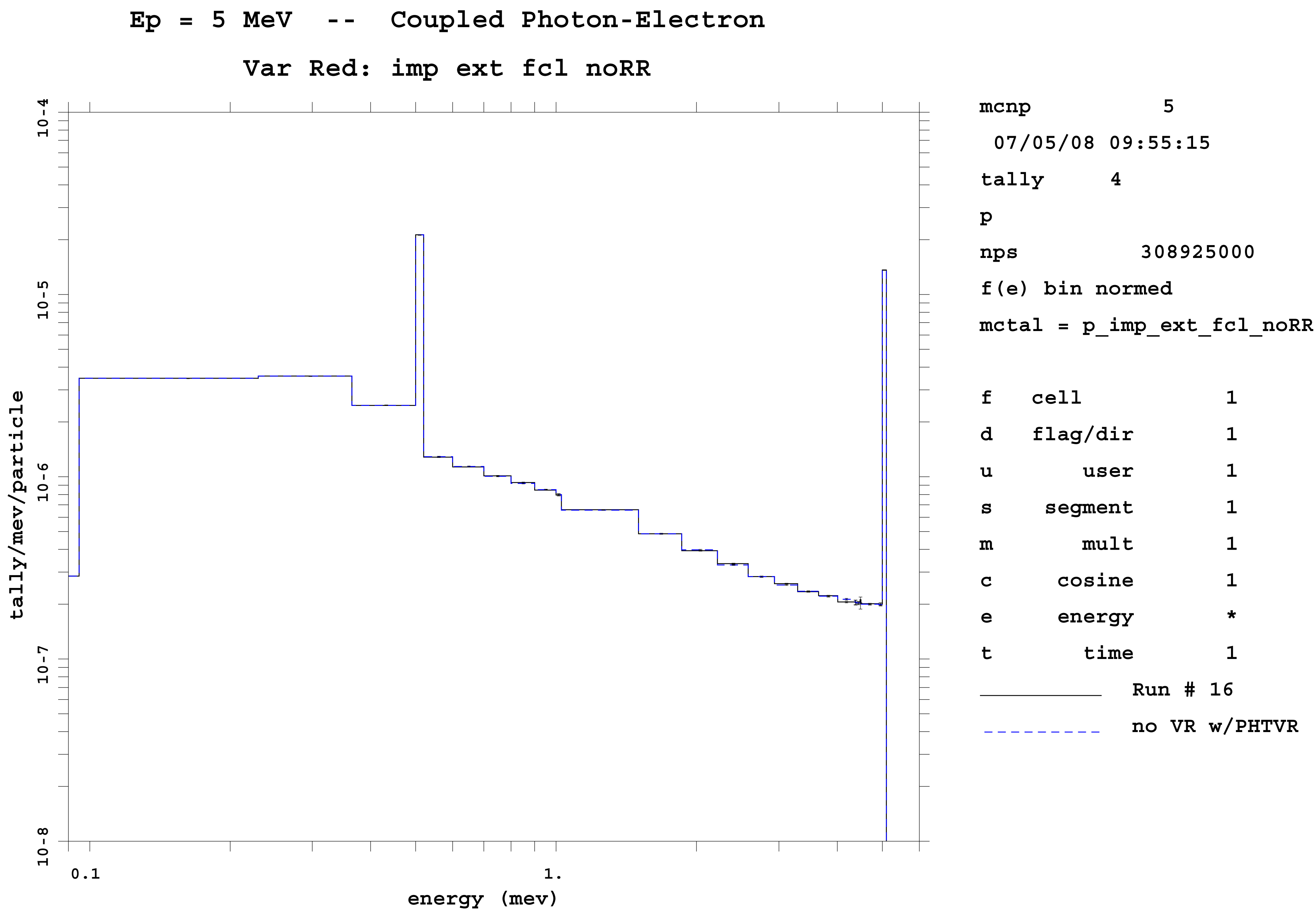
Ep = 5 MeV -- Coupled Photon-Electron

Var Red: imp esplt noRR

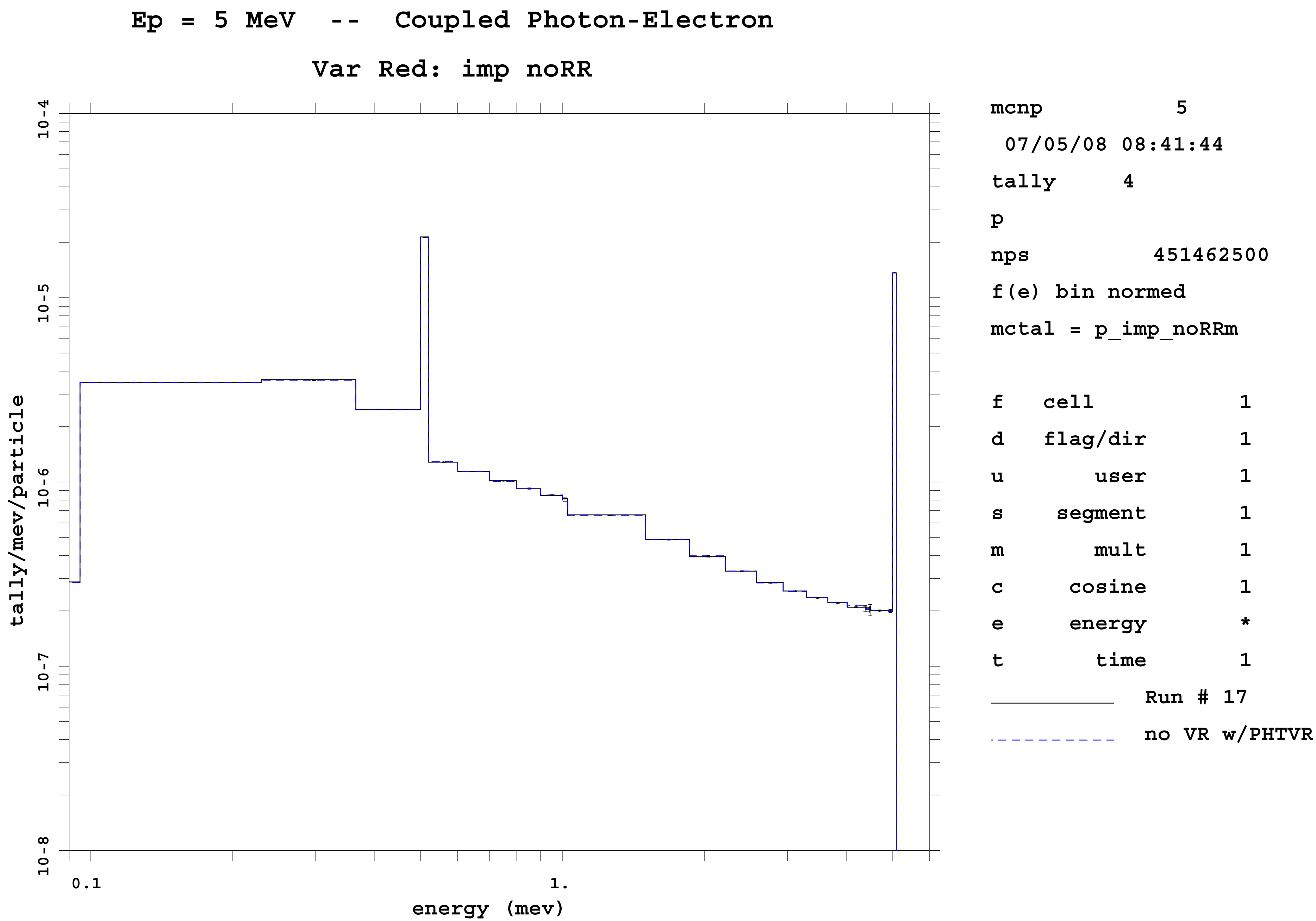




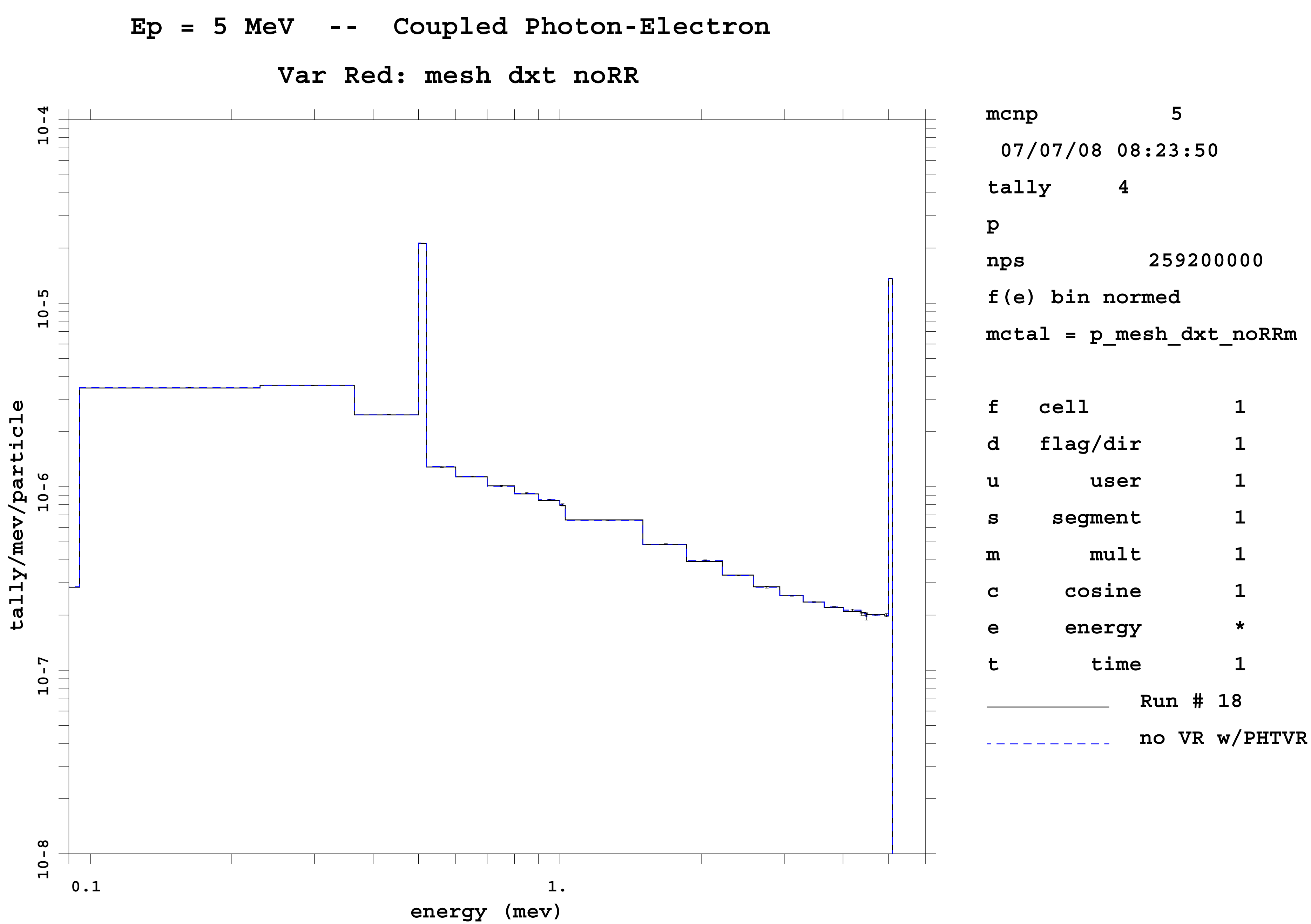
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp ext fcl wgt cutoff
10-4
10-5
10-6
10-7
10-8
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/05/08 09:52:09
tally 4
p
nps 425250000
f(e) bin normed
mctal = p_imp_ext_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 15
no VR w/PHTVR



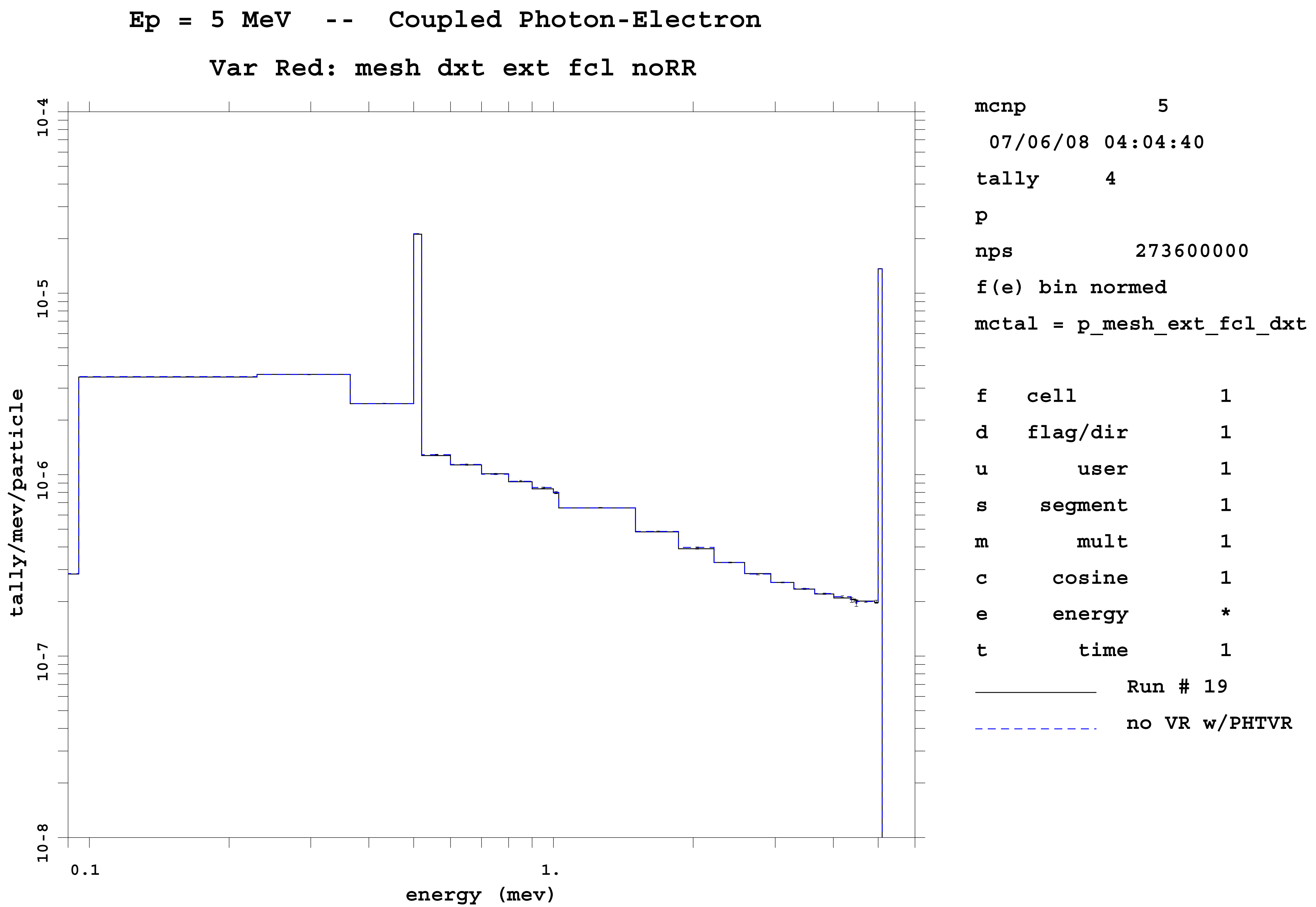
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp ext fcl noRR
10-4
10-5
10-6
10-7
10-8
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/05/08 09:55:15
tally 4
p
nps 308925000
f(e) bin normed
mctal = p_imp_ext_fcl_noRR
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 16
no VR w/PHTVR

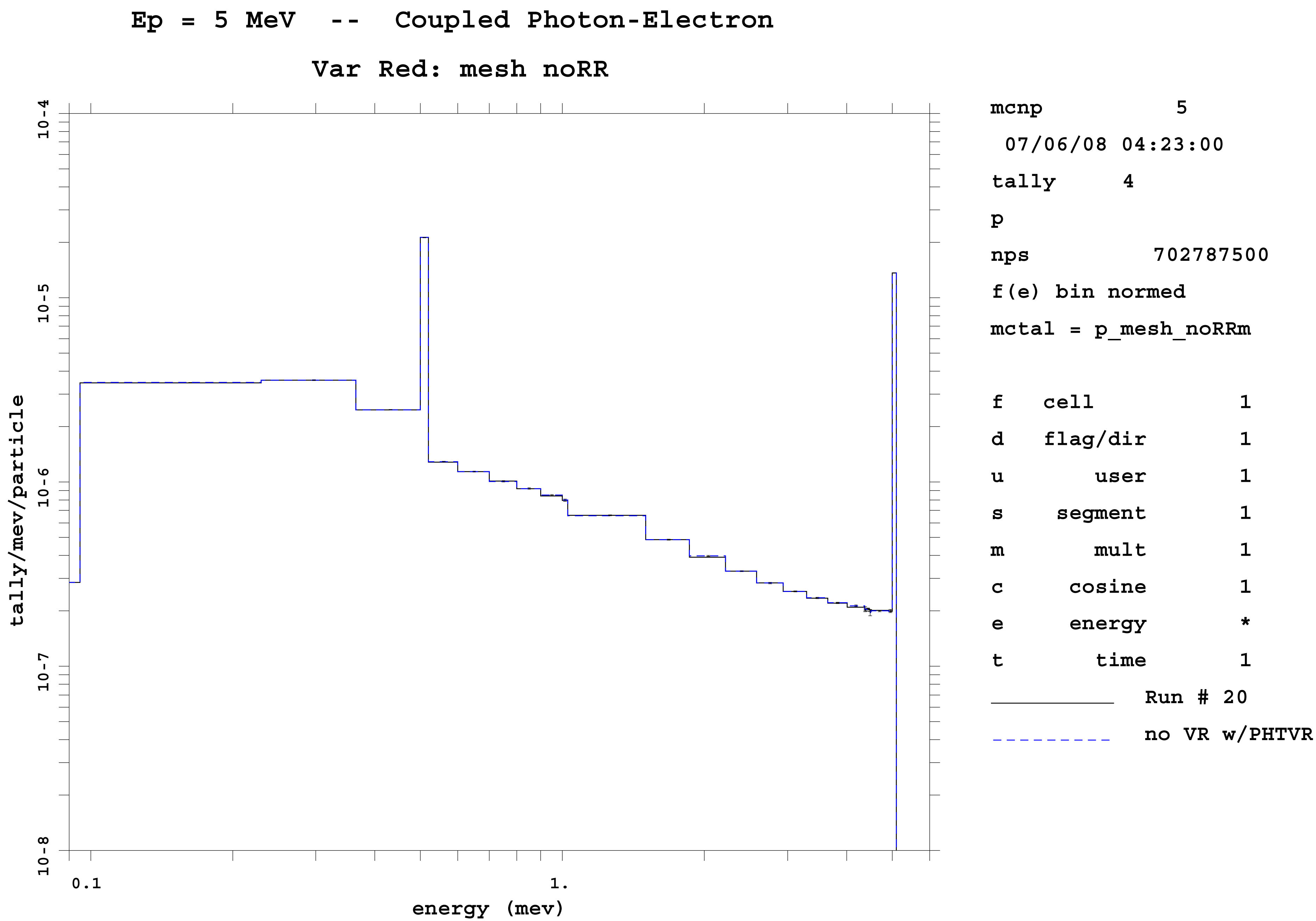


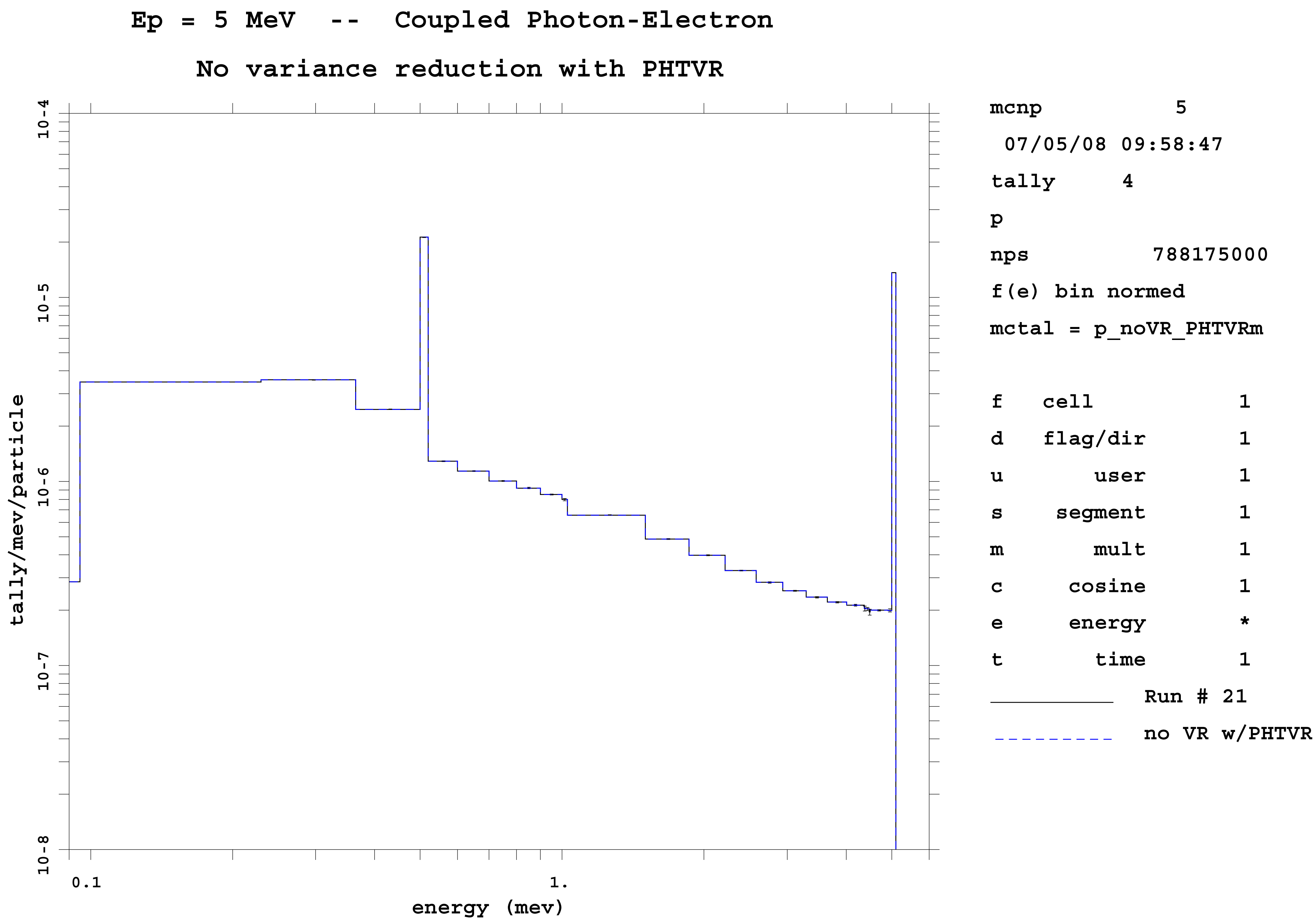
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp noRR
10-4
10-5
10-6
10-7
10-8
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/05/08 08:41:44
tally 4
p
nps 451462500
f(e) bin normed
mctal = p_imp_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 17
no VR w/PHTVR



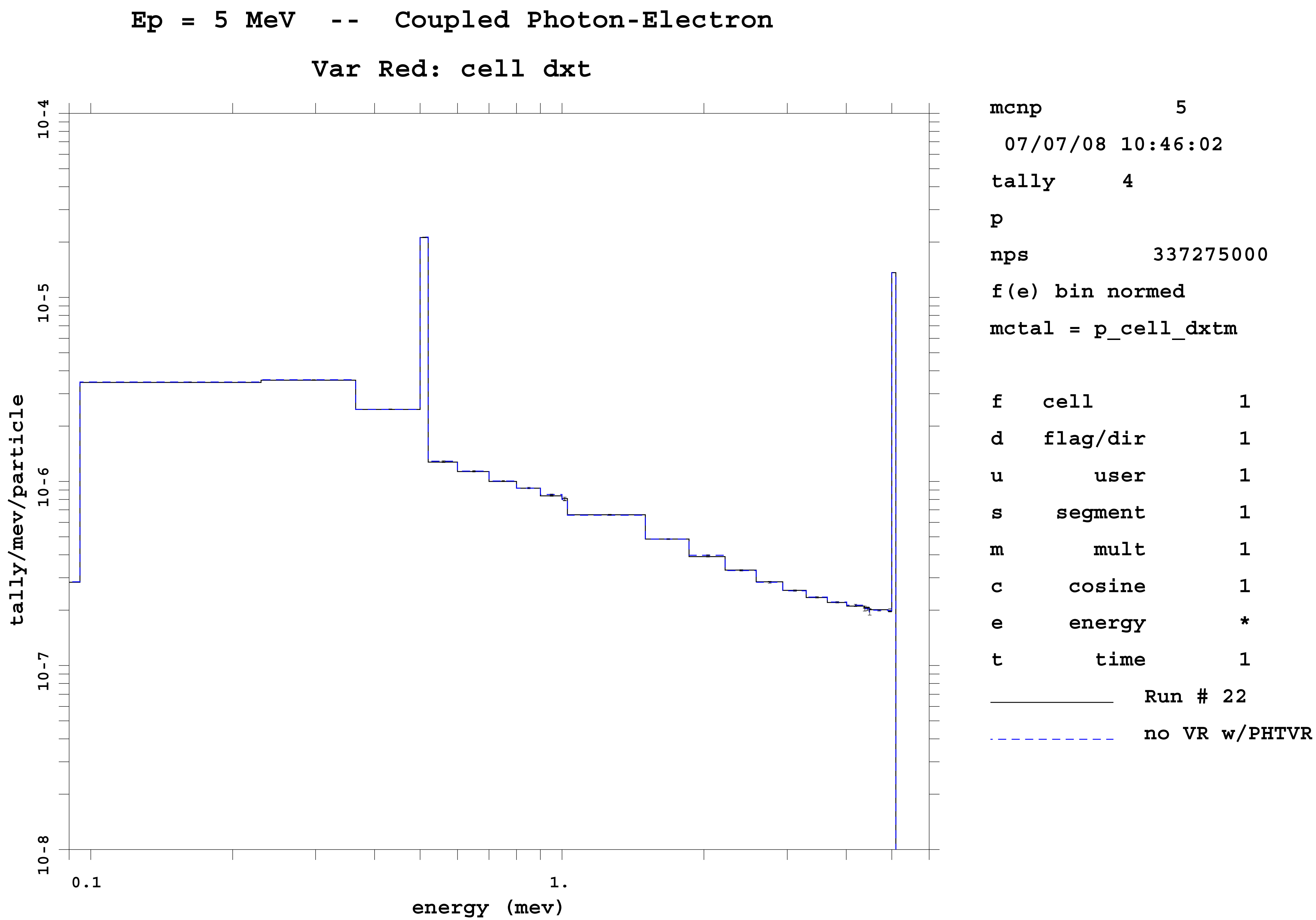
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: mesh dxt noRR
tally/mev/particle
10-4
10-5
10-6
10-7
10-8
0.1
1.
energy (mev)
mcnp 5
07/07/08 08:23:50
tally 4
p
nps 259200000
f(e) bin normed
mctal = p_mesh_dxt_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 18
no VR w/PHTVR

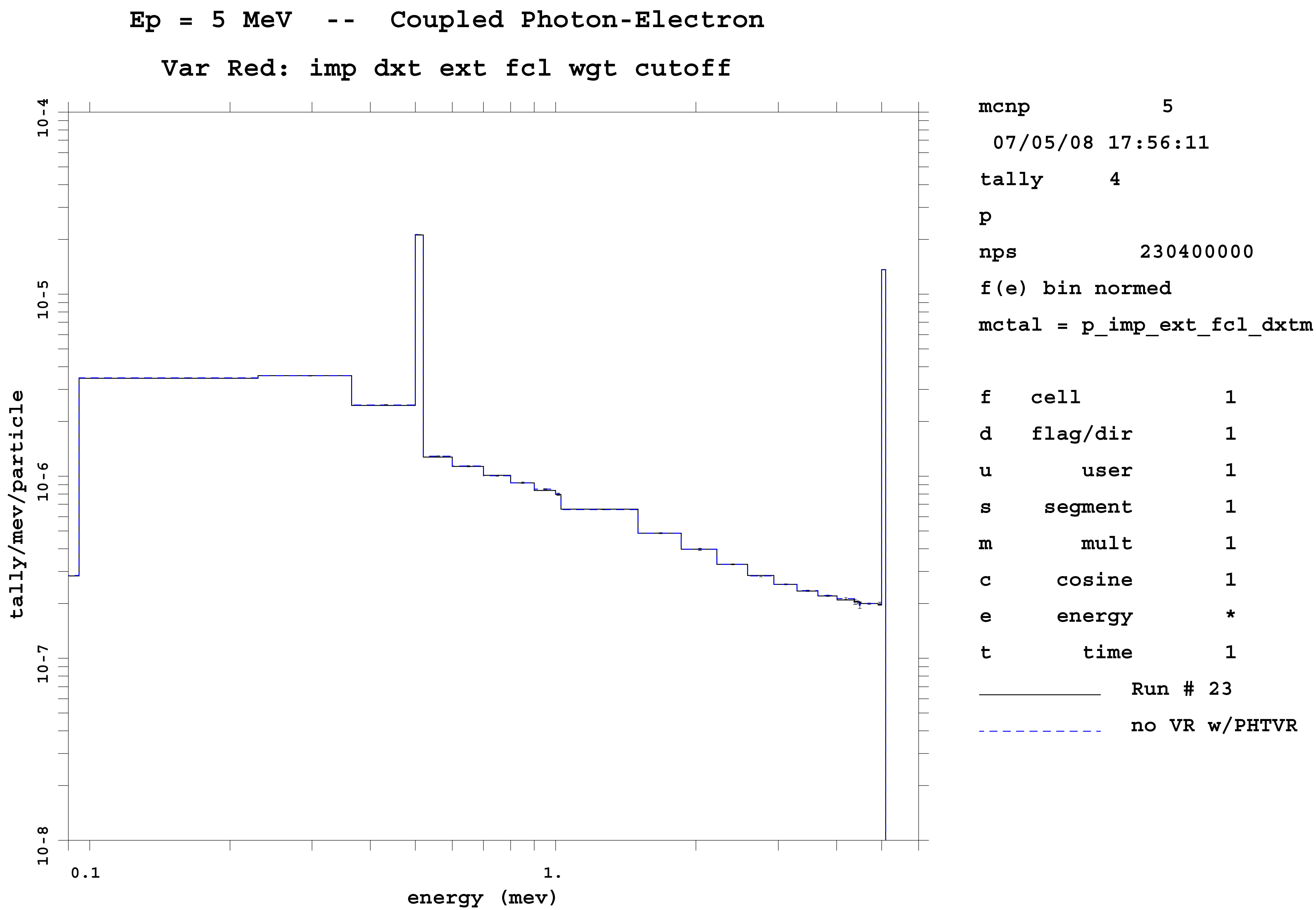

Ep = 5 MeV -- Coupled Photon-Electron
Var Red: mesh dxt ext fcl noRR
mcnp 5
07/06/08 04:04:40
tally 4
p
nps 273600000
f(e) bin normed
mctal = p_mesh_ext_fcl_dxt
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 19
no VR w/PHTVR
tally/mev/particle
10-4
10-5
10-6
10-7
10-8
0.1
1.
energy (mev)


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: mesh noRR
10-4
10-5
10-6
10-7
10-8
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/06/08 04:23:00
tally 4
p
nps 702787500
f(e) bin normed
mctal = p_mesh_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 20
no VR w/PHTVR

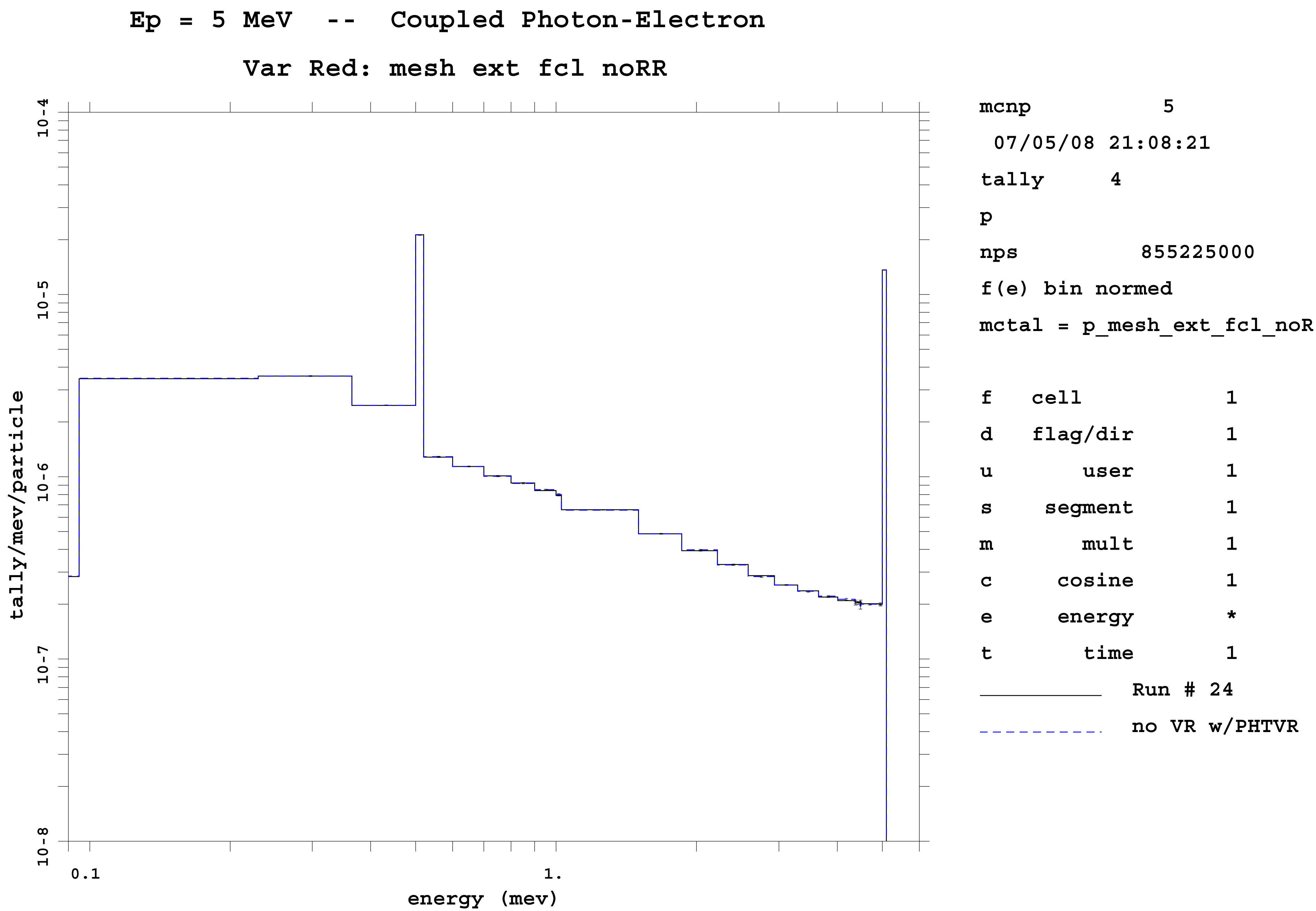


Ep = 5 MeV -- Coupled Photon-Electron
No variance reduction with PHTVR
10-4
10-5
10-6
10-7
10-8
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/05/08 09:58:47
tally 4
p
nps 788175000
f(e) bin normed
mctal = p_noVR_PHTVRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 21
no VR w/PHTVR

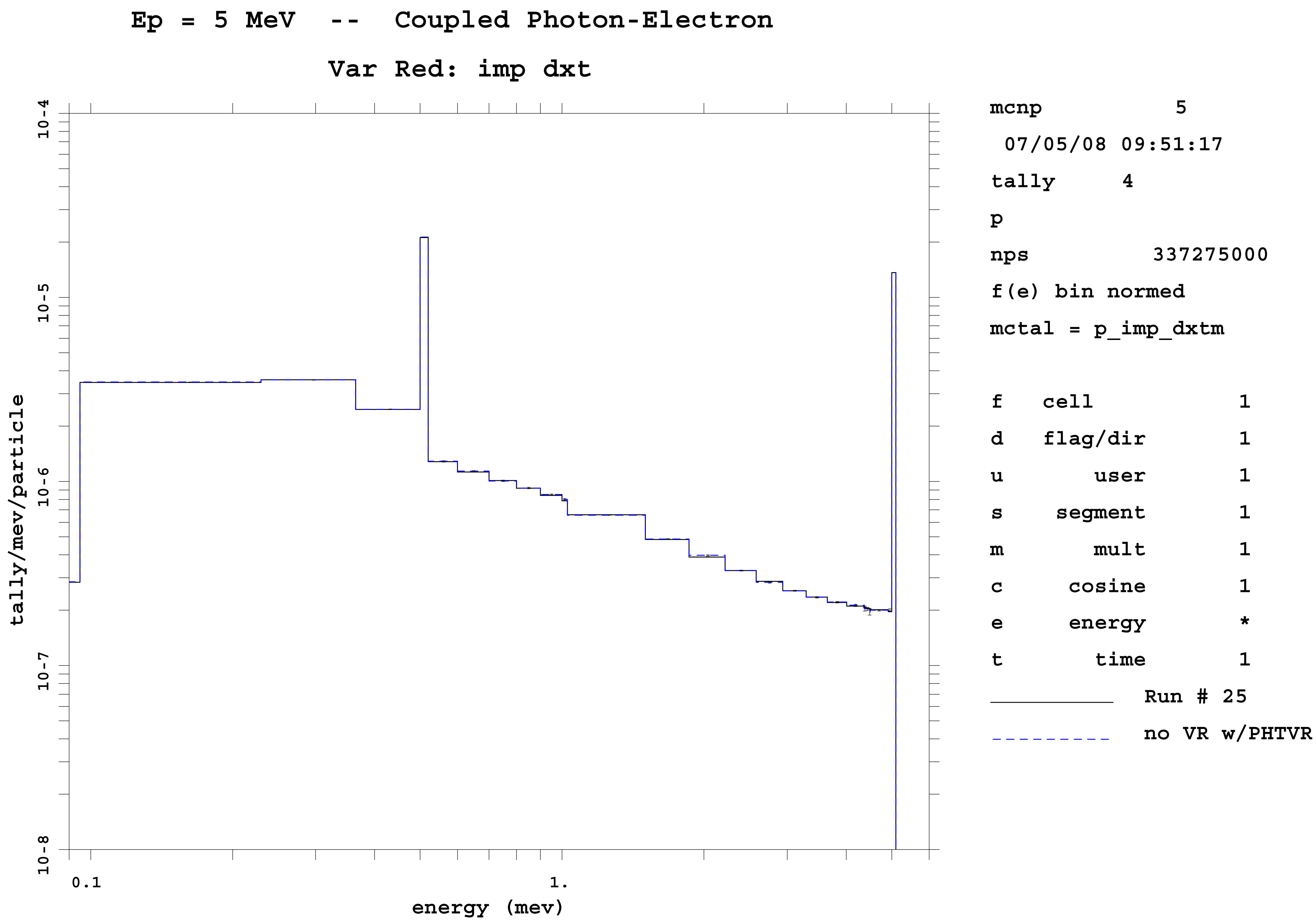

Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell dxt
10-4
10-5
10-6
10-7
10-8
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 10:46:02
tally 4
p
nps 337275000
f(e) bin normed
mctal = p_cell_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 22
no VR w/PHTVR



Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp dxt ext fcl wgt cutoff
tally/mev/particle
10-4
10-5
10-6
10-7
10-8
0.1
1.
energy (mev)
mcnp 5
07/05/08 17:56:11
tally 4
p
nps 230400000
f(e) bin normed
mctal = p_imp_ext_fcl_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 23
no VR w/PHTVR

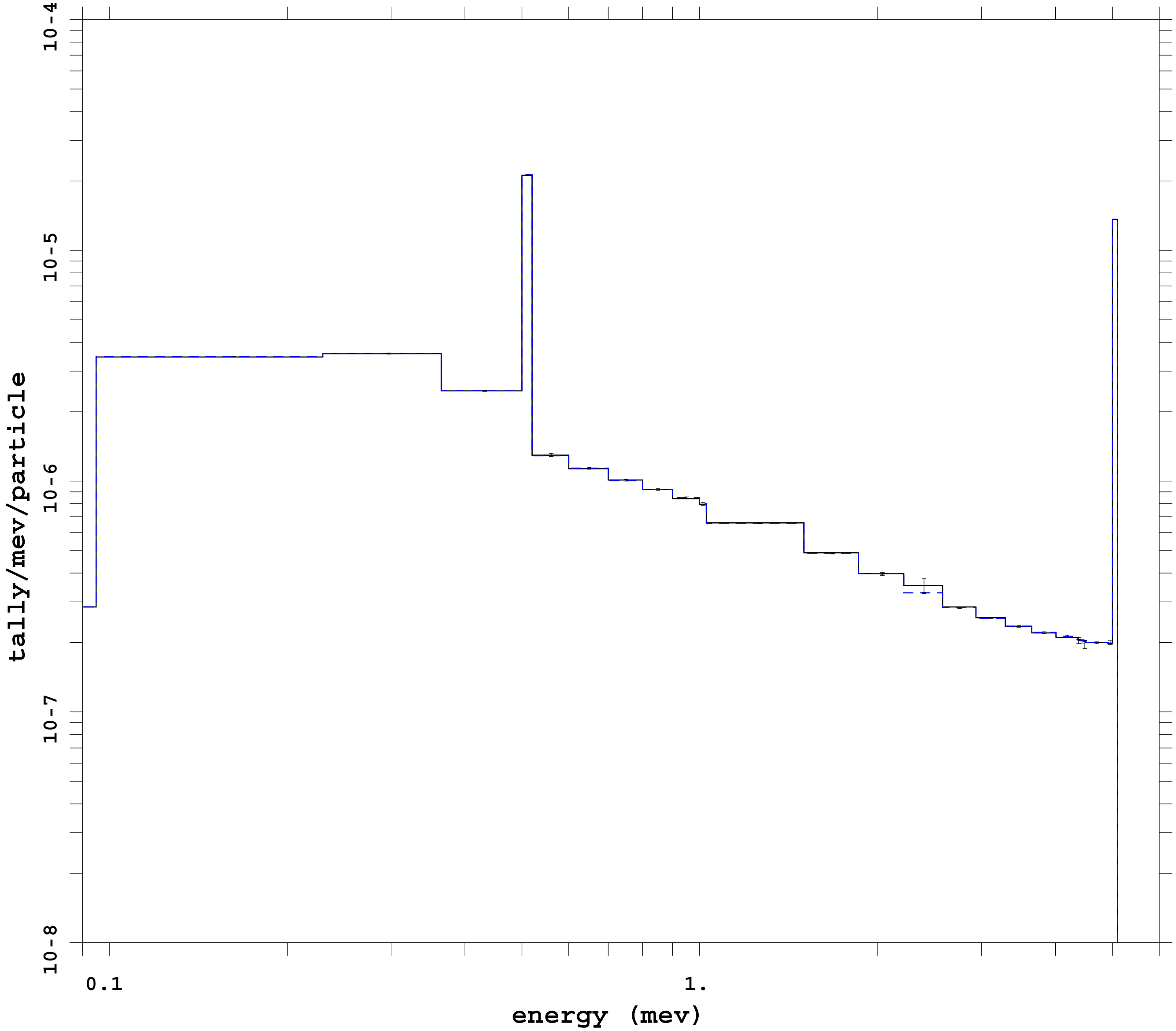


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: mesh ext fcl noRR
tally/mev/particle
10-4
10-5
10-6
10-7
10-8
0.1
1.
energy (mev)
mcnp 5
07/05/08 21:08:21
tally 4
p
nps 855225000
f(e) bin normed
mctal = p_mesh_ext_fcl_noR
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 24
no VR w/PHTVR


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp dxt
10-4
10-5
10-6
10-7
10-8
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/05/08 09:51:17
tally 4
p
nps 337275000
f(e) bin normed
mctal = p_imp_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 25
no VR w/PHTVR

Ep = 5 MeV -- Coupled Photon-Electron

Var Red: mesh dxt

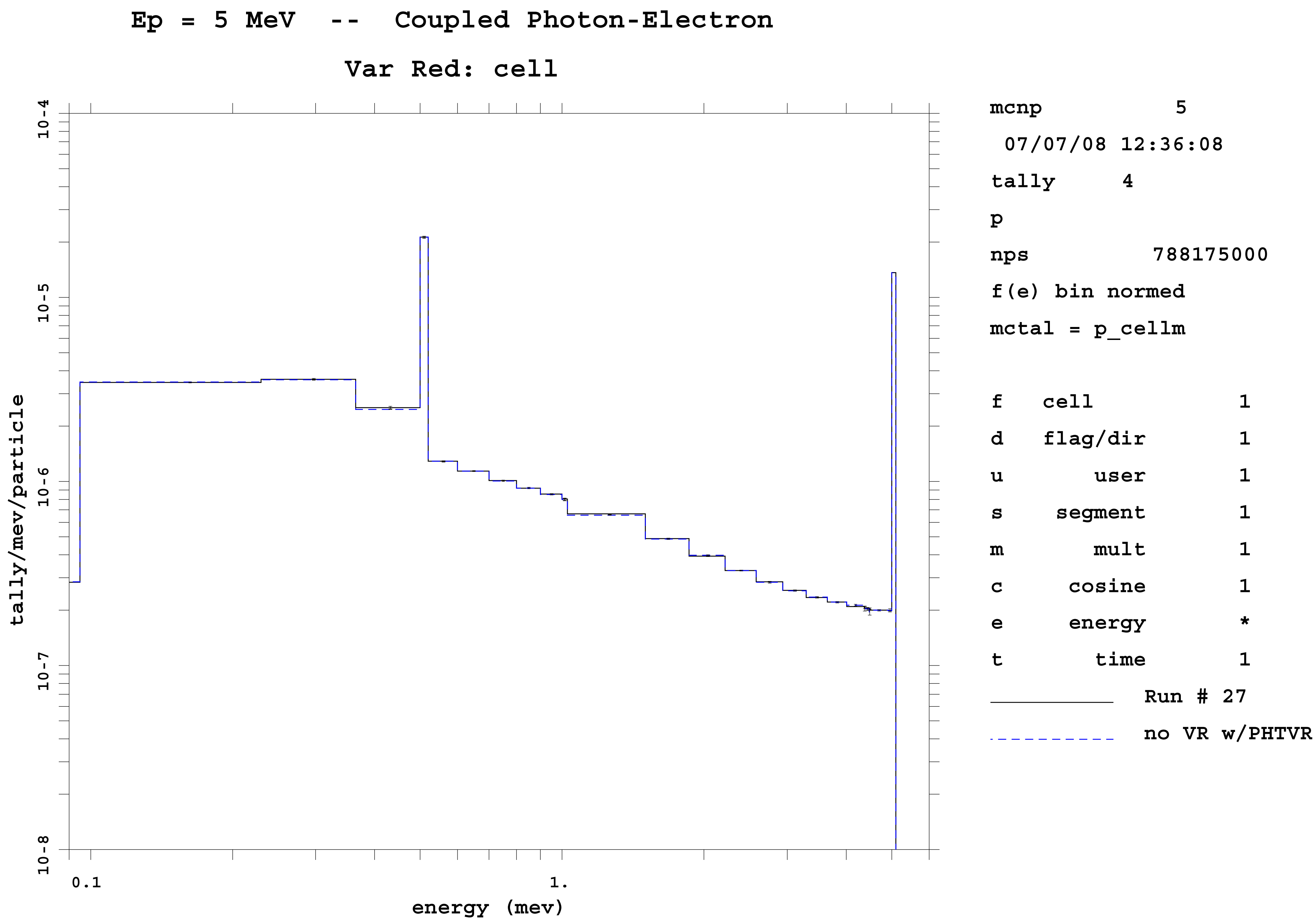


mcnp 5
07/06/08 07:27:05
tally 4
p
nps 1382400000
f(e) bin normed
mctal = p_mesh_dxtm

f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1

Run # 26

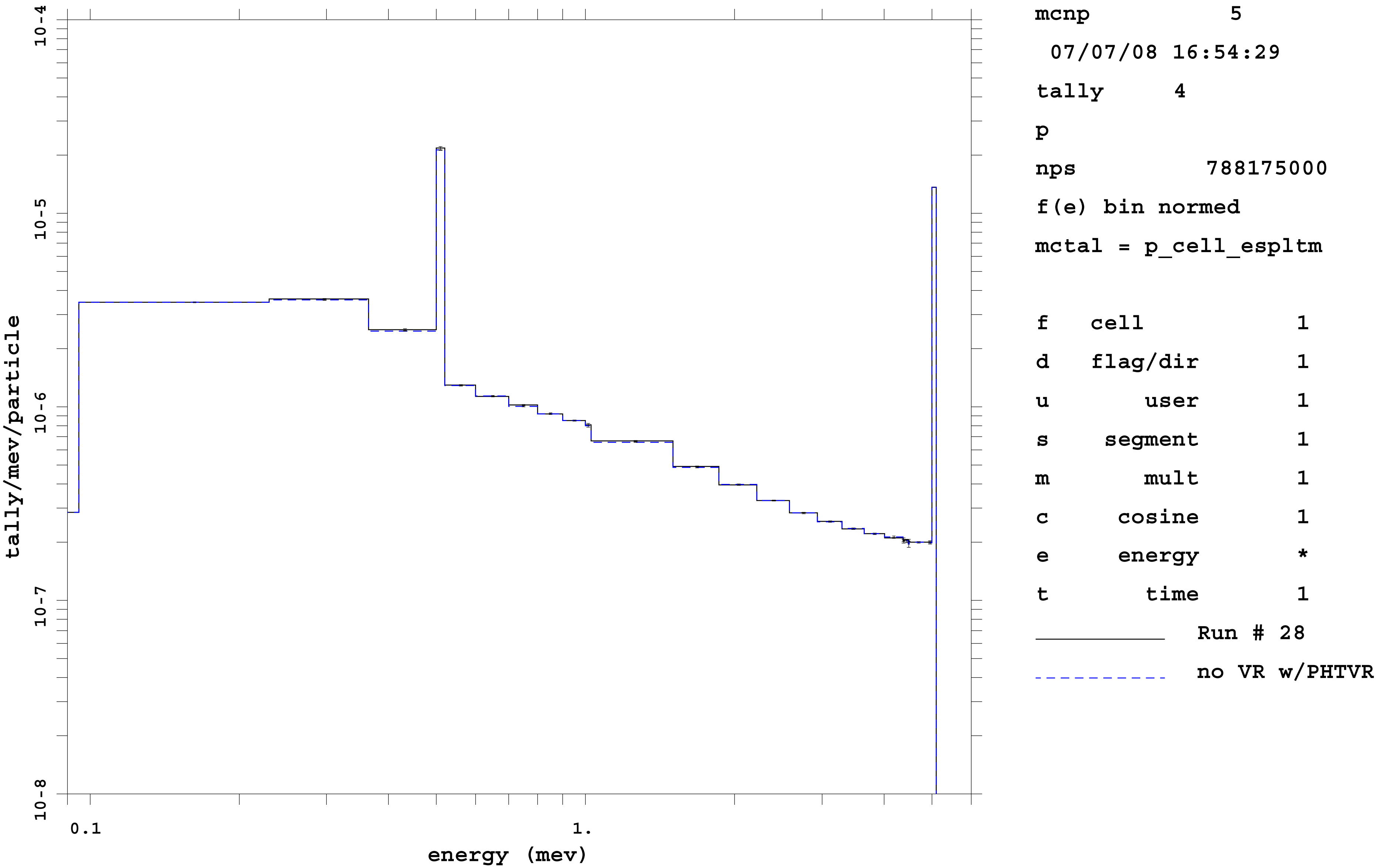
no VR w/PHTVR

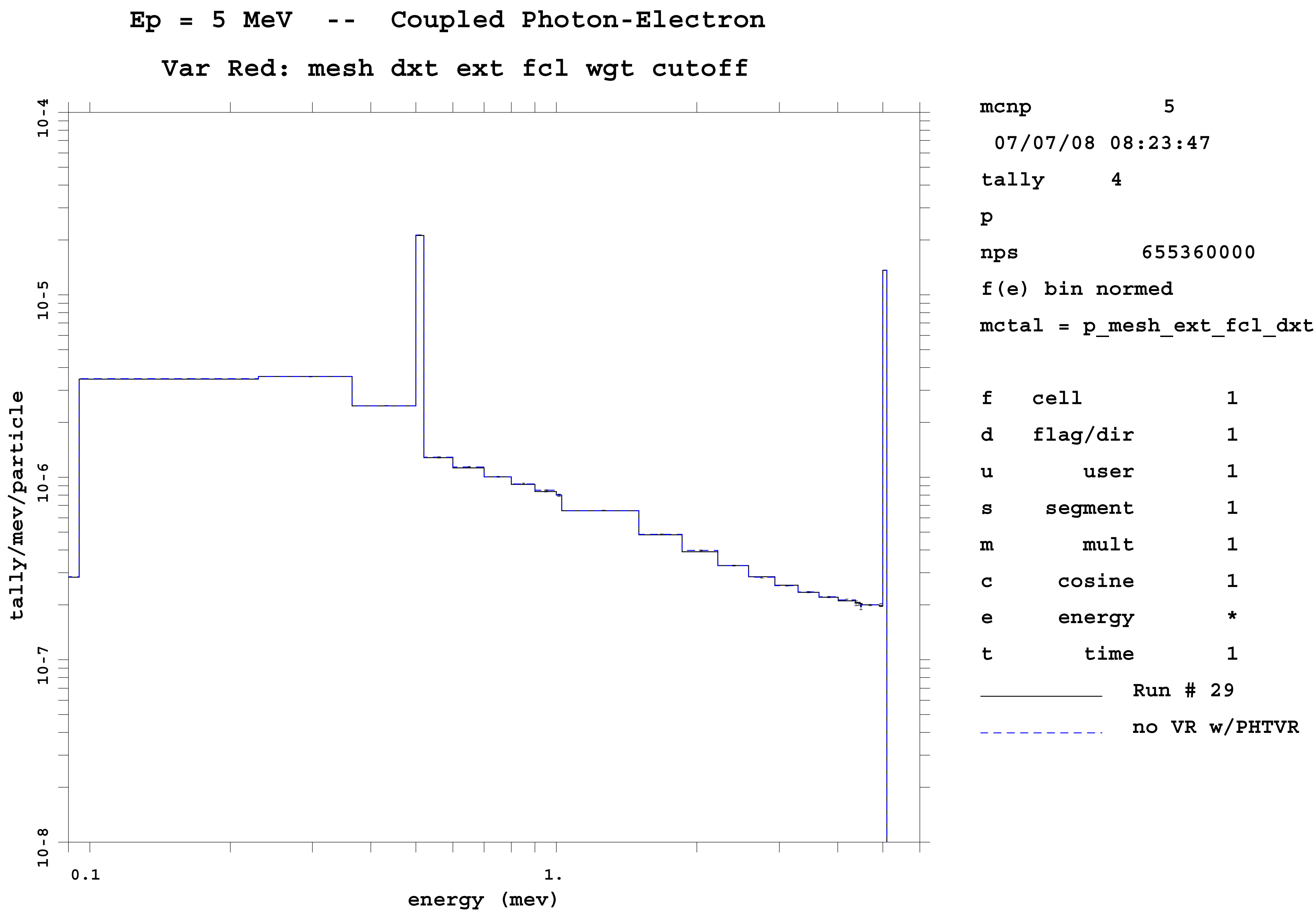


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell
10-4
10-5
10-6
10-7
10-8
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 12:36:08
tally 4
p
nps 788175000
f(e) bin normed
mctal = p_cellm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 27
no VR w/PHTVR

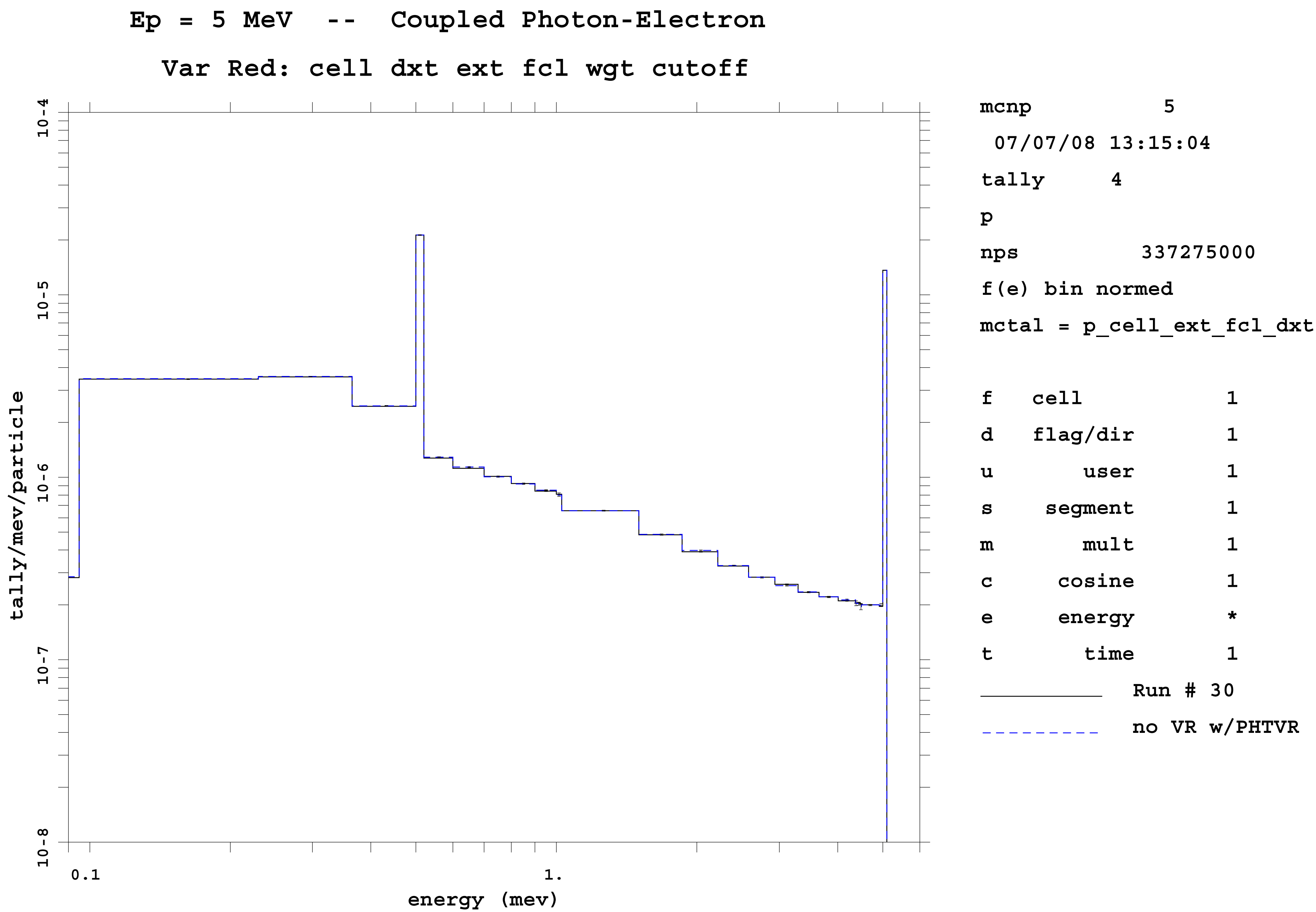
Ep = 5 MeV -- Coupled Photon-Electron

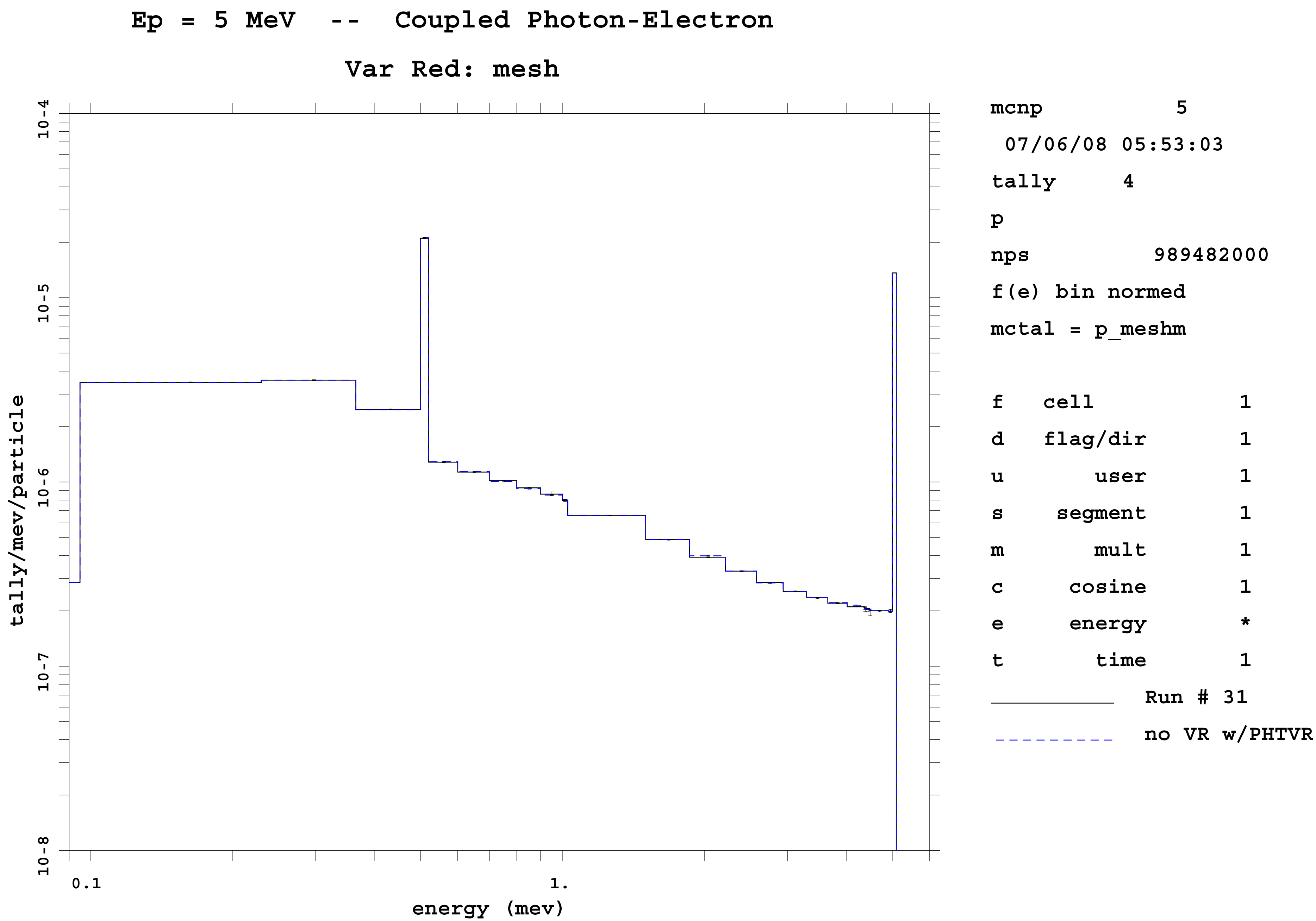
Var Red: cell espl t



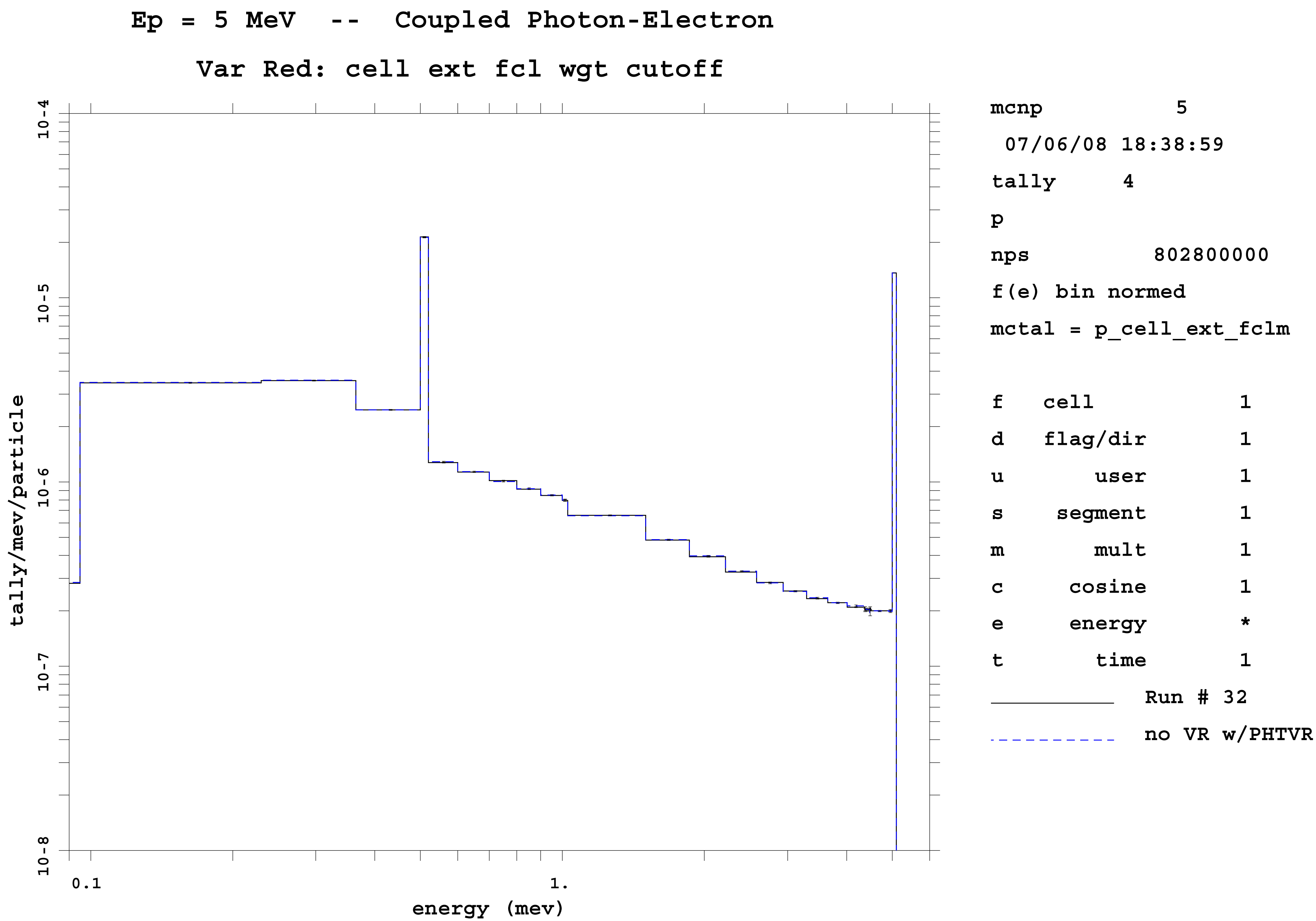


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: mesh dxt ext fcl wgt cutoff
10-4
10-5
10-6
10-7
10-8
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 08:23:47
tally 4
p
nps 655360000
f(e) bin normed
mctal = p_mesh_ext_fcl_dxt
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 29
no VR w/PHTVR


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell dxt ext fcl wgt cutoff
10-4
10-5
10-6
10-7
10-8
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 13:15:04
tally 4
p
nps 337275000
f(e) bin normed
mctal = p_cell_ext_fcl_dxt
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 30
no VR w/PHTVR

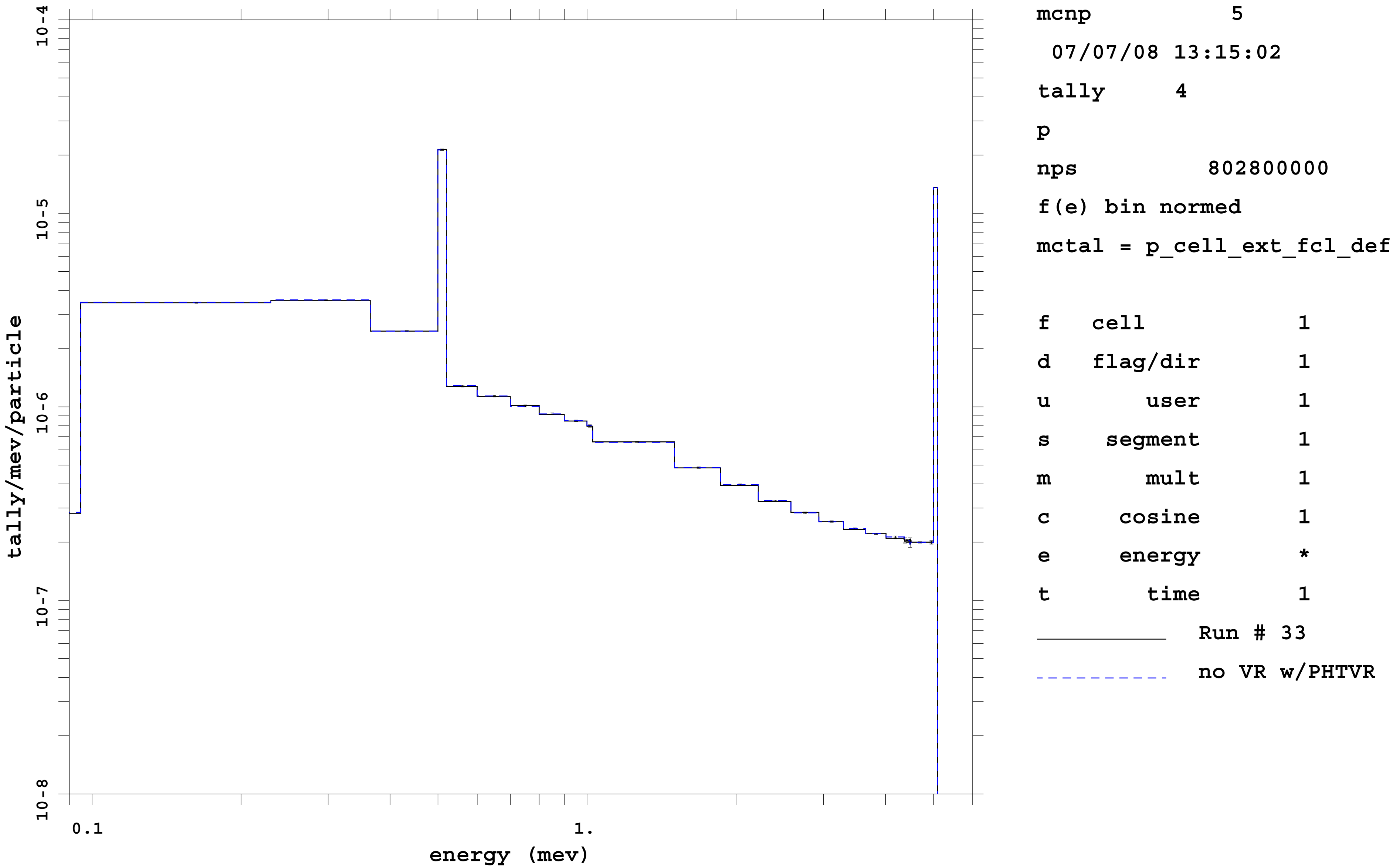


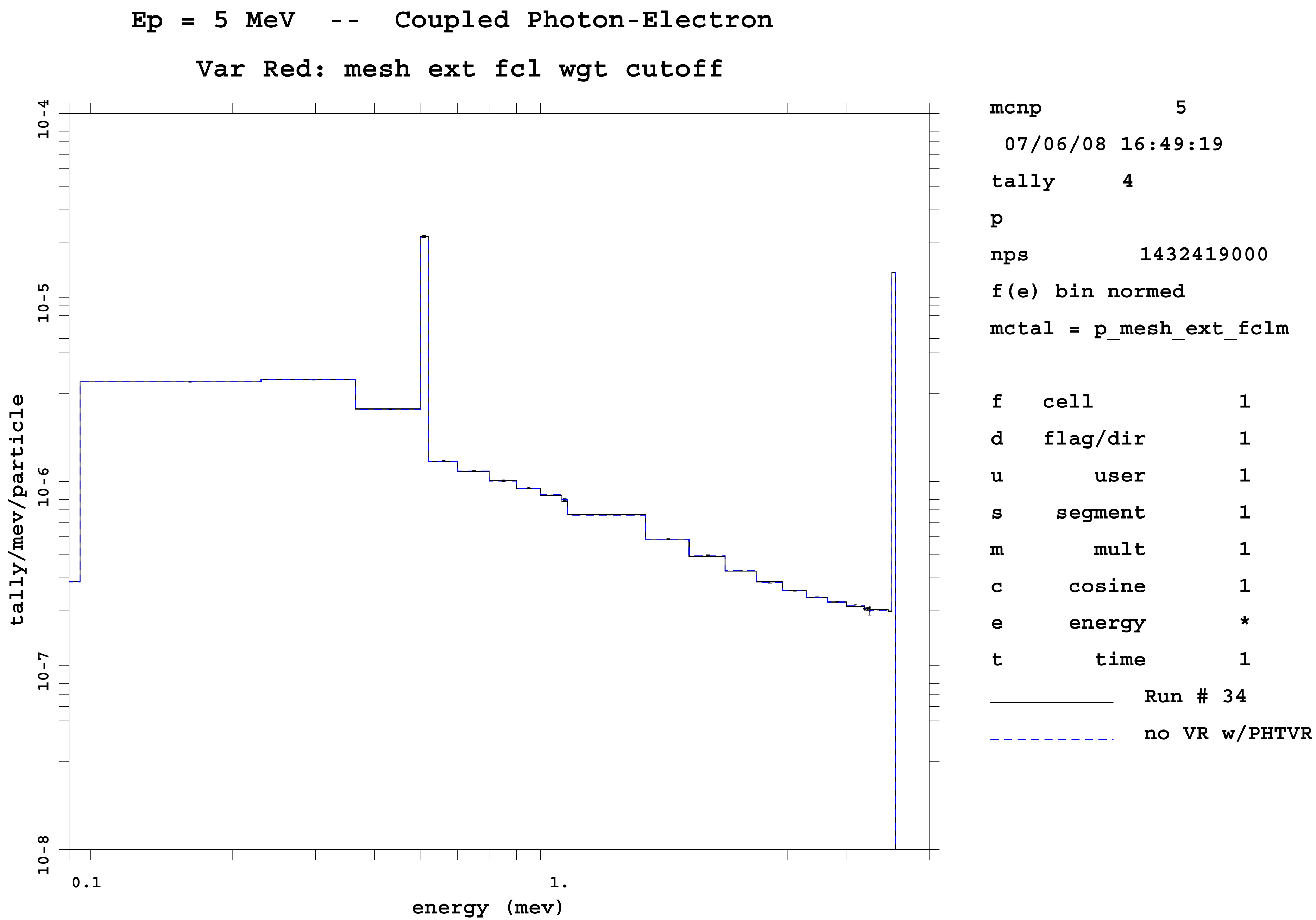
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: mesh
10-4
10-5
10-6
10-7
10-8
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/06/08 05:53:03
tally 4
p
nps 989482000
f(e) bin normed
mctal = p_meshm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 31
no VR w/PHTVR


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell ext fcl wgt cutoff
10-4
10-5
10-6
10-7
10-8
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/06/08 18:38:59
tally 4
p
nps 802800000
f(e) bin normed
mctal = p_cell_ext_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 32
no VR w/PHTVR

Ep = 5 MeV -- Coupled Photon-Electron

Var Red: cell ext fcl default wgt cutoff



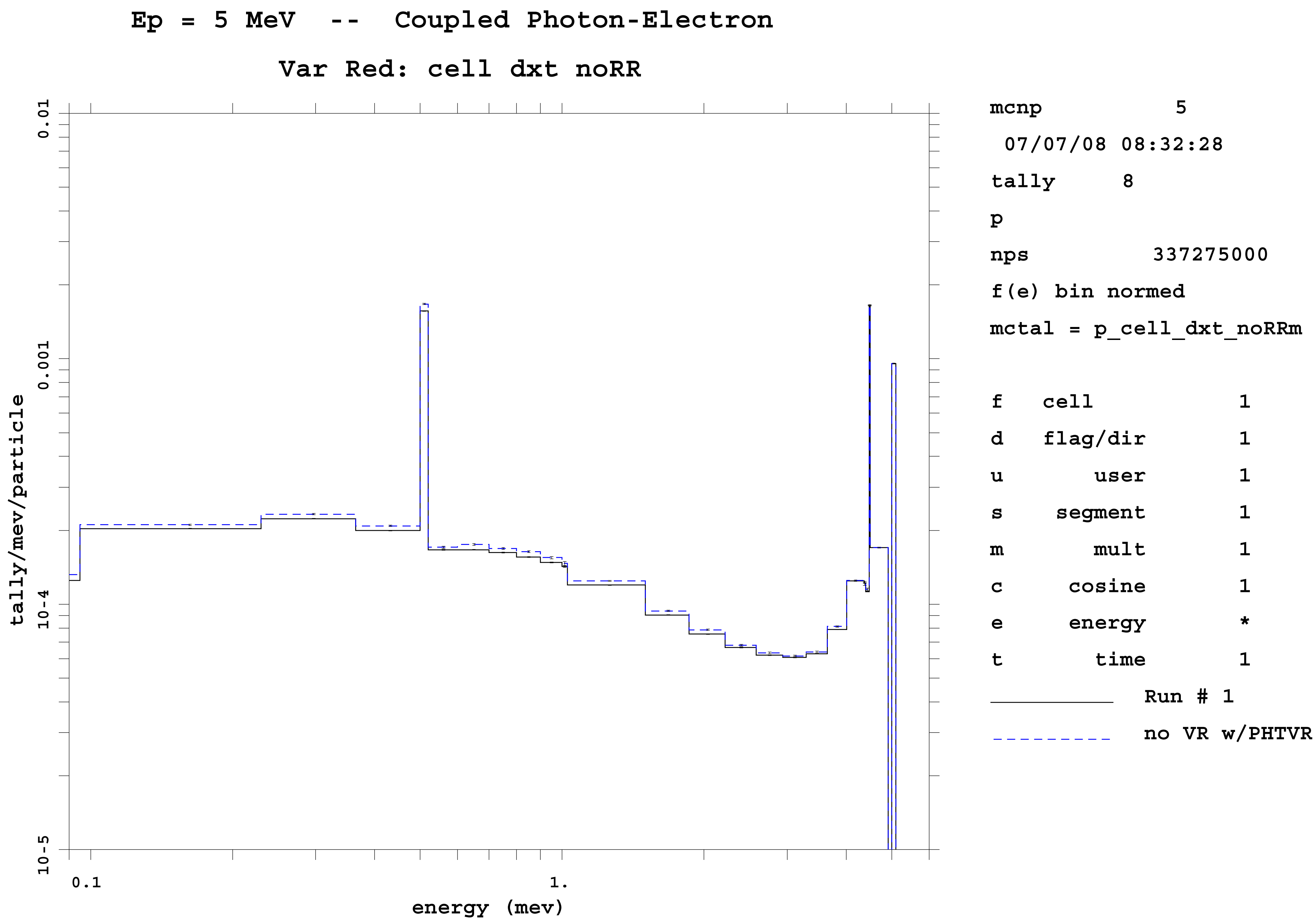

Ep = 5 MeV -- Coupled Photon-Electron
Var Red: mesh ext fcl wgt cutoff
mcnp 5
07/06/08 16:49:19
tally 4
p
nps 1432419000
f(e) bin normed
mctal = p_mesh_ext_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 34
no VR w/PHTVR
tally/mev/particle
10-4
10-5
10-6
10-7
10-8
0.1
1.
energy (mev)

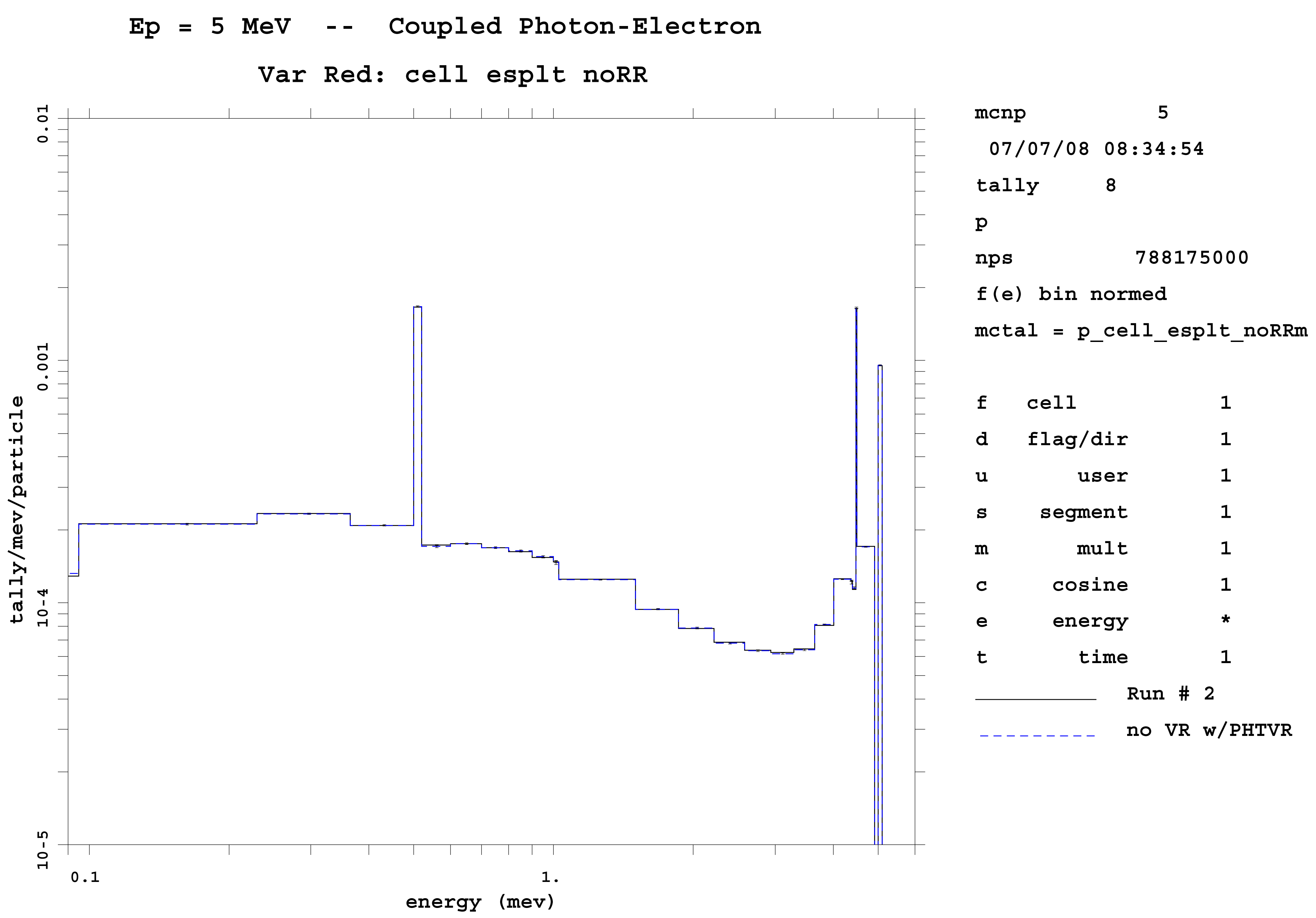
Appendix A.2.ii

Problem 1
Ge sphere Next To a U / O Stacked Cylinder Problem

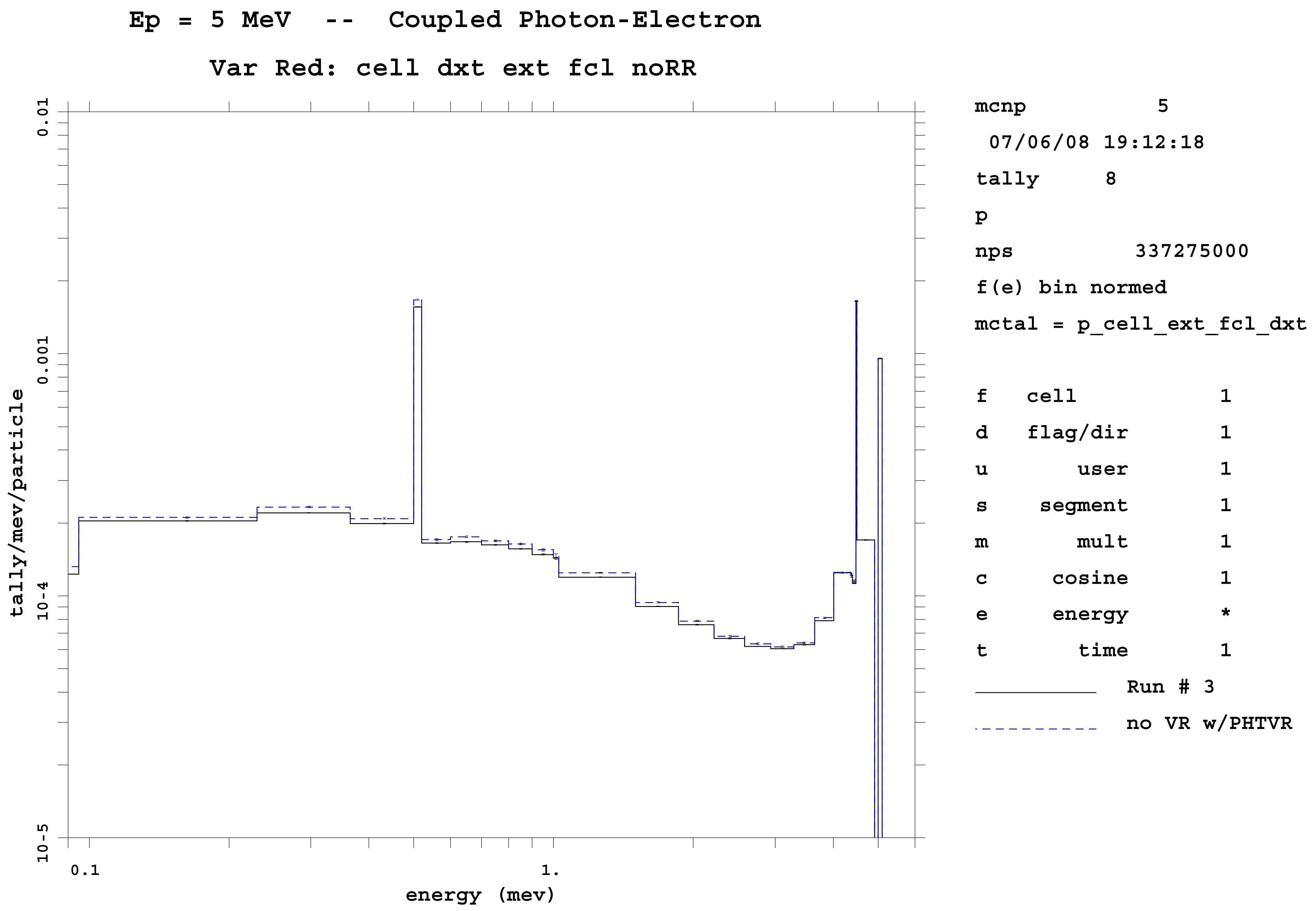
Plots of the pulse height tally spectra in the germanium sphere

Plots are in order of the run number listed in Table 3. The variance reduction methods used are listed in the plot title; the graph label contains the run number.

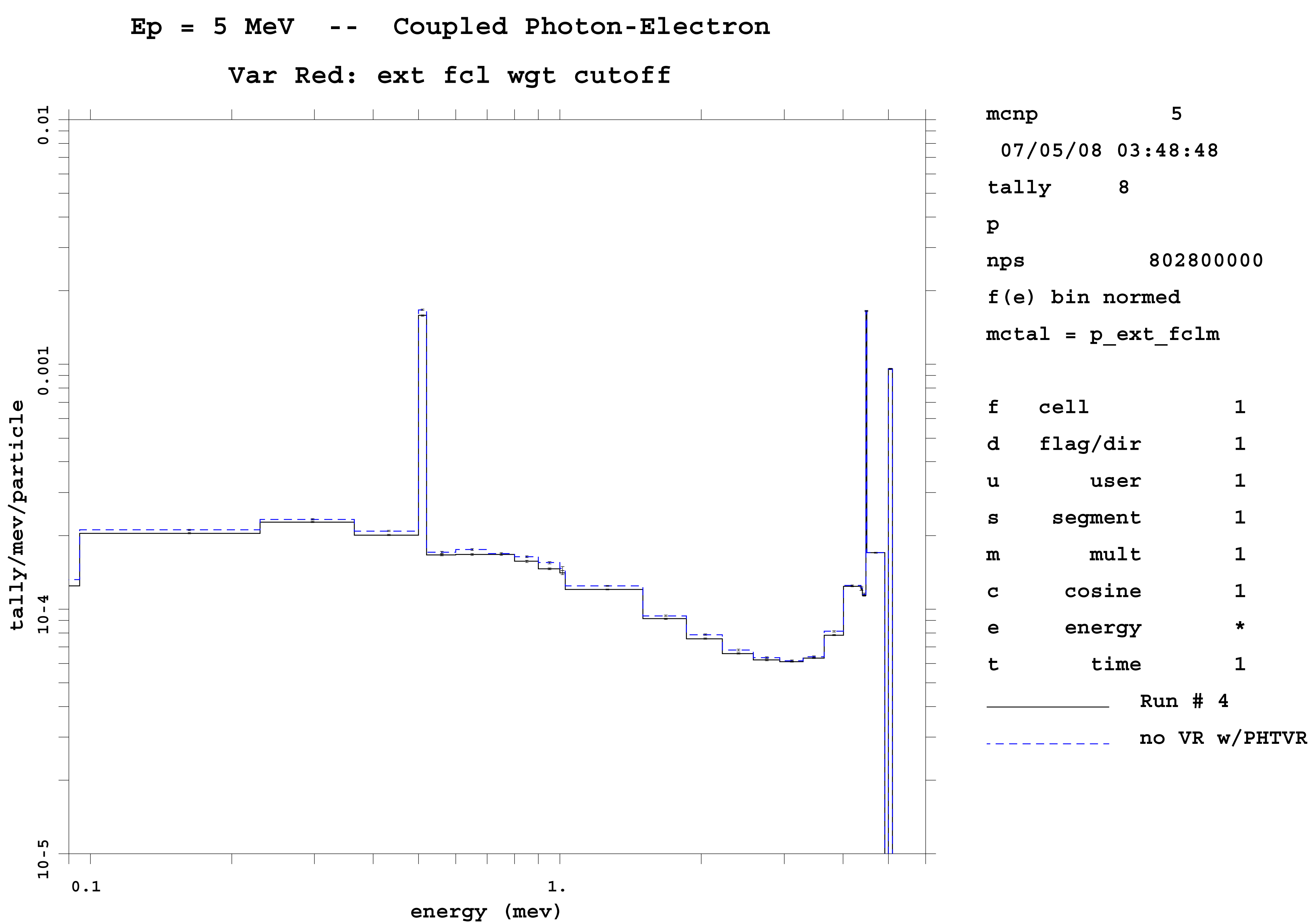

Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell dxt noRR
0.01
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 08:32:28
tally 8
p
nps 337275000
f(e) bin normed
mctal = p_cell_dxt_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 1
no VR w/PHTVR



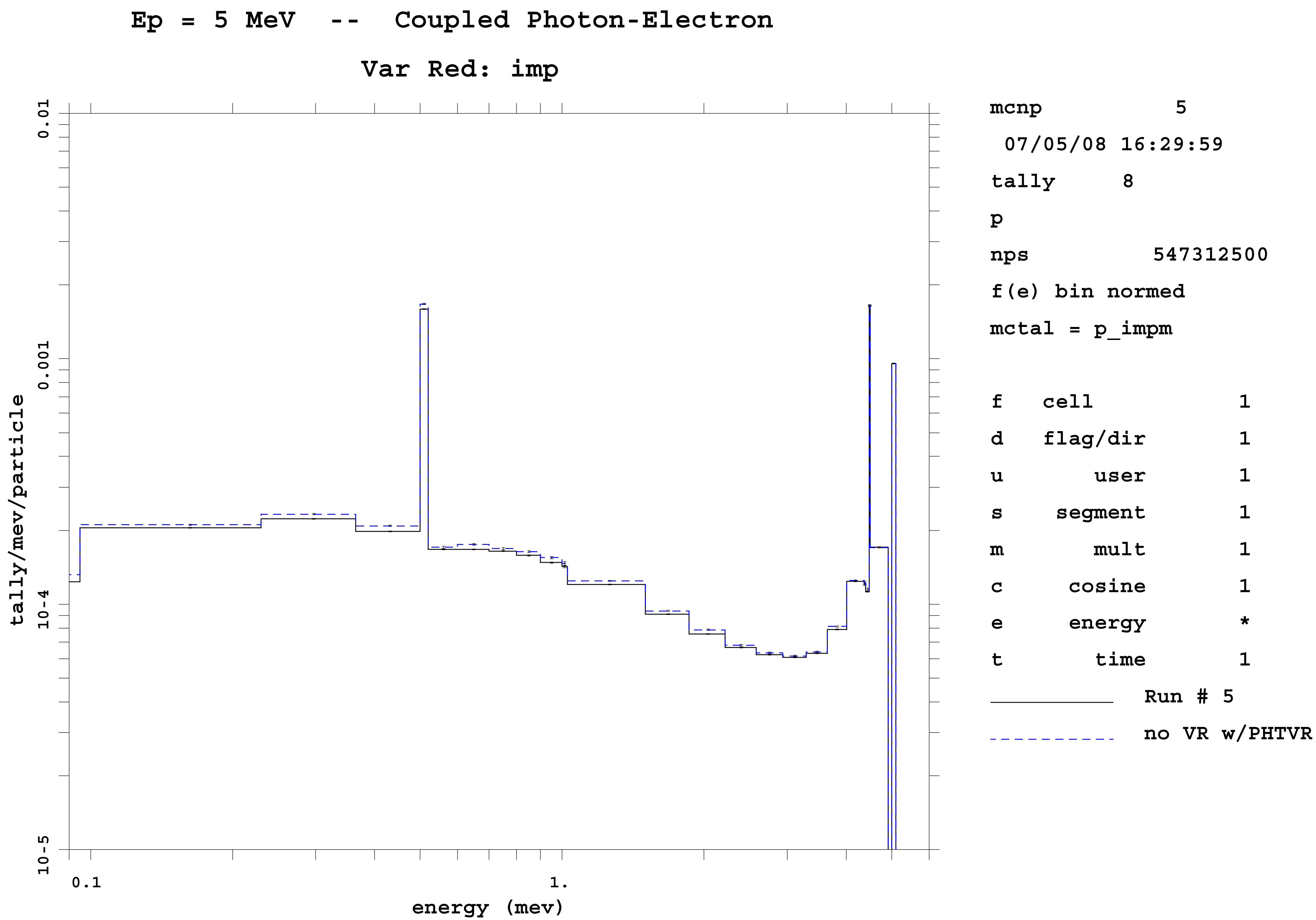
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell esplt noRR
tally/mev/particle
0.01
0.001
10-4
10-5
0.1
1.
energy (mev)
mcnp 5
07/07/08 08:34:54
tally 8
p
nps 788175000
f(e) bin normed
mctal = p_cell_esplt_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 2
no VR w/PHTVR



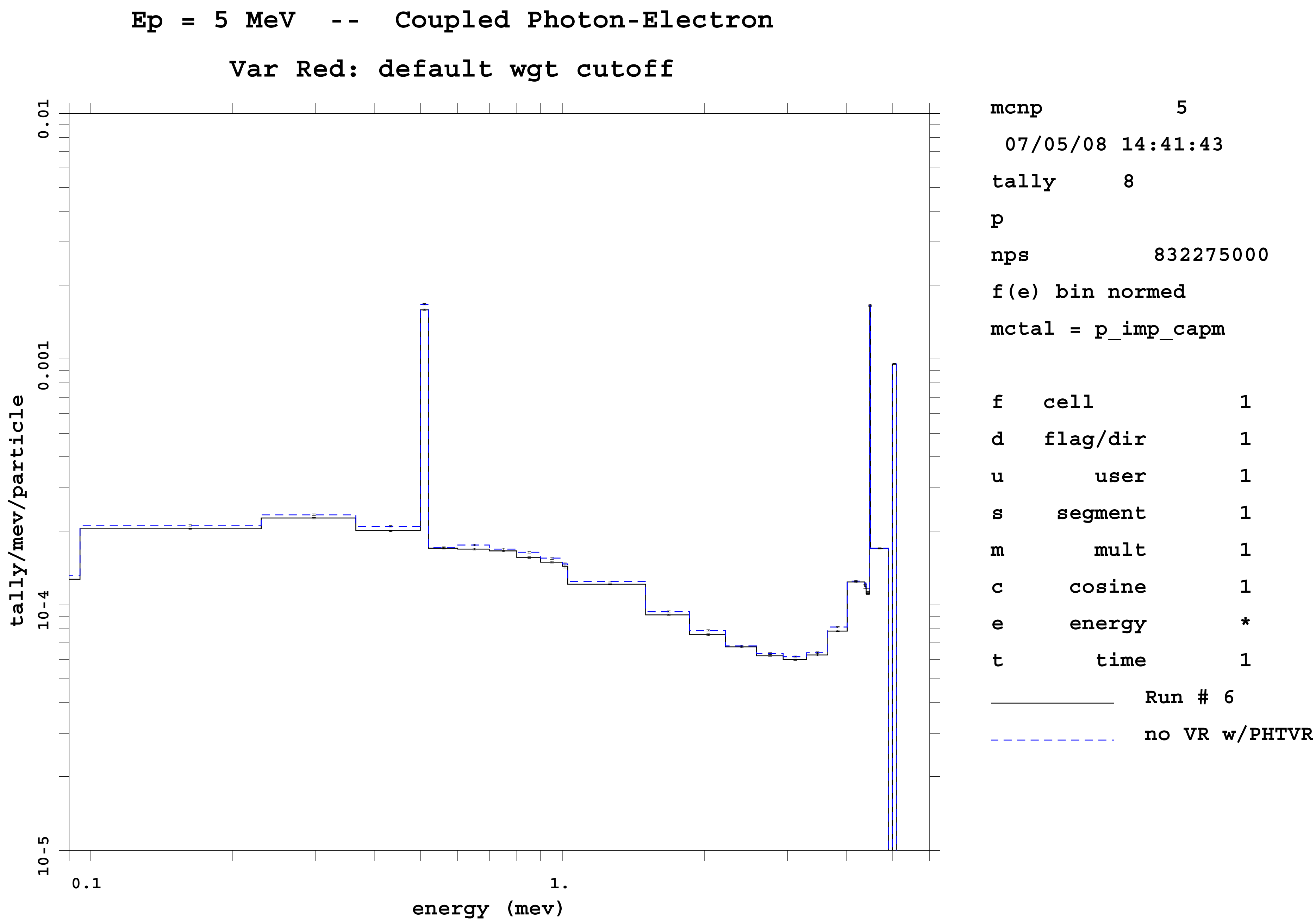
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell dxt ext fcl noRR
0.01
0.001
10-4
10-5
0.1
1.
energy (mev)
tally/mev/particle
mcnp 5
07/06/08 19:12:18
tally 8
p
nps 337275000
f(e) bin normed
mctal = p_cell_ext_fcl_dxt
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 3
no VR w/PHTVR

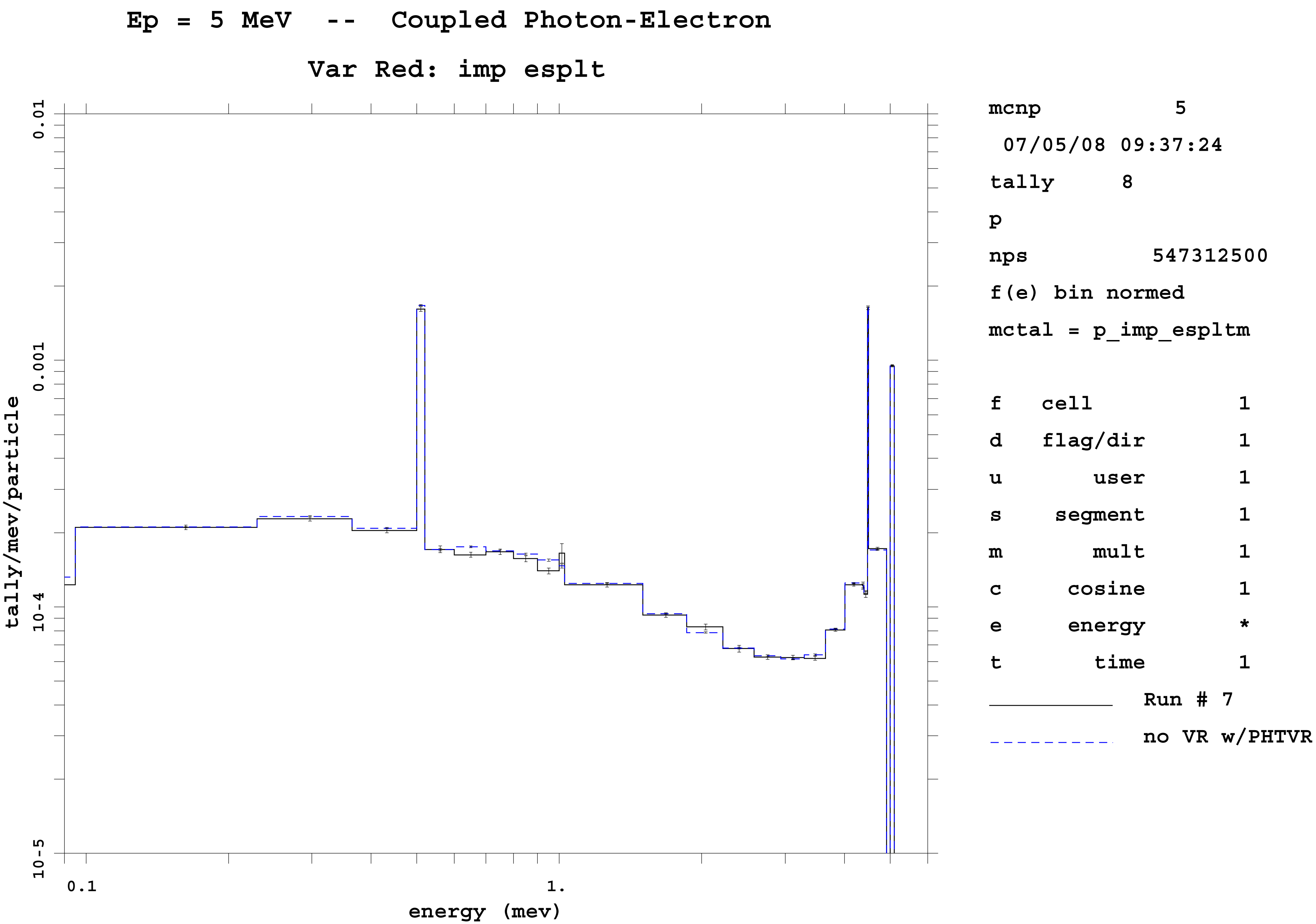


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: ext fcl wgt cutoff
0.01
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/05/08 03:48:48
tally 8
p
nps 802800000
f(e) bin normed
mctal = p_ext_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 4
no VR w/PHTVR

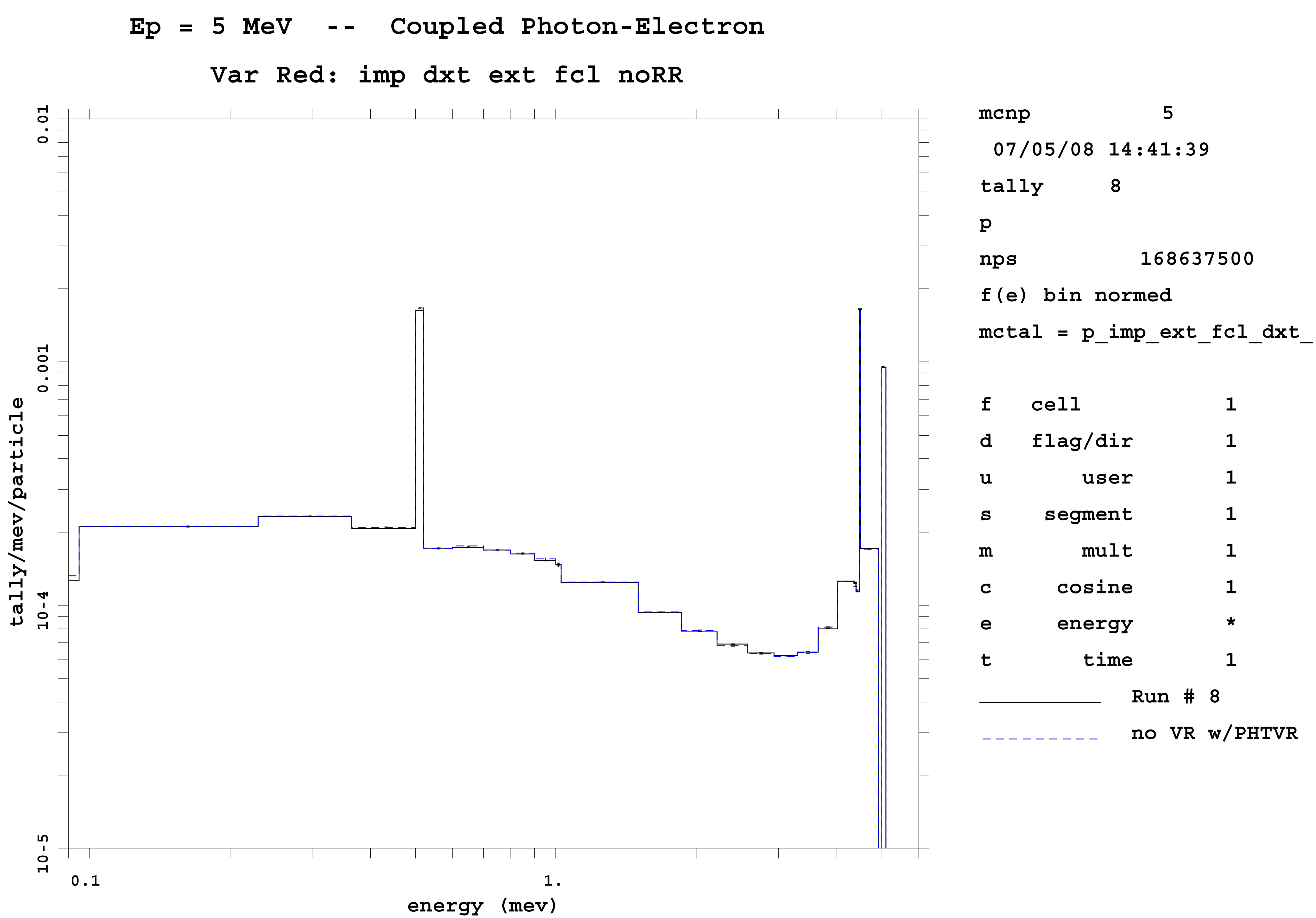


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp
0.01
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/05/08 16:29:59
tally 8
p
nps 547312500
f(e) bin normed
mctal = p_impm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 5
no VR w/PHTVR

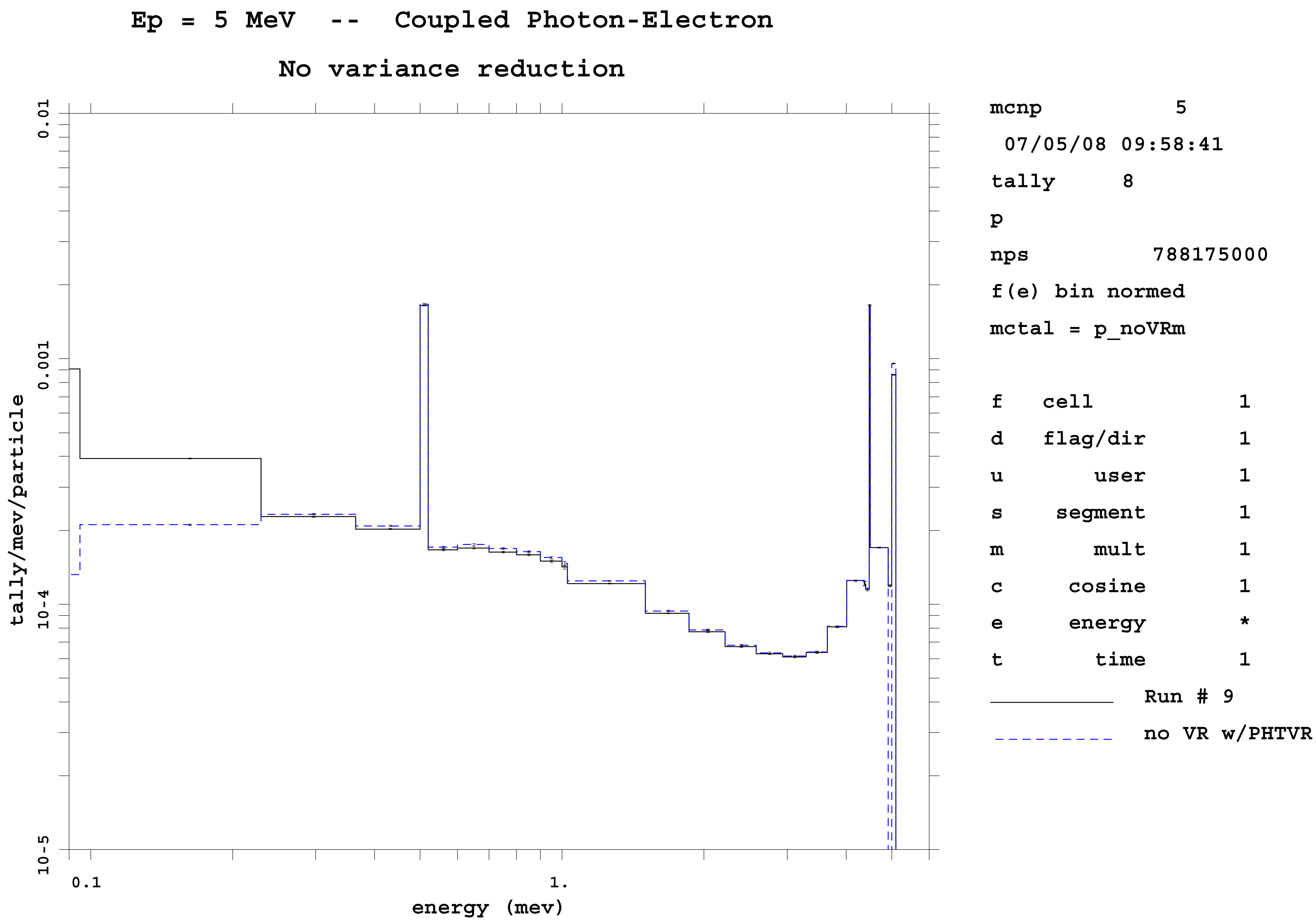

Ep = 5 MeV -- Coupled Photon-Electron
Var Red: default wgt cutoff
tally/mev/particle
0.01
0.001
10-4
10-5
0.1
1.
energy (mev)
mcnp 5
07/05/08 14:41:43
tally 8
p
nps 832275000
f(e) bin normed
mctal = p_imp_capm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 6
no VR w/PHTVR

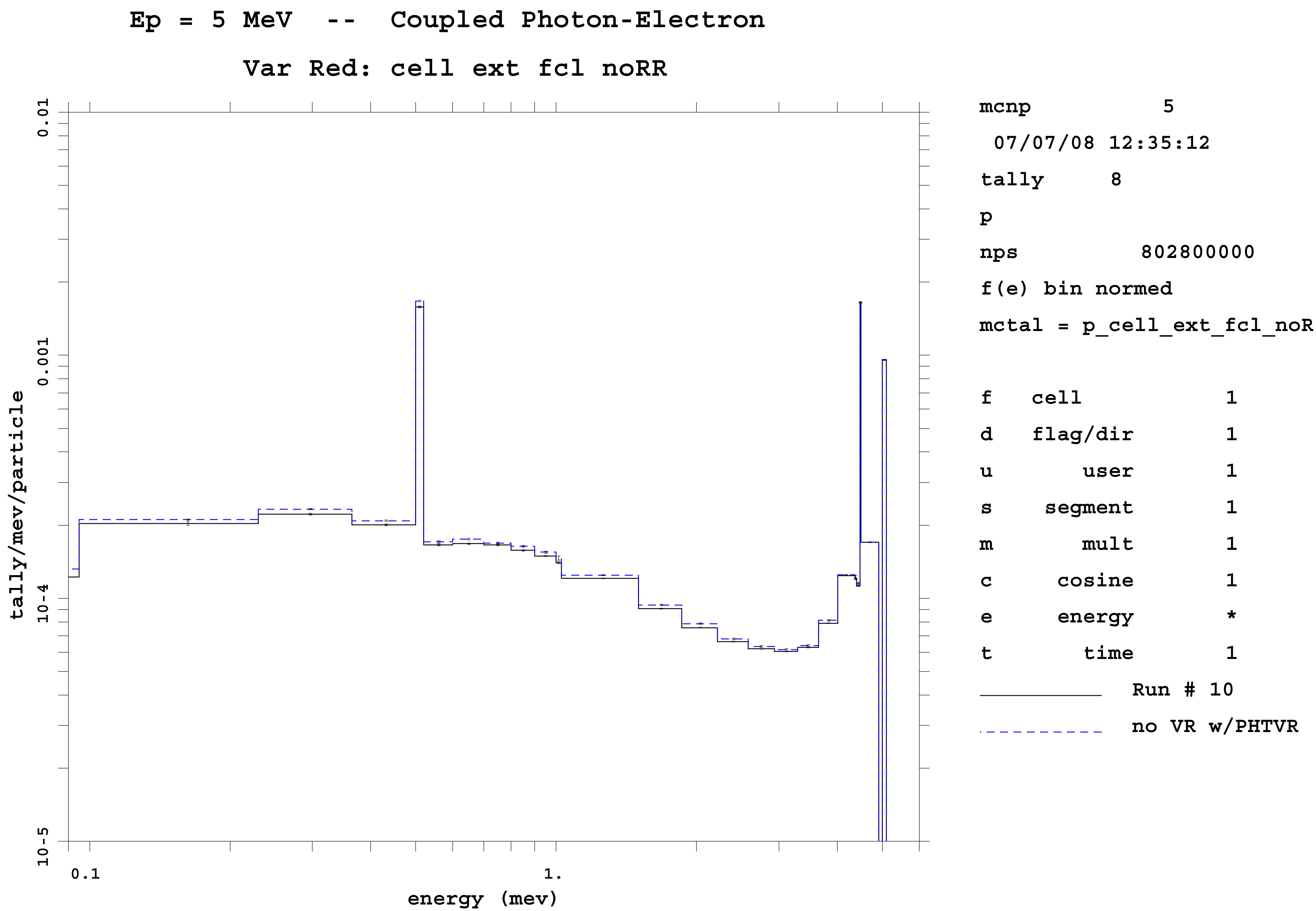


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp espltt
0.01
0.001
10-4
10-5
0.1
1.
energy (mev)
tally/mev/particle
mcnp 5
07/05/08 09:37:24
tally 8
p
nps 547312500
f(e) bin normed
mctal = p_imp_espltm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 7
no VR w/PHTVR

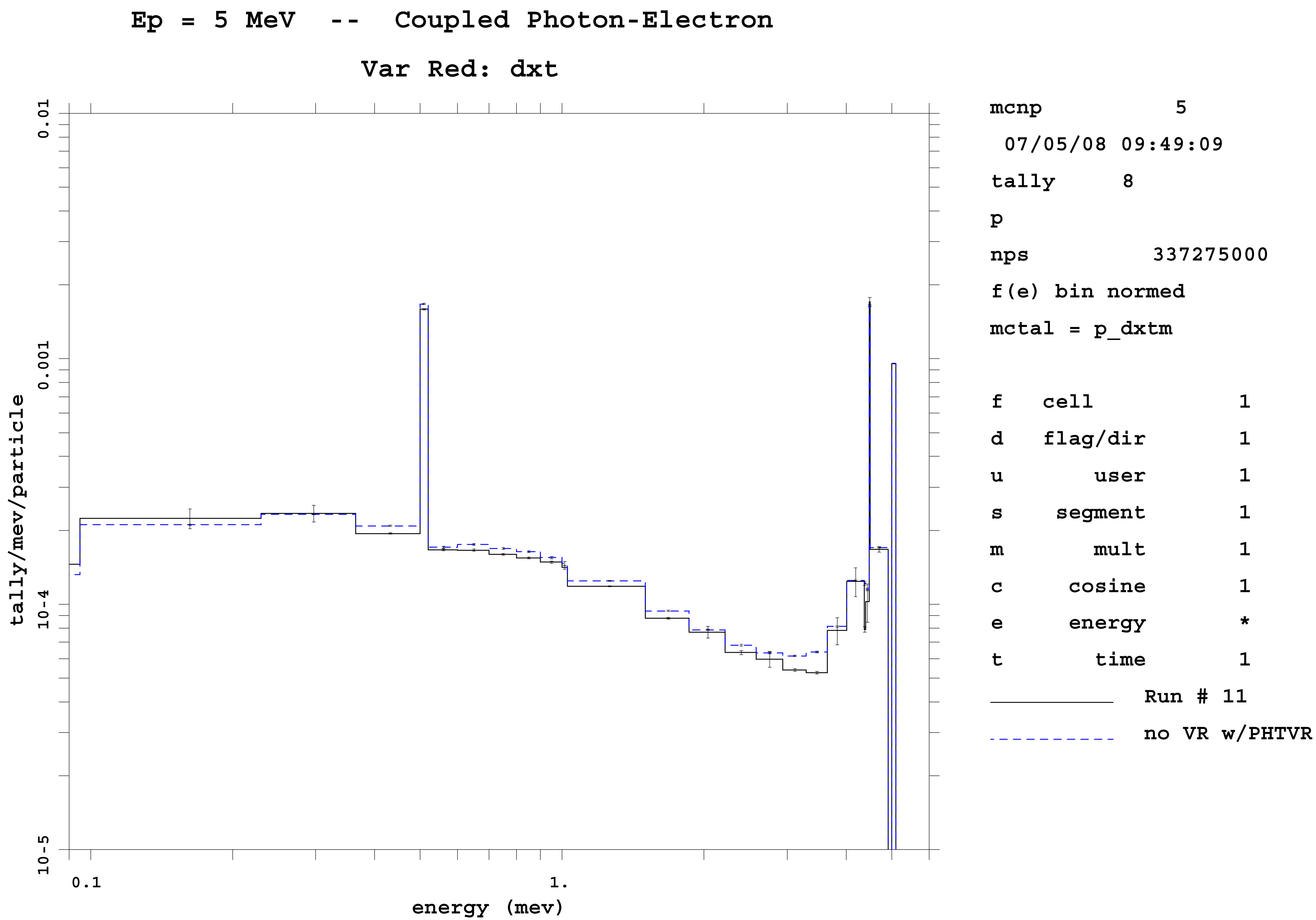


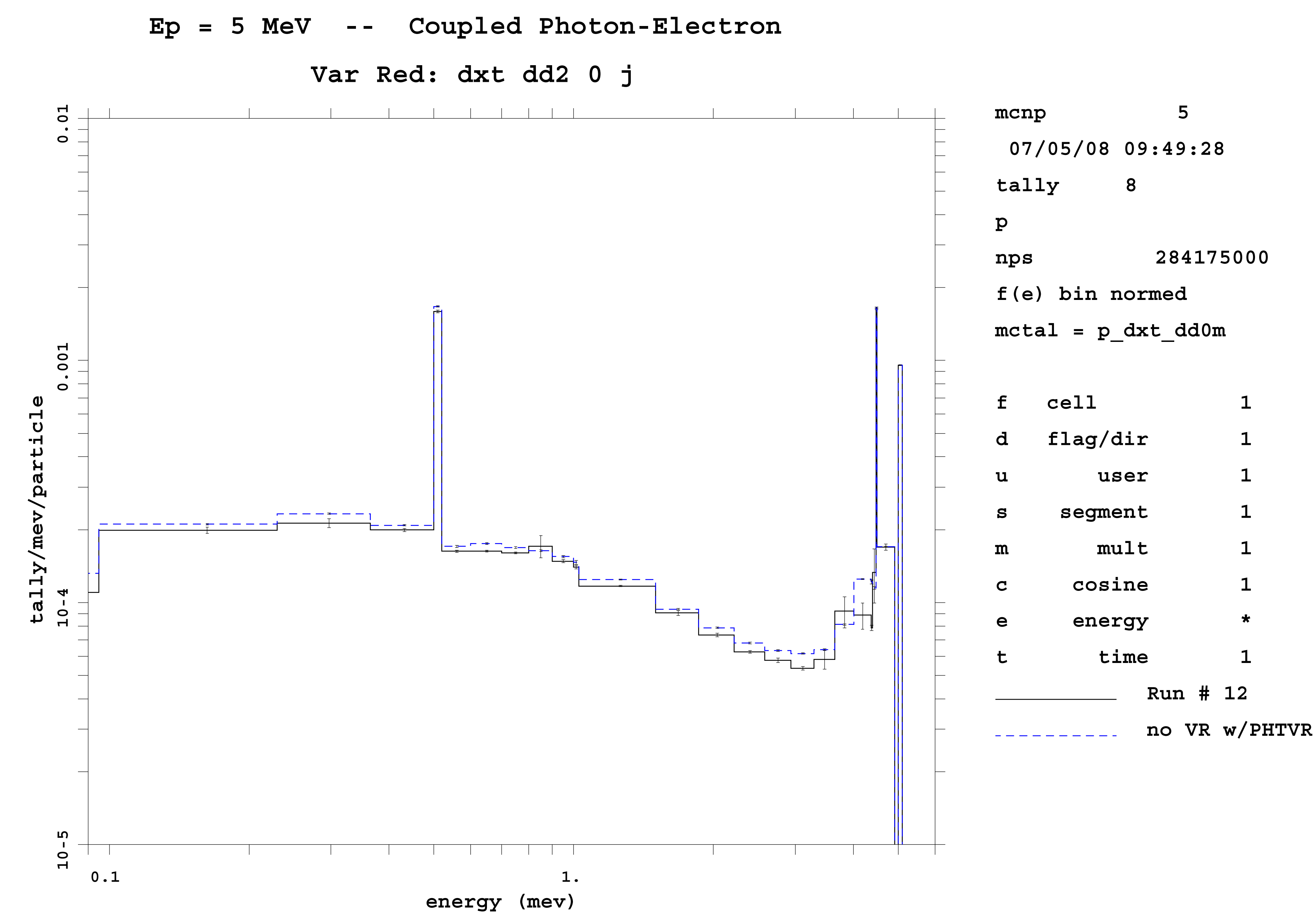
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp dxt ext fcl noRR
0.01
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/05/08 14:41:39
tally 8
p
nps 168637500
f(e) bin normed
mctal = p_imp_ext_fcl_dxt_
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 8
no VR w/PHTVR


Ep = 5 MeV -- Coupled Photon-Electron
No variance reduction
0.01
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/05/08 09:58:41
tally 8
p
nps 788175000
f(e) bin normed
mctal = p_noVRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 9
no VR w/PHTVR



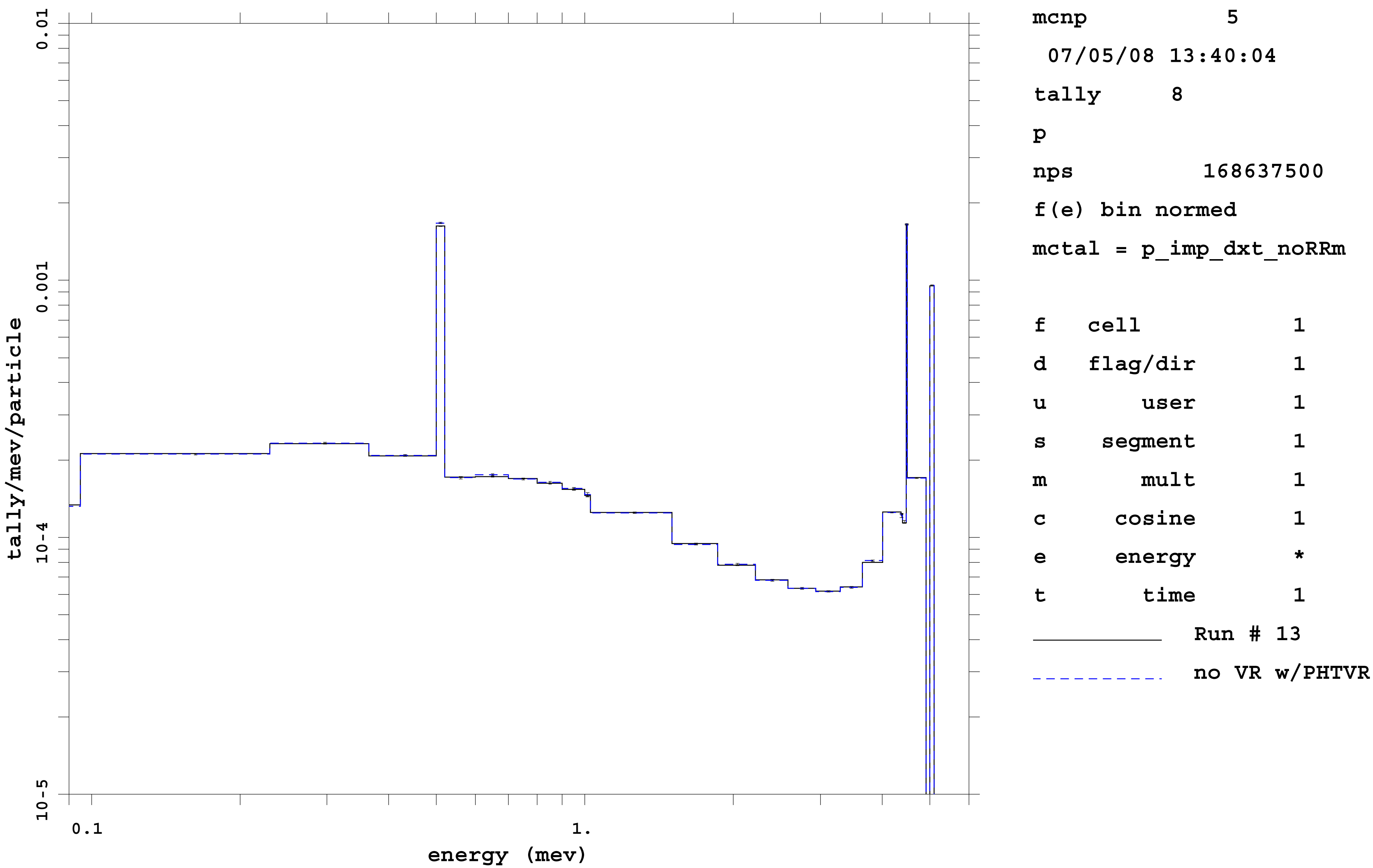
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell ext fcl noRR
0.01
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 12:35:12
tally 8
p
nps 802800000
f(e) bin normed
mctal = p_cell_ext_fcl_noR
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 10
no VR w/PHTVR

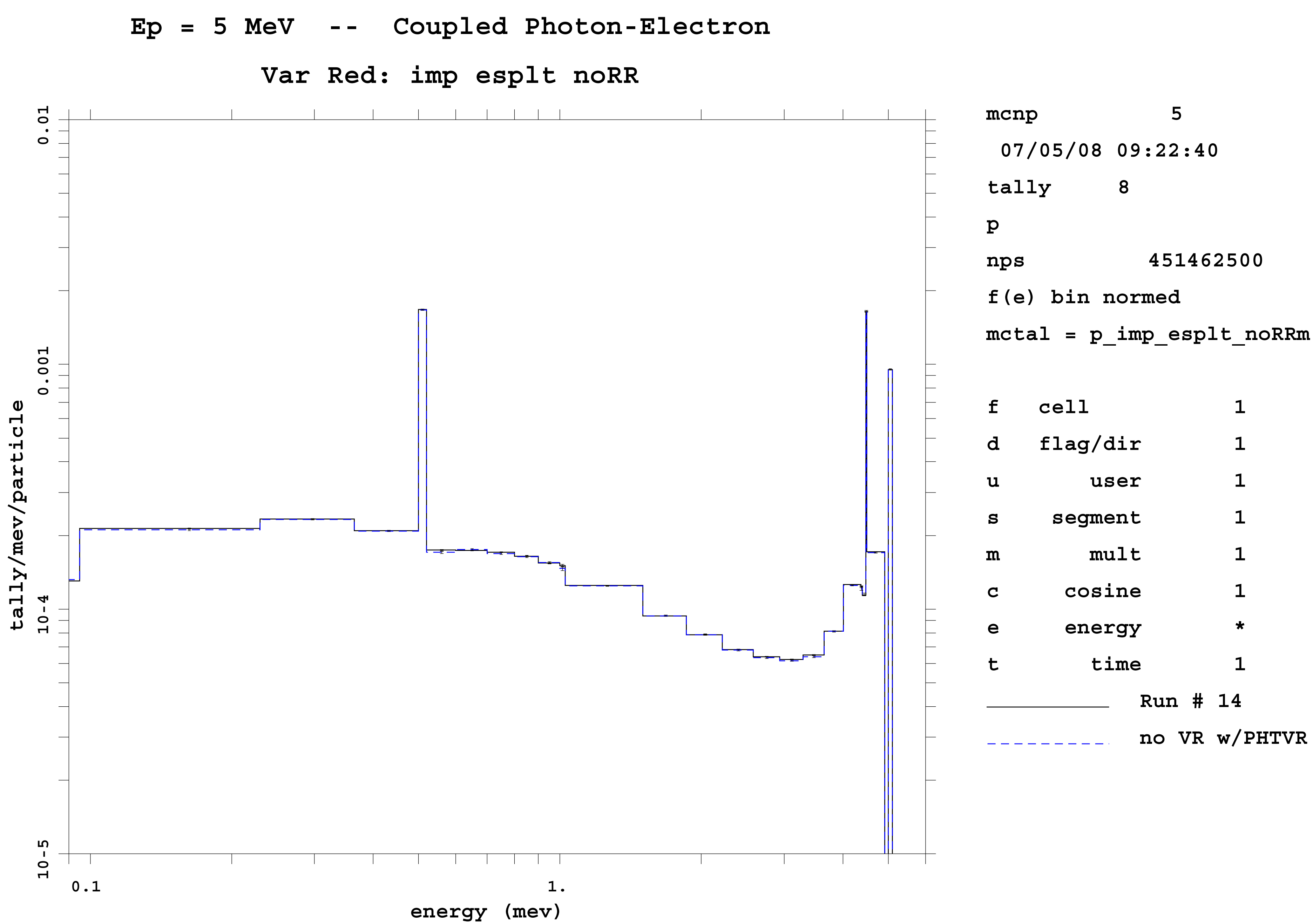

Ep = 5 MeV -- Coupled Photon-Electron
Var Red: dxt
tally/mev/particle
0.01
0.001
10-4
10-5
0.1
1.
energy (mev)
mcnp 5
07/05/08 09:49:09
tally 8
p
nps 337275000
f(e) bin normed
mctal = p_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 11
no VR w/PHTVR


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: dxt dd2 0 j
0.01
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/05/08 09:49:28
tally 8
p
nps 284175000
f(e) bin normed
mctal = p_dxt_dd0m
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 12
no VR w/PHTVR

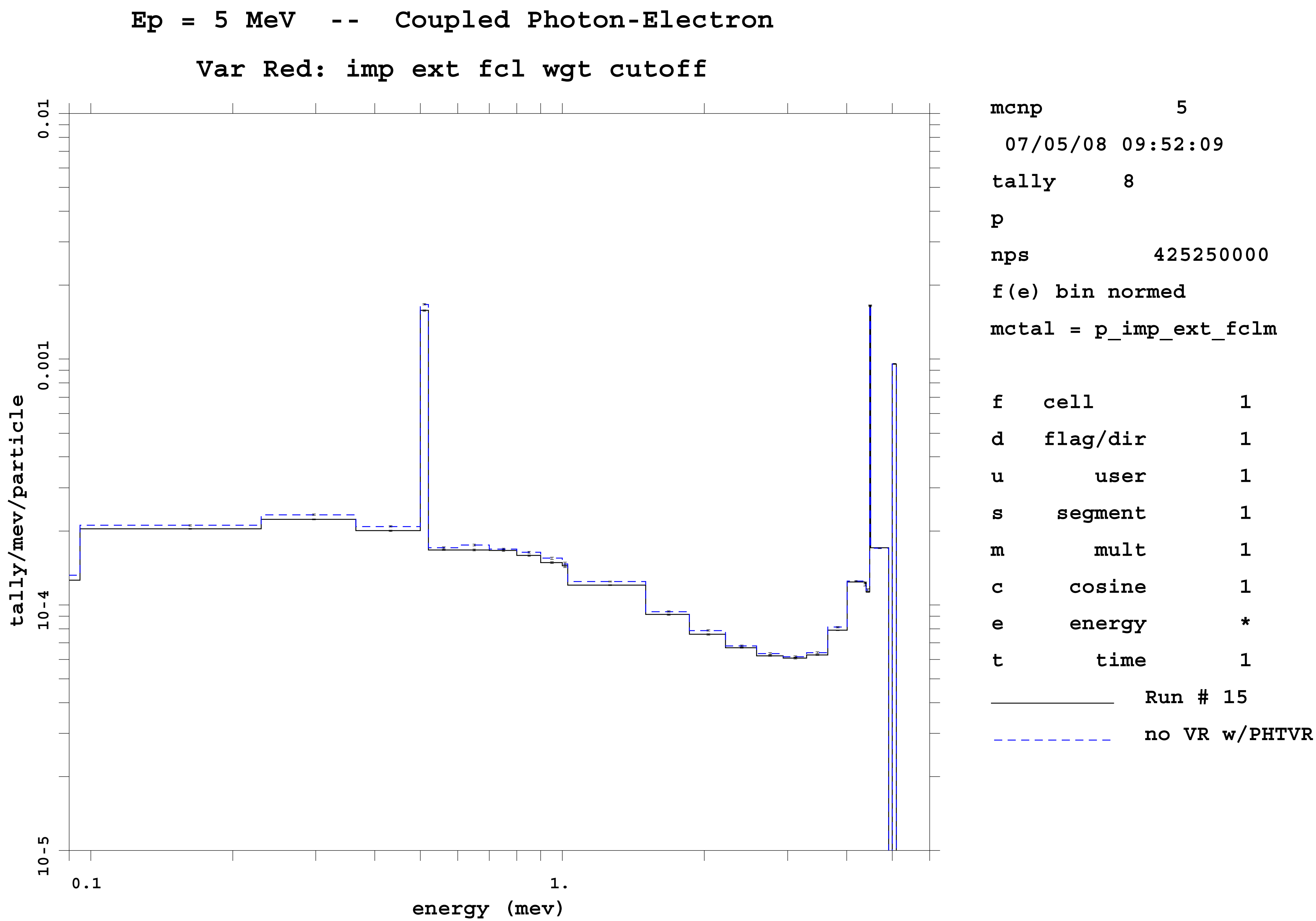
Ep = 5 MeV -- Coupled Photon-Electron

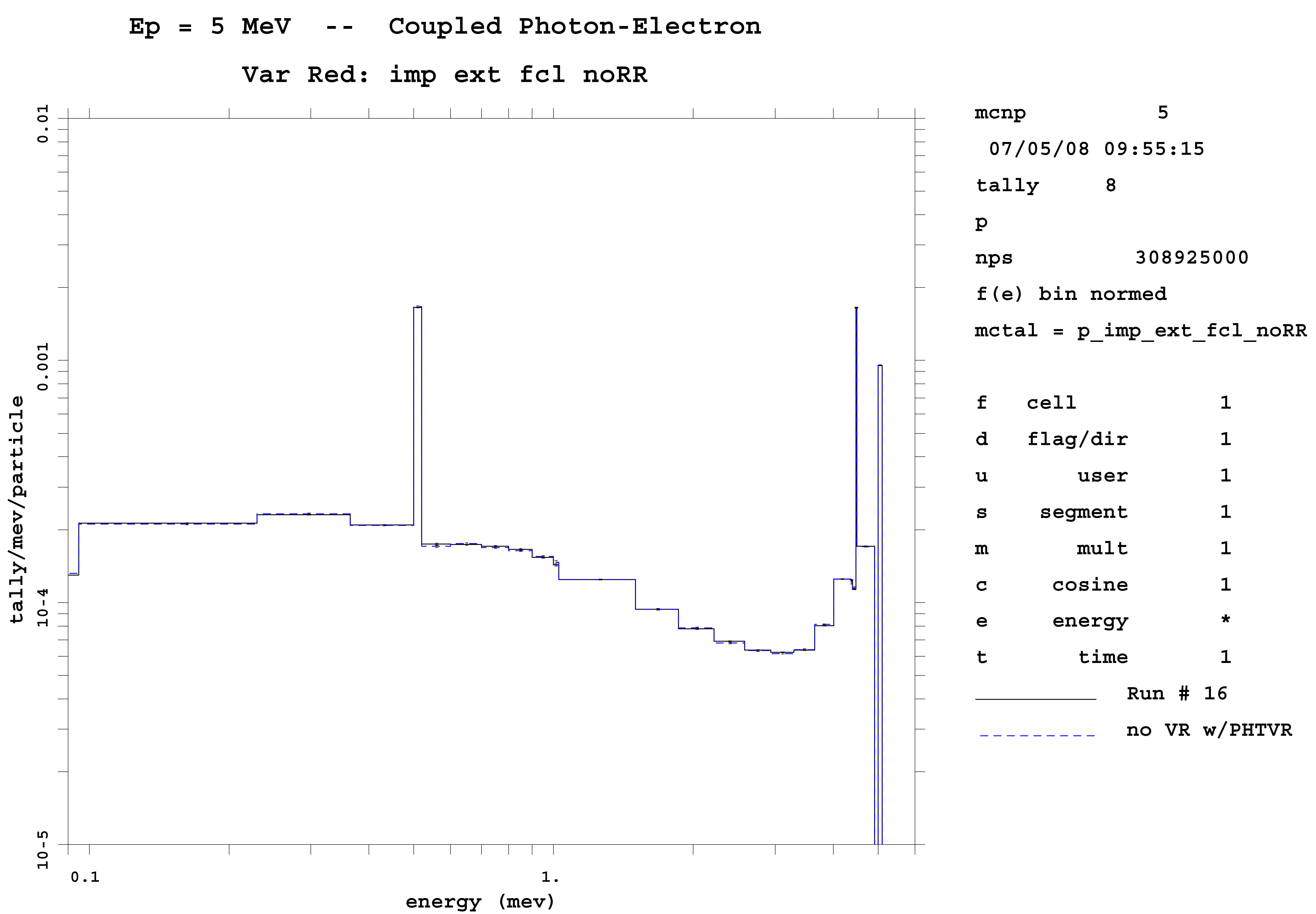
Var Red: imp dxt noRR



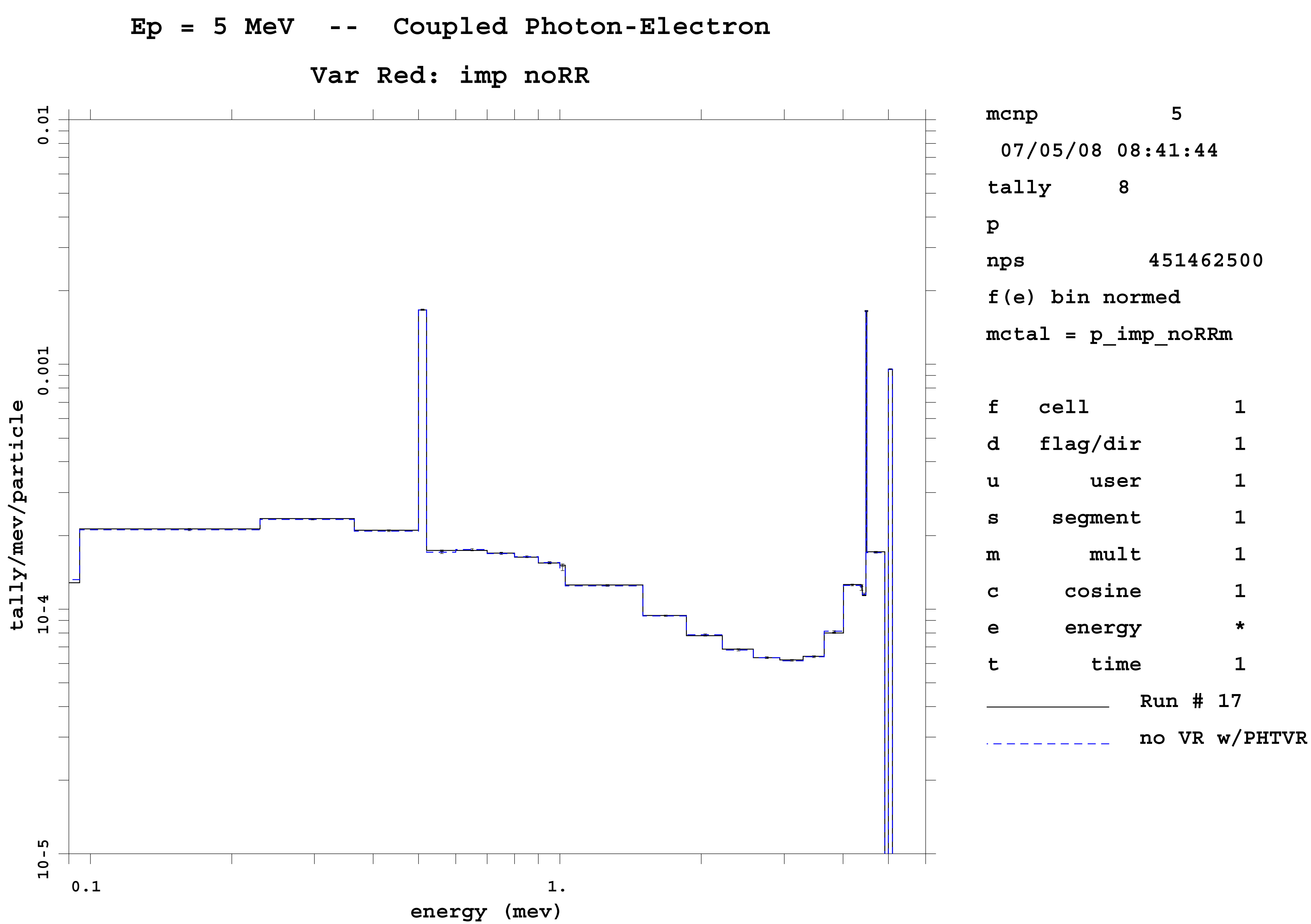


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp esplt noRR
tally/mev/particle
0.01
0.001
10-4
10-5
0.1
1.
energy (mev)
mcnp 5
07/05/08 09:22:40
tally 8
p
nps 451462500
f(e) bin normed
mctal = p_imp_esplt_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 14
no VR w/PHTVR


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp ext fcl wgt cutoff
tally/mev/particle
0.01
0.001
10-4
10-5
0.1
1.
energy (mev)
mcnp 5
07/05/08 09:52:09
tally 8
p
nps 425250000
f(e) bin normed
mctal = p_imp_ext_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 15
no VR w/PHTVR



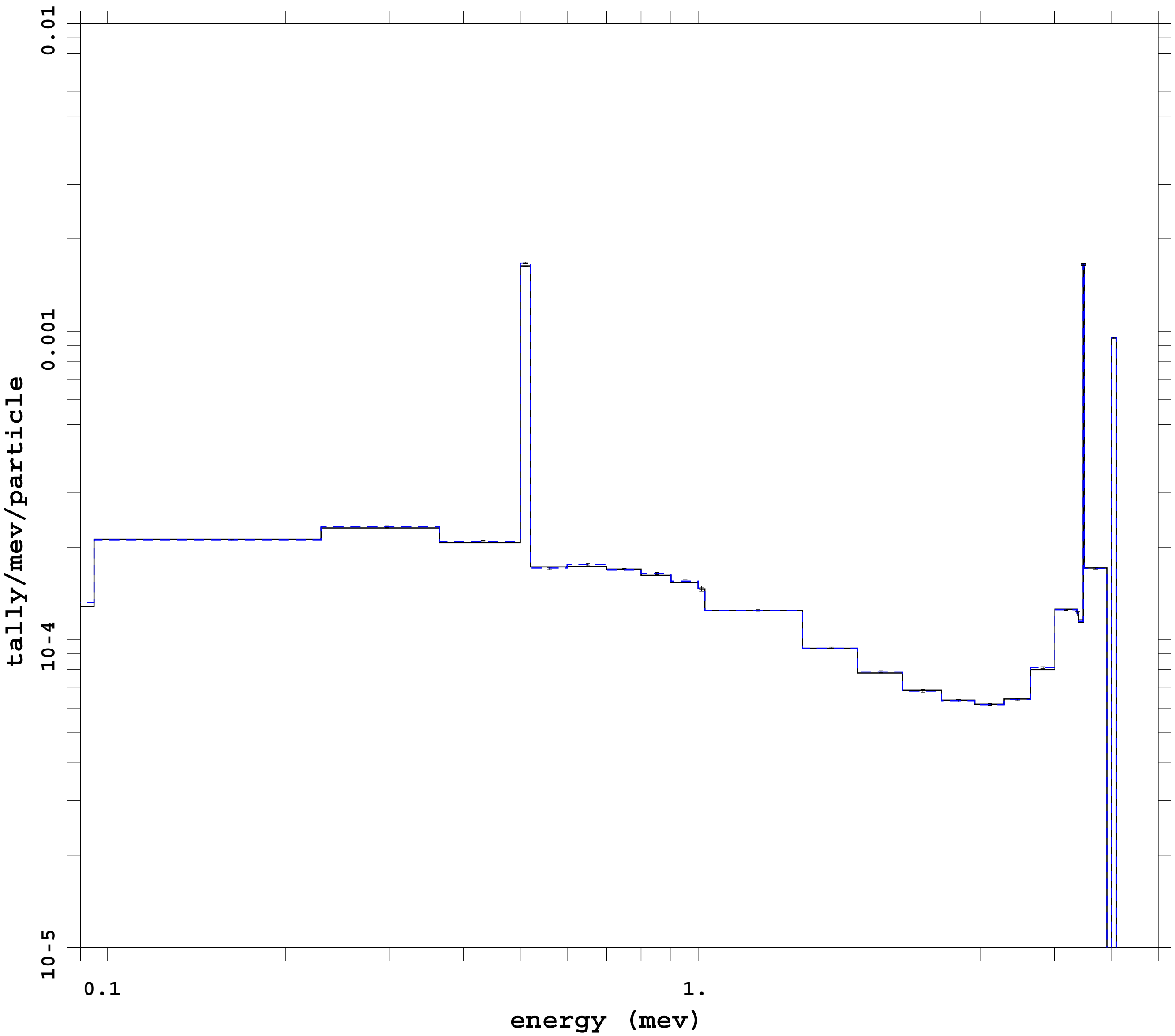
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp ext fcl noRR
0.01
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/05/08 09:55:15
tally 8
p
nps 308925000
f(e) bin normed
mctal = p_imp_ext_fcl_noRR
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 16
no VR w/PHTVR



Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp noRR
0.01
0.001
10-4
10-5
0.1
1.
energy (mev)
tally/mev/particle
mcnp 5
07/05/08 08:41:44
tally 8
p
nps 451462500
f(e) bin normed
mctal = p_imp_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 17
no VR w/PHTVR

Ep = 5 MeV -- Coupled Photon-Electron

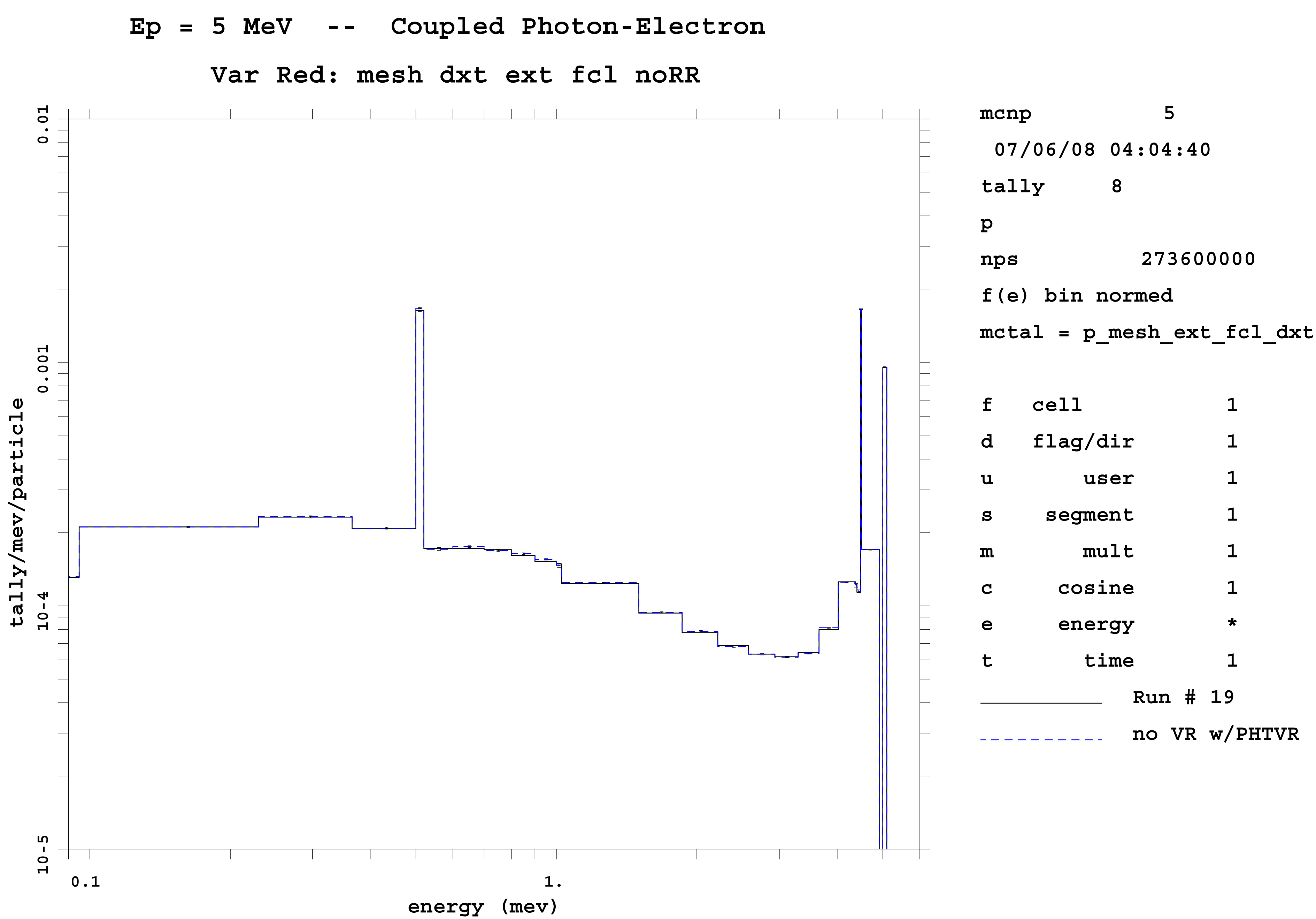
Var Red: mesh dxt noRR



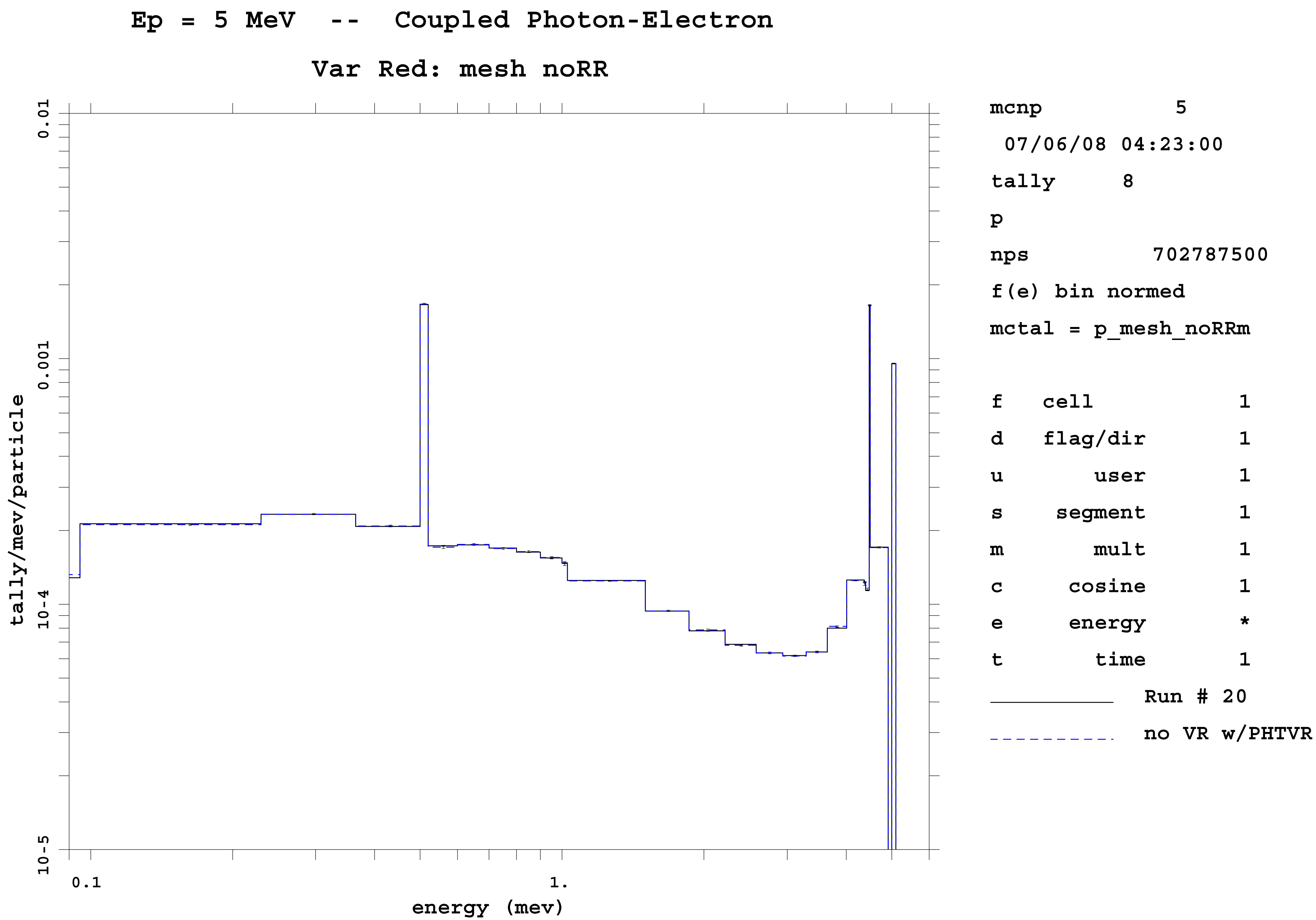
mcnp 5
07/07/08 08:23:50
tally 8
p
nps 259200000
f(e) bin normed
mctal = p_mesh_dxt_noRRm

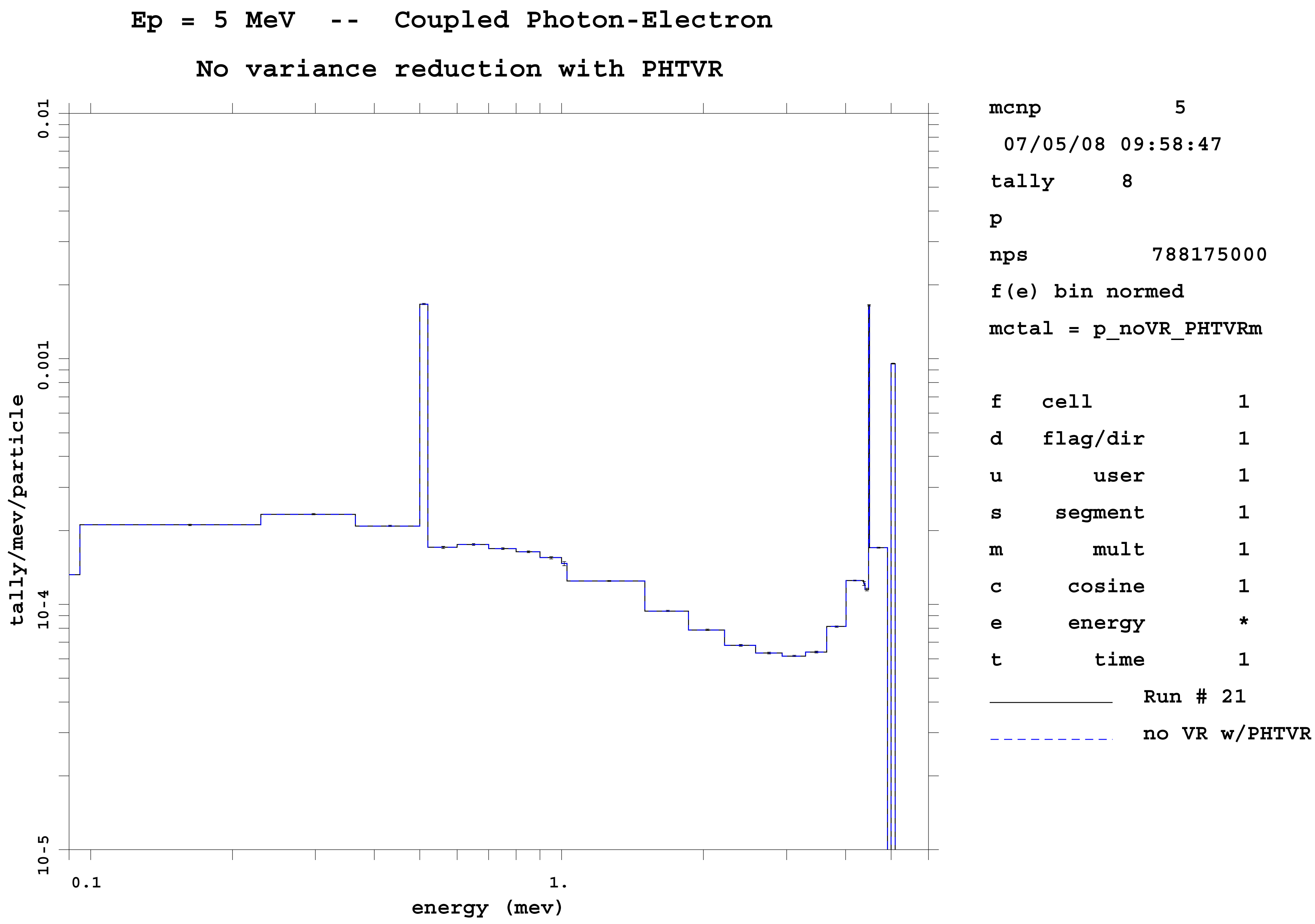
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1

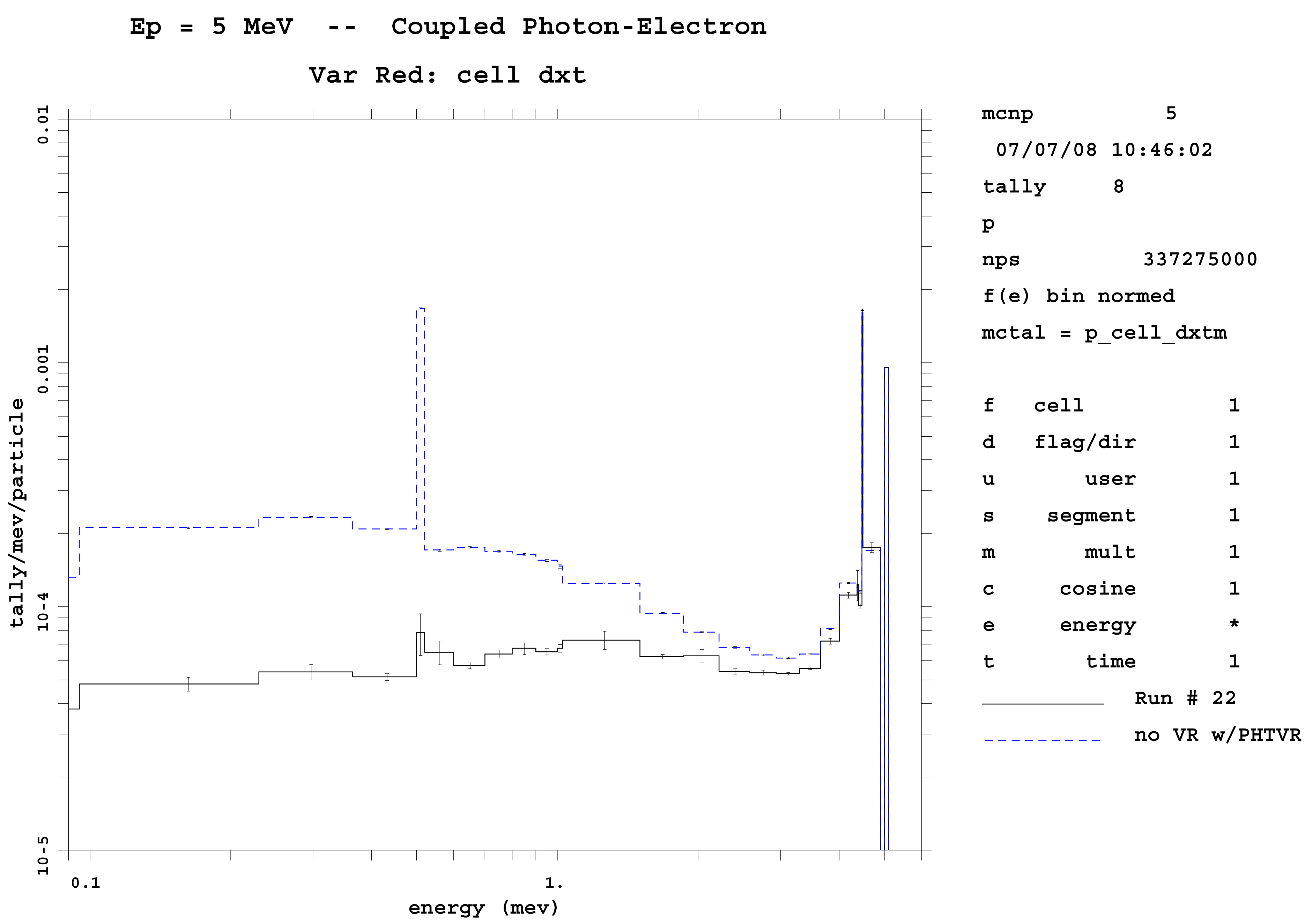
Run # 18
no VR w/PHTVR

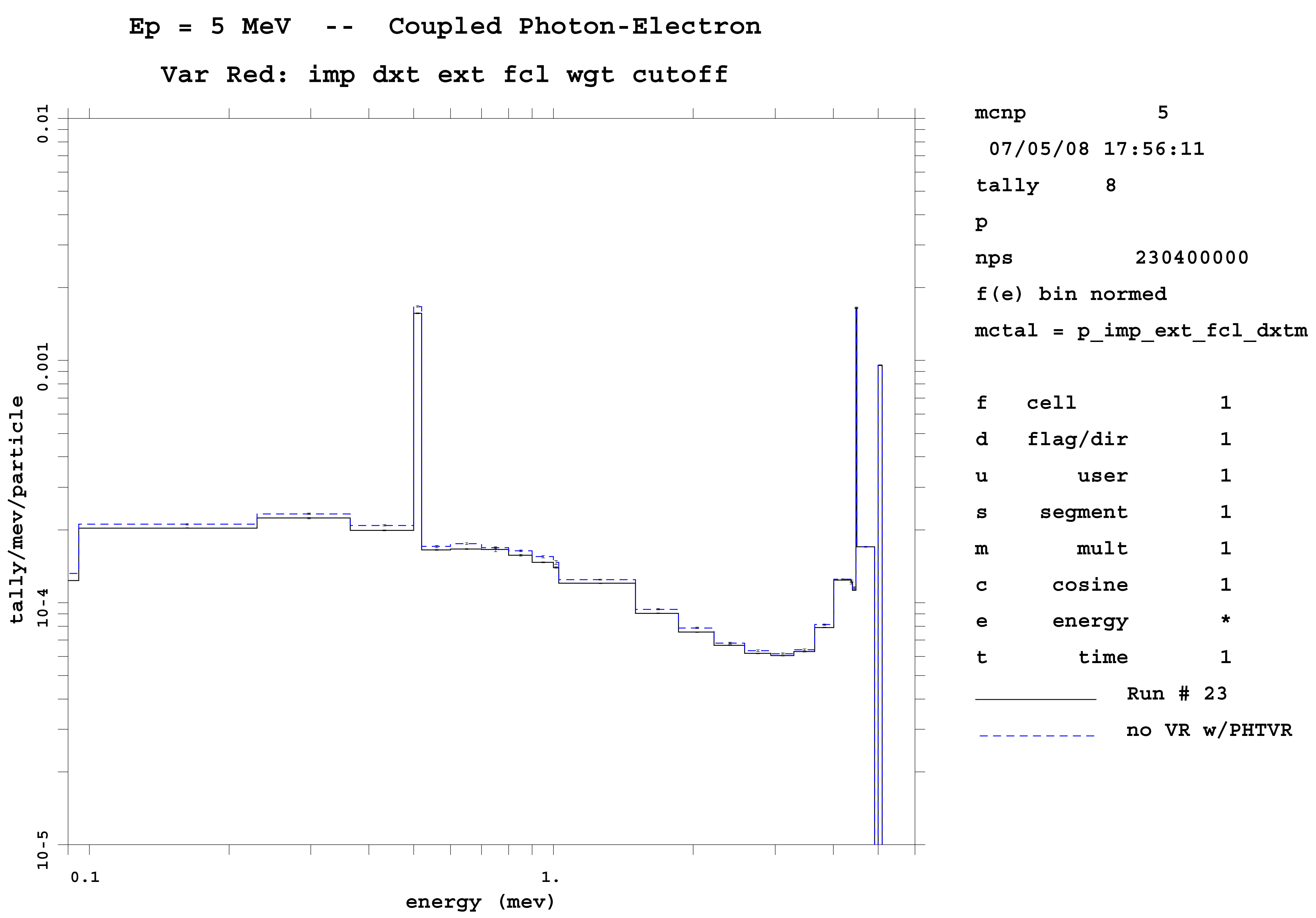


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: mesh dxt ext fcl noRR
0.01
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/06/08 04:04:40
tally 8
p
nps 273600000
f(e) bin normed
mctal = p_mesh_ext_fcl_dxt
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 19
no VR w/PHTVR


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: mesh noRR
0.01
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/06/08 04:23:00
tally 8
p
nps 702787500
f(e) bin normed
mctal = p_mesh_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 20
no VR w/PHTVR


Ep = 5 MeV -- Coupled Photon-Electron
No variance reduction with PHTVR
0.01
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/05/08 09:58:47
tally 8
p
nps 788175000
f(e) bin normed
mctal = p_noVR_PHTVRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 21
no VR w/PHTVR

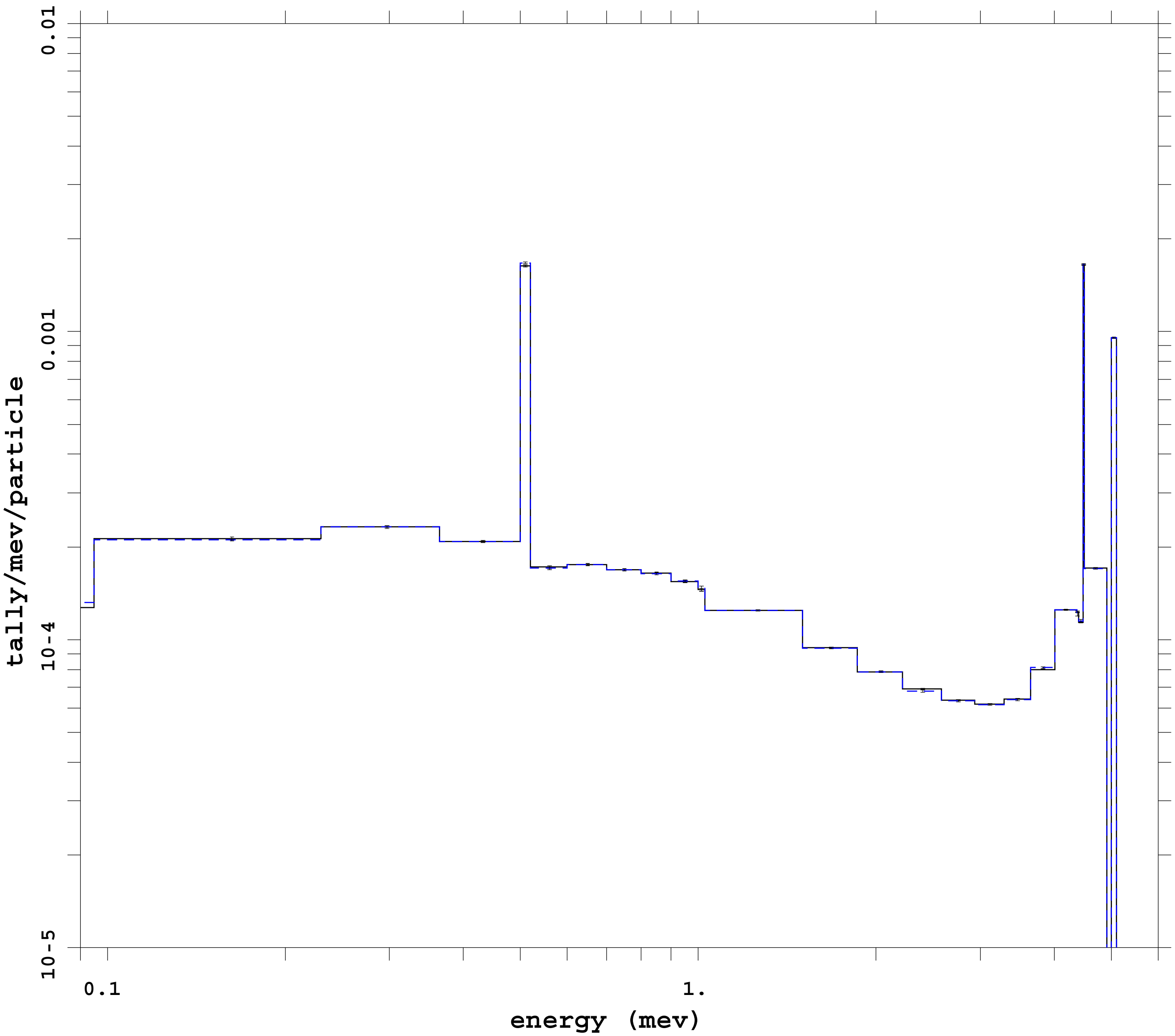

Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell dxt
0.01
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 10:46:02
tally 8
p
nps 337275000
f(e) bin normed
mctal = p_cell_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 22
no VR w/PHTVR



Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp dxt ext fcl wgt cutoff
0.01
0.001
10-4
10-5
0.1
1.
energy (mev)
tally/mev/particle
mcnp 5
07/05/08 17:56:11
tally 8
p
nps 230400000
f(e) bin normed
mctal = p_imp_ext_fcl_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 23
no VR w/PHTVR

Ep = 5 MeV -- Coupled Photon-Electron

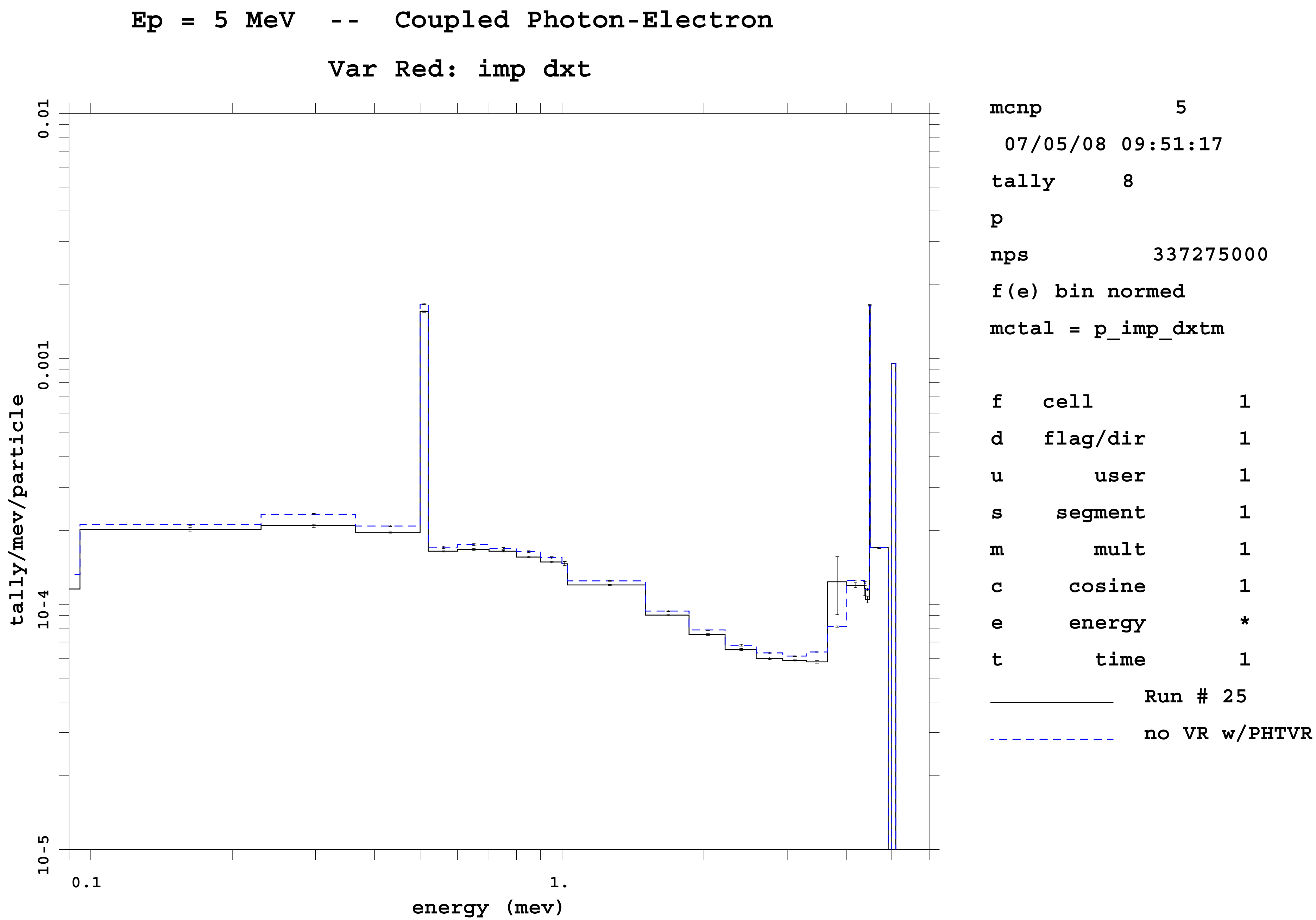
Var Red: mesh ext fcl noRR

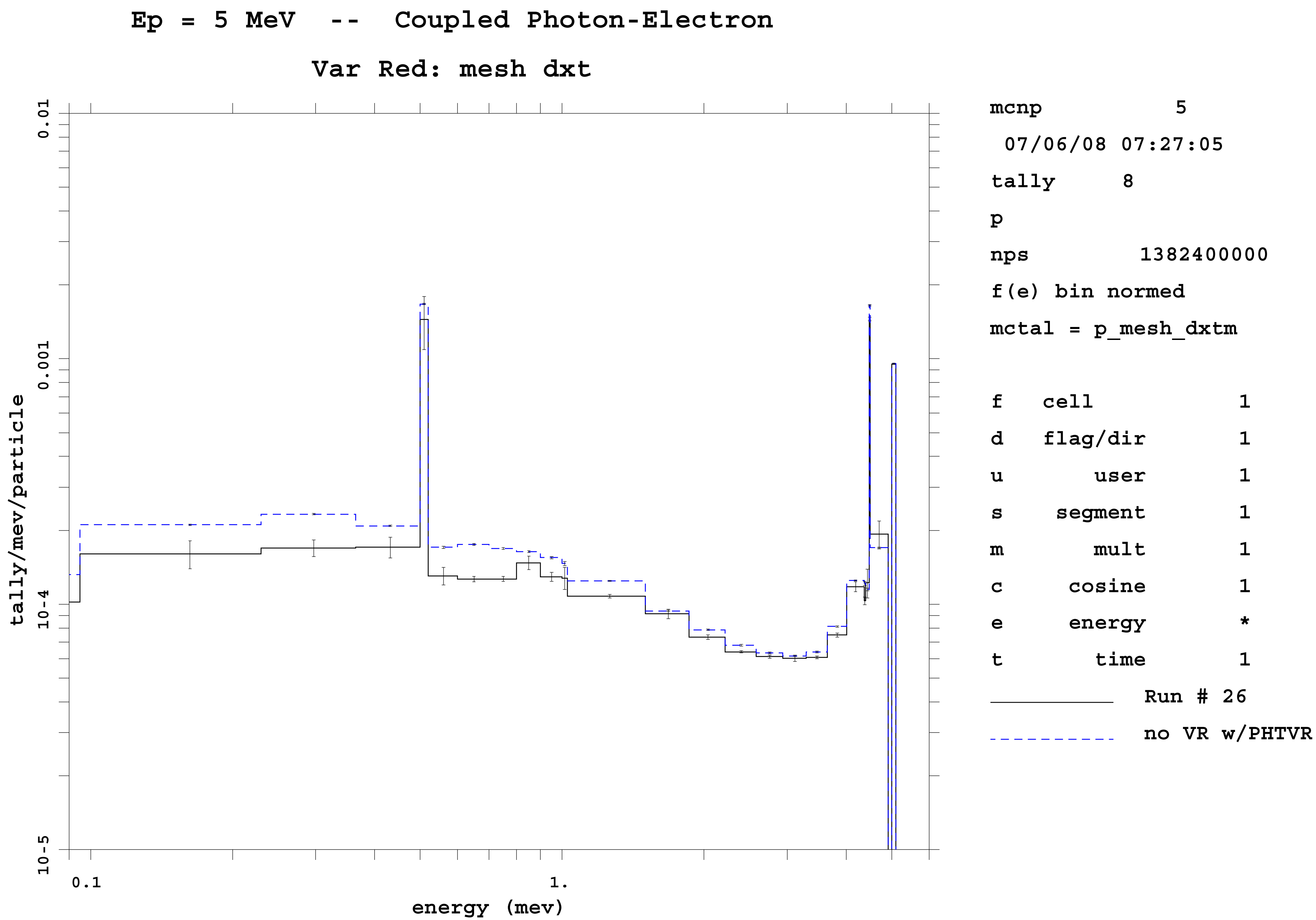


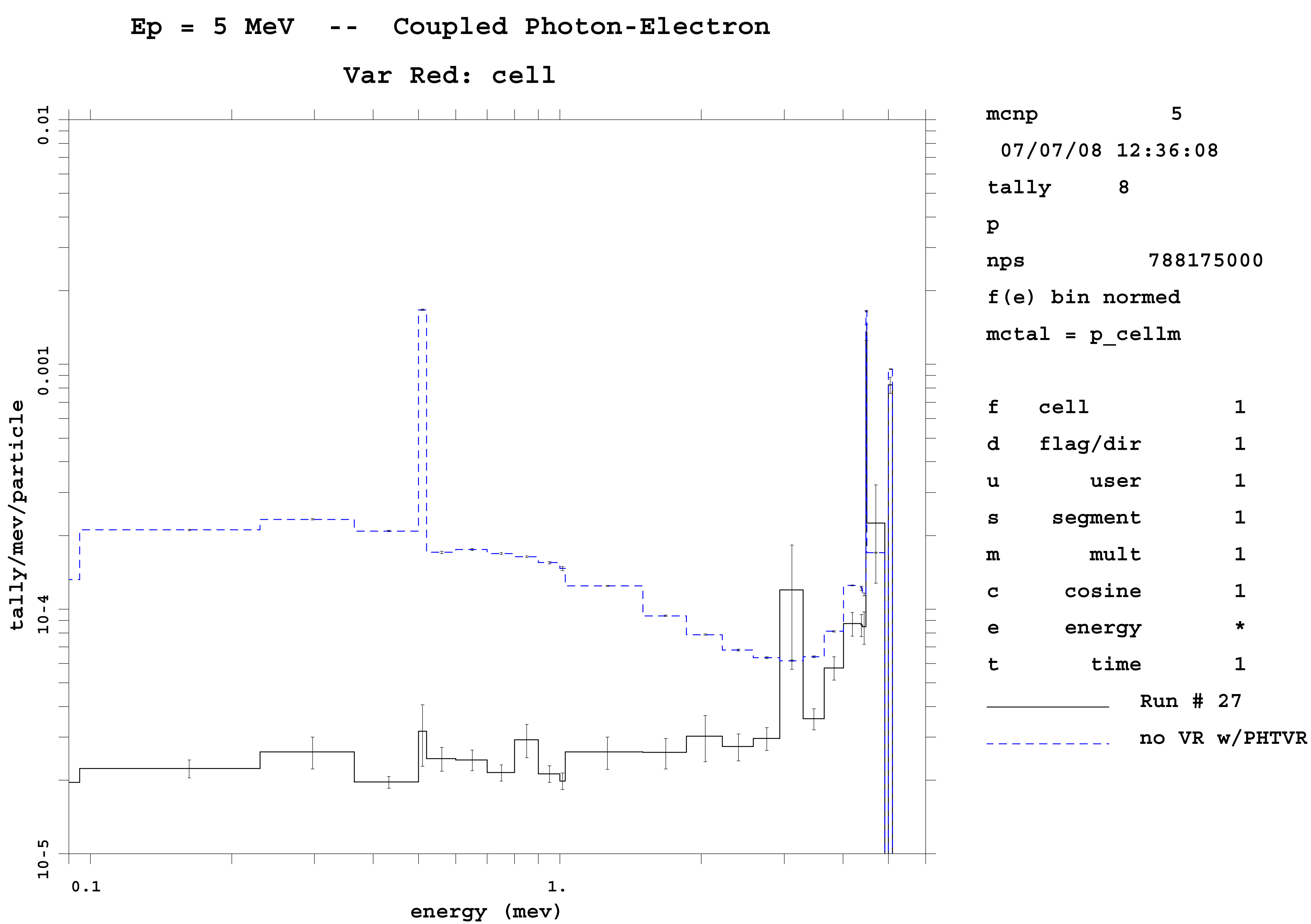
mcnp 5
07/05/08 21:08:21
tally 8
p
nps 855225000
f(e) bin normed
mctal = p_mesh_ext_fcl_noR

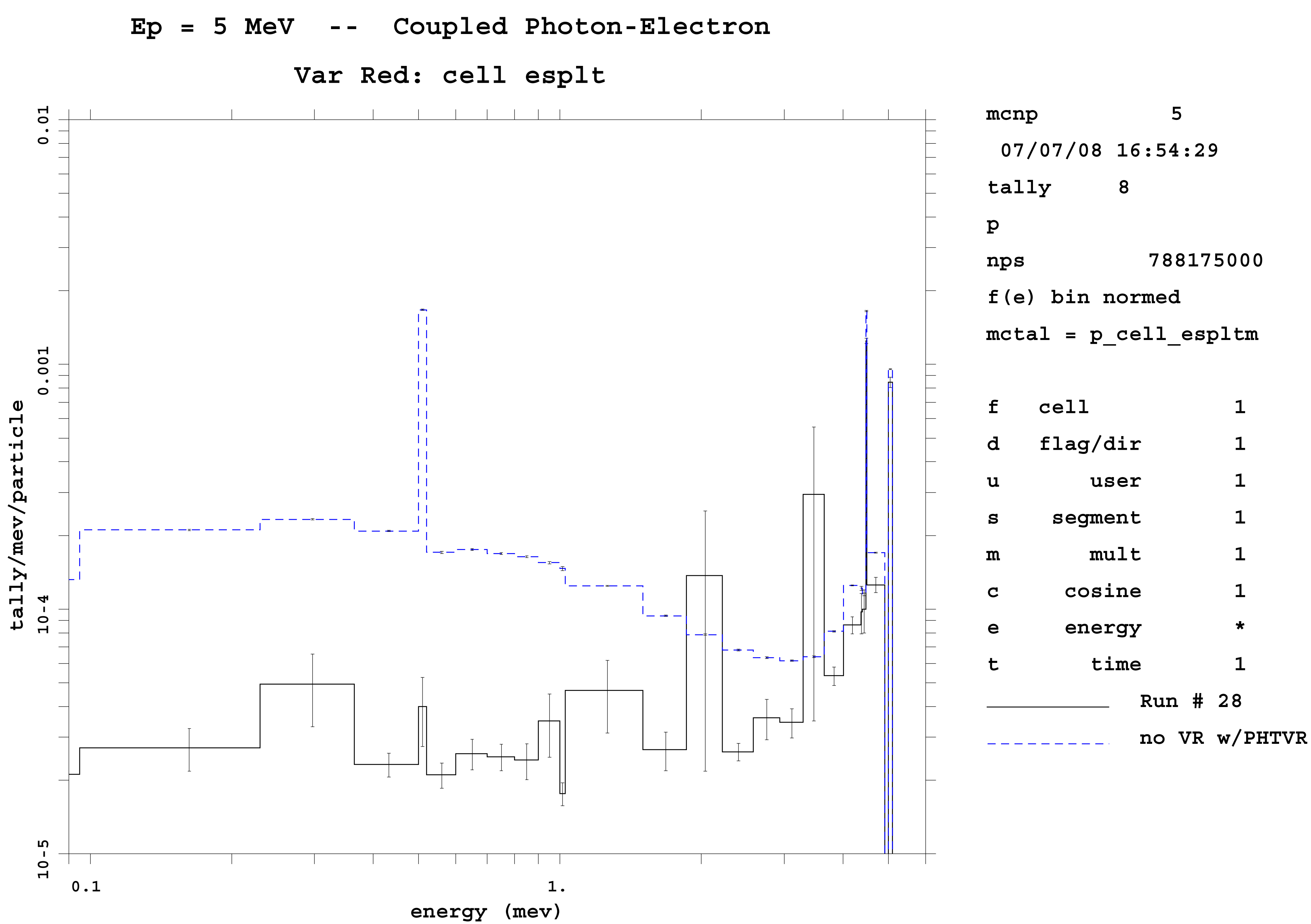
f	cell	1
d	flag/dir	1
u	user	1
s	segment	1
m	mult	1
c	cosine	1
e	energy	*
t	time	1

——— Run # 24
- - - no VR w/PHTVR

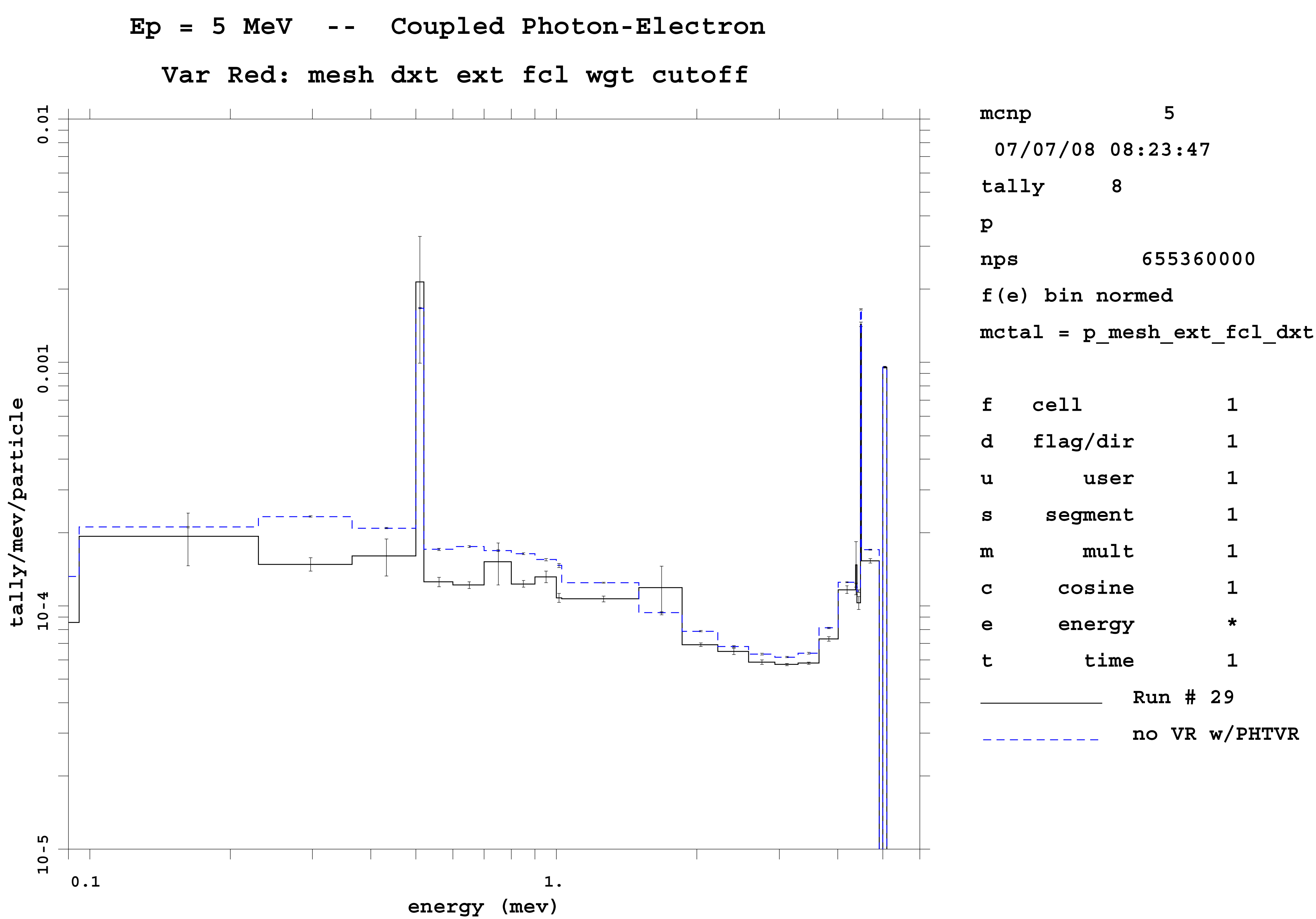

Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp dxt
tally/mev/particle
0.01
0.001
10-4
10-5
0.1
1.
energy (mev)
mcnp 5
07/05/08 09:51:17
tally 8
p
nps 337275000
f(e) bin normed
mctal = p_imp_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 25
no VR w/PHTVR


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: mesh dxt
tally/mev/particle
0.01
0.001
10-4
10-5
0.1
1.
energy (mev)
mcnp 5
07/06/08 07:27:05
tally 8
p
nps 1382400000
f(e) bin normed
mctal = p_mesh_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 26
no VR w/PHTVR

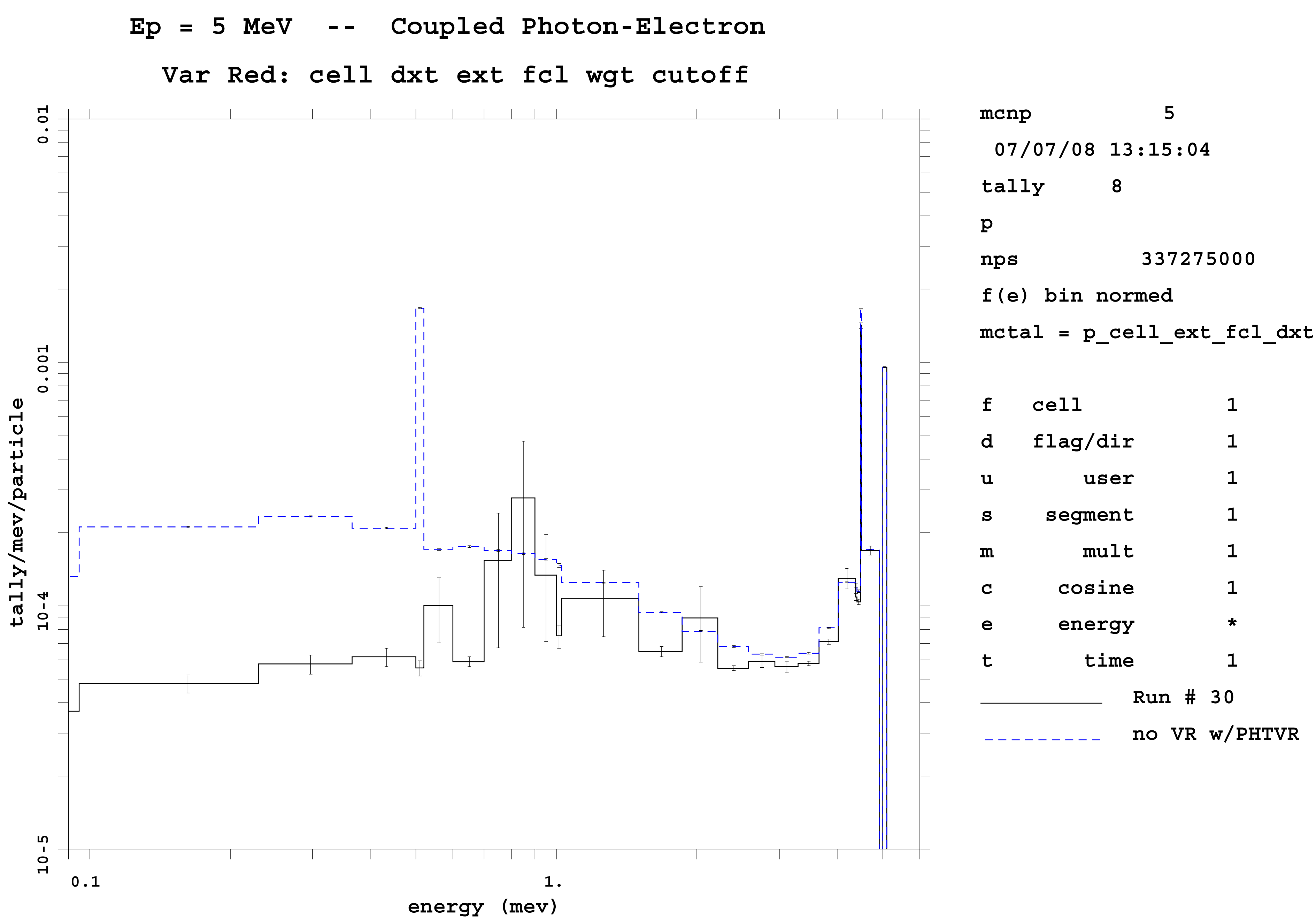

Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell
0.01
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 12:36:08
tally 8
p
nps 788175000
f(e) bin normed
mctal = p_cellm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 27
no VR w/PHTVR



Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell espl t
0.01
0.001
10-4
10-5
0.1
1.
energy (mev)
tally/mev/particle
mcnp 5
07/07/08 16:54:29
tally 8
p
nps 788175000
f(e) bin normed
mctal = p_cell_espltm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 28
no VR w/PHTVR



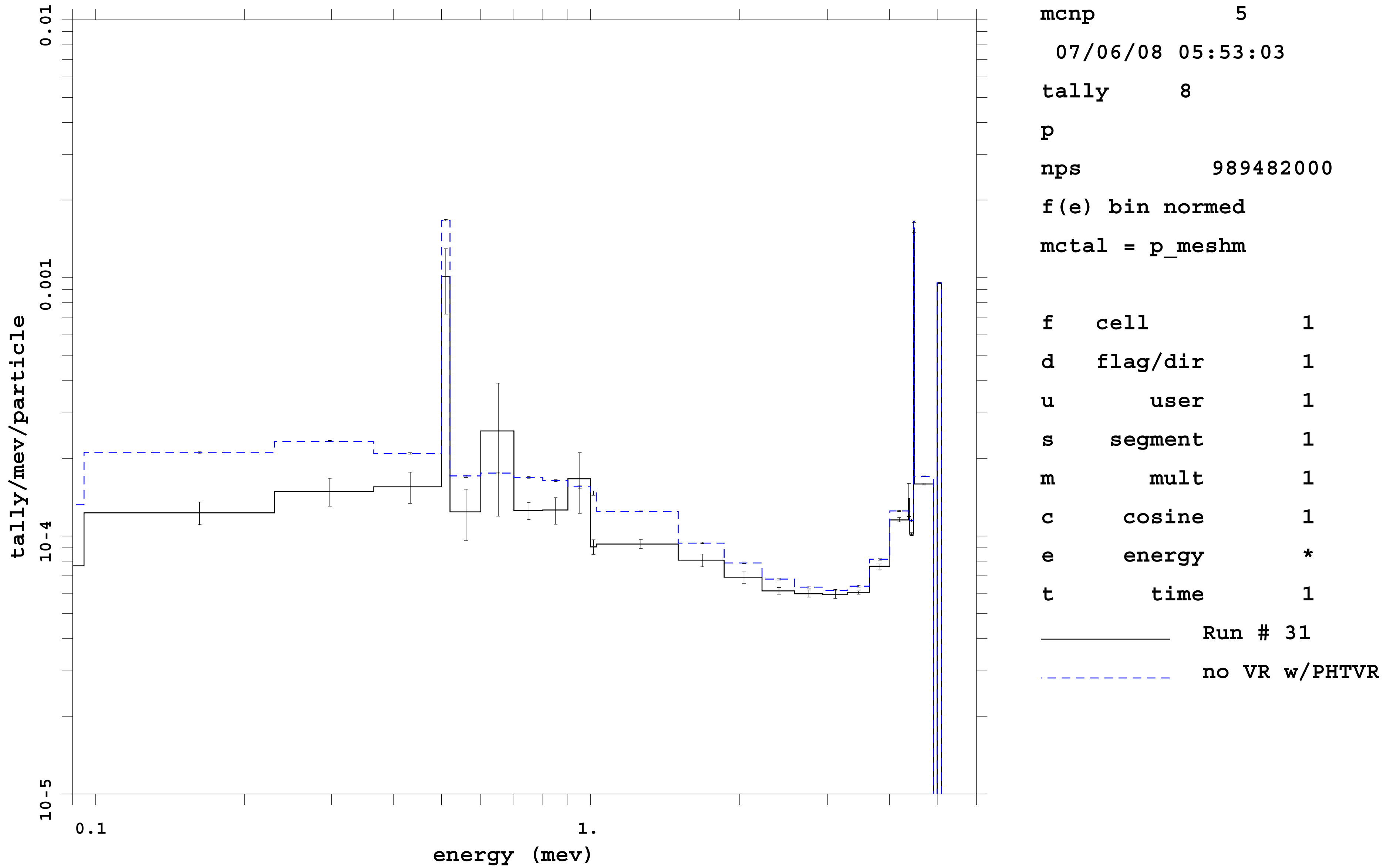
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: mesh dxt ext fcl wgt cutoff
0.01
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 08:23:47
tally 8
p
nps 655360000
f(e) bin normed
mctal = p_mesh_ext_fcl_dxt
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 29
no VR w/PHTVR

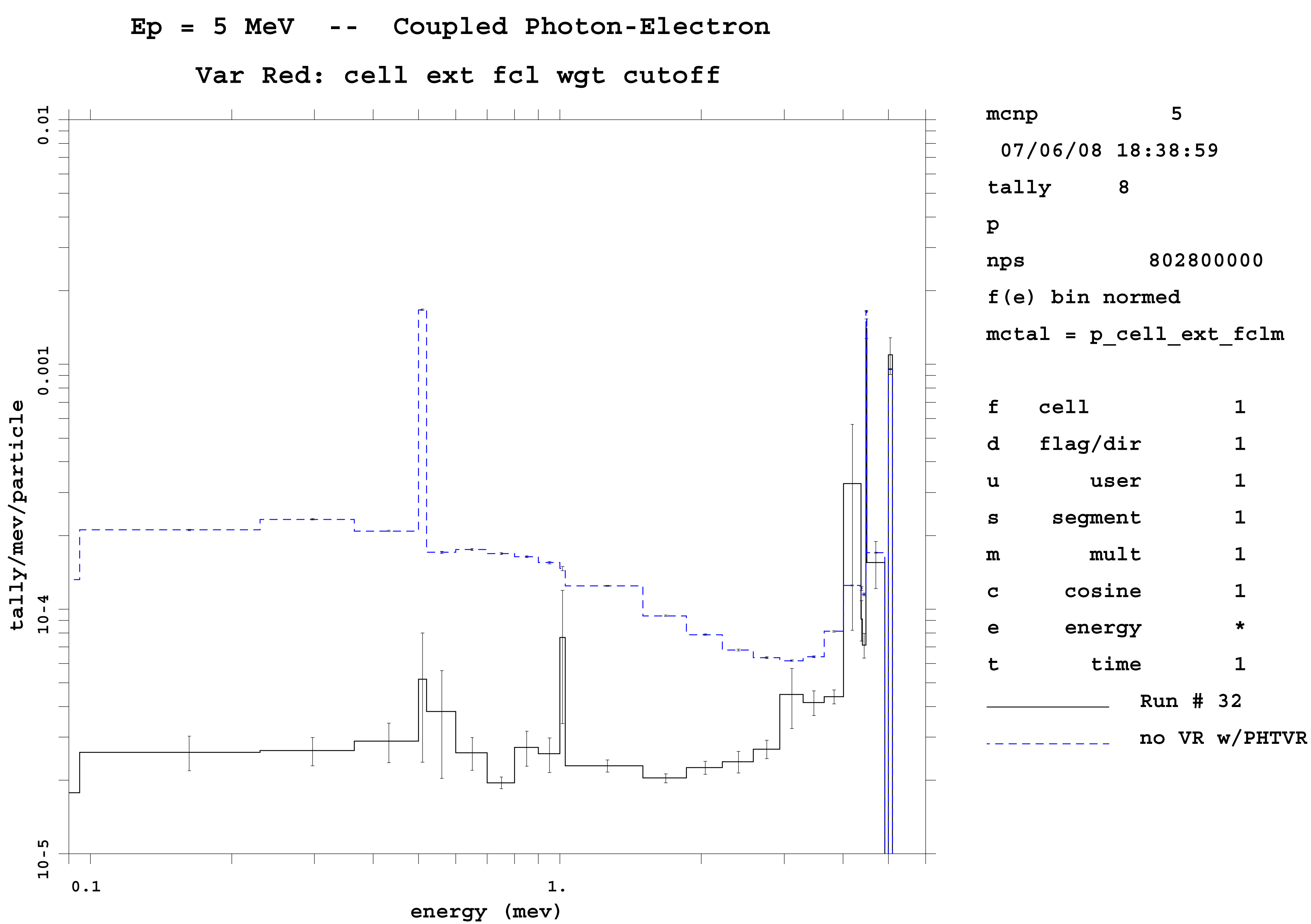


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell dxt ext fcl wgt cutoff
0.01
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 13:15:04
tally 8
p
nps 337275000
f(e) bin normed
mctal = p_cell_ext_fcl_dxt
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 30
no VR w/PHTVR

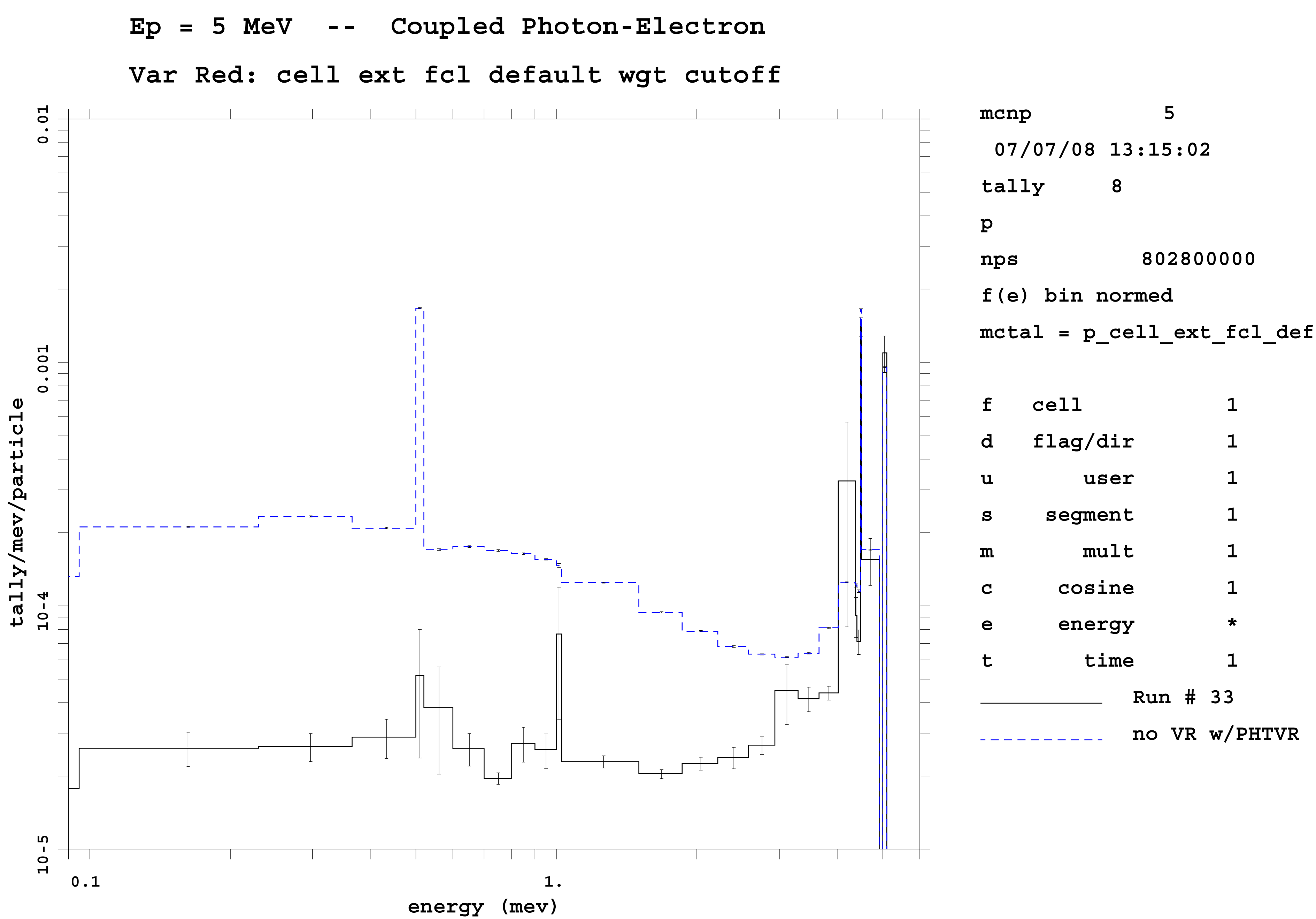
Ep = 5 MeV -- Coupled Photon-Electron

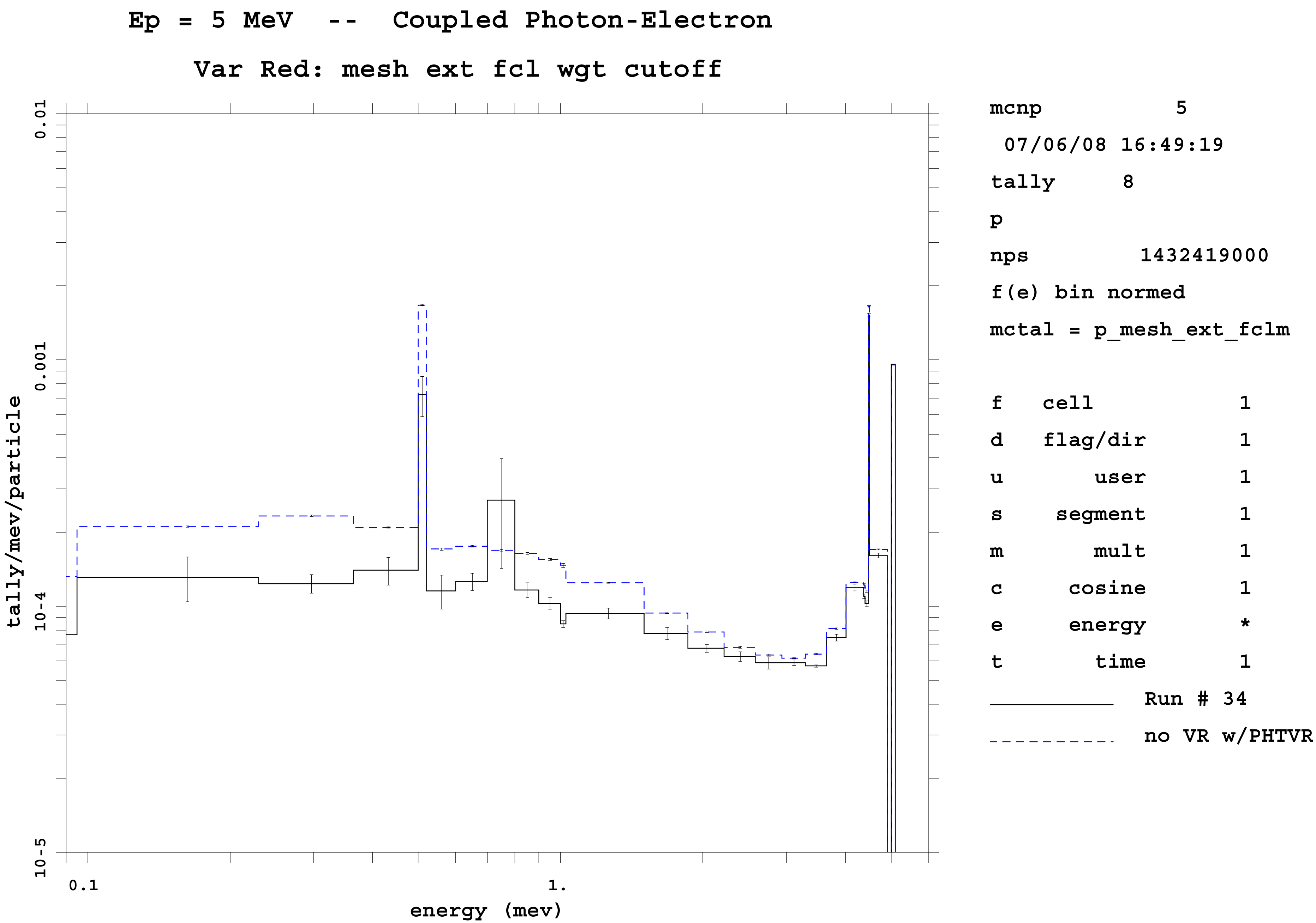
Var Red: mesh





Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell ext fcl wgt cutoff
0.01
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/06/08 18:38:59
tally 8
p
nps 802800000
f(e) bin normed
mctal = p_cell_ext_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 32
no VR w/PHTVR


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell ext fcl default wgt cutoff
0.01
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/07/08 13:15:02
tally 8
p
nps 802800000
f(e) bin normed
mctal = p_cell_ext_fcl_def
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 33
no VR w/PHTVR

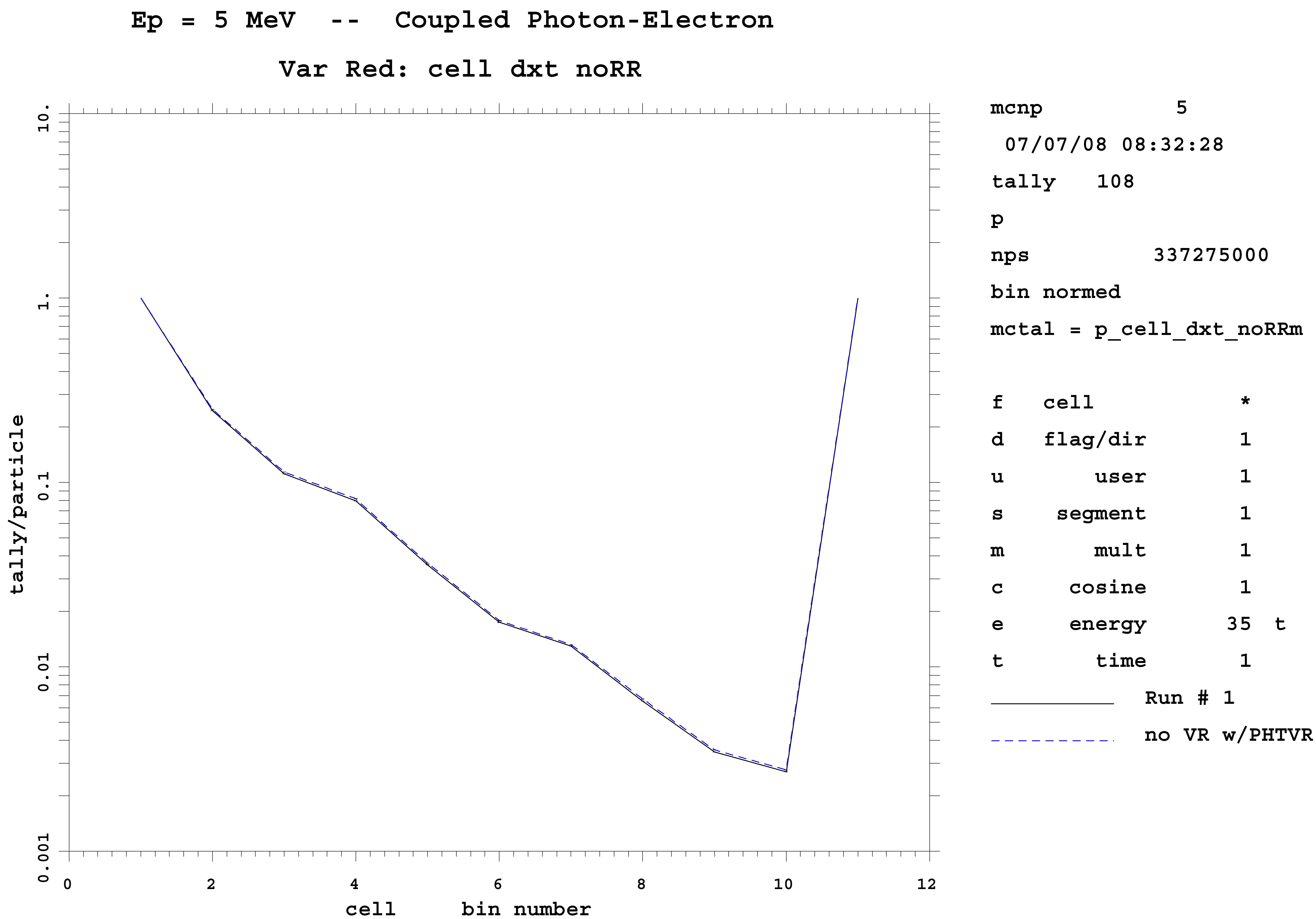

Ep = 5 MeV -- Coupled Photon-Electron
Var Red: mesh ext fcl wgt cutoff
0.01
0.001
10-4
10-5
tally/mev/particle
0.1
1.
energy (mev)
mcnp 5
07/06/08 16:49:19
tally 8
p
nps 1432419000
f(e) bin normed
mctal = p_mesh_ext_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 34
no VR w/PHTVR

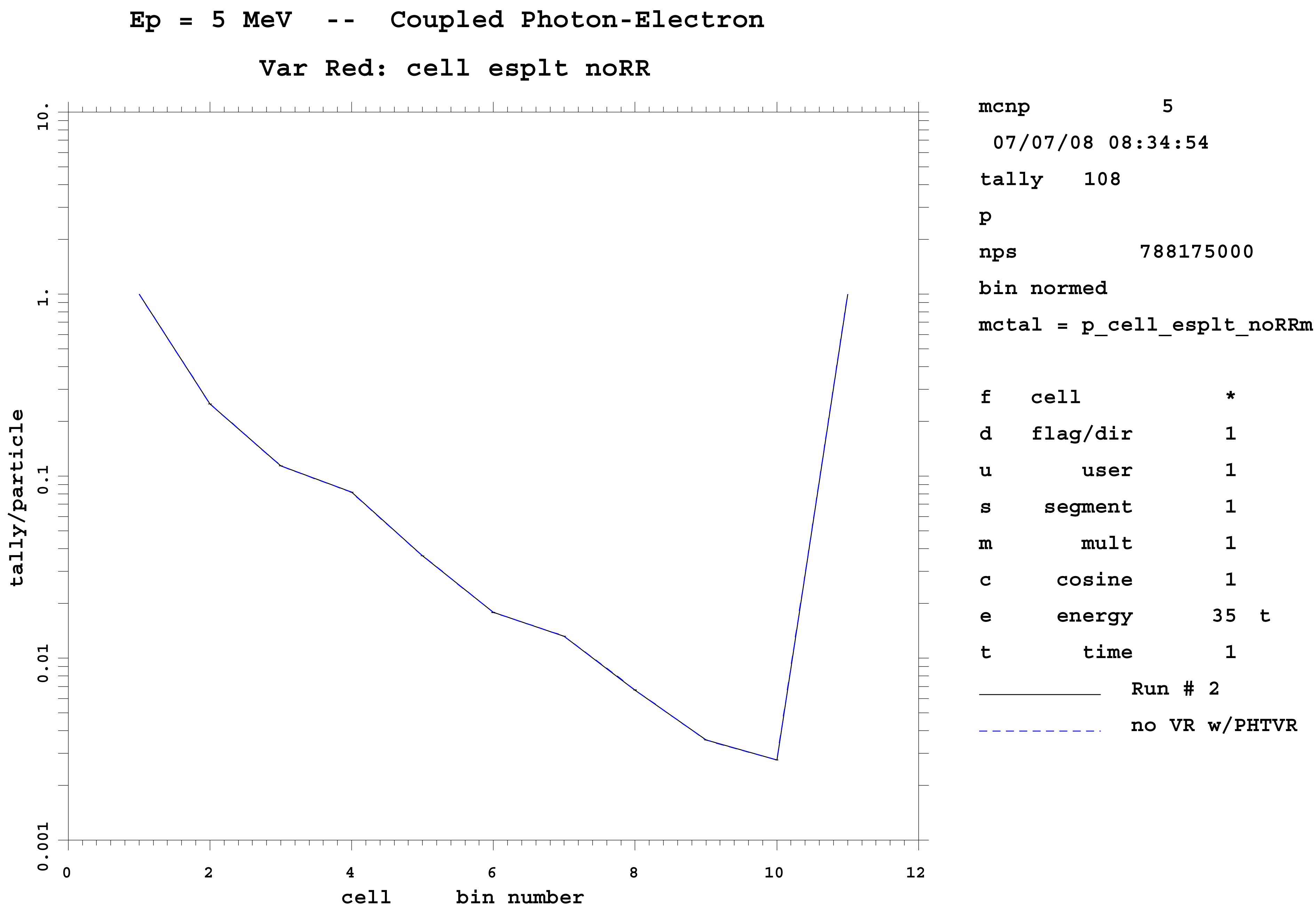
Appendix A.2.iii

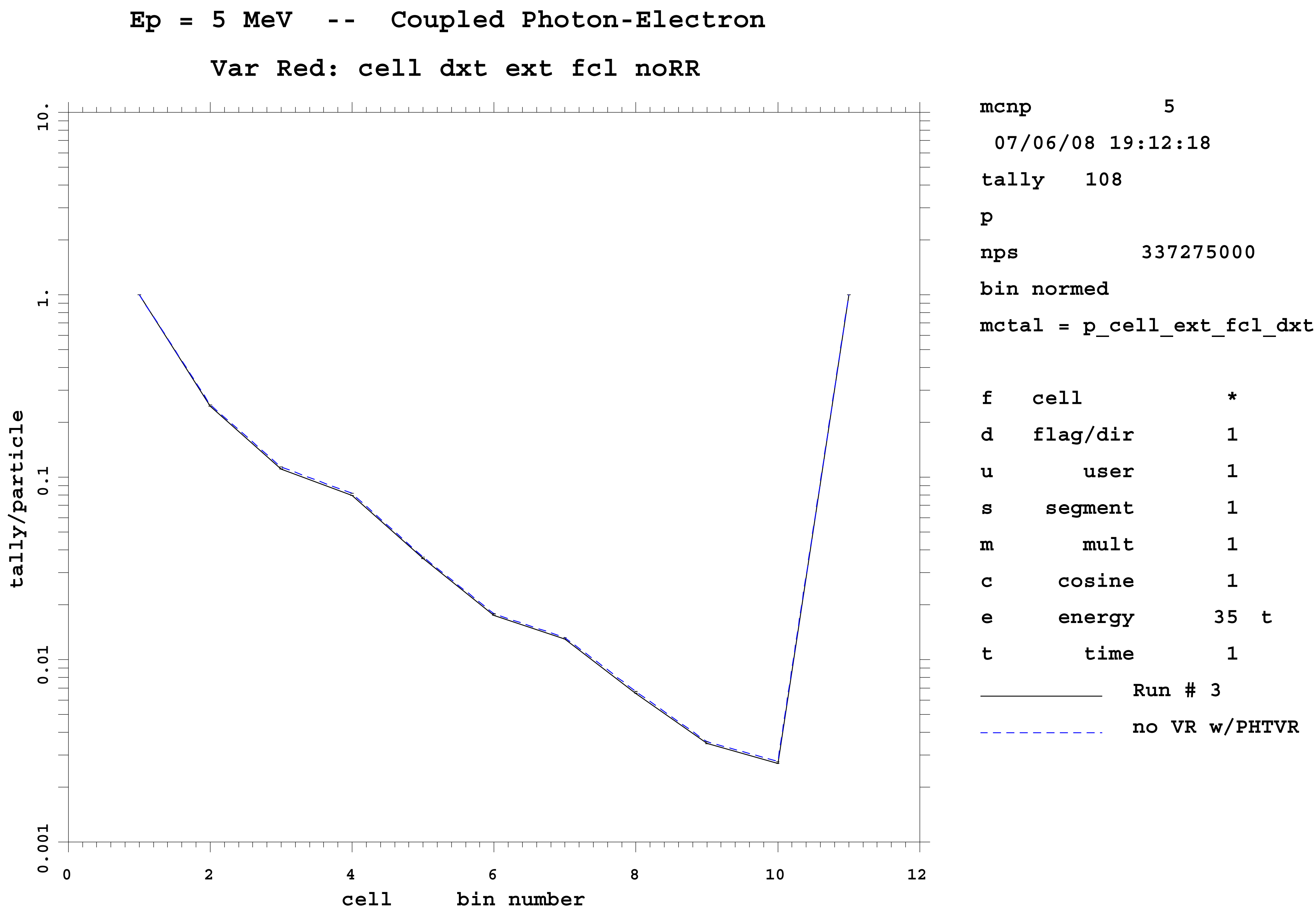
Problem 1
Ge sphere Next To a U / O Stacked Cylinder Problem

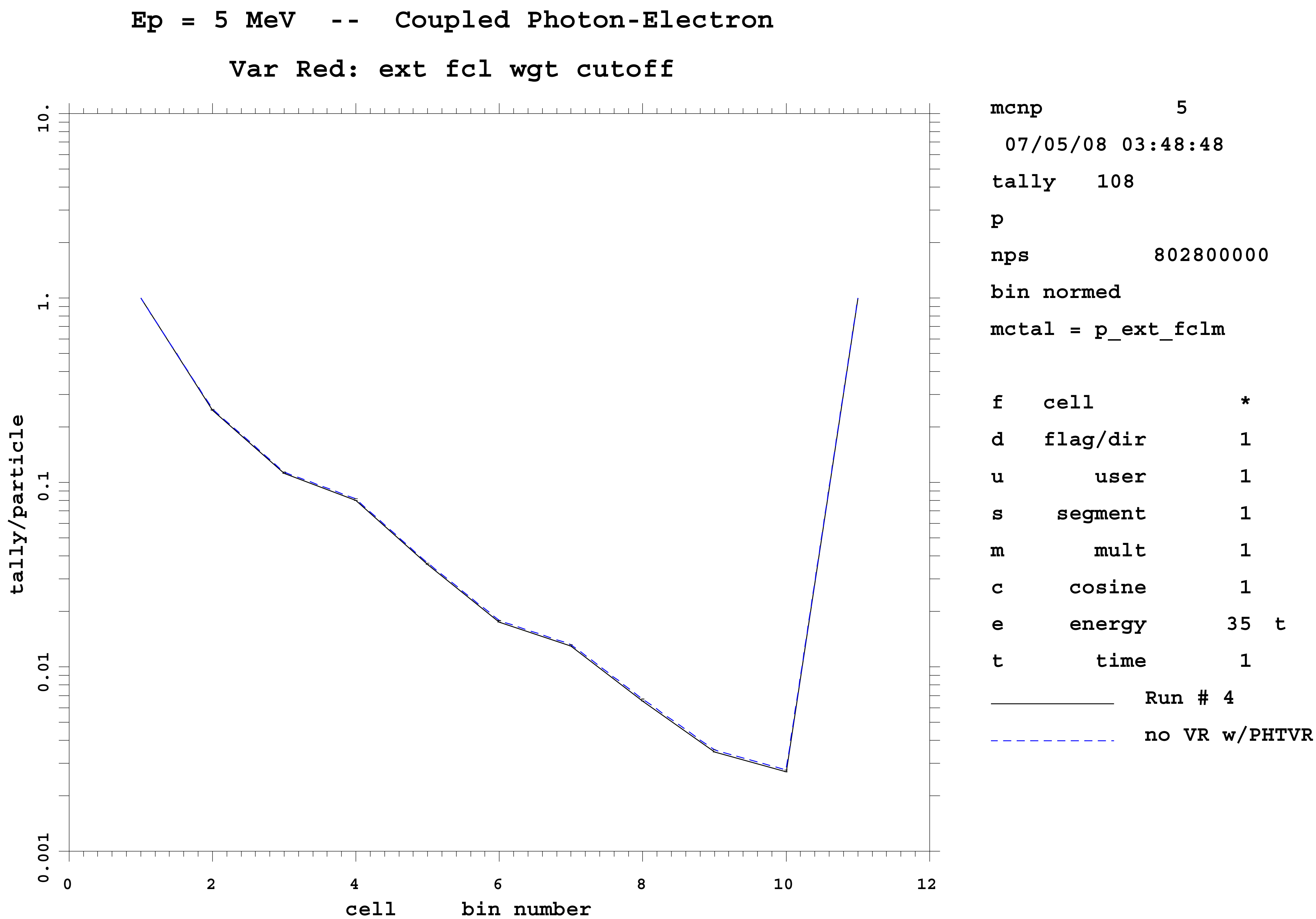
Plots of the total pulses in the sections of the cylinder

Plots are in order of the run number listed in Table 3. The variance reduction methods used are listed in the plot title; the graph label contains the run number.

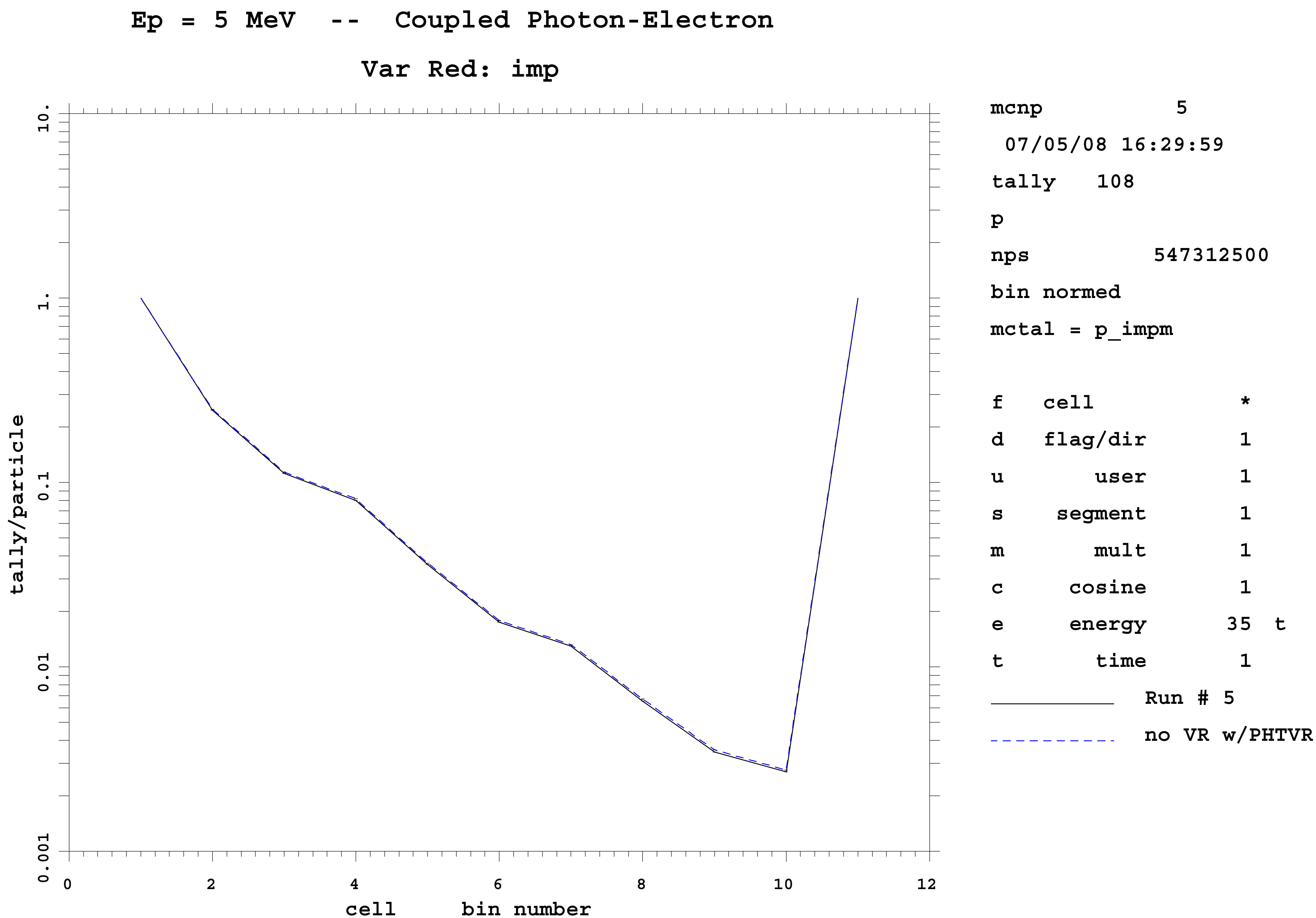

Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell dxt noRR
mcnp 5
07/07/08 08:32:28
tally 108
p
nps 337275000
bin normed
mctal = p_cell_dxt_noRRm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 1
no VR w/PHTVR
tally/particle
cell bin number
10.
1.
0.1
0.01
0.001
0
2
4
6
8
10
12


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell esplt noRR
tally/particle
10.
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/07/08 08:34:54
tally 108
p
nps 788175000
bin normed
mctal = p_cell_esplt_noRRm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 2
no VR w/PHTVR

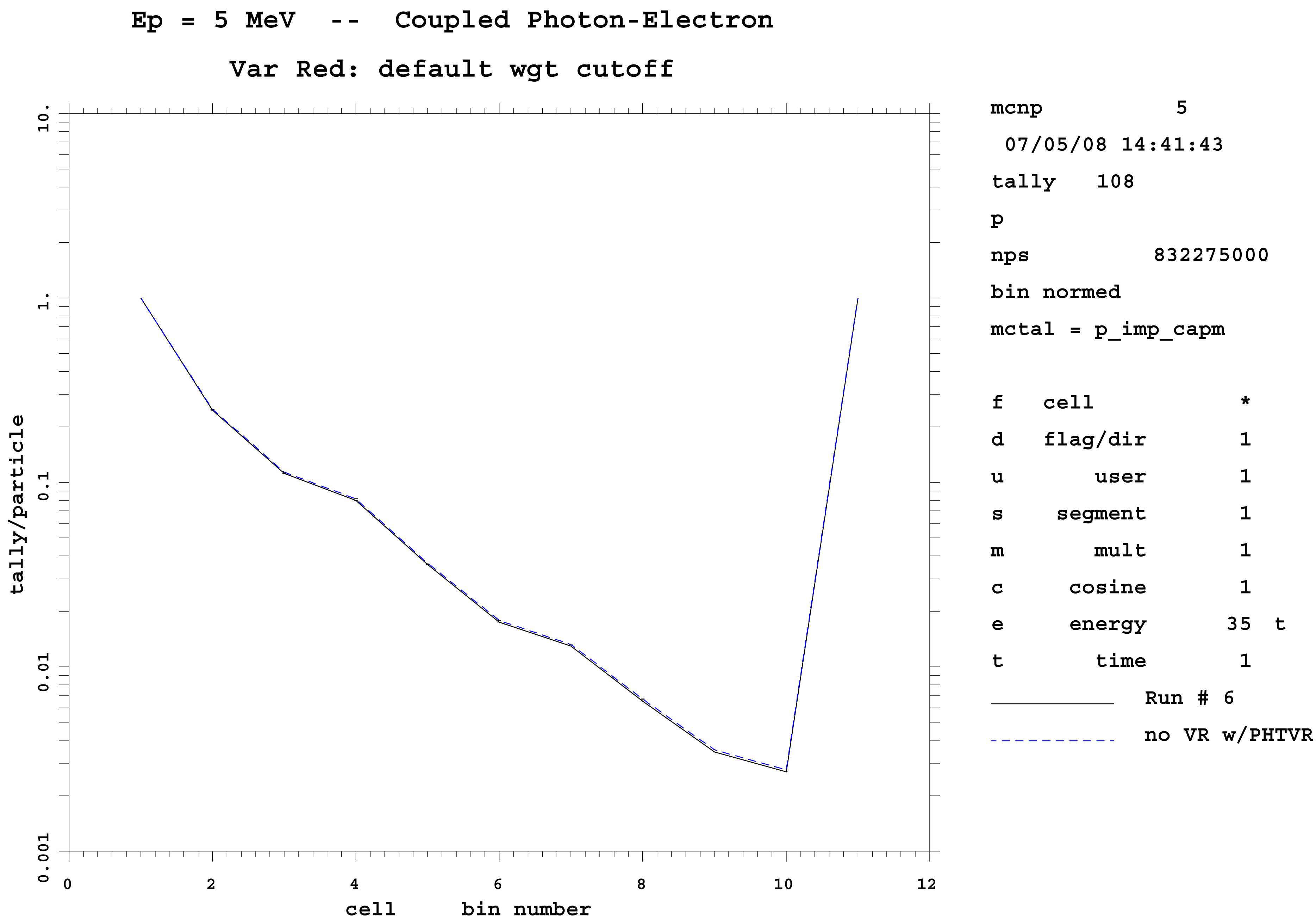

Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell dxt ext fcl noRR
tally/particle
10.
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/06/08 19:12:18
tally 108
p
nps 337275000
bin normed
mctal = p_cell_ext_fcl_dxt
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 3
no VR w/PHTVR

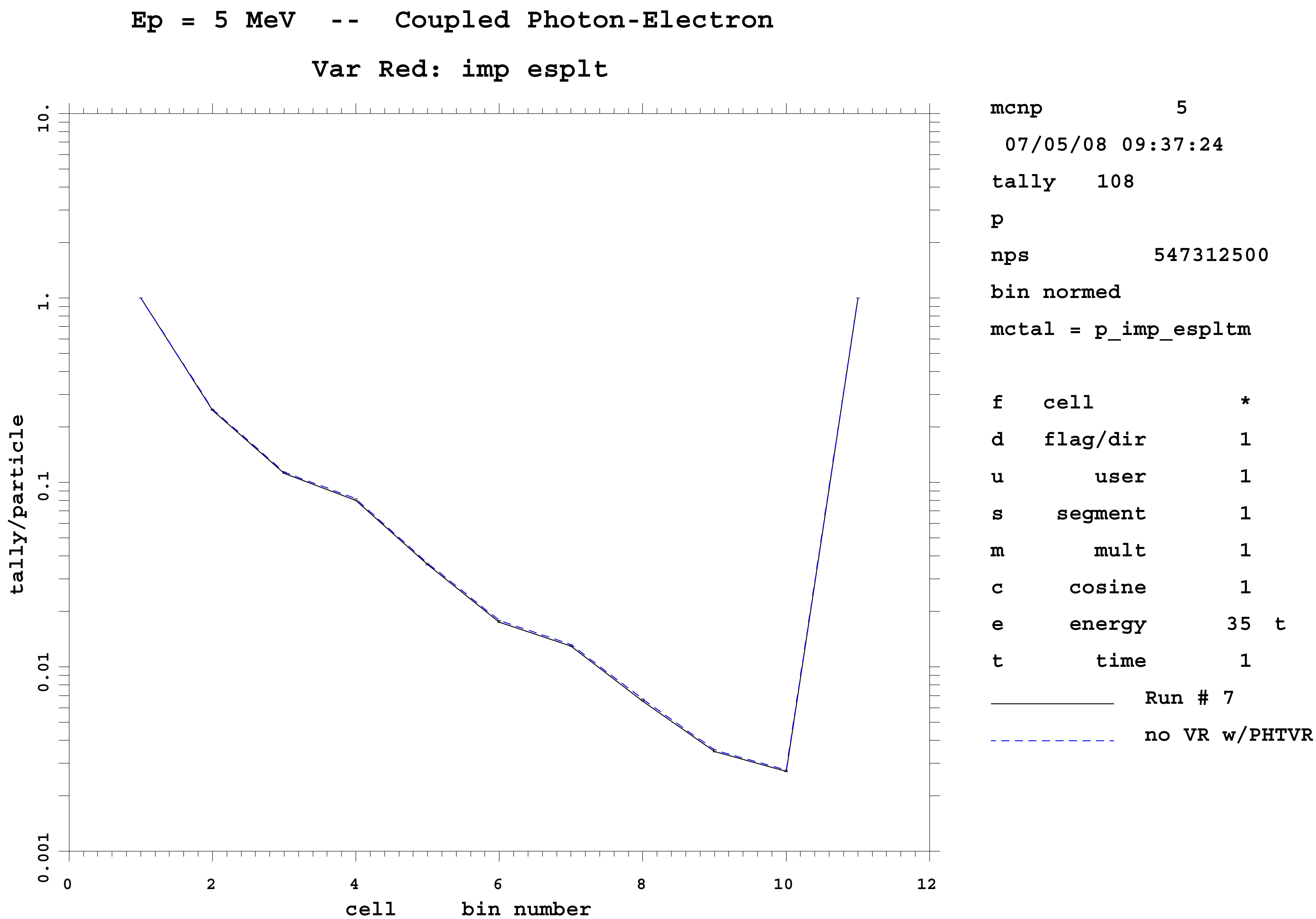


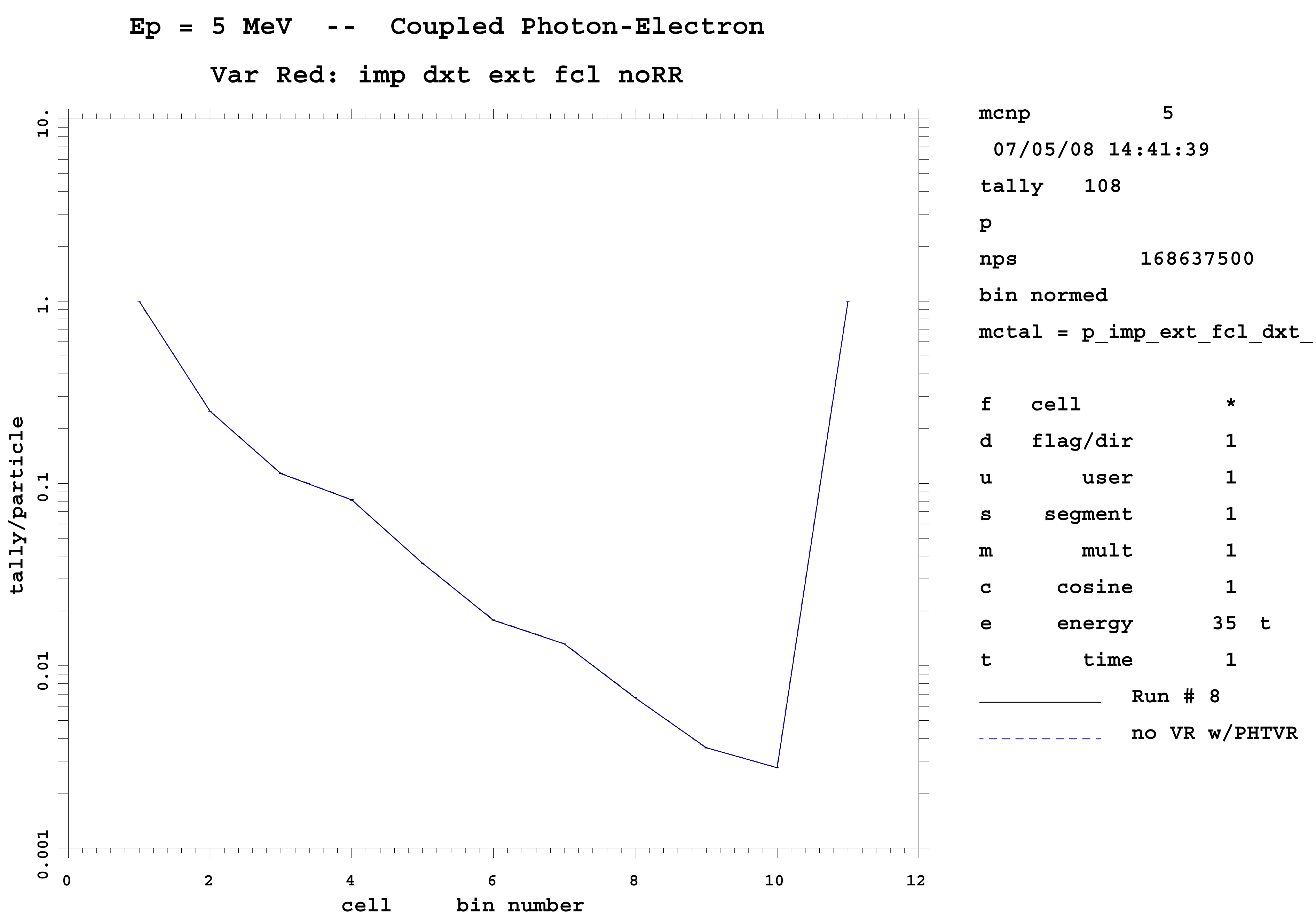
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: ext fcl wgt cutoff
tally/particle
10.
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/05/08 03:48:48
tally 108
p
nps 802800000
bin normed
mctal = p_ext_fclm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 4
no VR w/PHTVR



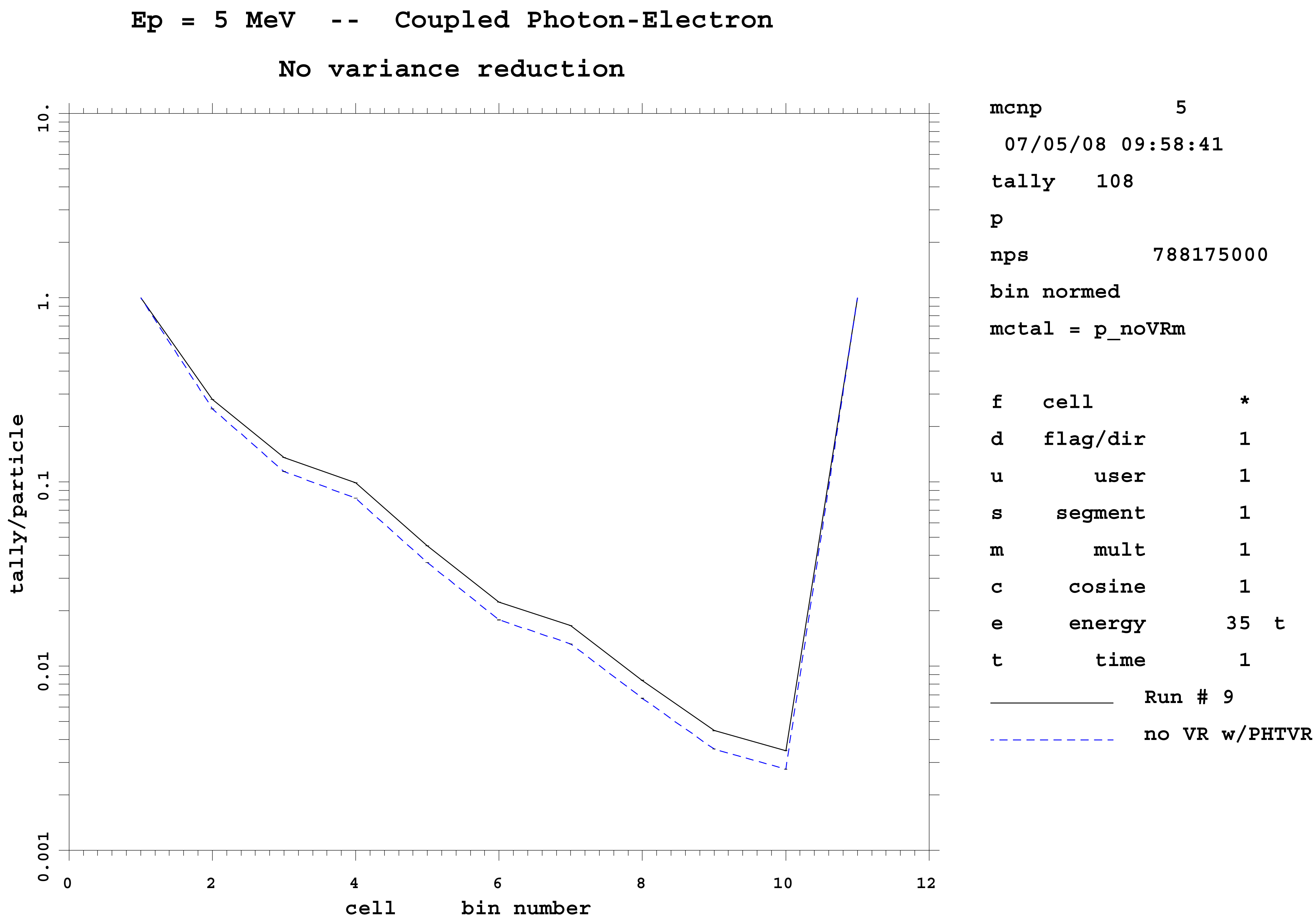
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp
tally/particle
10.
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/05/08 16:29:59
tally 108
p
nps 547312500
bin normed
mctal = p_impm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 5
no VR w/PHTVR


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: default wgt cutoff
10.
1.
0.1
0.01
0.001
tally/particle
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/05/08 14:41:43
tally 108
p
nps 832275000
bin normed
mctal = p_imp_capm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 6
no VR w/PHTVR

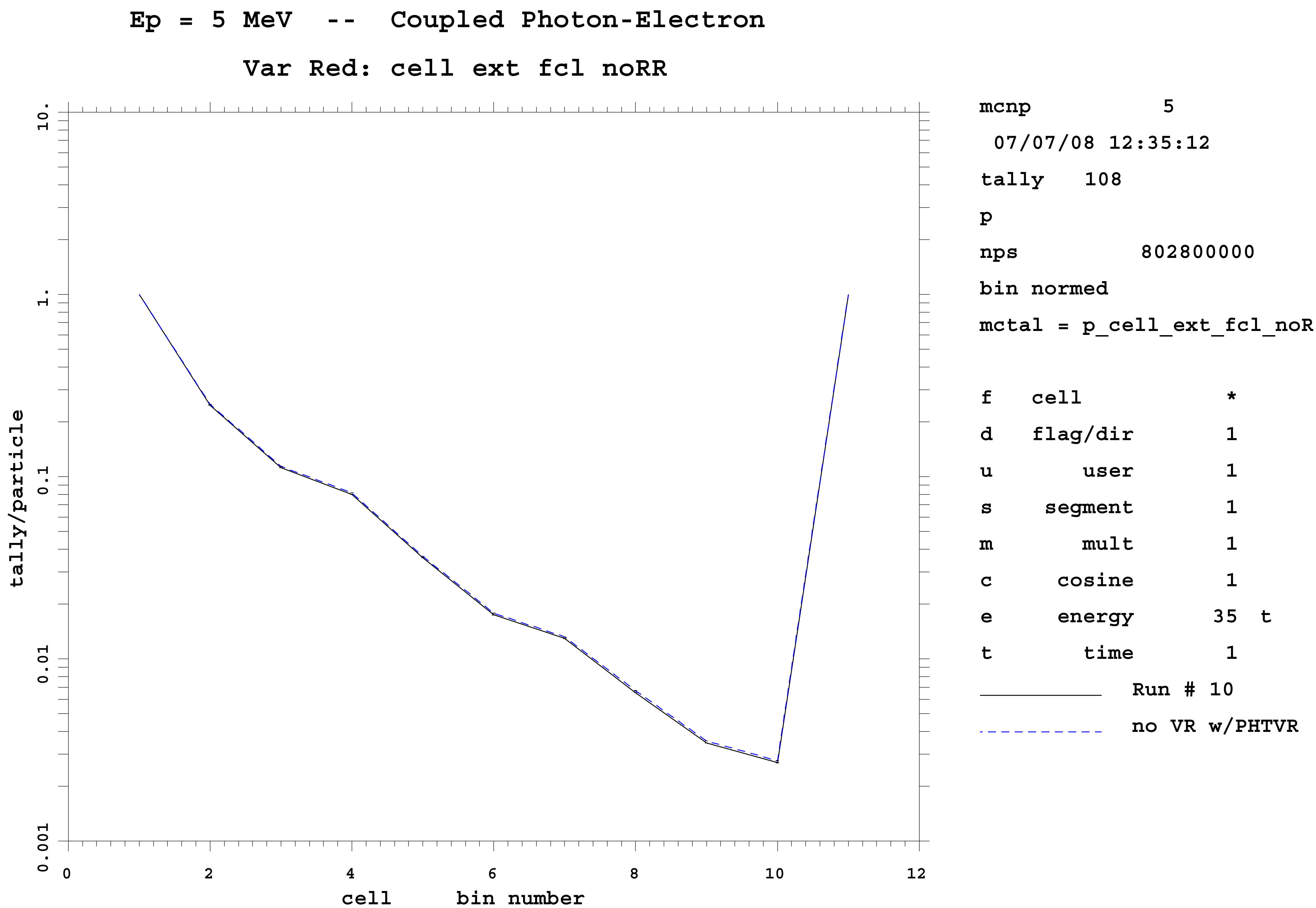

Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp espl t
tally/particle
10.
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/05/08 09:37:24
tally 108
p
nps 547312500
bin normed
mctal = p_imp_espltm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 7
no VR w/PHTVR



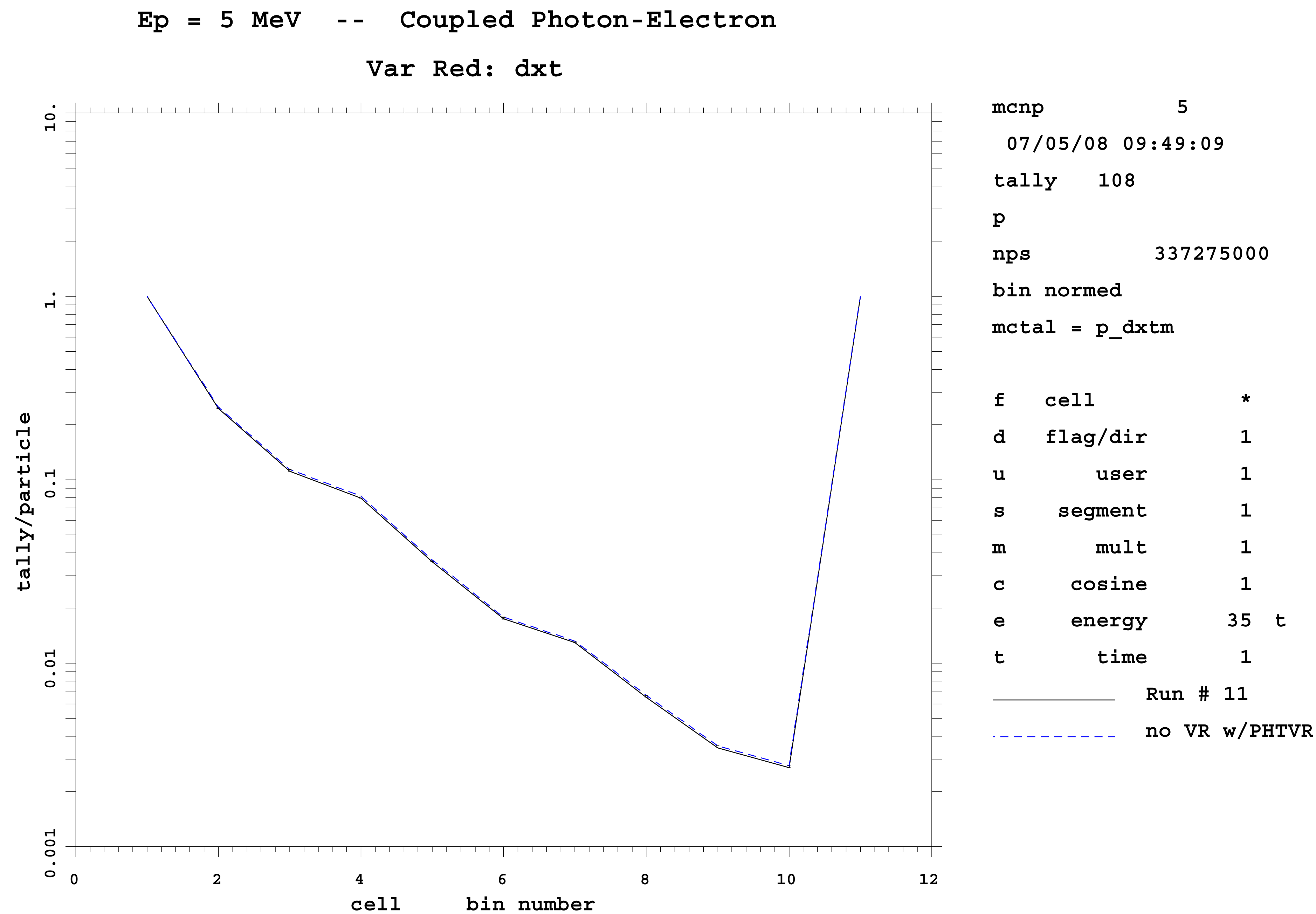
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp dxt ext fcl noRR
tally/particle
10.
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/05/08 14:41:39
tally 108
p
nps 168637500
bin normed
mctal = p_imp_ext_fcl_dxt_
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 8
no VR w/PHTVR



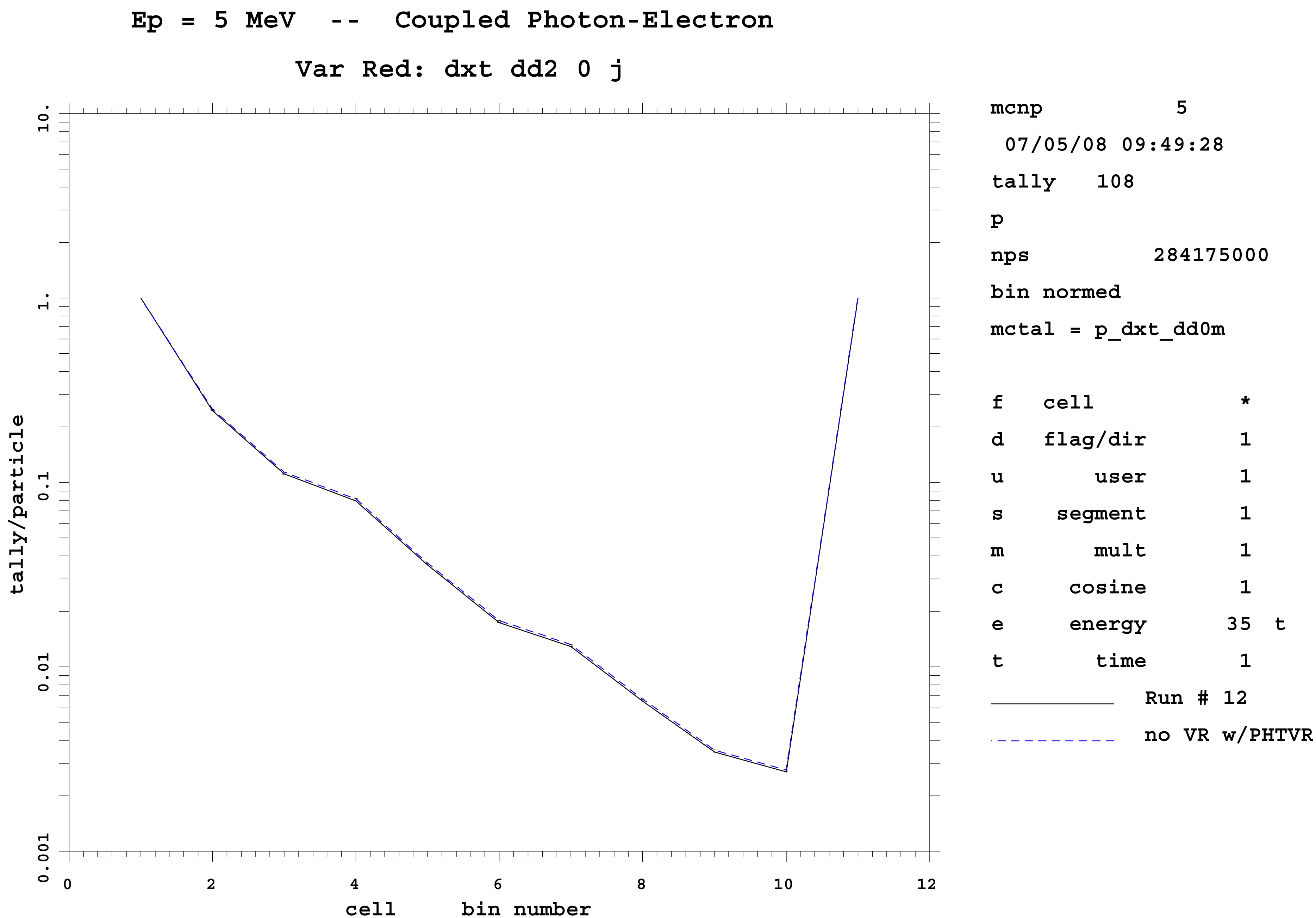
Ep = 5 MeV -- Coupled Photon-Electron
No variance reduction
tally/particle
10.
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/05/08 09:58:41
tally 108
p
nps 788175000
bin normed
mctal = p_noVRm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 9
no VR w/PHTVR



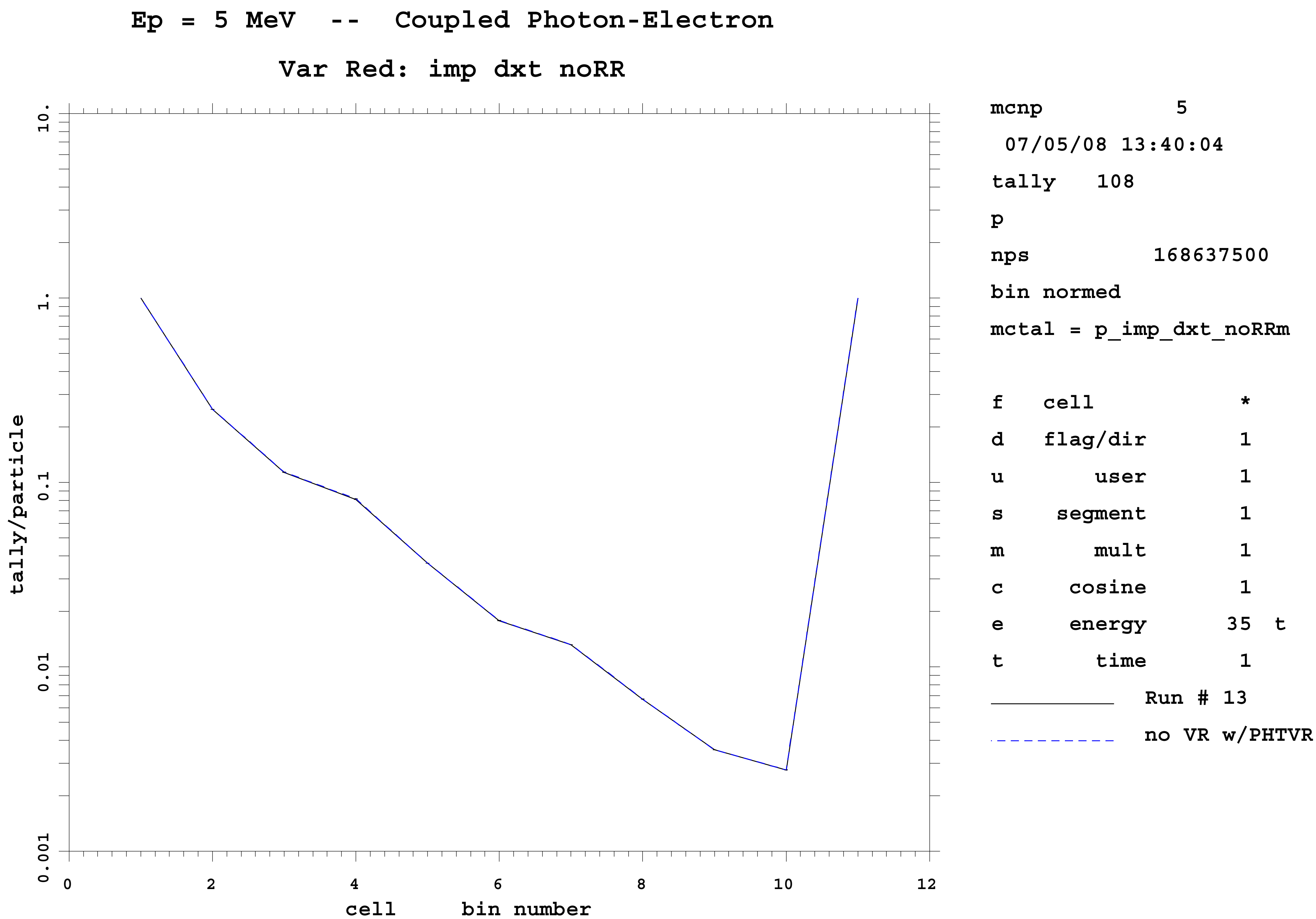
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell ext fcl noRR
tally/particle
cell bin number
mcnp 5
07/07/08 12:35:12
tally 108
p
nps 802800000
bin normed
mctal = p_cell_ext_fcl_noR
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 10
no VR w/PHTVR



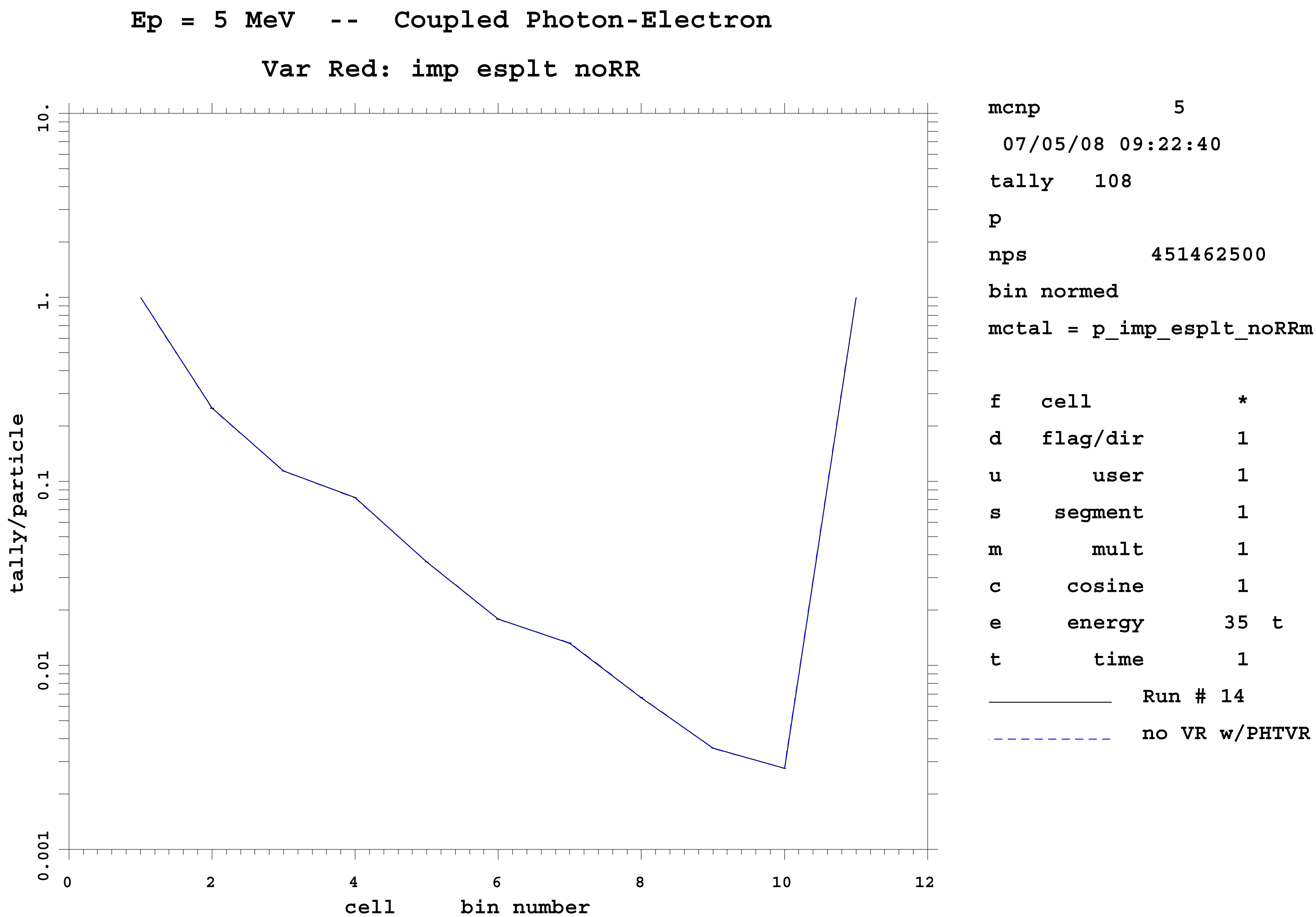
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: dxt
tally/particle
10.
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/05/08 09:49:09
tally 108
p
nps 337275000
bin normed
mctal = p_dxtm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 11
no VR w/PHTVR



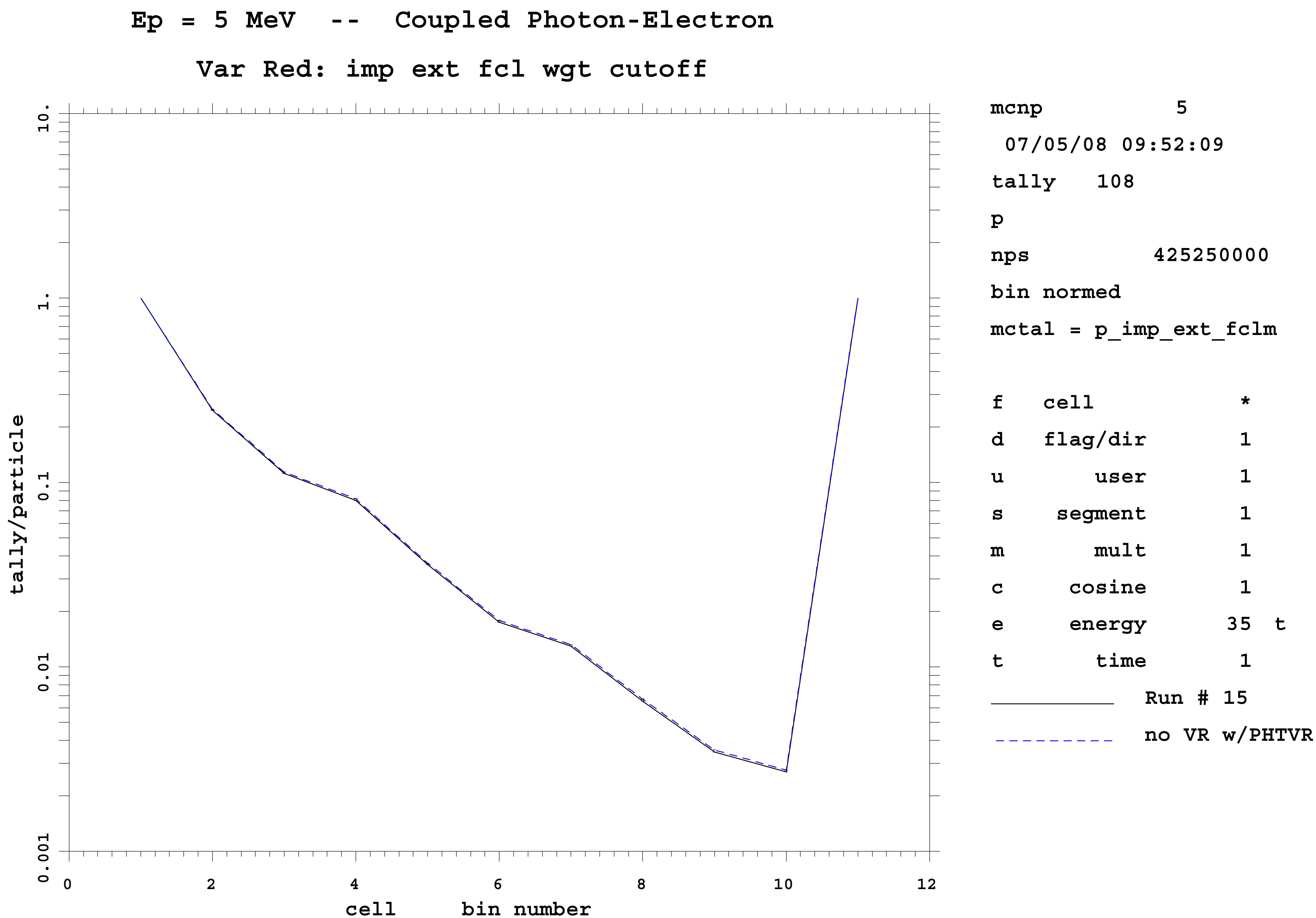
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: dxt dd2 0 j
10.
1.
0.1
0.01
0.001
tally/particle
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/05/08 09:49:28
tally 108
p
nps 284175000
bin normed
mctal = p_dxt_dd0m
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 12
no VR w/PHTVR

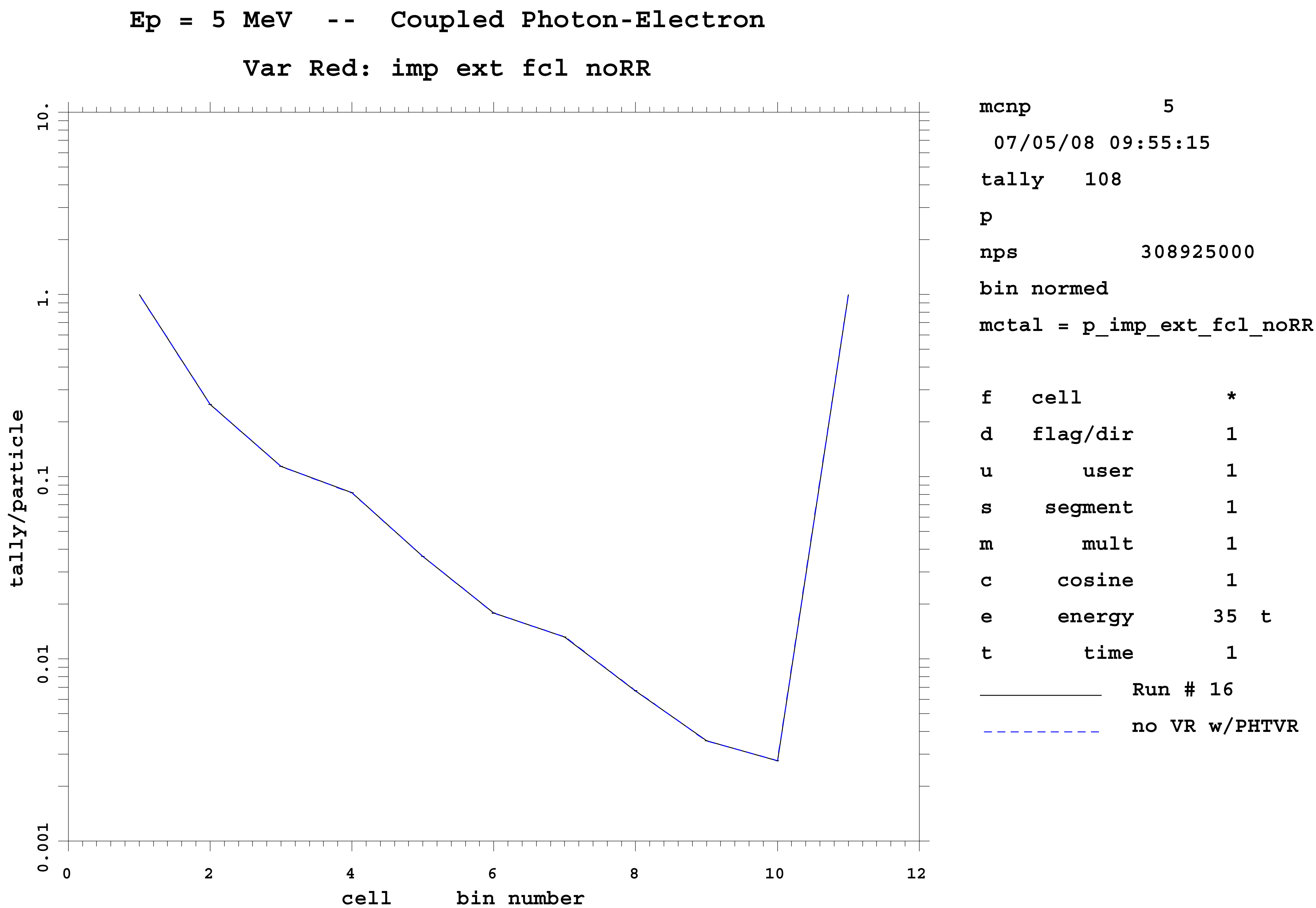


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp dxt noRR
tally/particle
10.
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/05/08 13:40:04
tally 108
p
nps 168637500
bin normed
mctal = p_imp_dxt_noRRm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 13
no VR w/PHTVR



Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp esplt noRR
10.
1.
0.1
0.01
0.001
tally/particle
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/05/08 09:22:40
tally 108
p
nps 451462500
bin normed
mctal = p_imp_esplt_noRRm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 14
no VR w/PHTVR

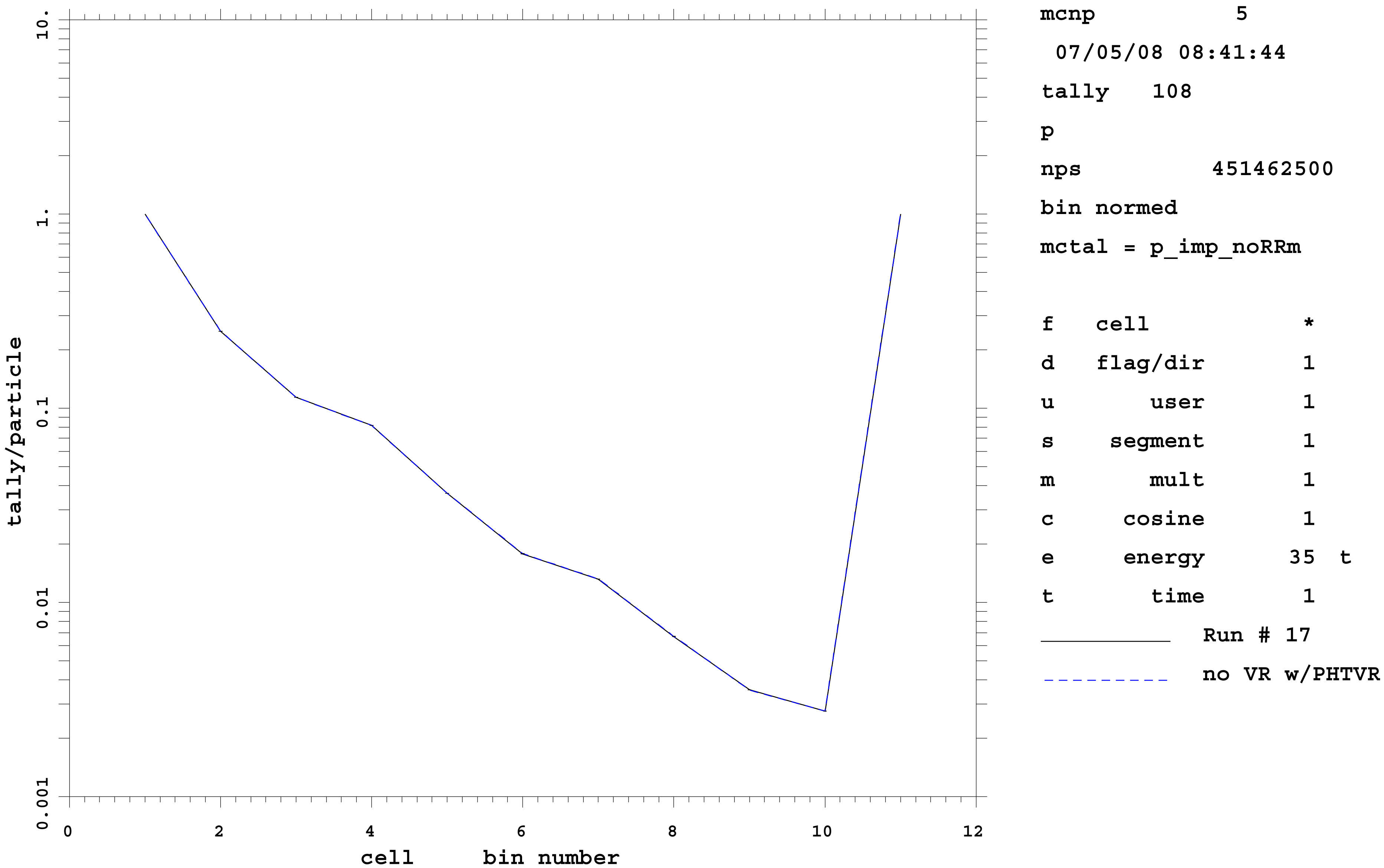

Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp ext fcl wgt cutoff
mcnp 5
07/05/08 09:52:09
tally 108
p
nps 425250000
bin normed
mctal = p_imp_ext_fclm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 15
no VR w/PHTVR
tally/particle
10.
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number



Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp ext fcl noRR
10.
1.
0.1
0.01
0.001
tally/particle
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/05/08 09:55:15
tally 108
p
nps 308925000
bin normed
mctal = p_imp_ext_fcl_noRR
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 16
no VR w/PHTVR

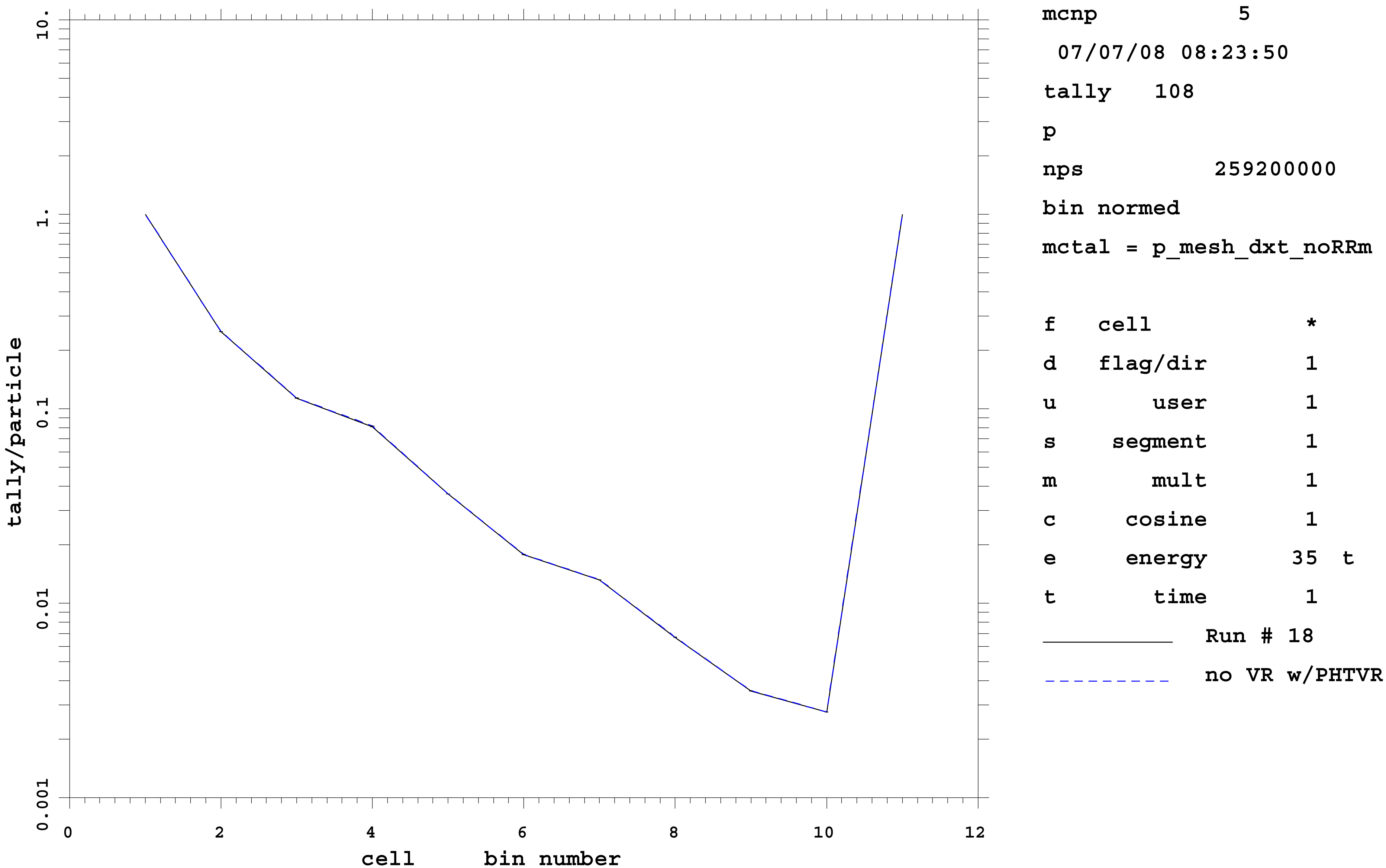
Ep = 5 MeV -- Coupled Photon-Electron

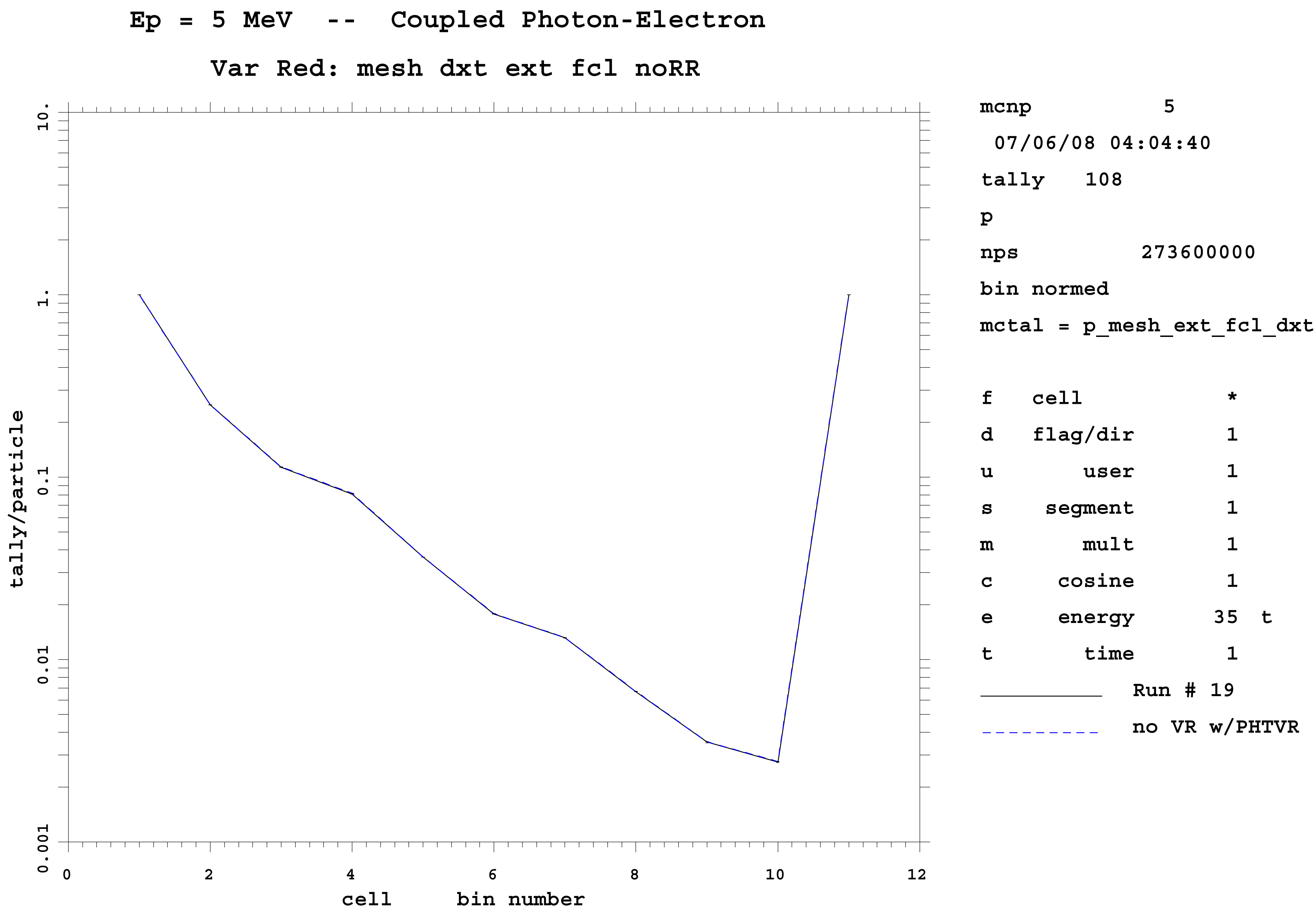
Var Red: imp noRR



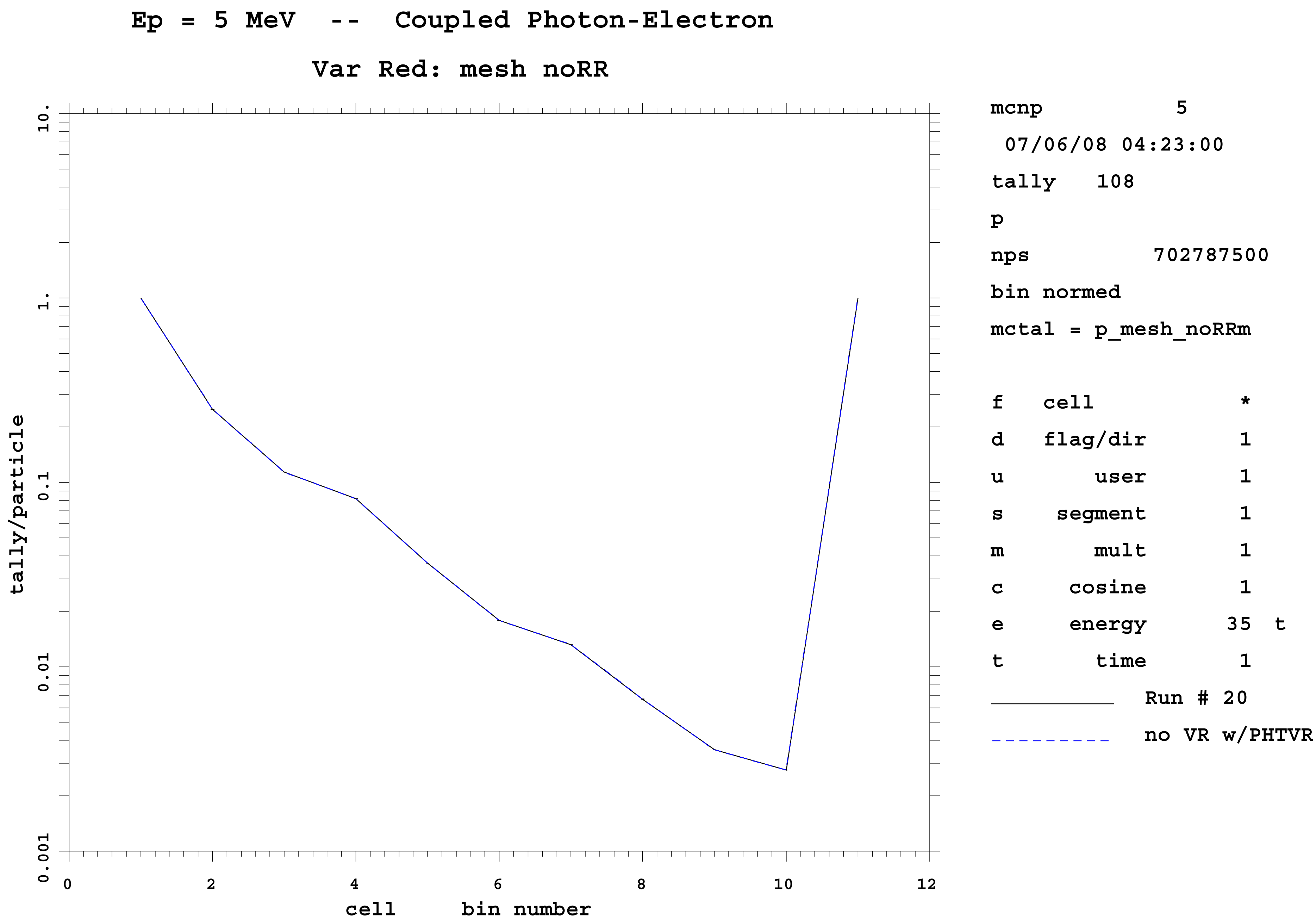
Ep = 5 MeV -- Coupled Photon-Electron

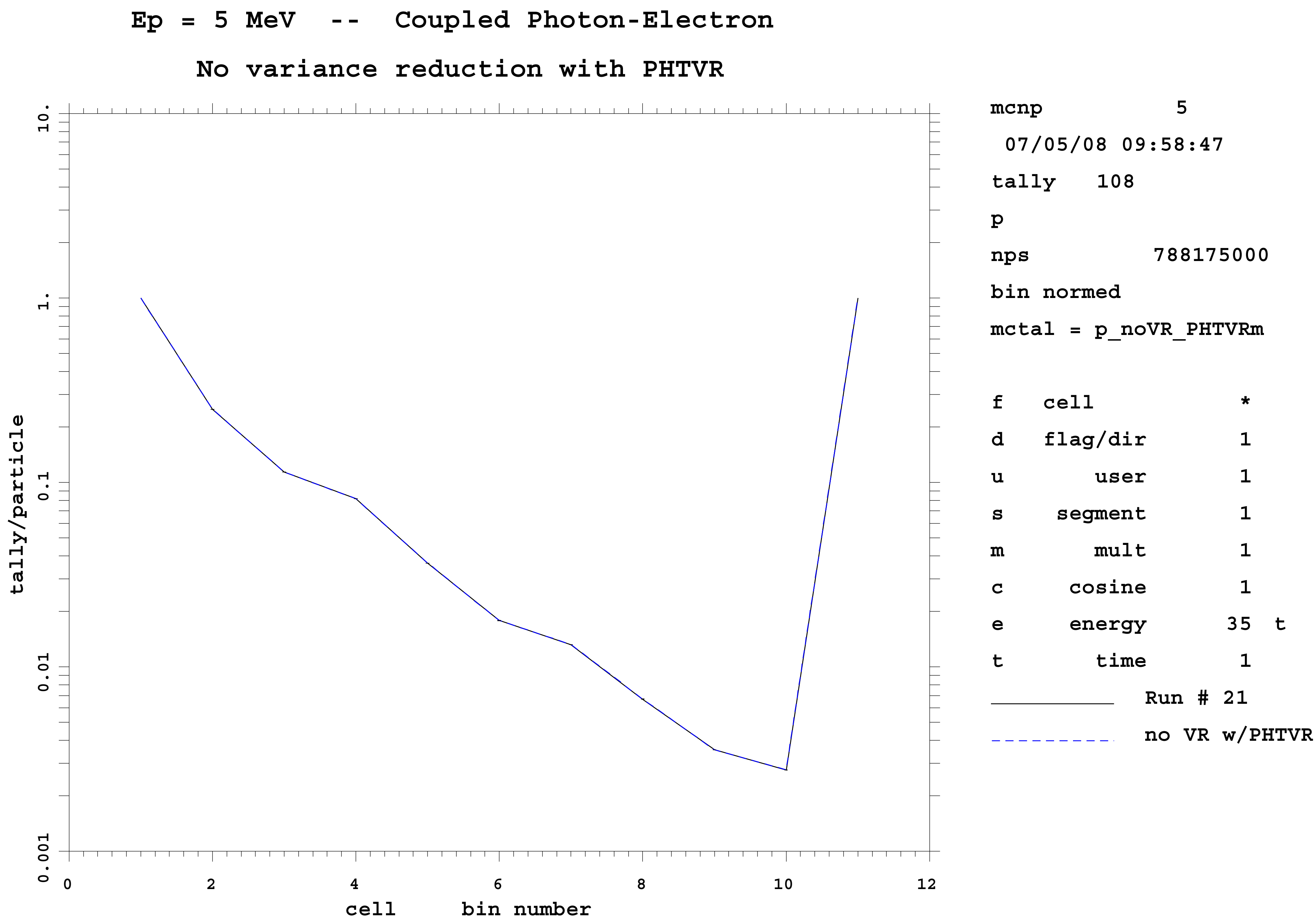
Var Red: mesh dxt noRR

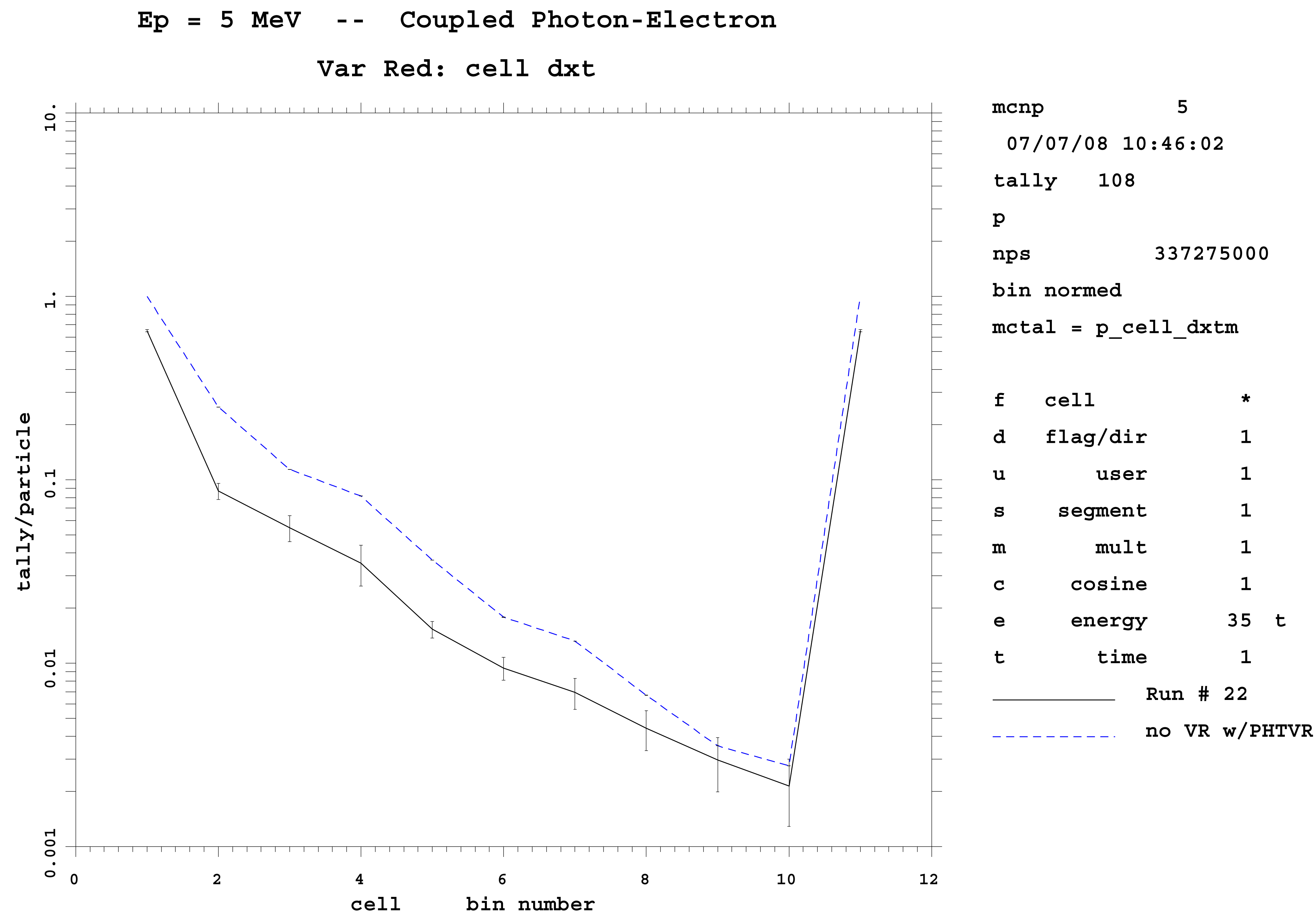




Ep = 5 MeV -- Coupled Photon-Electron
Var Red: mesh dxt ext fcl noRR
10.
1.
0.1
0.01
0.001
tally/particle
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/06/08 04:04:40
tally 108
p
nps 273600000
bin normed
mctal = p_mesh_ext_fcl_dxt
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 19
no VR w/PHTVR


Ep = 5 MeV -- Coupled Photon-Electron
Var Red: mesh noRR
tally/particle
cell bin number
10.
1.
0.1
0.01
0.001
0 2 4 6 8 10 12
mcnp 5
07/06/08 04:23:00
tally 108
p
nps 702787500
bin normed
mctal = p_mesh_noRRm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 20
no VR w/PHTVR

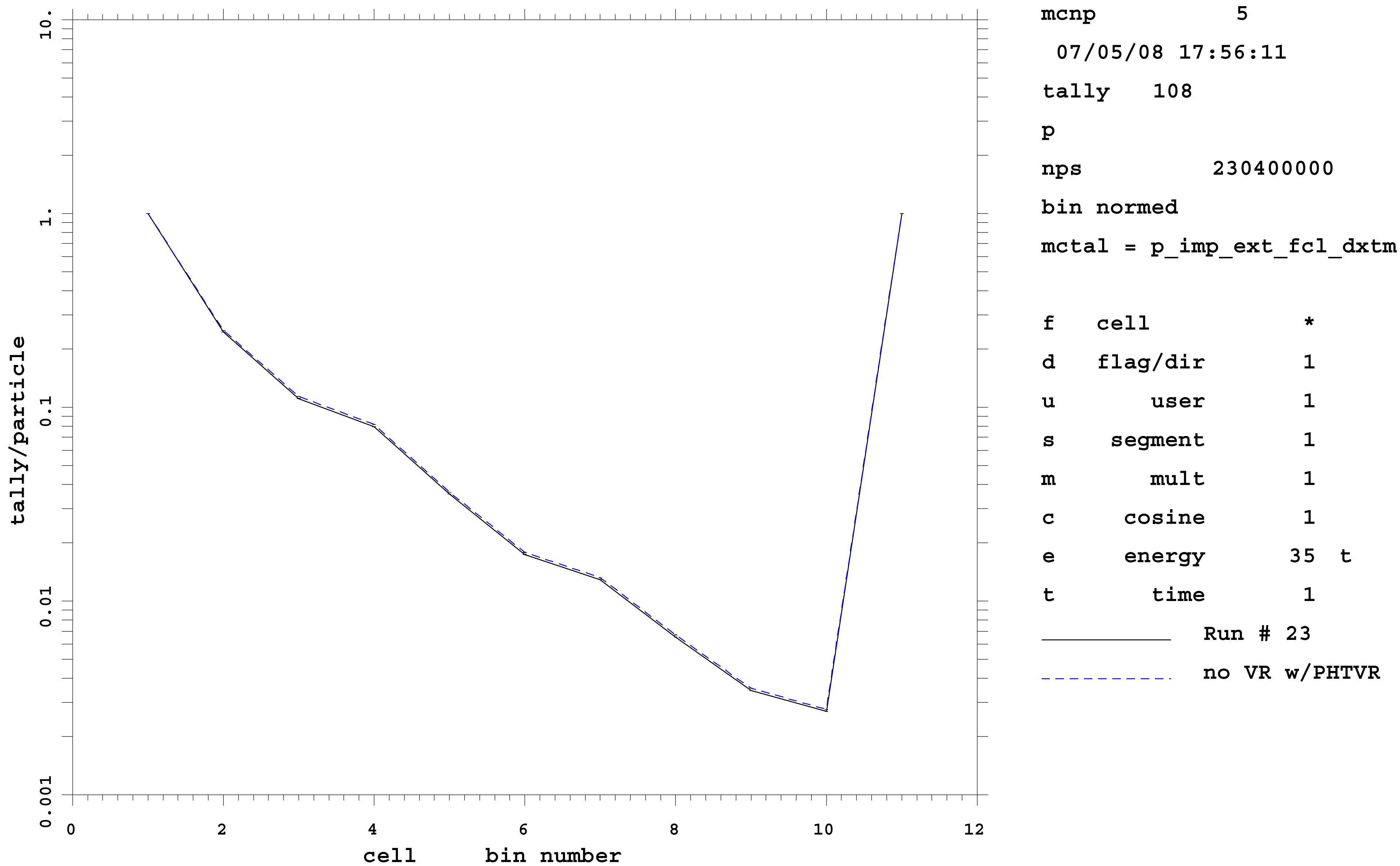

Ep = 5 MeV -- Coupled Photon-Electron
No variance reduction with PHTVR
tally/particle
10.
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/05/08 09:58:47
tally 108
p
nps 788175000
bin normed
mctal = p_noVR_PHTVRm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 21
no VR w/PHTVR

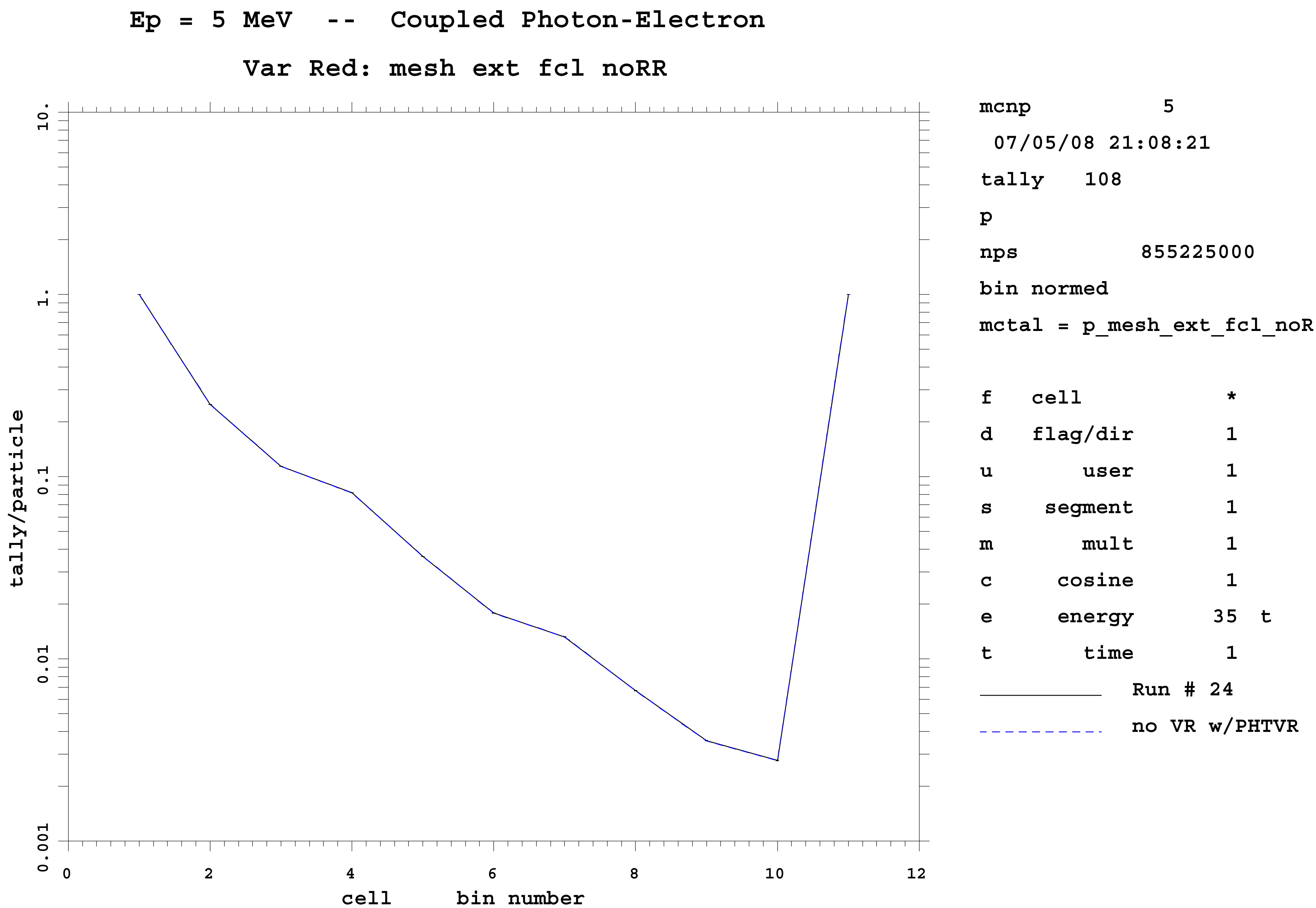


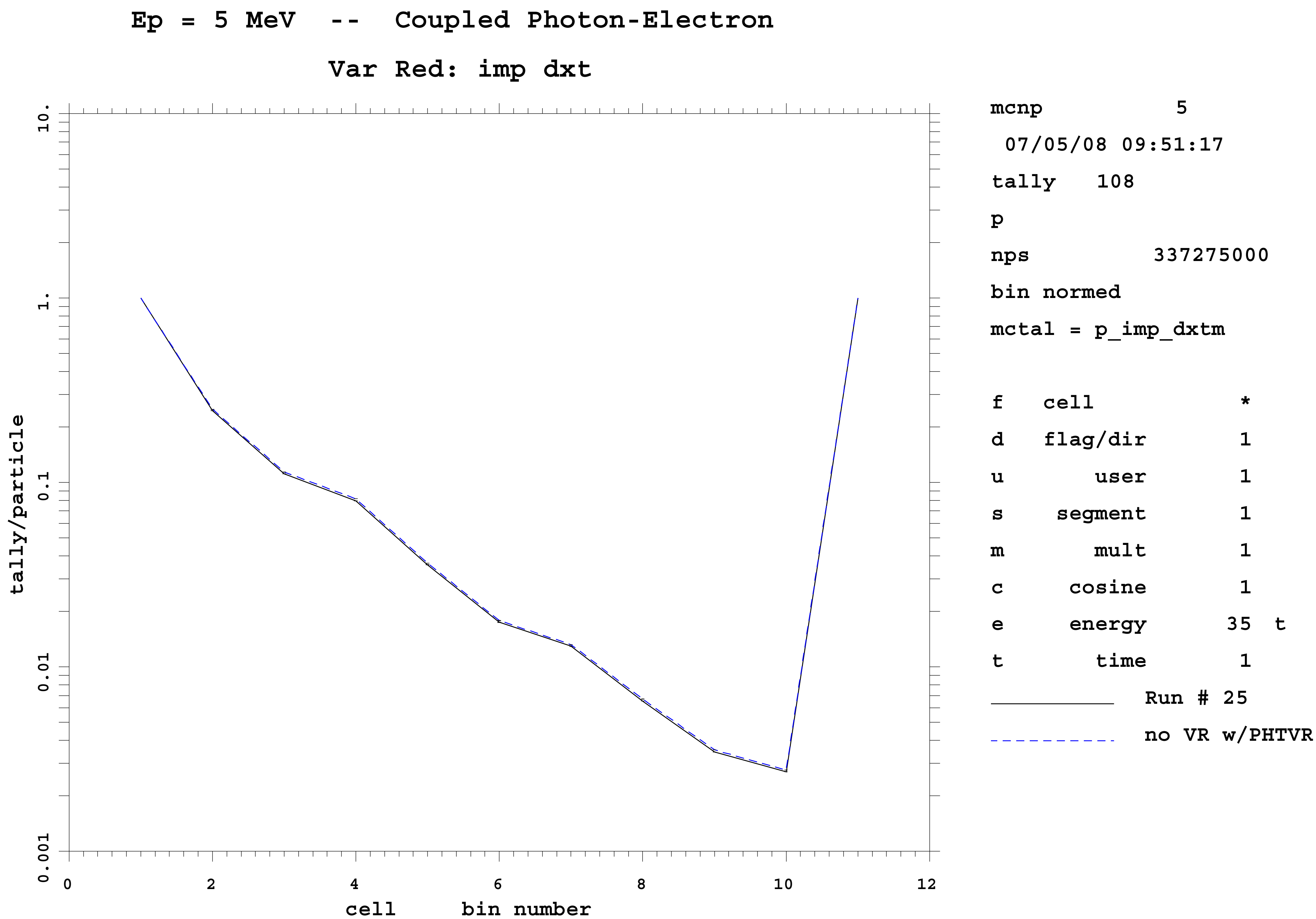
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell dxt
10.
1.
0.1
0.01
0.001
tally/particle
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/07/08 10:46:02
tally 108
p
nps 337275000
bin normed
mctal = p_cell_dxtm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 22
no VR w/PHTVR

Ep = 5 MeV -- Coupled Photon-Electron

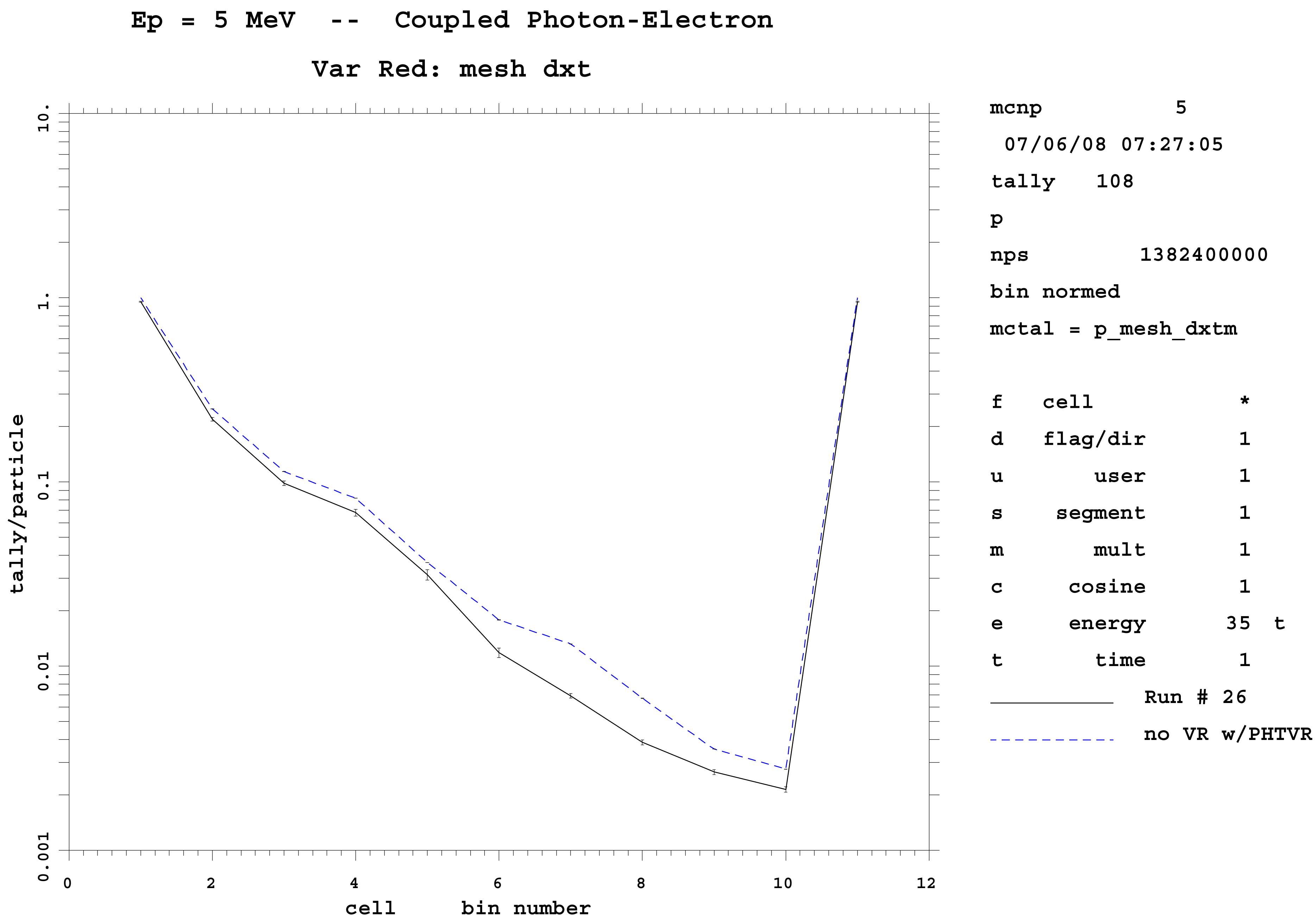
Var Red: imp dxt ext fcl wgt cutoff



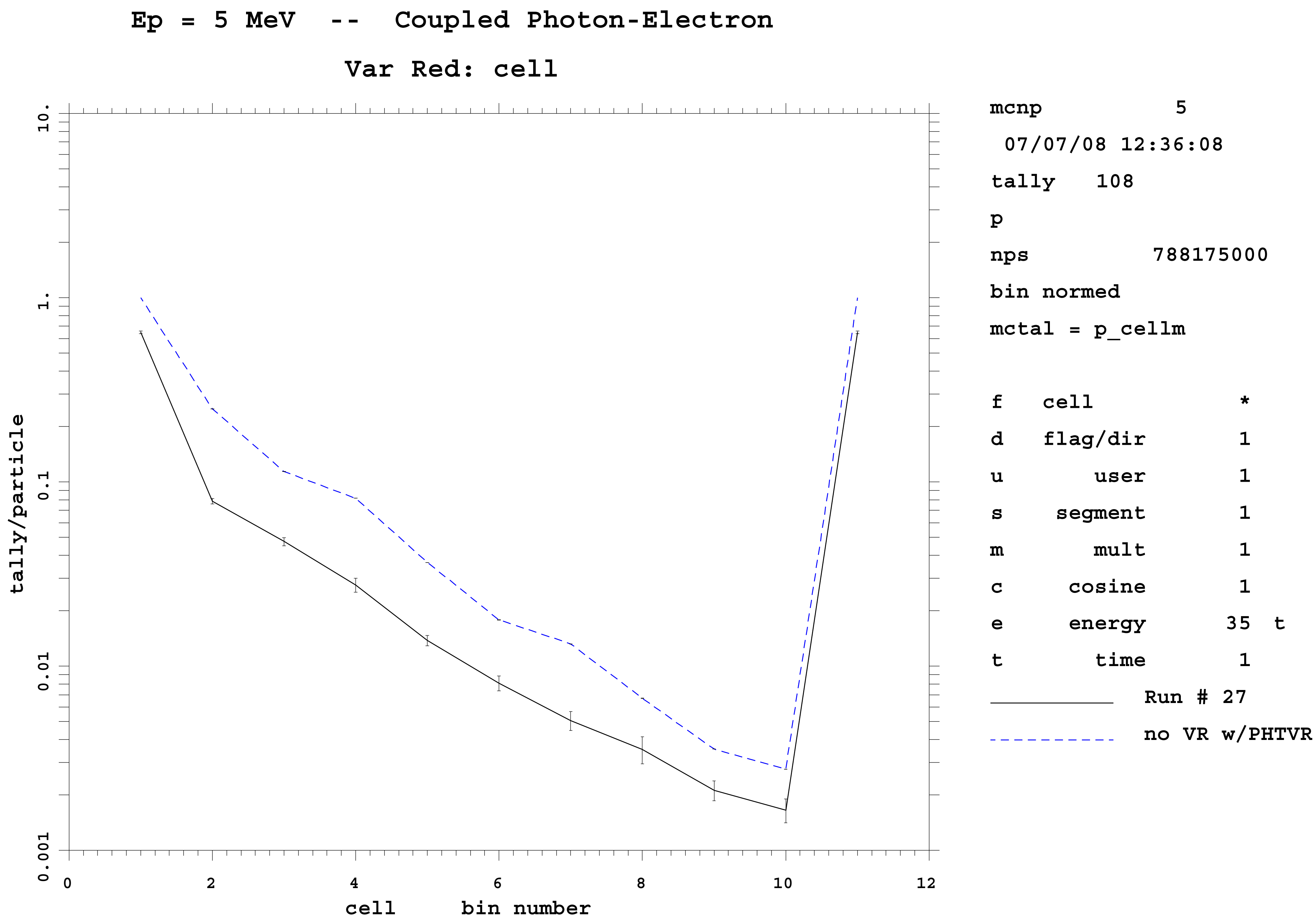

Ep = 5 MeV -- Coupled Photon-Electron
Var Red: mesh ext fcl noRR
tally/particle
10.
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/05/08 21:08:21
tally 108
p
nps 855225000
bin normed
mctal = p_mesh_ext_fcl_noR
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 24
no VR w/PHTVR



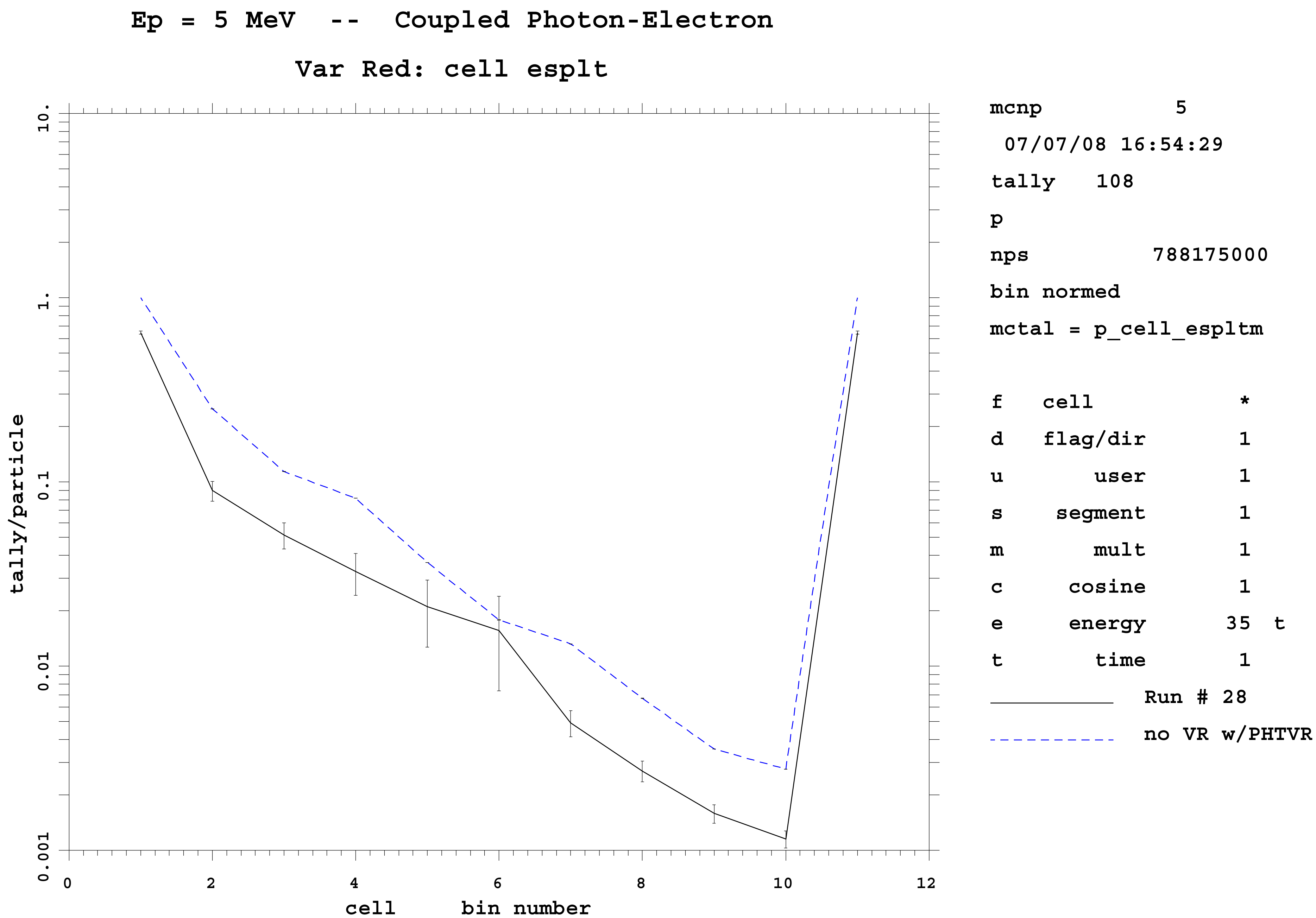
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: imp dxt
tally/particle
10.
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/05/08 09:51:17
tally 108
p
nps 337275000
bin normed
mctal = p_imp_dxtm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 25
no VR w/PHTVR



Ep = 5 MeV -- Coupled Photon-Electron
Var Red: mesh dxt
tally/particle
10.
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/06/08 07:27:05
tally 108
p
nps 1382400000
bin normed
mctal = p_mesh_dxtm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 26
no VR w/PHTVR



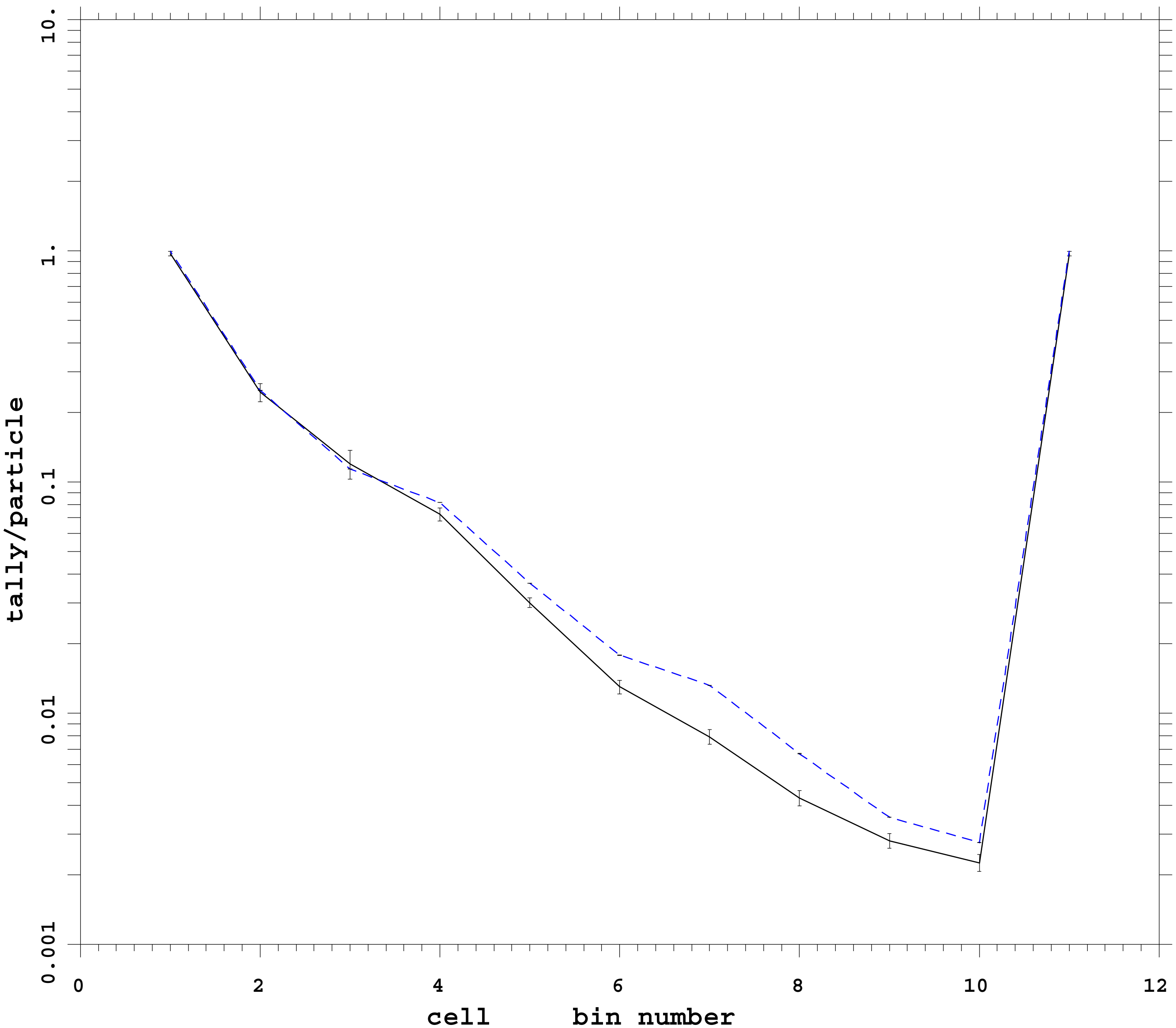
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell
tally/particle
10.
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/07/08 12:36:08
tally 108
p
nps 788175000
bin normed
mctal = p_cellm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 27
no VR w/PHTVR



Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell espl t
tally/particle
10.
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/07/08 16:54:29
tally 108
p
nps 788175000
bin normed
mctal = p_cell_espltm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 28
no VR w/PHTVR

Ep = 5 MeV -- Coupled Photon-Electron

Var Red: mesh dxt ext fcl wgt cutoff

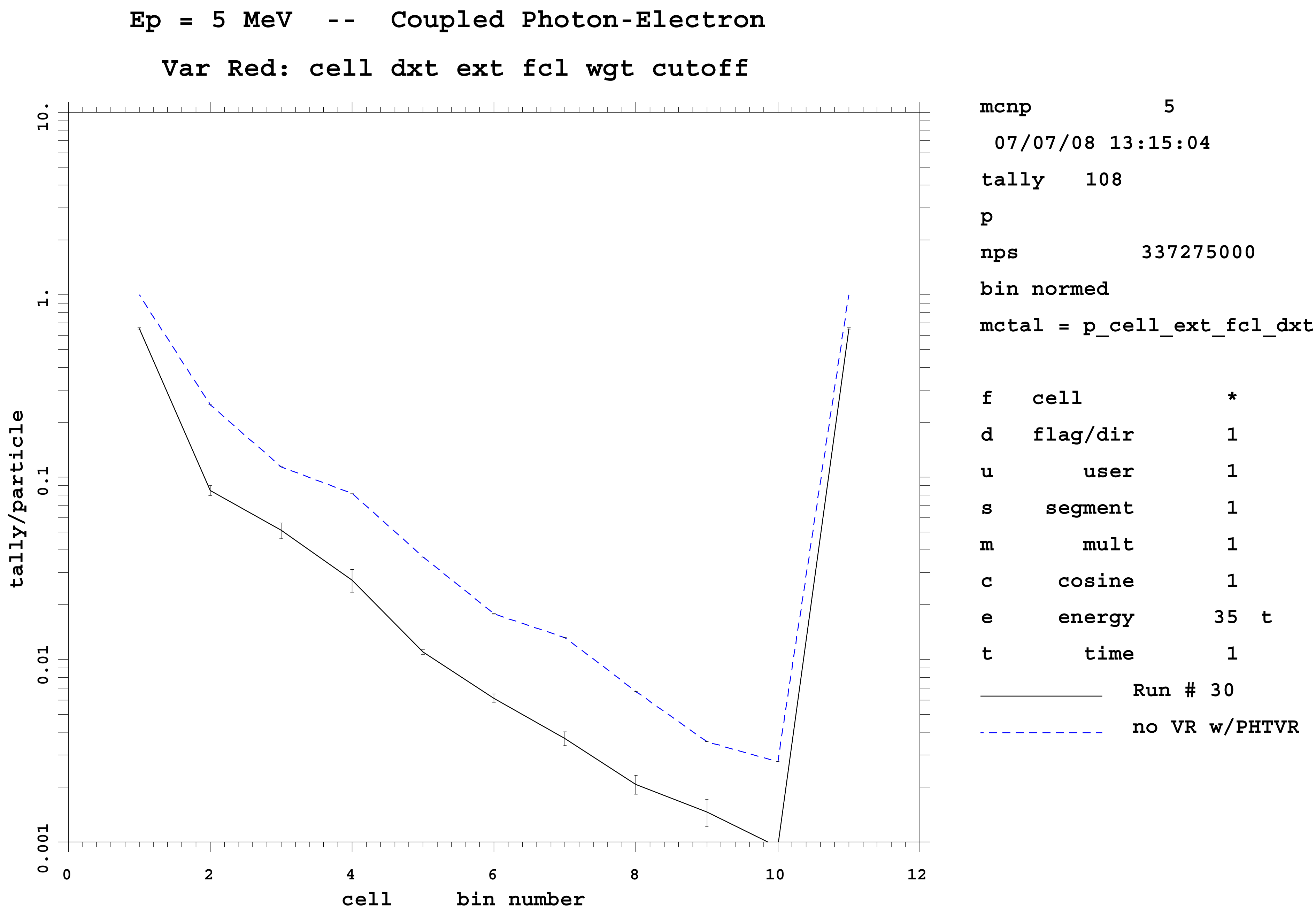


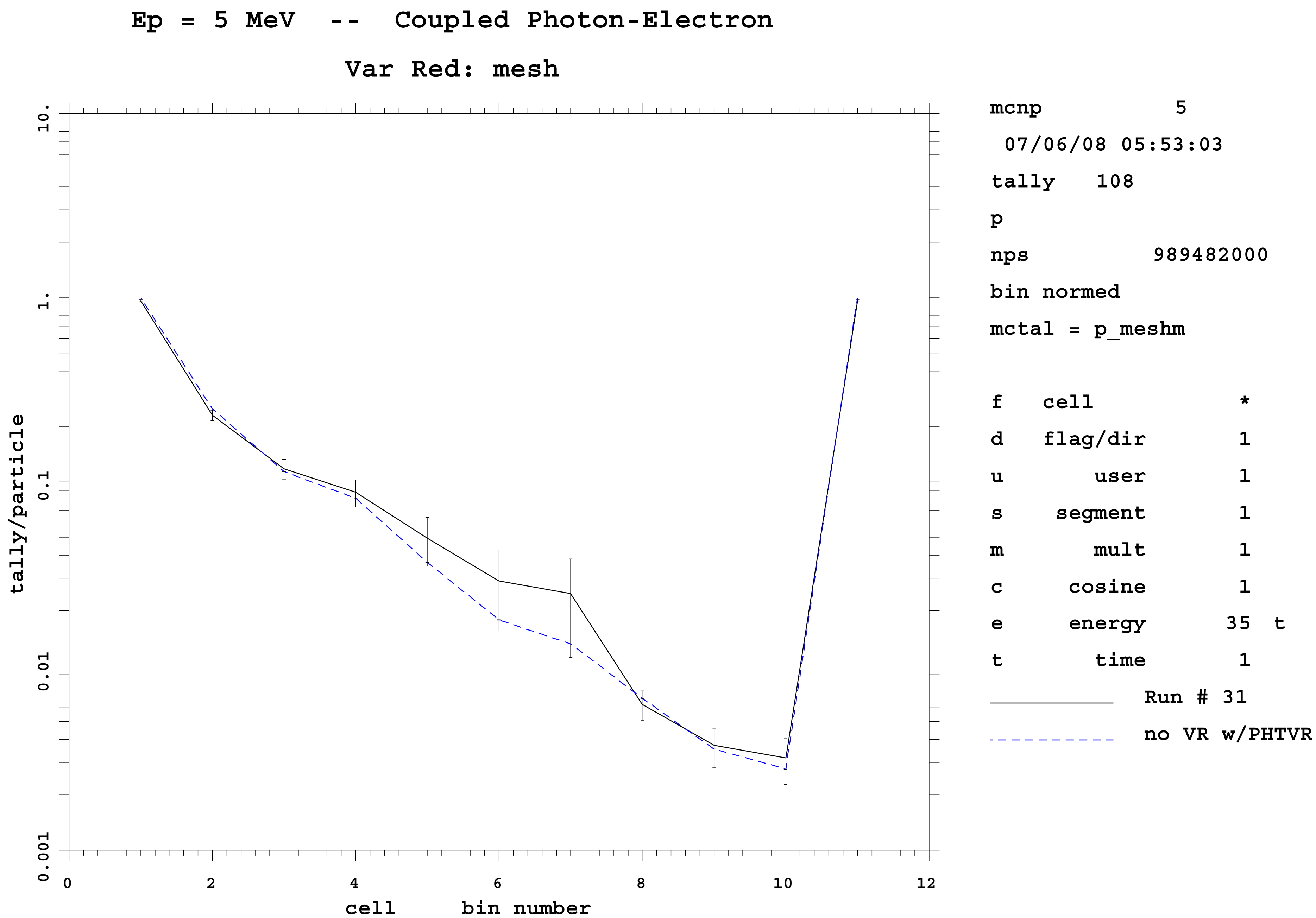
mcnp 5
07/07/08 08:23:47
tally 108
p
nps 655360000
bin normed
mctal = p_mesh_ext_fcl_dxt

f	cell	*
d	flag/dir	1
u	user	1
s	segment	1
m	mult	1
c	cosine	1
e	energy	35 t
t	time	1

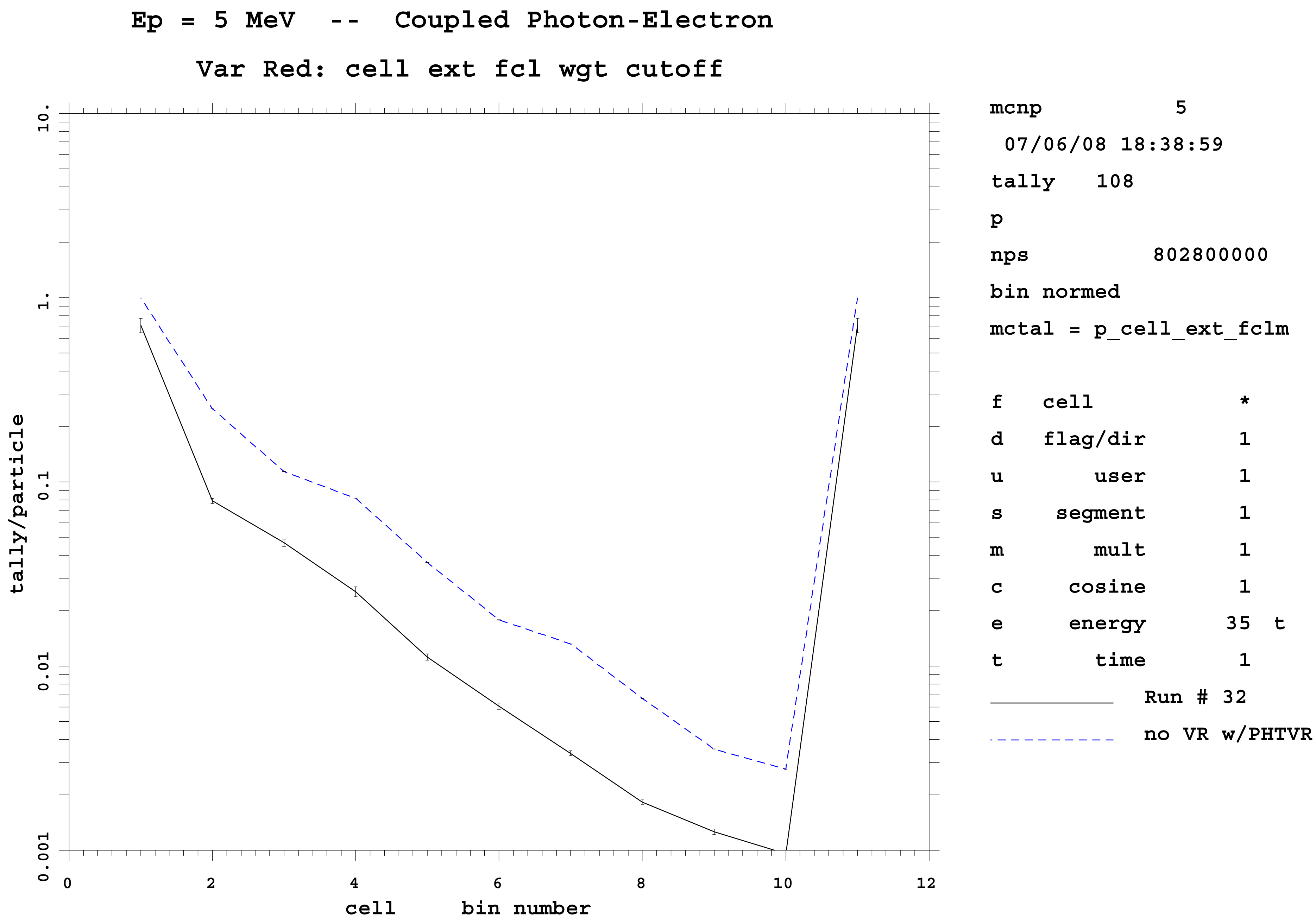
——— Run # 29

- - - no VR w/PHTVR

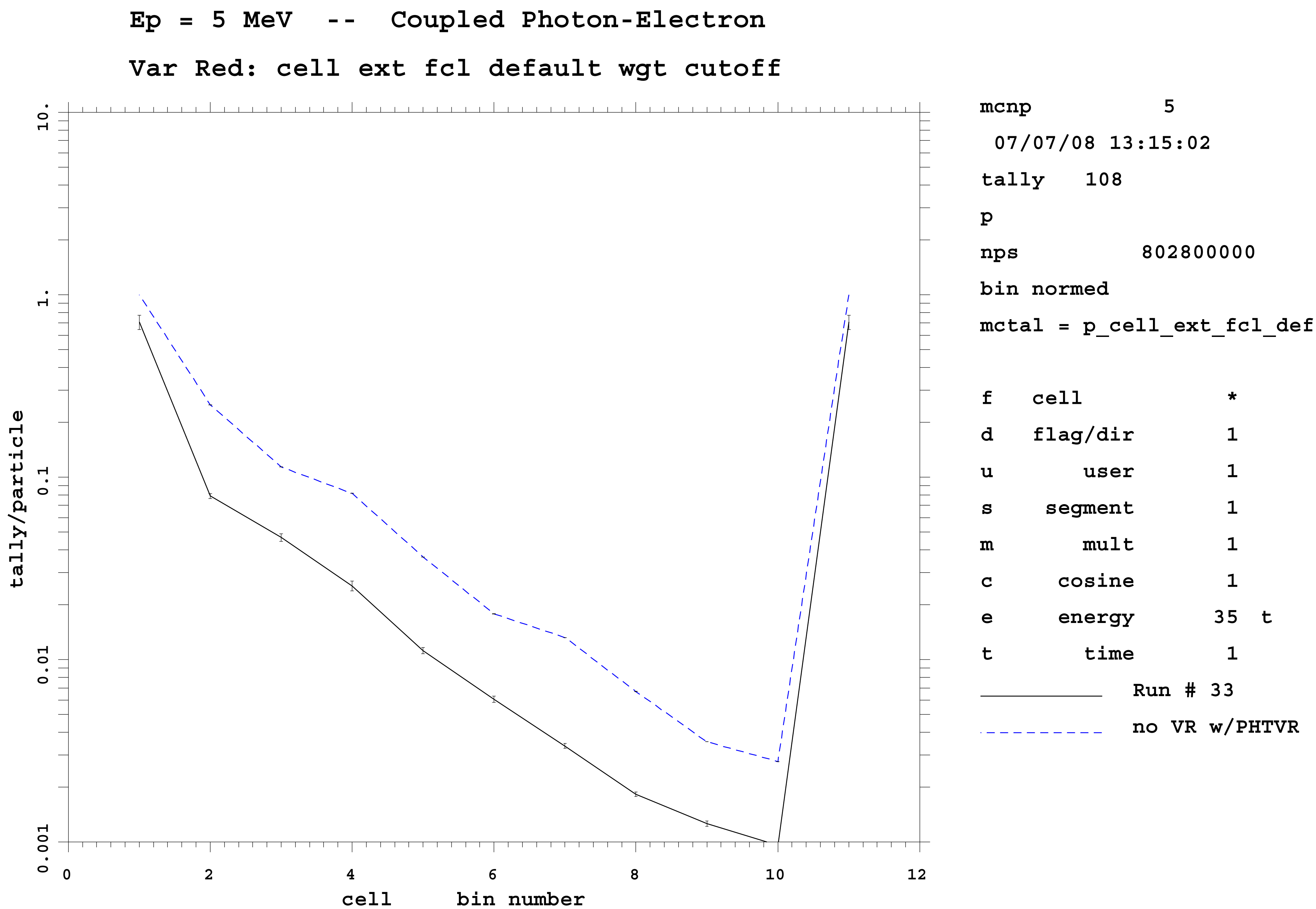

Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell dxt ext fcl wgt cutoff
tally/particle
10.
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/07/08 13:15:04
tally 108
p
nps 337275000
bin normed
mctal = p_cell_ext_fcl_dxt
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 30
no VR w/PHTVR



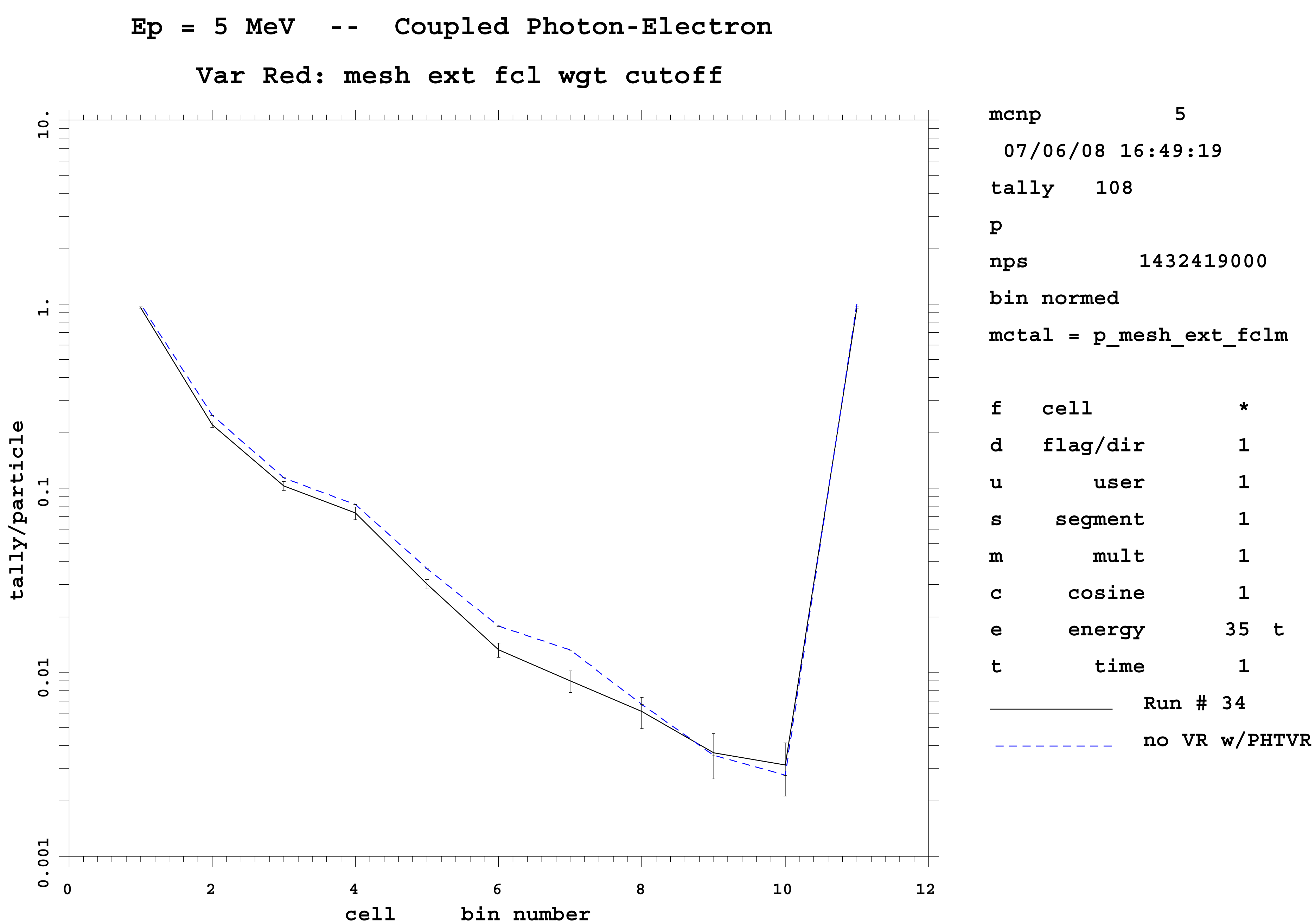
Ep = 5 MeV -- Coupled Photon-Electron
Var Red: mesh
tally/particle
10.
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/06/08 05:53:03
tally 108
p
nps 989482000
bin normed
mctal = p_meshm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 31
no VR w/PHTVR



Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell ext fcl wgt cutoff
10.
1.
0.1
0.01
0.001
tally/particle
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/06/08 18:38:59
tally 108
p
nps 802800000
bin normed
mctal = p_cell_ext_fclm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 32
no VR w/PHTVR



Ep = 5 MeV -- Coupled Photon-Electron
Var Red: cell ext fcl default wgt cutoff
tally/particle
10.
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/07/08 13:15:02
tally 108
p
nps 802800000
bin normed
mctal = p_cell_ext_fcl_def
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 33
no VR w/PHTVR



Ep = 5 MeV -- Coupled Photon-Electron
Var Red: mesh ext fcl wgt cutoff
tally/particle
10.
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/06/08 16:49:19
tally 108
p
nps 1432419000
bin normed
mctal = p_mesh_ext_fclm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 35 t
t time 1
Run # 34
no VR w/PHTVR

Appendix A.3.i

Problem 1
Ge sphere Next To a U / O Stacked Cylinder Problem

Plots of the track length tally spectra in the germanium sphere

Plots are in order of the run number listed in Table 4. The variance reduction methods used are listed in the plot title; the graph label contains the run number.

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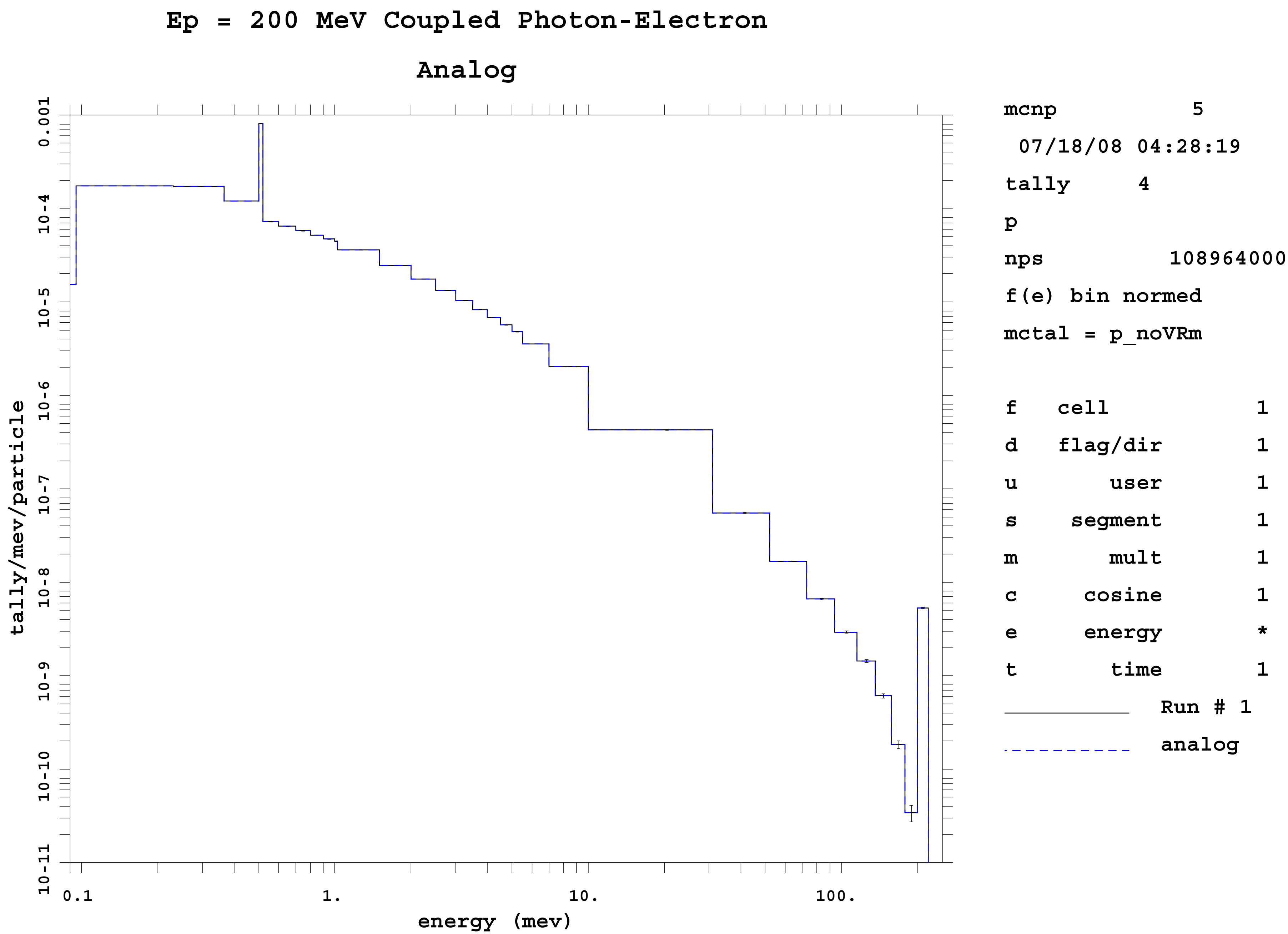
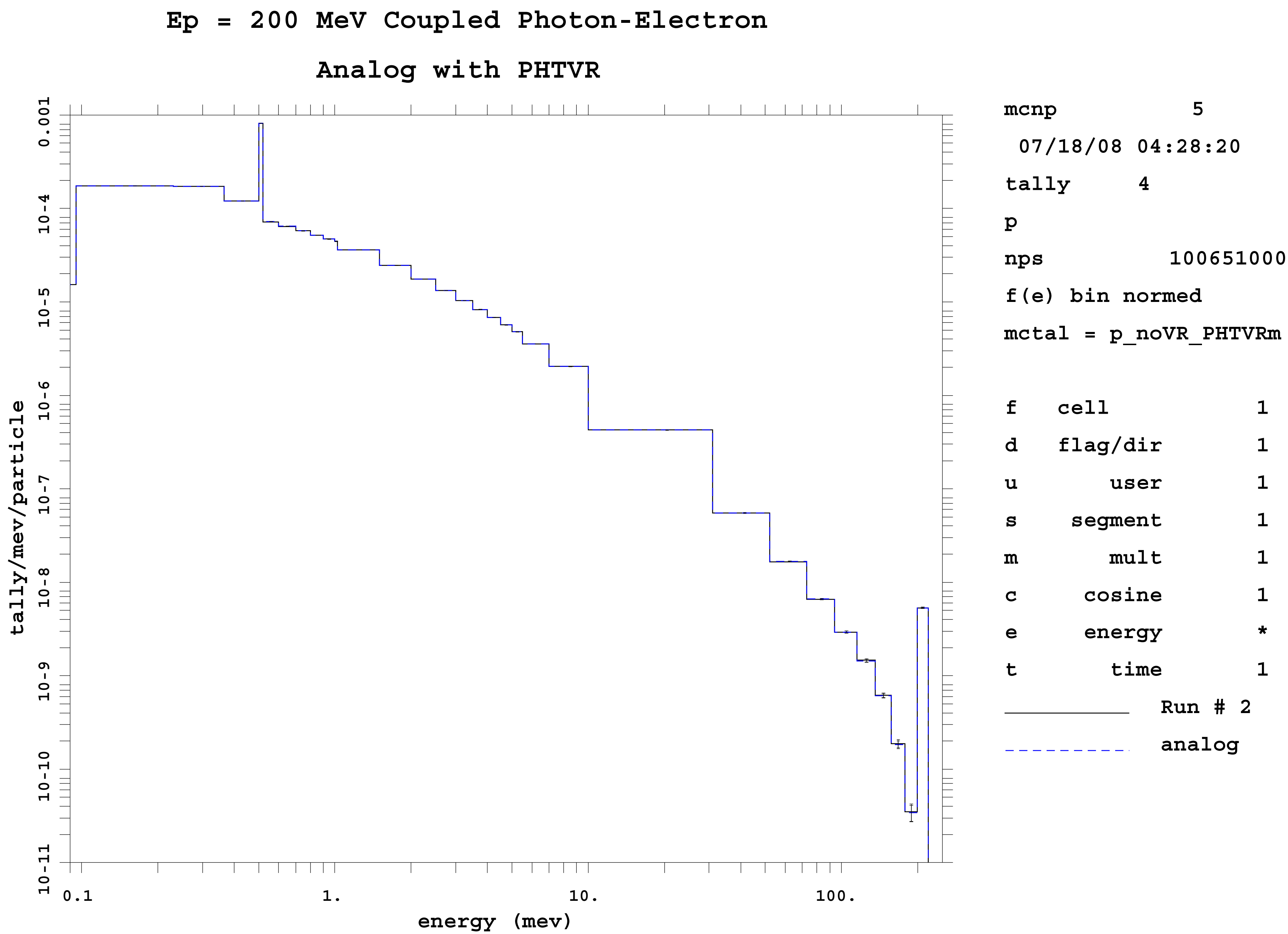
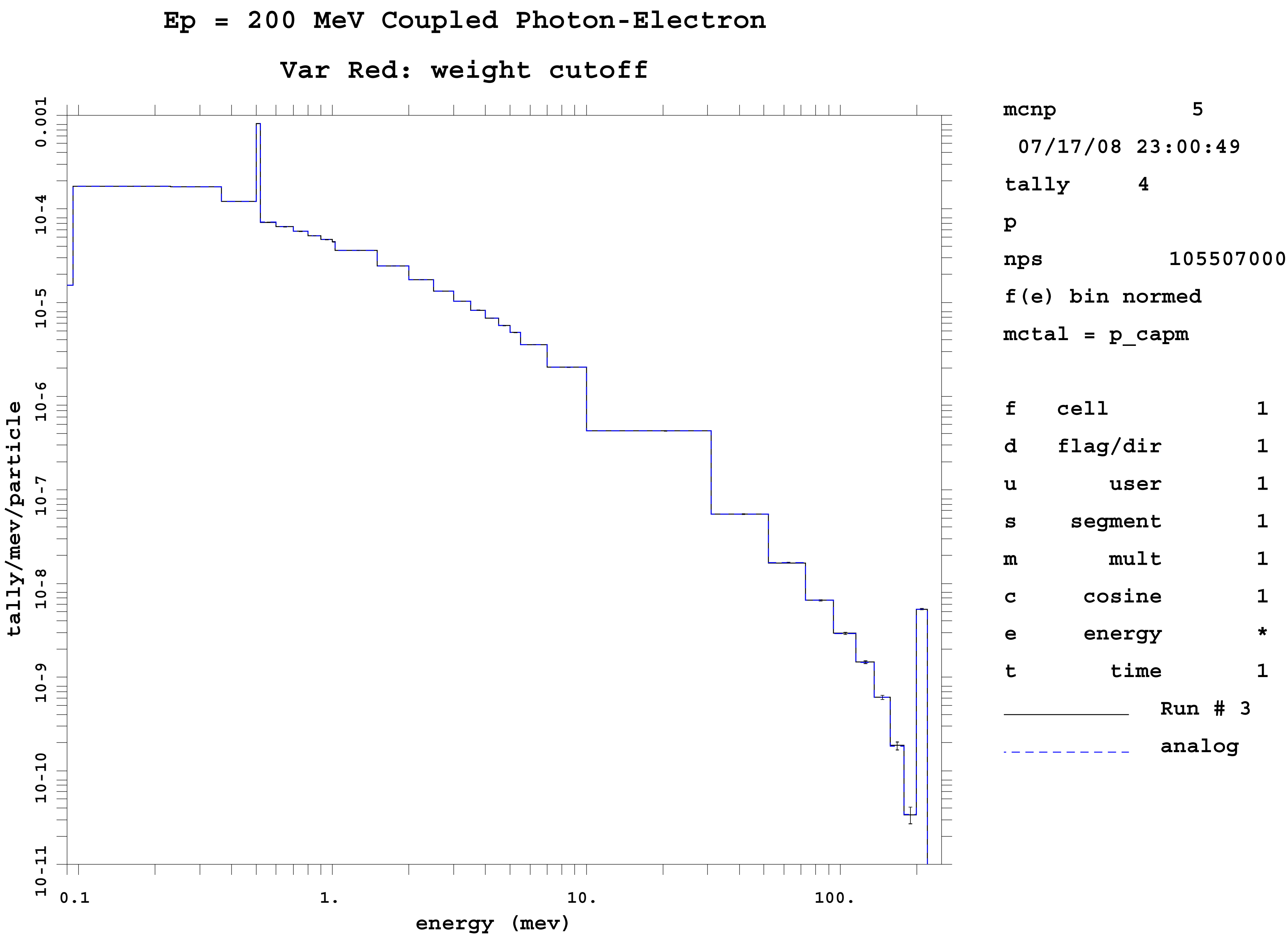
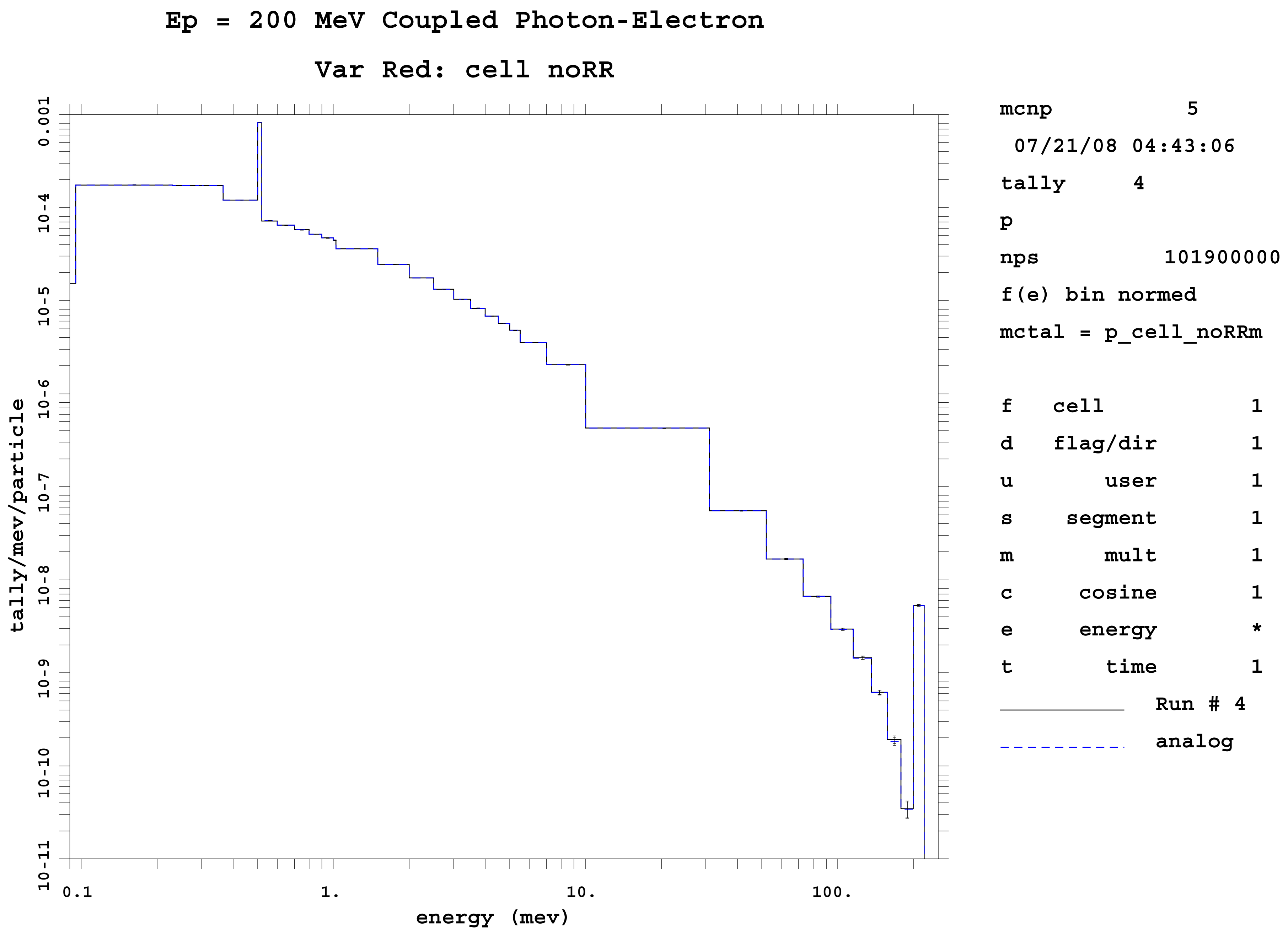


Ep = 200 MeV Coupled Photon-Electron
Analog
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/18/08 04:28:19
tally 4
p
nps 108964000
f(e) bin normed
mctal = p_noVRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 1
analog

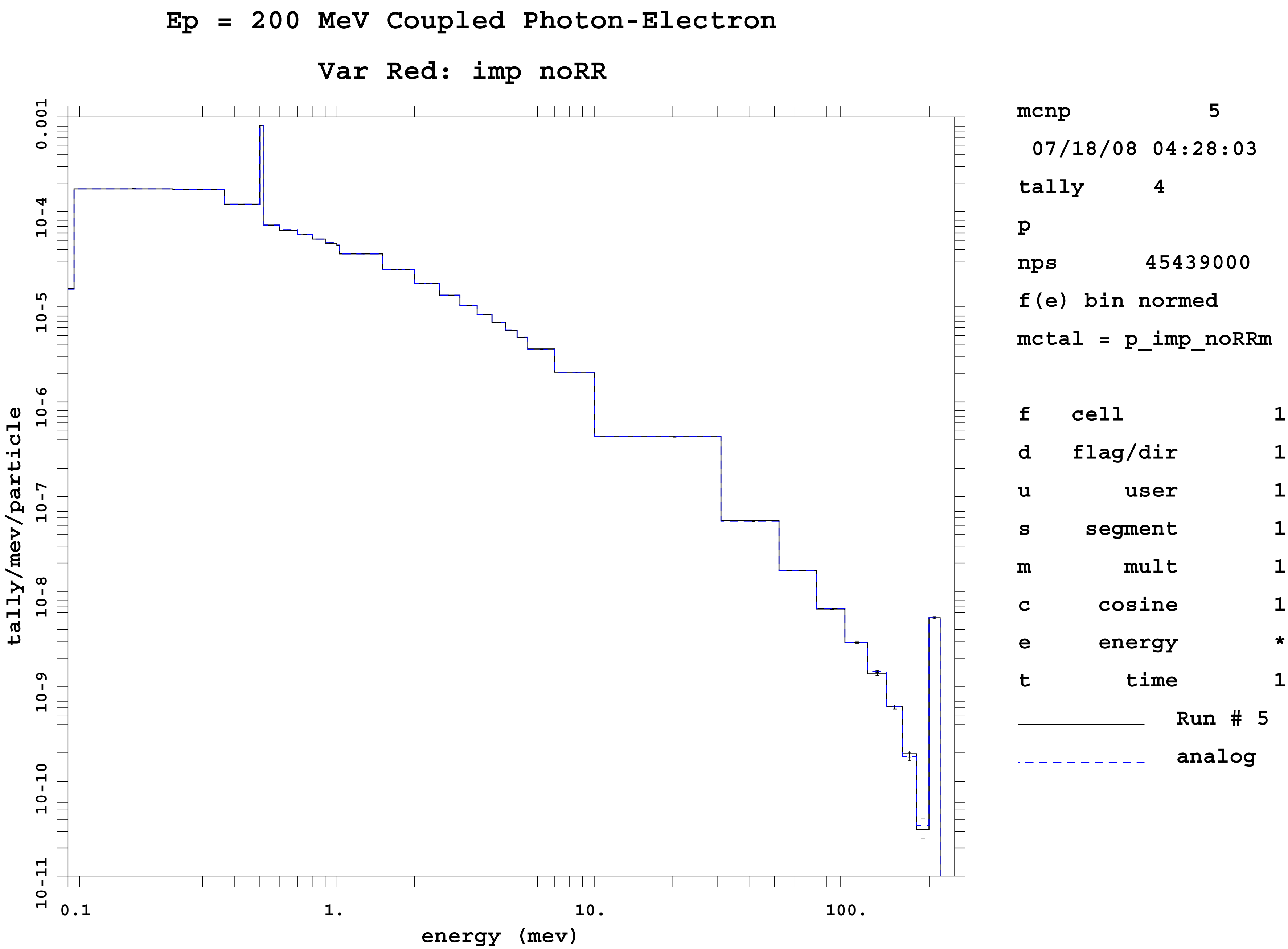


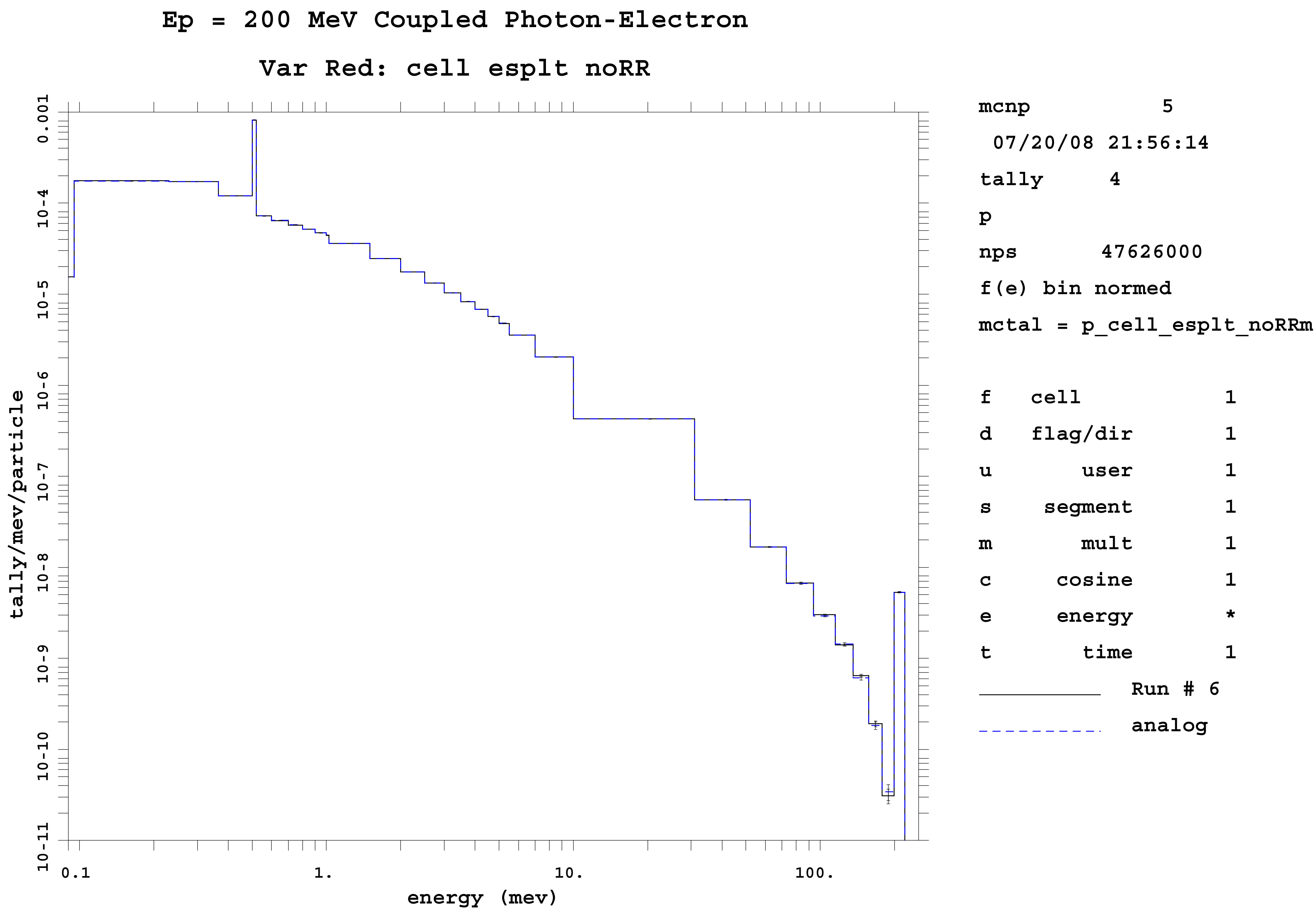
Ep = 200 MeV Coupled Photon-Electron
Analog with PHTVR
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/18/08 04:28:20
tally 4
p
nps 100651000
f(e) bin normed
mctal = p_noVR_PHTVRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 2
analog

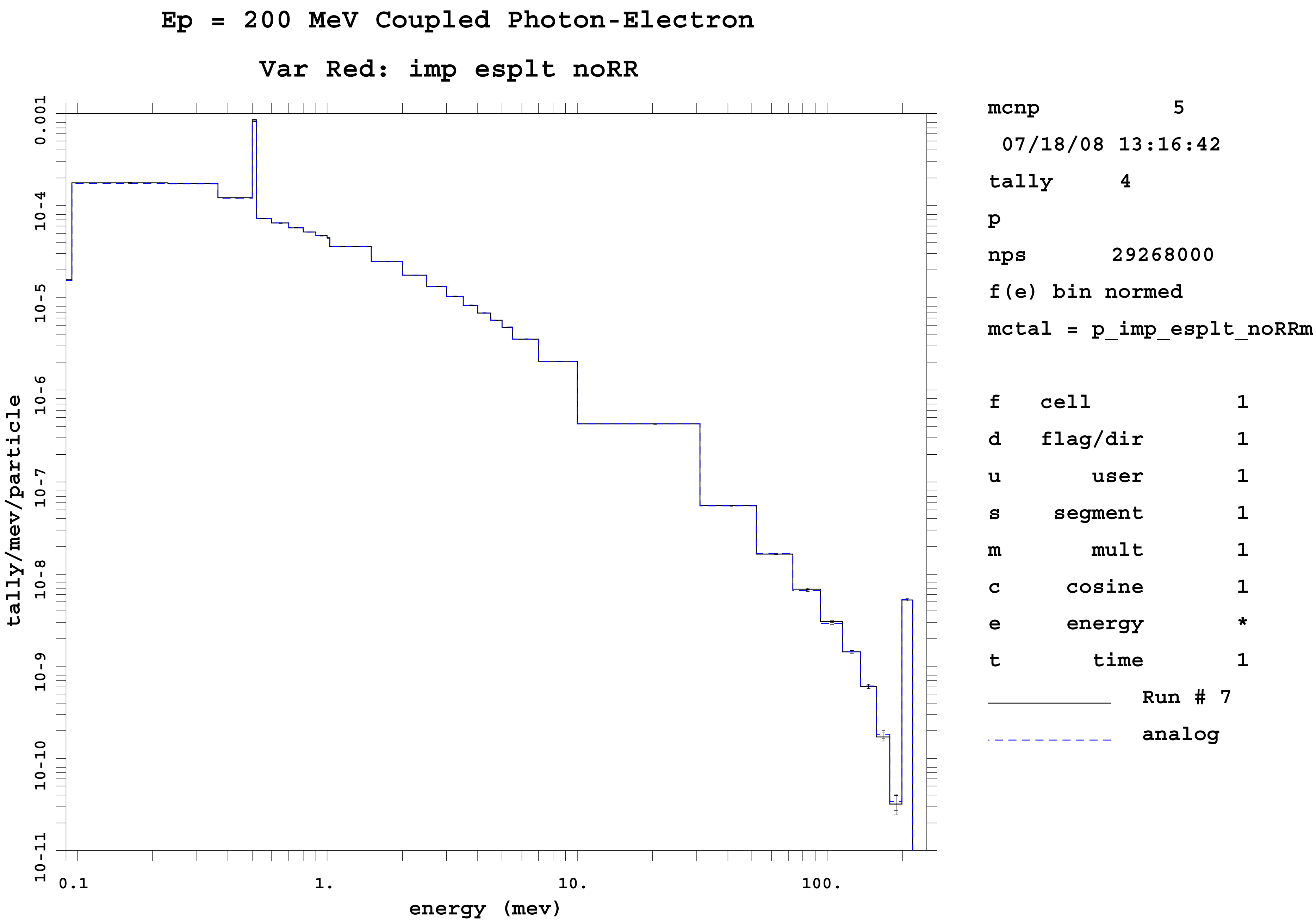

Ep = 200 MeV Coupled Photon-Electron
Var Red: weight cutoff
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/17/08 23:00:49
tally 4
p
nps 105507000
f(e) bin normed
mctal = p_capm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 3
analog

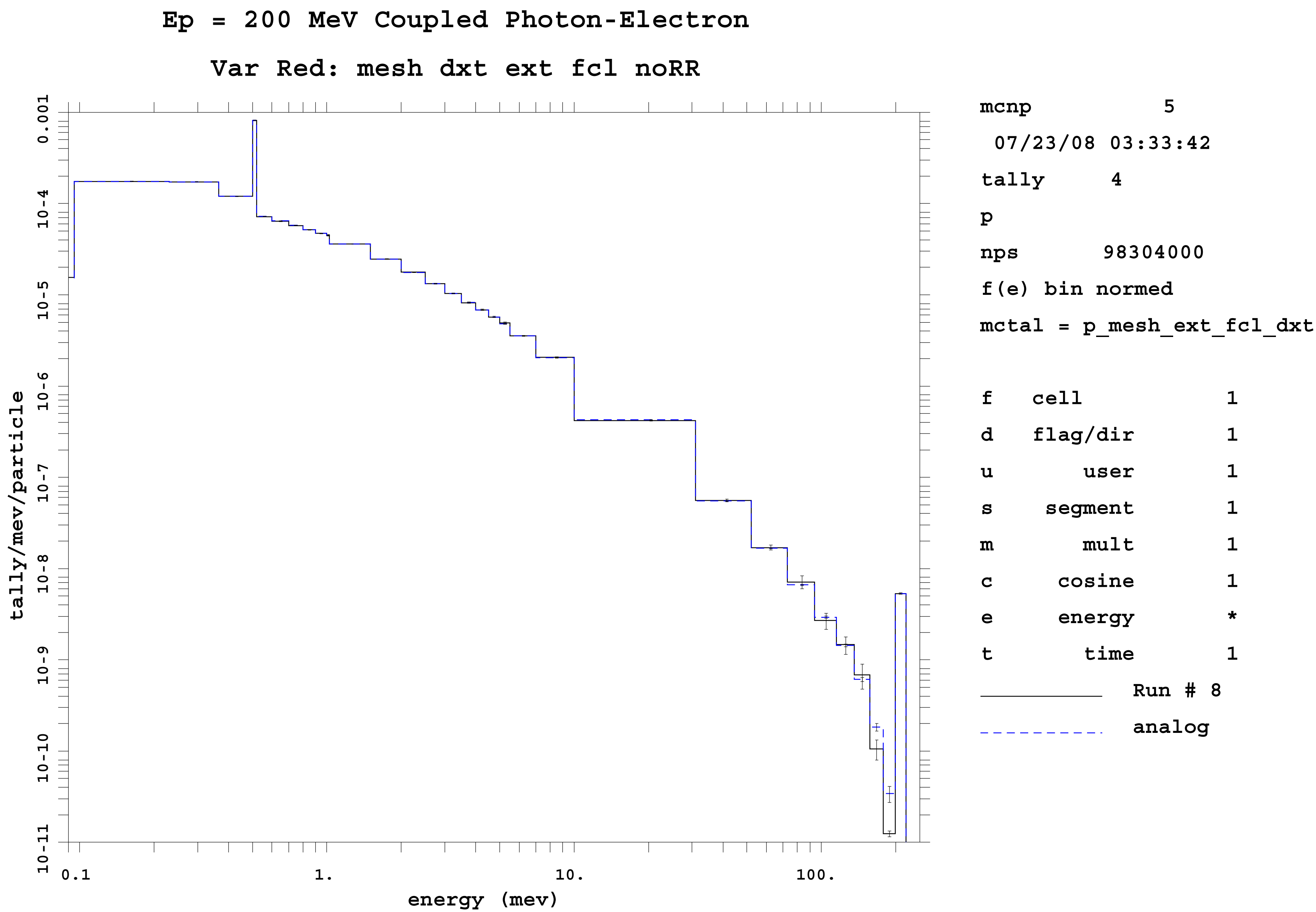


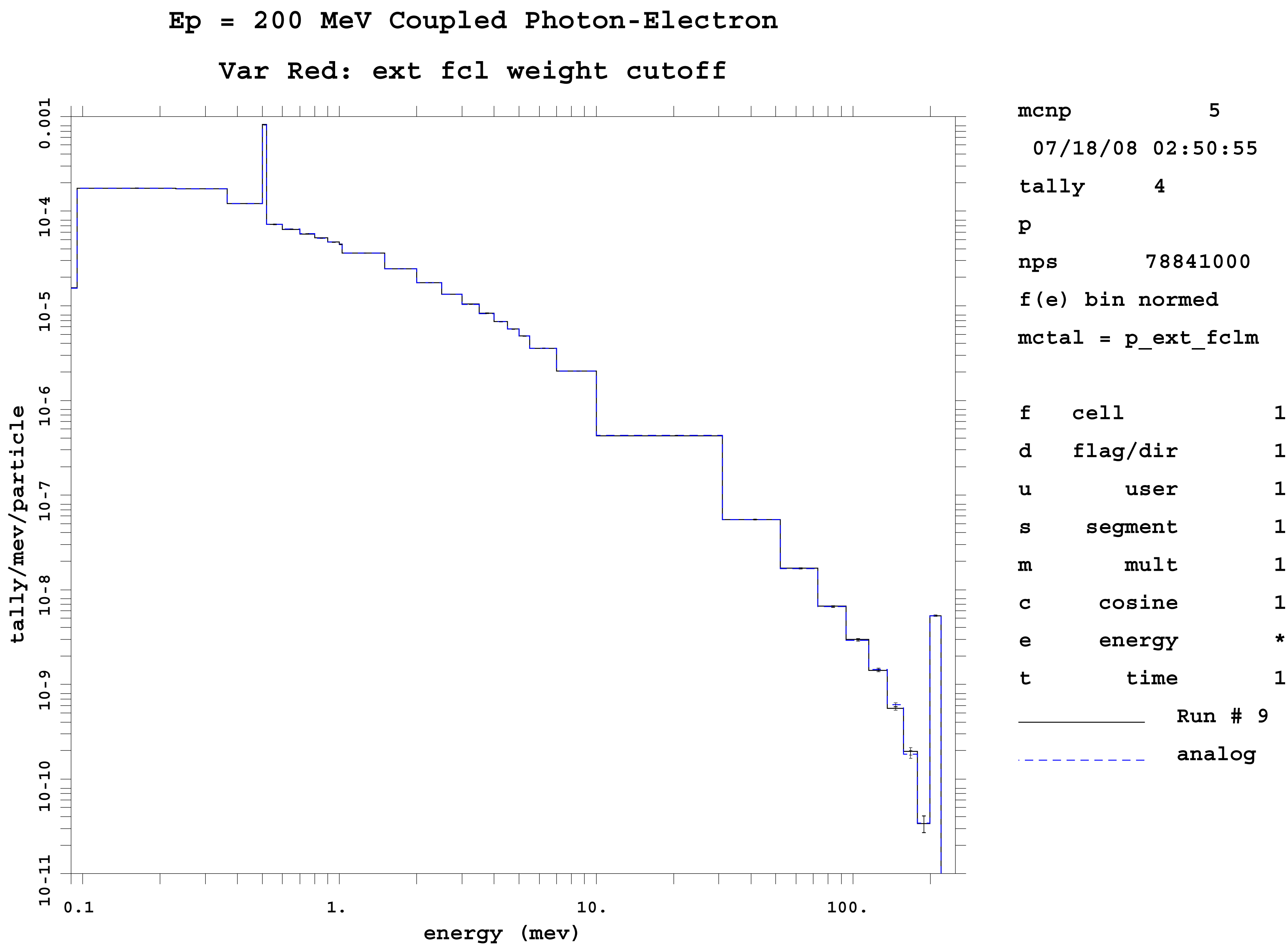
Ep = 200 MeV Coupled Photon-Electron
Var Red: cell noRR
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/21/08 04:43:06
tally 4
p
nps 101900000
f(e) bin normed
mctal = p_cell_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 4
analog


Ep = 200 MeV Coupled Photon-Electron
Var Red: imp noRR
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/18/08 04:28:03
tally 4
p
nps 45439000
f(e) bin normed
mctal = p_imp_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 5
analog

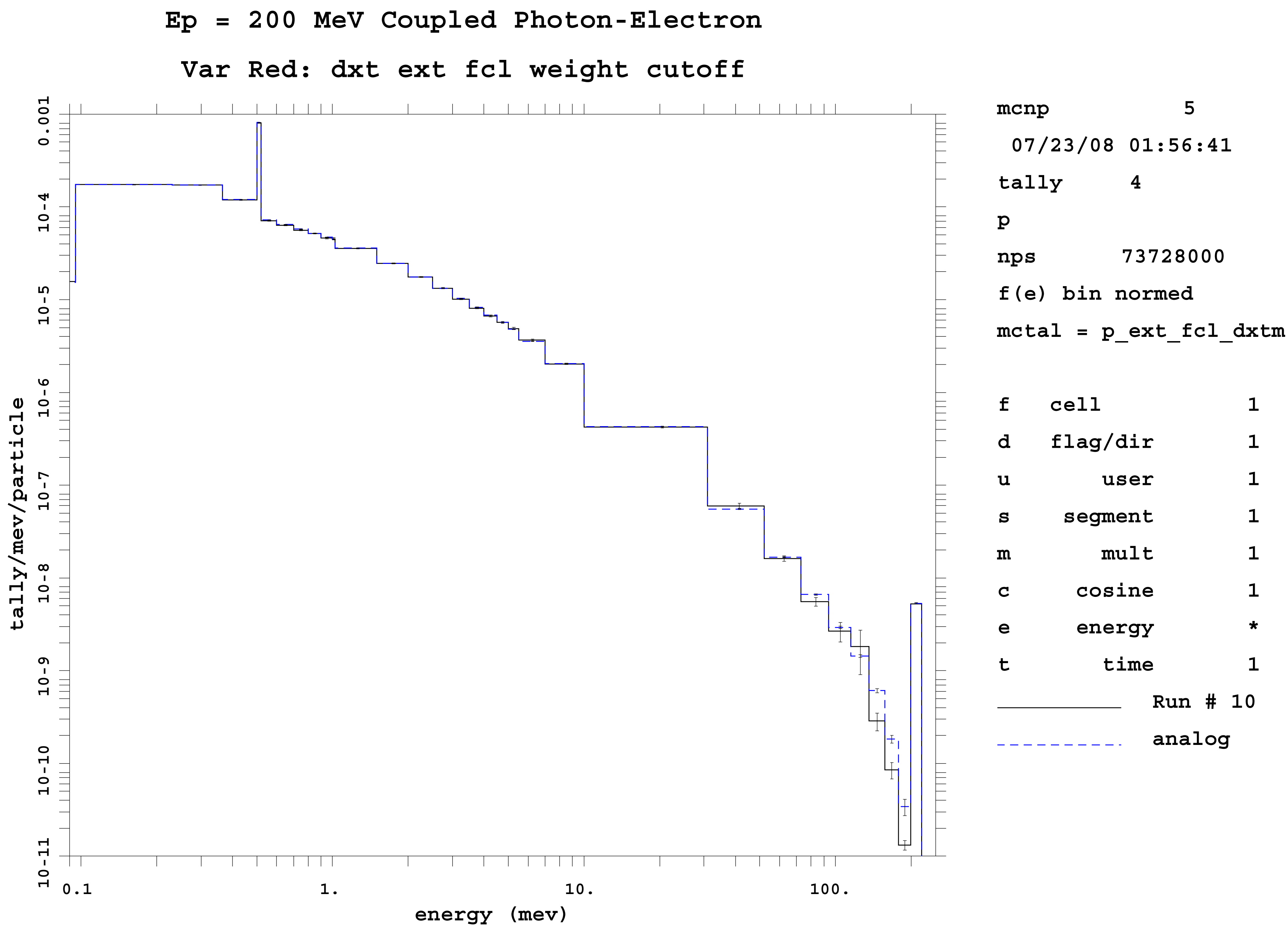

Ep = 200 MeV Coupled Photon-Electron
Var Red: cell esplt noRR
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/20/08 21:56:14
tally 4
p
nps 47626000
f(e) bin normed
mctal = p_cell_esplt_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 6
analog


Ep = 200 MeV Coupled Photon-Electron
Var Red: imp esplt noRR
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/18/08 13:16:42
tally 4
p
nps 29268000
f(e) bin normed
mctal = p_imp_esplt_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 7
analog

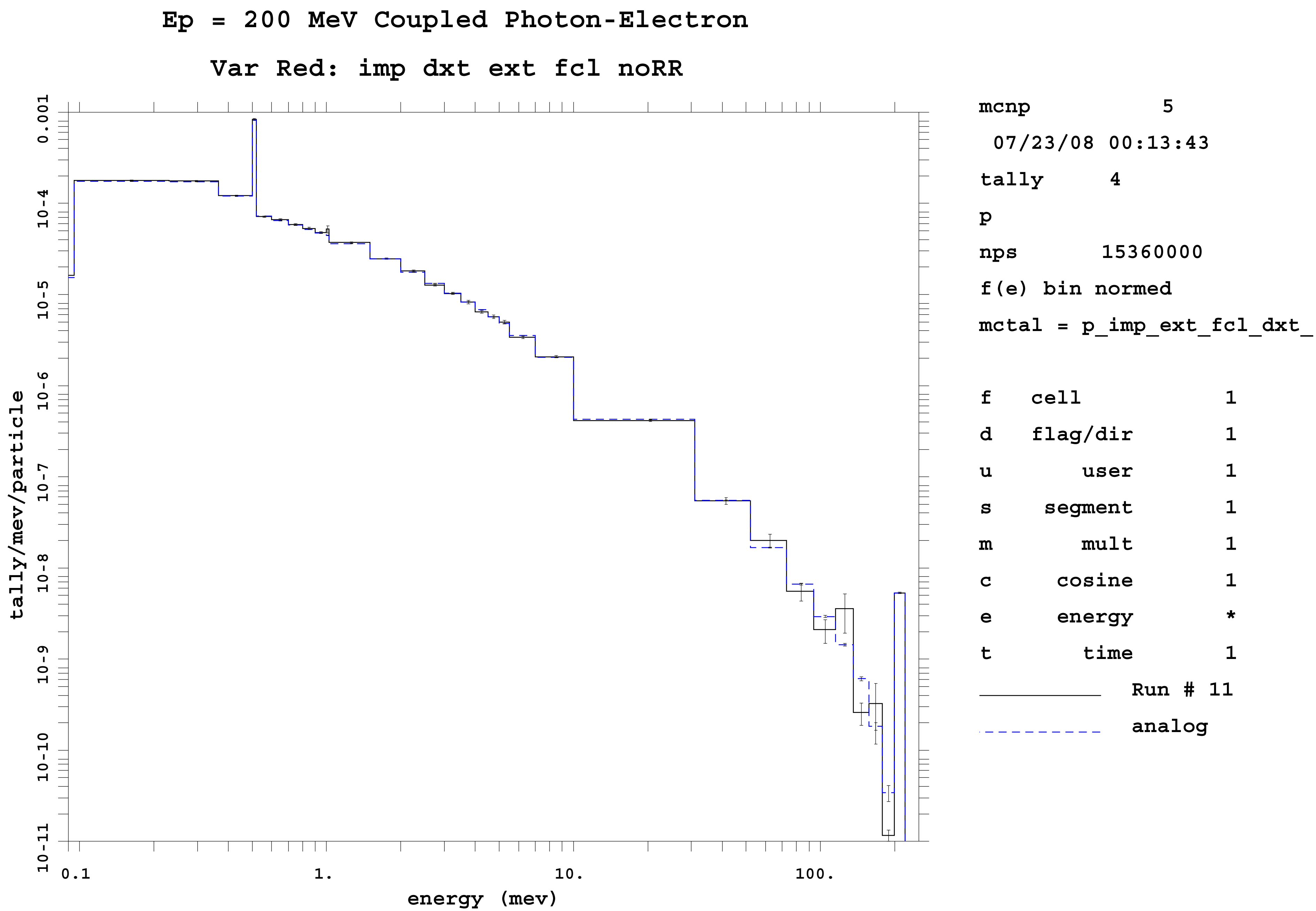

Ep = 200 MeV Coupled Photon-Electron
Var Red: mesh dxt ext fcl noRR
tally/mev/particle
energy (mev)
0.1
1.
10.
100.
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
mcnp 5
07/23/08 03:33:42
tally 4
p
nps 98304000
f(e) bin normed
mctal = p_mesh_ext_fcl_dxt
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 8
analog

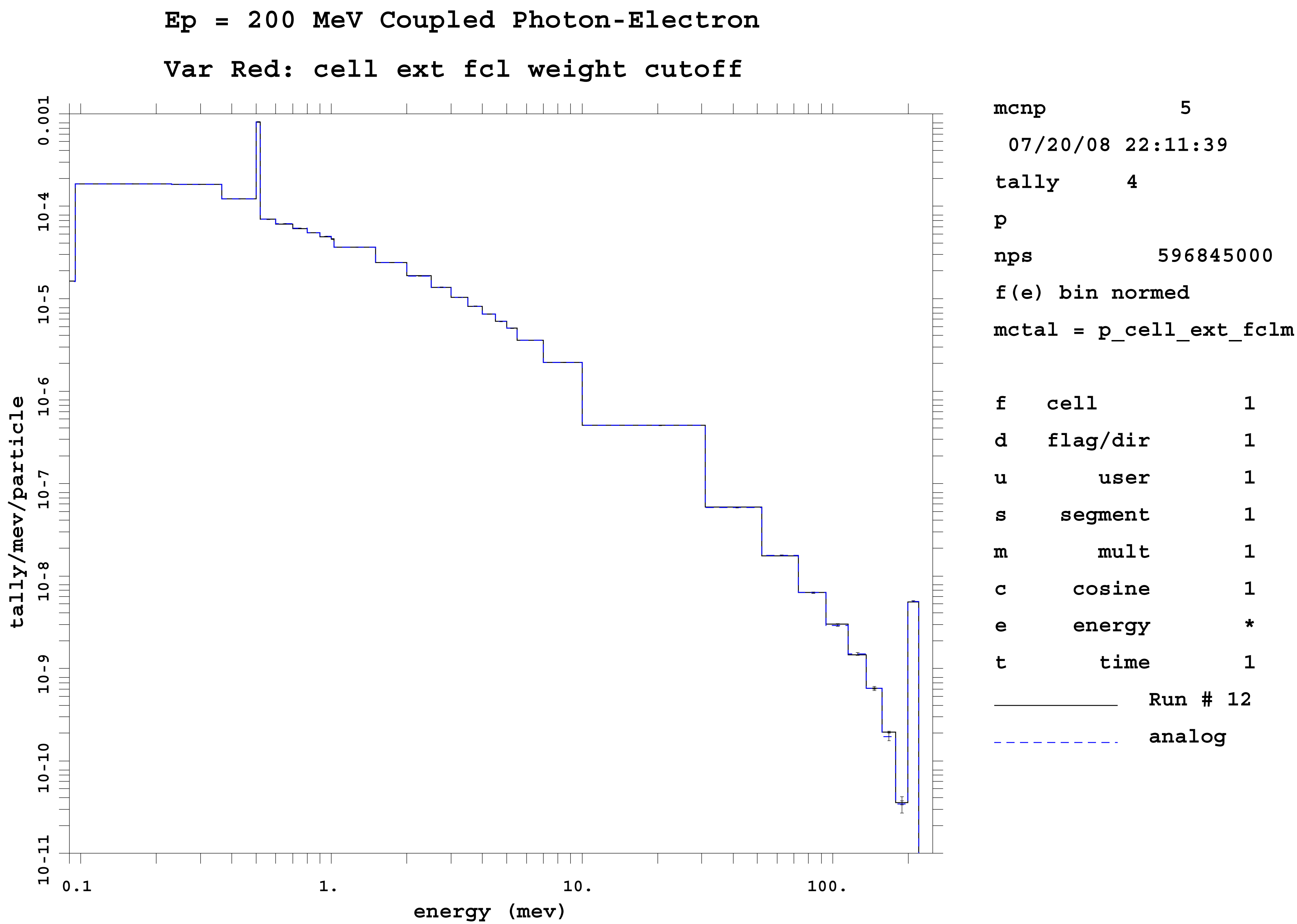


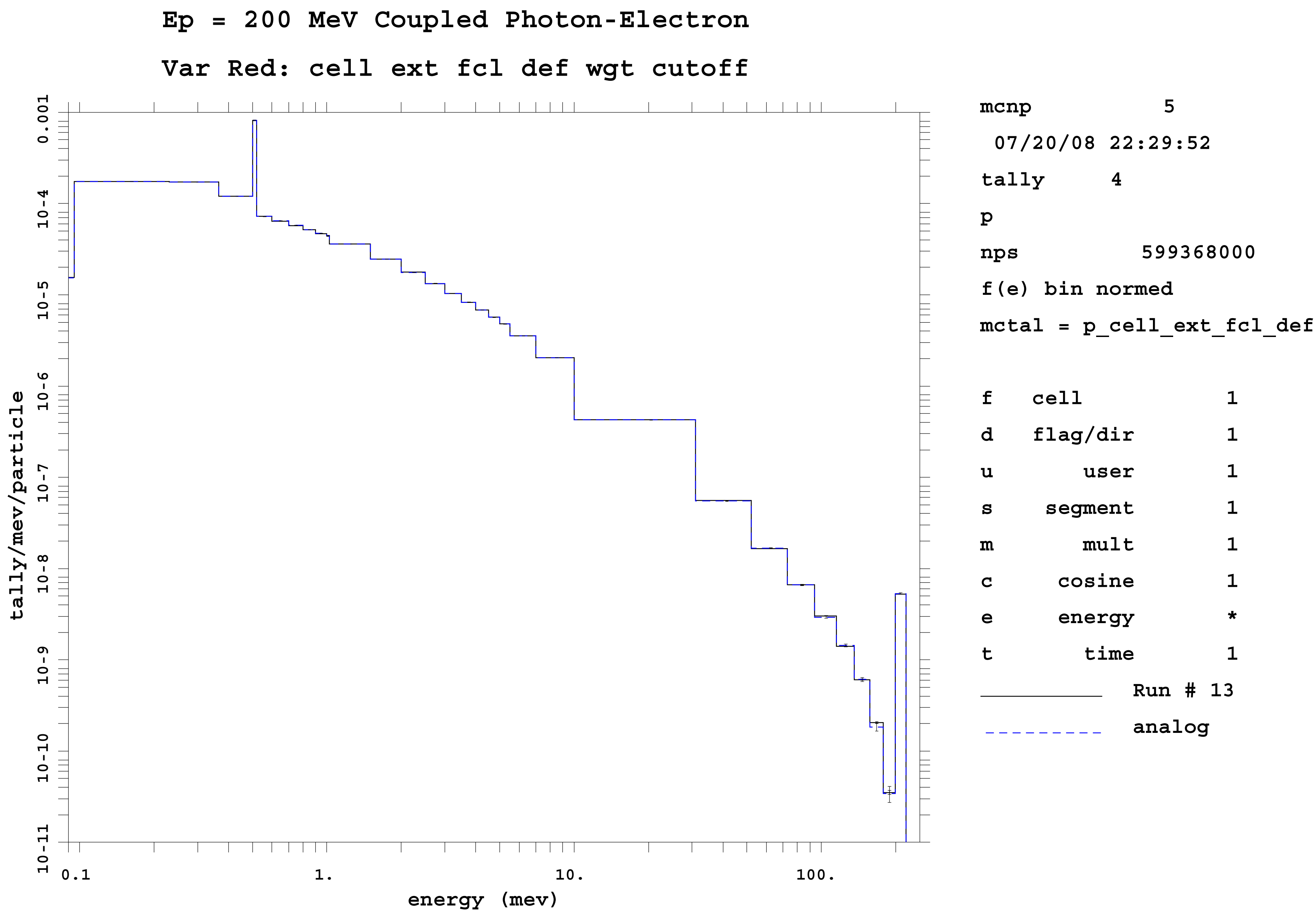
Ep = 200 MeV Coupled Photon-Electron
Var Red: ext fcl weight cutoff
mcnp 5
07/18/08 02:50:55
tally 4
p
nps 78841000
f(e) bin normed
mctal = p_ext_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 9
analog
tally/mev/particle
energy (mev)
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.



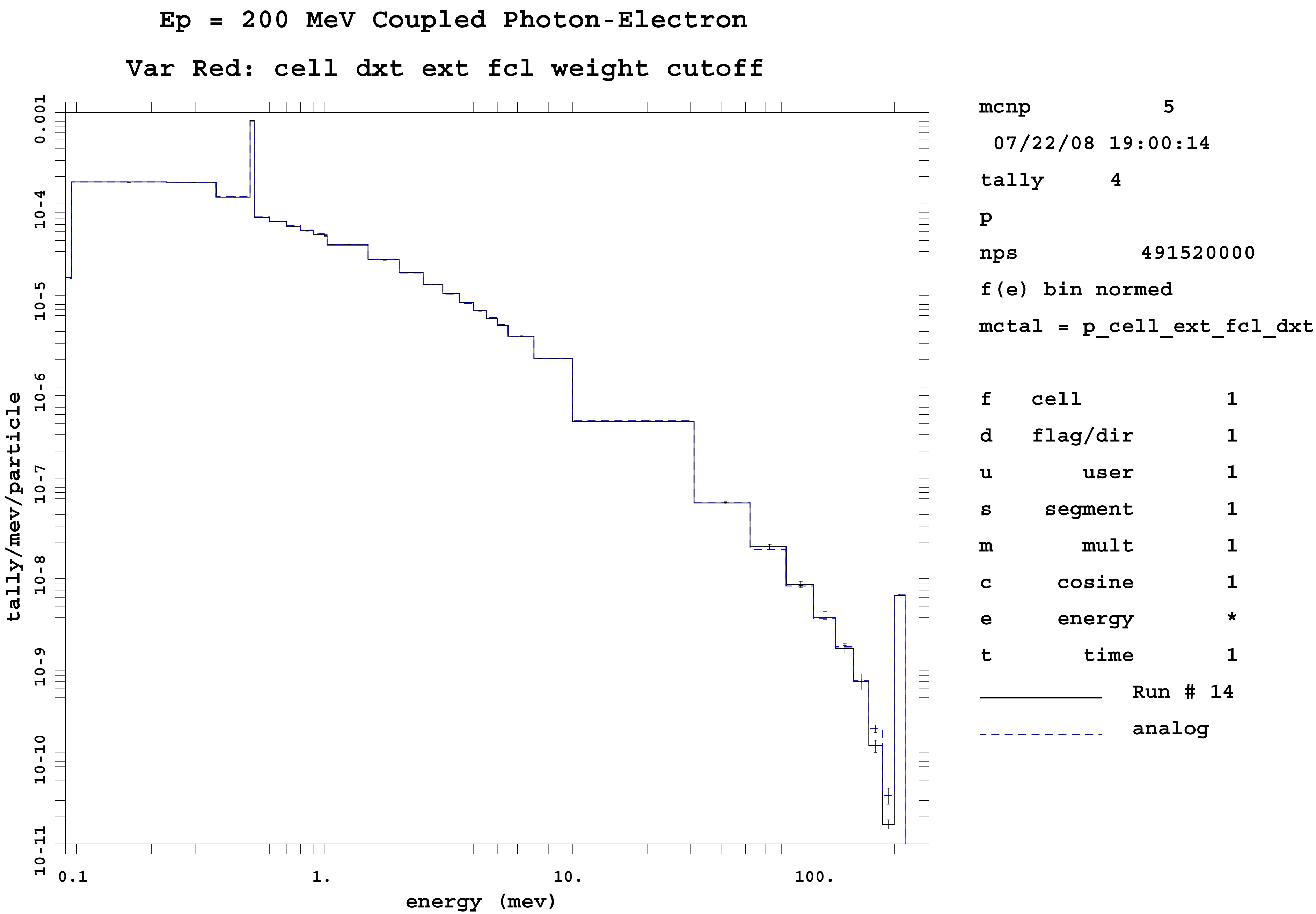
Ep = 200 MeV Coupled Photon-Electron
Var Red: dxt ext fcl weight cutoff
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/23/08 01:56:41
tally 4
p
nps 73728000
f(e) bin normed
mctal = p_ext_fcl_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 10
analog


Ep = 200 MeV Coupled Photon-Electron
Var Red: imp dxt ext fcl noRR
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/23/08 00:13:43
tally 4
p
nps 15360000
f(e) bin normed
mctal = p_imp_ext_fcl_dxt_
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 11
analog

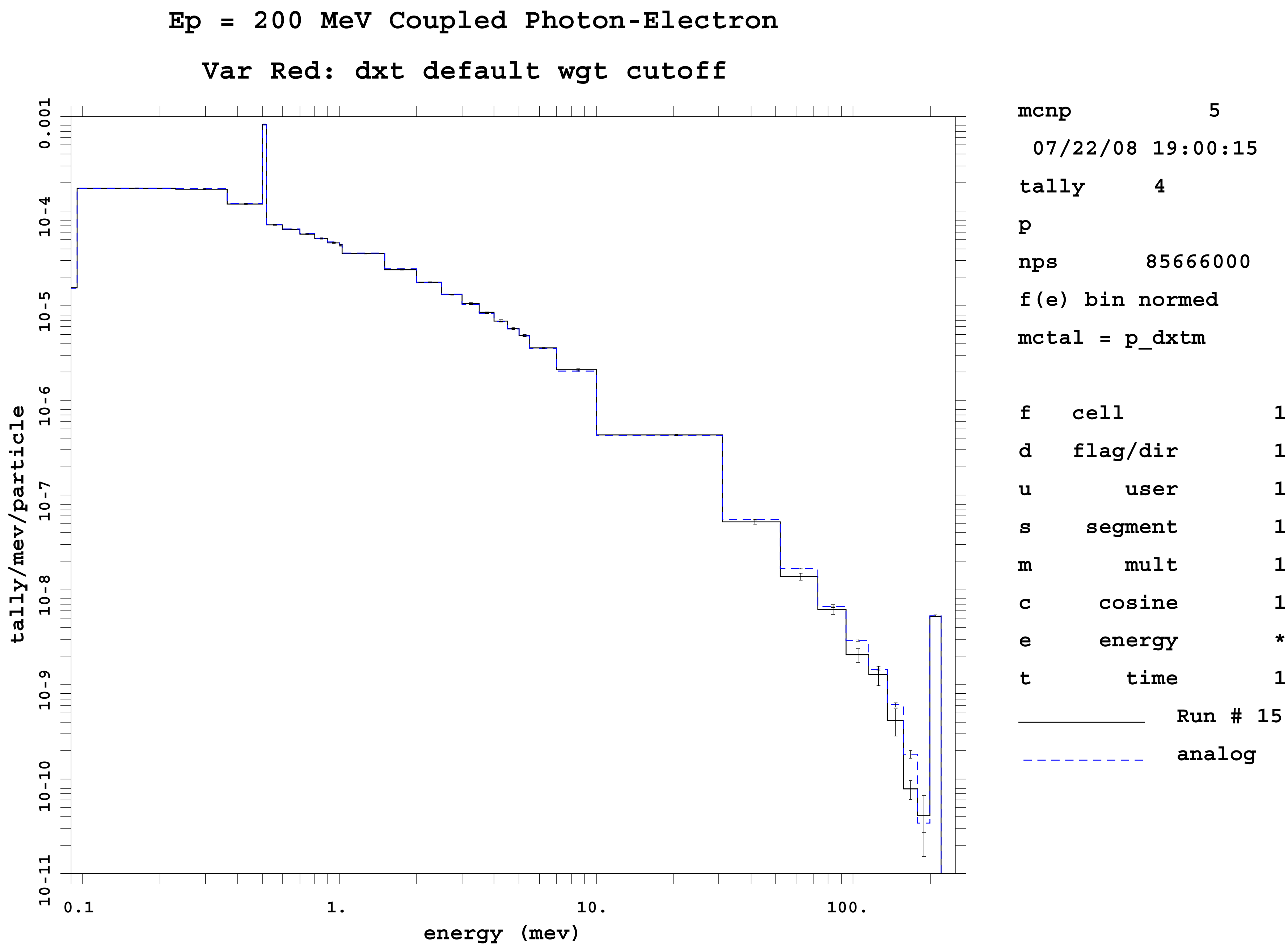

Ep = 200 MeV Coupled Photon-Electron
Var Red: cell ext fcl weight cutoff
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/20/08 22:11:39
tally 4
p
nps 596845000
f(e) bin normed
mctal = p_cell_ext_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 12
analog

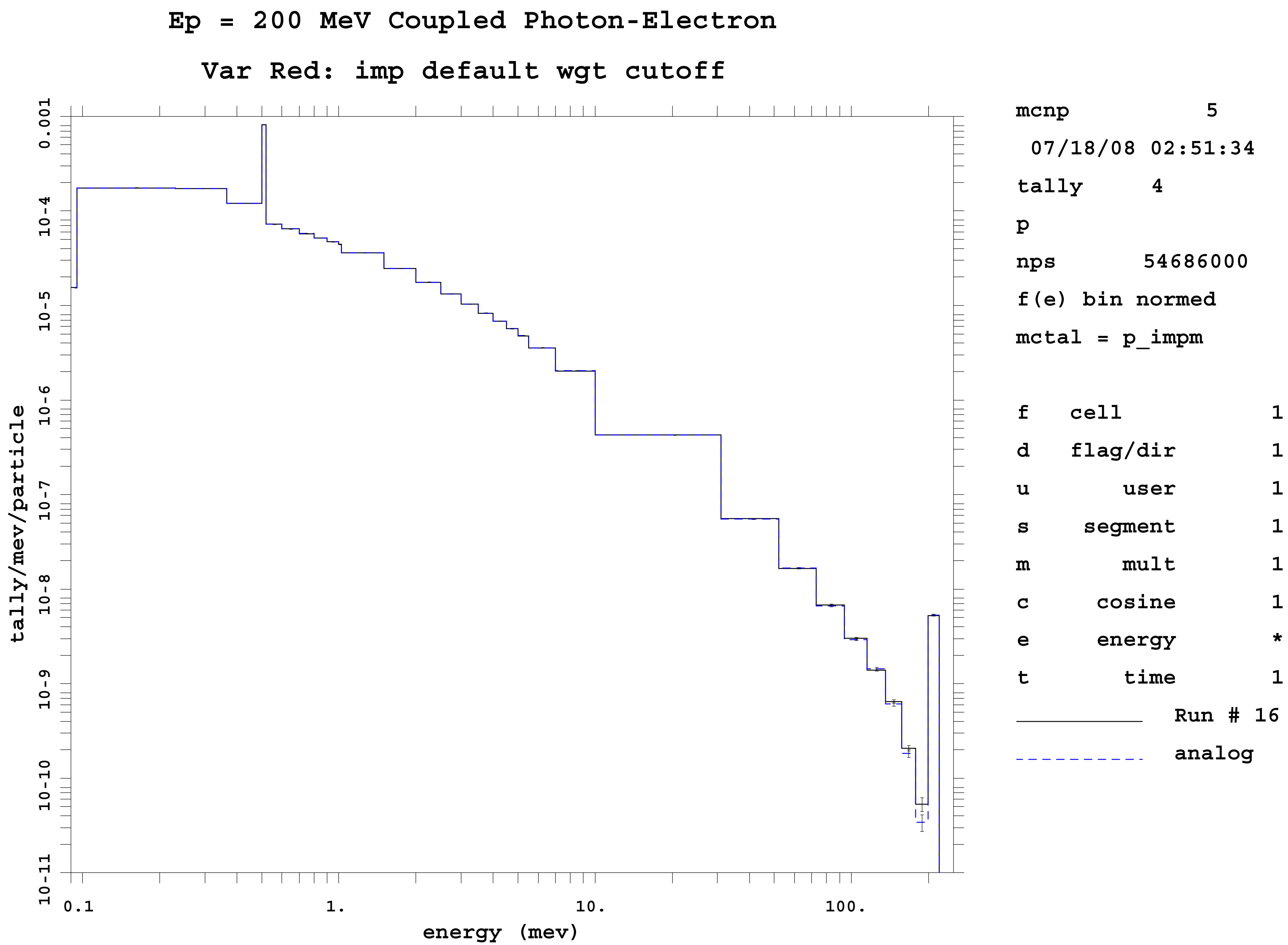


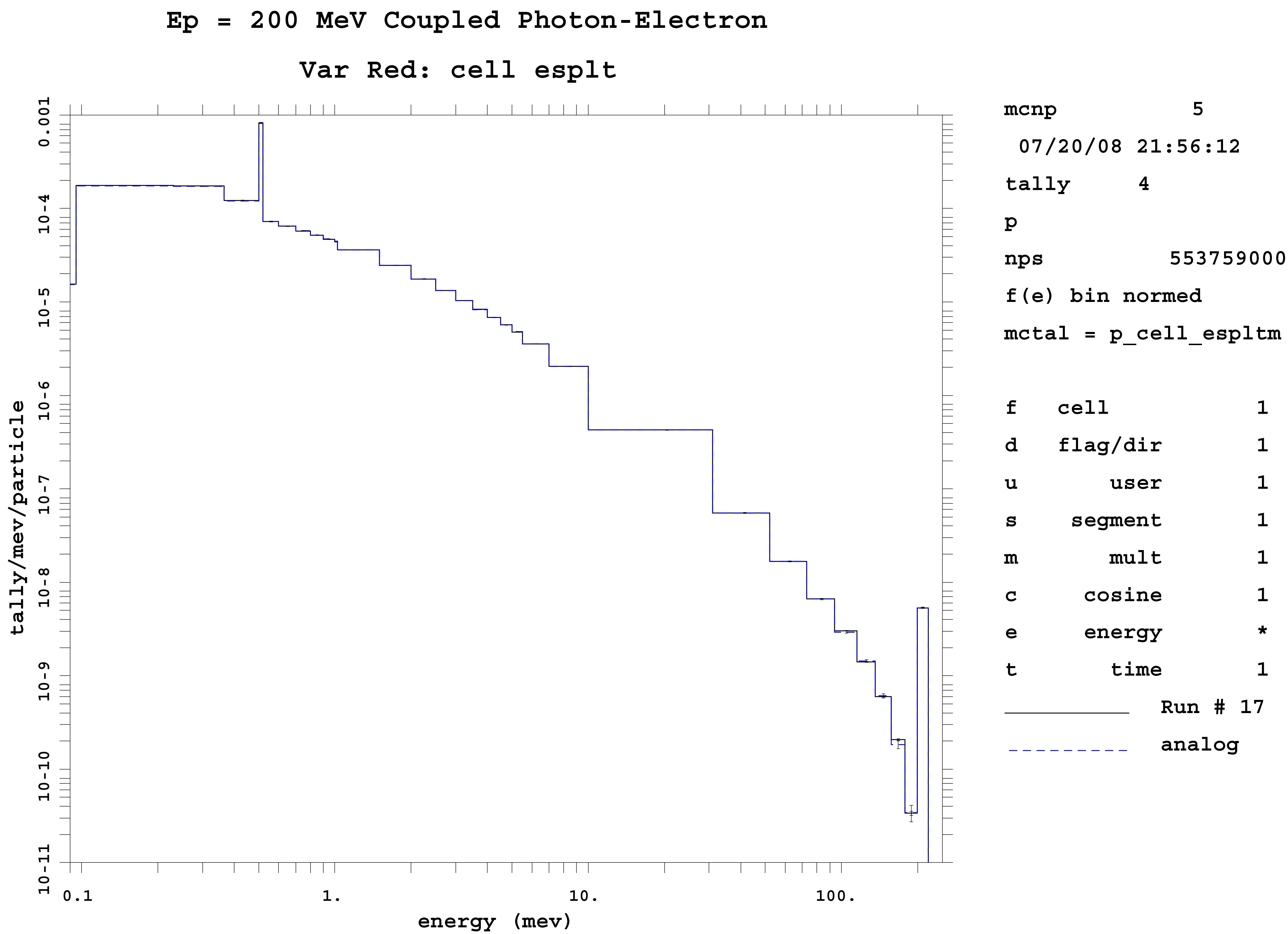
Ep = 200 MeV Coupled Photon-Electron
Var Red: cell ext fcl def wgt cutoff
tally/mev/particle
energy (mev)
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
mcnp 5
07/20/08 22:29:52
tally 4
p
nps 599368000
f(e) bin normed
mctal = p_cell_ext_fcl_def
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 13
analog



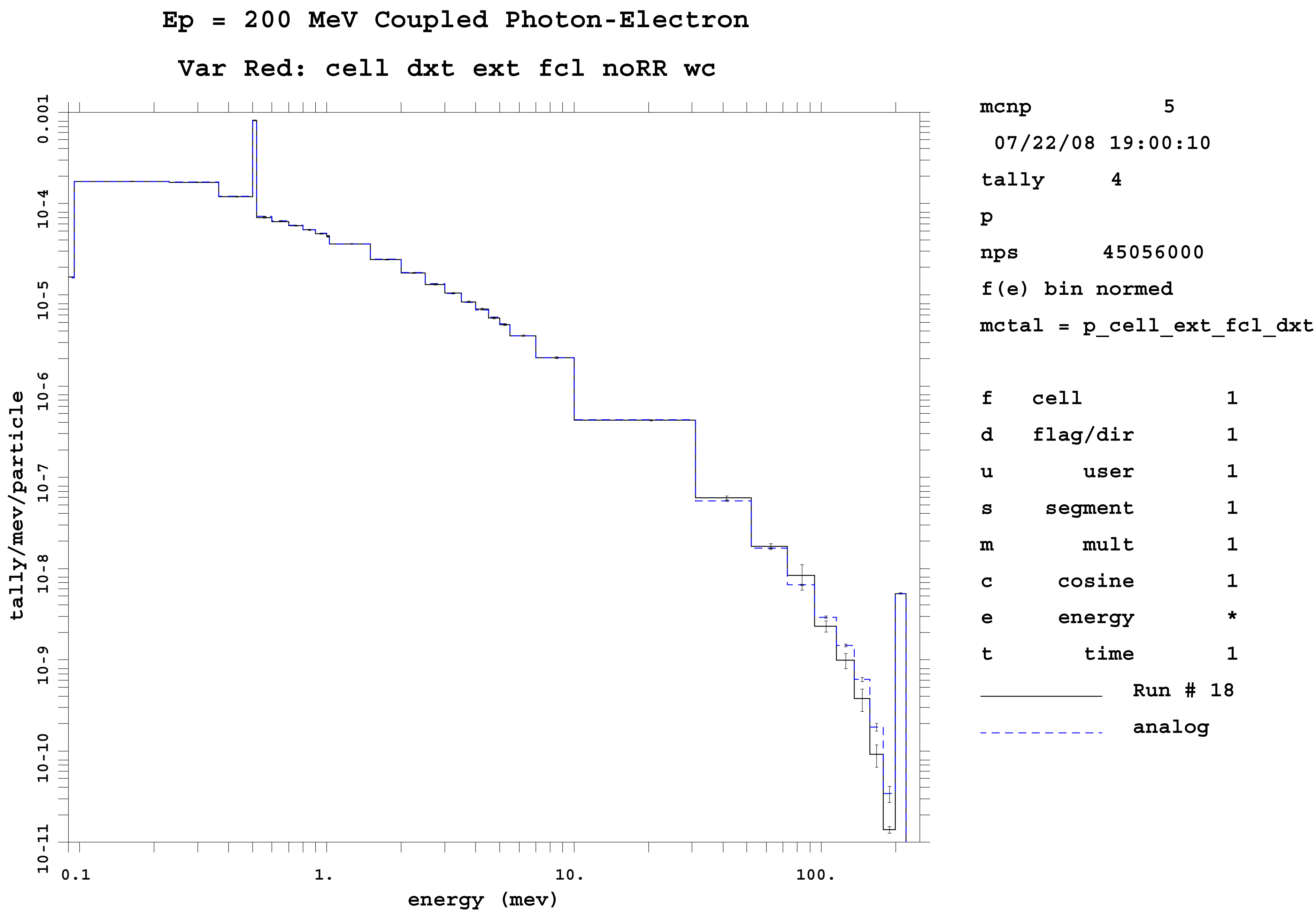
Ep = 200 MeV Coupled Photon-Electron
Var Red: cell dxt ext fcl weight cutoff
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
tally/mev/particle
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/22/08 19:00:14
tally 4
p
nps 491520000
f(e) bin normed
mctal = p_cell_ext_fcl_dxt
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 14
analog


Ep = 200 MeV Coupled Photon-Electron
Var Red: dxt default wgt cutoff
tally/mev/particle
energy (mev)
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
mcnp 5
07/22/08 19:00:15
tally 4
p
nps 85666000
f(e) bin normed
mctal = p_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 15
analog

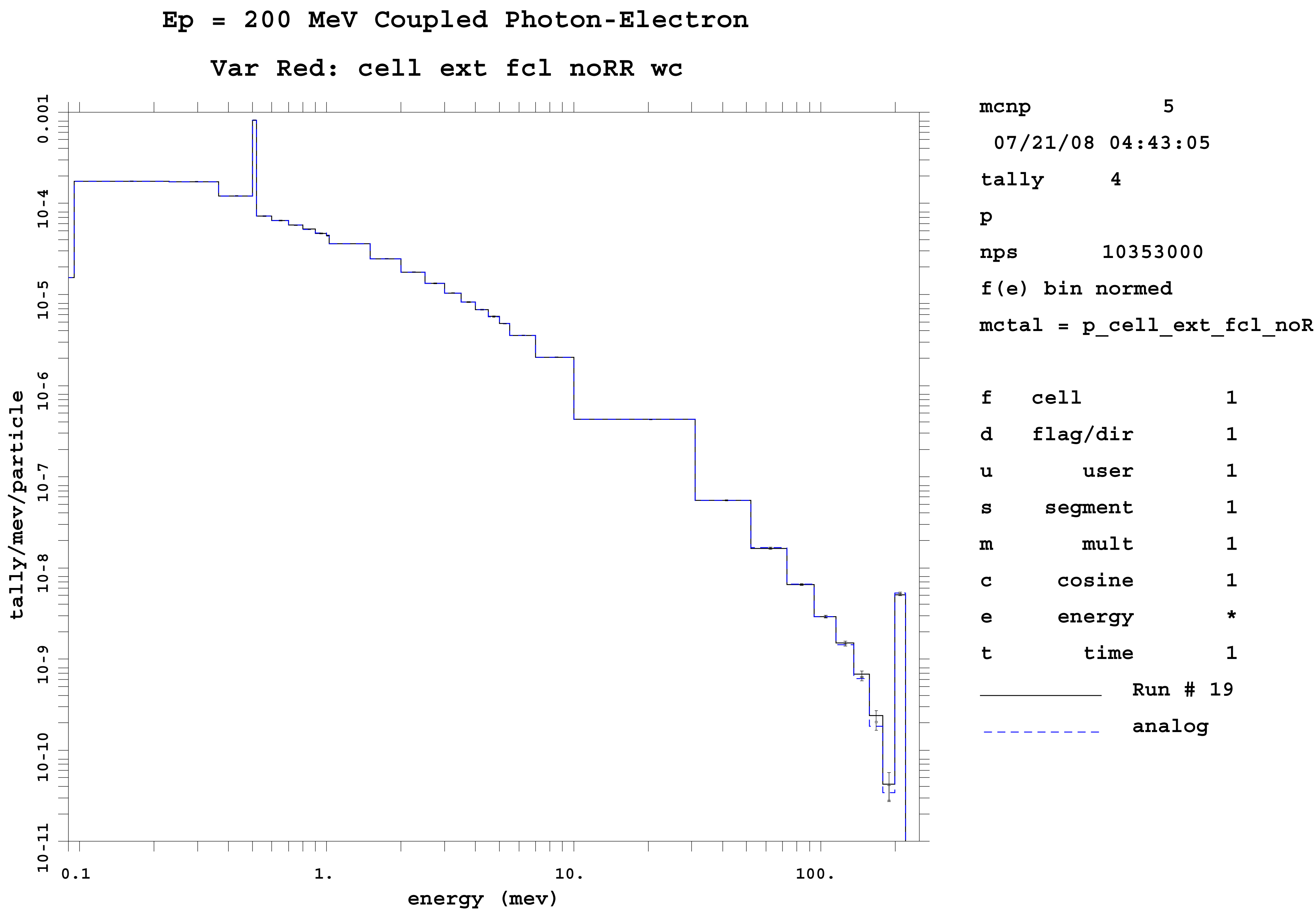

Ep = 200 MeV Coupled Photon-Electron
Var Red: imp default wgt cutoff
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/18/08 02:51:34
tally 4
p
nps 54686000
f(e) bin normed
mctal = p_impm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 16
analog

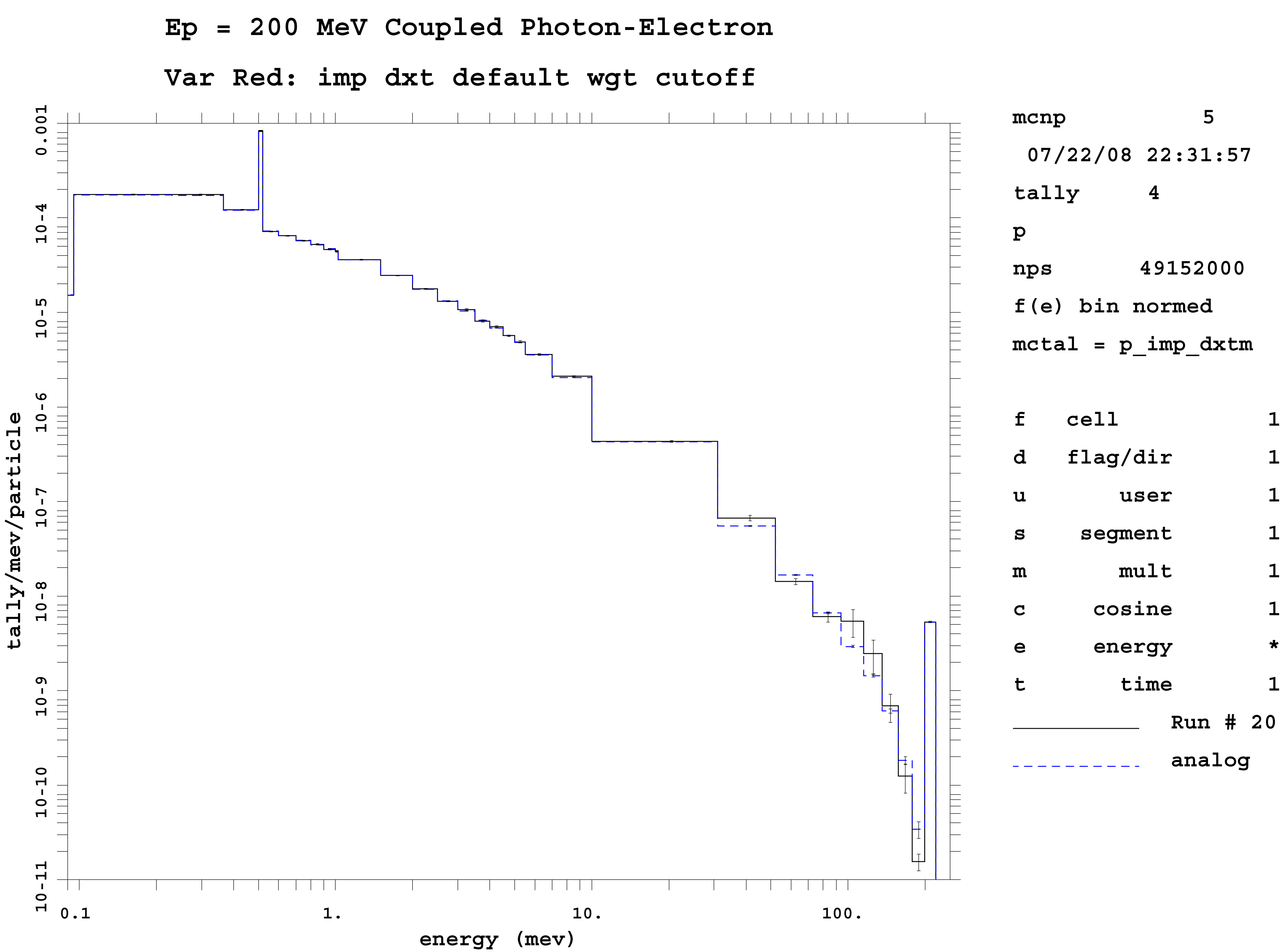


Ep = 200 MeV Coupled Photon-Electron
Var Red: cell espl t
tally/mev/particle
energy (mev)
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
mcnp 5
07/20/08 21:56:12
tally 4
p
nps 553759000
f(e) bin normed
mctal = p_cell_espltm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 17
analog

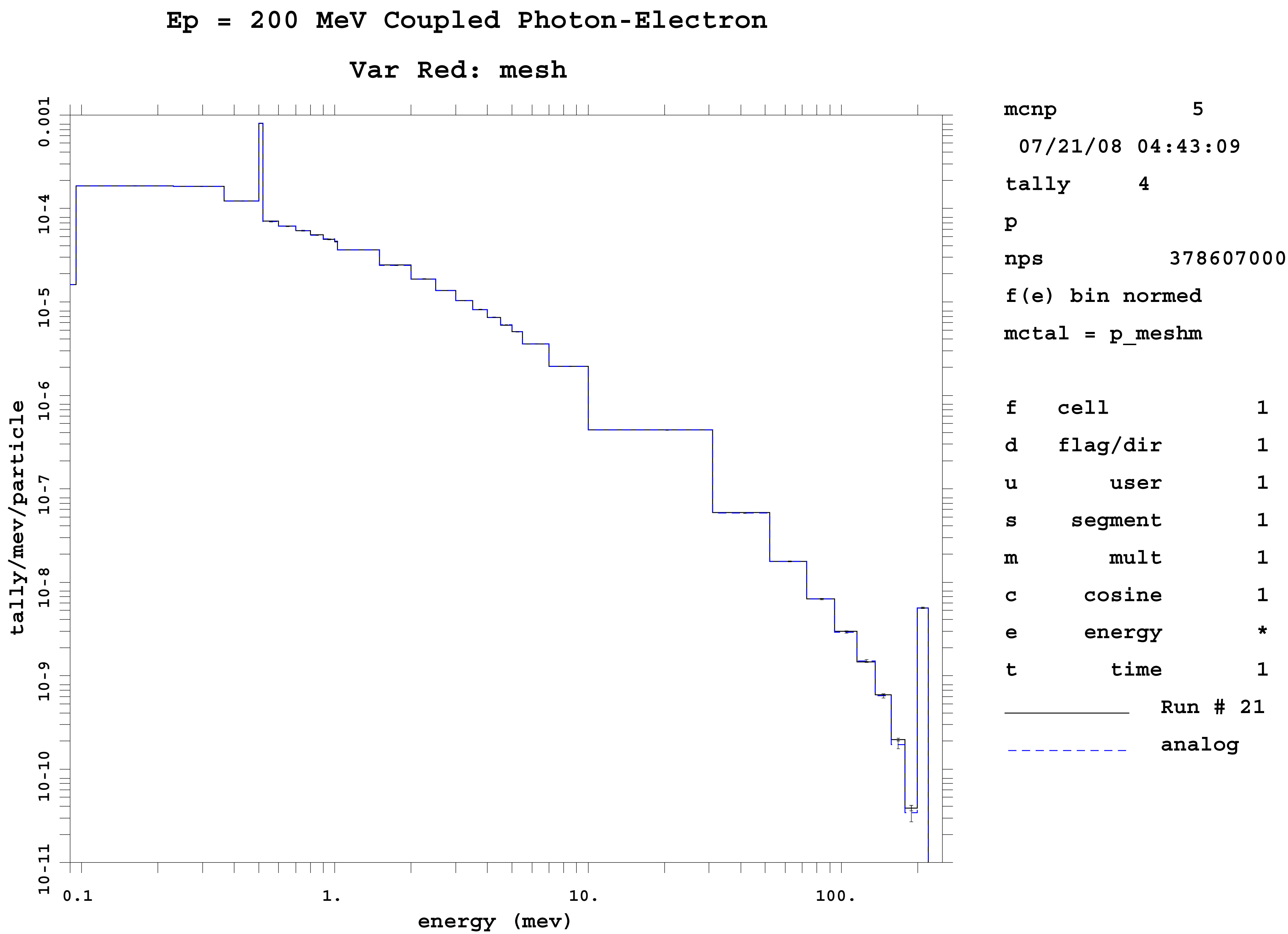


Ep = 200 MeV Coupled Photon-Electron
Var Red: cell dxt ext fcl noRR wc
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/22/08 19:00:10
tally 4
p
nps 45056000
f(e) bin normed
mctal = p_cell_ext_fcl_dxt
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 18
analog

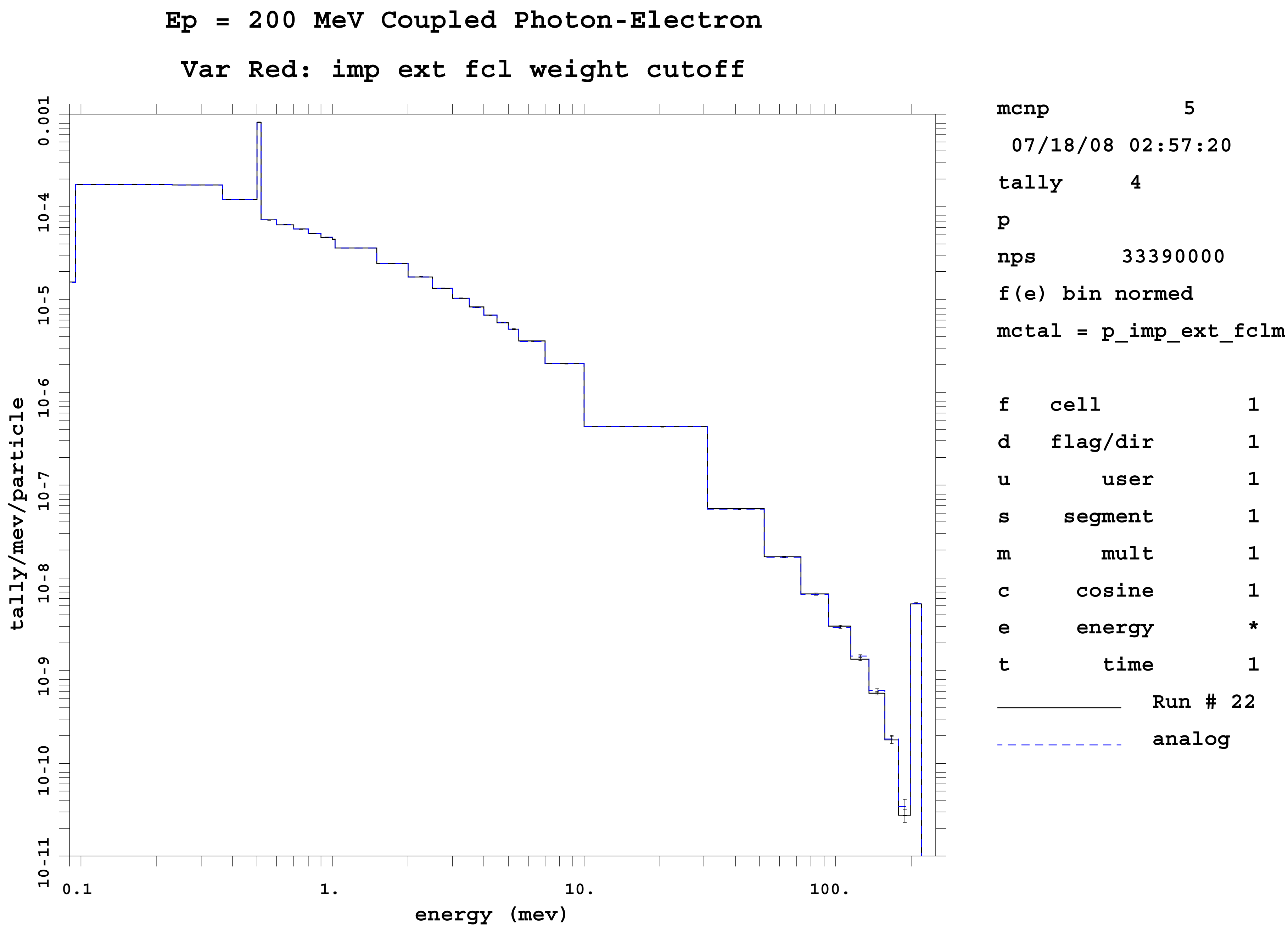

Ep = 200 MeV Coupled Photon-Electron
Var Red: cell ext fcl noRR wc
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/21/08 04:43:05
tally 4
p
nps 10353000
f(e) bin normed
mctal = p_cell_ext_fcl_noR
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 19
analog

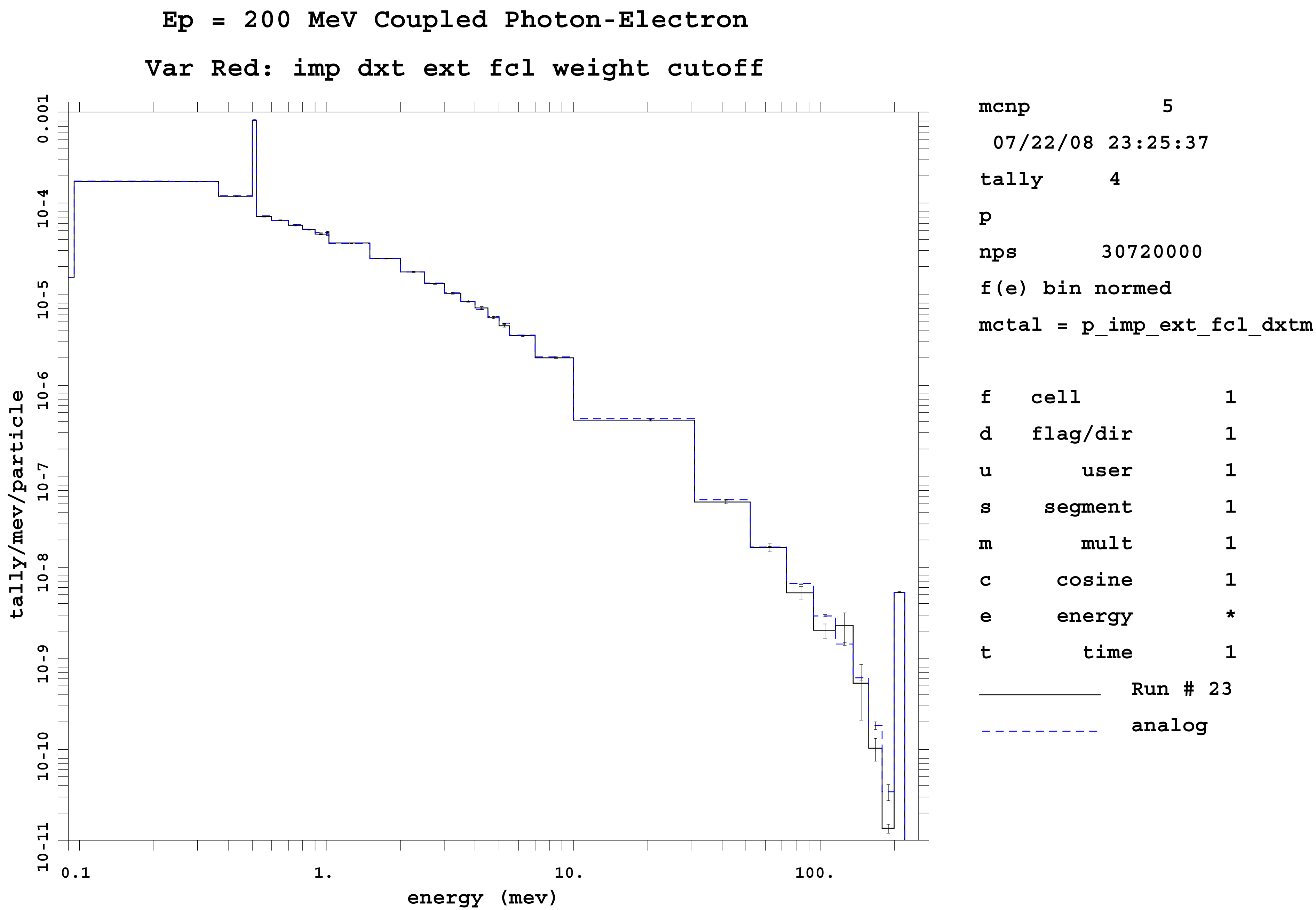


Ep = 200 MeV Coupled Photon-Electron
Var Red: imp dxt default wgt cutoff
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/22/08 22:31:57
tally 4
p
nps 49152000
f(e) bin normed
mctal = p_imp_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 20
analog

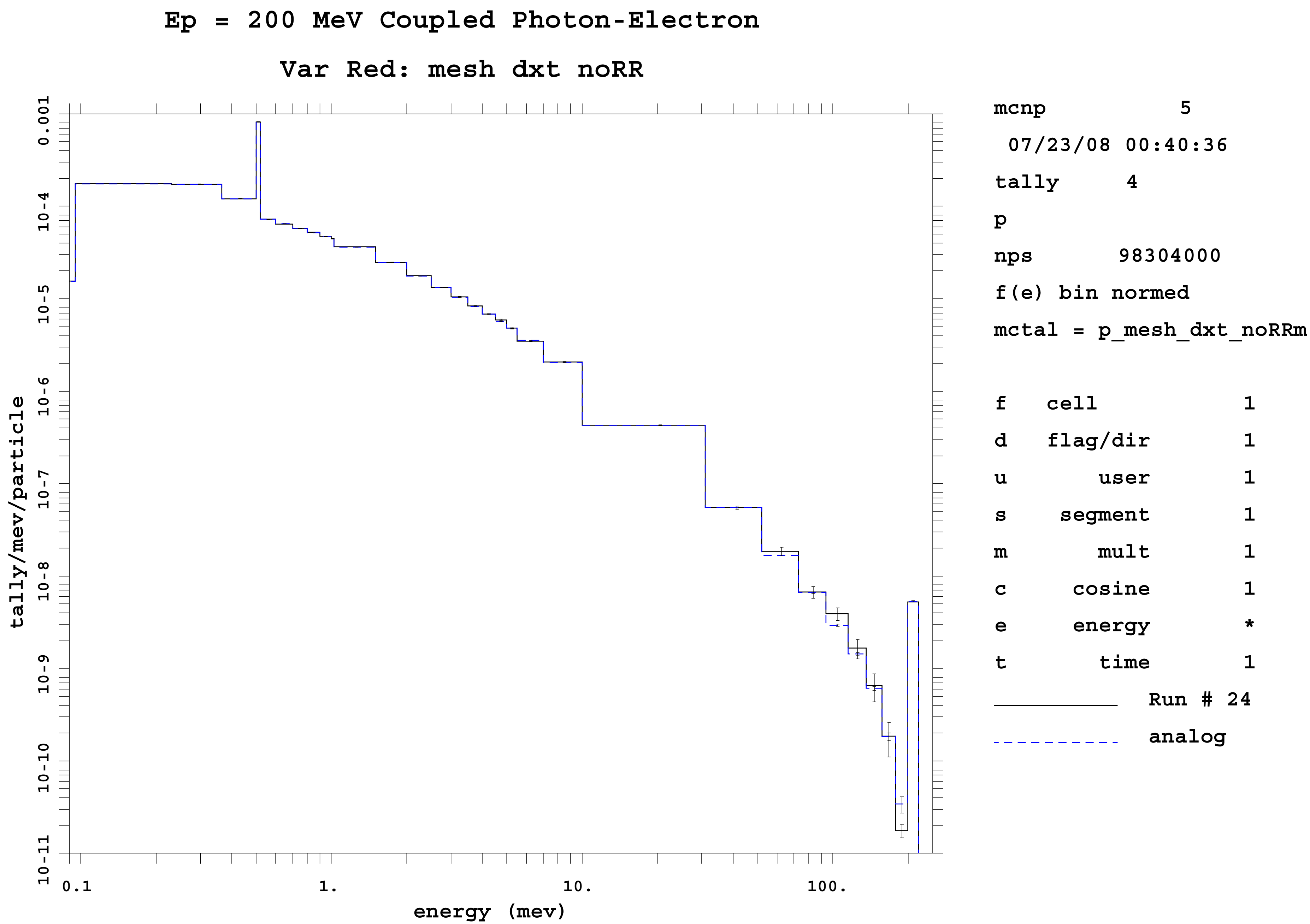


Ep = 200 MeV Coupled Photon-Electron
Var Red: mesh
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/21/08 04:43:09
tally 4
p
nps 378607000
f(e) bin normed
mctal = p_meshm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 21
analog


Ep = 200 MeV Coupled Photon-Electron
Var Red: imp ext fcl weight cutoff
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/18/08 02:57:20
tally 4
p
nps 33390000
f(e) bin normed
mctal = p_imp_ext_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 22
analog



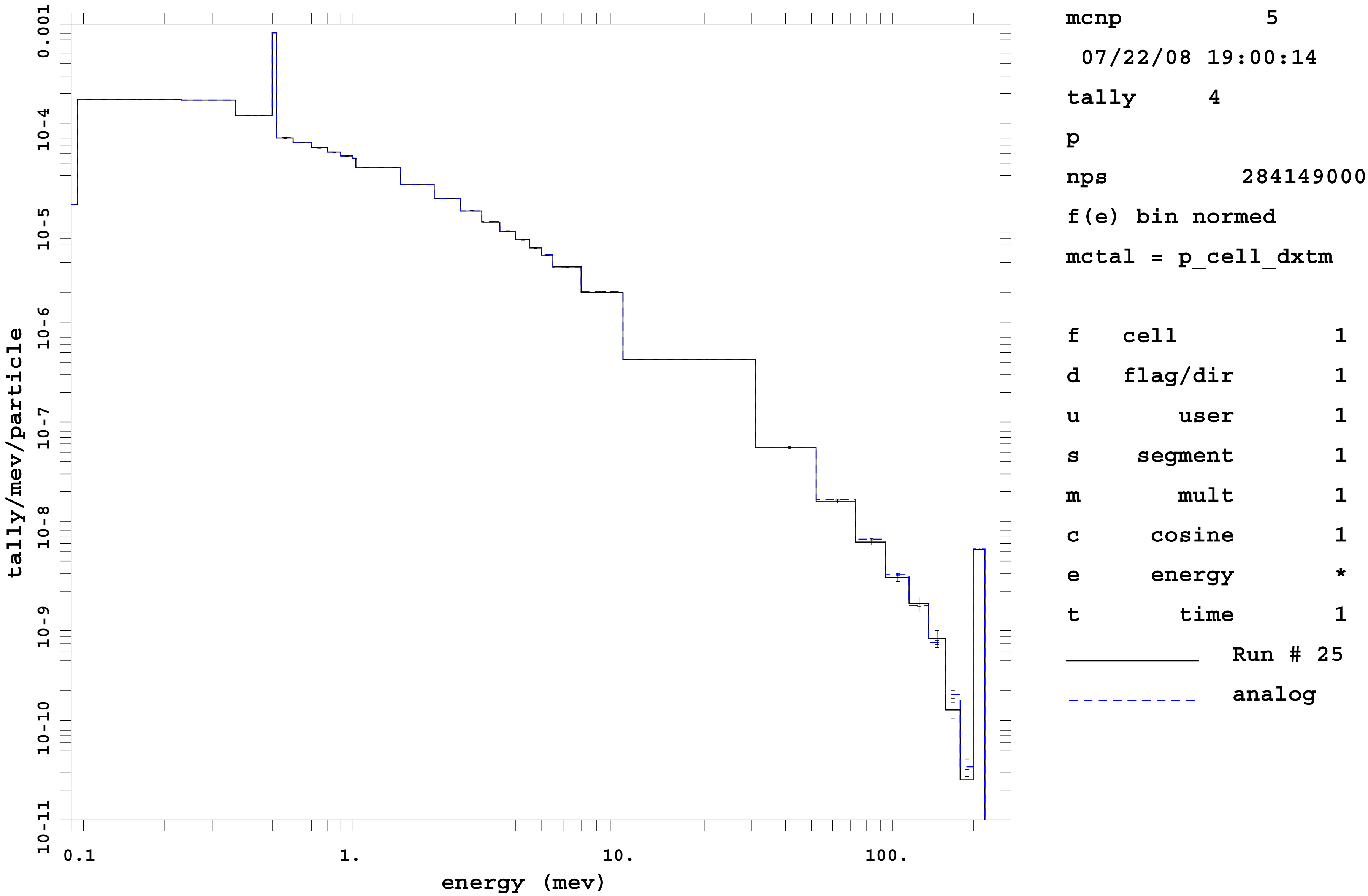
Ep = 200 MeV Coupled Photon-Electron
Var Red: imp dxt ext fcl weight cutoff
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/22/08 23:25:37
tally 4
p
nps 30720000
f(e) bin normed
mctal = p_imp_ext_fcl_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 23
analog

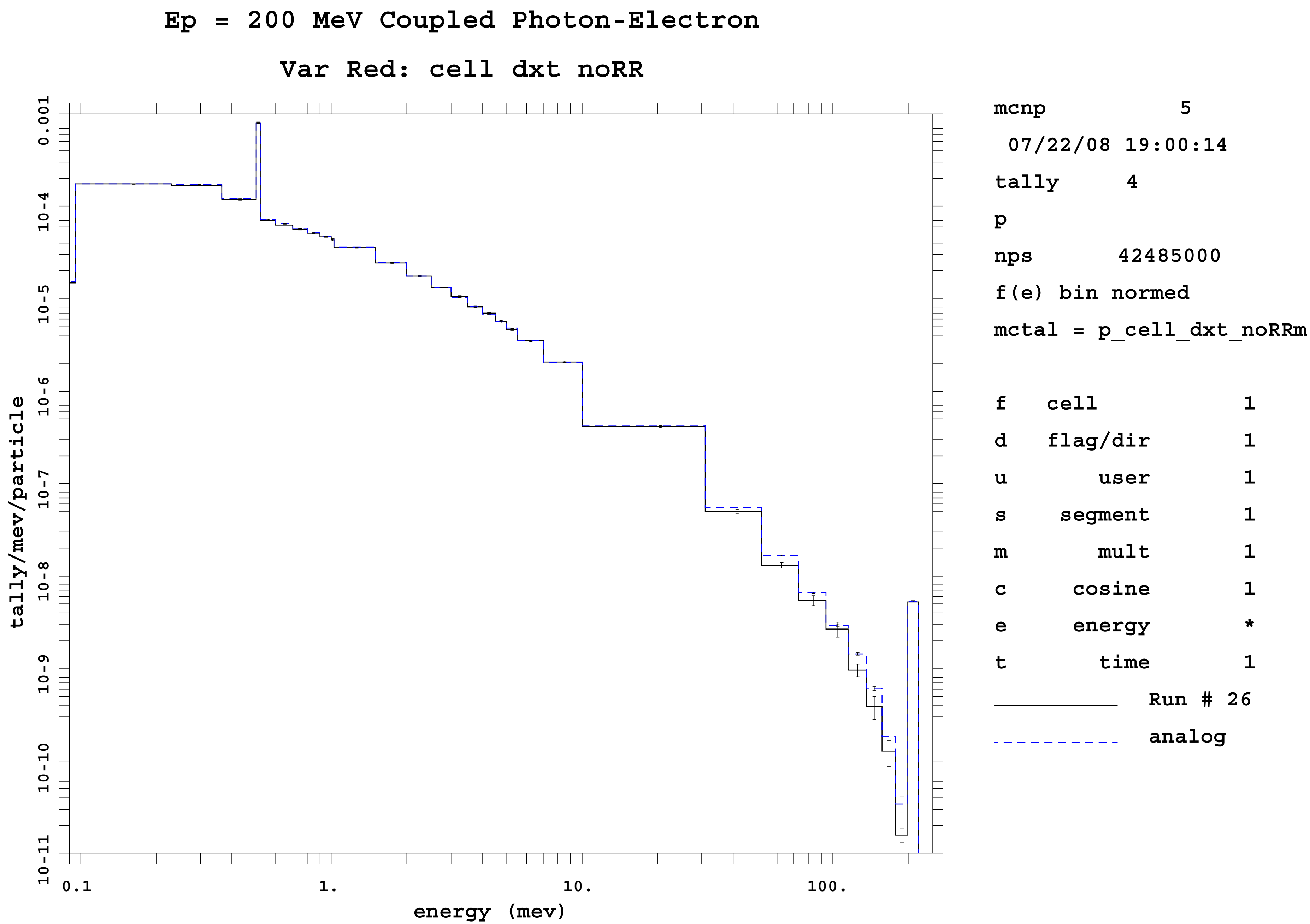


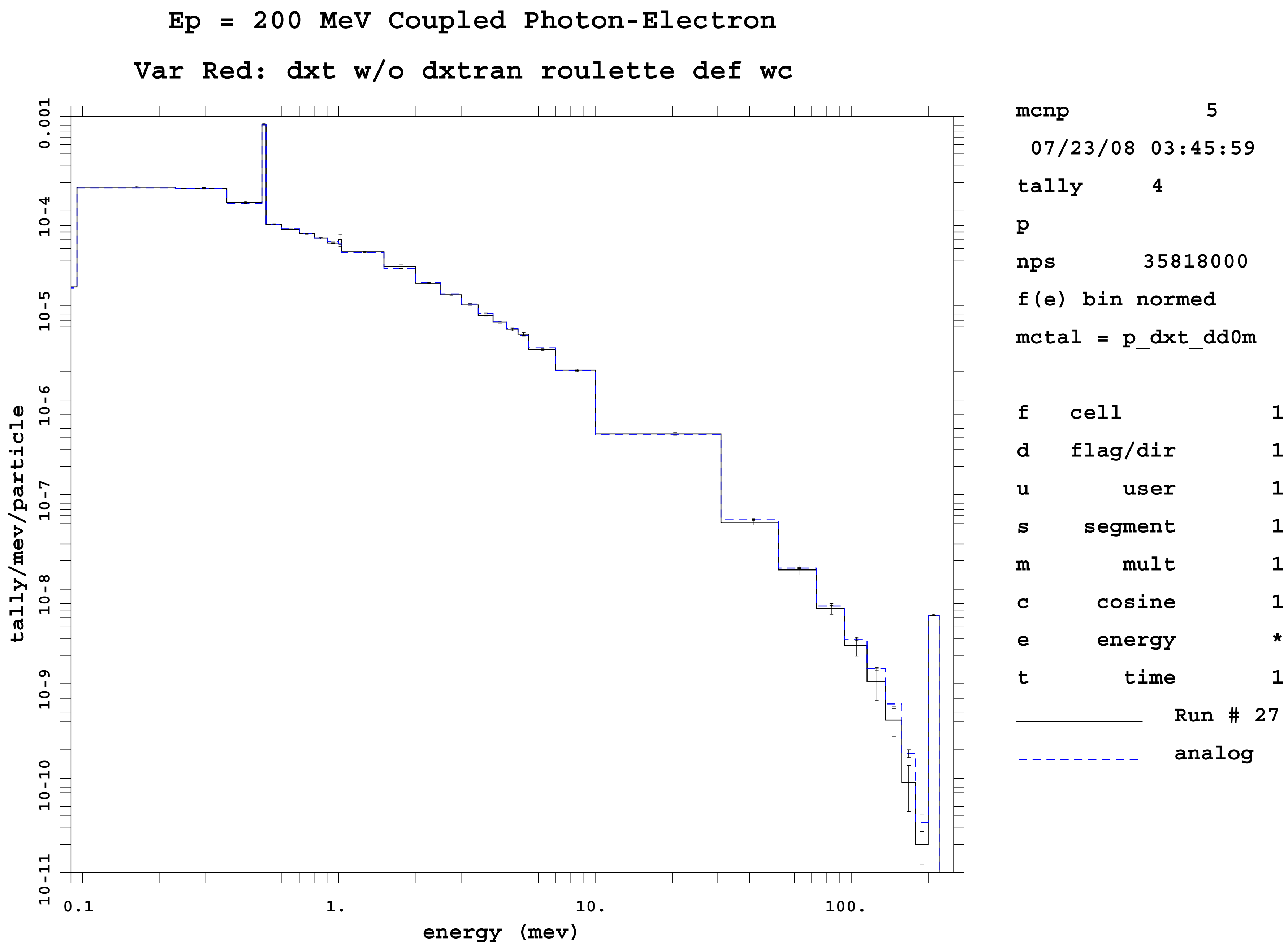
Ep = 200 MeV Coupled Photon-Electron
Var Red: mesh dxt noRR
tally/mev/particle
energy (mev)
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
mcnp 5
07/23/08 00:40:36
tally 4
p
nps 98304000
f(e) bin normed
mctal = p_mesh_dxt_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 24
analog

Ep = 200 MeV Coupled Photon-Electron

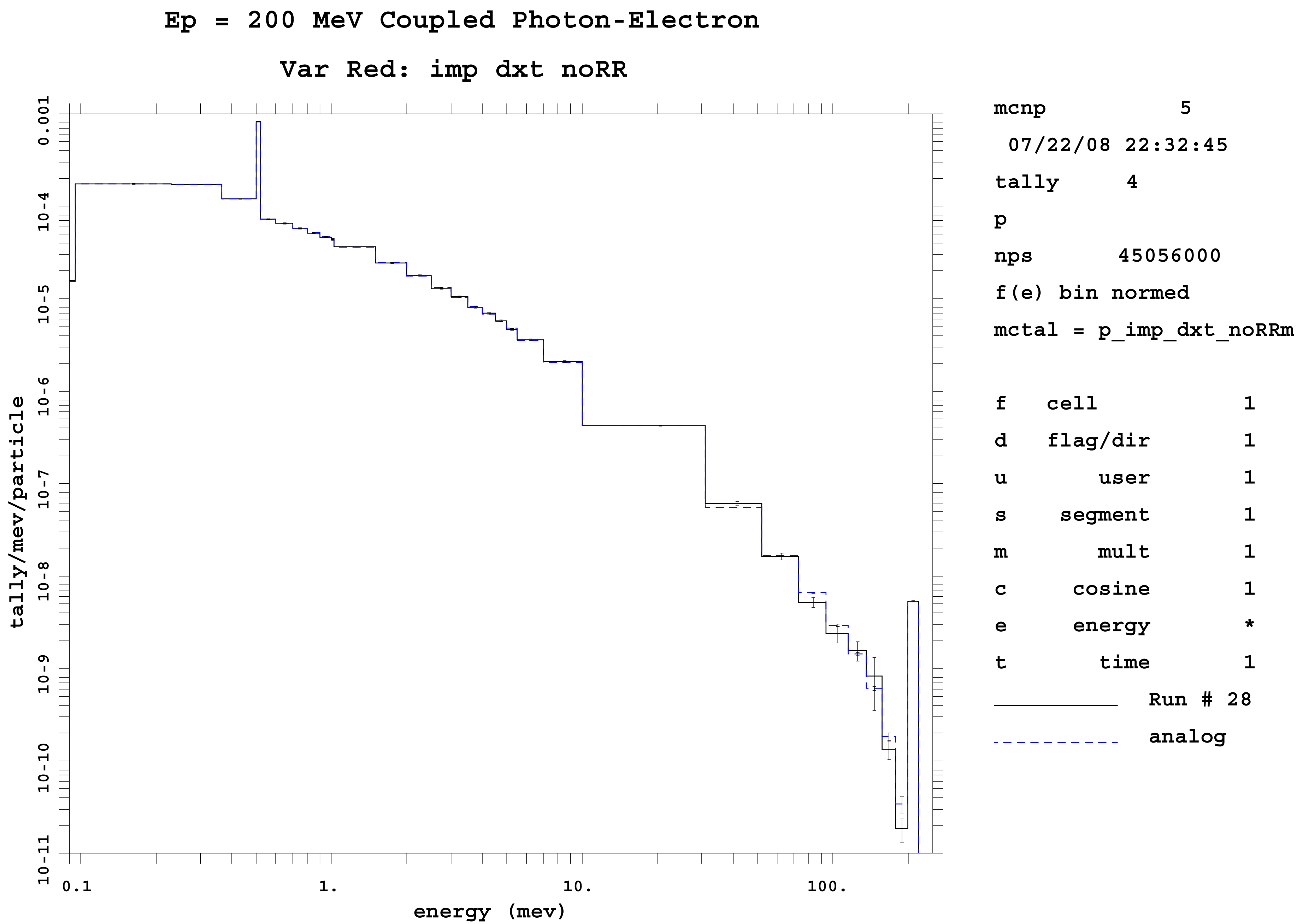
Var Red: cell dxt default wgt cutoff

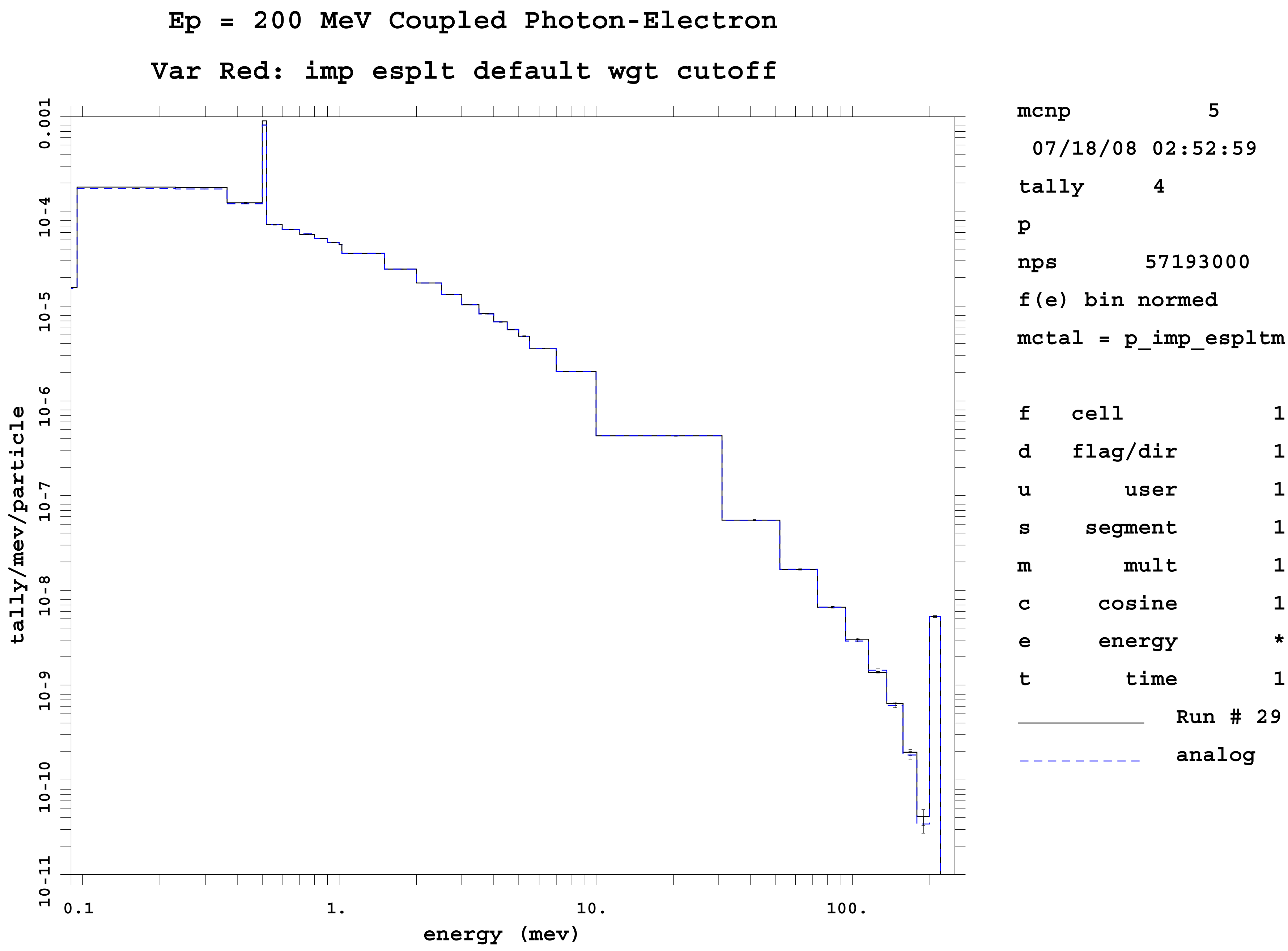


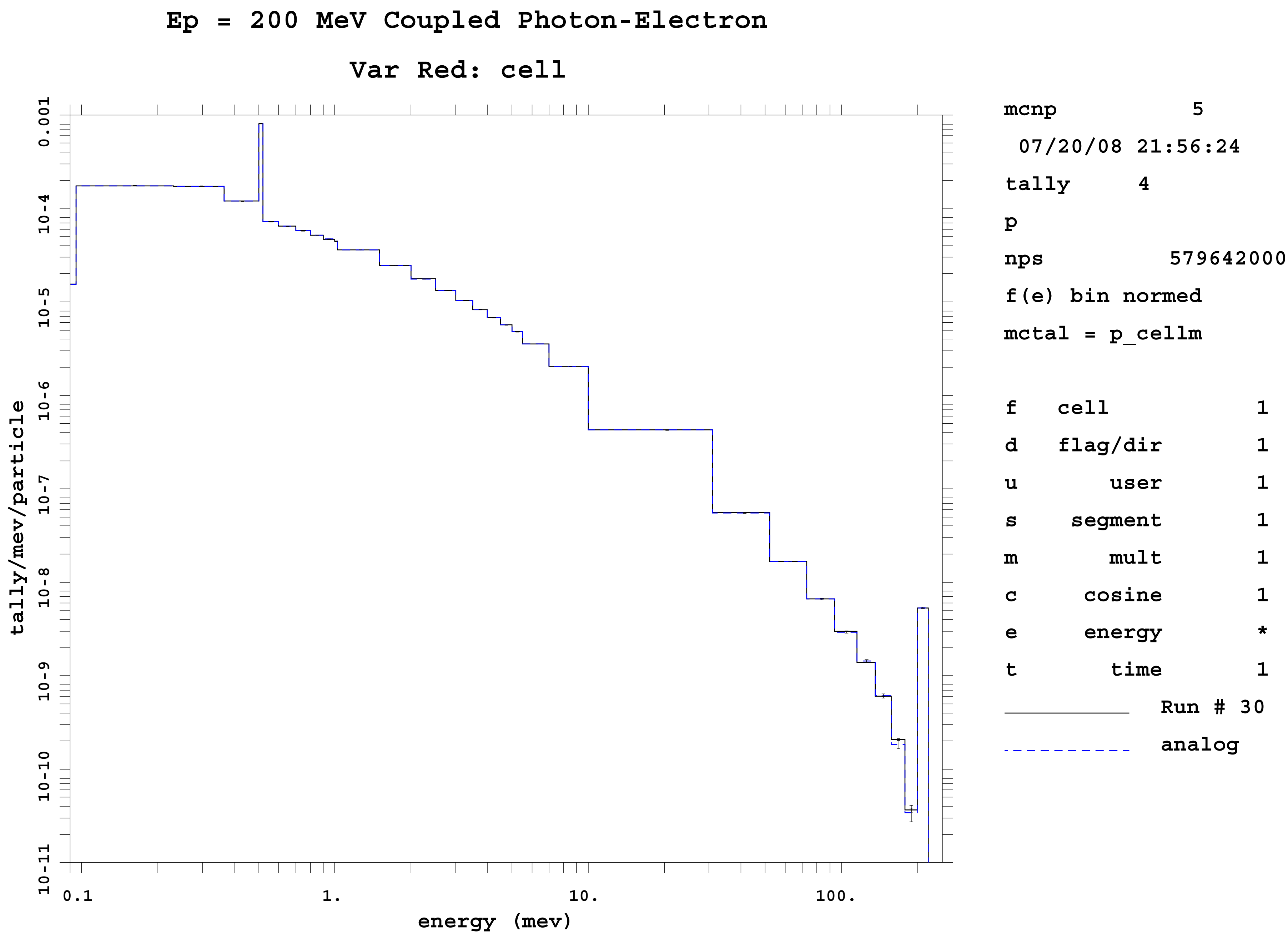

Ep = 200 MeV Coupled Photon-Electron
Var Red: cell dxt noRR
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/22/08 19:00:14
tally 4
p
nps 42485000
f(e) bin normed
mctal = p_cell_dxt_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 26
analog



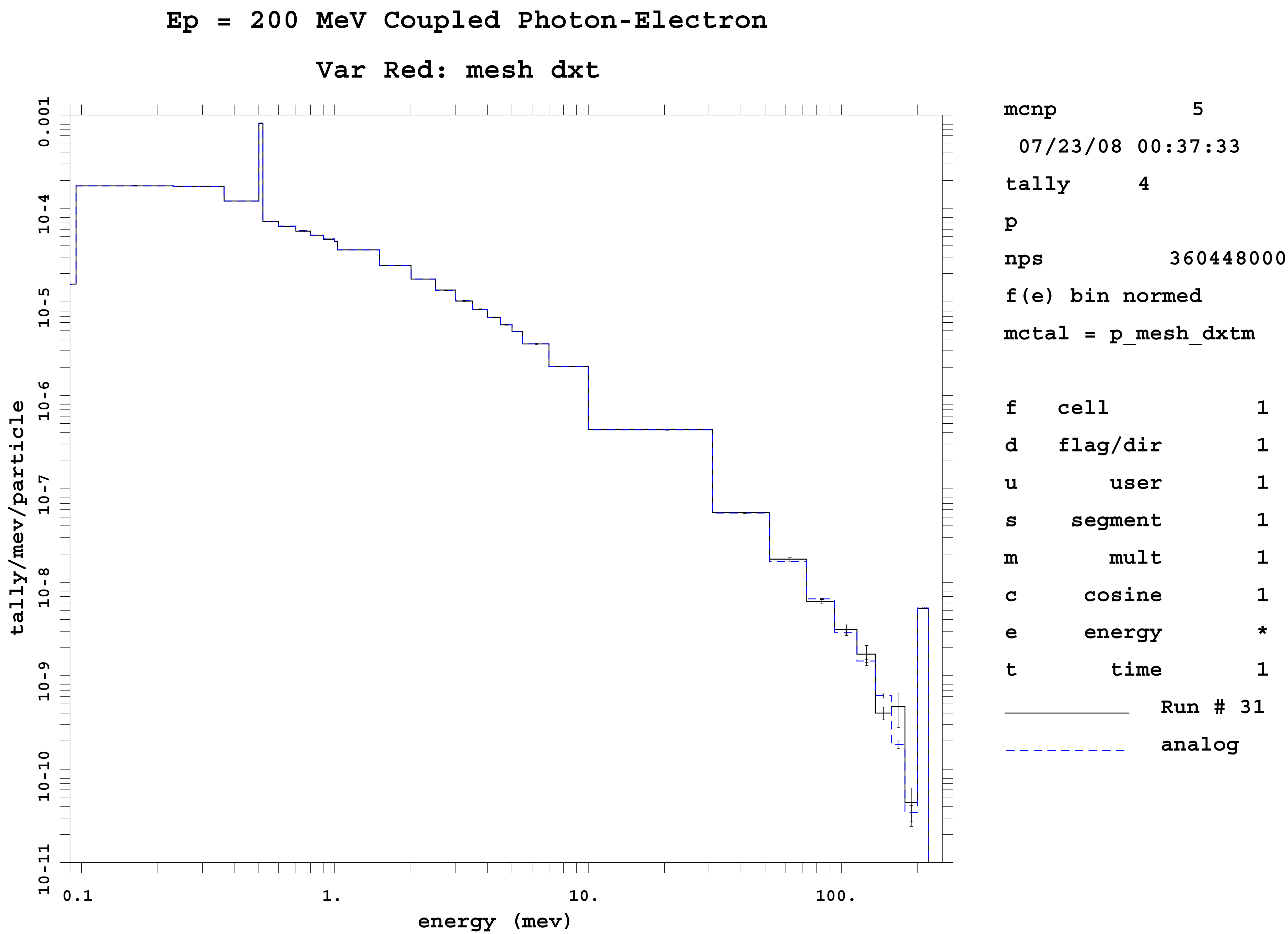
Ep = 200 MeV Coupled Photon-Electron
Var Red: dxt w/o dxtran roulette def wc
tally/mev/particle
energy (mev)
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
mcnp 5
07/23/08 03:45:59
tally 4
p
nps 35818000
f(e) bin normed
mctal = p_dxt_dd0m
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 27
analog


Ep = 200 MeV Coupled Photon-Electron
Var Red: imp dxt noRR
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/22/08 22:32:45
tally 4
p
nps 45056000
f(e) bin normed
mctal = p_imp_dxt_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 28
analog


Ep = 200 MeV Coupled Photon-Electron
Var Red: imp esplt default wgt cutoff
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/18/08 02:52:59
tally 4
p
nps 57193000
f(e) bin normed
mctal = p_imp_espltm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 29
analog



Ep = 200 MeV Coupled Photon-Electron
Var Red: cell
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/20/08 21:56:24
tally 4
p
nps 579642000
f(e) bin normed
mctal = p_cellm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 30
analog



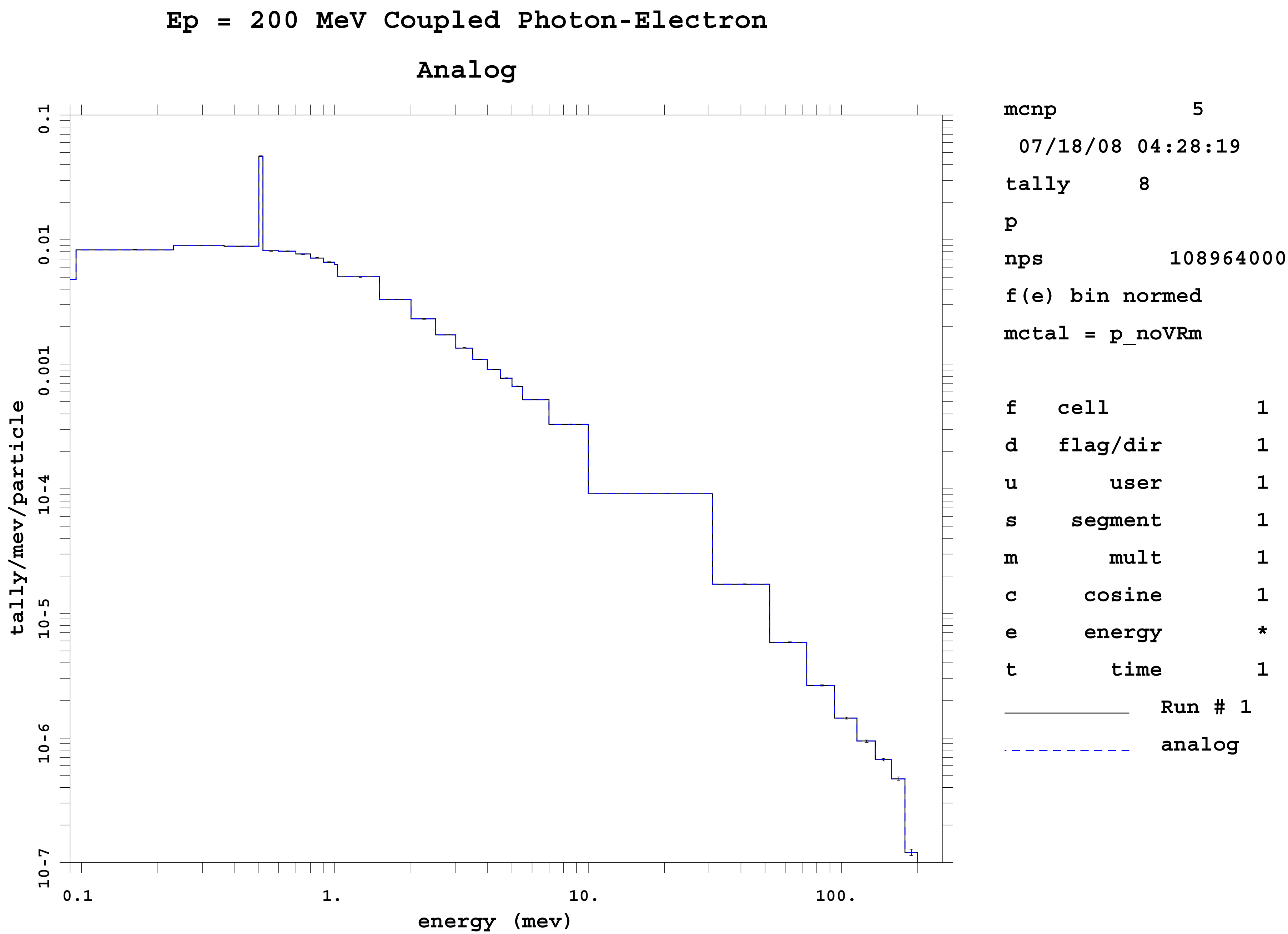
Ep = 200 MeV Coupled Photon-Electron
Var Red: mesh dxt
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/23/08 00:37:33
tally 4
p
nps 360448000
f(e) bin normed
mctal = p_mesh_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 31
analog

Appendix A.3.ii

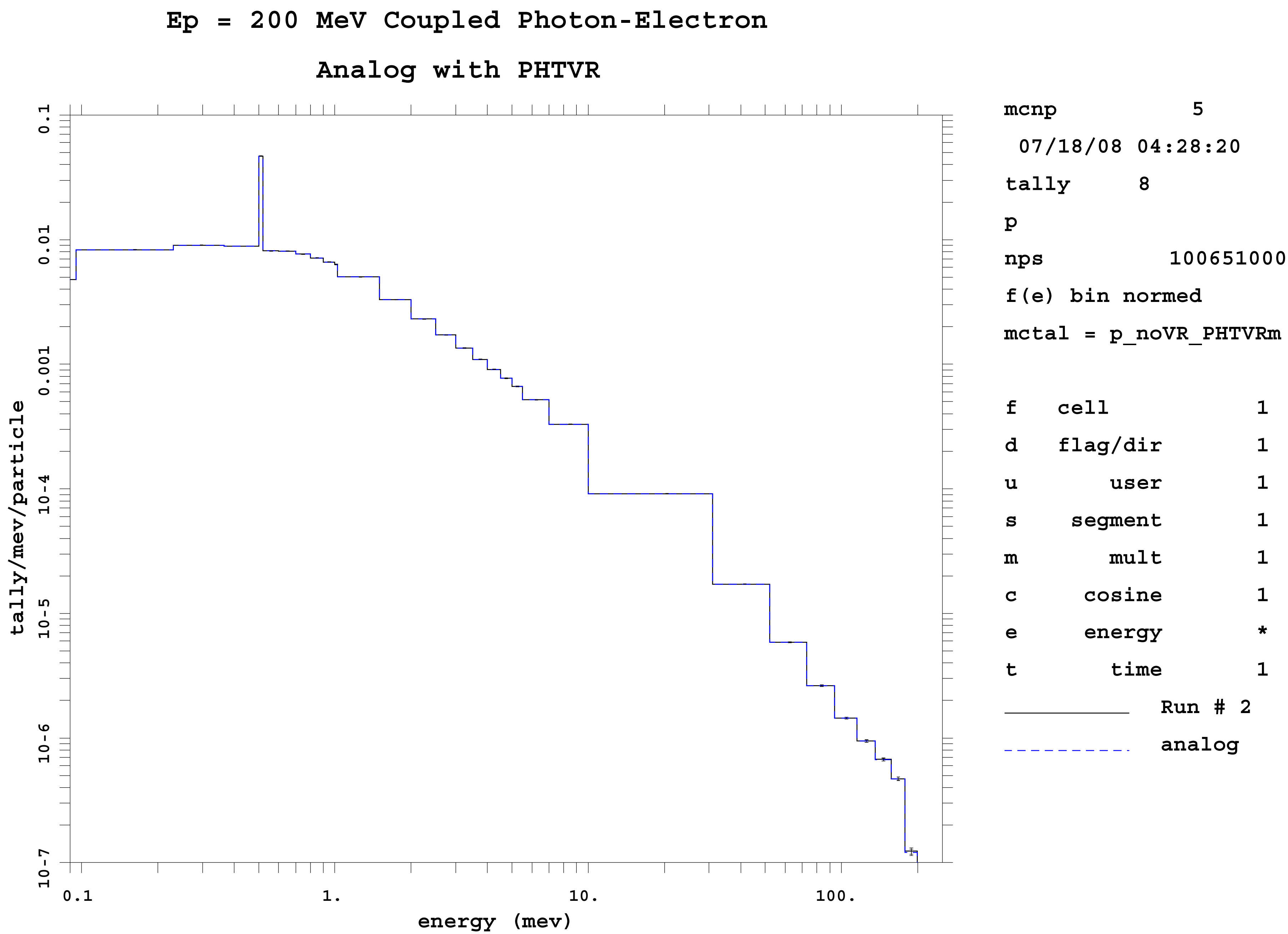
Problem 1
Ge sphere Next To a U / O Stacked Cylinder Problem

Plots of the pulse height tally spectra in the germanium sphere

Plots are in order of the run number listed in Table 4. The variance reduction methods used are listed in the plot title; the graph label contains the run number.

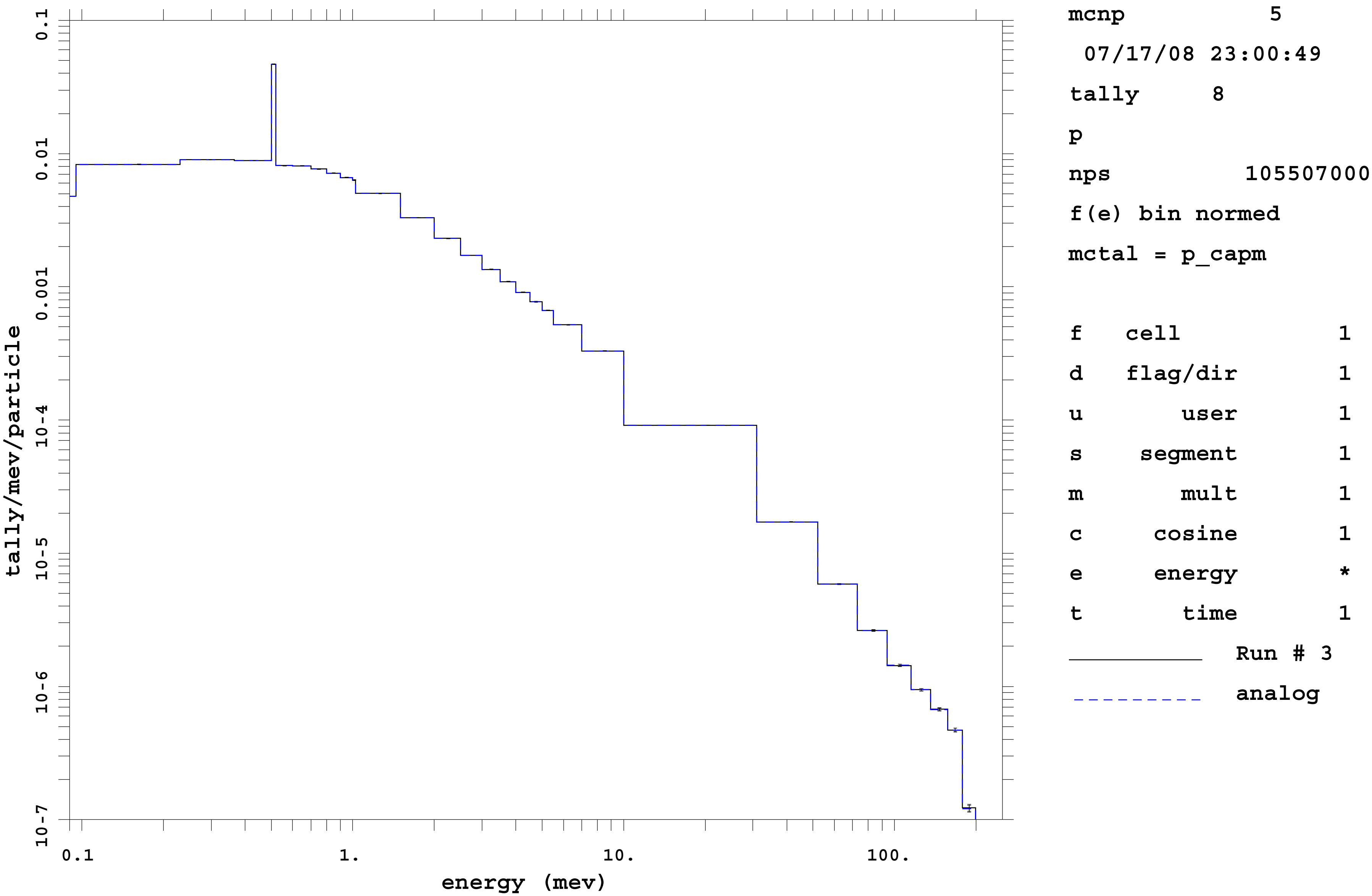


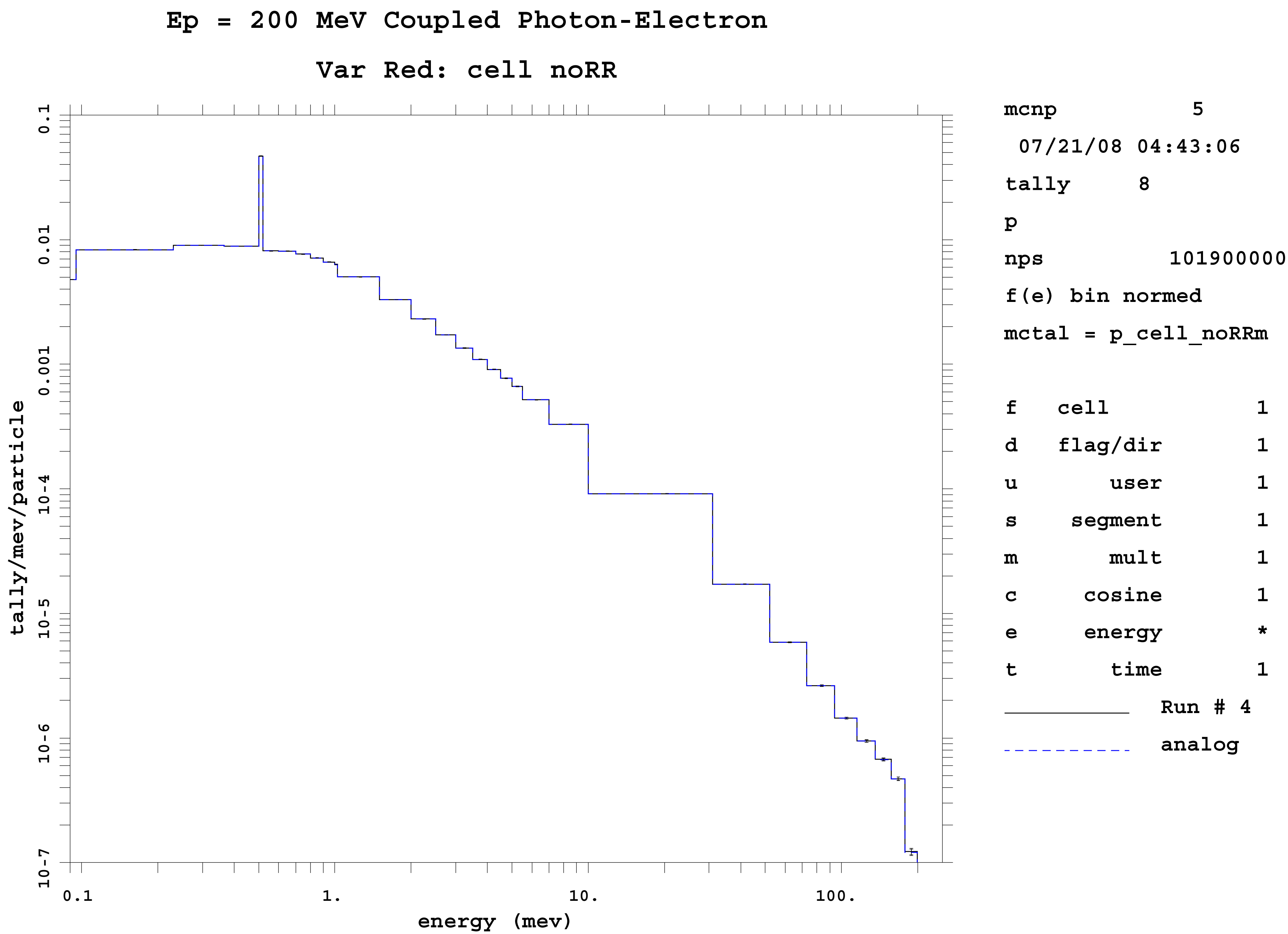
Ep = 200 MeV Coupled Photon-Electron
Analog
tally/mev/particle
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/18/08 04:28:19
tally 8
p
nps 108964000
f(e) bin normed
mctal = p_noVRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 1
analog

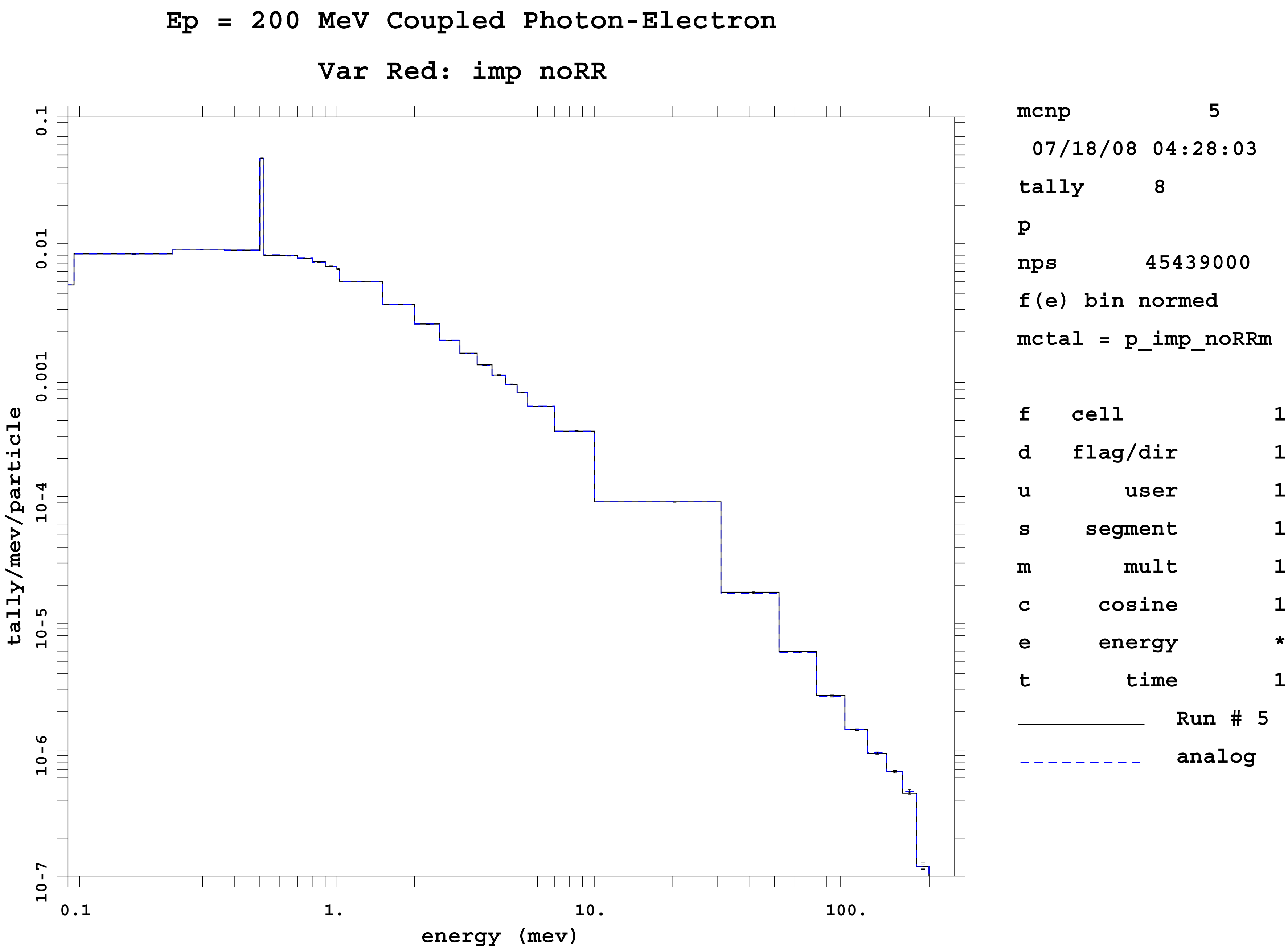

Ep = 200 MeV Coupled Photon-Electron
Analog with PHTVR
tally/mev/particle
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/18/08 04:28:20
tally 8
p
nps 100651000
f(e) bin normed
mctal = p_noVR_PHTVRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 2
analog

Ep = 200 MeV Coupled Photon-Electron

Var Red: weight cutoff

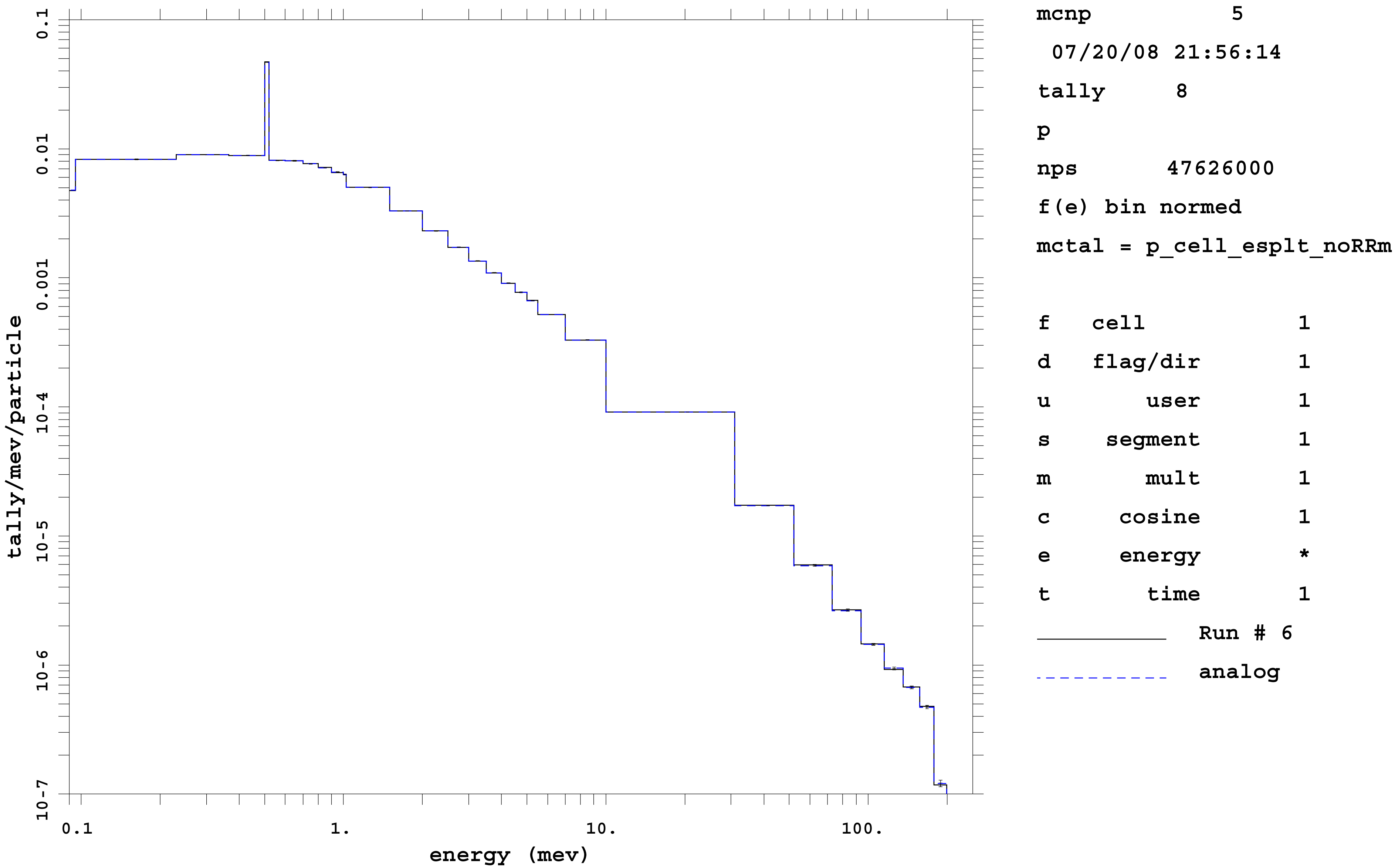


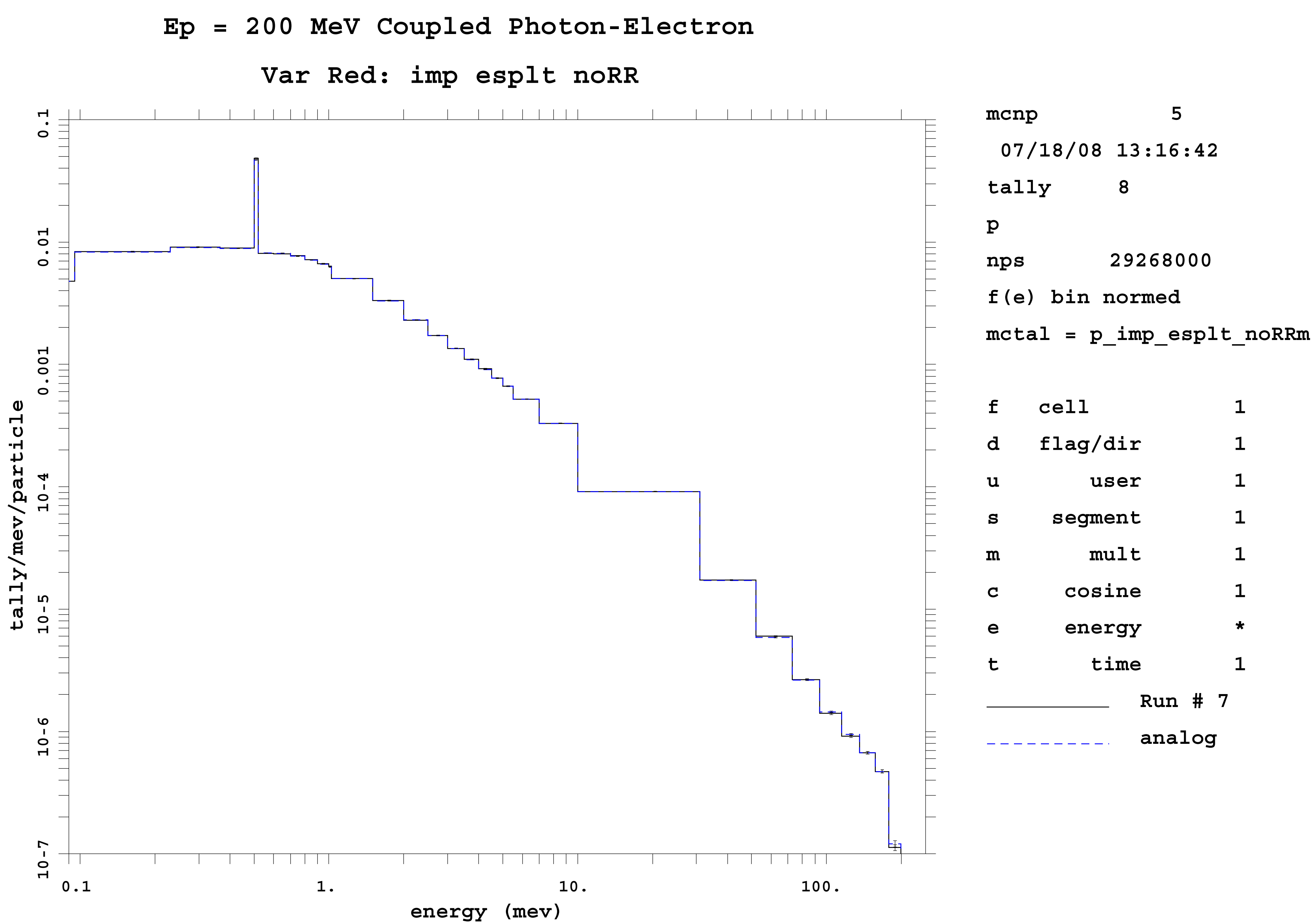

Ep = 200 MeV Coupled Photon-Electron
Var Red: cell noRR
tally/mev/particle
energy (mev)
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
mcnp 5
07/21/08 04:43:06
tally 8
p
nps 101900000
f(e) bin normed
mctal = p_cell_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 4
analog


Ep = 200 MeV Coupled Photon-Electron
Var Red: imp noRR
tally/mev/particle
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/18/08 04:28:03
tally 8
p
nps 45439000
f(e) bin normed
mctal = p_imp_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 5
analog

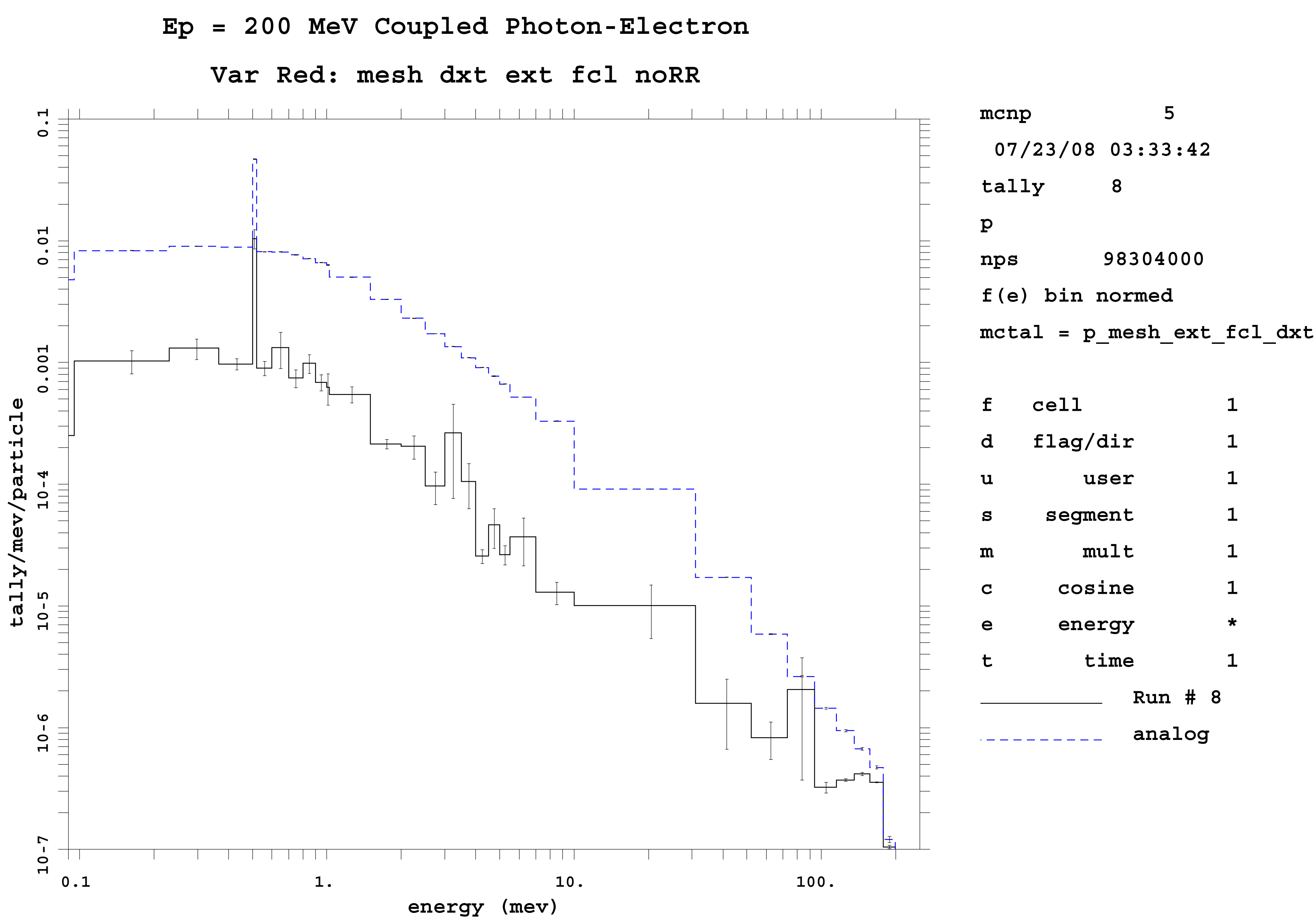
Ep = 200 MeV Coupled Photon-Electron

Var Red: cell esplt noRR





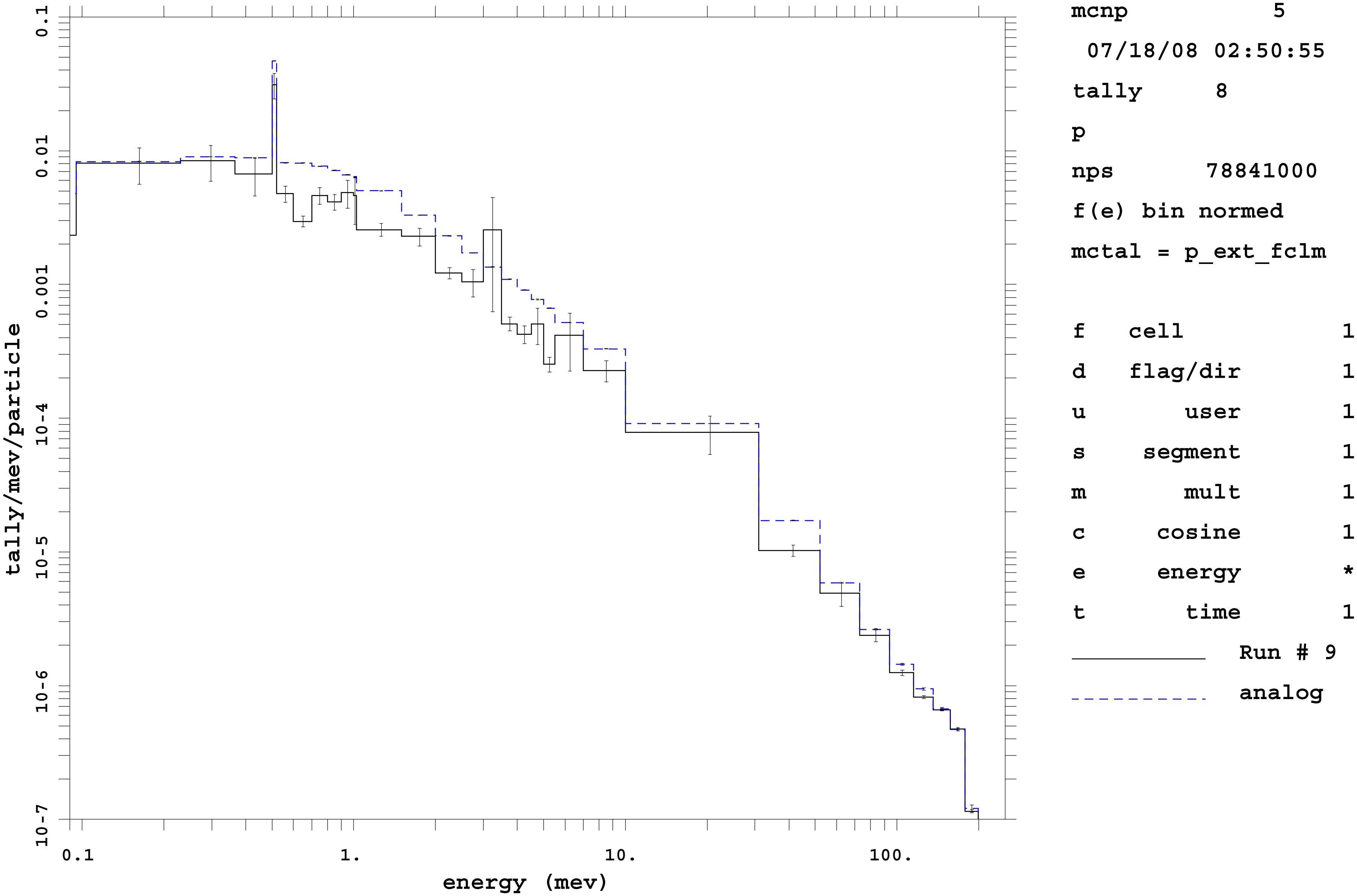
Ep = 200 MeV Coupled Photon-Electron
Var Red: imp esplt noRR
tally/mev/particle
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/18/08 13:16:42
tally 8
p
nps 29268000
f(e) bin normed
mctal = p_imp_esplt_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 7
analog

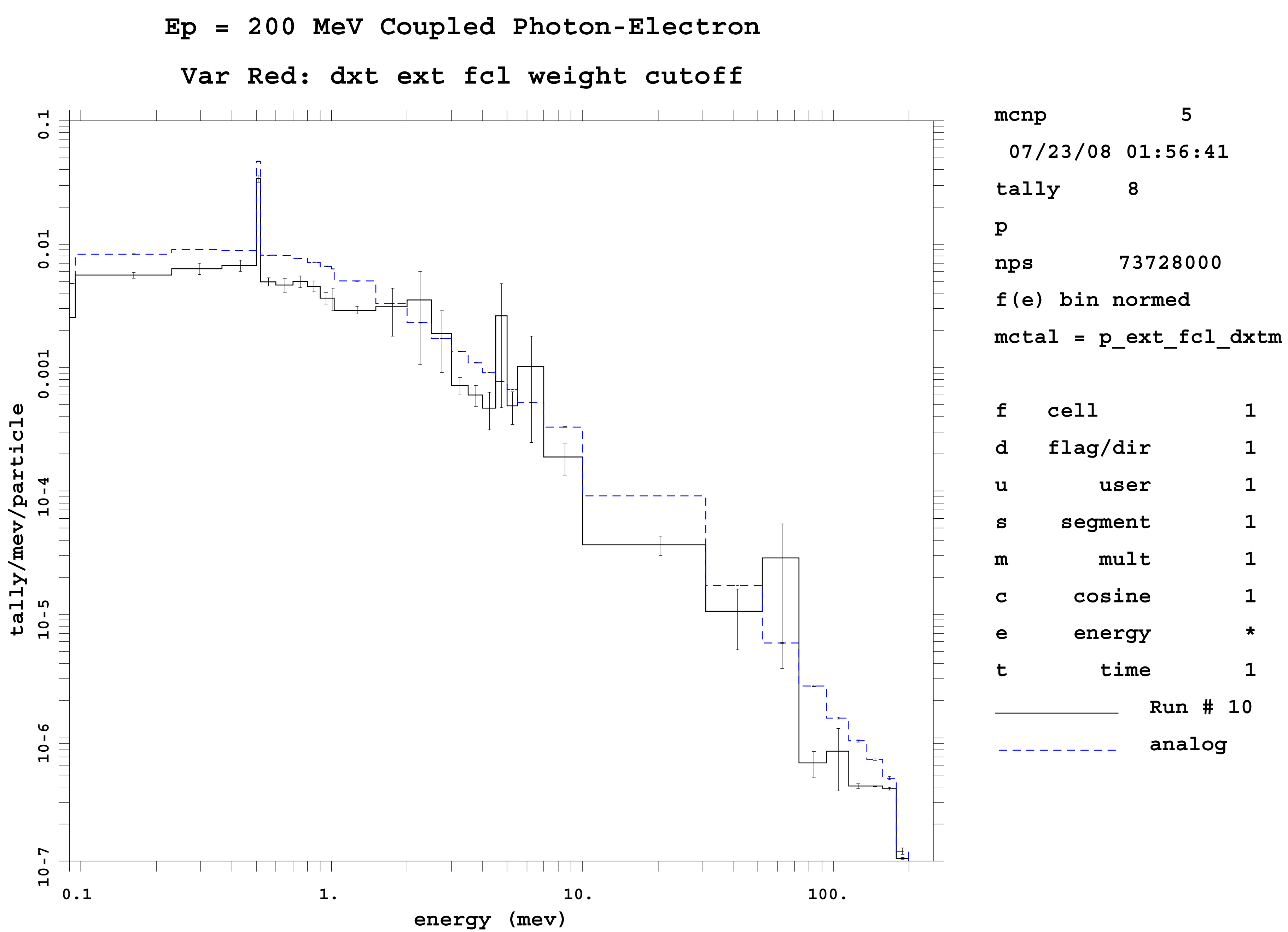


Ep = 200 MeV Coupled Photon-Electron
Var Red: mesh dxt ext fcl noRR
tally/mev/particle
energy (mev)
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
mcnp 5
07/23/08 03:33:42
tally 8
p
nps 98304000
f(e) bin normed
mctal = p_mesh_ext_fcl_dxt
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 8
analog

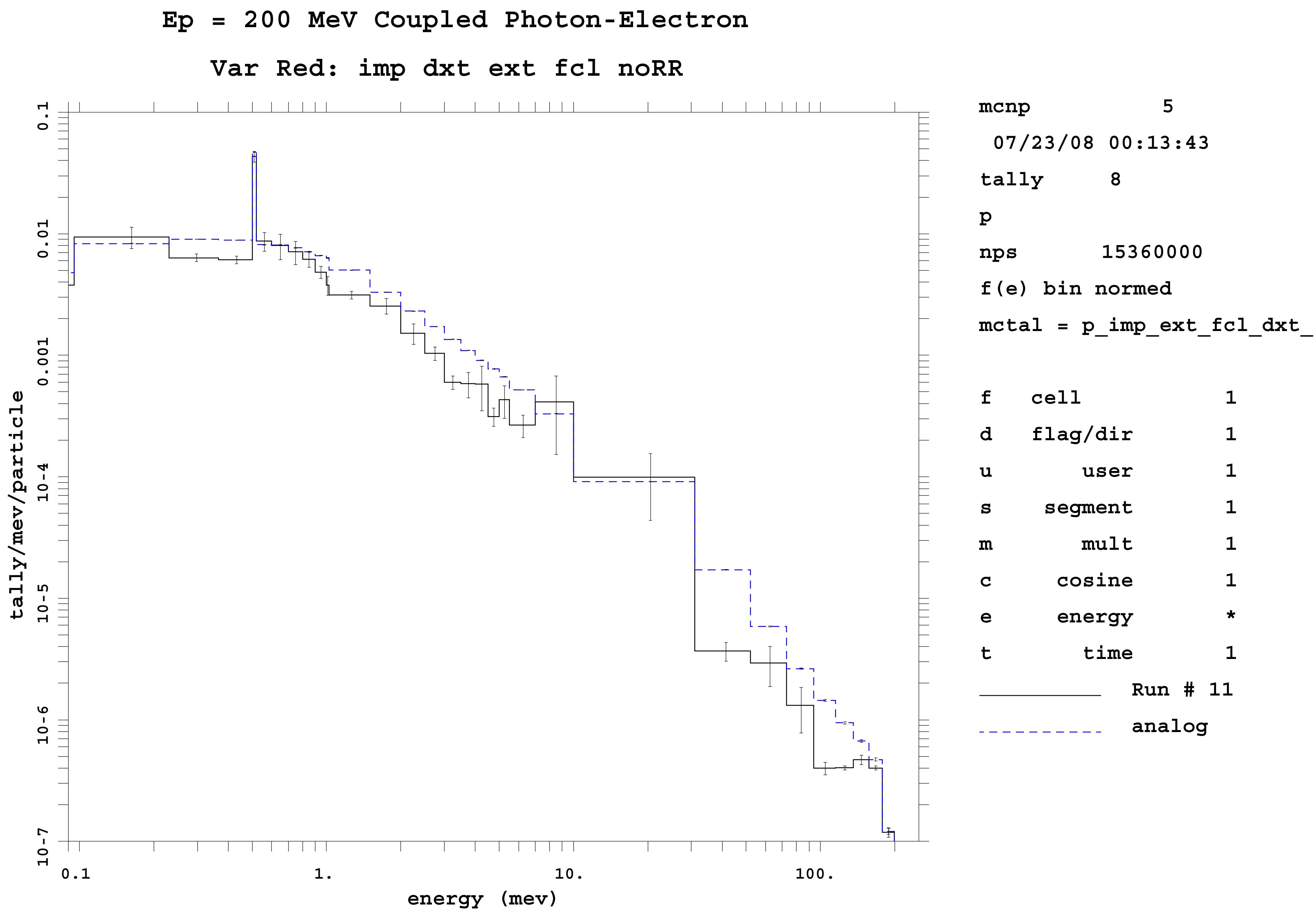
Ep = 200 MeV Coupled Photon-Electron

Var Red: ext fcl weight cutoff

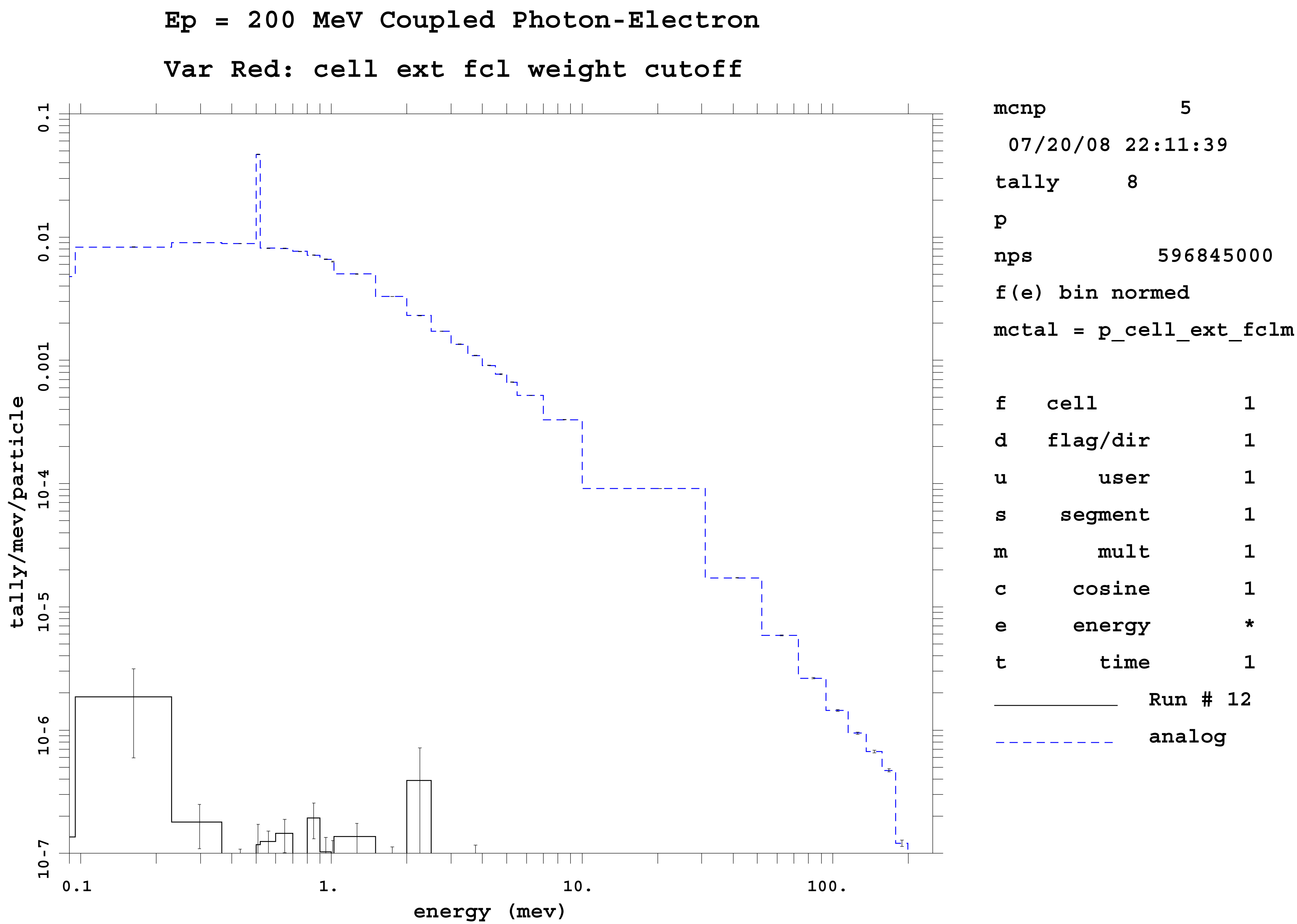


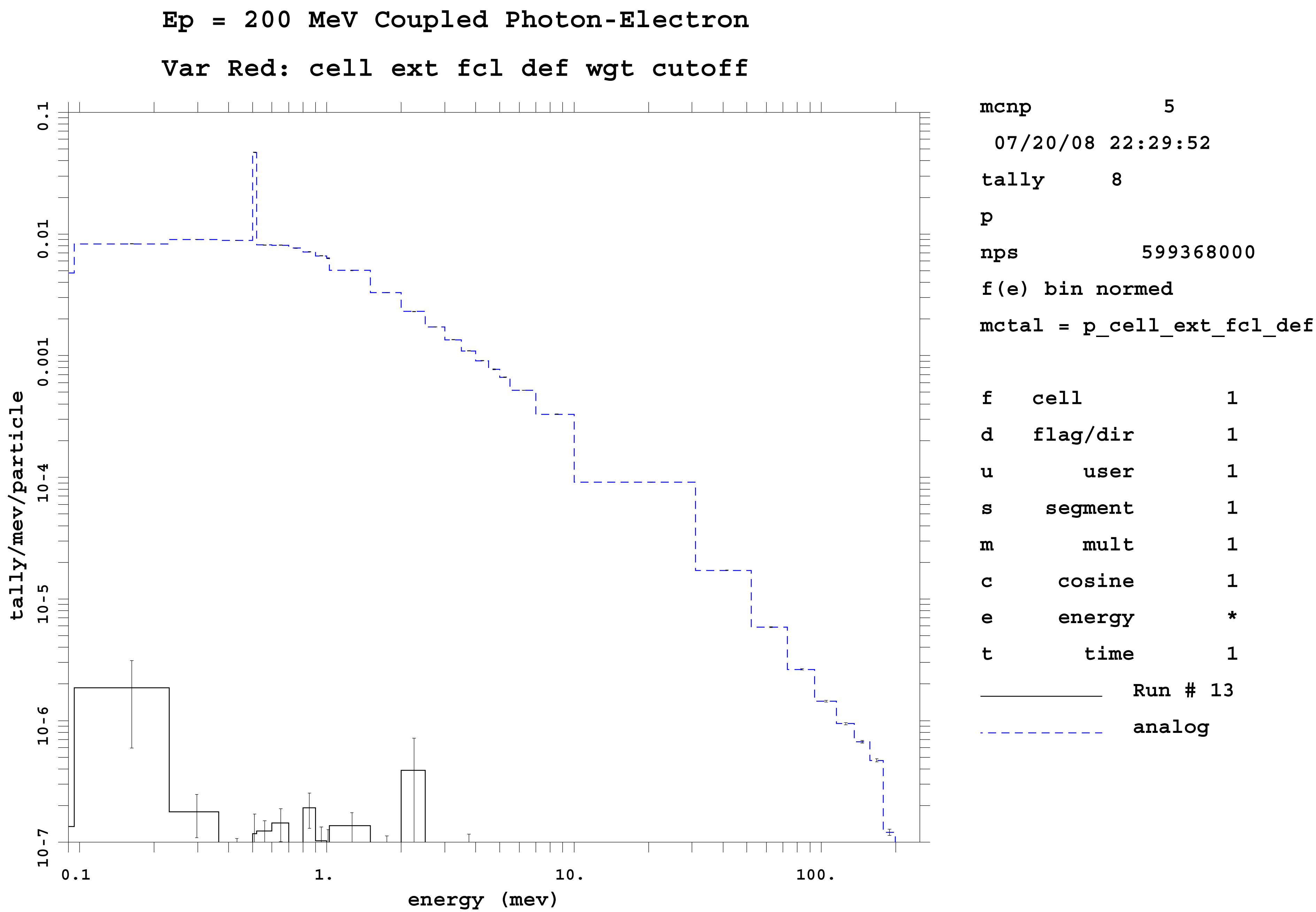


Ep = 200 MeV Coupled Photon-Electron
Var Red: dxt ext fcl weight cutoff
tally/mev/particle
energy (mev)
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
mcnp 5
07/23/08 01:56:41
tally 8
p
nps 73728000
f(e) bin normed
mctal = p_ext_fcl_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 10
analog

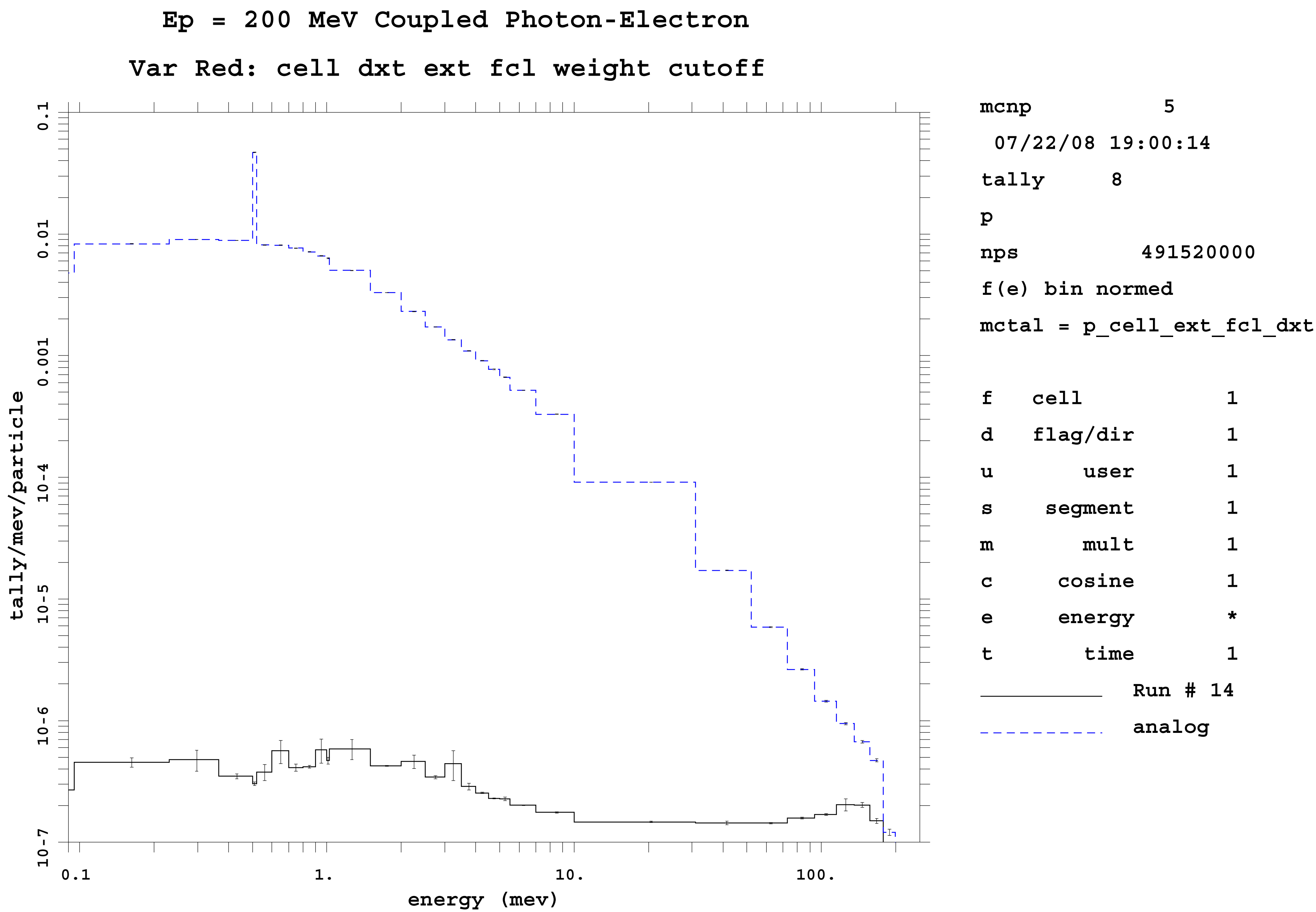


Ep = 200 MeV Coupled Photon-Electron
Var Red: imp dxt ext fcl noRR
tally/mev/particle
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/23/08 00:13:43
tally 8
p
nps 15360000
f(e) bin normed
mctal = p_imp_ext_fcl_dxt_
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 11
analog

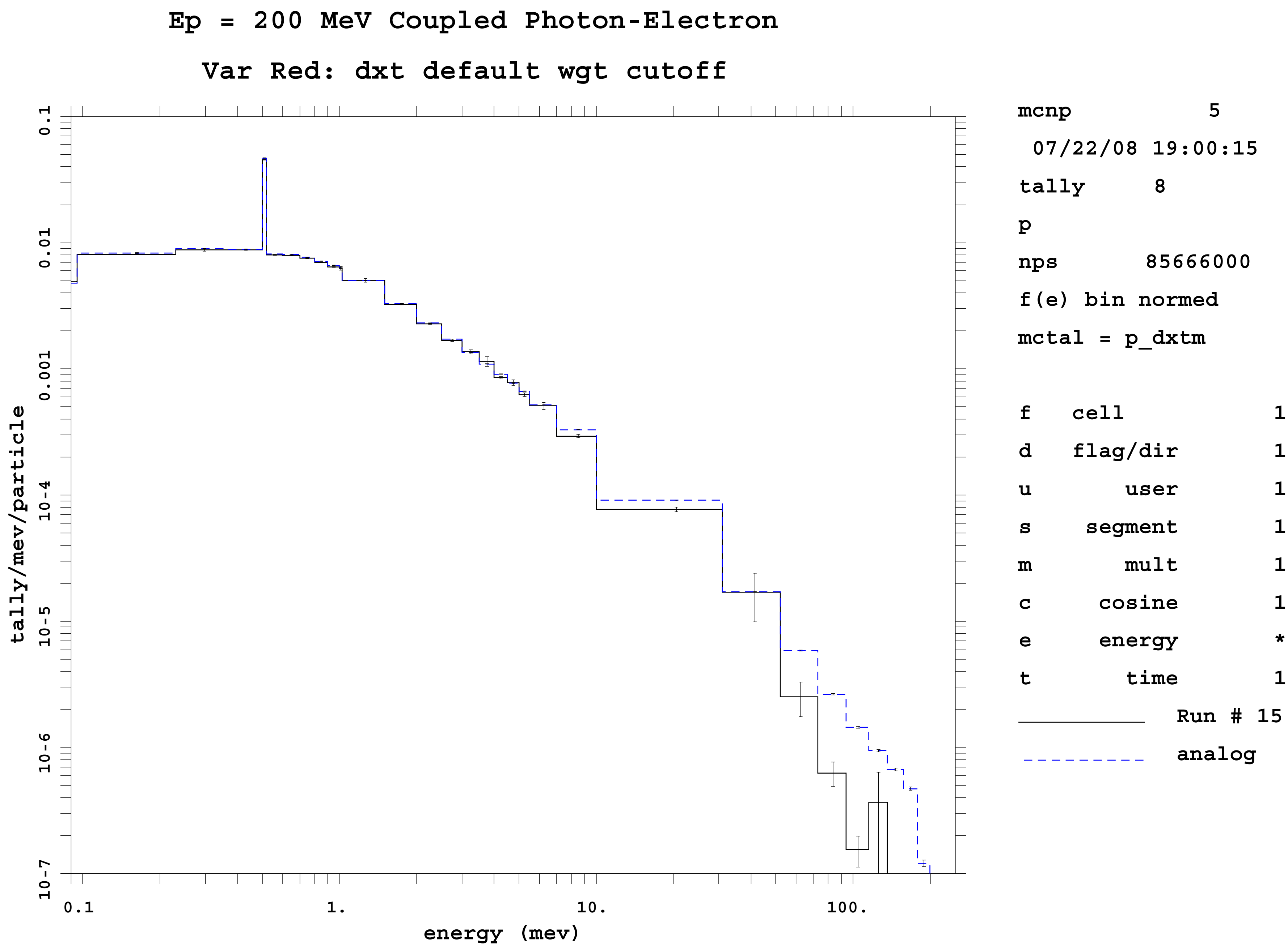

Ep = 200 MeV Coupled Photon-Electron
Var Red: cell ext fcl weight cutoff
0.1
0.01
0.001
10-4
10-5
10-6
10-7
tally/mev/particle
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/20/08 22:11:39
tally 8
p
nps 596845000
f(e) bin normed
mctal = p_cell_ext_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 12
analog



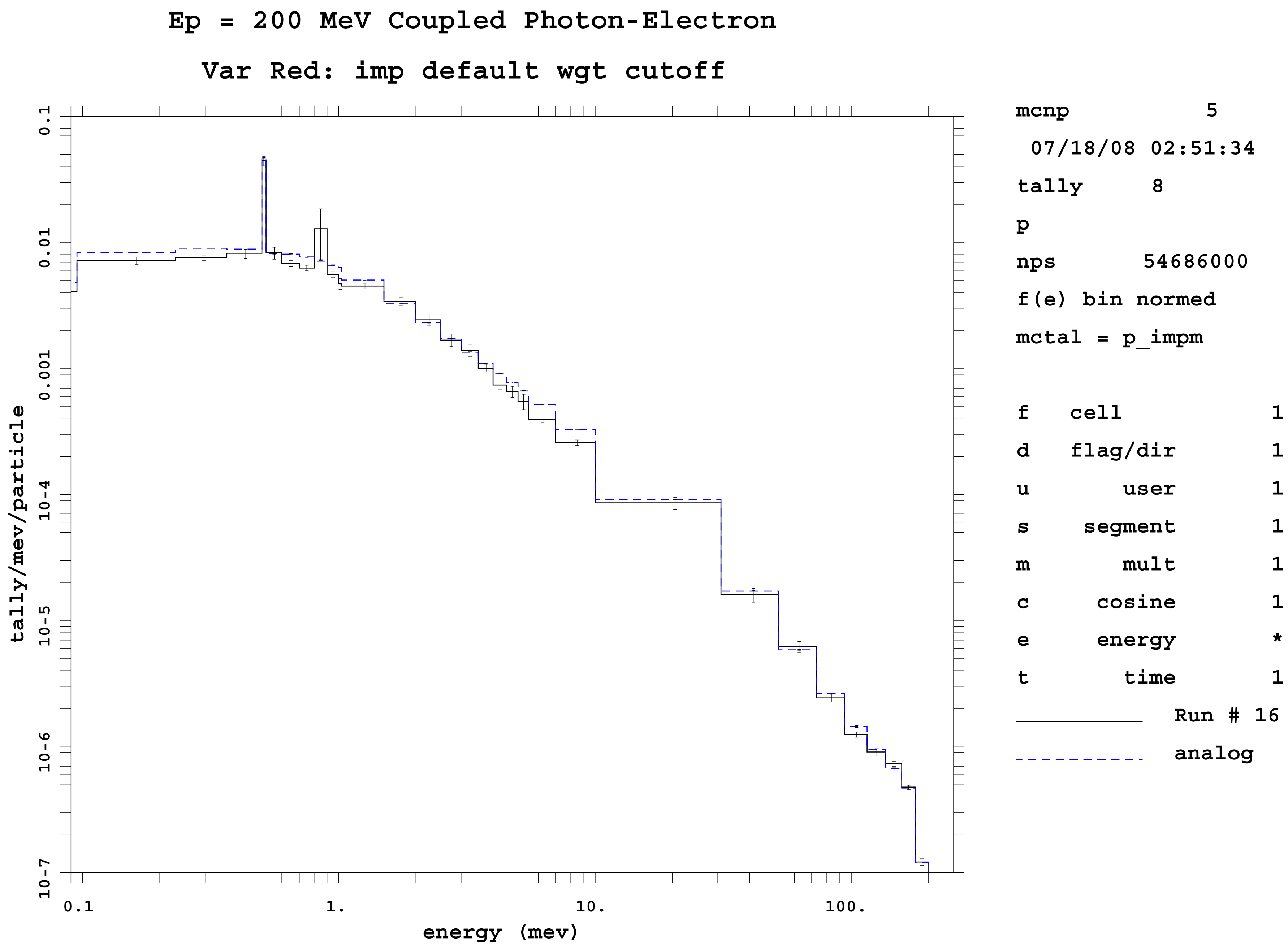
Ep = 200 MeV Coupled Photon-Electron
Var Red: cell ext fcl def wgt cutoff
tally/mev/particle
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/20/08 22:29:52
tally 8
p
nps 599368000
f(e) bin normed
mctal = p_cell_ext_fcl_def
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 13
analog



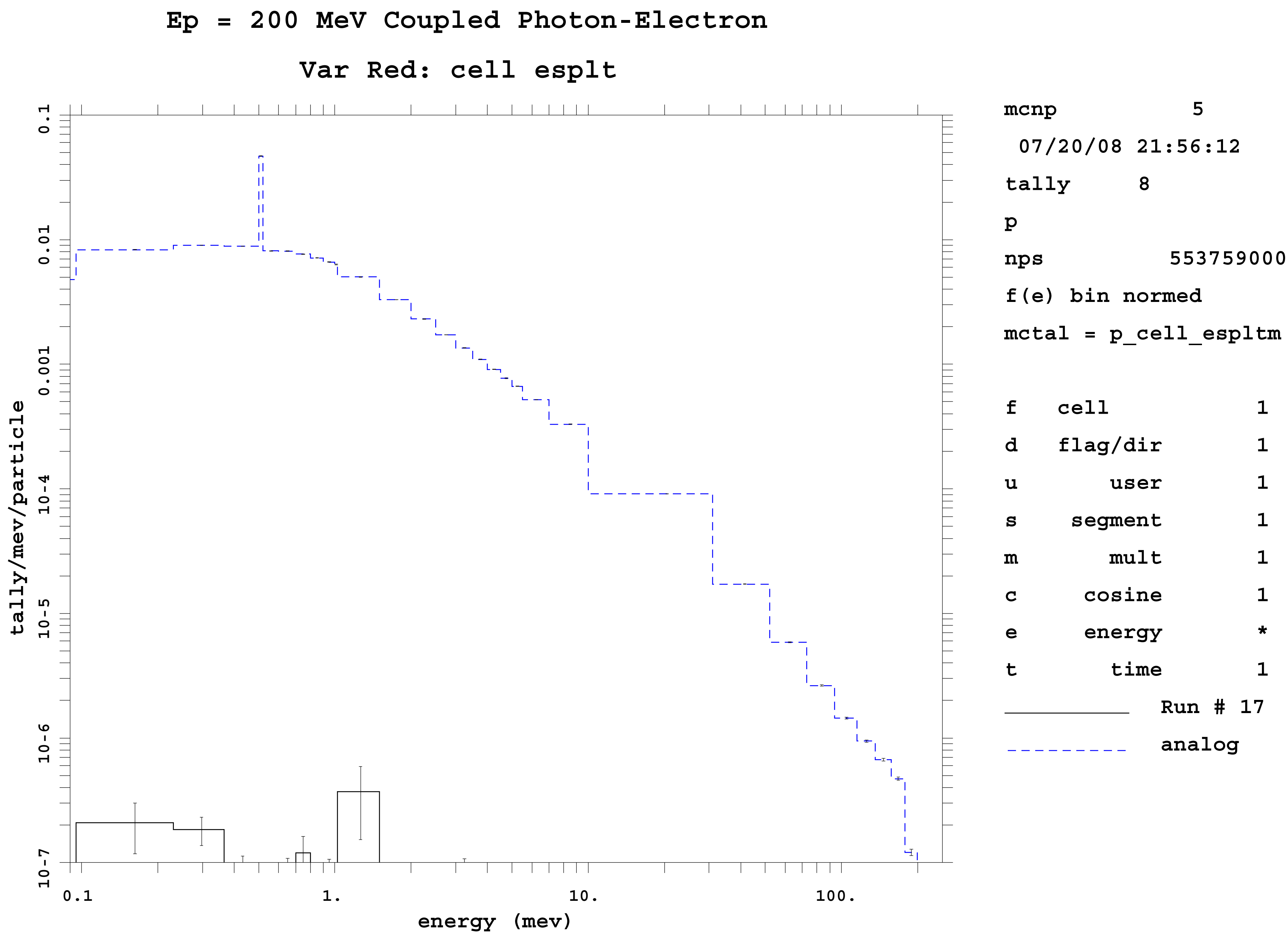
Ep = 200 MeV Coupled Photon-Electron
Var Red: cell dxt ext fcl weight cutoff
tally/mev/particle
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/22/08 19:00:14
tally 8
p
nps 491520000
f(e) bin normed
mctal = p_cell_ext_fcl_dxt
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 14
analog

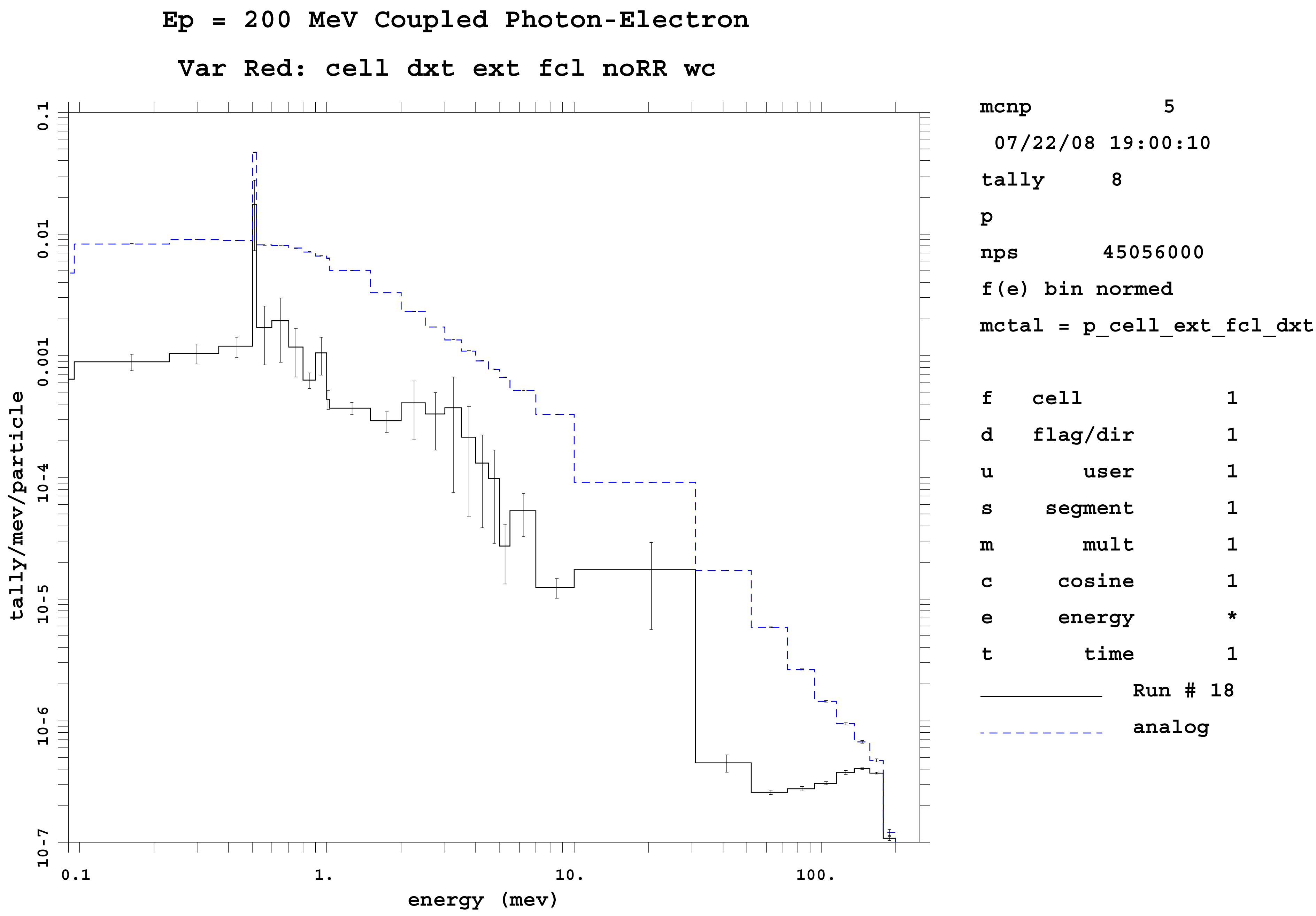


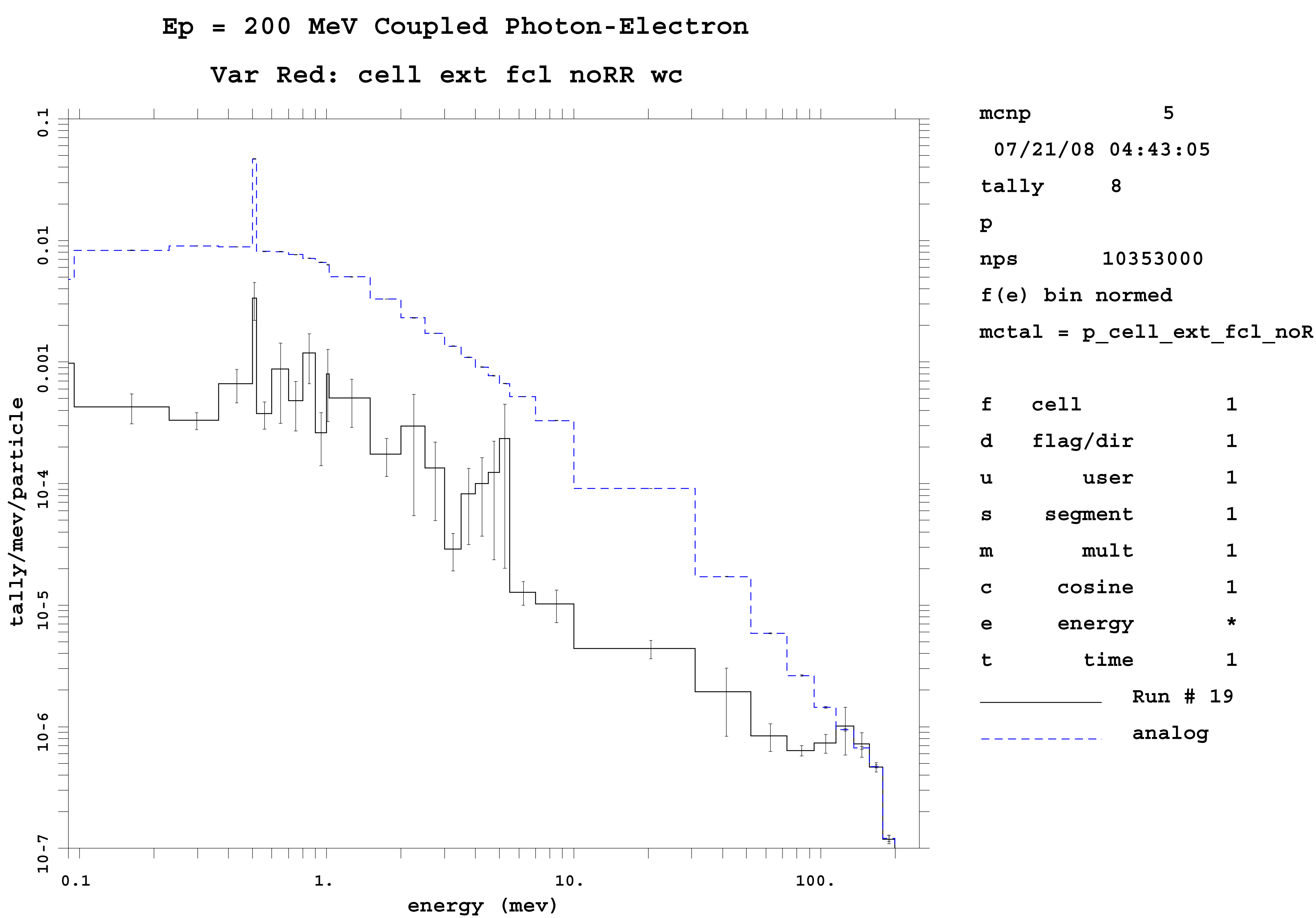
Ep = 200 MeV Coupled Photon-Electron
Var Red: dxt default wgt cutoff
tally/mev/particle
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/22/08 19:00:15
tally 8
p
nps 85666000
f(e) bin normed
mctal = p_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 15
analog



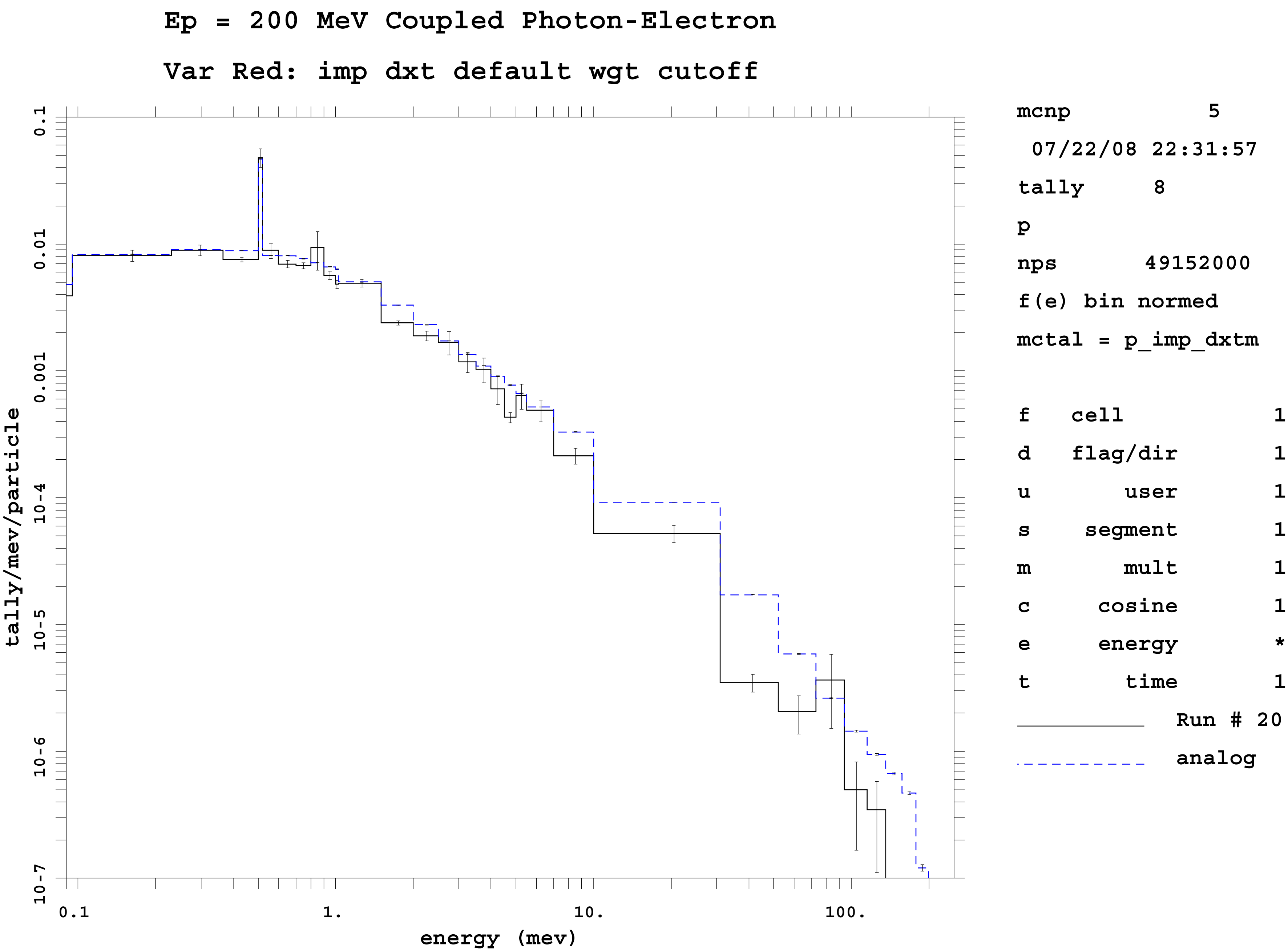
Ep = 200 MeV Coupled Photon-Electron
Var Red: imp default wgt cutoff
tally/mev/particle
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/18/08 02:51:34
tally 8
p
nps 54686000
f(e) bin normed
mctal = p_impm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 16
analog


Ep = 200 MeV Coupled Photon-Electron
Var Red: cell espl t
mcnp 5
07/20/08 21:56:12
tally 8
p
nps 553759000
f(e) bin normed
mctal = p_cell_espltm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 17
analog
tally/mev/particle
energy (mev)
0.1
1.
10.
100.
0.01
0.001
10-4
10-5
10-6
10-7

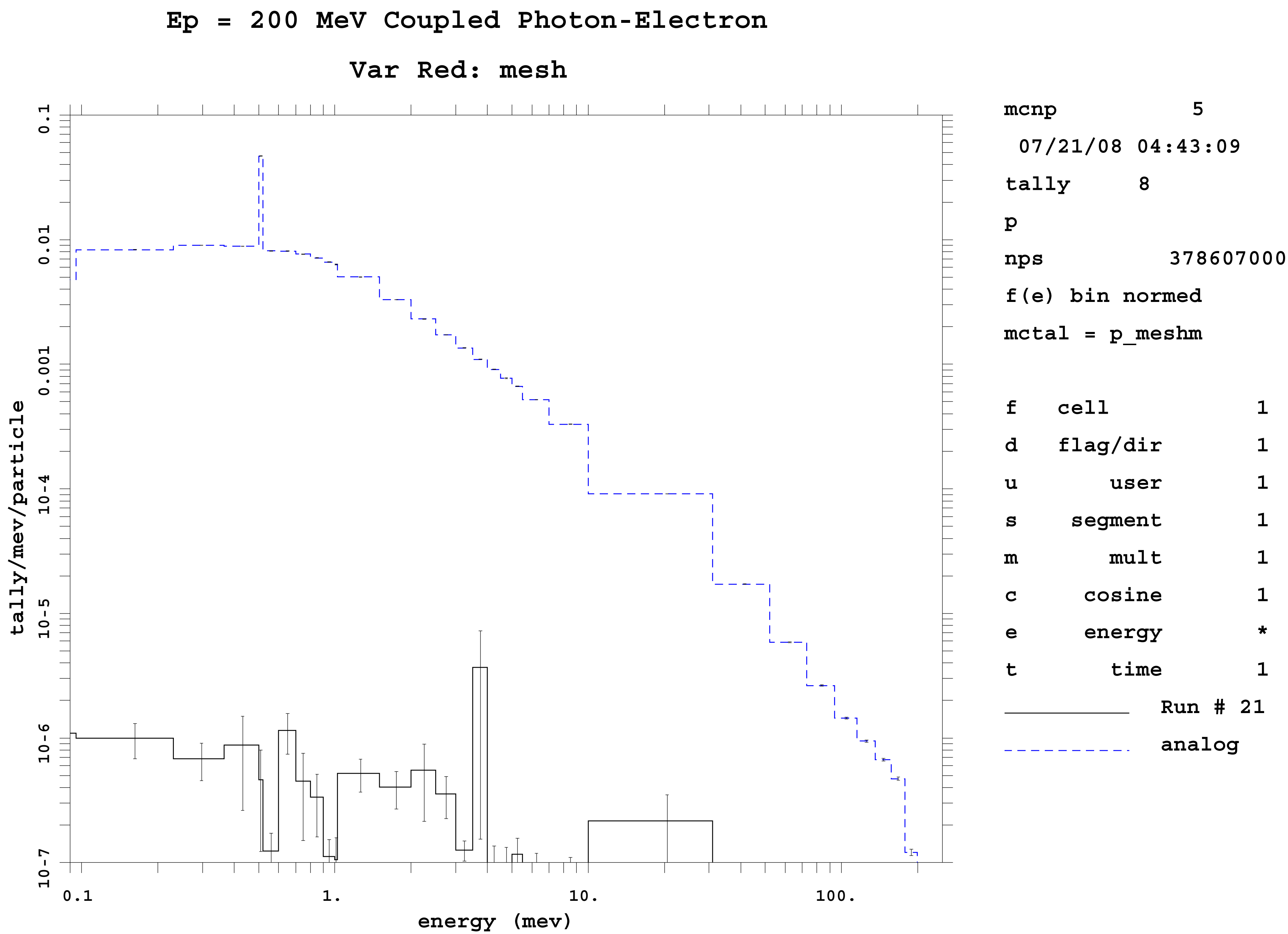

Ep = 200 MeV Coupled Photon-Electron
Var Red: cell dxt ext fcl noRR wc
tally/mev/particle
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/22/08 19:00:10
tally 8
p
nps 45056000
f(e) bin normed
mctal = p_cell_ext_fcl_dxt
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 18
analog



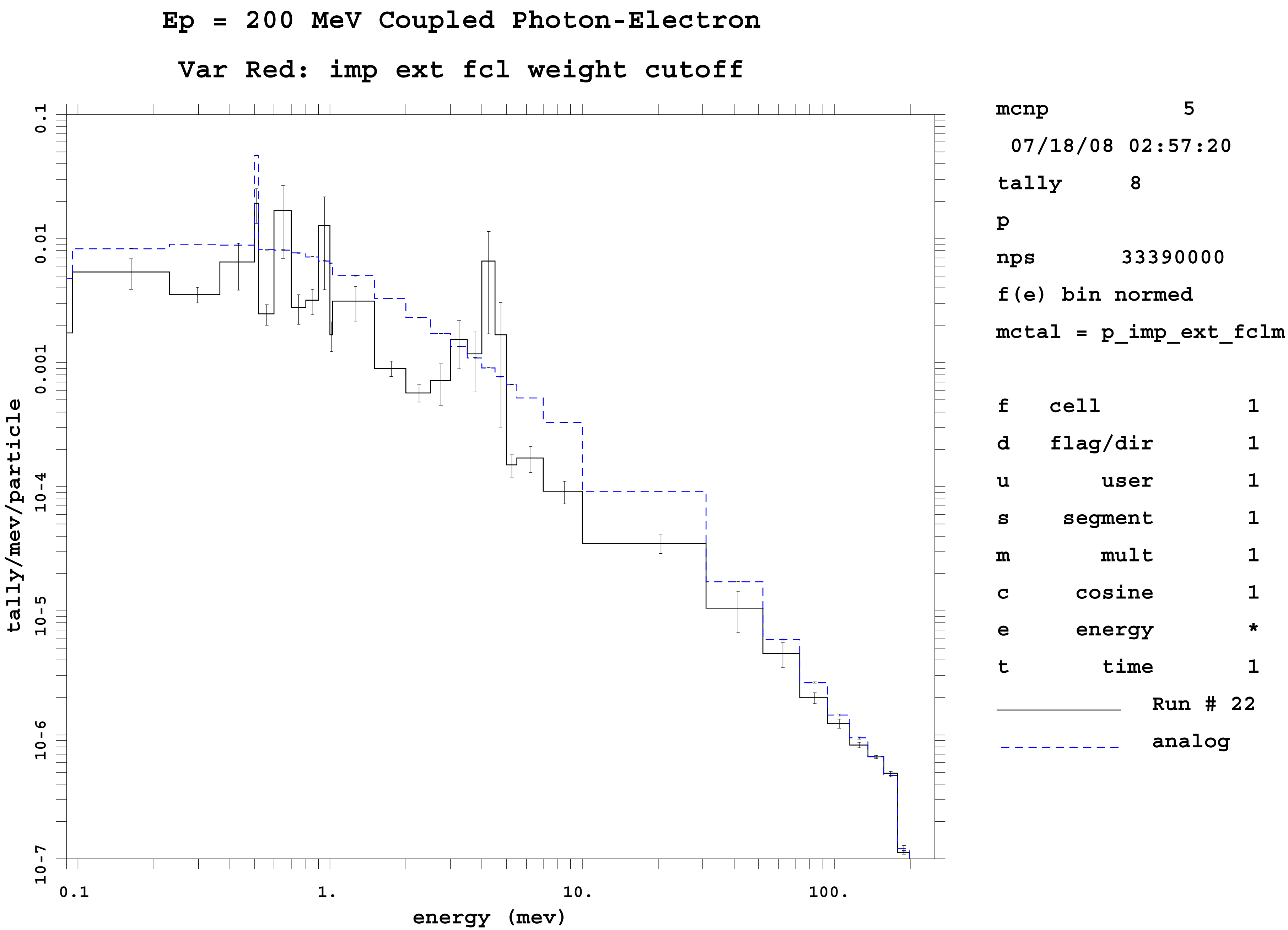
Ep = 200 MeV Coupled Photon-Electron
Var Red: cell ext fcl noRR wc
tally/mev/particle
energy (mev)
0.1
0.01
0.001
10-4
10-5
10-6
10-7
1.
10.
100.
mcnp 5
07/21/08 04:43:05
tally 8
p
nps 10353000
f(e) bin normed
mctal = p_cell_ext_fcl_noR
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 19
analog



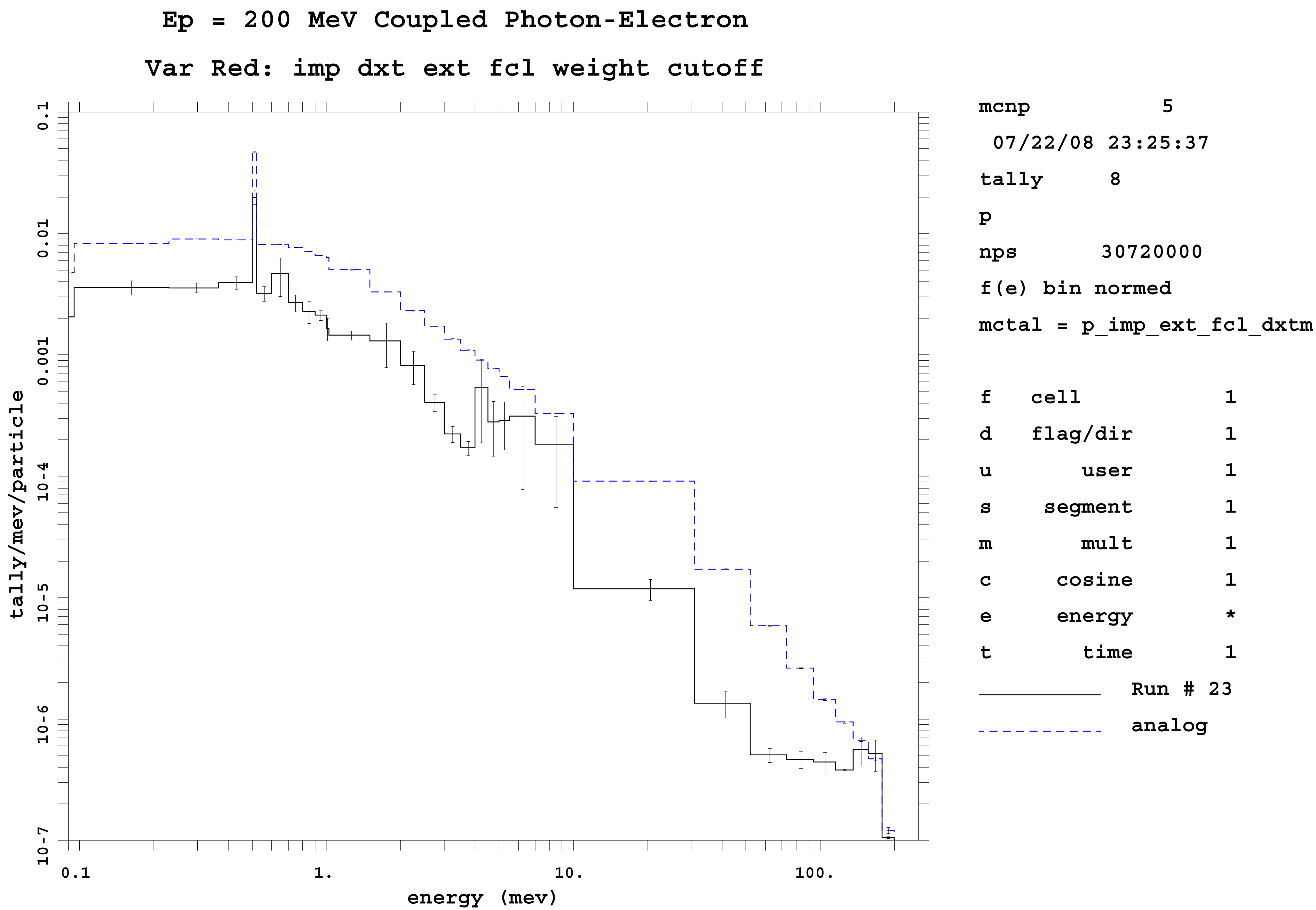
Ep = 200 MeV Coupled Photon-Electron
Var Red: imp dxt default wgt cutoff
tally/mev/particle
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/22/08 22:31:57
tally 8
p
nps 49152000
f(e) bin normed
mctal = p_imp_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 20
analog



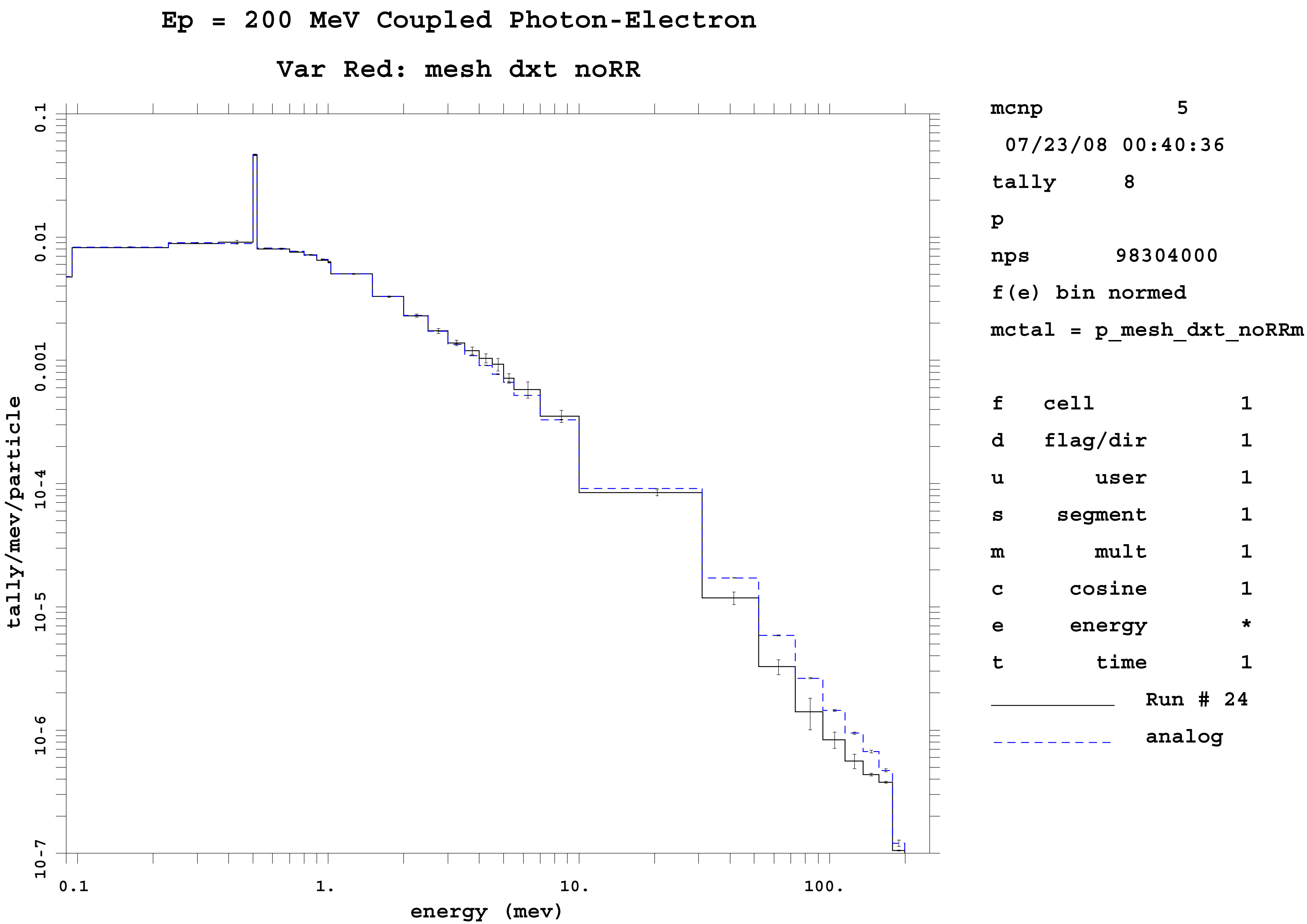
Ep = 200 MeV Coupled Photon-Electron
Var Red: mesh
tally/mev/particle
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/21/08 04:43:09
tally 8
p
nps 378607000
f(e) bin normed
mctal = p_meshm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 21
analog



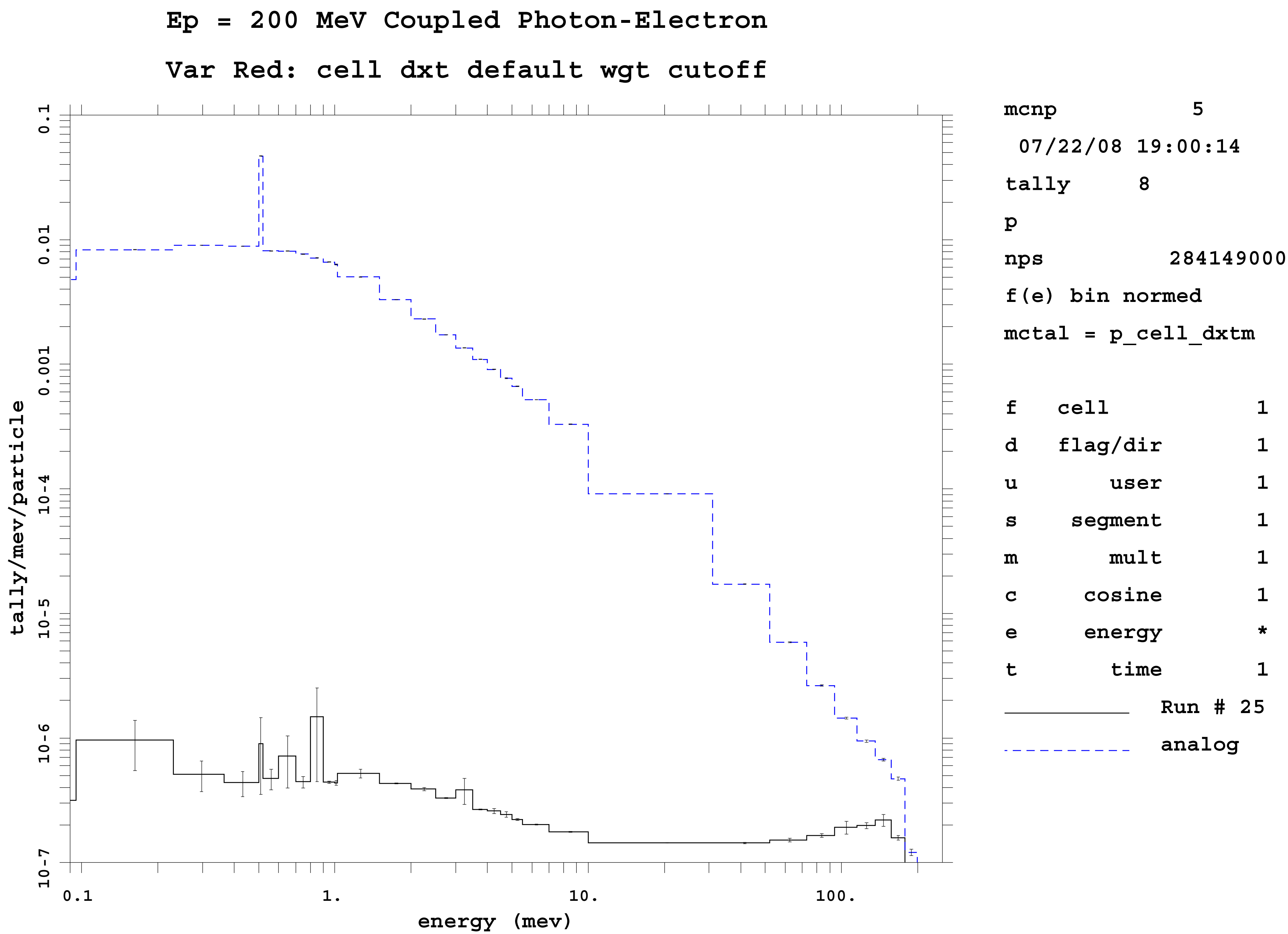
Ep = 200 MeV Coupled Photon-Electron
Var Red: imp ext fcl weight cutoff
tally/mev/particle
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/18/08 02:57:20
tally 8
p
nps 33390000
f(e) bin normed
mctal = p_imp_ext_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 22
analog



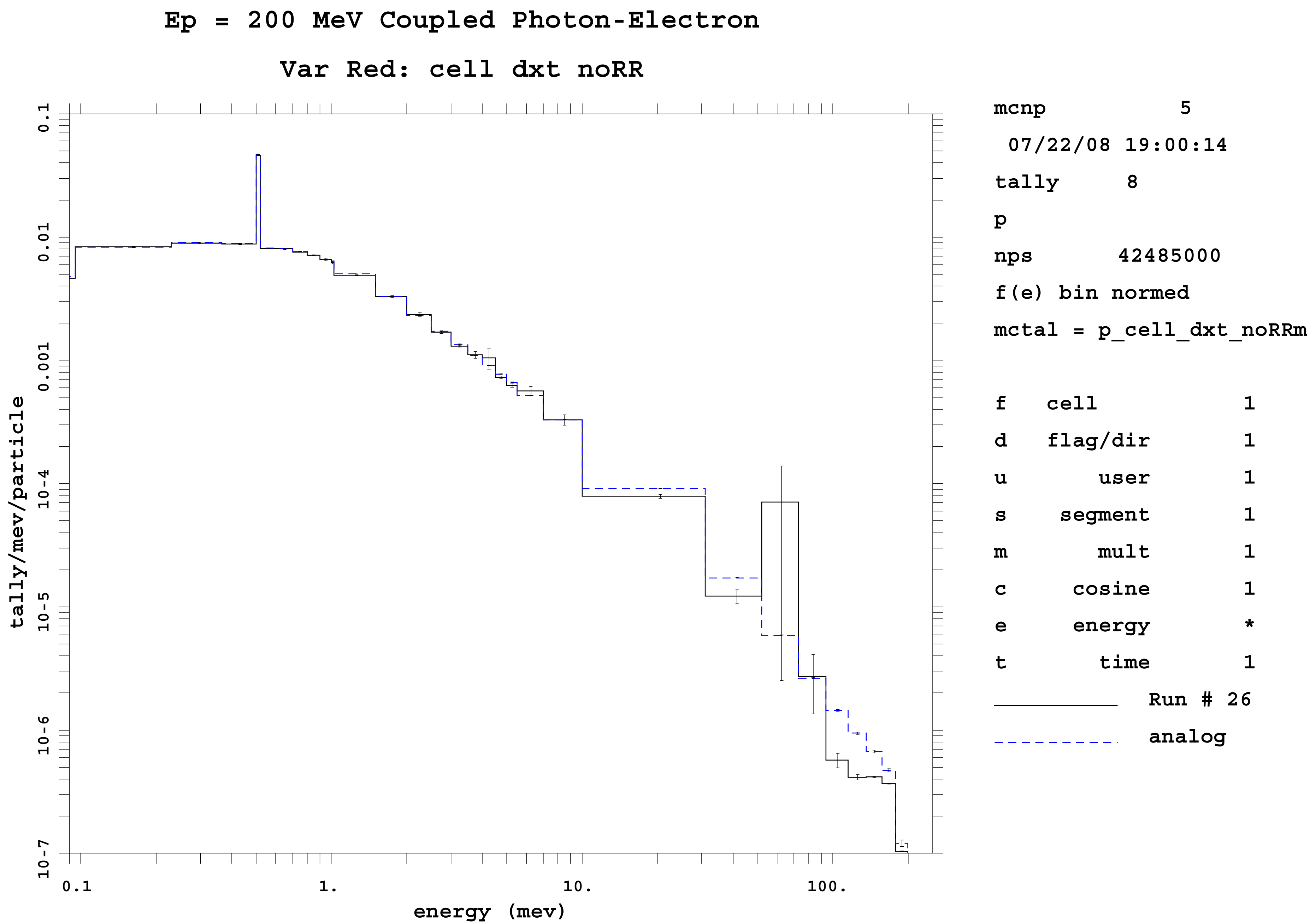
Ep = 200 MeV Coupled Photon-Electron
Var Red: imp dxt ext fcl weight cutoff
tally/mev/particle
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/22/08 23:25:37
tally 8
p
nps 30720000
f(e) bin normed
mctal = p_imp_ext_fcl_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 23
analog



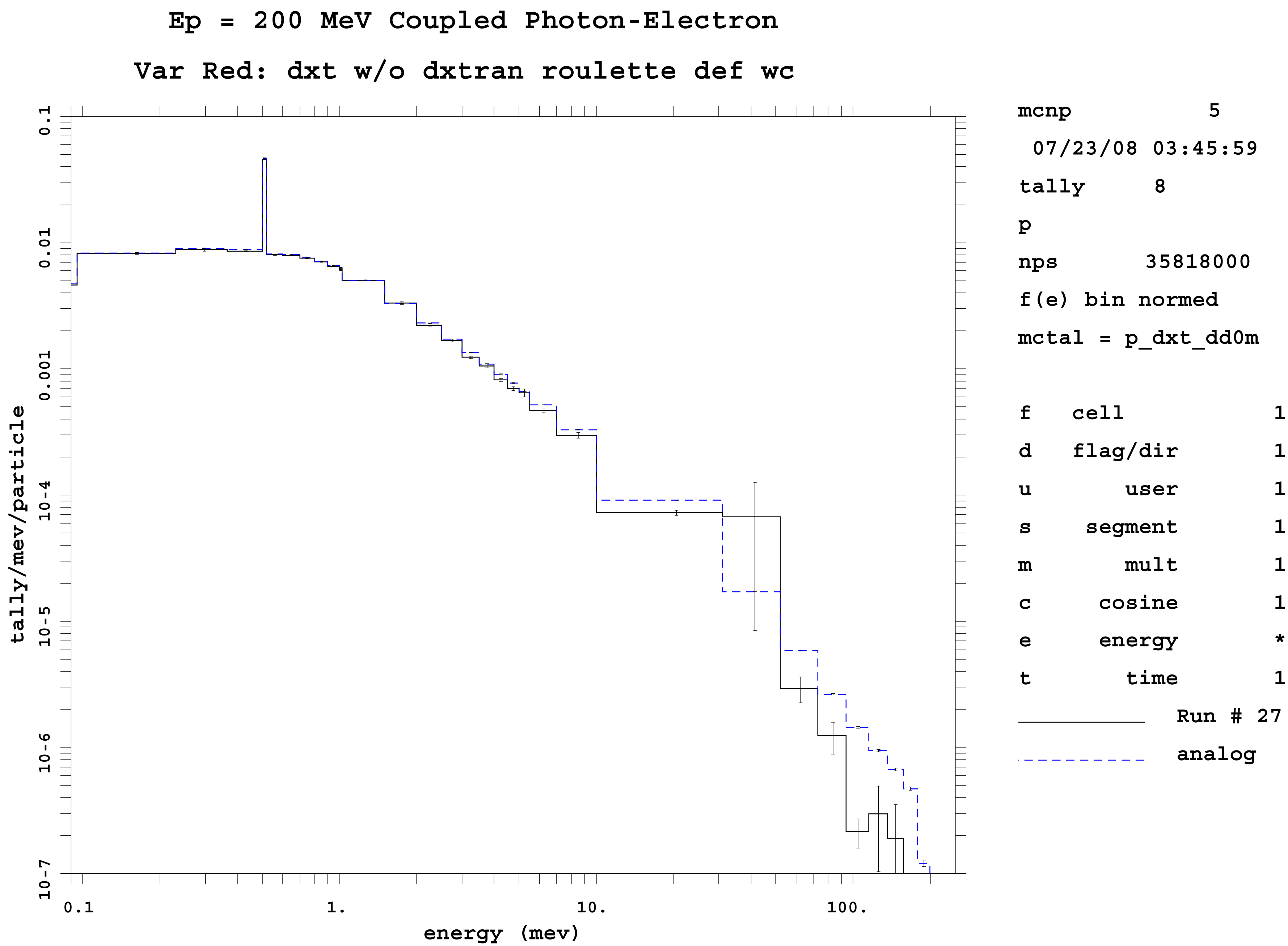
Ep = 200 MeV Coupled Photon-Electron
Var Red: mesh dxt noRR
tally/mev/particle
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/23/08 00:40:36
tally 8
p
nps 98304000
f(e) bin normed
mctal = p_mesh_dxt_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 24
analog



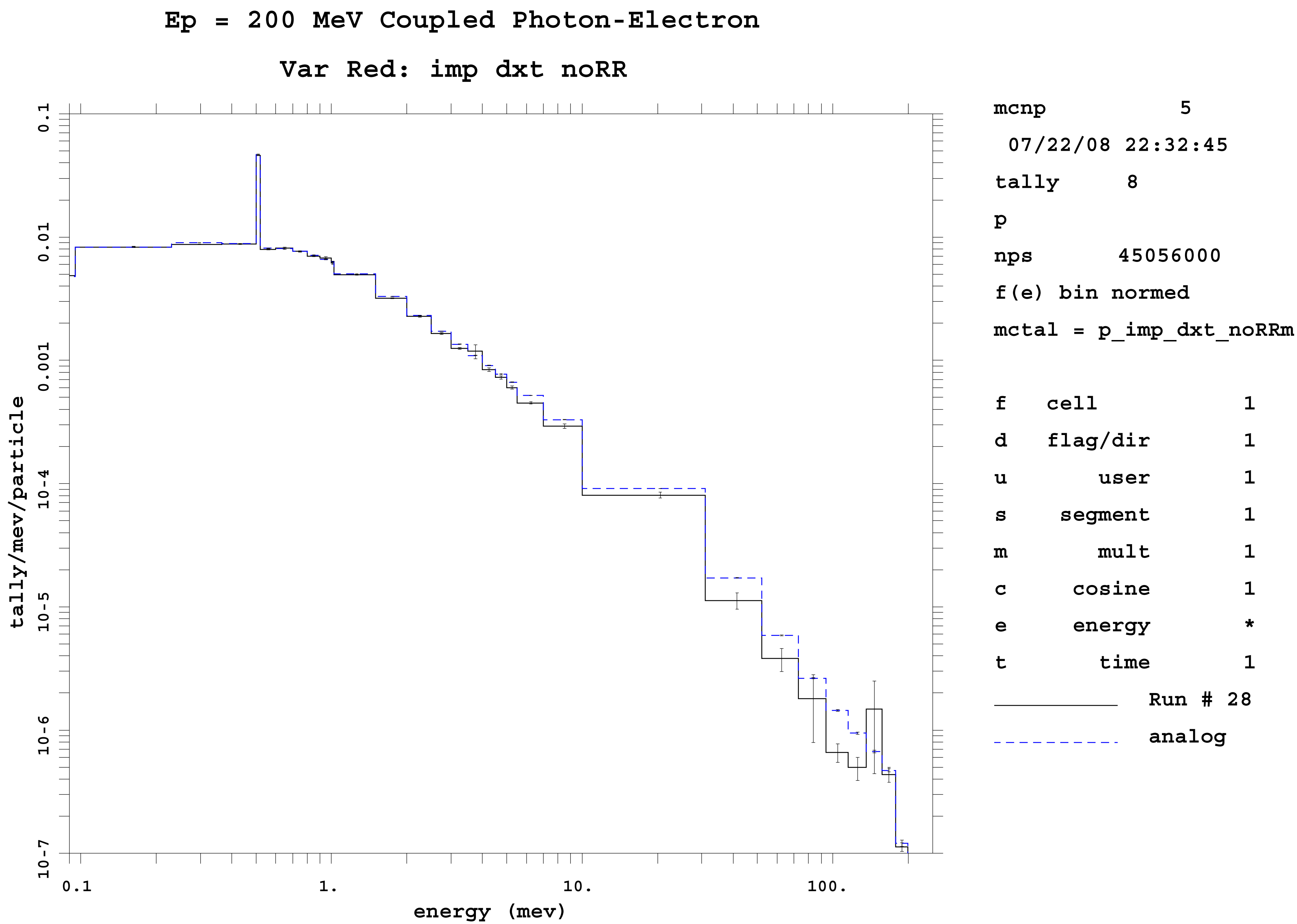
Ep = 200 MeV Coupled Photon-Electron
Var Red: cell dxt default wgt cutoff
tally/mev/particle
energy (mev)
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
mcnp 5
07/22/08 19:00:14
tally 8
p
nps 284149000
f(e) bin normed
mctal = p_cell_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 25
analog



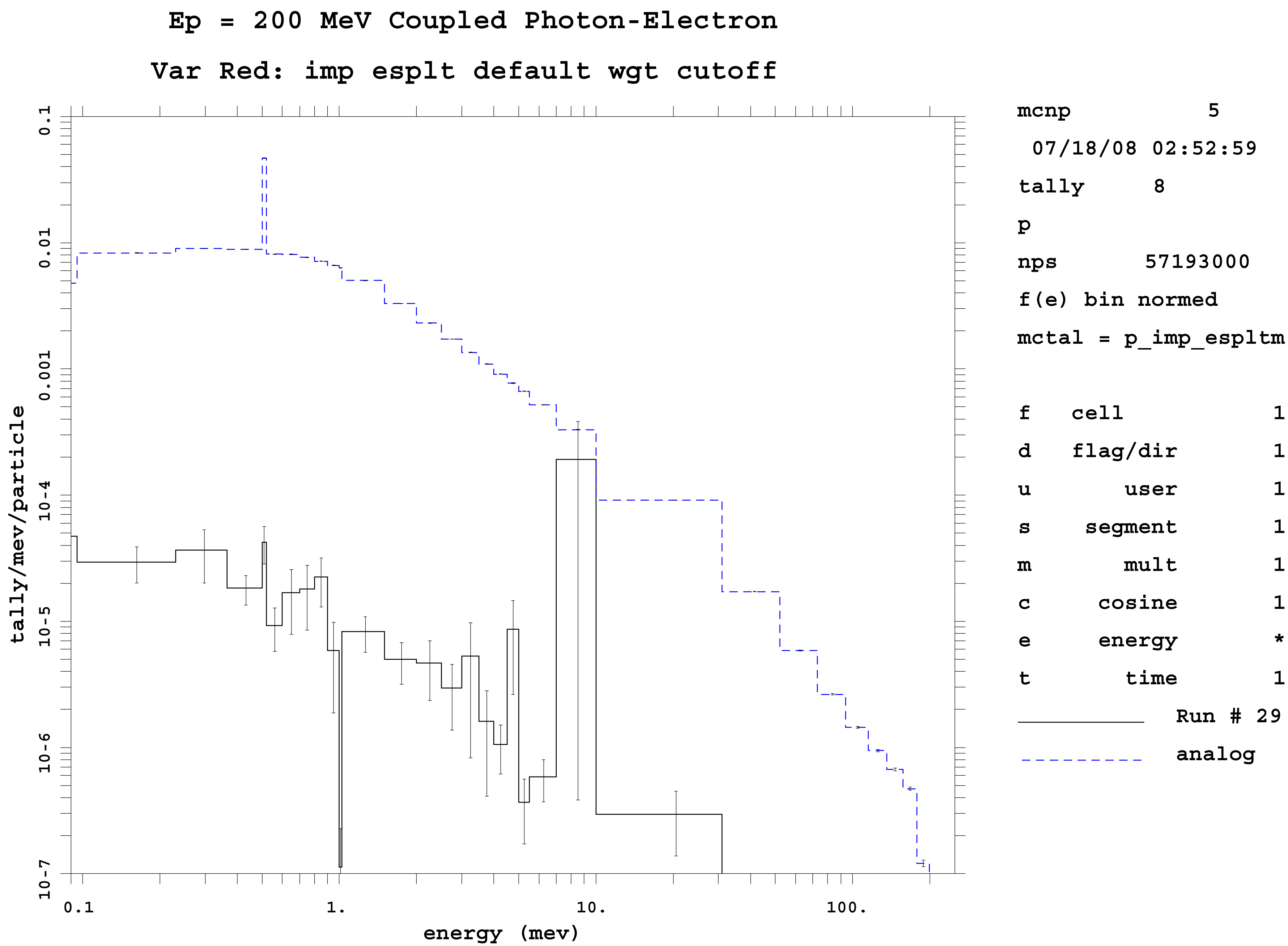
Ep = 200 MeV Coupled Photon-Electron
Var Red: cell dxt noRR
0.1
0.01
0.001
10-4
10-5
10-6
10-7
tally/mev/particle
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/22/08 19:00:14
tally 8
p
nps 42485000
f(e) bin normed
mctal = p_cell_dxt_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 26
analog



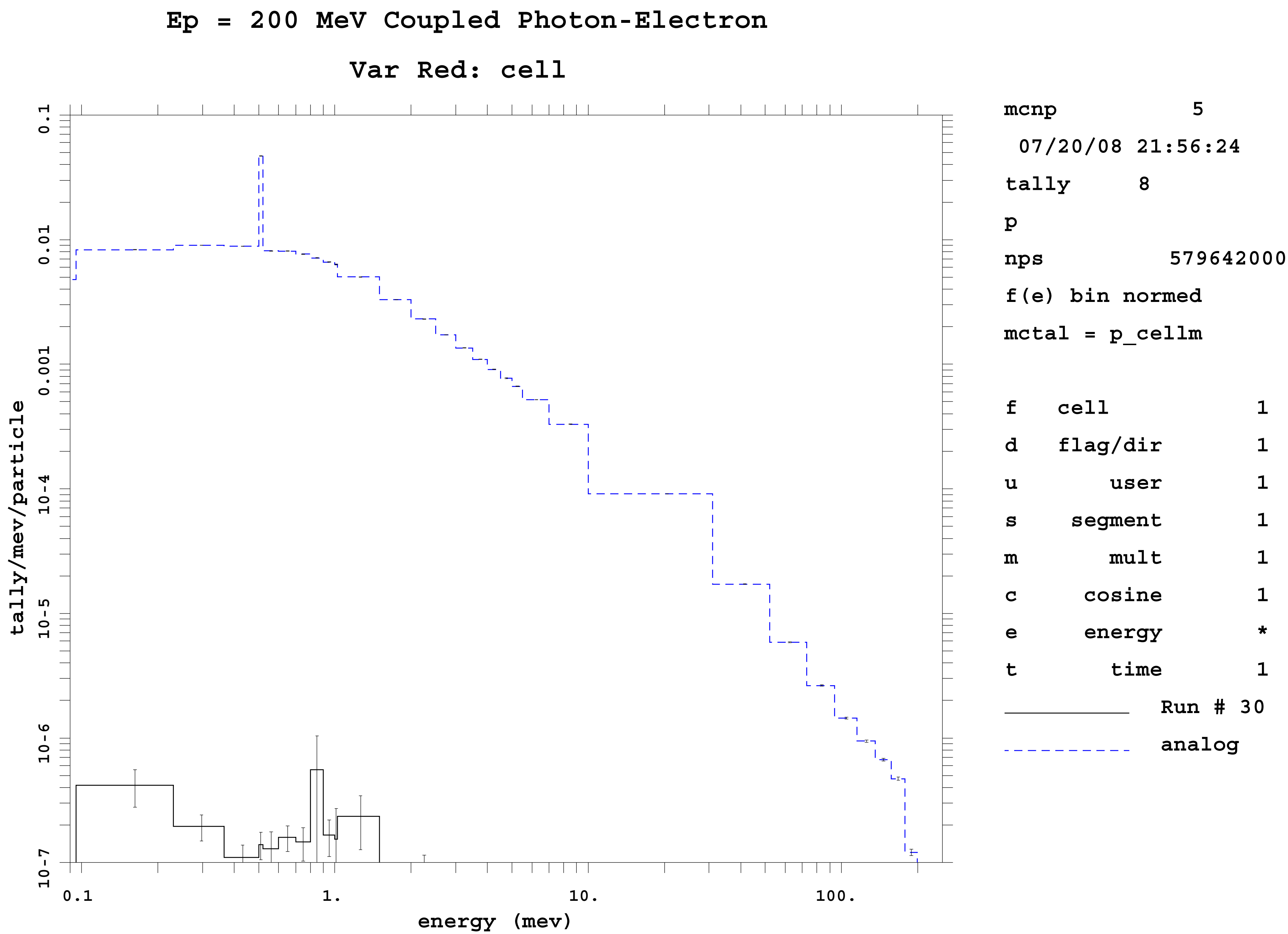
Ep = 200 MeV Coupled Photon-Electron
Var Red: dxt w/o dxtran roulette def wc
tally/mev/particle
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/23/08 03:45:59
tally 8
p
nps 35818000
f(e) bin normed
mctal = p_dxt_dd0m
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 27
analog



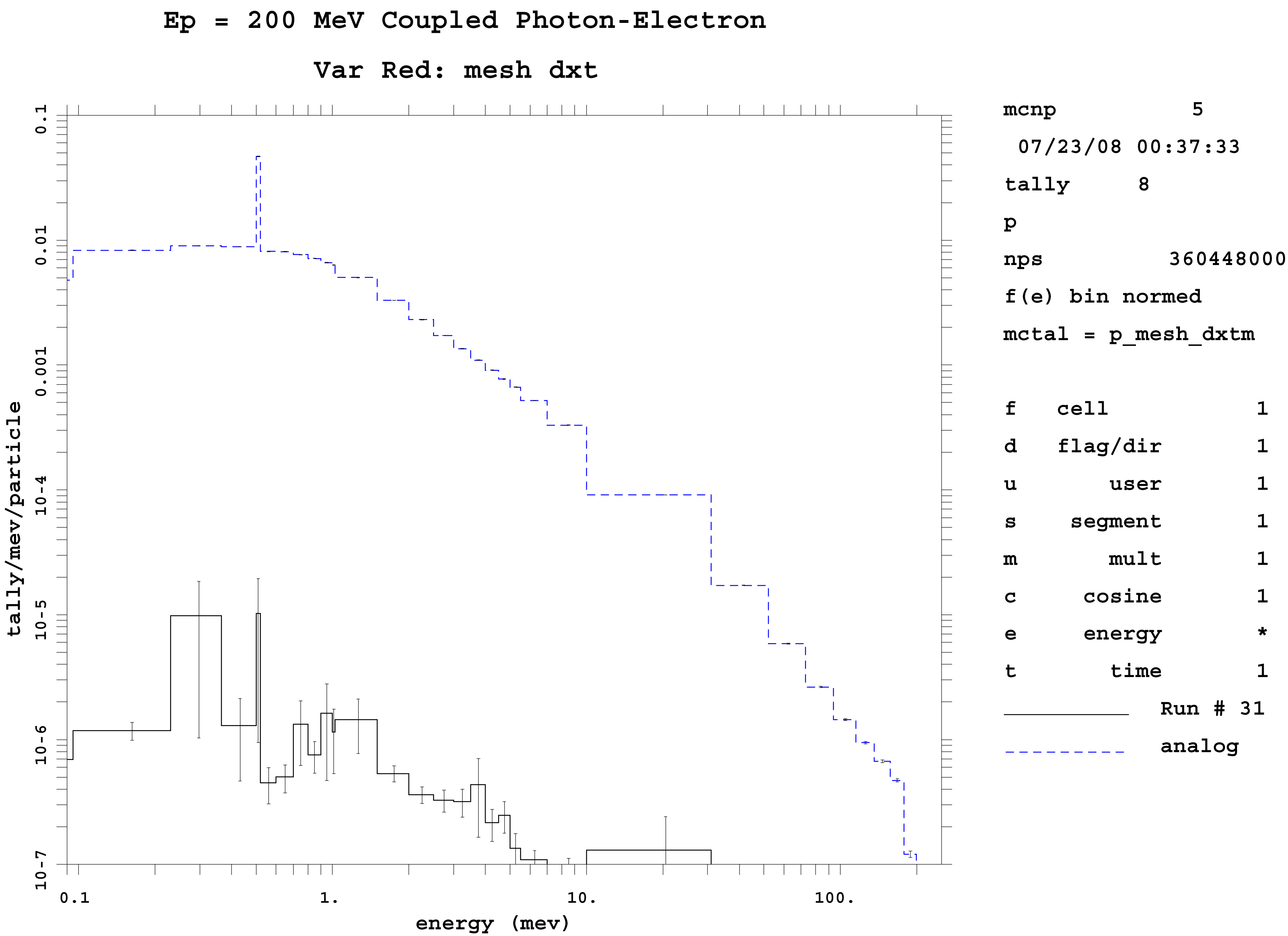
Ep = 200 MeV Coupled Photon-Electron
Var Red: imp dxt noRR
tally/mev/particle
energy (mev)
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
mcnp 5
07/22/08 22:32:45
tally 8
p
nps 45056000
f(e) bin normed
mctal = p_imp_dxt_noRRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 28
analog



Ep = 200 MeV Coupled Photon-Electron
Var Red: imp esplt default wgt cutoff
tally/mev/particle
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/18/08 02:52:59
tally 8
p
nps 57193000
f(e) bin normed
mctal = p_imp_espltm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 29
analog



Ep = 200 MeV Coupled Photon-Electron
Var Red: cell
tally/mev/particle
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/20/08 21:56:24
tally 8
p
nps 579642000
f(e) bin normed
mctal = p_cellm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 30
analog



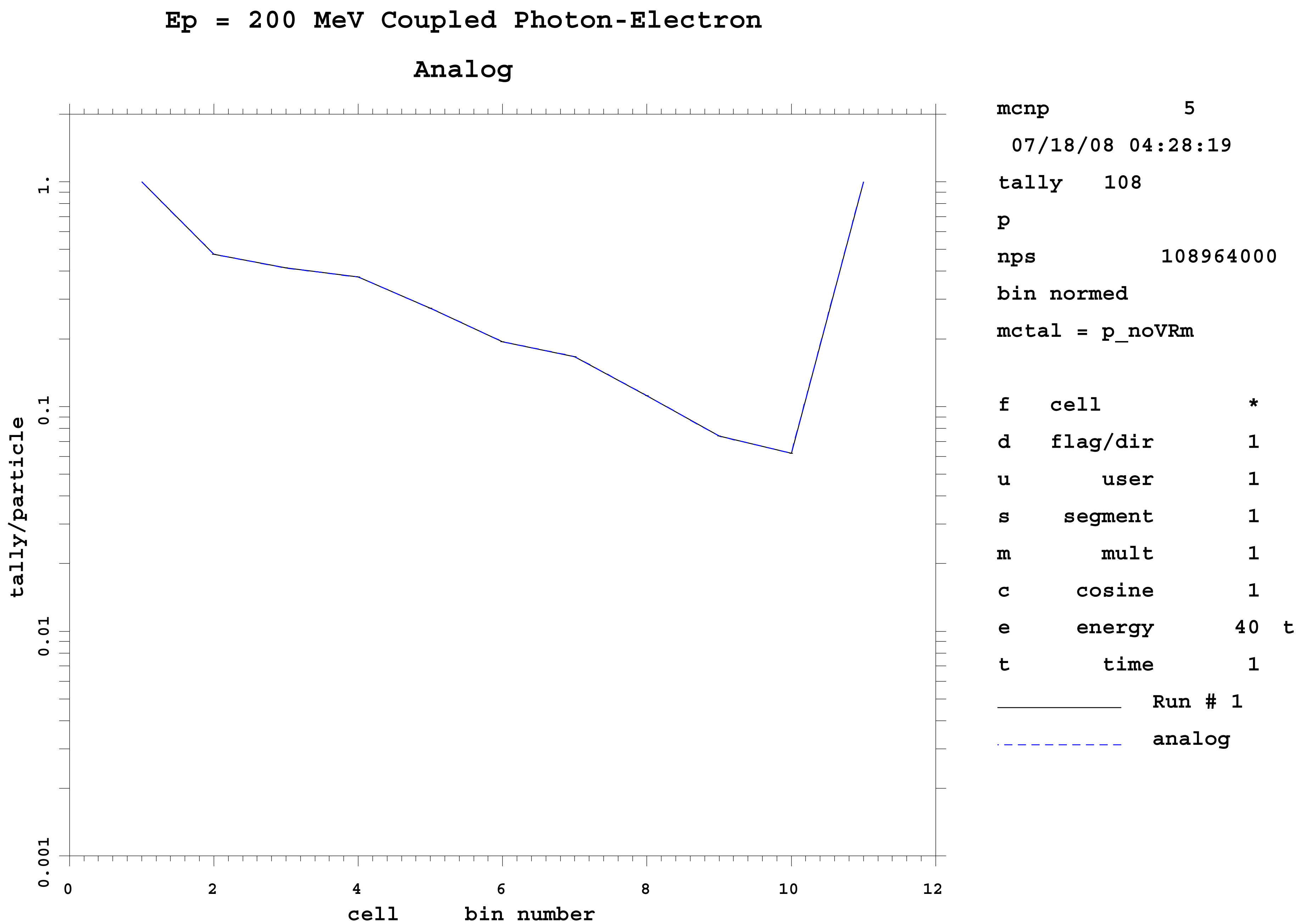
Ep = 200 MeV Coupled Photon-Electron
Var Red: mesh dxt
tally/mev/particle
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.1
1.
10.
100.
energy (mev)
mcnp 5
07/23/08 00:37:33
tally 8
p
nps 360448000
f(e) bin normed
mctal = p_mesh_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
Run # 31
analog

Appendix A.3.iii

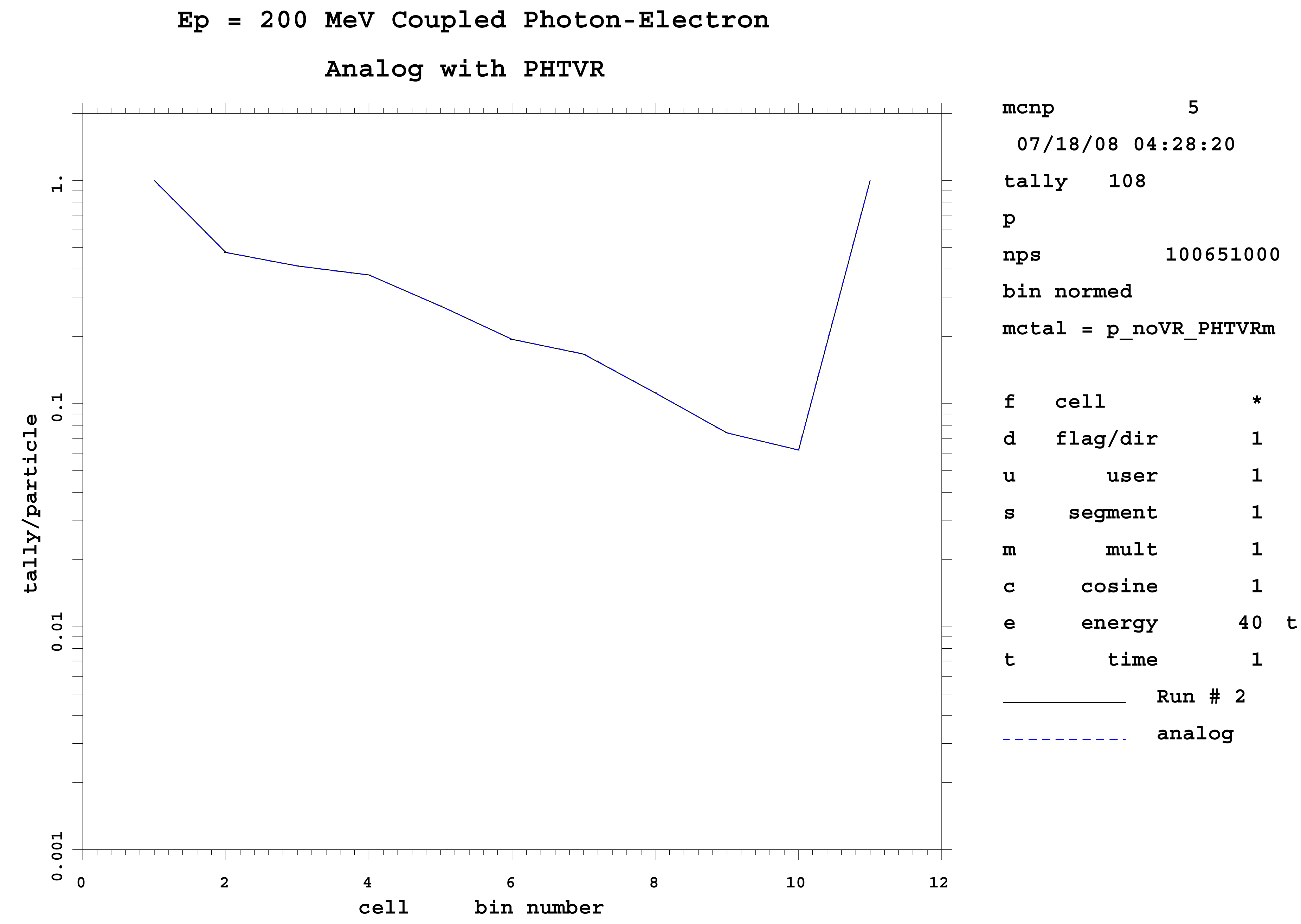
Problem 1
Ge sphere Next To a U / O Stacked Cylinder Problem

Plots of the total pulses in the sections of the cylinder

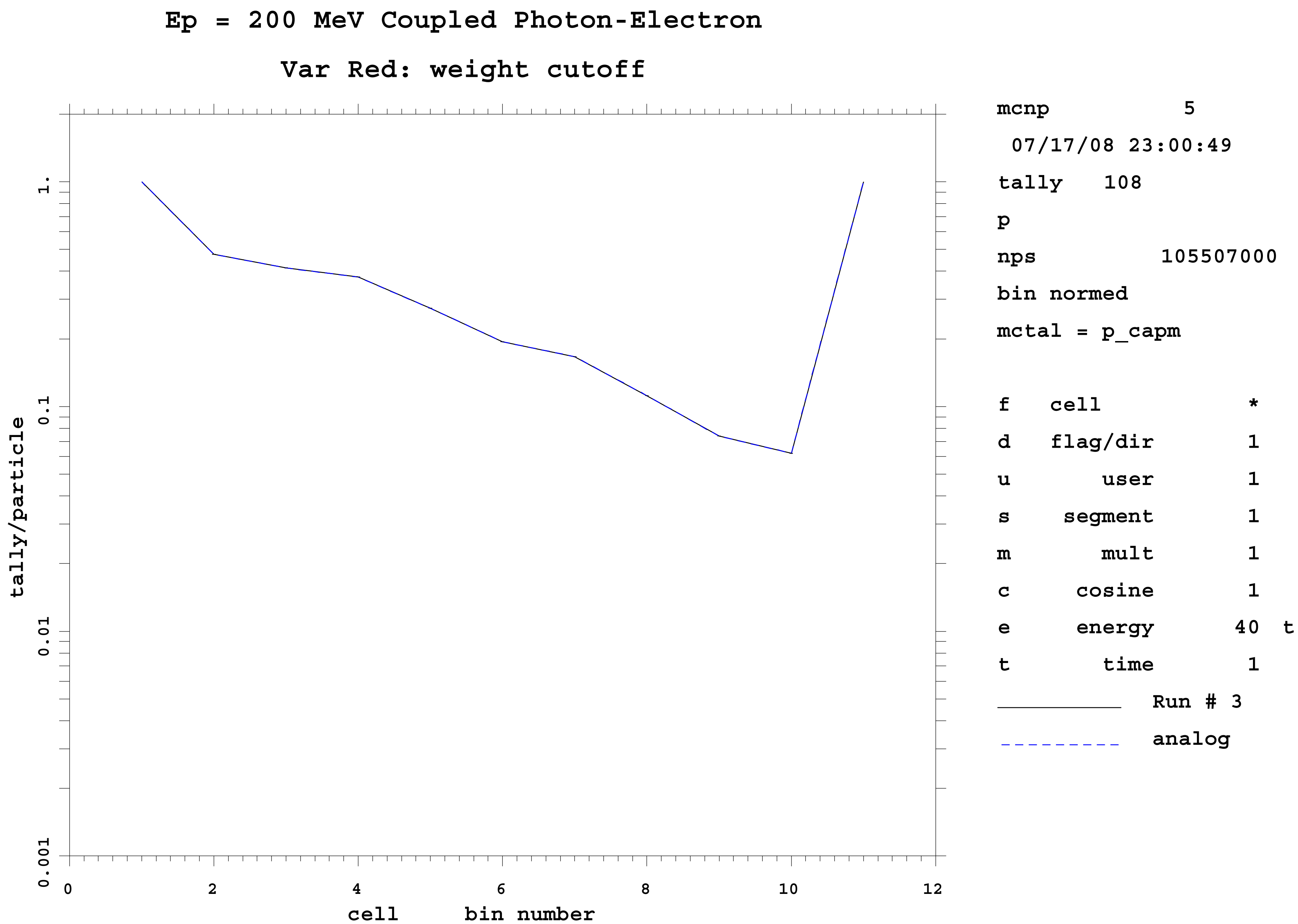
Plots are in order of the run number listed in Table 4. The variance reduction methods used are listed in the plot title; the graph label contains the run number.



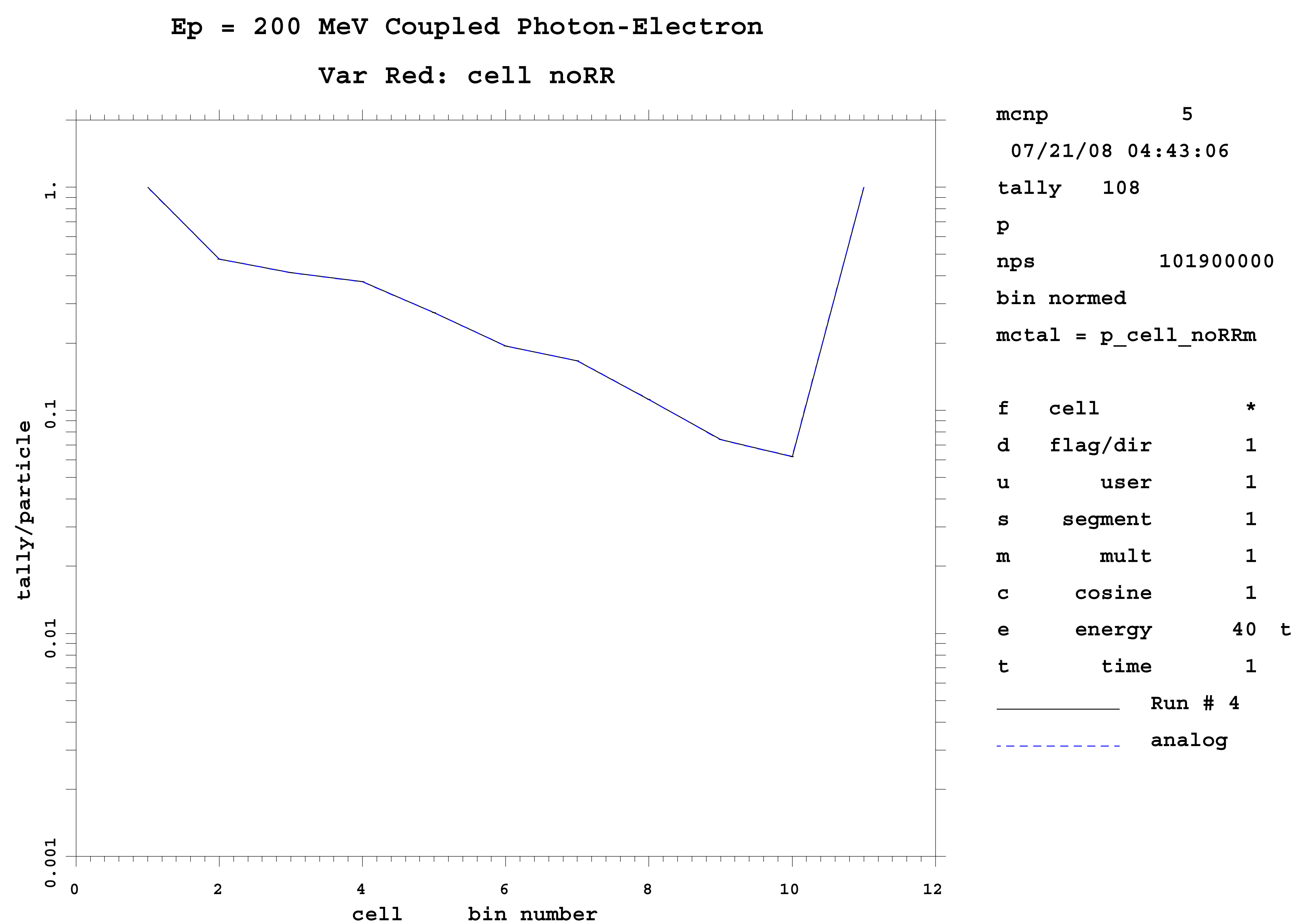
Ep = 200 MeV Coupled Photon-Electron
Analog
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/18/08 04:28:19
tally 108
p
nps 108964000
bin normed
mctal = p_noVRm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 1
analog

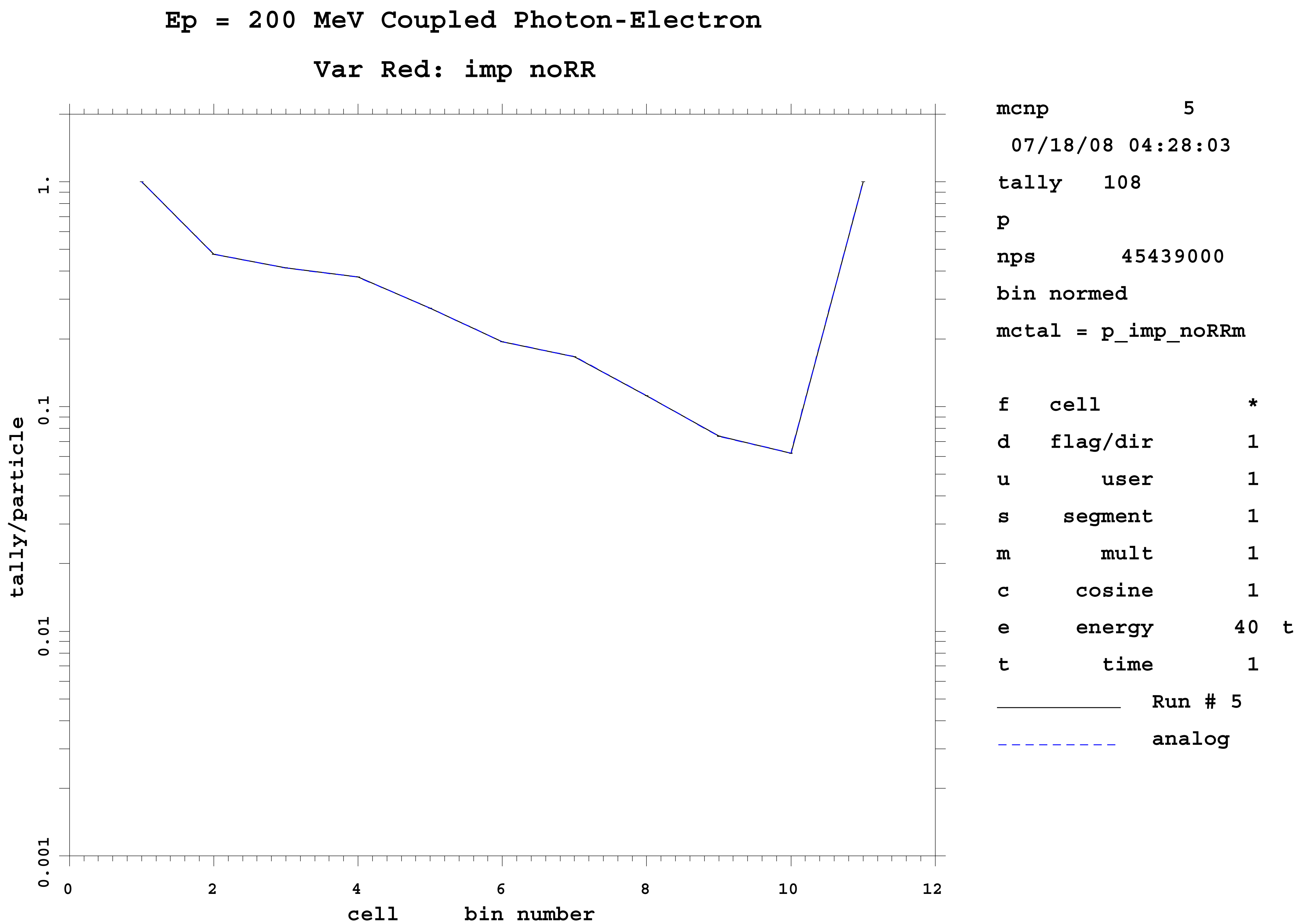


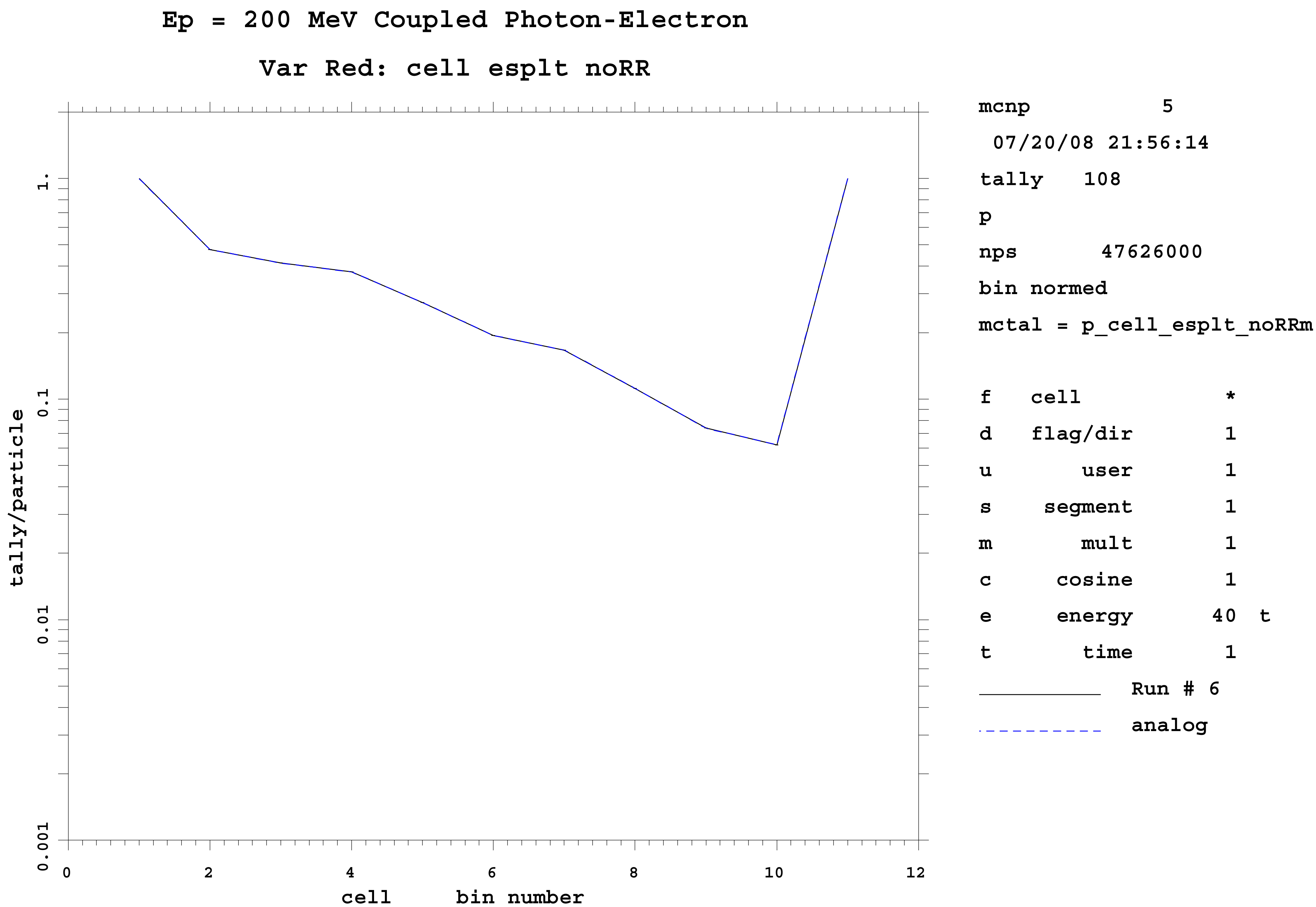
Ep = 200 MeV Coupled Photon-Electron
Analog with PHTVR
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/18/08 04:28:20
tally 108
p
nps 100651000
bin normed
mctal = p_noVR_PHTVRm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 2
analog



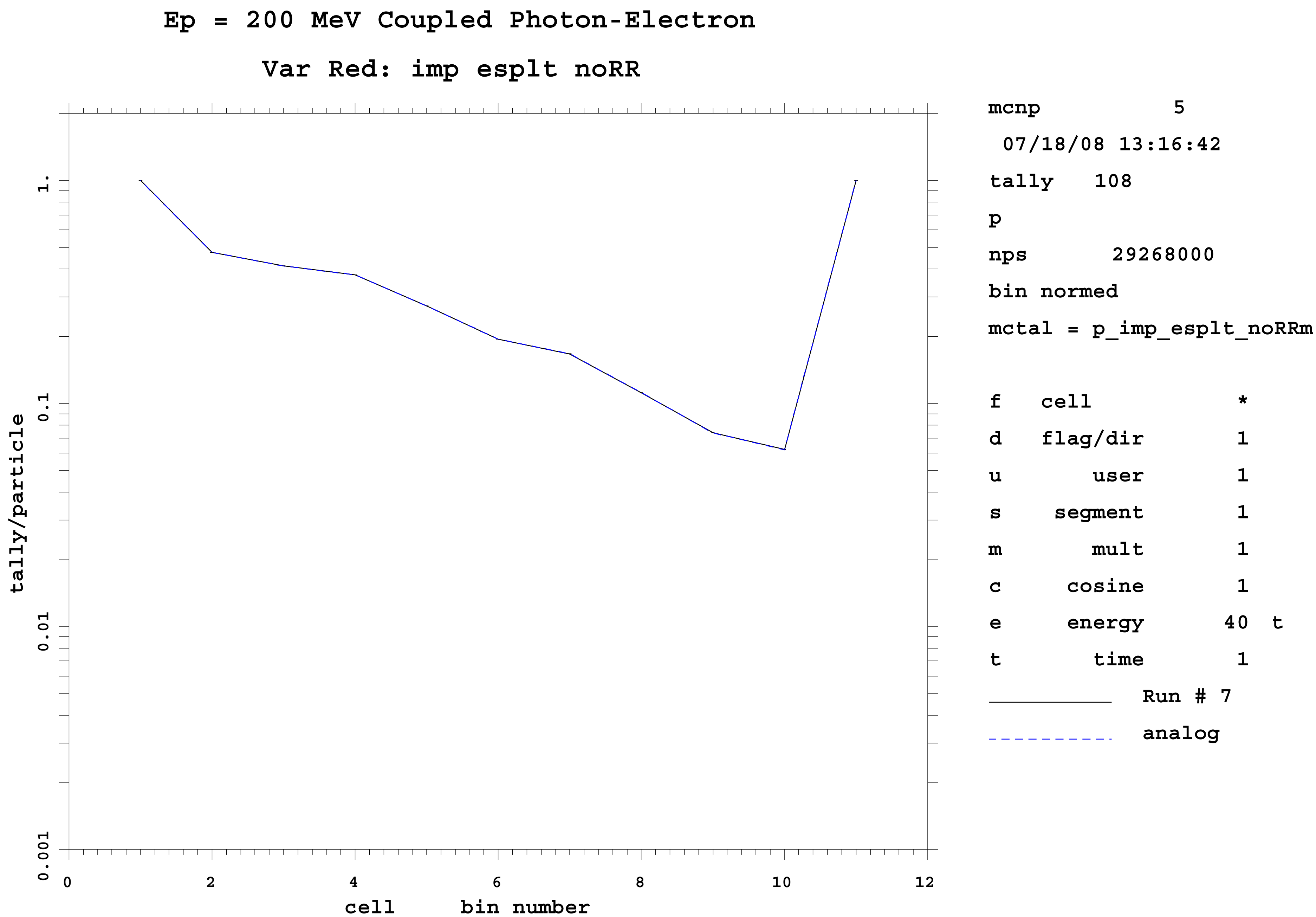
Ep = 200 MeV Coupled Photon-Electron
Var Red: weight cutoff
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/17/08 23:00:49
tally 108
p
nps 105507000
bin normed
mctal = p_capm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 3
analog


Ep = 200 MeV Coupled Photon-Electron
Var Red: cell noRR
tally/particle
1.
0.1
0.01
0.001
0 2 4 6 8 10 12
cell bin number
mcnp 5
07/21/08 04:43:06
tally 108
p
nps 101900000
bin normed
mctal = p_cell_noRRm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 4
analog

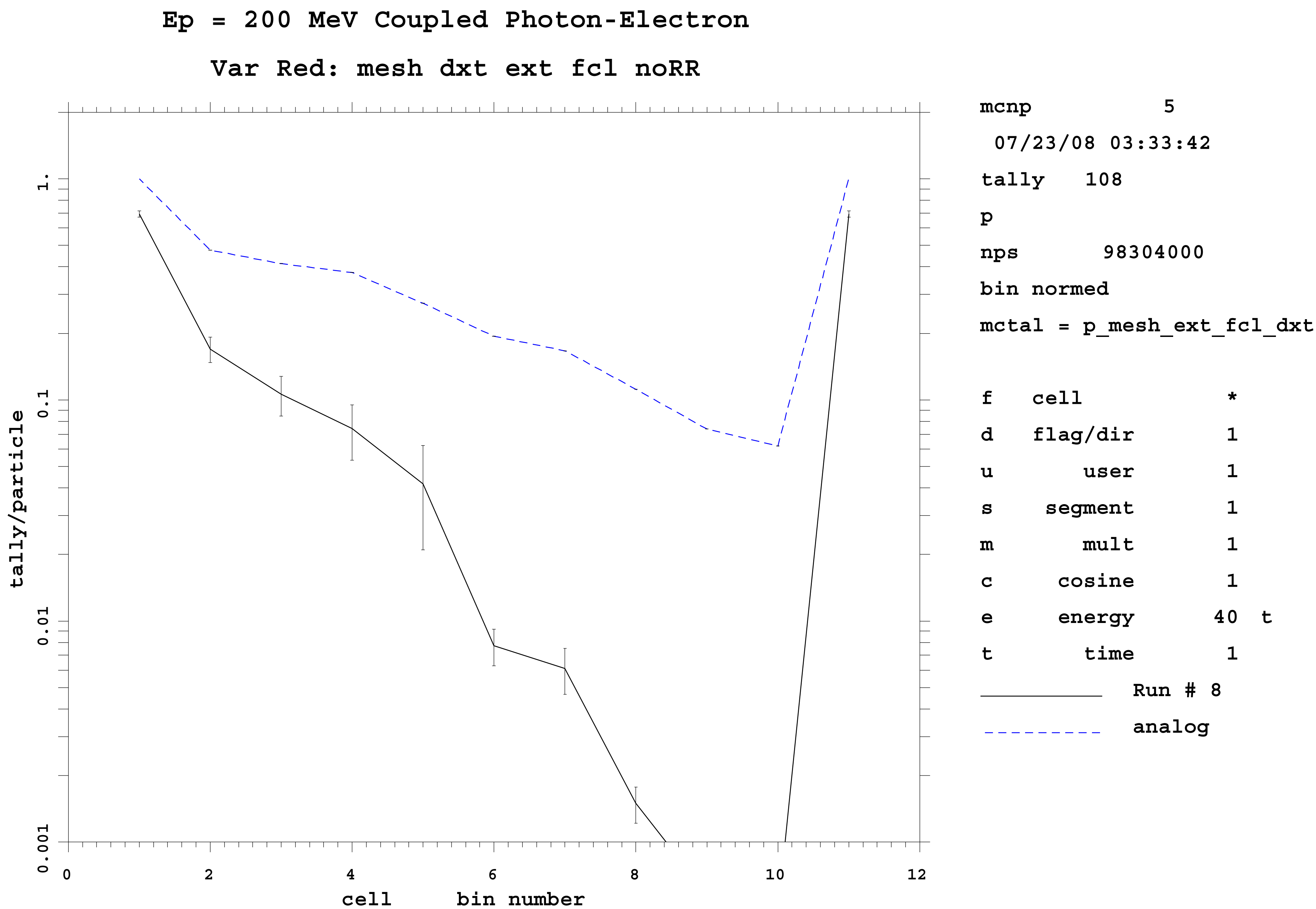

Ep = 200 MeV Coupled Photon-Electron
Var Red: imp noRR
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/18/08 04:28:03
tally 108
p
nps 45439000
bin normed
mctal = p_imp_noRRm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 5
analog



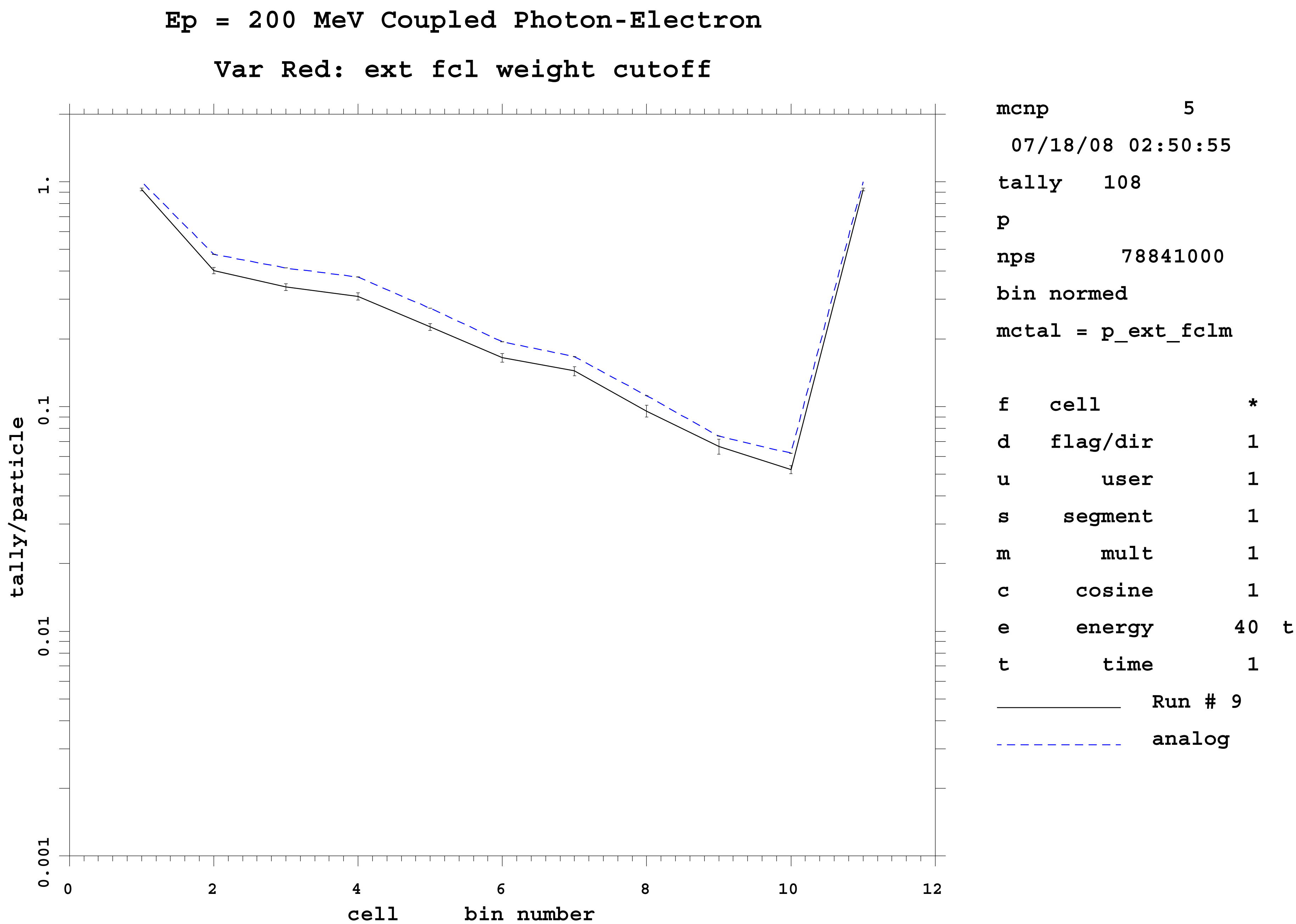
Ep = 200 MeV Coupled Photon-Electron
Var Red: cell esplt noRR
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/20/08 21:56:14
tally 108
p
nps 47626000
bin normed
mctal = p_cell_esplt_noRRm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 6
analog



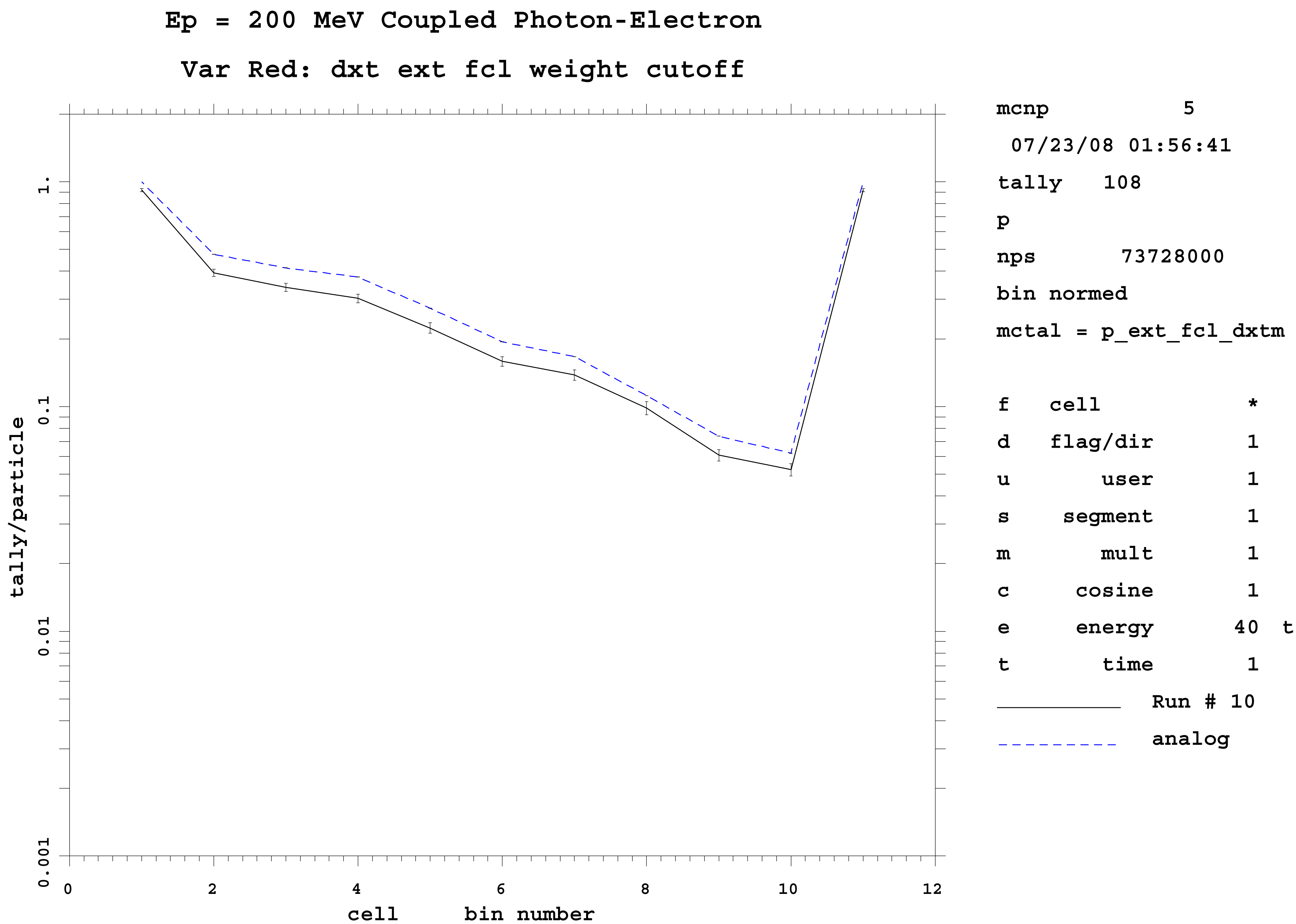
Ep = 200 MeV Coupled Photon-Electron
Var Red: imp esplt noRR
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/18/08 13:16:42
tally 108
p
nps 29268000
bin normed
mctal = p_imp_esplt_noRRm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 7
analog

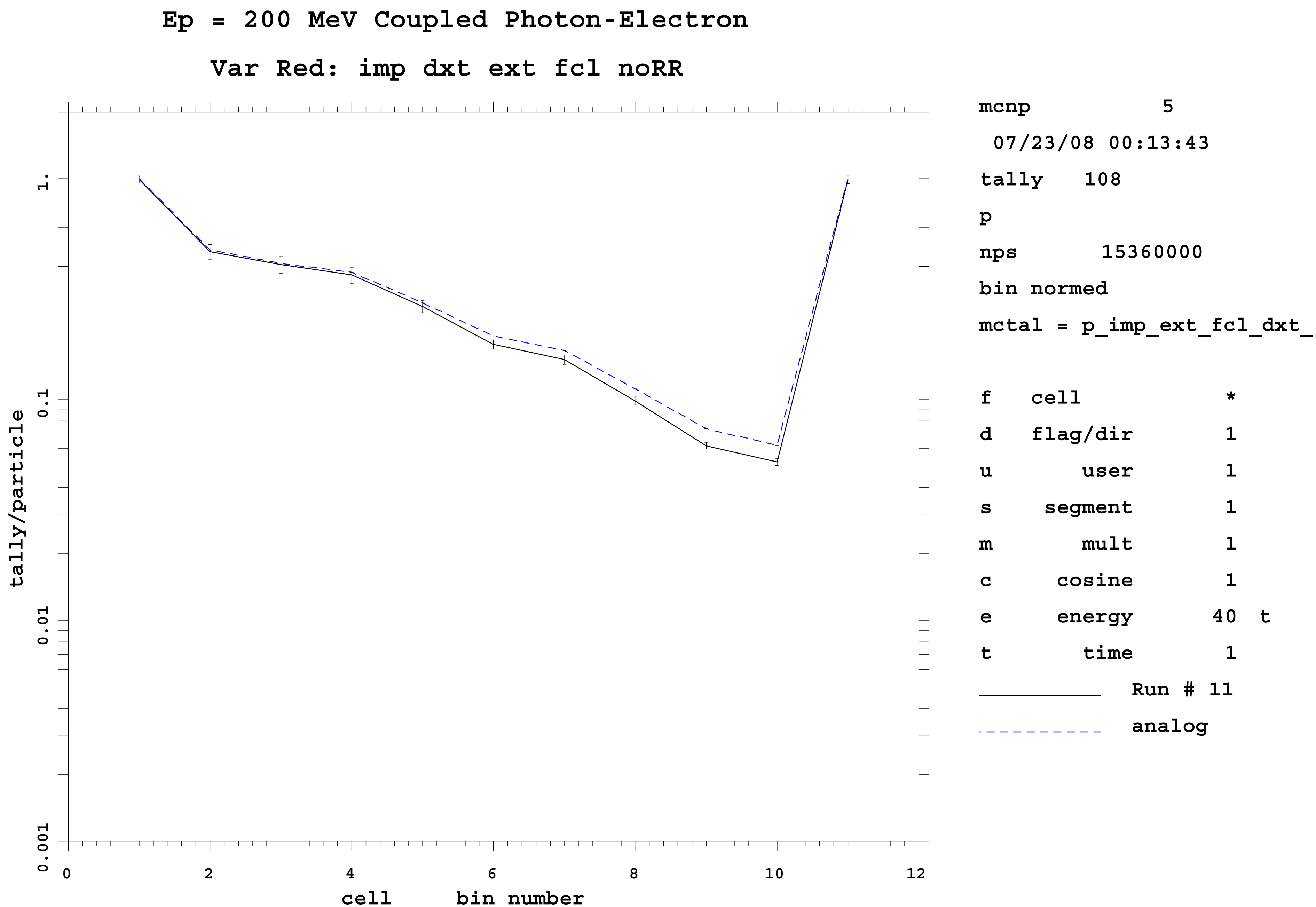


Ep = 200 MeV Coupled Photon-Electron
Var Red: mesh dxt ext fcl noRR
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/23/08 03:33:42
tally 108
p
nps 98304000
bin normed
mctal = p_mesh_ext_fcl_dxt
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 8
analog

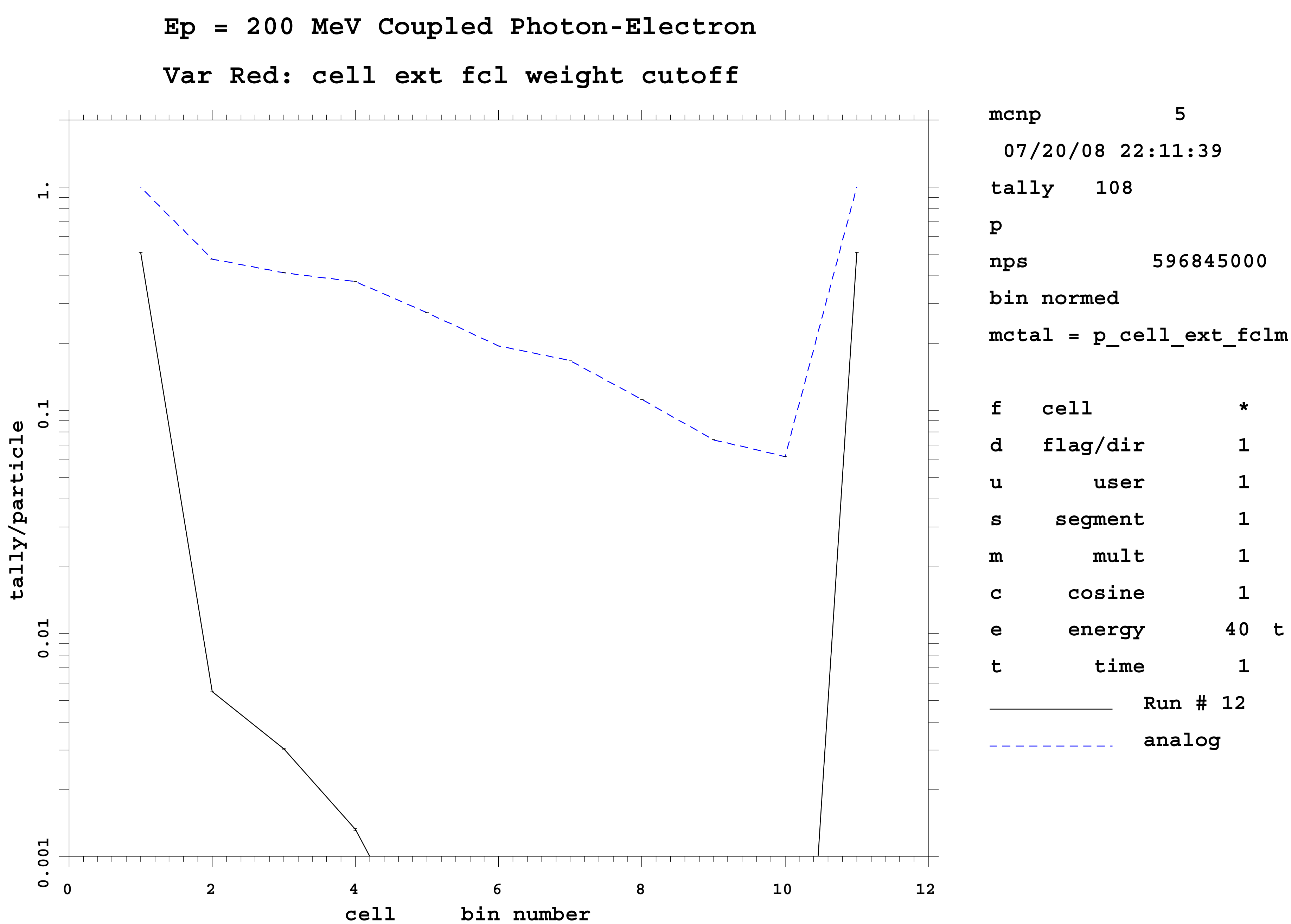


Ep = 200 MeV Coupled Photon-Electron
Var Red: ext fcl weight cutoff
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/18/08 02:50:55
tally 108
p
nps 78841000
bin normed
mctal = p_ext_fclm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 9
analog

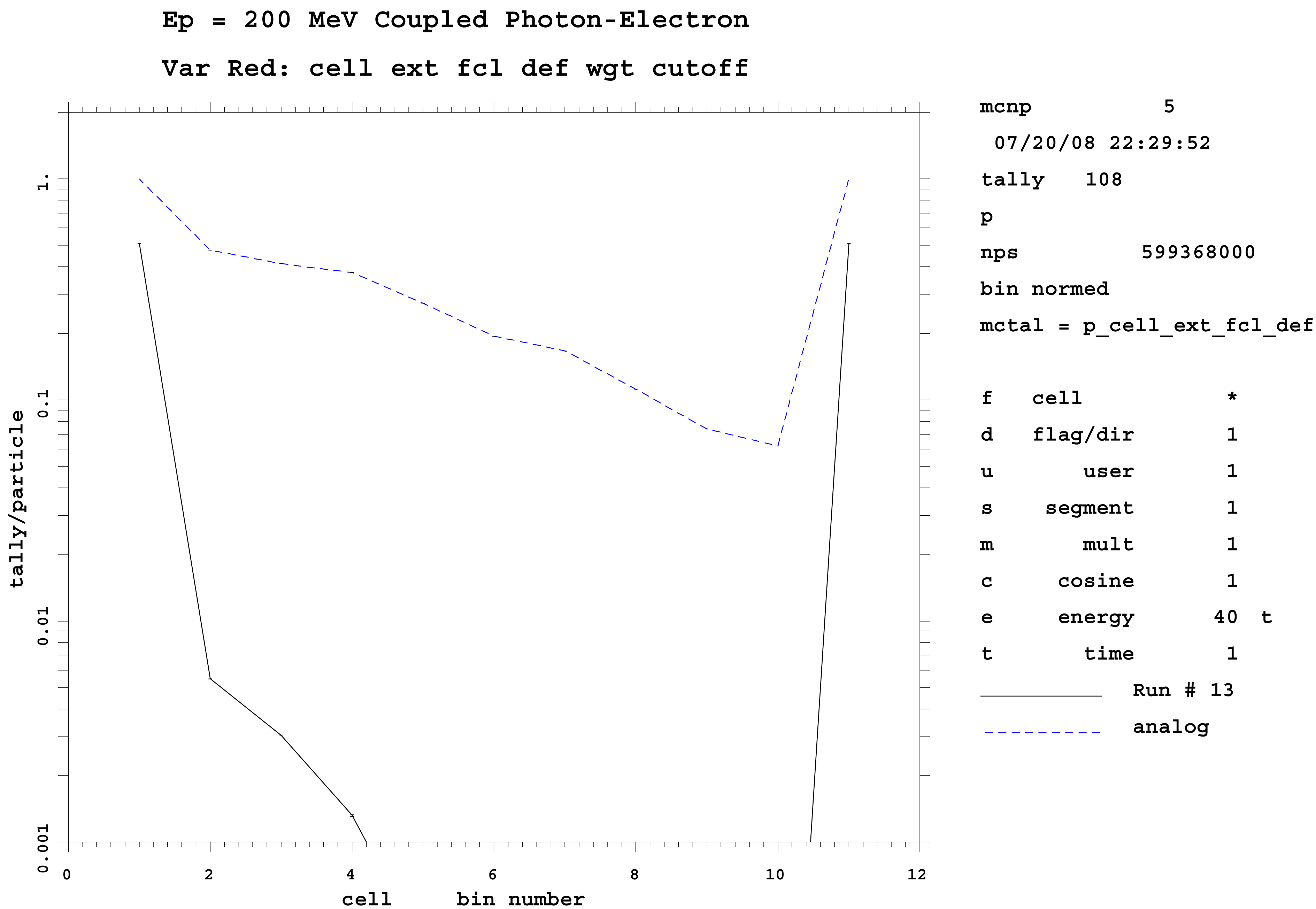

Ep = 200 MeV Coupled Photon-Electron
Var Red: dxt ext fcl weight cutoff
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/23/08 01:56:41
tally 108
p
nps 73728000
bin normed
mctal = p_ext_fcl_dxtm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 10
analog



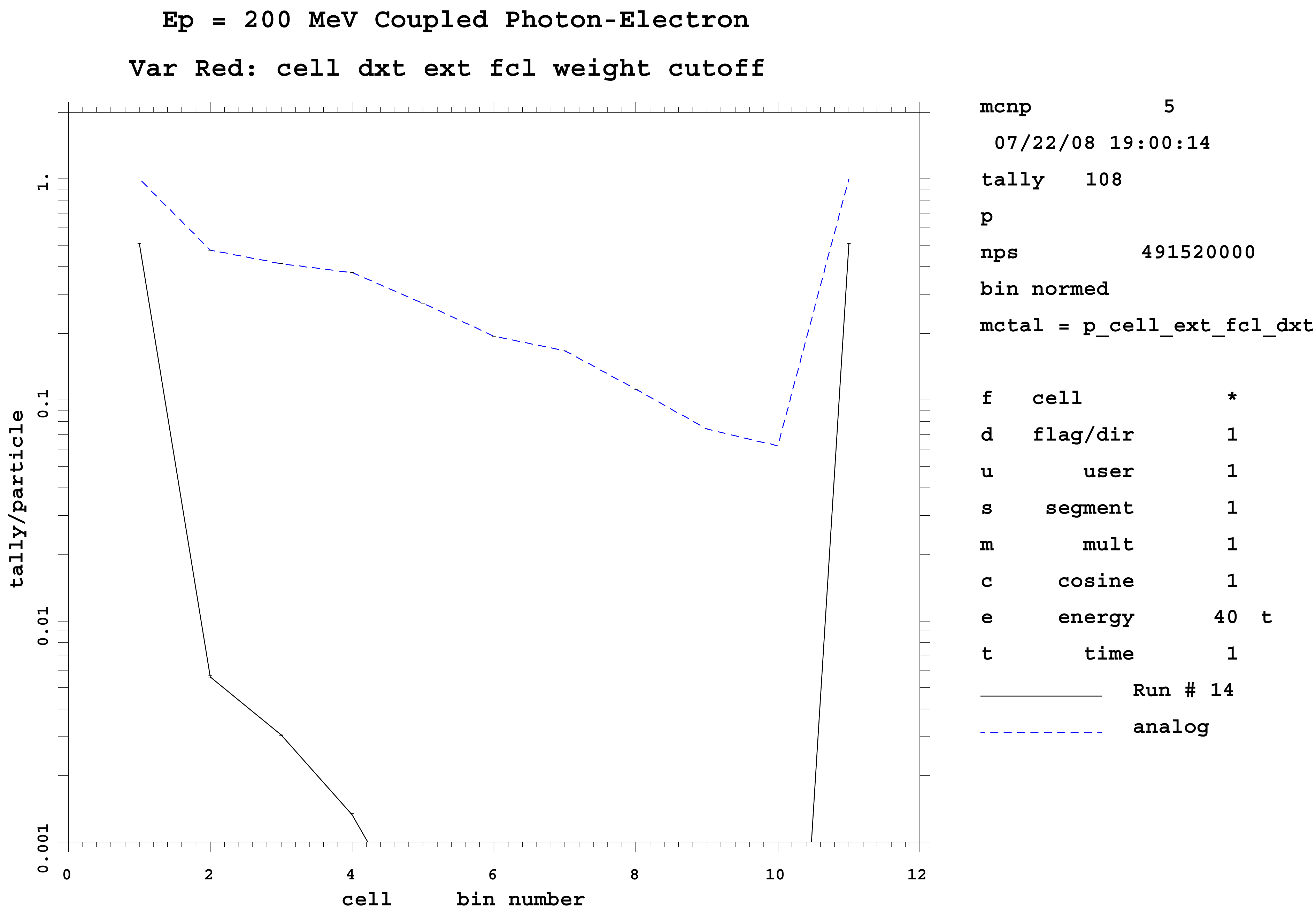
Ep = 200 MeV Coupled Photon-Electron
Var Red: imp dxt ext fcl noRR
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/23/08 00:13:43
tally 108
p
nps 15360000
bin normed
mctal = p_imp_ext_fcl_dxt_
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 11
analog

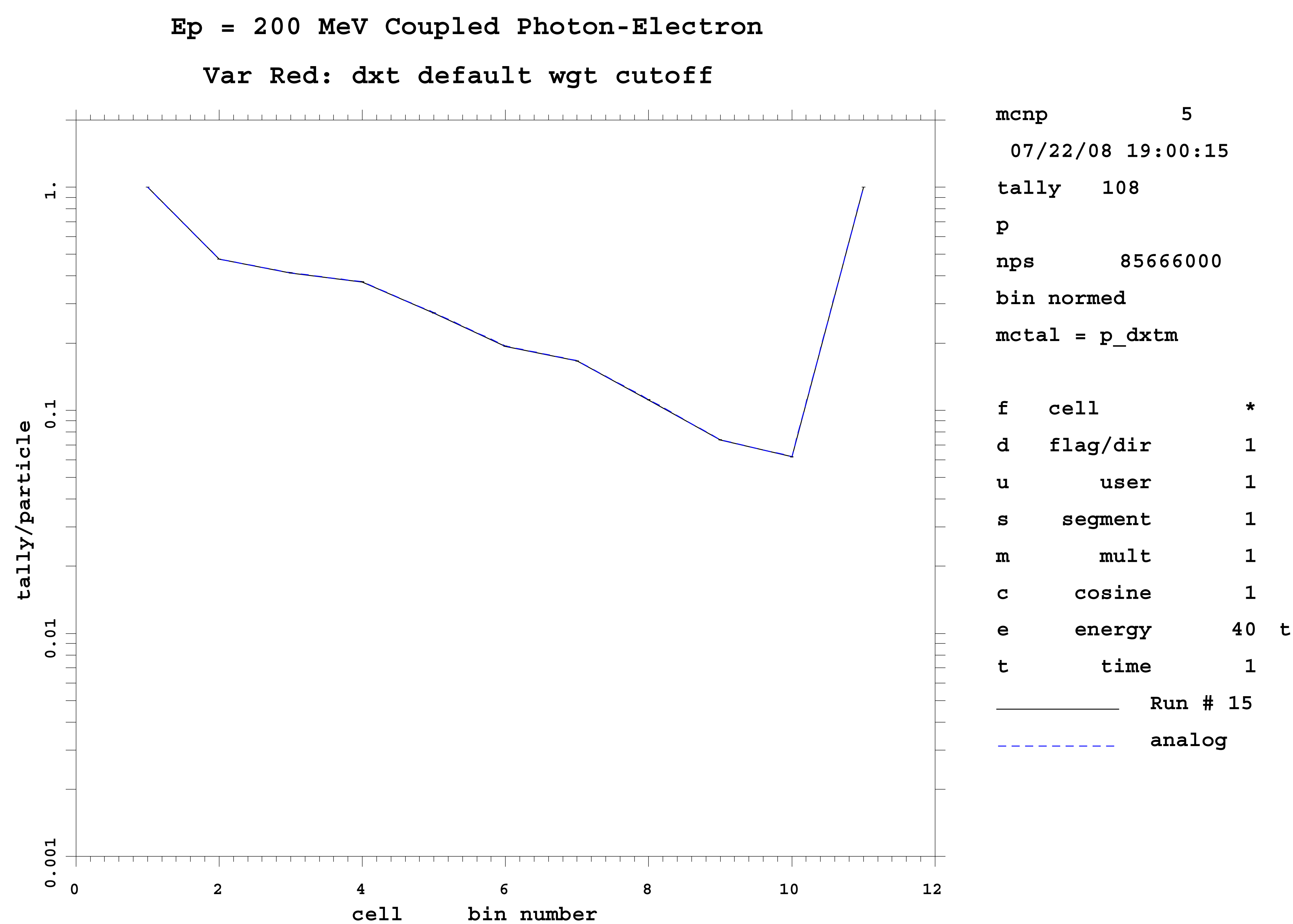


Ep = 200 MeV Coupled Photon-Electron
Var Red: cell ext fcl weight cutoff
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/20/08 22:11:39
tally 108
p
nps 596845000
bin normed
mctal = p_cell_ext_fclm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 12
analog

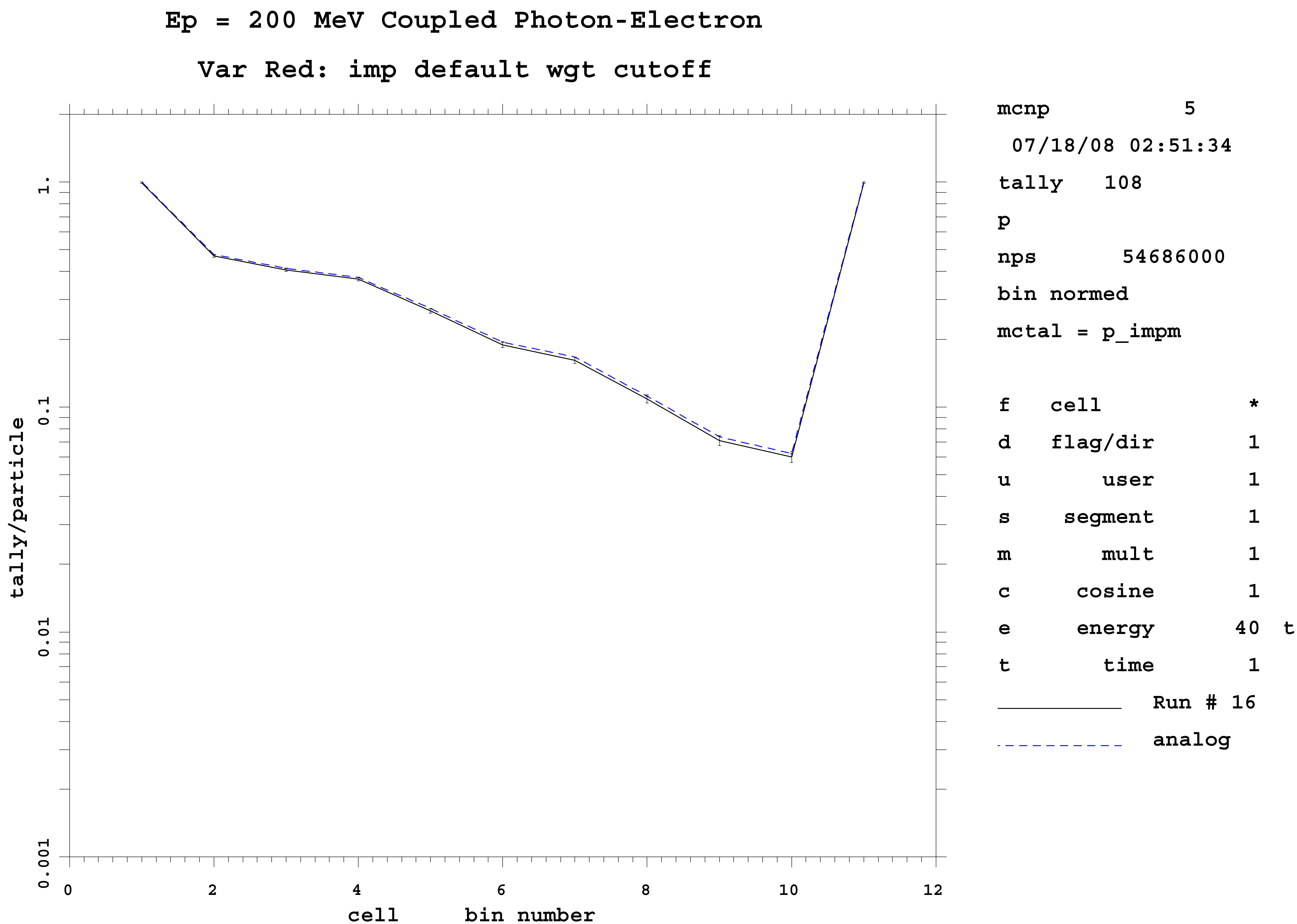


Ep = 200 MeV Coupled Photon-Electron
Var Red: cell ext fcl def wgt cutoff
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/20/08 22:29:52
tally 108
p
nps 599368000
bin normed
mctal = p_cell_ext_fcl_def
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 13
analog

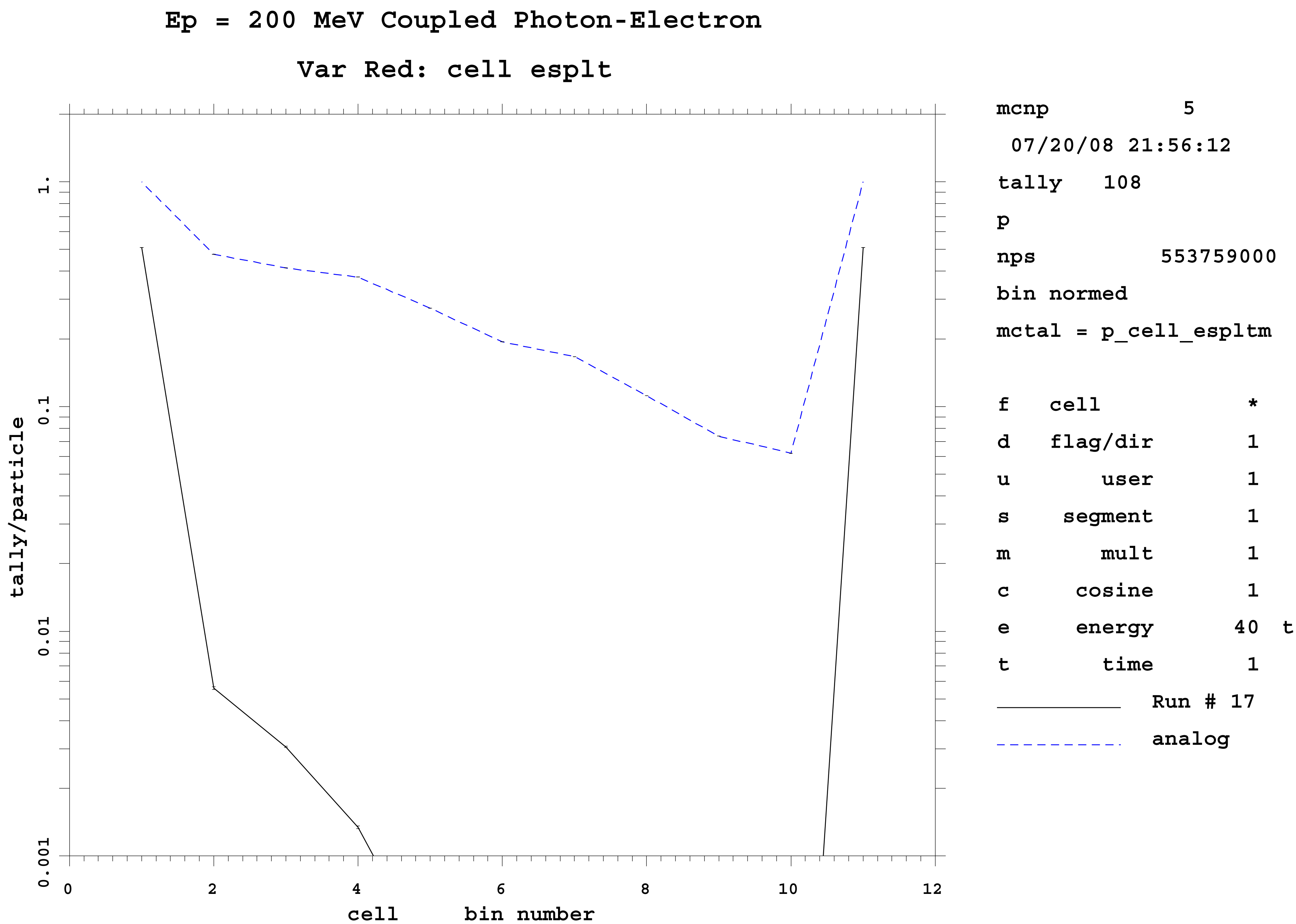

Ep = 200 MeV Coupled Photon-Electron
Var Red: cell dxt ext fcl weight cutoff
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/22/08 19:00:14
tally 108
p
nps 491520000
bin normed
mctal = p_cell_ext_fcl_dxt
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 14
analog



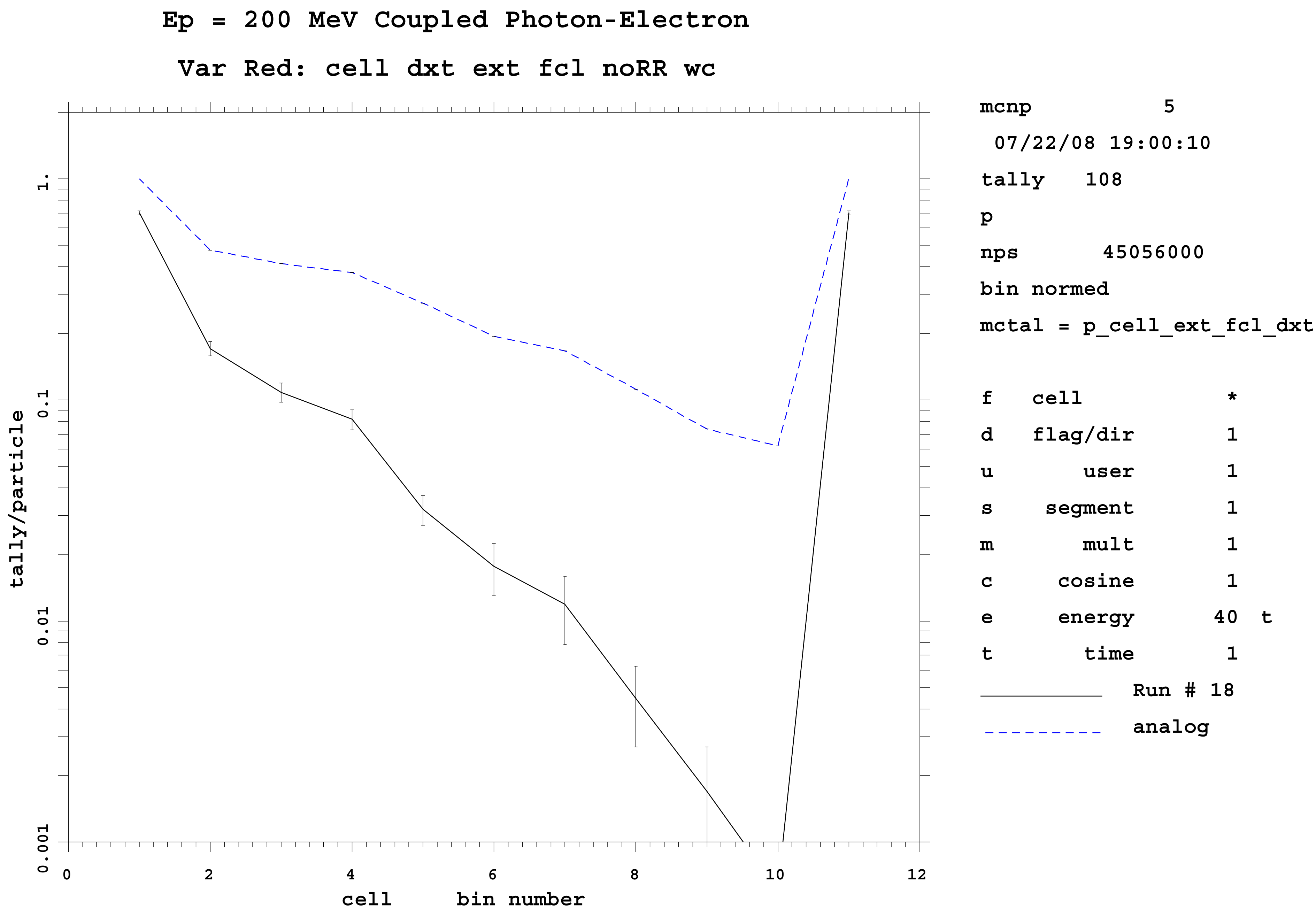
Ep = 200 MeV Coupled Photon-Electron
Var Red: dxt default wgt cutoff
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/22/08 19:00:15
tally 108
p
nps 85666000
bin normed
mctal = p_dxtm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 15
analog

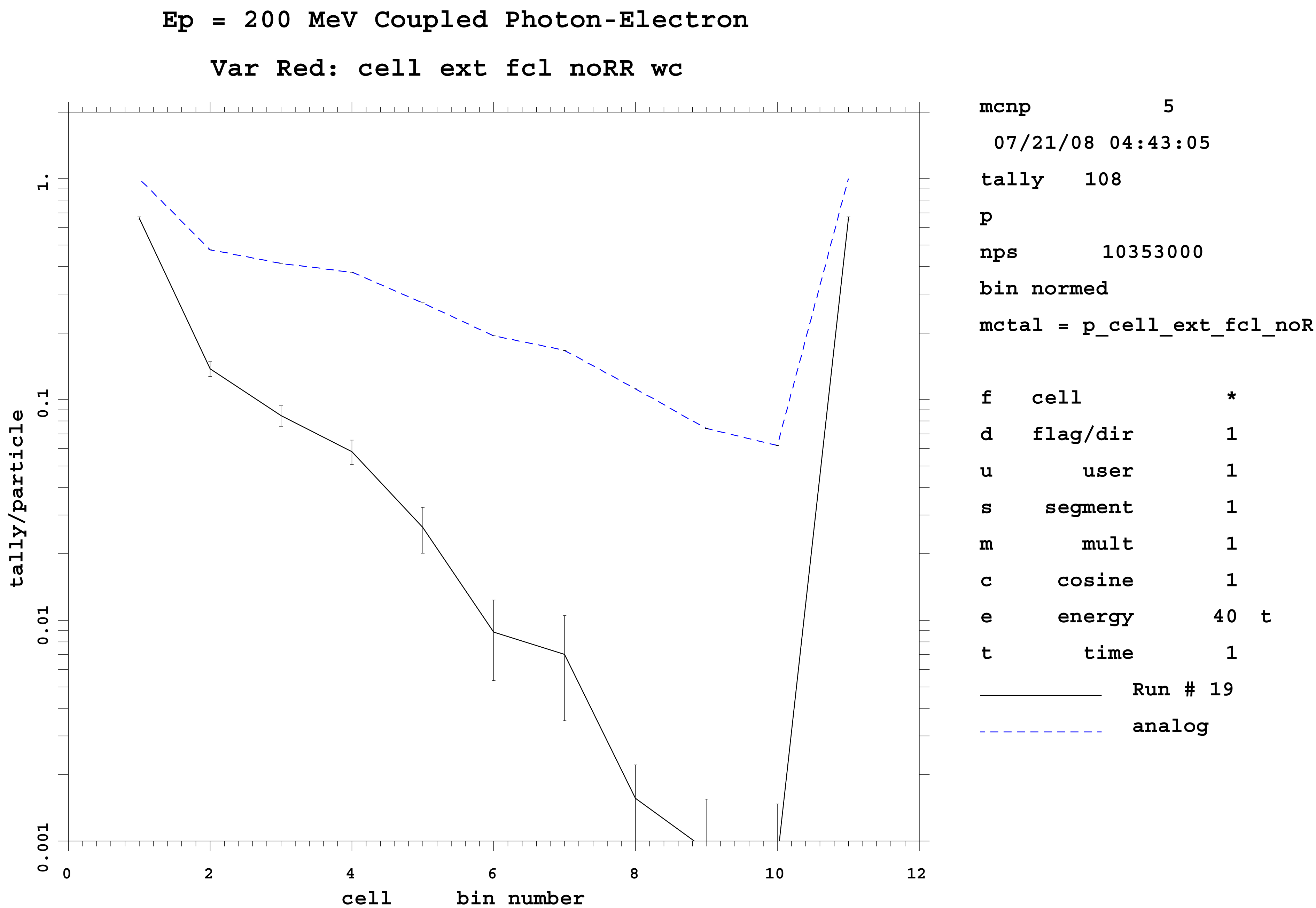


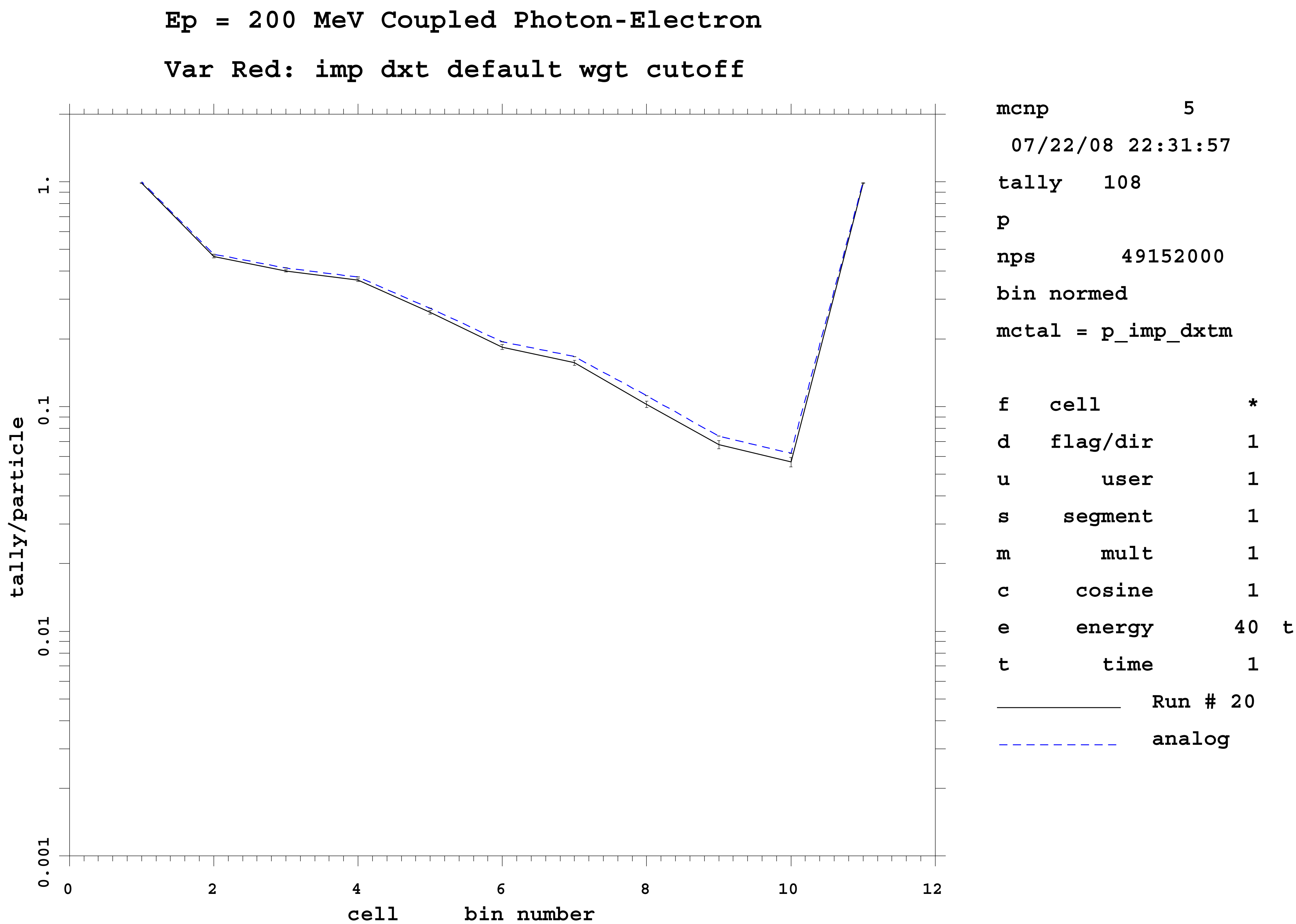
Ep = 200 MeV Coupled Photon-Electron
Var Red: imp default wgt cutoff
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/18/08 02:51:34
tally 108
p
nps 54686000
bin normed
mctal = p_impm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 16
analog



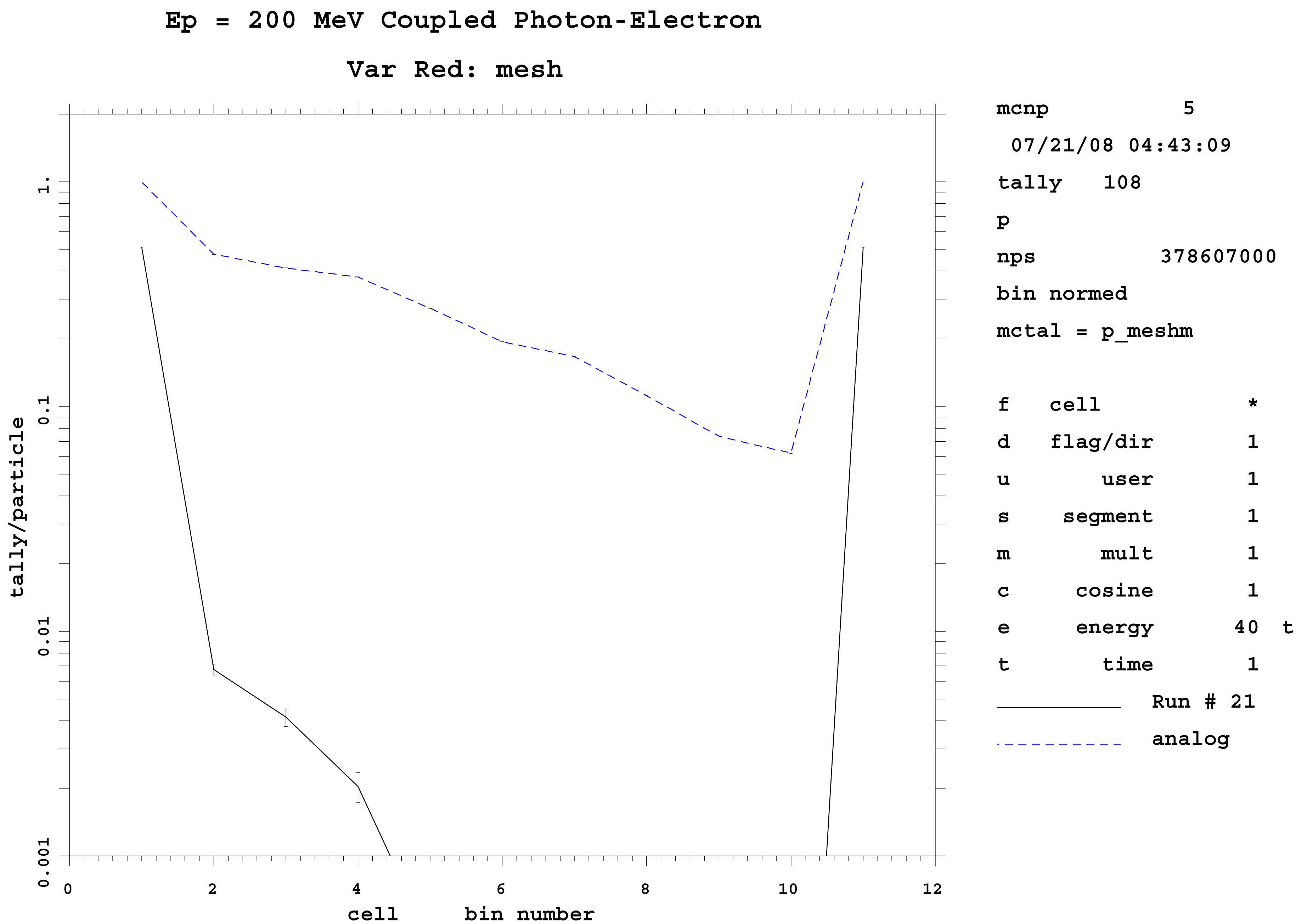
Ep = 200 MeV Coupled Photon-Electron
Var Red: cell espltt
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/20/08 21:56:12
tally 108
p
nps 553759000
bin normed
mctal = p_cell_espltm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 17
analog


Ep = 200 MeV Coupled Photon-Electron
Var Red: cell dxt ext fcl noRR wc
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/22/08 19:00:10
tally 108
p
nps 45056000
bin normed
mctal = p_cell_ext_fcl_dxt
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 18
analog

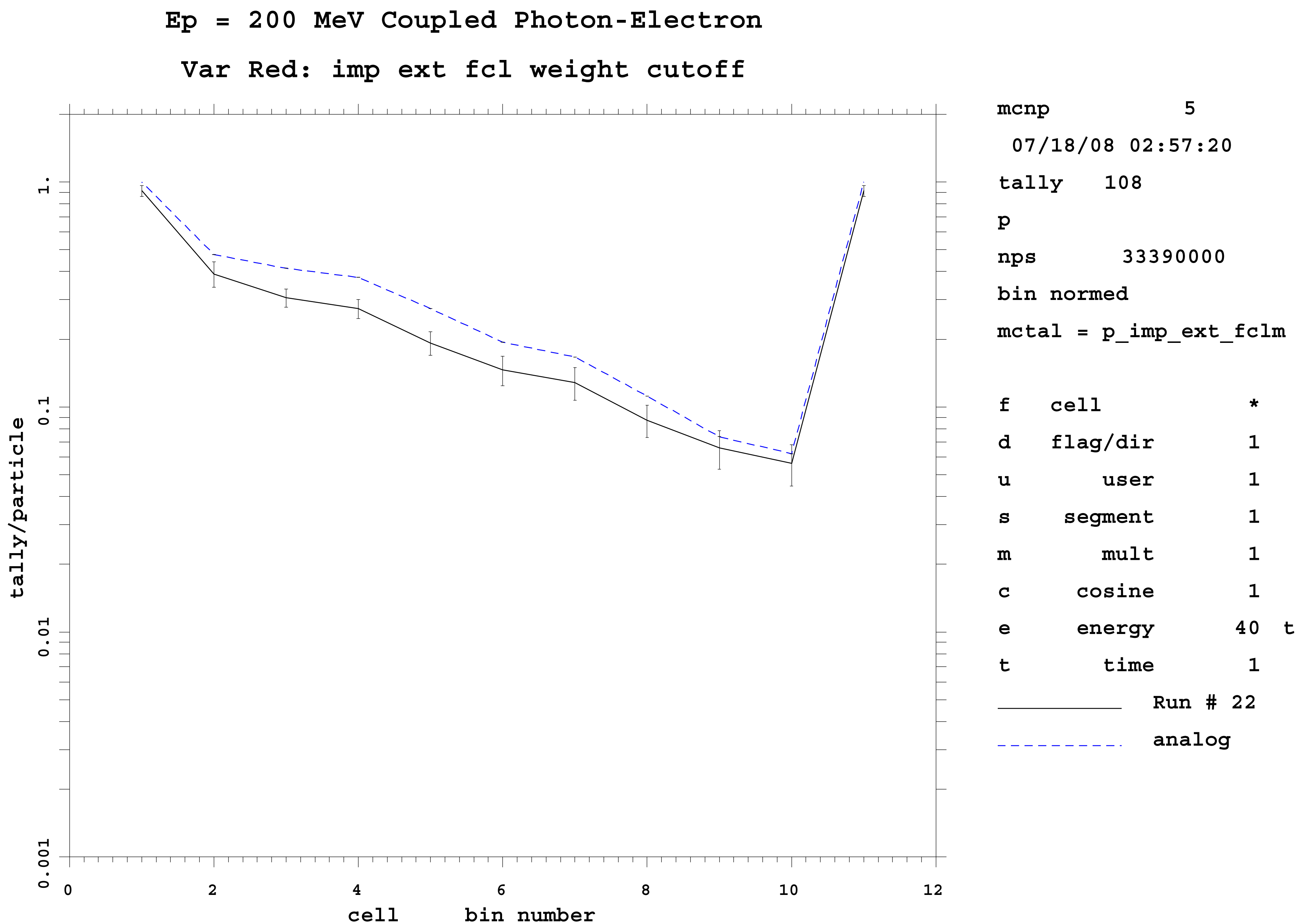

Ep = 200 MeV Coupled Photon-Electron
Var Red: cell ext fcl noRR wc
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/21/08 04:43:05
tally 108
p
nps 10353000
bin normed
mctal = p_cell_ext_fcl_noR
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 19
analog



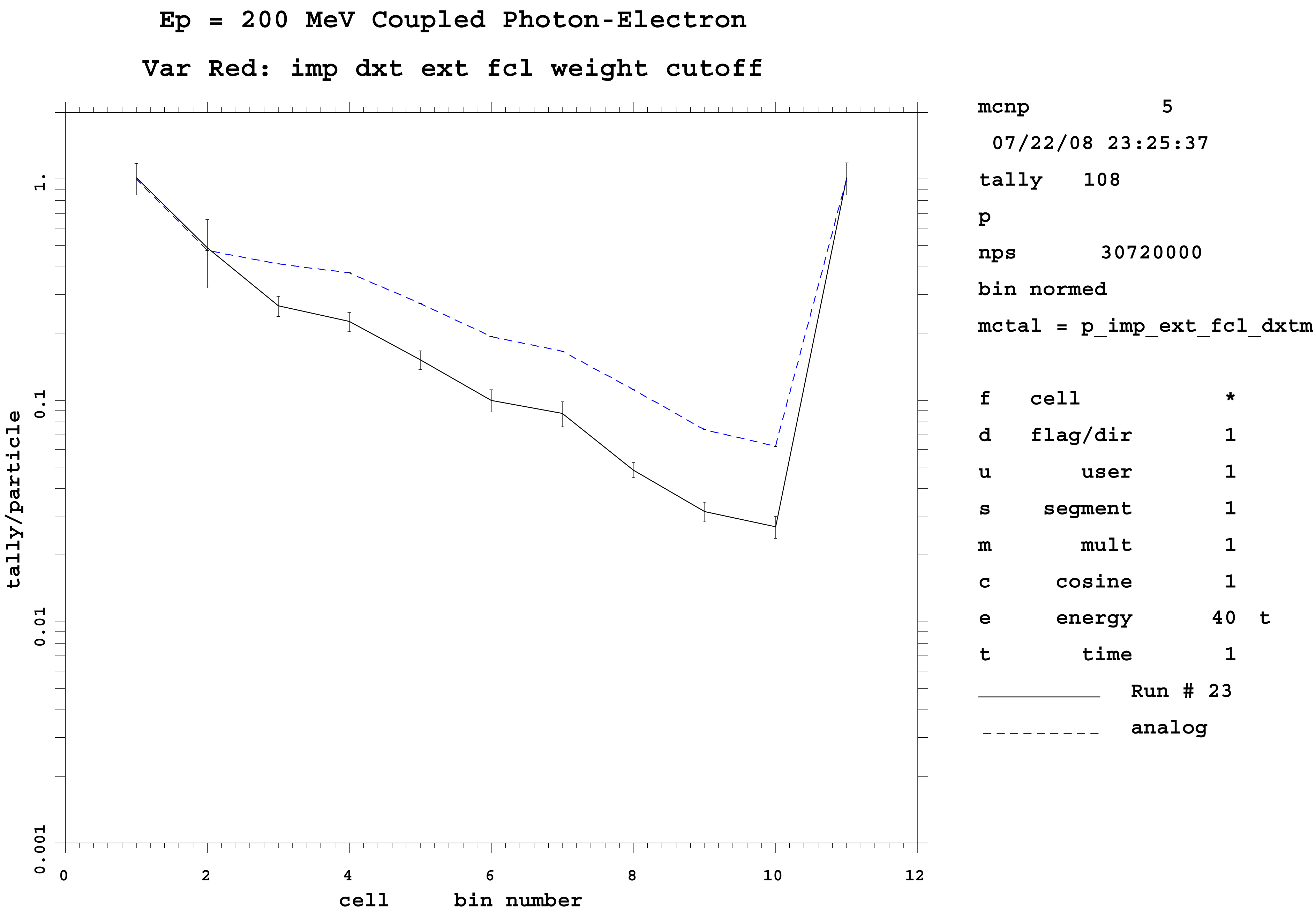
Ep = 200 MeV Coupled Photon-Electron
Var Red: imp dxt default wgt cutoff
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/22/08 22:31:57
tally 108
p
nps 49152000
bin normed
mctal = p_imp_dxtm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 20
analog



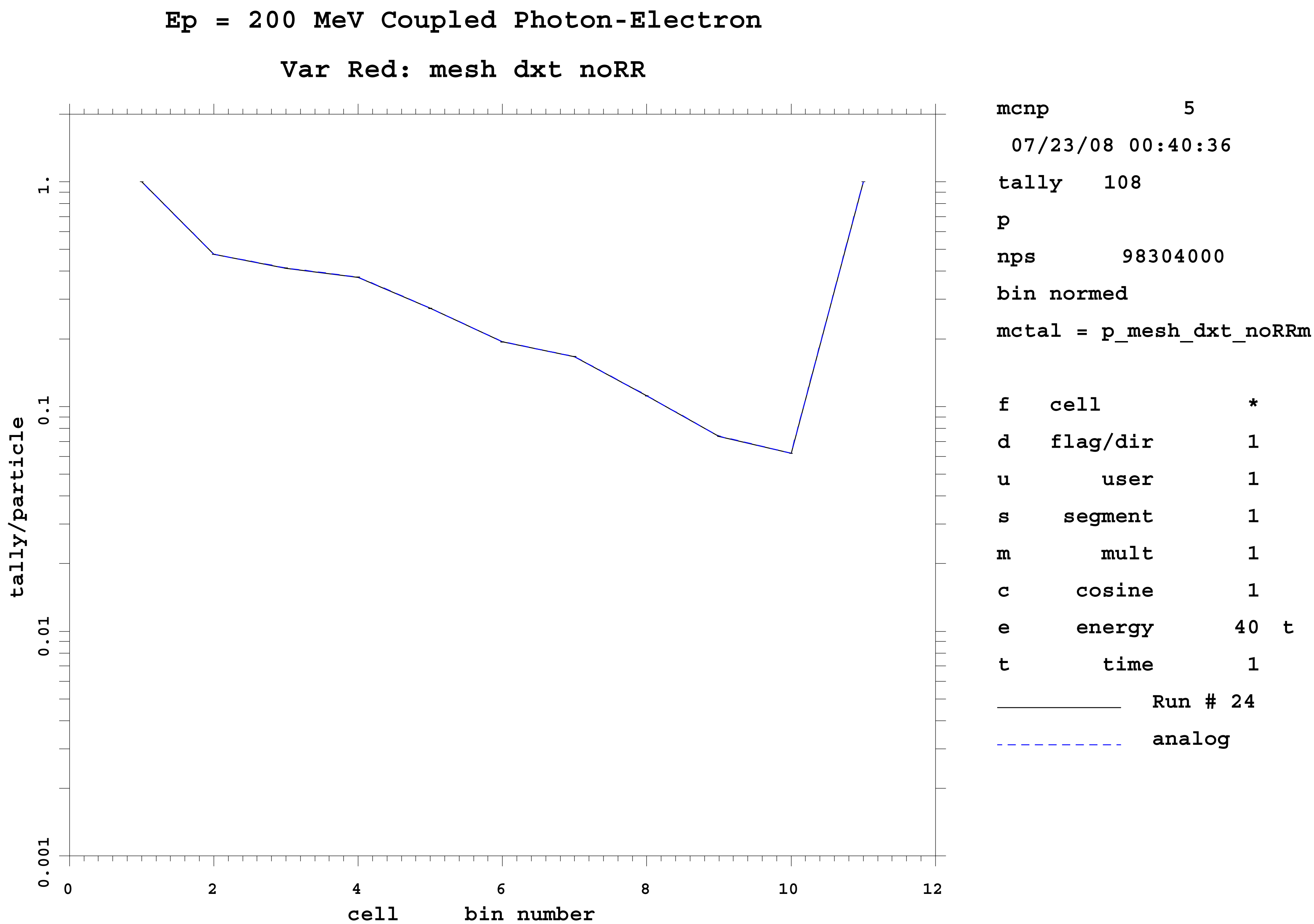
Ep = 200 MeV Coupled Photon-Electron
Var Red: mesh
mcnp 5
07/21/08 04:43:09
tally 108
p
nps 378607000
bin normed
mctal = p_meshm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 21
analog
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number

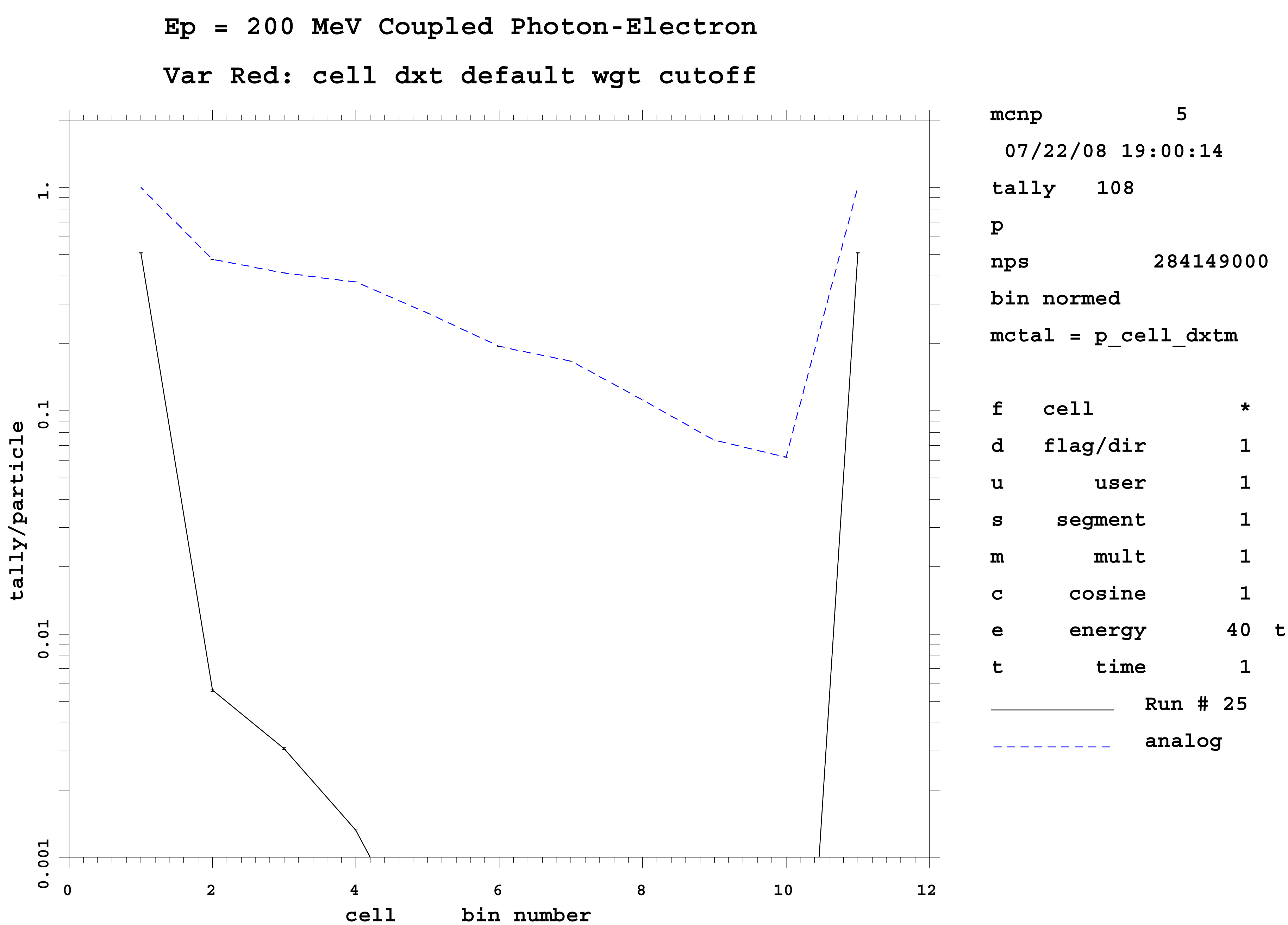


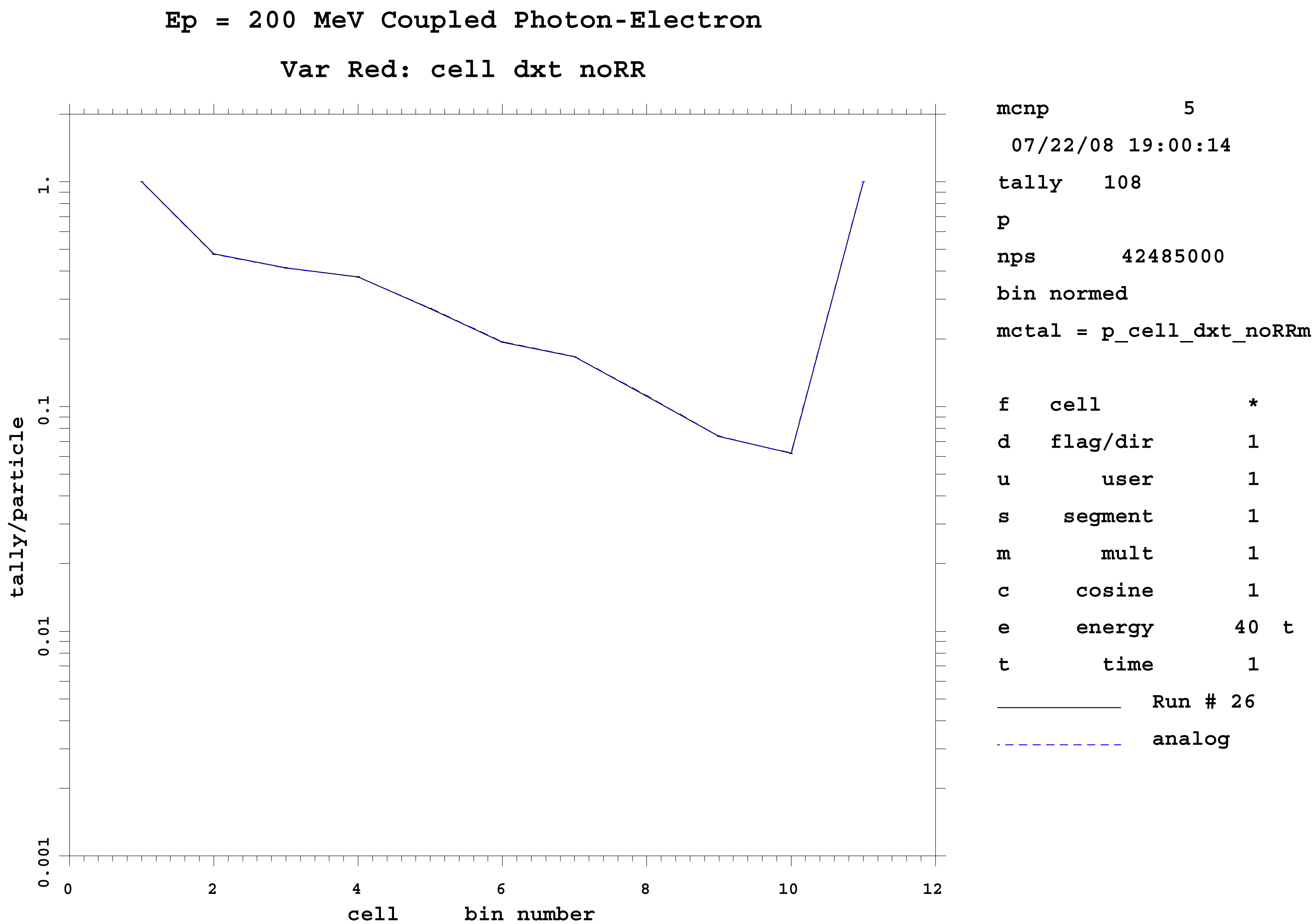
Ep = 200 MeV Coupled Photon-Electron
Var Red: imp ext fcl weight cutoff
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/18/08 02:57:20
tally 108
p
nps 33390000
bin normed
mctal = p_imp_ext_fclm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 22
analog



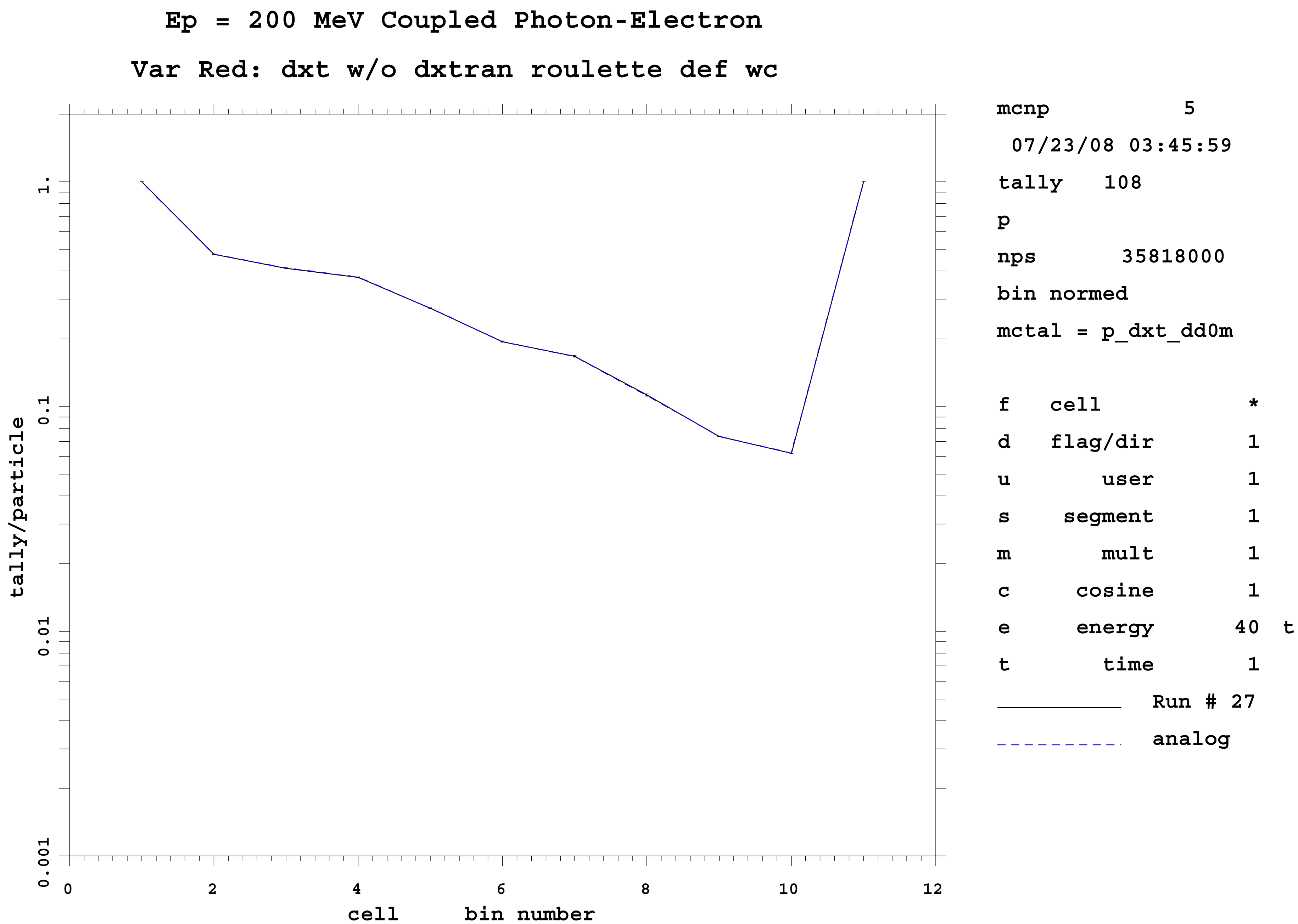
Ep = 200 MeV Coupled Photon-Electron
Var Red: imp dxt ext fcl weight cutoff
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/22/08 23:25:37
tally 108
p
nps 30720000
bin normed
mctal = p_imp_ext_fcl_dxtm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 23
analog


Ep = 200 MeV Coupled Photon-Electron
Var Red: mesh dxt noRR
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/23/08 00:40:36
tally 108
p
nps 98304000
bin normed
mctal = p_mesh_dxt_noRRm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 24
analog


Ep = 200 MeV Coupled Photon-Electron
Var Red: cell dxt default wgt cutoff
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/22/08 19:00:14
tally 108
p
nps 284149000
bin normed
mctal = p_cell_dxtm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 25
analog



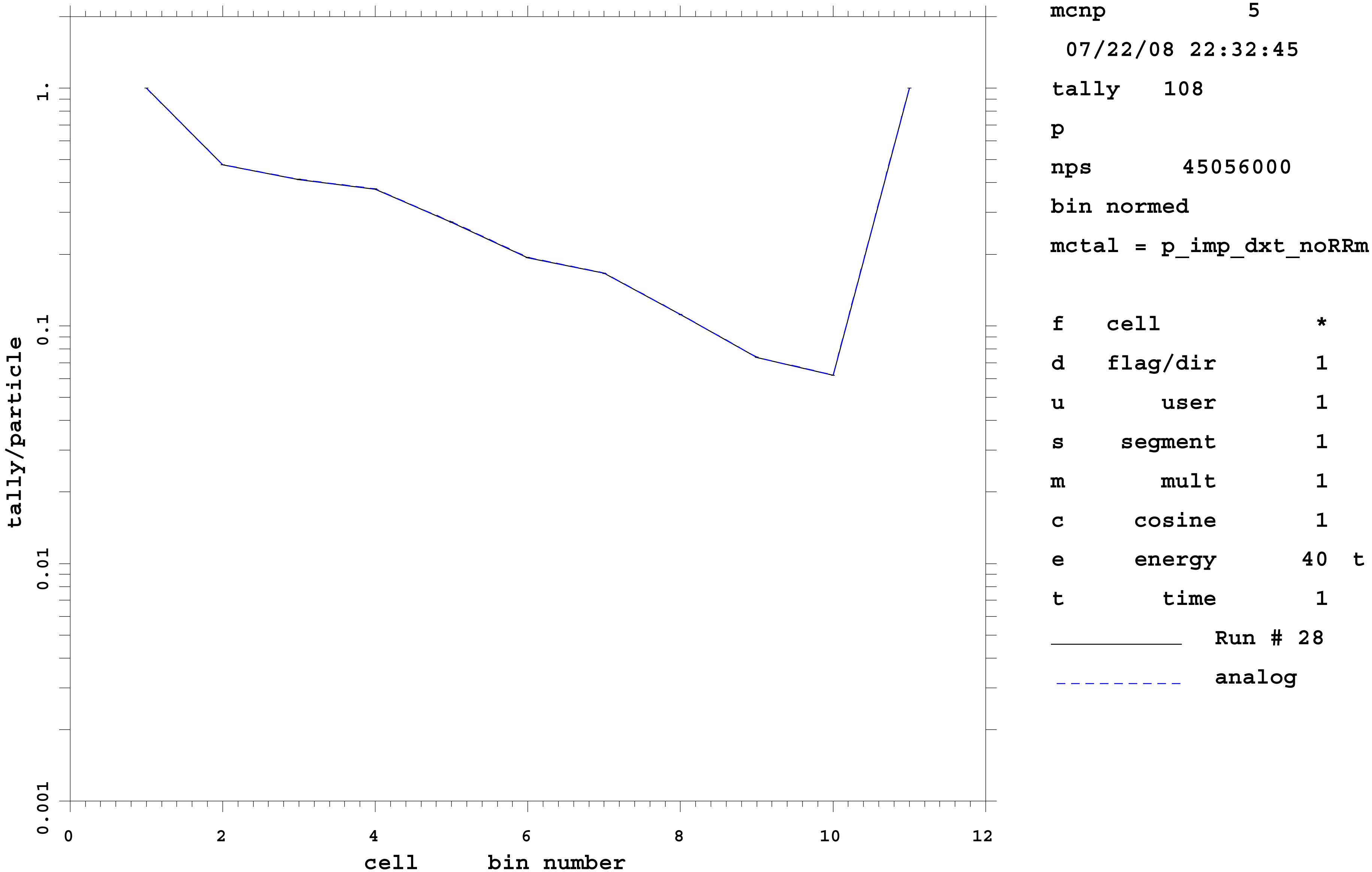
Ep = 200 MeV Coupled Photon-Electron
Var Red: cell dxt noRR
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/22/08 19:00:14
tally 108
p
nps 42485000
bin normed
mctal = p_cell_dxt_noRRm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 26
analog

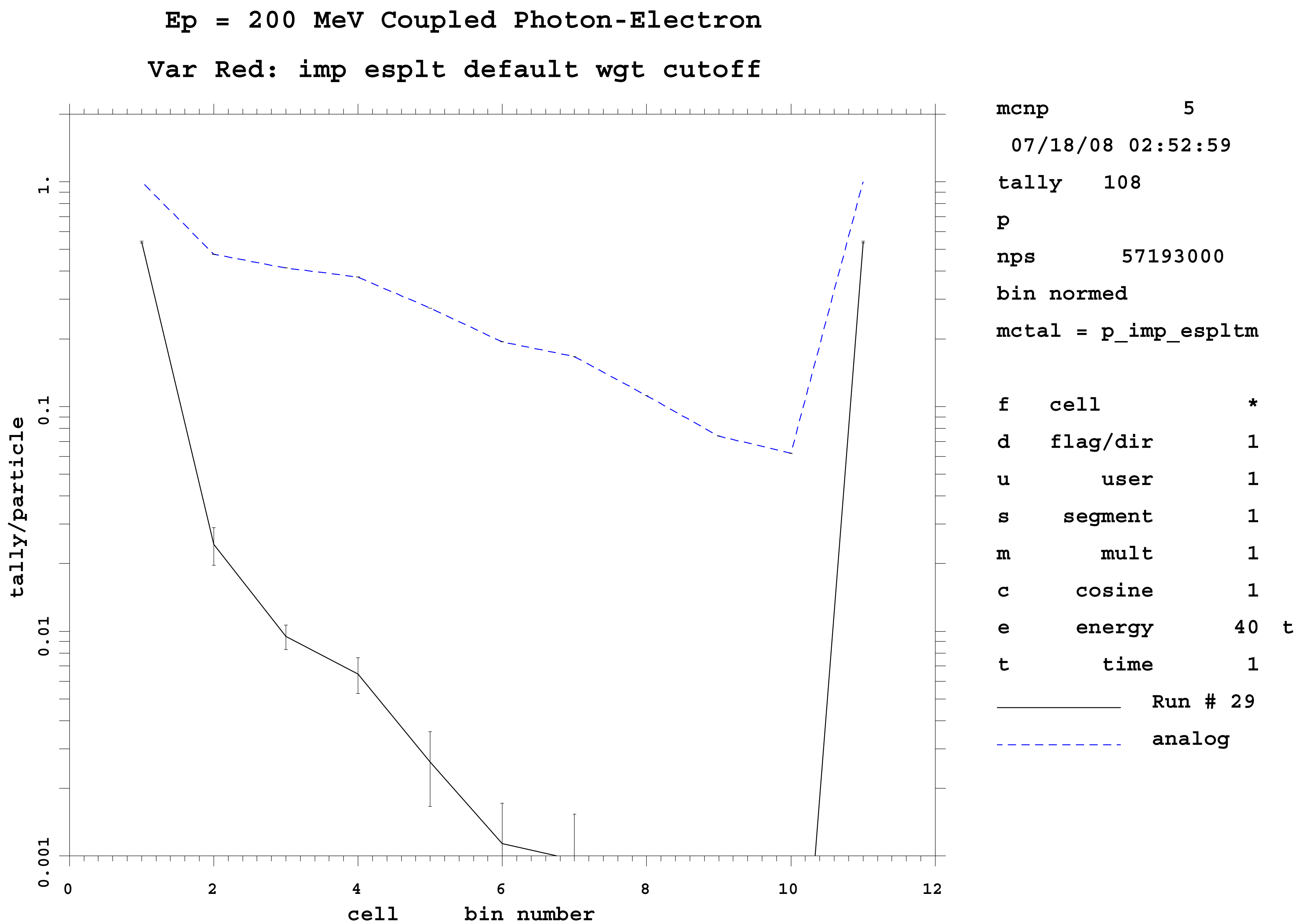


Ep = 200 MeV Coupled Photon-Electron
Var Red: dxt w/o dxtran roulette def wc
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/23/08 03:45:59
tally 108
p
nps 35818000
bin normed
mctal = p_dxt_dd0m
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 27
analog

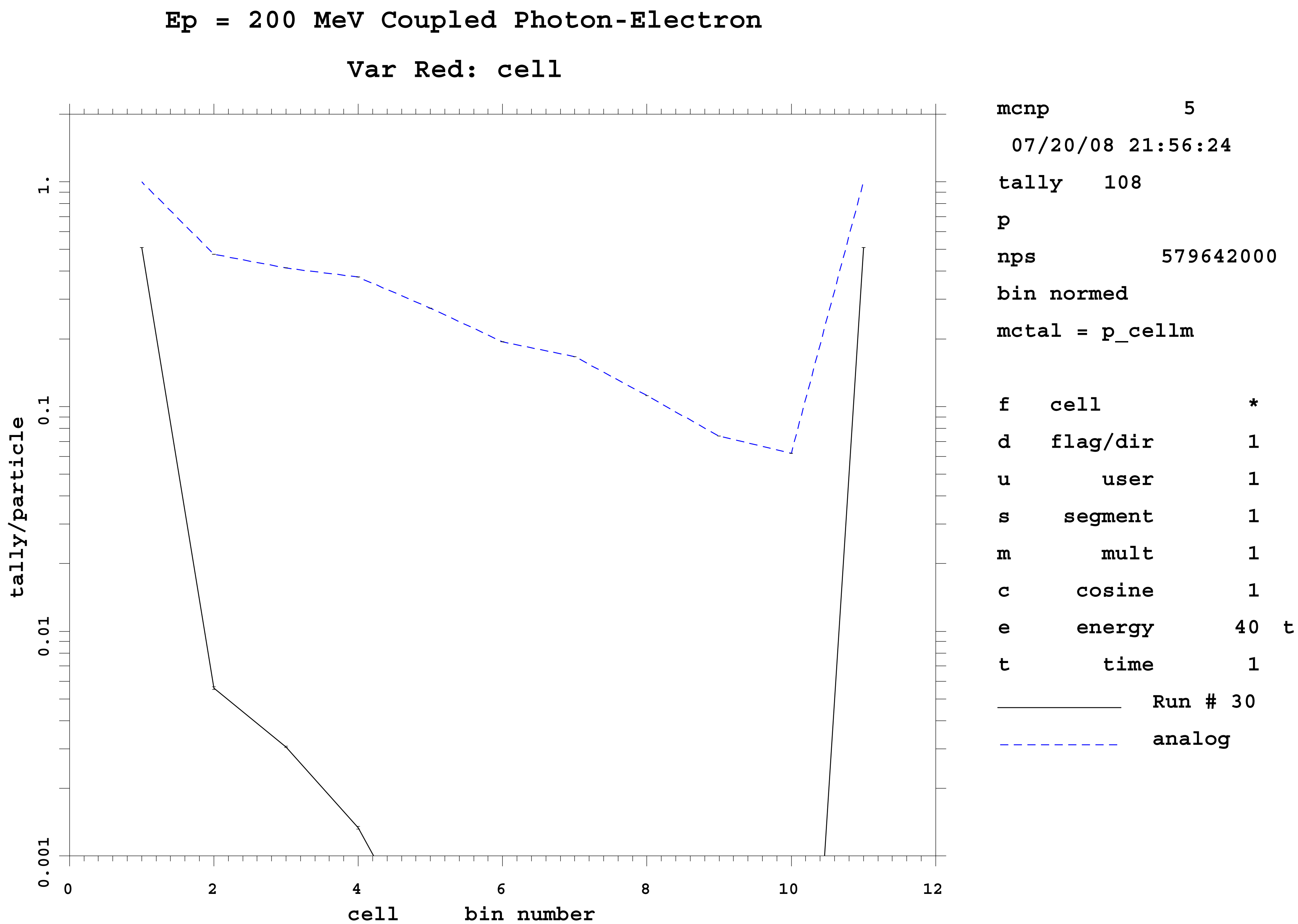
Ep = 200 MeV Coupled Photon-Electron

Var Red: imp dxt noRR

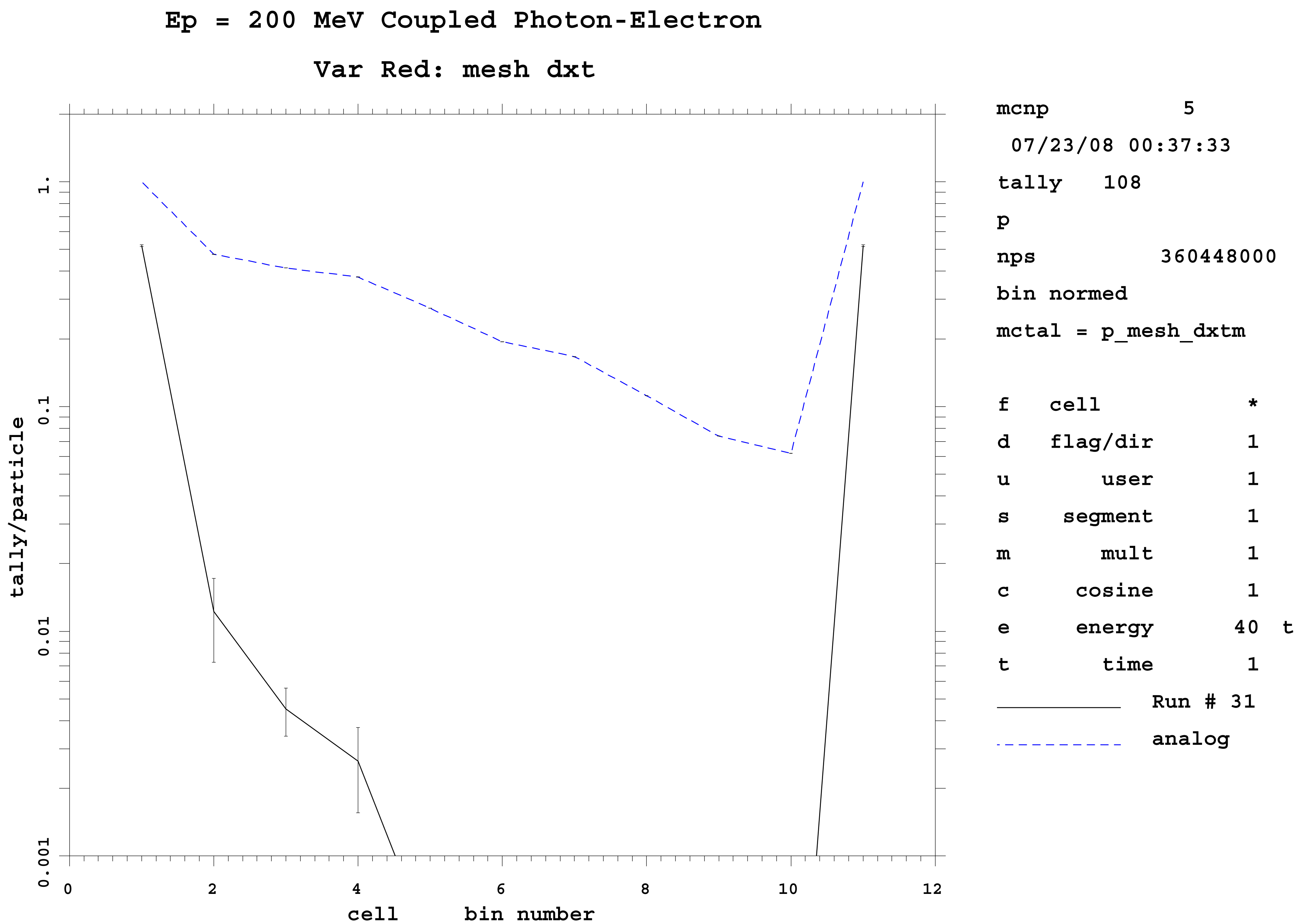




Ep = 200 MeV Coupled Photon-Electron
Var Red: imp esplt default wgt cutoff
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/18/08 02:52:59
tally 108
p
nps 57193000
bin normed
mctal = p_imp_espltm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 29
analog



Ep = 200 MeV Coupled Photon-Electron
Var Red: cell
tally/particle
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
cell bin number
mcnp 5
07/20/08 21:56:24
tally 108
p
nps 579642000
bin normed
mctal = p_cellm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 30
analog

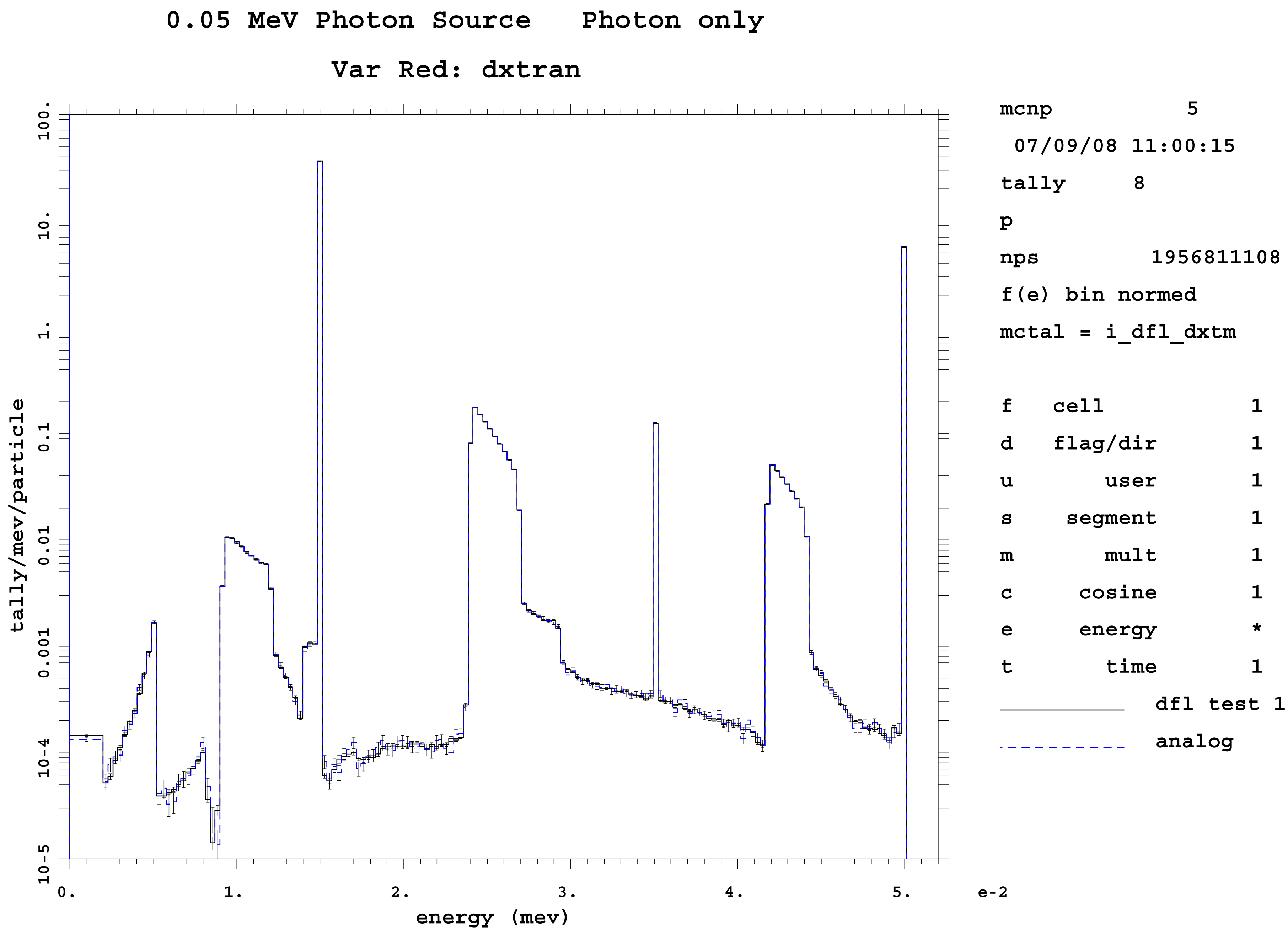

Ep = 200 MeV Coupled Photon-Electron
Var Red: mesh dxt
tally/particle
cell bin number
1.
0.1
0.01
0.001
0
2
4
6
8
10
12
mcnp 5
07/23/08 00:37:33
tally 108
p
nps 360448000
bin normed
mctal = p_mesh_dxtm
f cell *
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy 40 t
t time 1
Run # 31
analog

Appendix B

Problem 2
Uranium Sphere Surrounded By a Uranium Shell

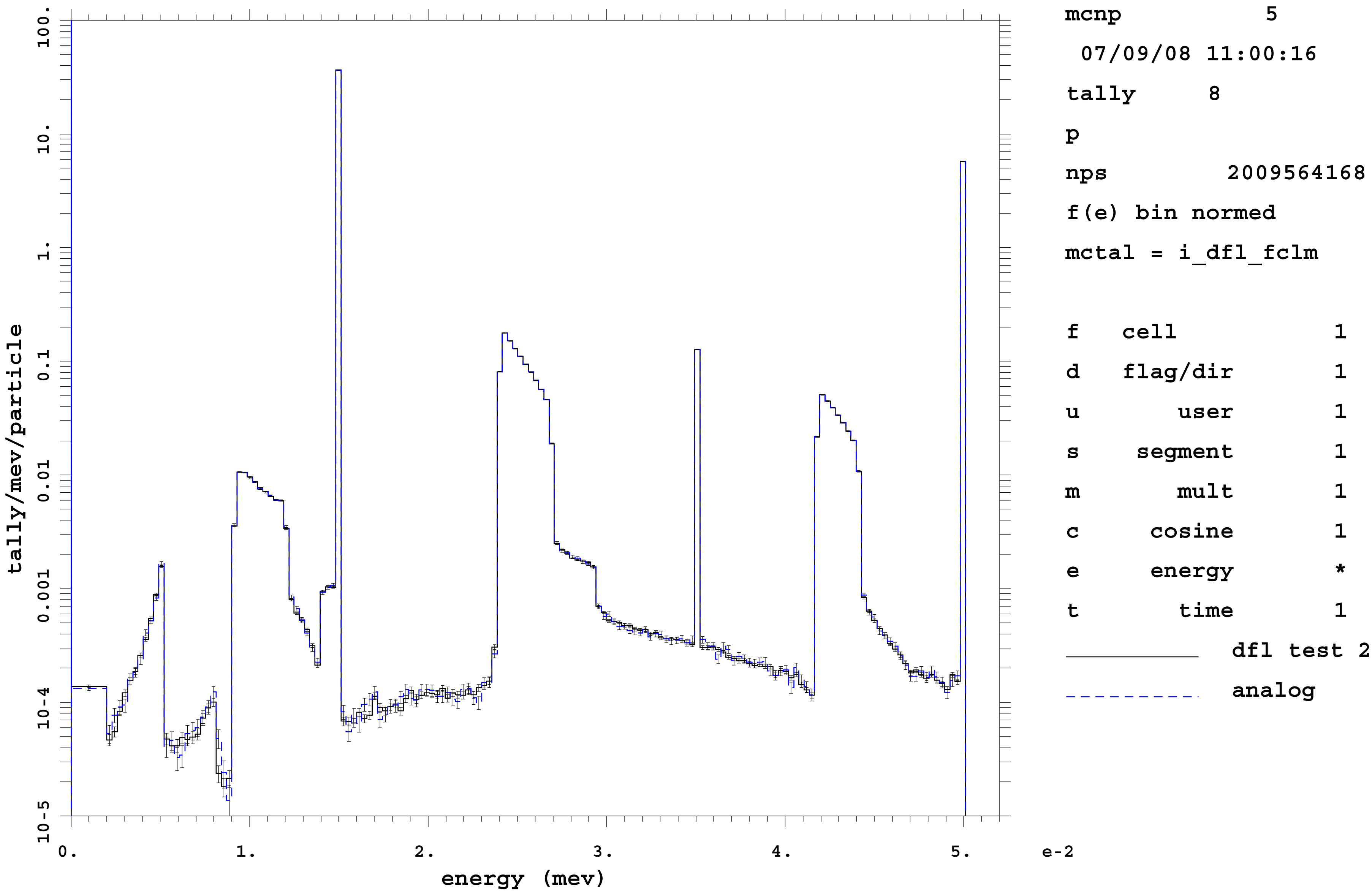
Pulse Height Tally Spectra for the Uranium Sphere

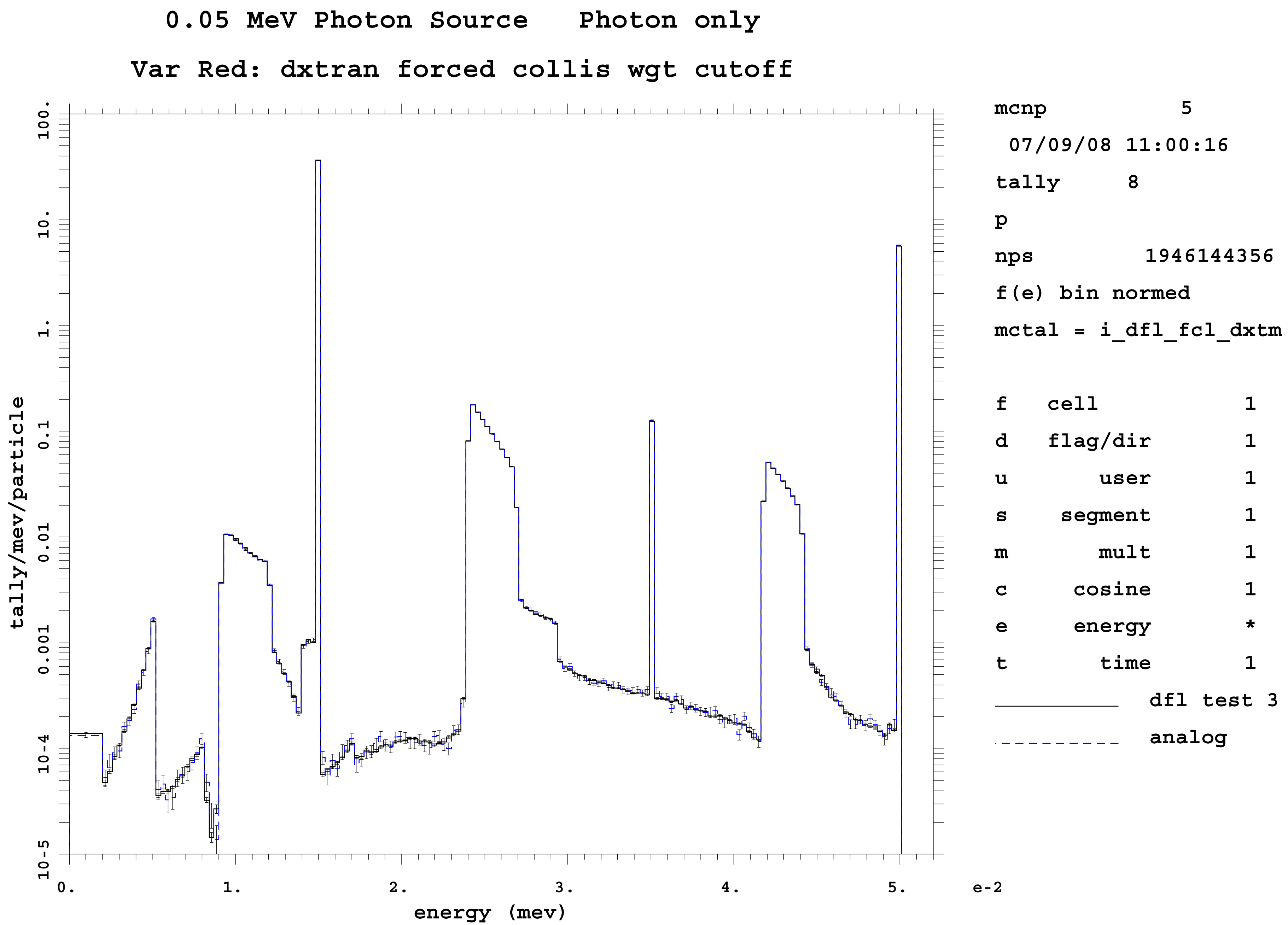
Plot Number	**Plot Title**
	0.05 MeV Photon Source Photon only
1	Var Red: dxtran
2	Var Red: forced collisions wgt cutoffs
3	Var Red: dxtran forced collis wgt cutoff
4	Analog using PHTVR
	0.2 MeV Photon Source Photon only
5	Var Red: dxtran
6	Var Red: forced collisions wgt cutoffs
7	Var Red: dxtran forced collis wgt cutoff
8	Analog using PHTVR
	2.75 MeV Photon Source Photon only
9	Var Red: dxtran
10	Var Red: forced collisions wgt cutoffs
11	Var Red: dxtran forced collis wgt cutoff
12	Analog using PHTVR
	0.2 Electron Source Photon-Electron Mode
13	Var Red: dxtran
14	Var Red: forced collisions wgt cutoffs
15	Var Red: dxtran forced collis wgt cutoff
16	Analog using PHTVR
	2.75 Electron Source Photon-Elect Mode
17	Var Red: dxtran
18	Var Red: forced collisions wgt cutoffs
19	Var Red: dxtran forced collis wgt cutoff
20	Analog using PHTVR


0.05 MeV Photon Source   Photon only
Var Red: dxtran
tally/mev/particle
energy (mev)
e-2
100.
10.
1.
0.1
0.01
0.001
10-4
10-5
0.
1.
2.
3.
4.
5.
mcnp 5
07/09/08 11:00:15
tally 8
p
nps 1956811108
f(e) bin normed
mctal = i_dfl_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
dfl test 1
analog

0.05 MeV Photon Source   Photon only

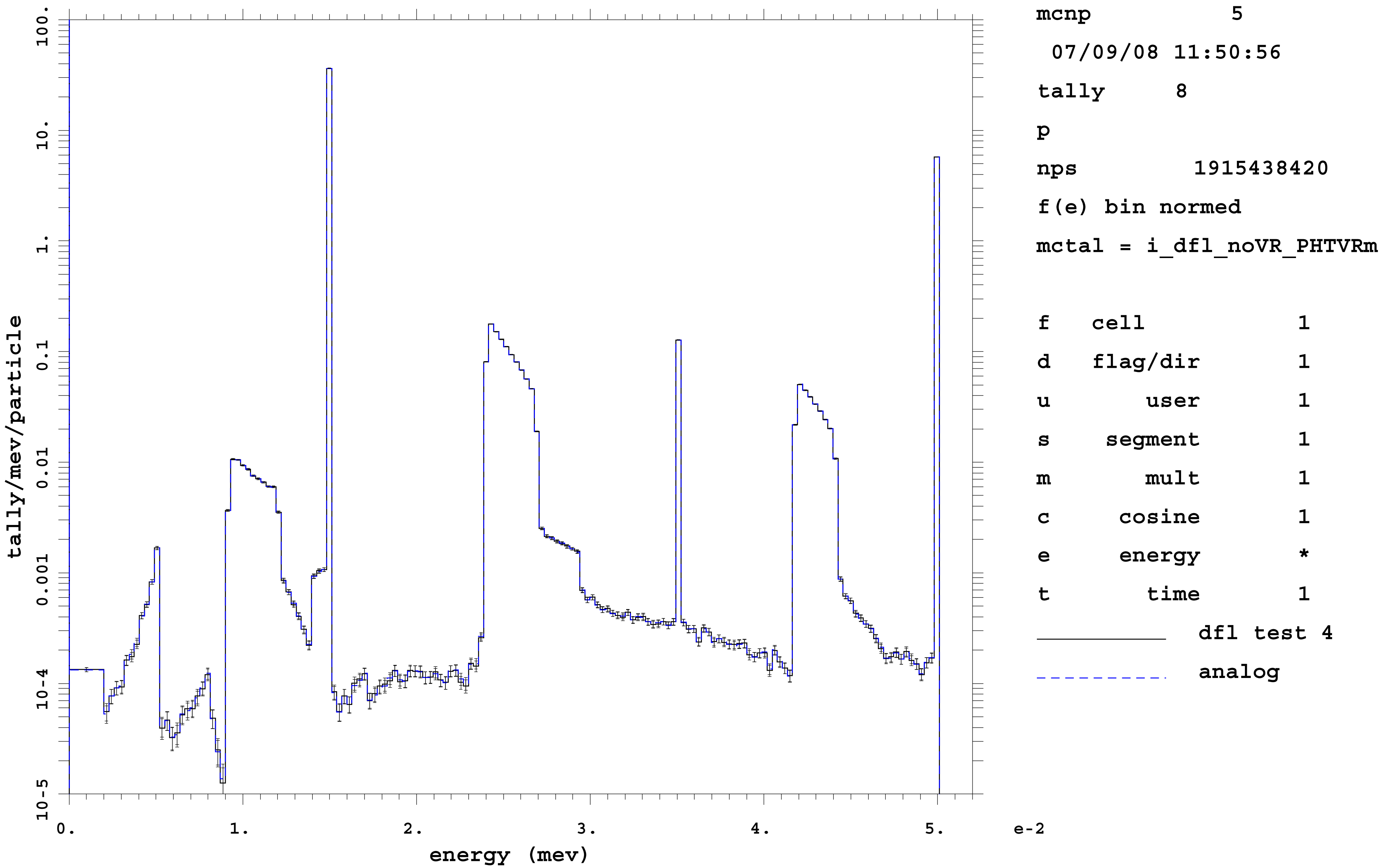
Var Red: forced collisions wgt cutoffs

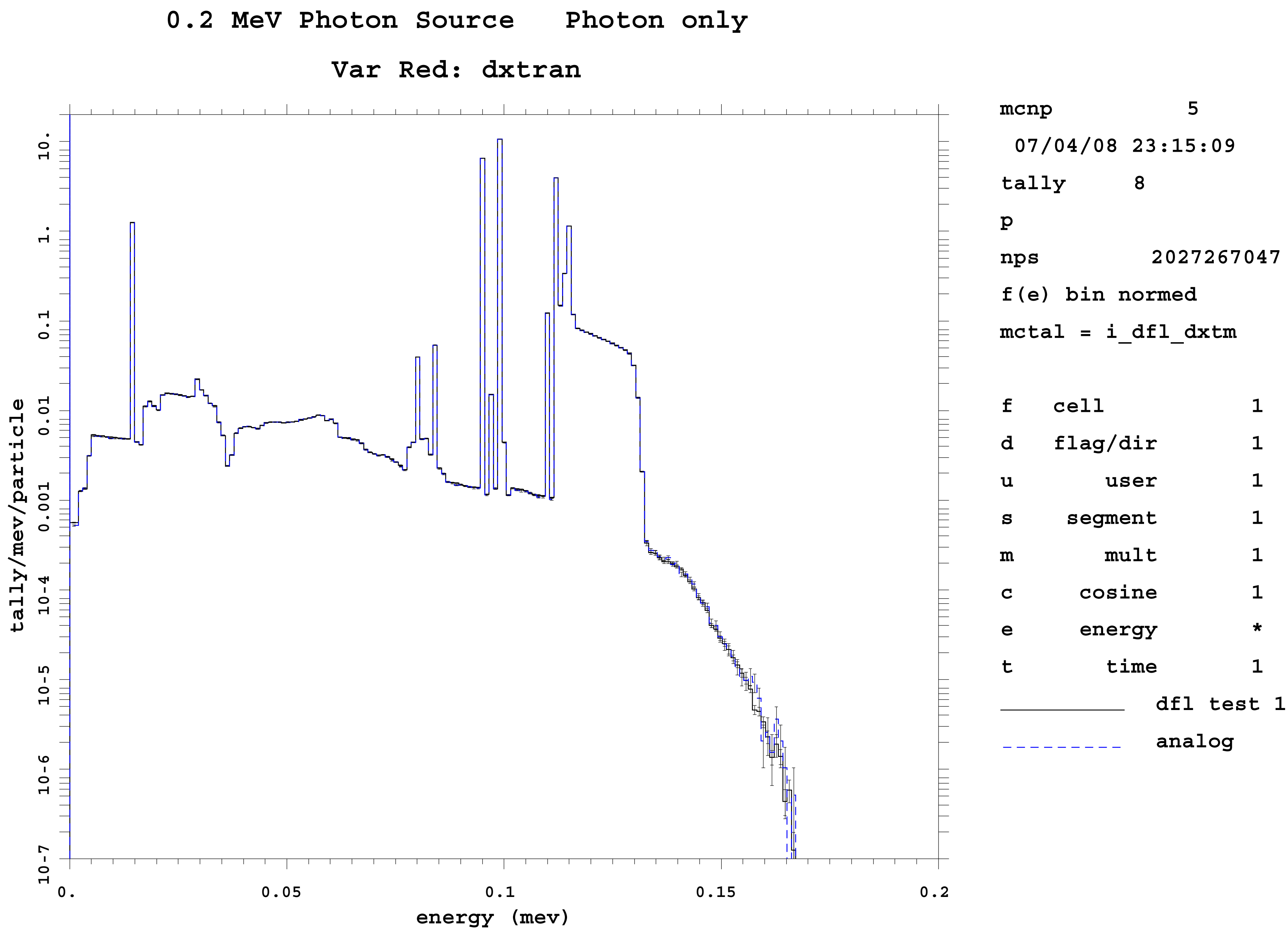


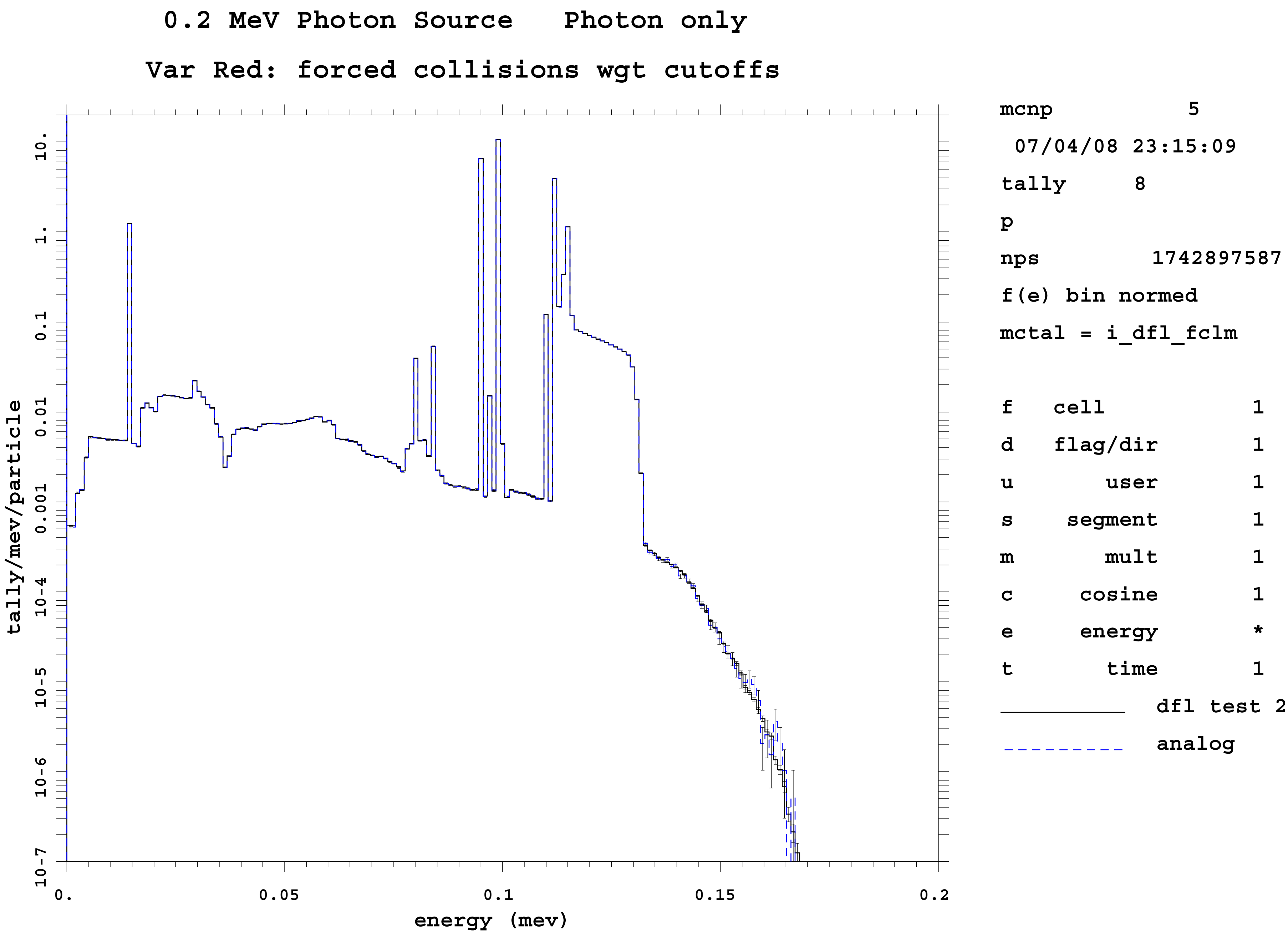

0.05 MeV Photon Source Photon only
Var Red: dxtran forced collis wgt cutoff
mcnp 5
07/09/08 11:00:16
tally 8
p
nps 1946144356
f(e) bin normed
mctal = i_dfl_fcl_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
dfl test 3
analog
tally/mev/particle
100.
10.
1.
0.1
0.01
0.001
10-4
10-5
0.
1.
2.
3.
4.
5.
e-2
energy (mev)

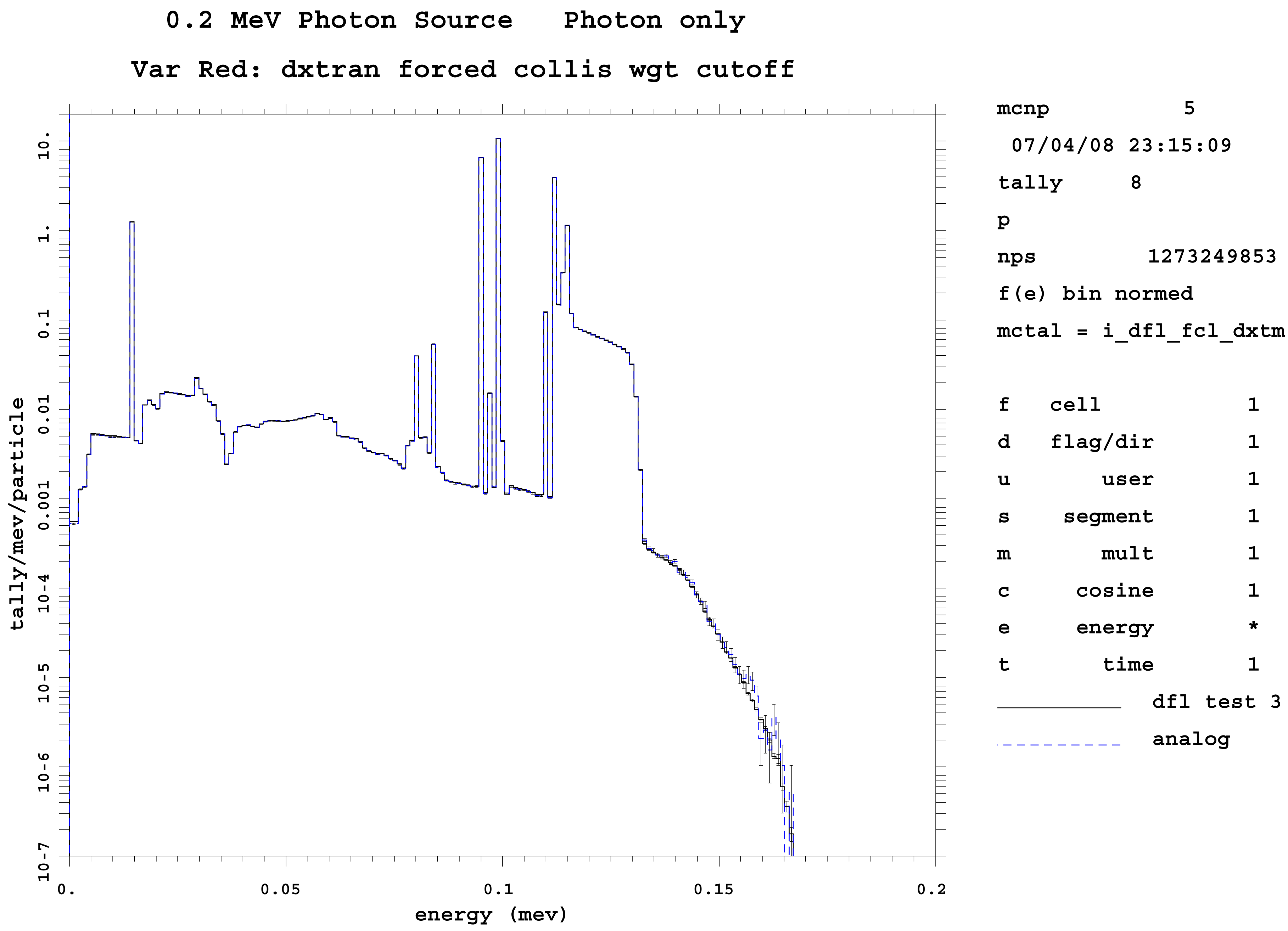
0.05 MeV Photon Source   Photon only

Var Red: analog using PHTVR




0.2 MeV Photon Source Photon only
Var Red: dxtran
tally/mev/particle
energy (mev)
10.
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.
0.05
0.1
0.15
0.2
mcnp 5
07/04/08 23:15:09
tally 8
p
nps 2027267047
f(e) bin normed
mctal = i_dfl_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
dfl test 1
analog

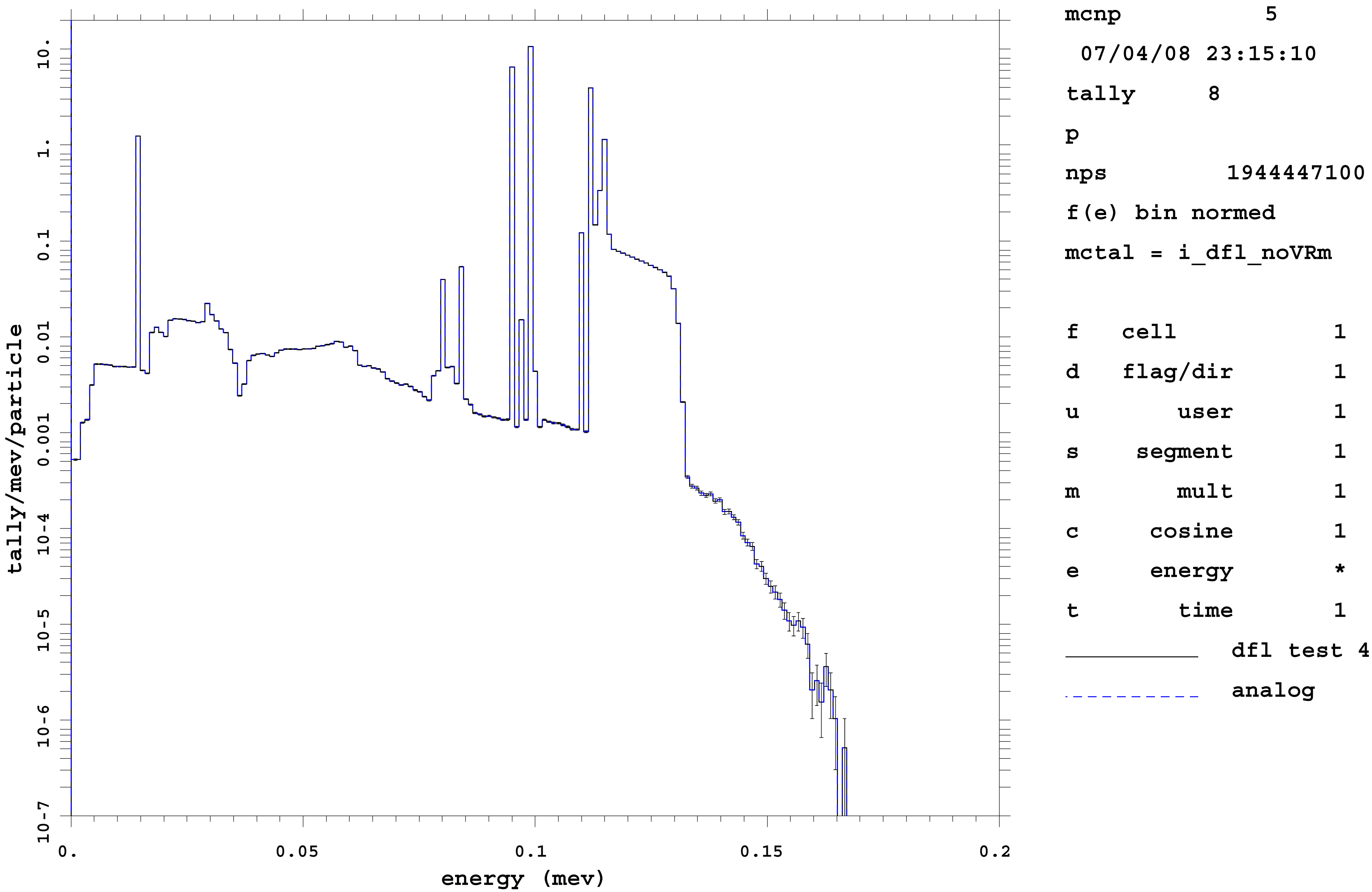

0.2 MeV Photon Source   Photon only
Var Red: forced collisions wgt cutoffs
tally/mev/particle
10.
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.
0.05
0.1
0.15
0.2
energy (mev)
mcnp 5
07/04/08 23:15:09
tally 8
p
nps 1742897587
f(e) bin normed
mctal = i_dfl_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
dfl test 2
analog

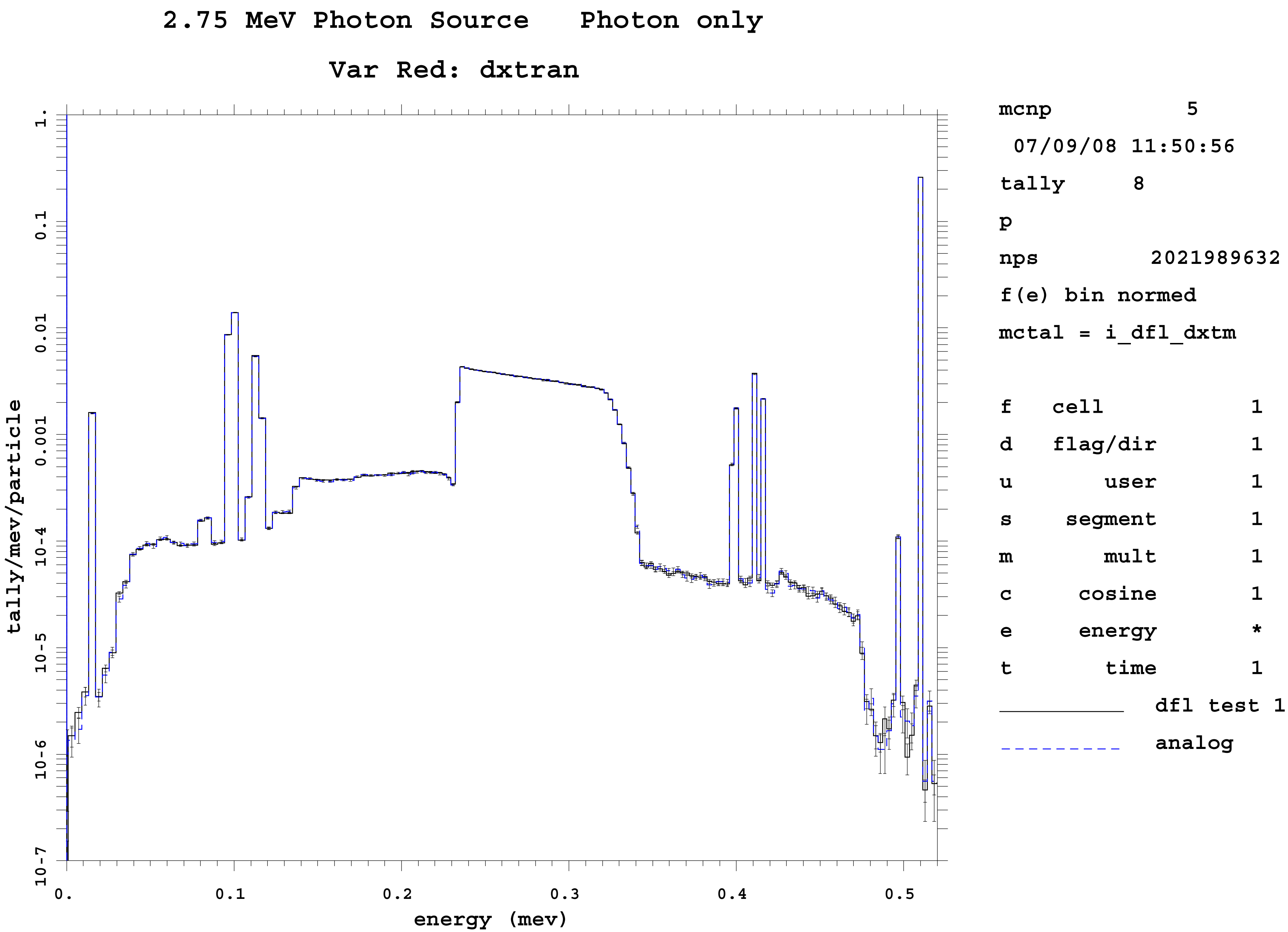


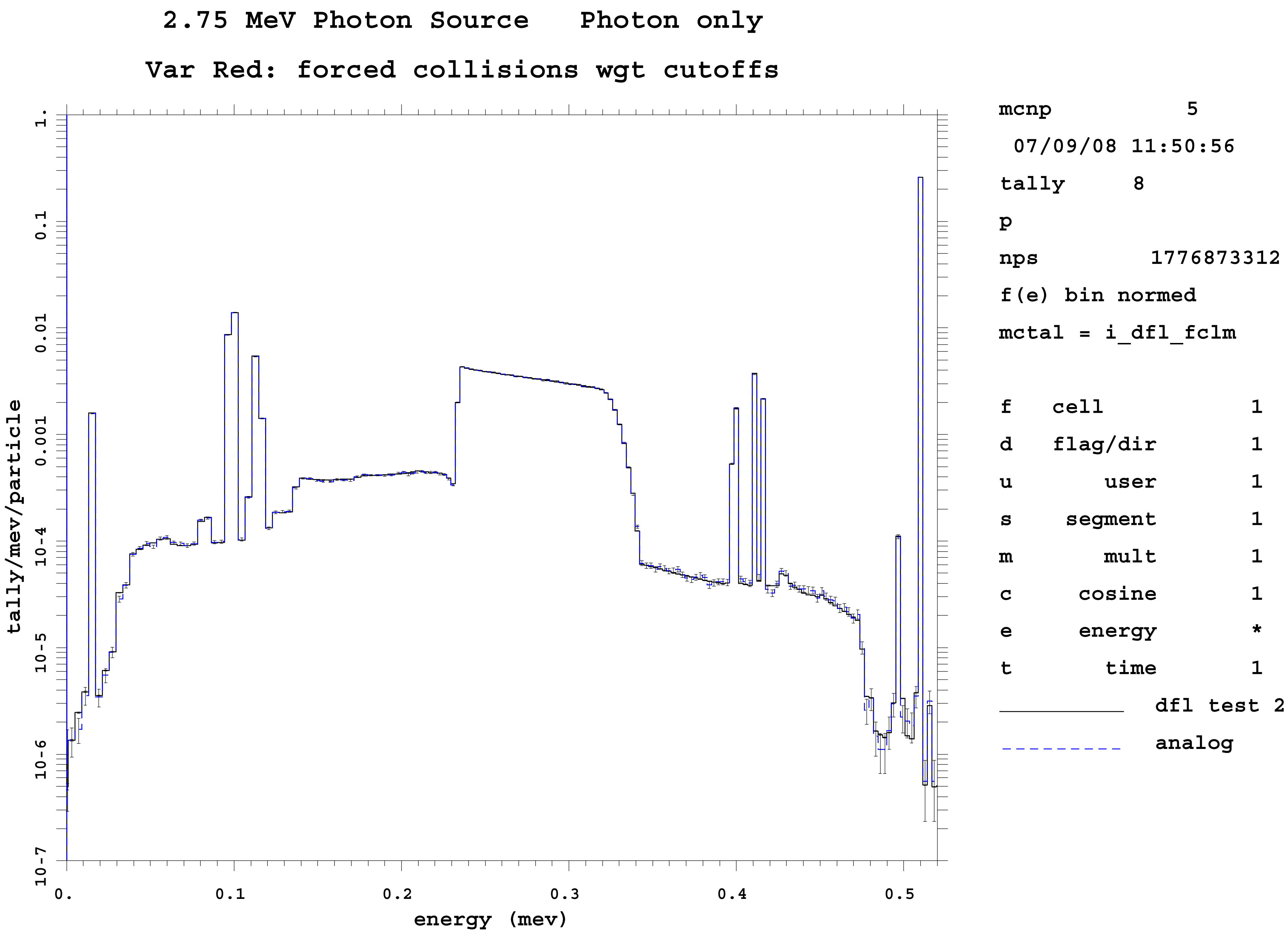
0.2 MeV Photon Source   Photon only
Var Red: dxtran forced collis wgt cutoff
tally/mev/particle
10.
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.
0.05
0.1
0.15
0.2
energy (mev)
mcnp 5
07/04/08 23:15:09
tally 8
p
nps 1273249853
f(e) bin normed
mctal = i_dfl_fcl_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
dfl test 3
analog

0.2 MeV Photon Source   Photon only

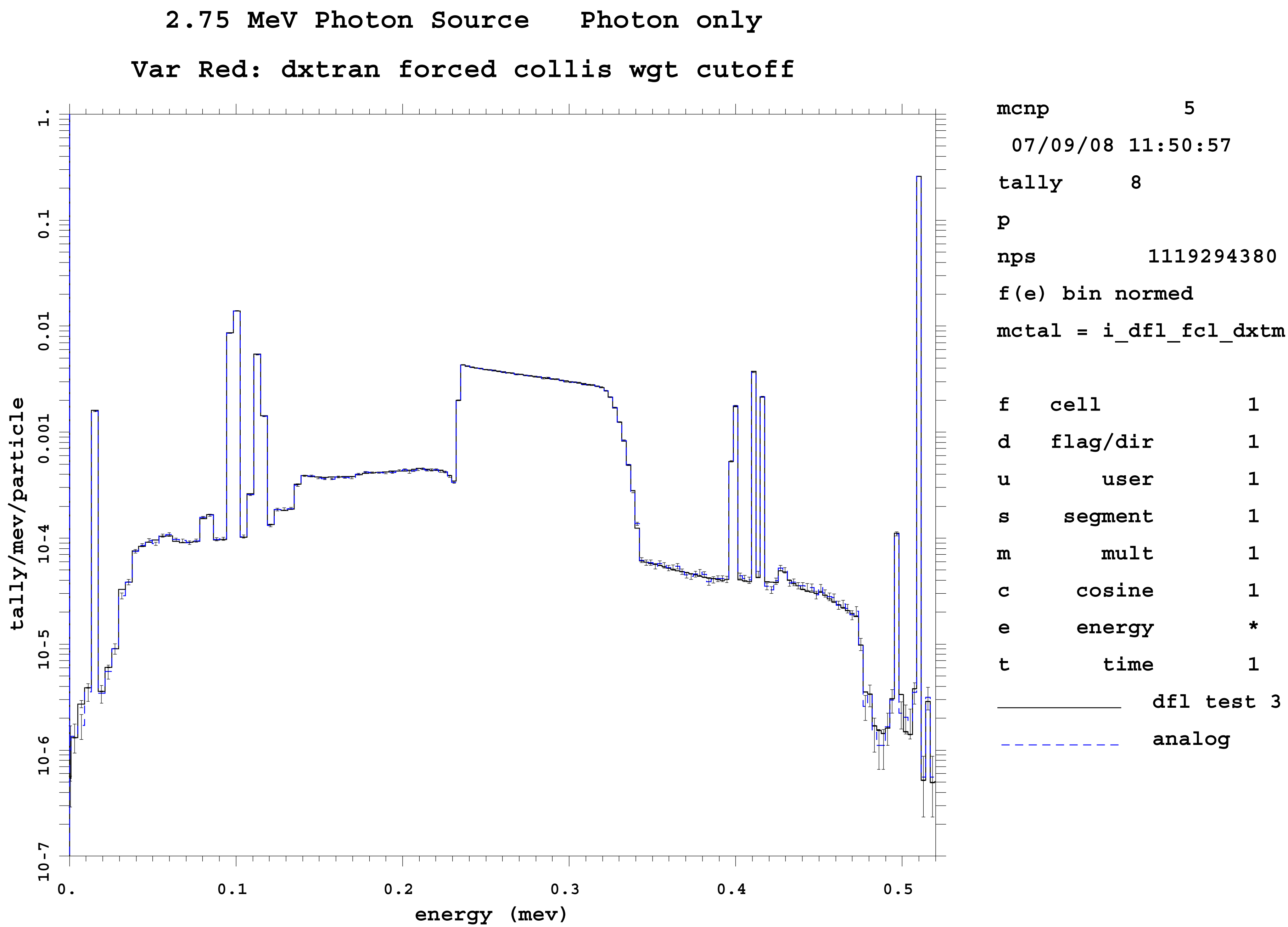
Var Red: analog using PHTVR



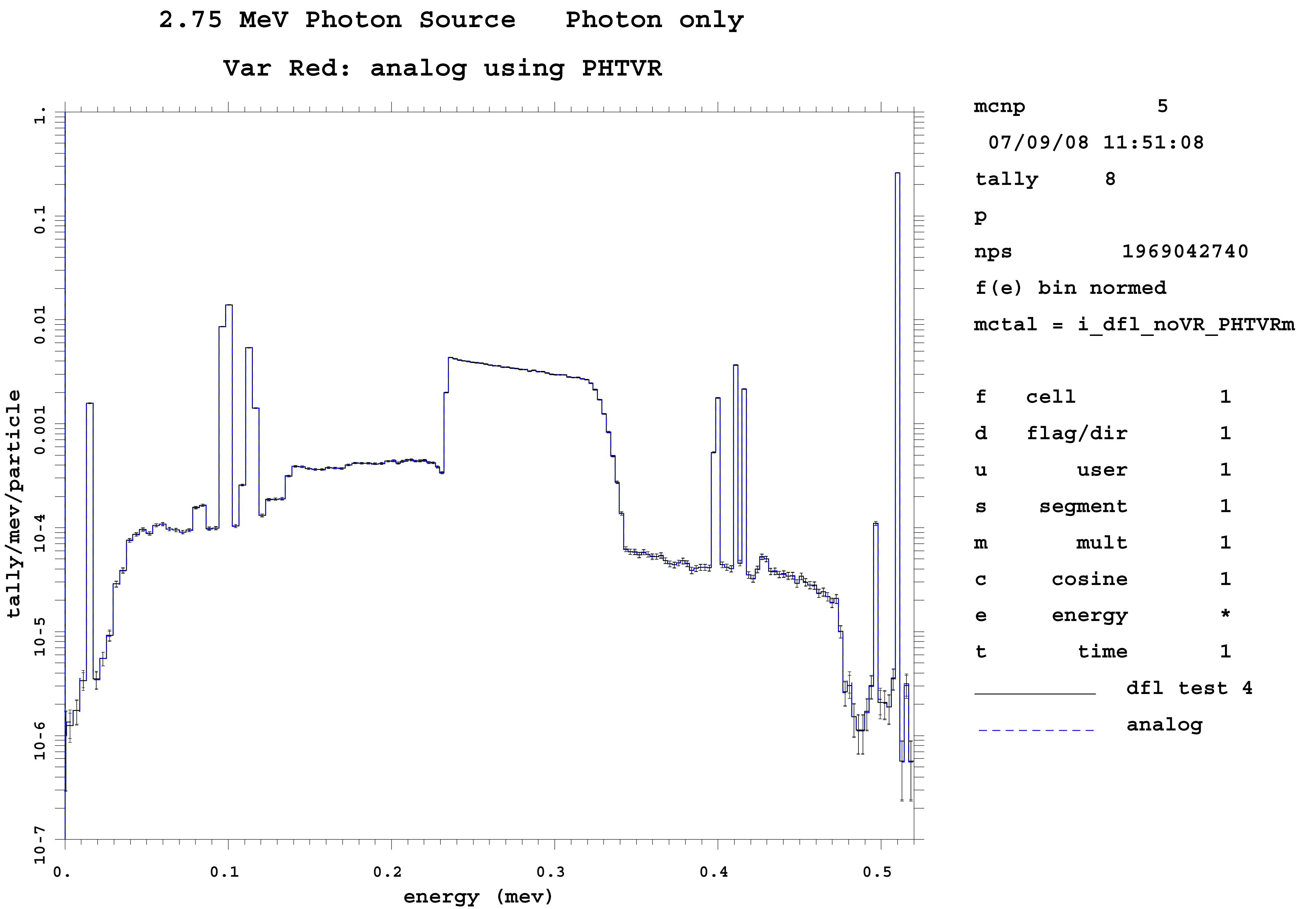

2.75 MeV Photon Source   Photon only
Var Red: dxtran
mcnp 5
07/09/08 11:50:56
tally 8
p
nps 2021989632
f(e) bin normed
mctal = i_dfl_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
dfl test 1
analog
tally/mev/particle
energy (mev)
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.
0.1
0.2
0.3
0.4
0.5

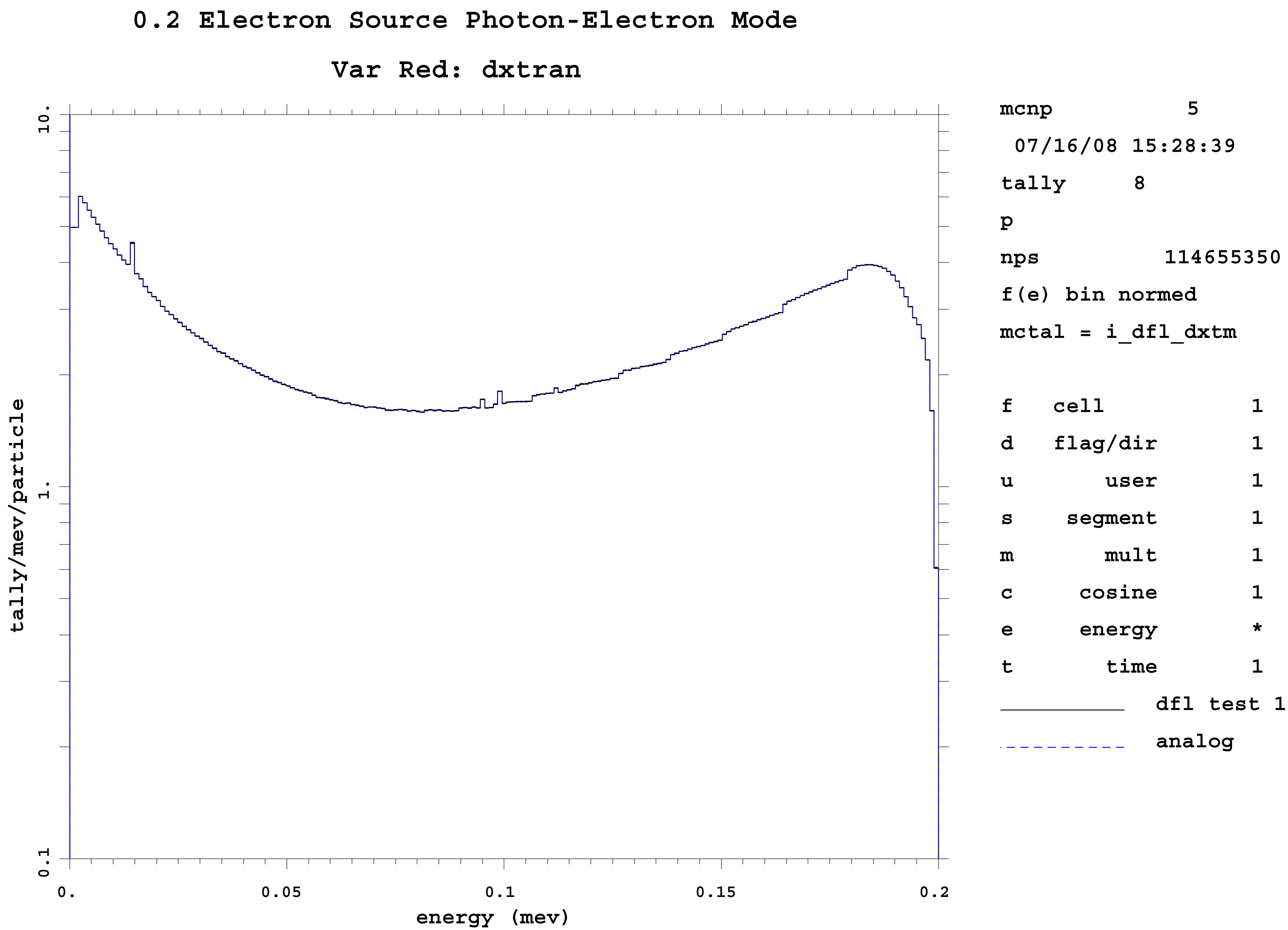


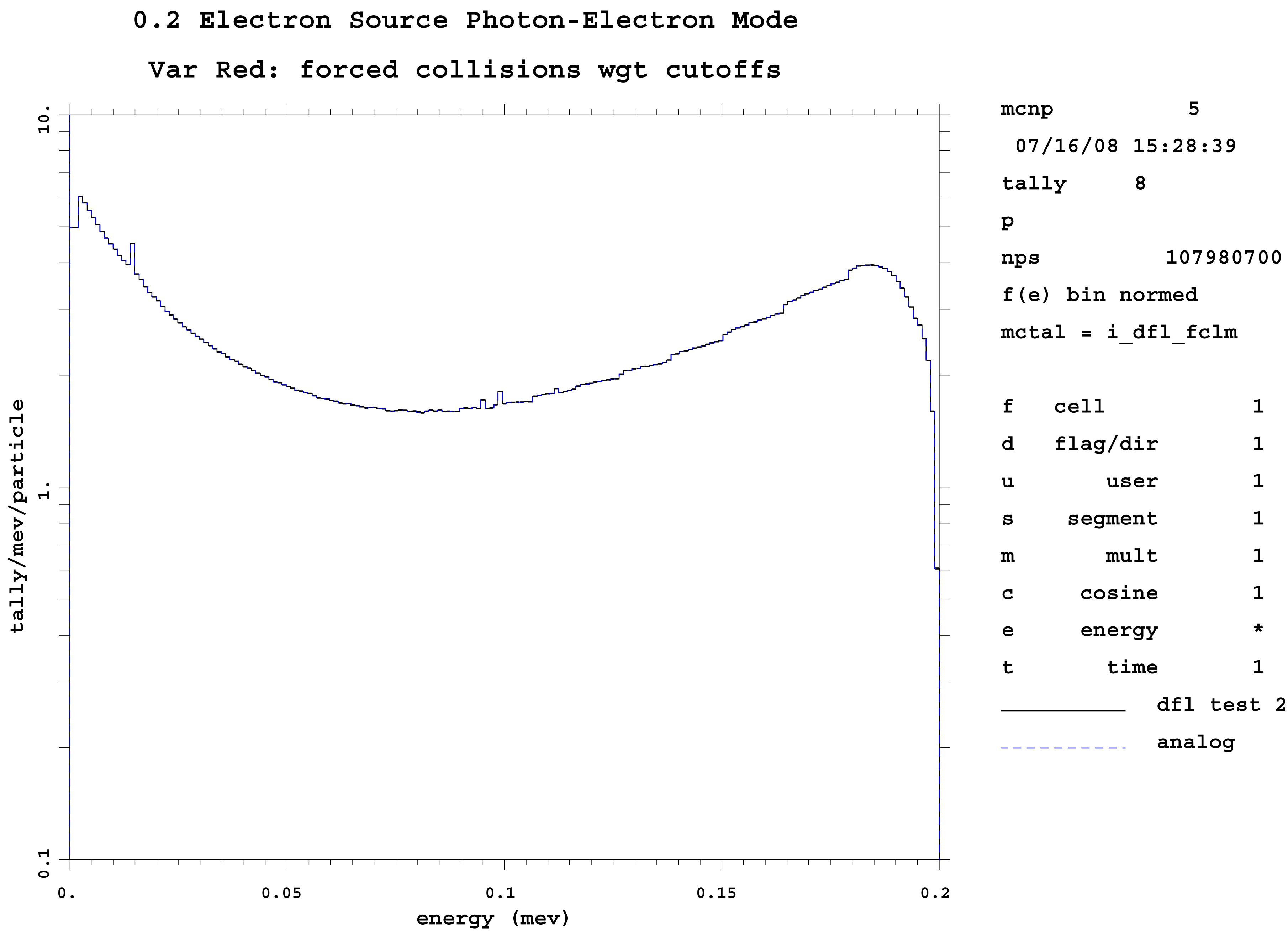
2.75 MeV Photon Source Photon only
Var Red: forced collisions wgt cutoffs
tally/mev/particle
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.
0.1
0.2
0.3
0.4
0.5
energy (mev)
mcnp 5
07/09/08 11:50:56
tally 8
p
nps 1776873312
f(e) bin normed
mctal = i_dfl_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
dfl test 2
analog

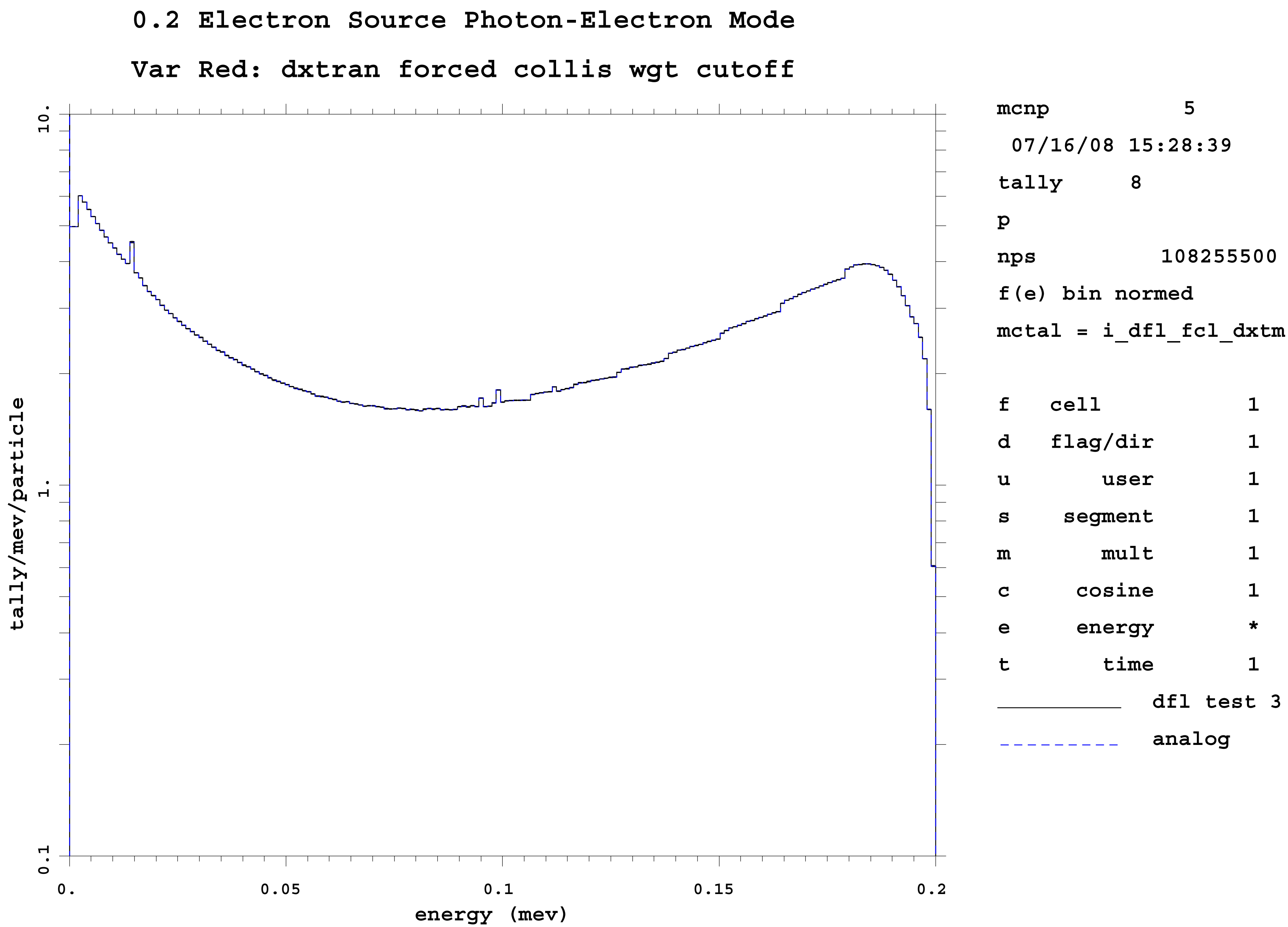


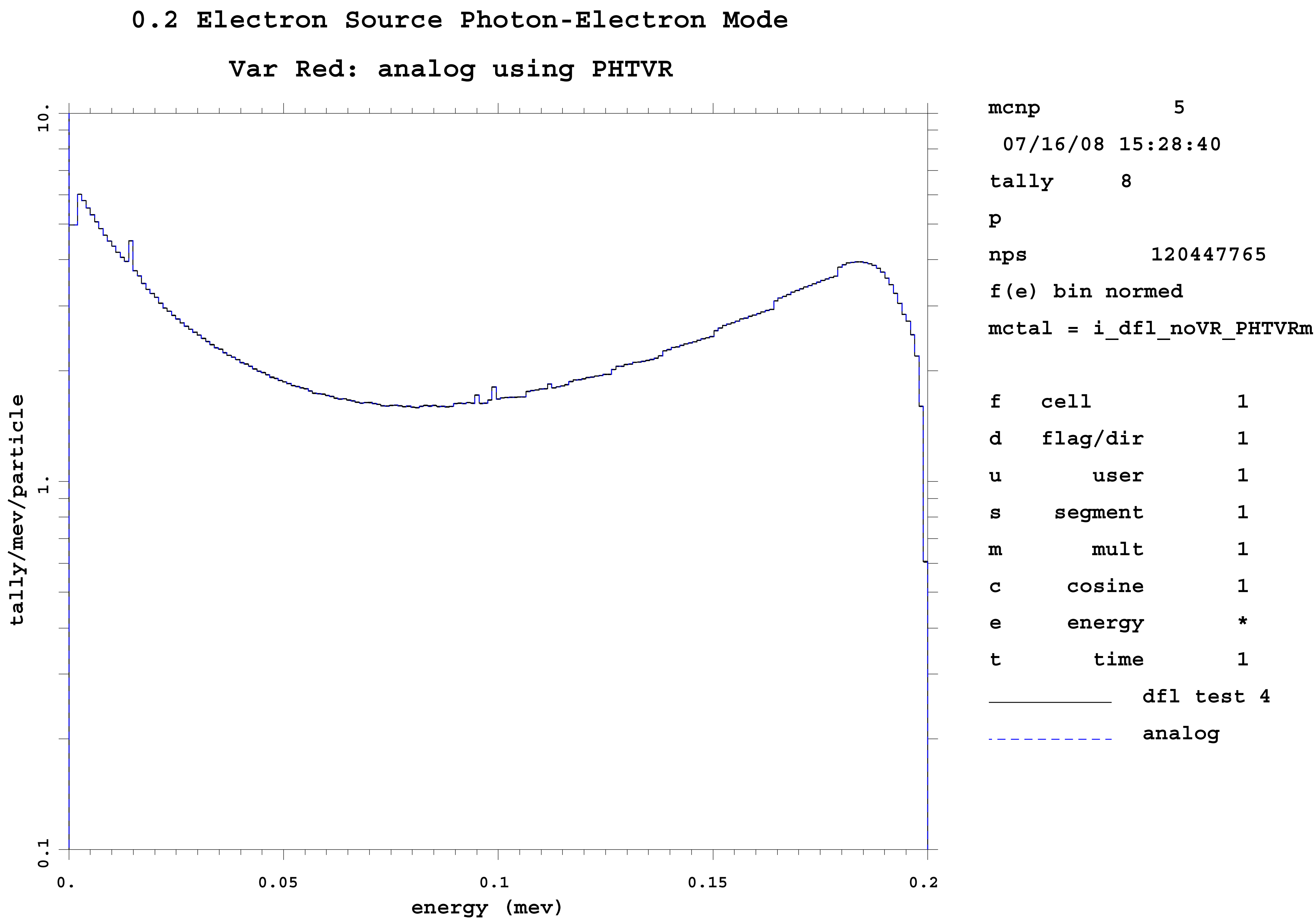
2.75 MeV Photon Source Photon only
Var Red: dxtran forced collis wgt cutoff
tally/mev/particle
energy (mev)
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.
0.1
0.2
0.3
0.4
0.5
mcnp 5
07/09/08 11:50:57
tally 8
p
nps 1119294380
f(e) bin normed
mctal = i_dfl_fcl_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
dfl test 3
analog

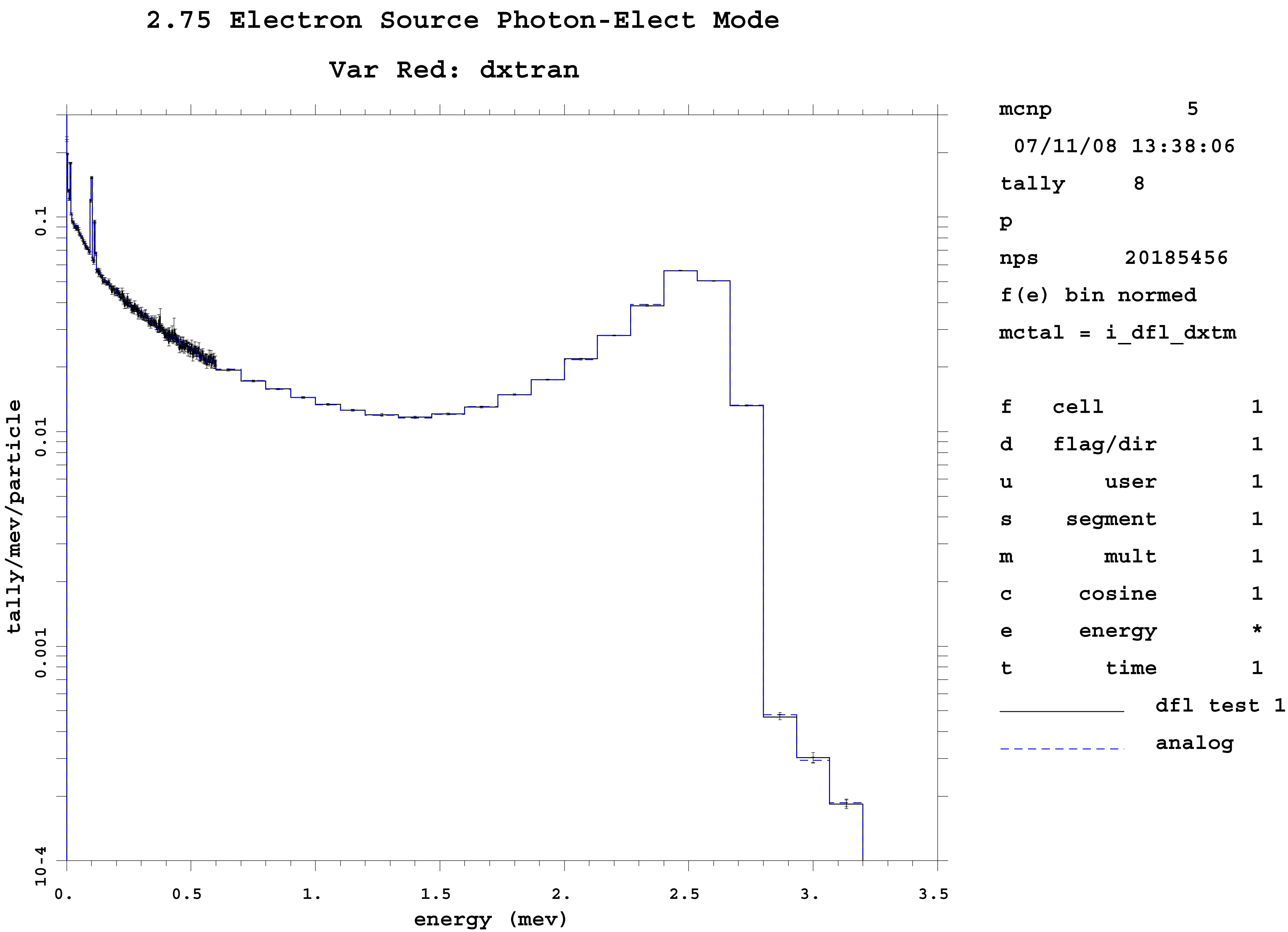

2.75 MeV Photon Source   Photon only
Var Red: analog using PHTVR
tally/mev/particle
energy (mev)
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.
0.1
0.2
0.3
0.4
0.5
mcnp 5
07/09/08 11:51:08
tally 8
p
nps 1969042740
f(e) bin normed
mctal = i_dfl_noVR_PHTVRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
dfl test 4
analog


0.2 Electron Source Photon-Electron Mode
Var Red: dxtran
10.
1.
0.1
tally/mev/particle
0.
0.05
0.1
0.15
0.2
energy (mev)
mcnp 5
07/16/08 15:28:39
tally 8
p
nps 114655350
f(e) bin normed
mctal = i_dfl_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
dfl test 1
analog

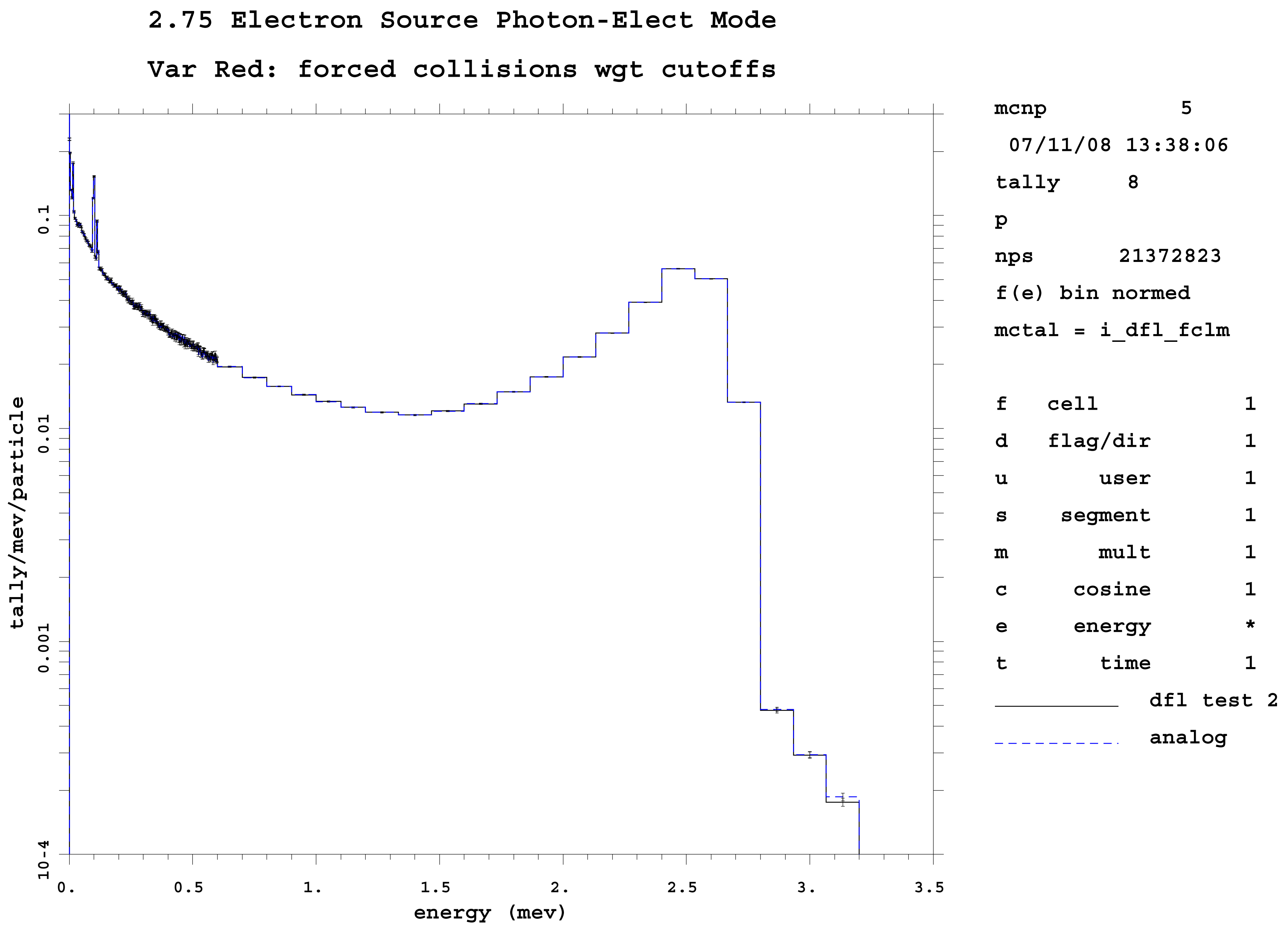

0.2 Electron Source Photon-Electron Mode
Var Red: forced collisions wgt cutoffs
10.
1.
0.1
tally/mev/particle
0.
0.05
0.1
0.15
0.2
energy (mev)
mcnp 5
07/16/08 15:28:39
tally 8
p
nps 107980700
f(e) bin normed
mctal = i_dfl_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
dfl test 2
analog


0.2 Electron Source Photon-Electron Mode
Var Red: dxtran forced collis wgt cutoff
10.
1.
0.1
tally/mev/particle
0.
0.05
0.1
0.15
0.2
energy (mev)
mcnp 5
07/16/08 15:28:39
tally 8
p
nps 108255500
f(e) bin normed
mctal = i_dfl_fcl_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
dfl test 3
analog

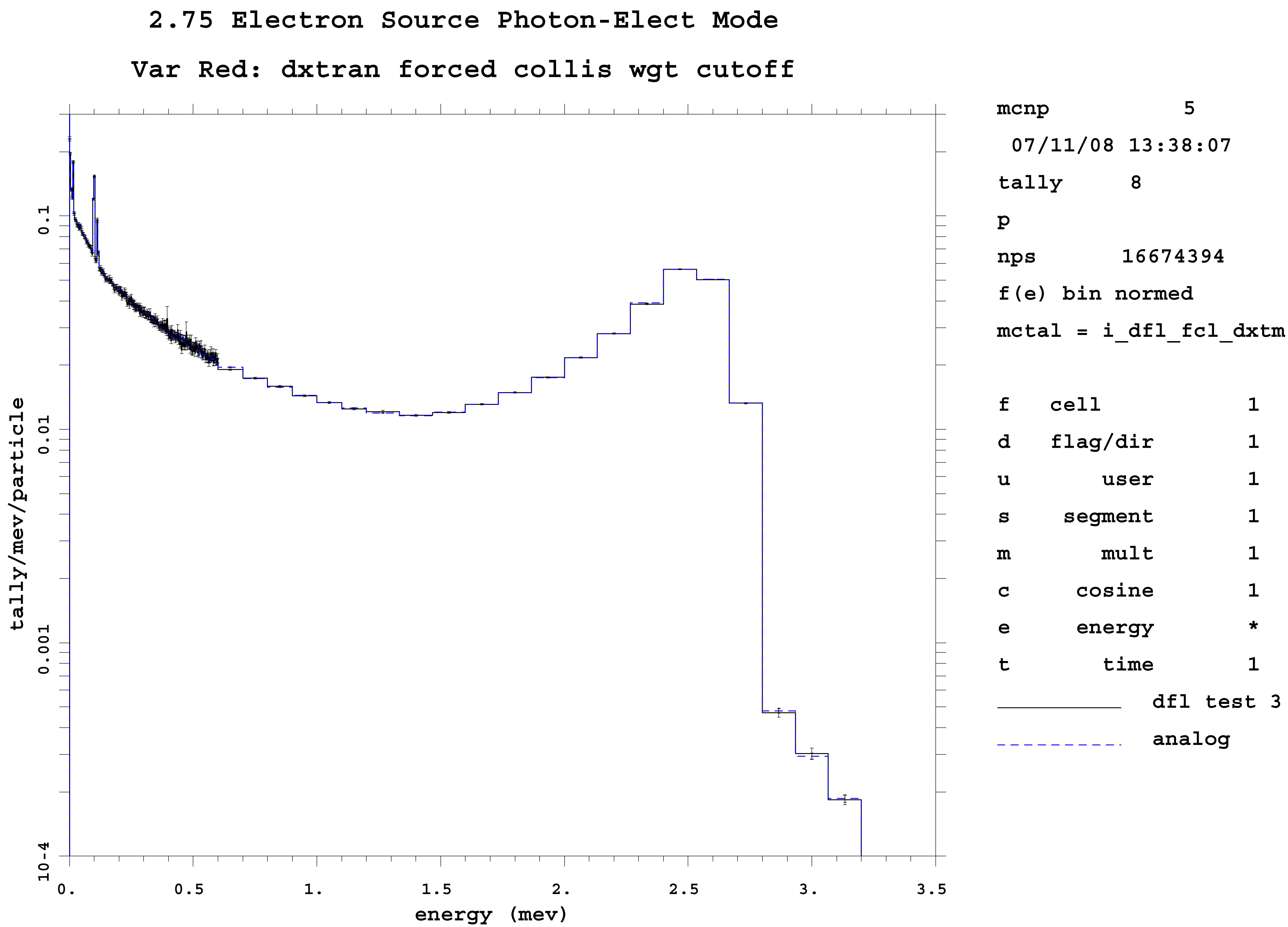

0.2 Electron Source Photon-Electron Mode
Var Red: analog using PHTVR
tally/mev/particle
10.
1.
0.1
0.
0.05
0.1
0.15
0.2
energy (mev)
mcnp 5
07/16/08 15:28:40
tally 8
p
nps 120447765
f(e) bin normed
mctal = i_dfl_noVR_PHTVRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
dfl test 4
analog

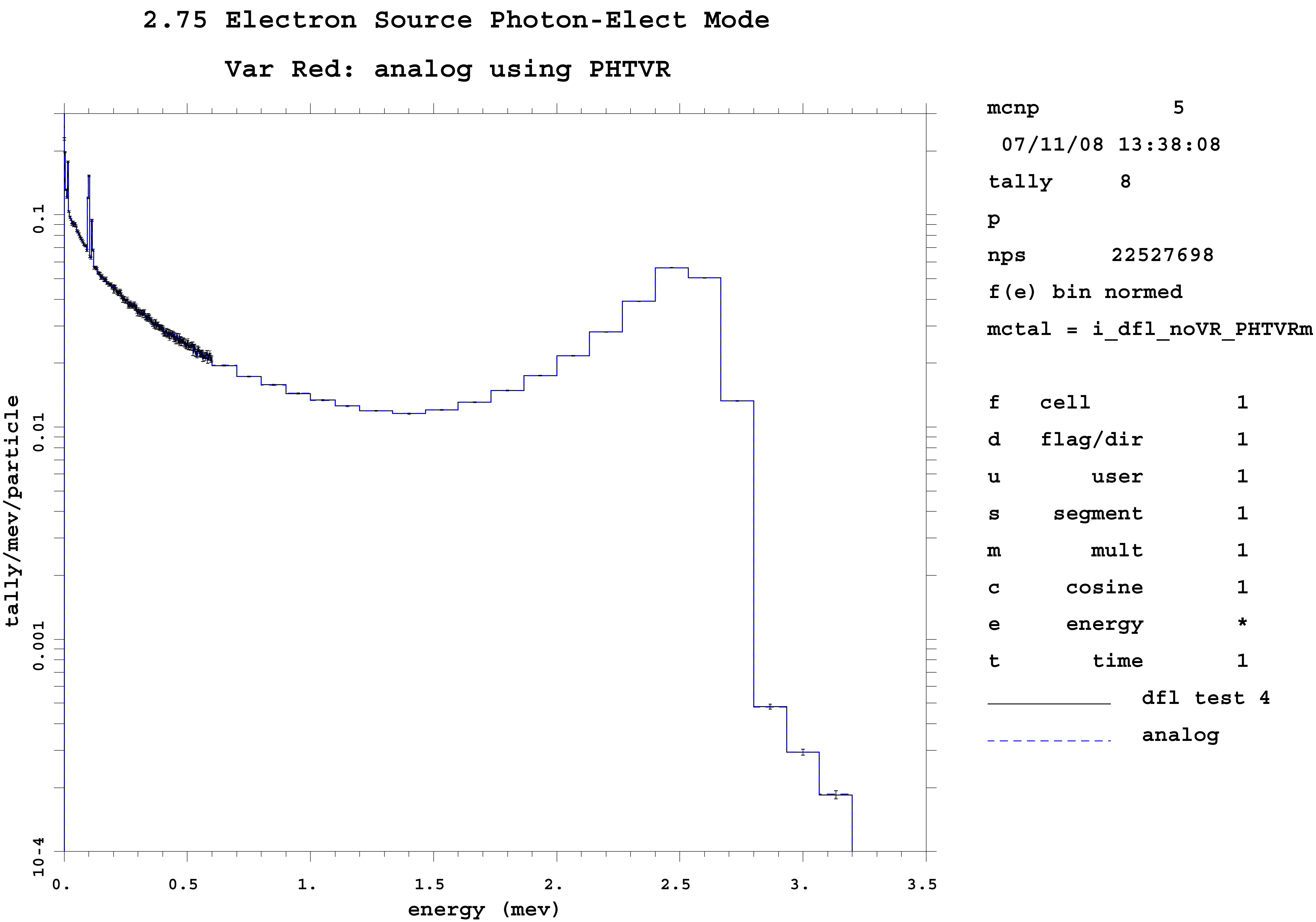


2.75 Electron Source Photon-Elect Mode
Var Red: dxtran
tally/mev/particle
0.1
0.01
0.001
10-4
0.
0.5
1.
1.5
2.
2.5
3.
3.5
energy (mev)
mcnp 5
07/11/08 13:38:06
tally 8
p
nps 20185456
f(e) bin normed
mctal = i_dfl_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
dfl test 1
analog



2.75 Electron Source Photon-Elect Mode
Var Red: forced collisions wgt cutoffs
mcnp 5
07/11/08 13:38:06
tally 8
p
nps 21372823
f(e) bin normed
mctal = i_dfl_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
dfl test 2
analog
tally/mev/particle
0.1
0.01
0.001
10-4
0.
0.5
1.
1.5
2.
2.5
3.
3.5
energy (mev)


2.75 Electron Source Photon-Elect Mode
Var Red: dxtran forced collis wgt cutoff
tally/mev/particle
0.1
0.01
0.001
10-4
0.
0.5
1.
1.5
2.
2.5
3.
3.5
energy (mev)
mcnp 5
07/11/08 13:38:07
tally 8
p
nps 16674394
f(e) bin normed
mctal = i_dfl_fcl_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
dfl test 3
analog



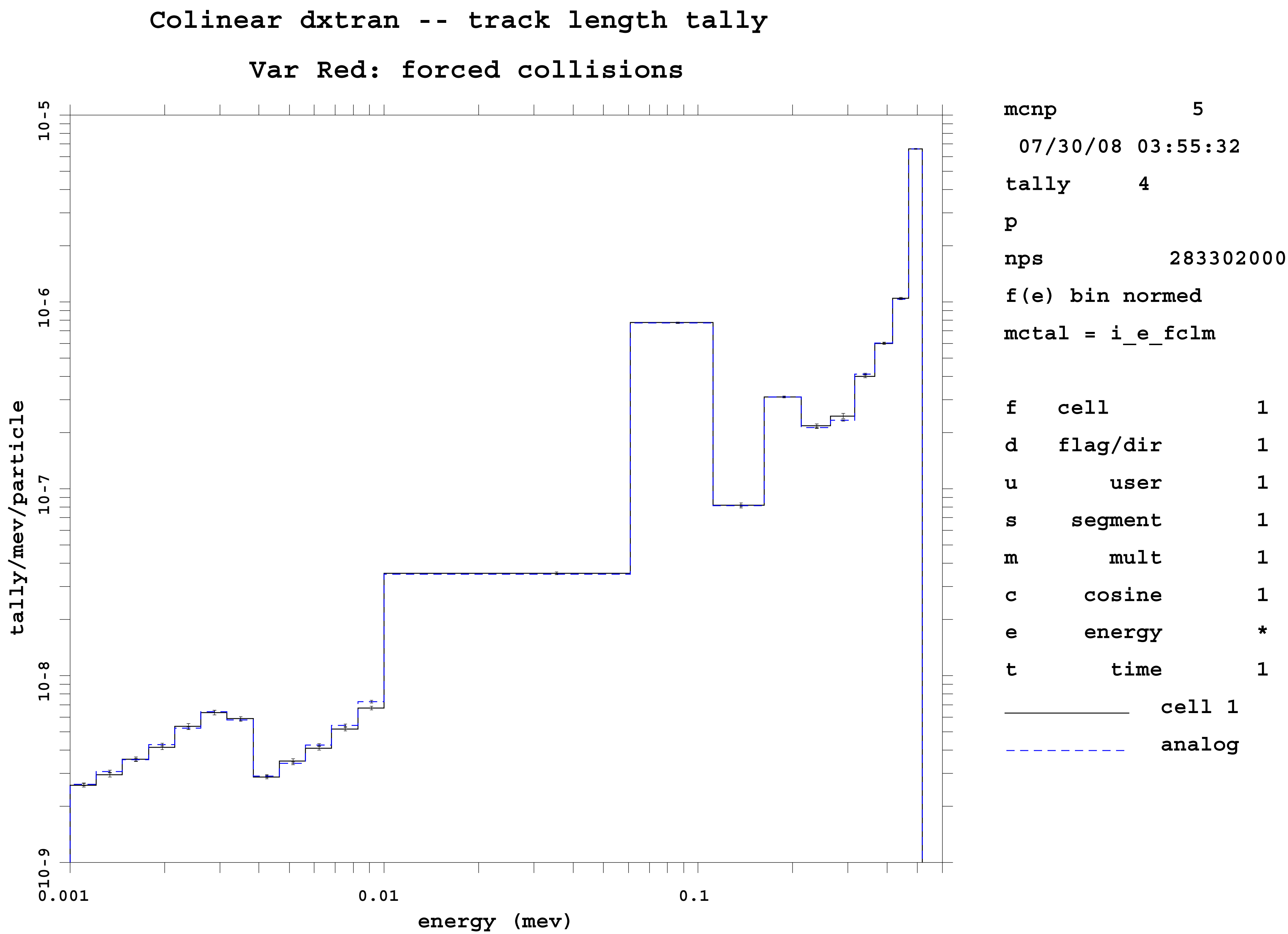
2.75 Electron Source Photon-Elect Mode
Var Red: analog using PHTVR
tally/mev/particle
0.1
0.01
0.001
10-4
0.
0.5
1.
1.5
2.
2.5
3.
3.5
energy (mev)
mcnp 5
07/11/08 13:38:08
tally 8
p
nps 22527698
f(e) bin normed
mctal = i_dfl_noVR_PHTVRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
dfl test 4
analog

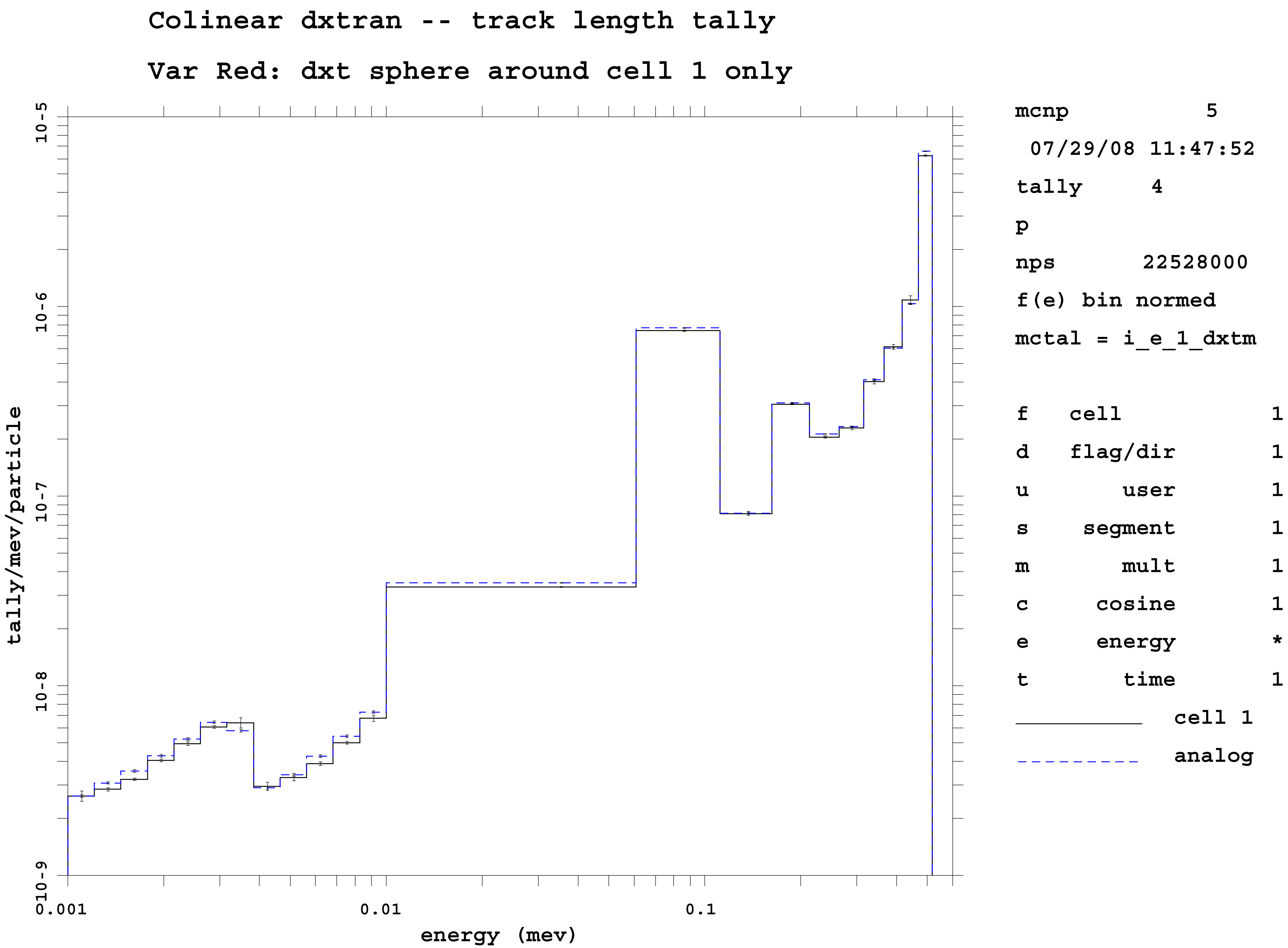
Appendix C.1

Collinear DXTRAN Spheres

Track Length Tally Spectra

Plot Number	Plot Title
	Cell 1
1	Var Red: forced collisions
2	Var Red: dxt sphere around cell 1 only
3	Var Red: dxt sphere around cell 4 only
4	Var Red: 5 dxtran spheres
5	Var Red: 5 dxtran spheres w/ for. colls.
6	Var Red: 5 dxtran spheres w/ dxc cards
7	Analog with PHTVR
	Cell 2
8	Var Red: forced collisions
9	Var Red: dxt sphere around cell 1 only
10	Var Red: dxt sphere around cell 4 only
11	Var Red: 5 dxtran spheres
12	Var Red: 5 dxtran spheres w/ for. colls.
13	Var Red: 5 dxtran spheres w/ dxc cards
14	Analog with PHTVR
	Cell 3
15	Var Red: forced collisions
16	Var Red: dxt sphere around cell 1 only
17	Var Red: dxt sphere around cell 4 only
18	Var Red: 5 dxtran spheres
19	Var Red: 5 dxtran spheres w/ for. colls.
20	Var Red: 5 dxtran spheres w/ dxc cards
21	Analog with PHTVR
	Cell 4
22	Var Red: forced collisions
23	Var Red: dxt sphere around cell 1 only
24	Var Red: dxt sphere around cell 4 only
25	Var Red: 5 dxtran spheres
26	Var Red: 5 dxtran spheres w/ for. colls.
27	Var Red: 5 dxtran spheres w/ dxc cards
28	Analog with PHTVR
	Cell 5
29	Var Red: forced collisions
30	Var Red: dxt sphere around cell 1 only
31	Var Red: dxt sphere around cell 4 only
32	Var Red: 5 dxtran spheres
33	Var Red: 5 dxtran spheres w/ for. colls.
34	Var Red: 5 dxtran spheres w/ dxc cards
35	Analog with PHTVR

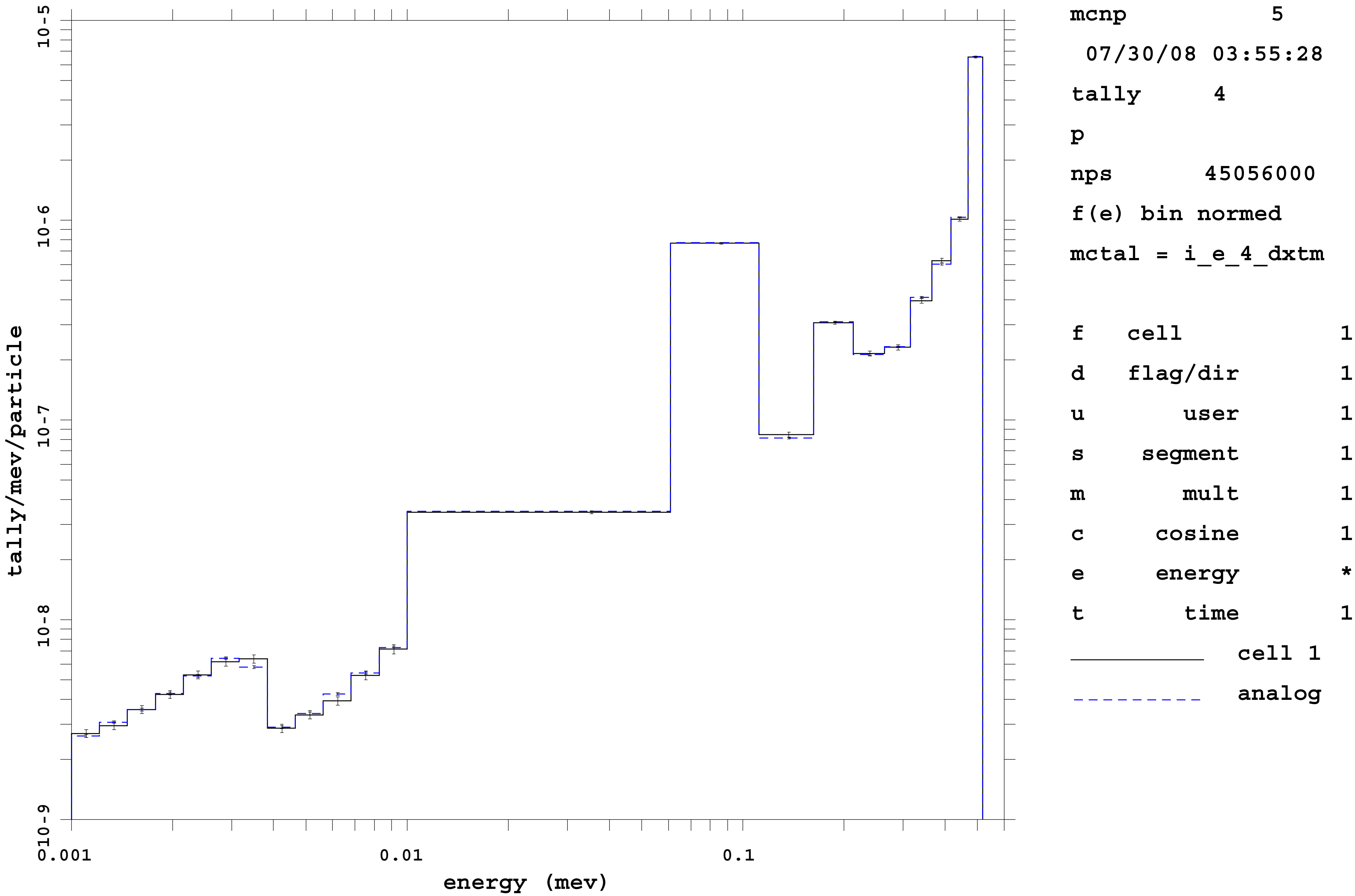

Colinear dxtran -- track length tally
Var Red: forced collisions
tally/mev/particle
10-5
10-6
10-7
10-8
10-9
0.001
0.01
0.1
energy (mev)
mcnp 5
07/30/08 03:55:32
tally 4
p
nps 283302000
f(e) bin normed
mctal = i_e_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 1
analog

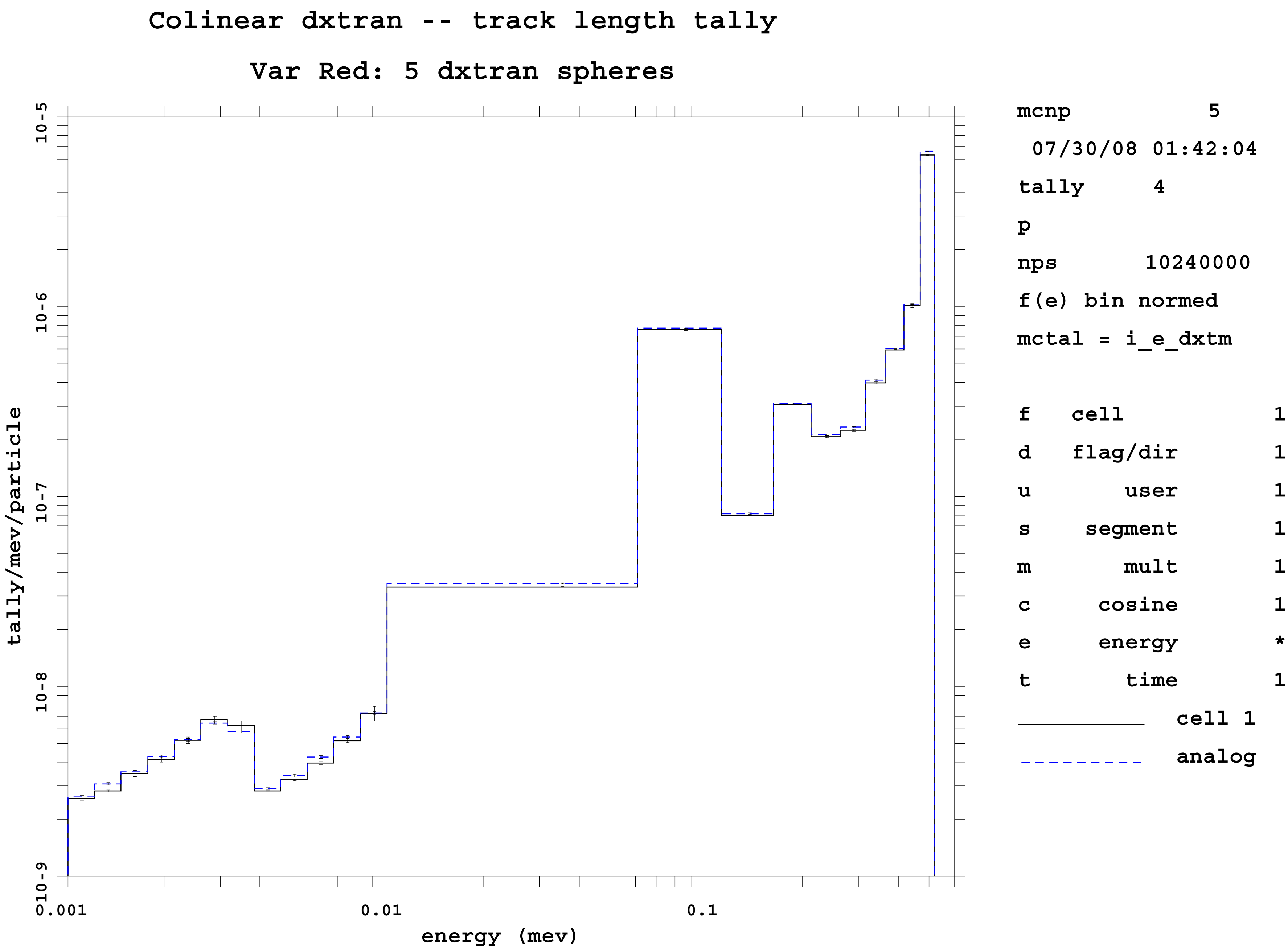


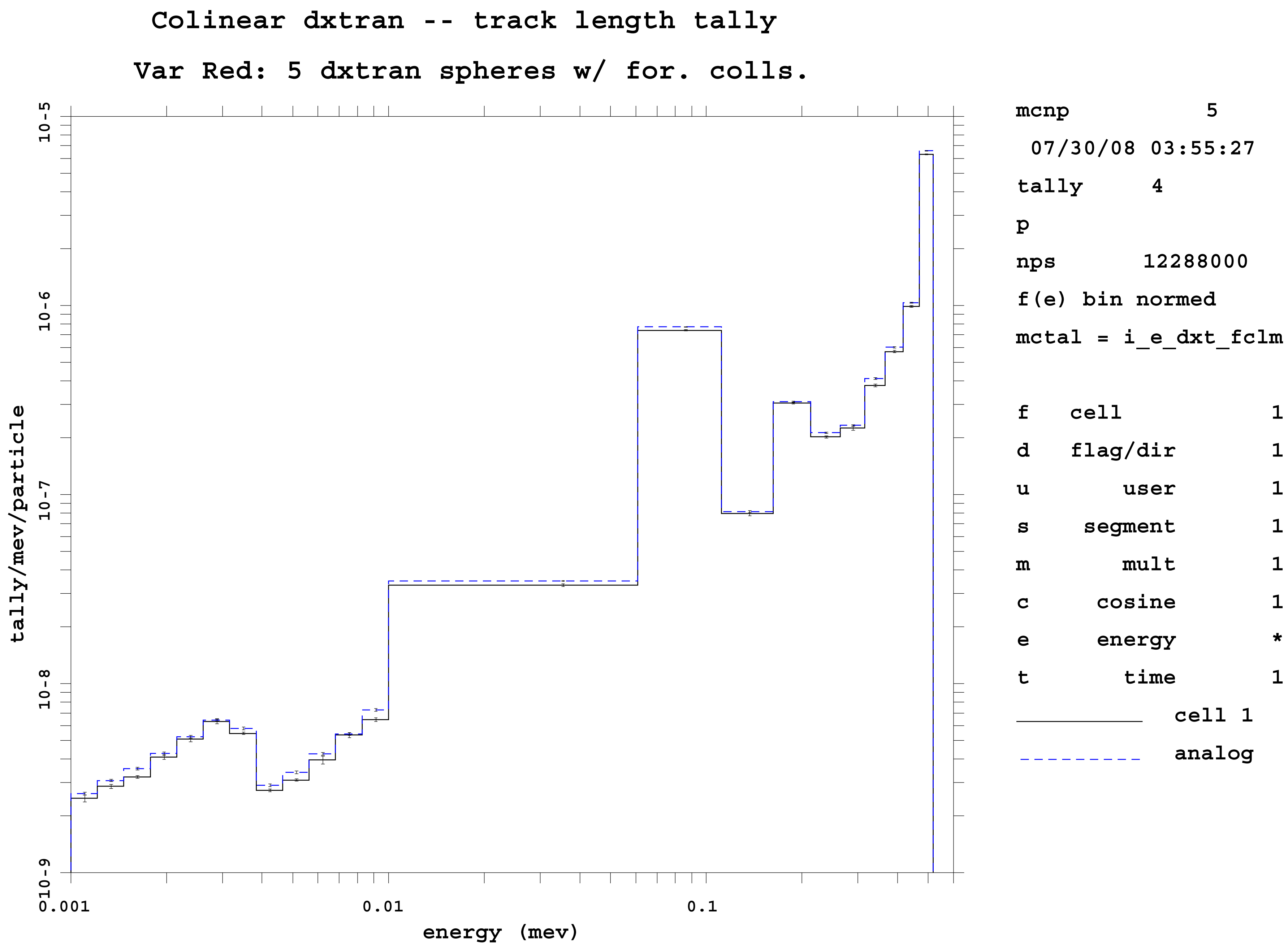
Colinear dxtran -- track length tally
Var Red: dxt sphere around cell 1 only
10-5
10-6
10-7
10-8
10-9
tally/mev/particle
0.001
0.01
0.1
energy (mev)
mcnp 5
07/29/08 11:47:52
tally 4
p
nps 22528000
f(e) bin normed
mctal = i_e_1_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 1
analog

Colinear dxtran -- track length tally

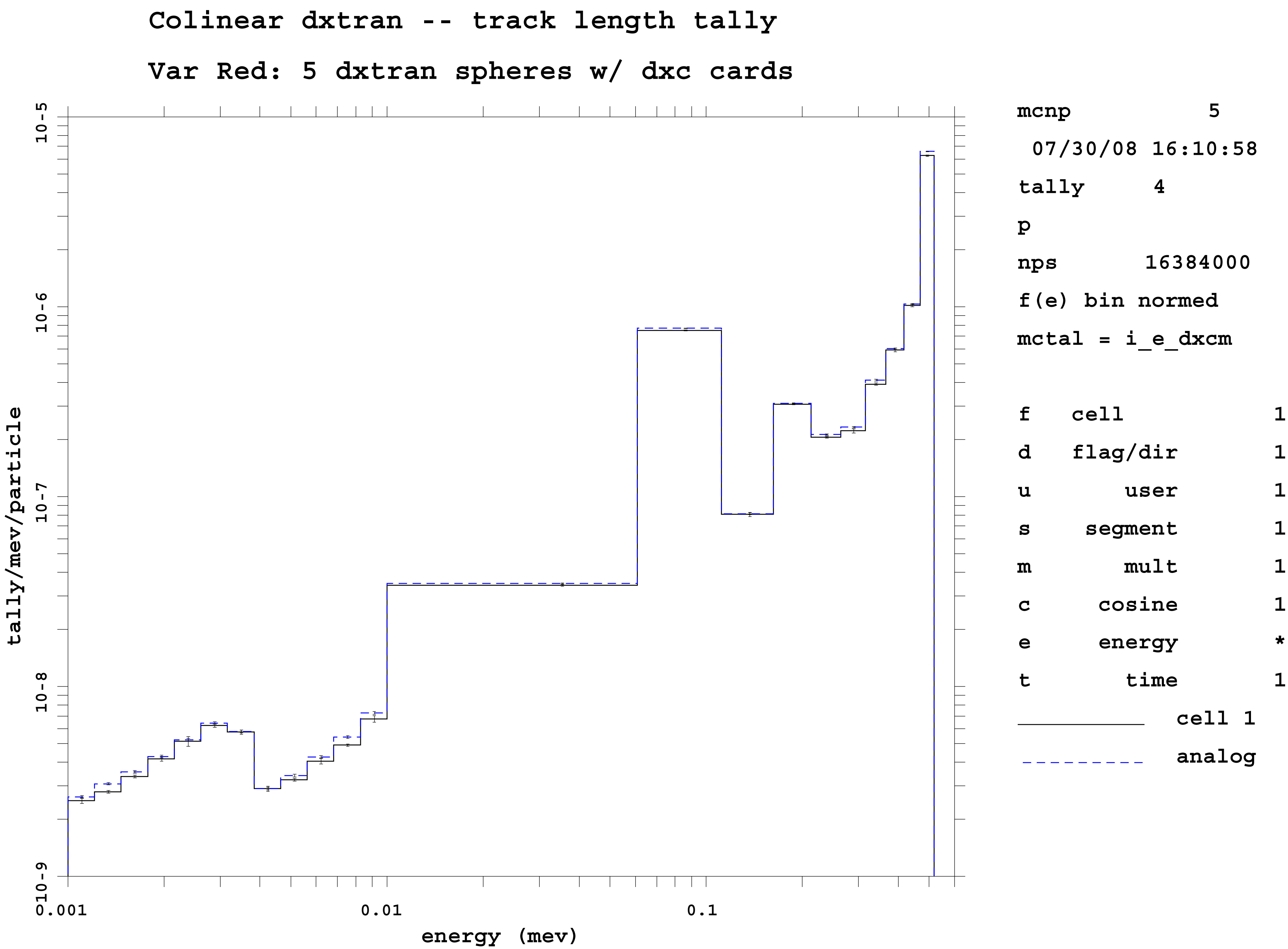
Var Red: dxt sphere around cell 4 only




Colinear dxtran -- track length tally
Var Red: 5 dxtran spheres
10-5
10-6
10-7
10-8
10-9
tally/mev/particle
0.001
0.01
0.1
energy (mev)
mcnp 5
07/30/08 01:42:04
tally 4
p
nps 10240000
f(e) bin normed
mctal = i_e_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 1
analog

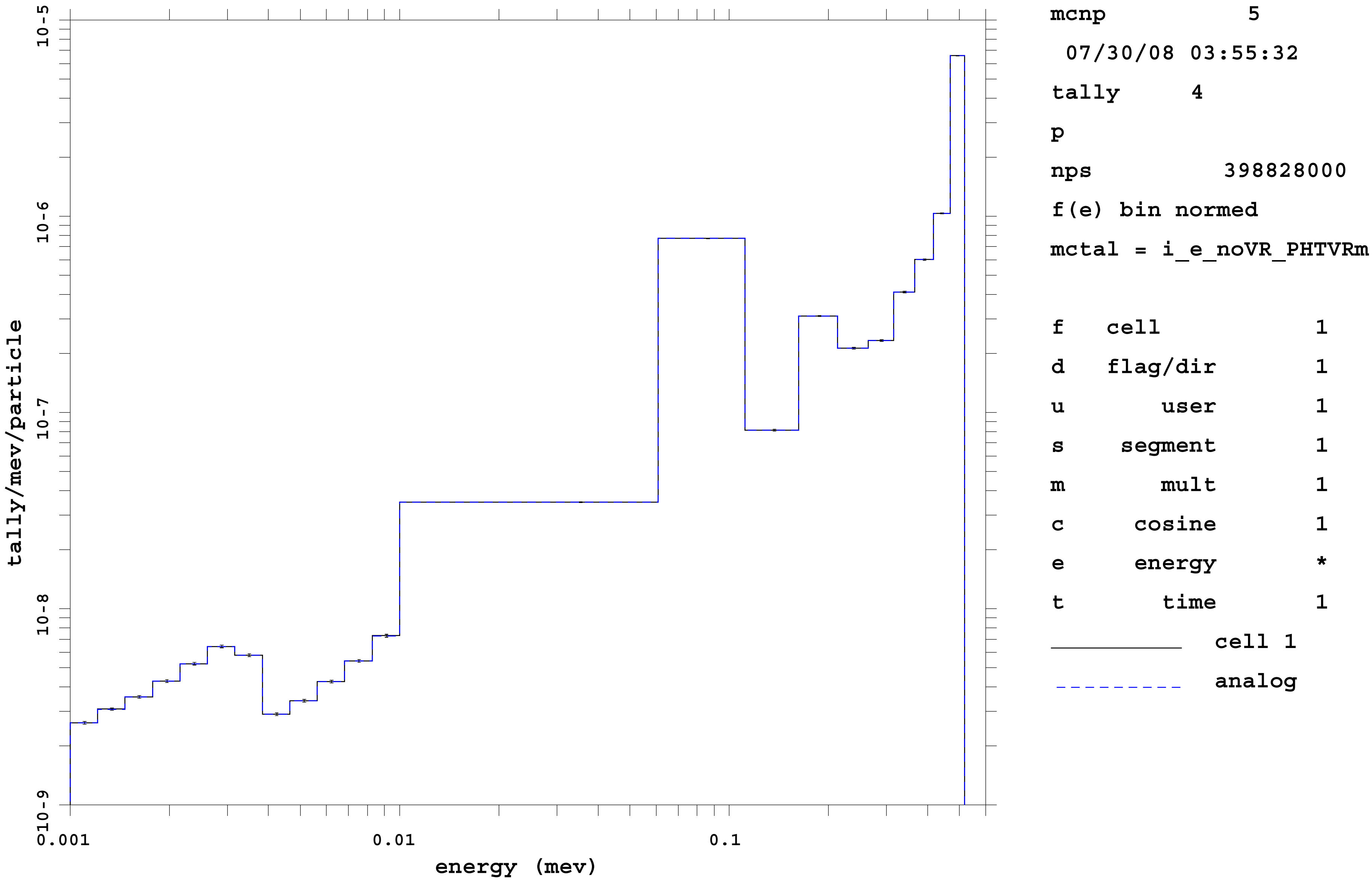


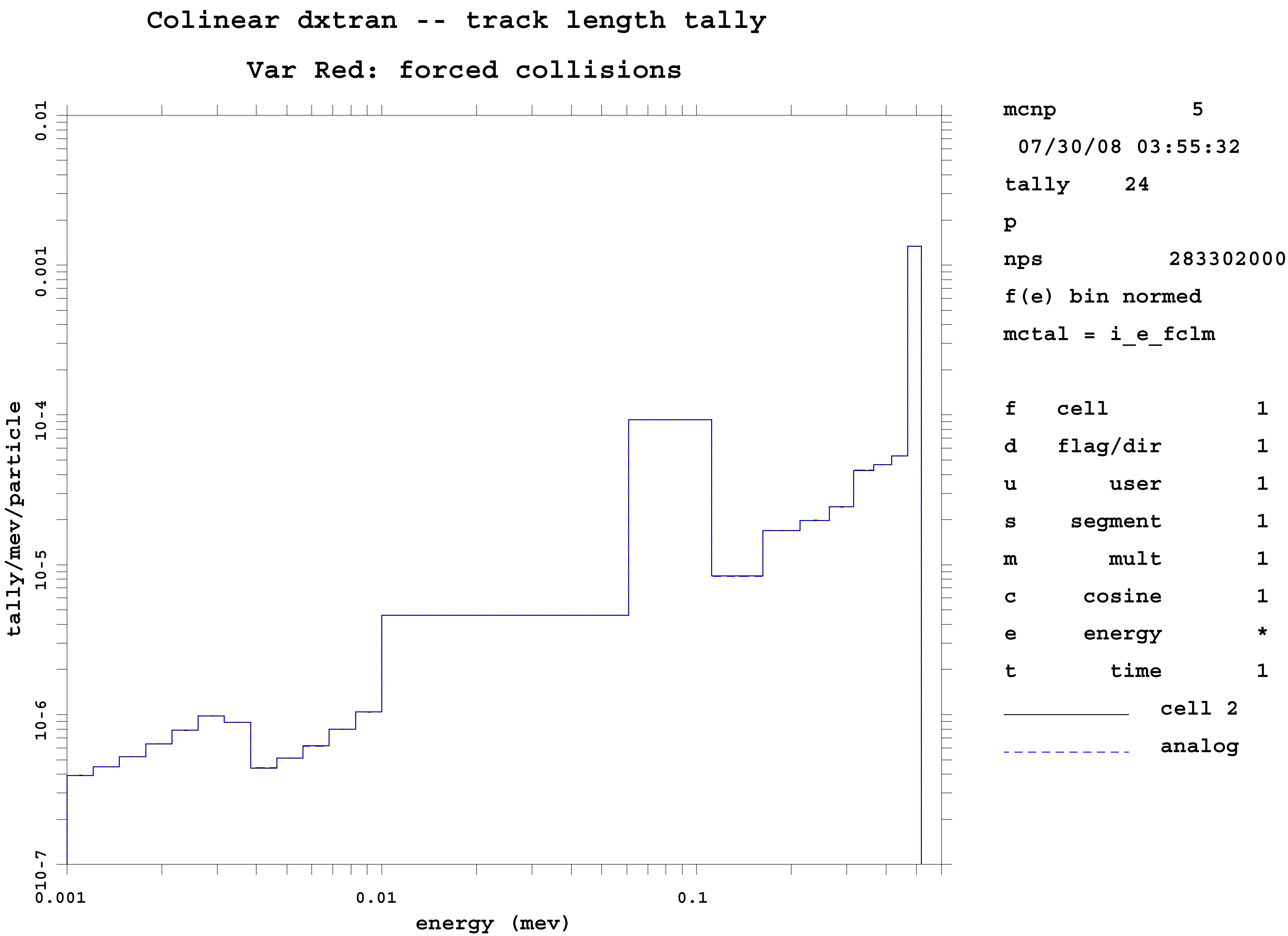
Colinear dxtran -- track length tally
Var Red: 5 dxtran spheres w/ for. colls.
10-5
10-6
10-7
10-8
10-9
tally/mev/particle
0.001
0.01
0.1
energy (mev)
mcnp 5
07/30/08 03:55:27
tally 4
p
nps 12288000
f(e) bin normed
mctal = i_e_dxt_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 1
analog


Colinear dxtran -- track length tally
Var Red: 5 dxtran spheres w/ dxc cards
tally/mev/particle
10-5
10-6
10-7
10-8
10-9
0.001
0.01
0.1
energy (mev)
mcnp 5
07/30/08 16:10:58
tally 4
p
nps 16384000
f(e) bin normed
mctal = i_e_dxcm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 1
analog

Colinear dxtran -- track length tally

Analog with PHTVR

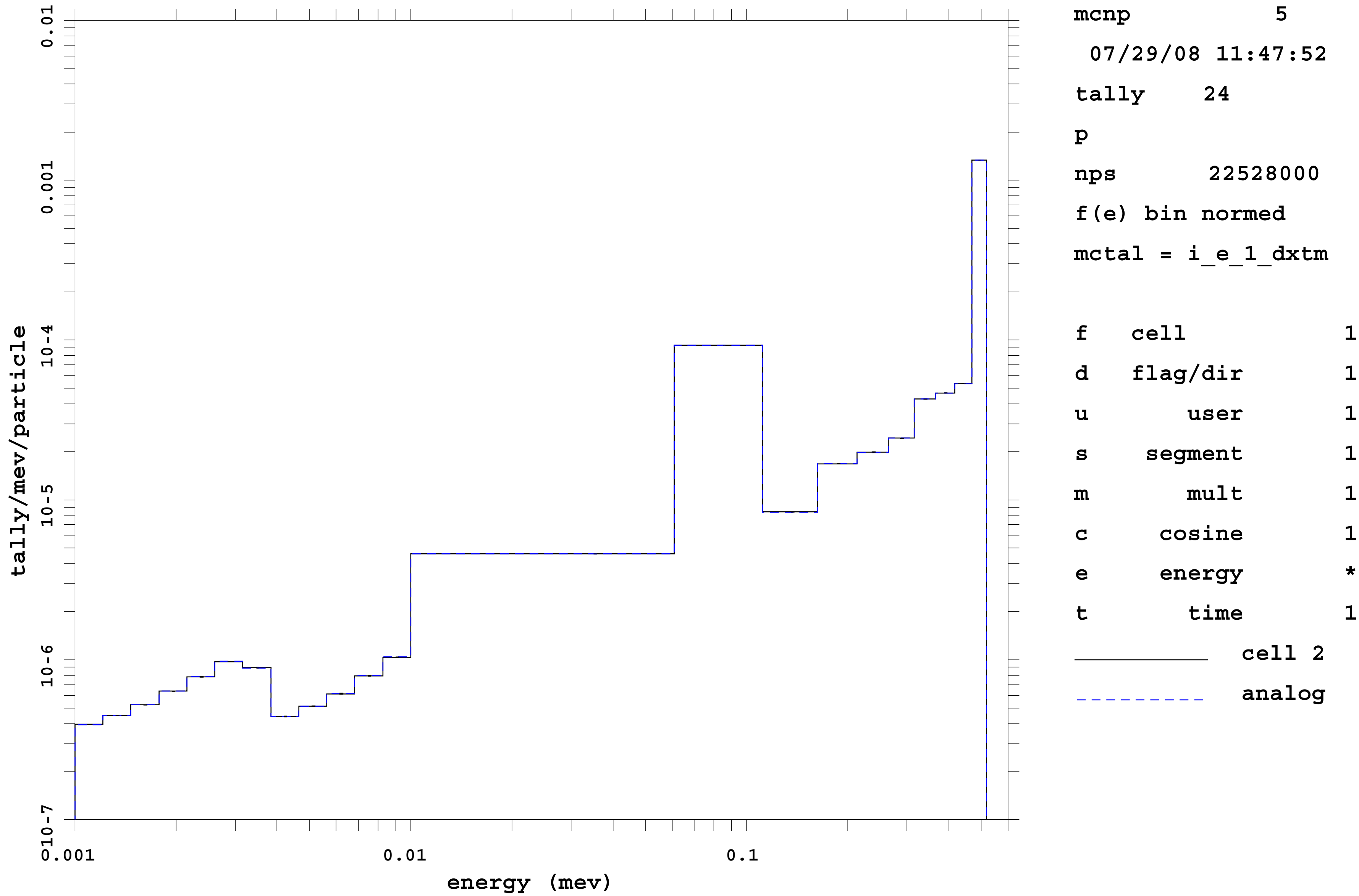


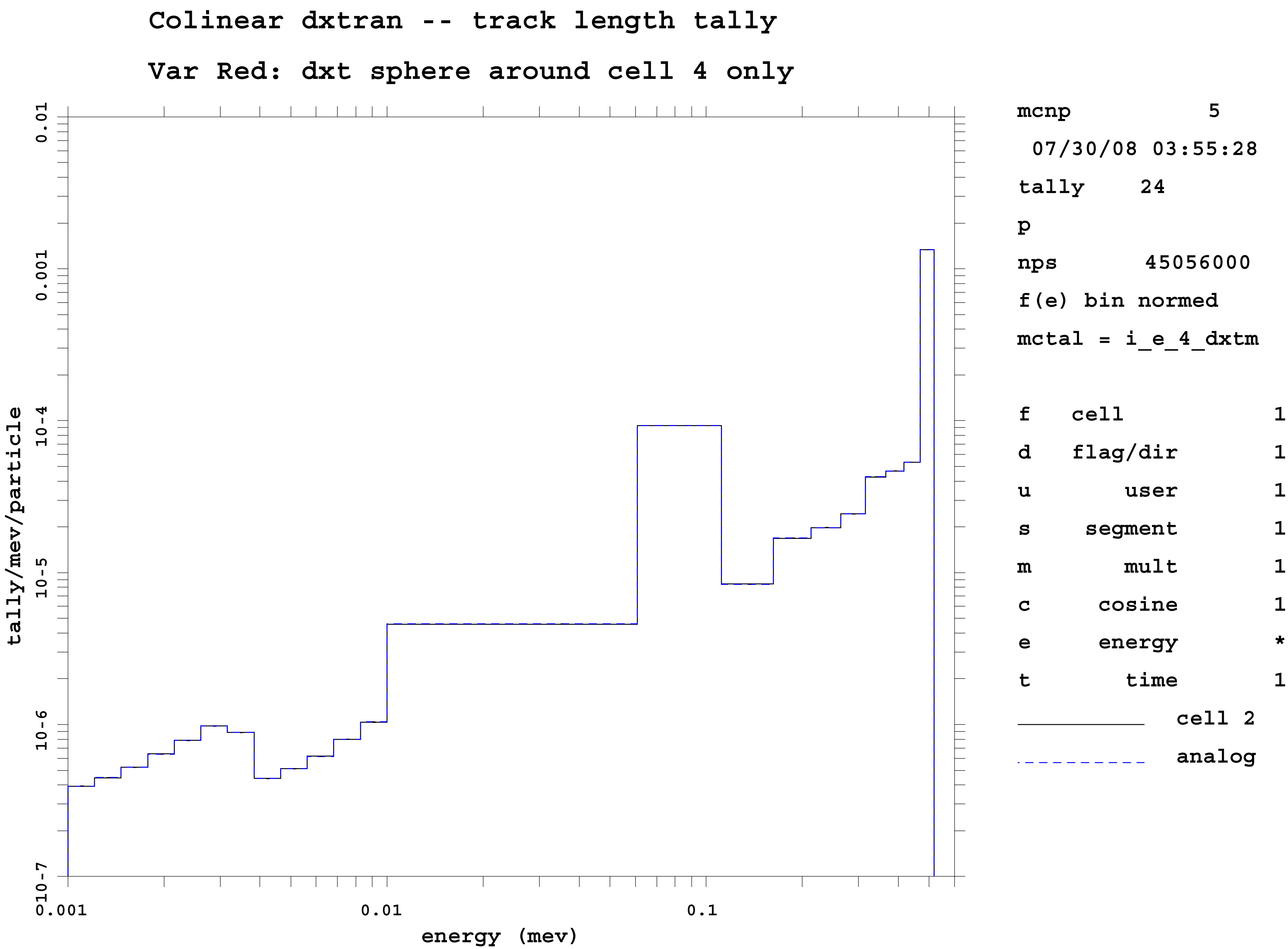


Colinear dxtran -- track length tally
Var Red: forced collisions
tally/mev/particle
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
energy (mev)
mcnp 5
07/30/08 03:55:32
tally 24
p
nps 283302000
f(e) bin normed
mctal = i_e_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 2
analog

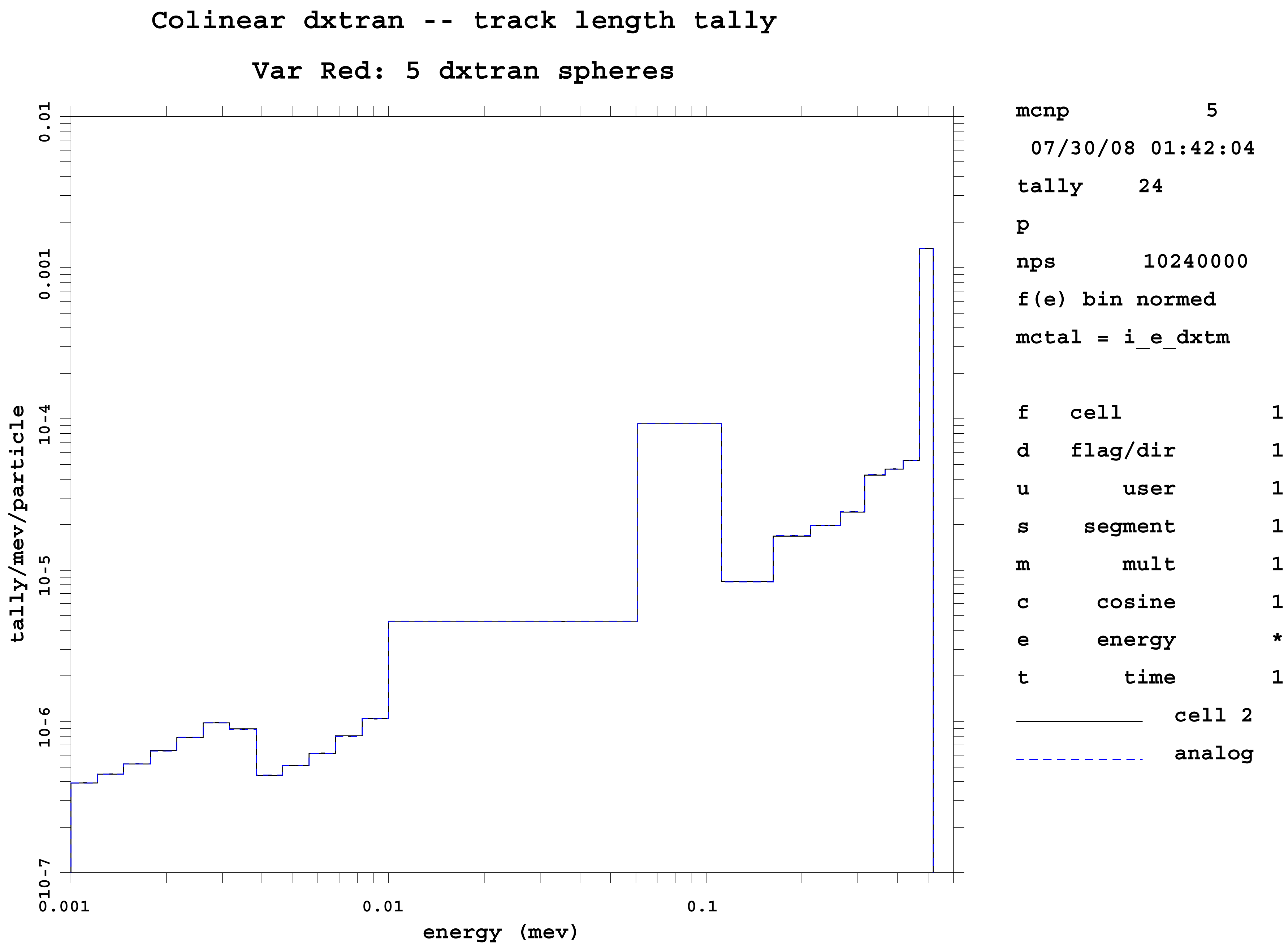
Colinear dxtran -- track length tally

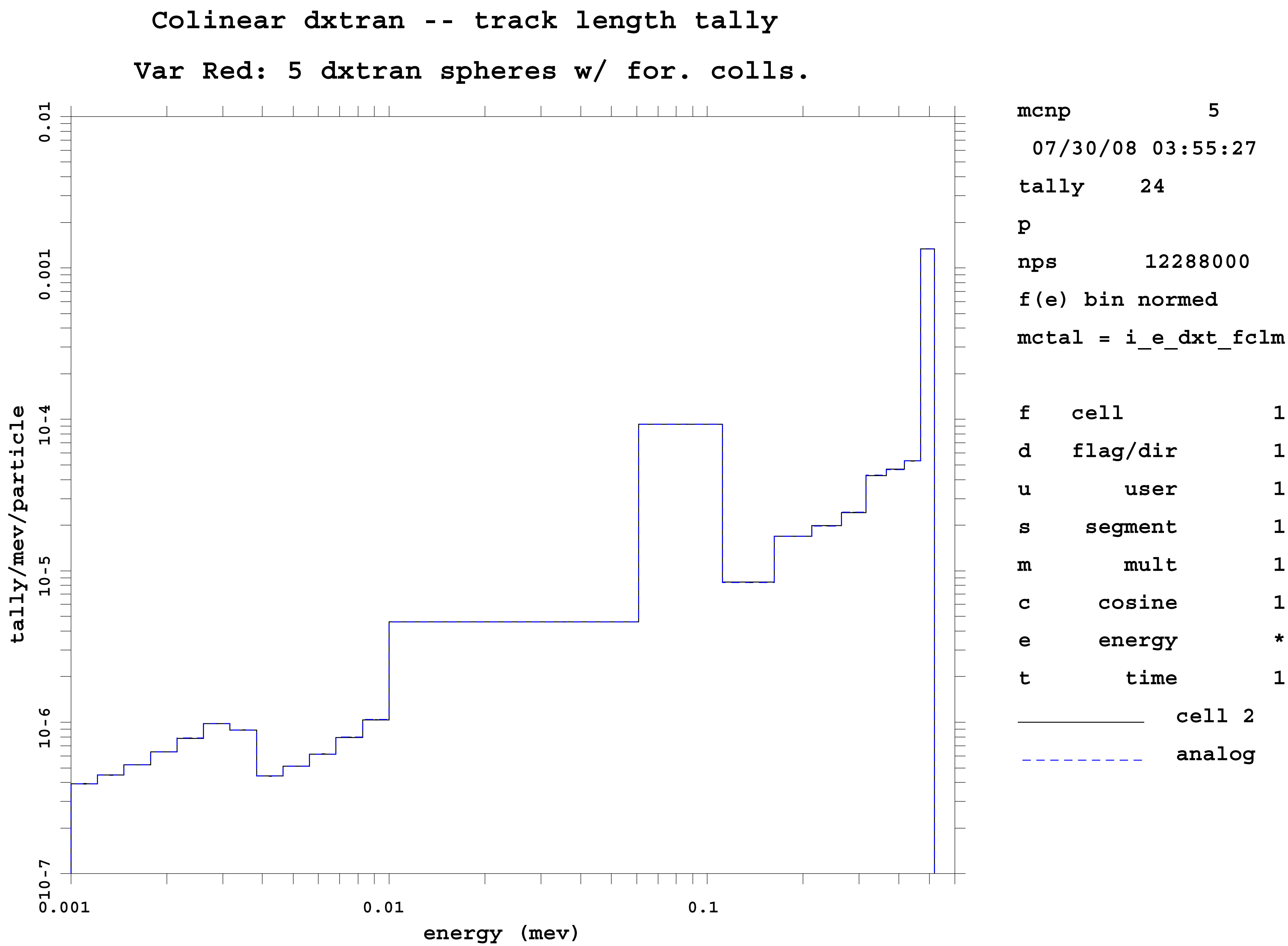
Var Red: dxt sphere around cell 1 only





Colinear dxtran -- track length tally
Var Red: dxt sphere around cell 4 only
tally/mev/particle
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
energy (mev)
mcnp 5
07/30/08 03:55:28
tally 24
p
nps 45056000
f(e) bin normed
mctal = i_e_4_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 2
analog

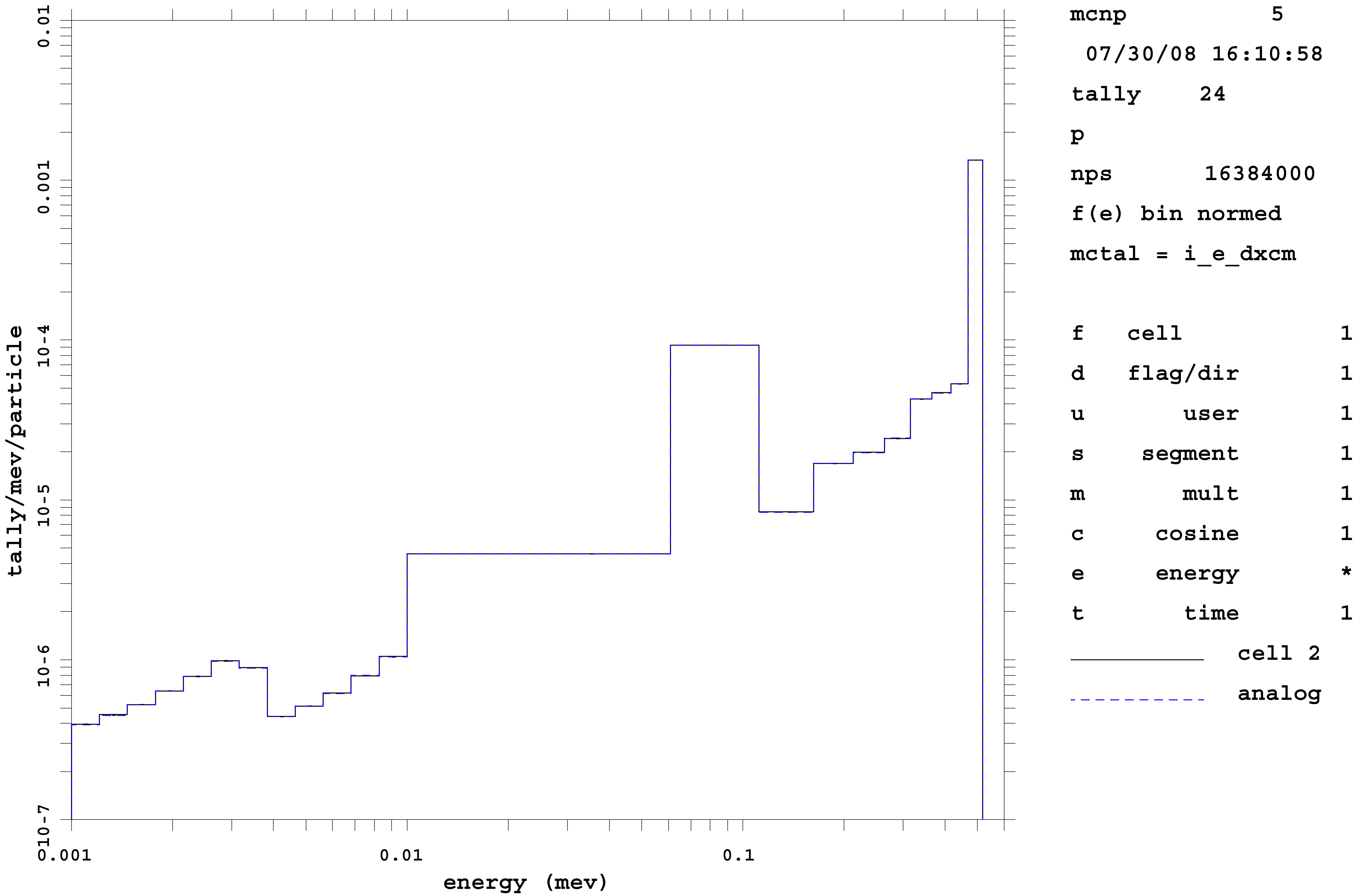

Colinear dxtran -- track length tally
Var Red: 5 dxtran spheres
tally/mev/particle
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
energy (mev)
mcnp 5
07/30/08 01:42:04
tally 24
p
nps 10240000
f(e) bin normed
mctal = i_e_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 2
analog

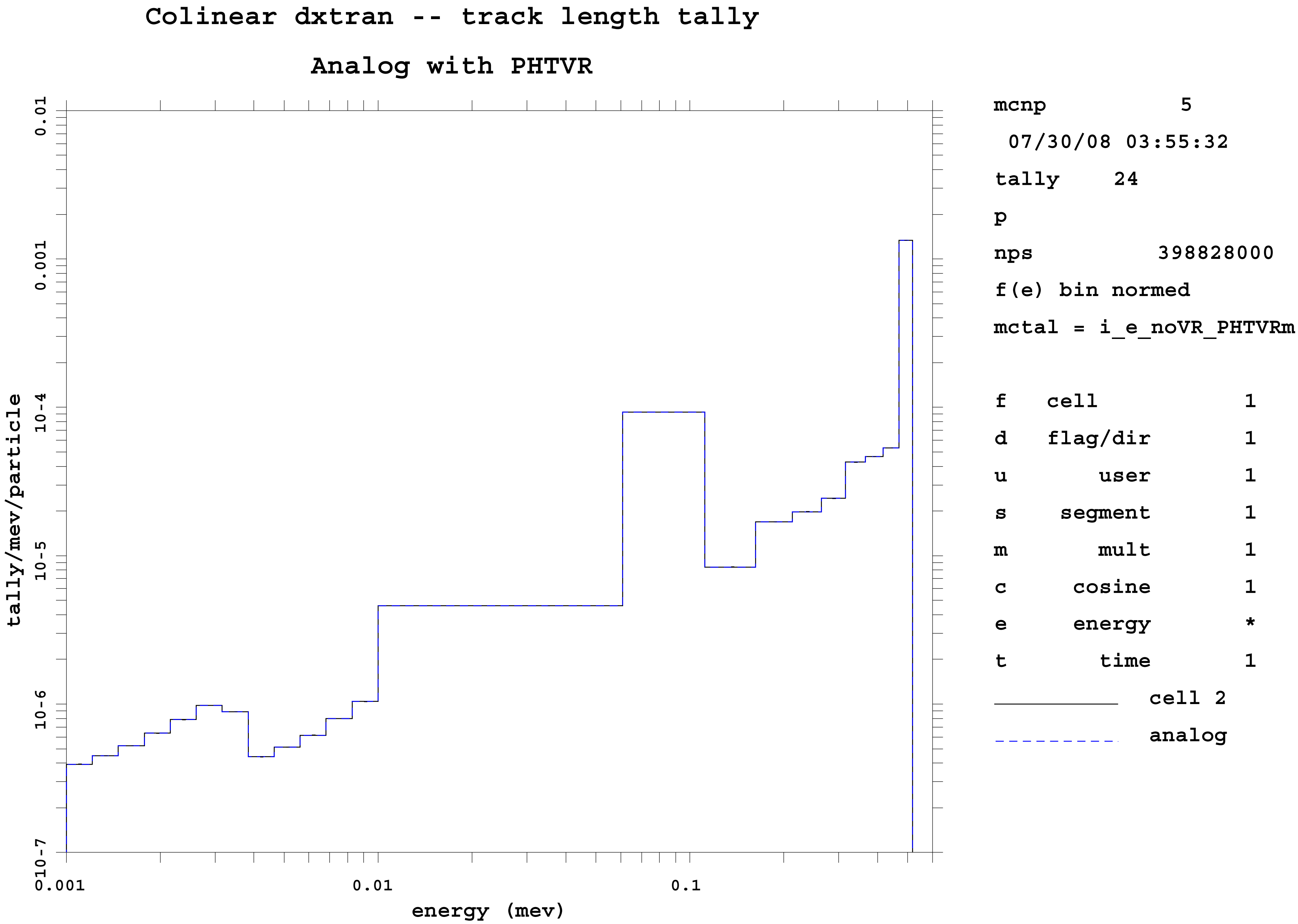


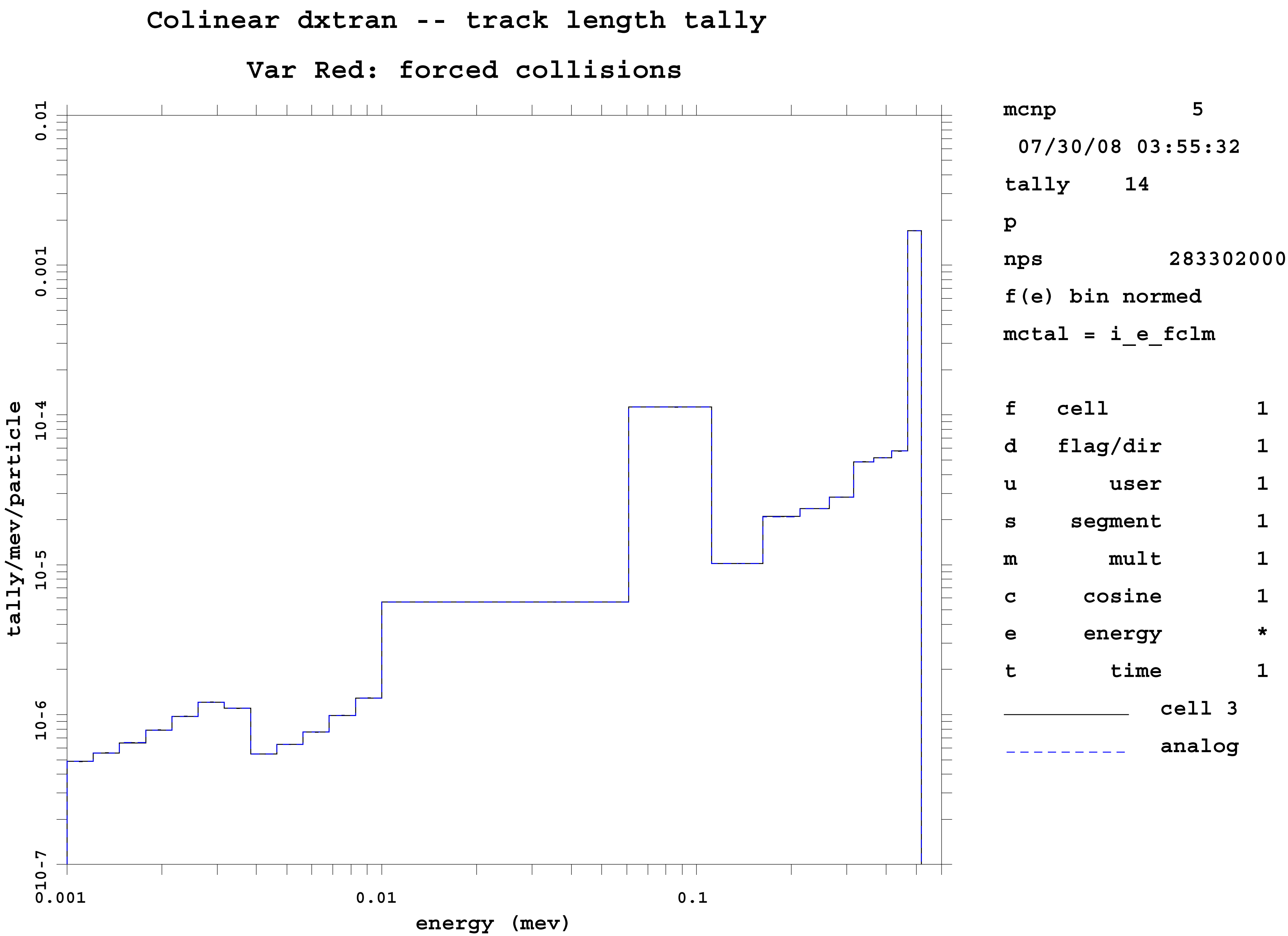
Colinear dxtran -- track length tally
Var Red: 5 dxtran spheres w/ for. colls.
mcnp 5
07/30/08 03:55:27
tally 24
p
nps 12288000
f(e) bin normed
mctal = i_e_dxt_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 2
analog
tally/mev/particle
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
energy (mev)

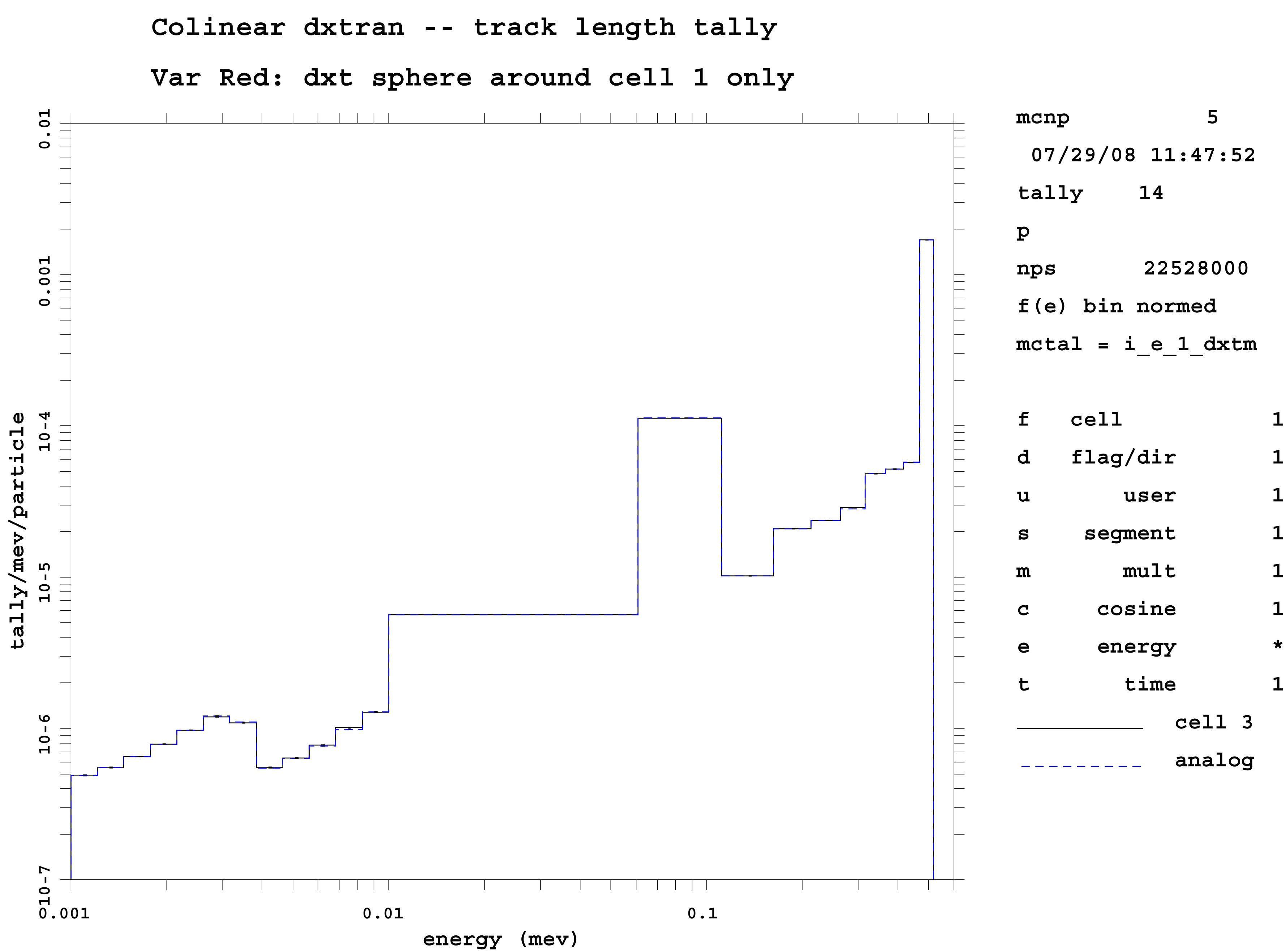
Colinear dxtran -- track length tally

Var Red: 5 dxtran spheres w/ dxc cards




Colinear dxtran -- track length tally
Analog with PHTVR
tally/mev/particle
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
energy (mev)
mcnp 5
07/30/08 03:55:32
tally 24
p
nps 398828000
f(e) bin normed
mctal = i_e_noVR_PHTVRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 2
analog

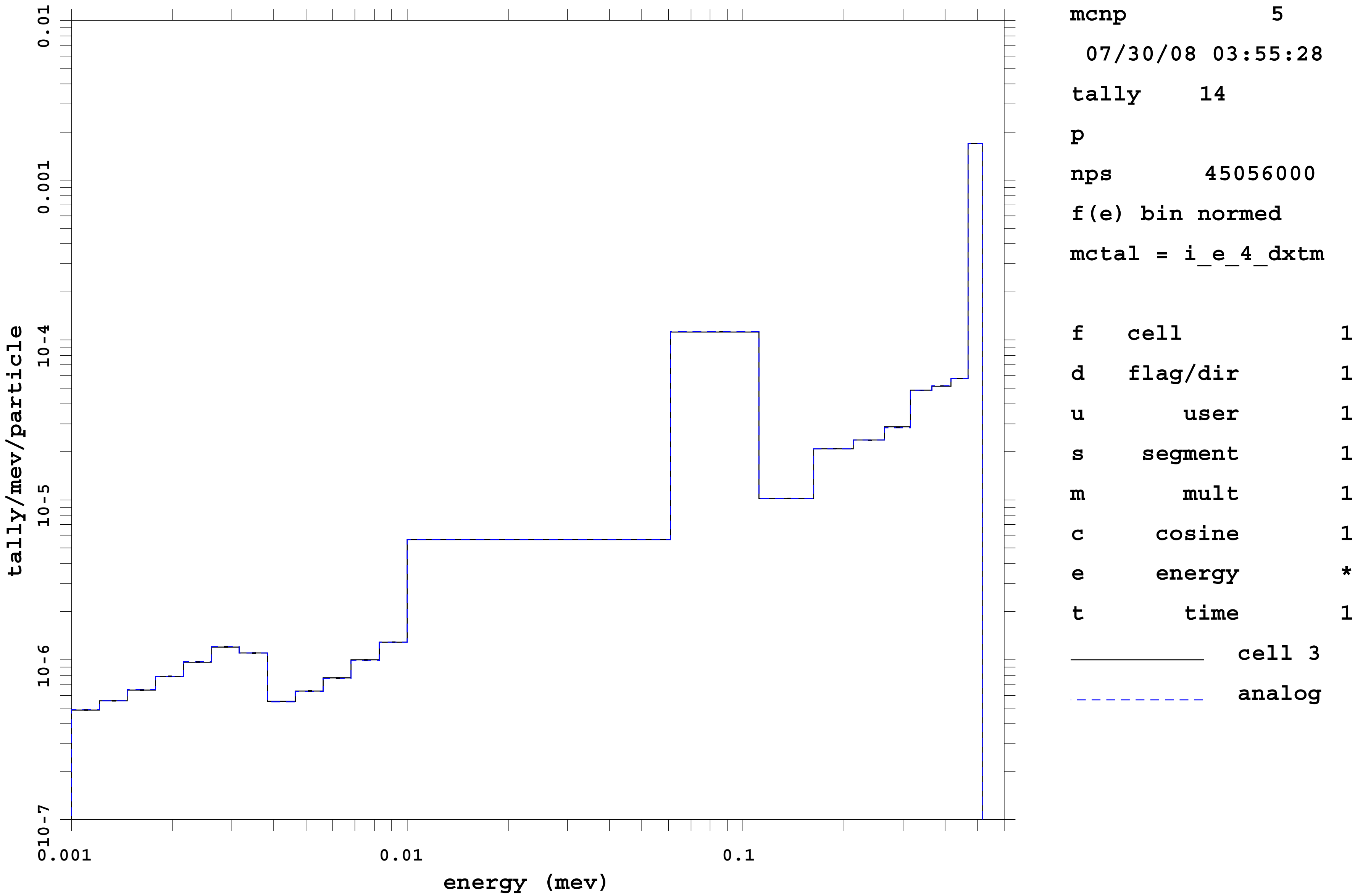

Colinear dxtran -- track length tally
Var Red: forced collisions
tally/mev/particle
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
energy (mev)
mcnp 5
07/30/08 03:55:32
tally 14
p
nps 283302000
f(e) bin normed
mctal = i_e_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 3
analog

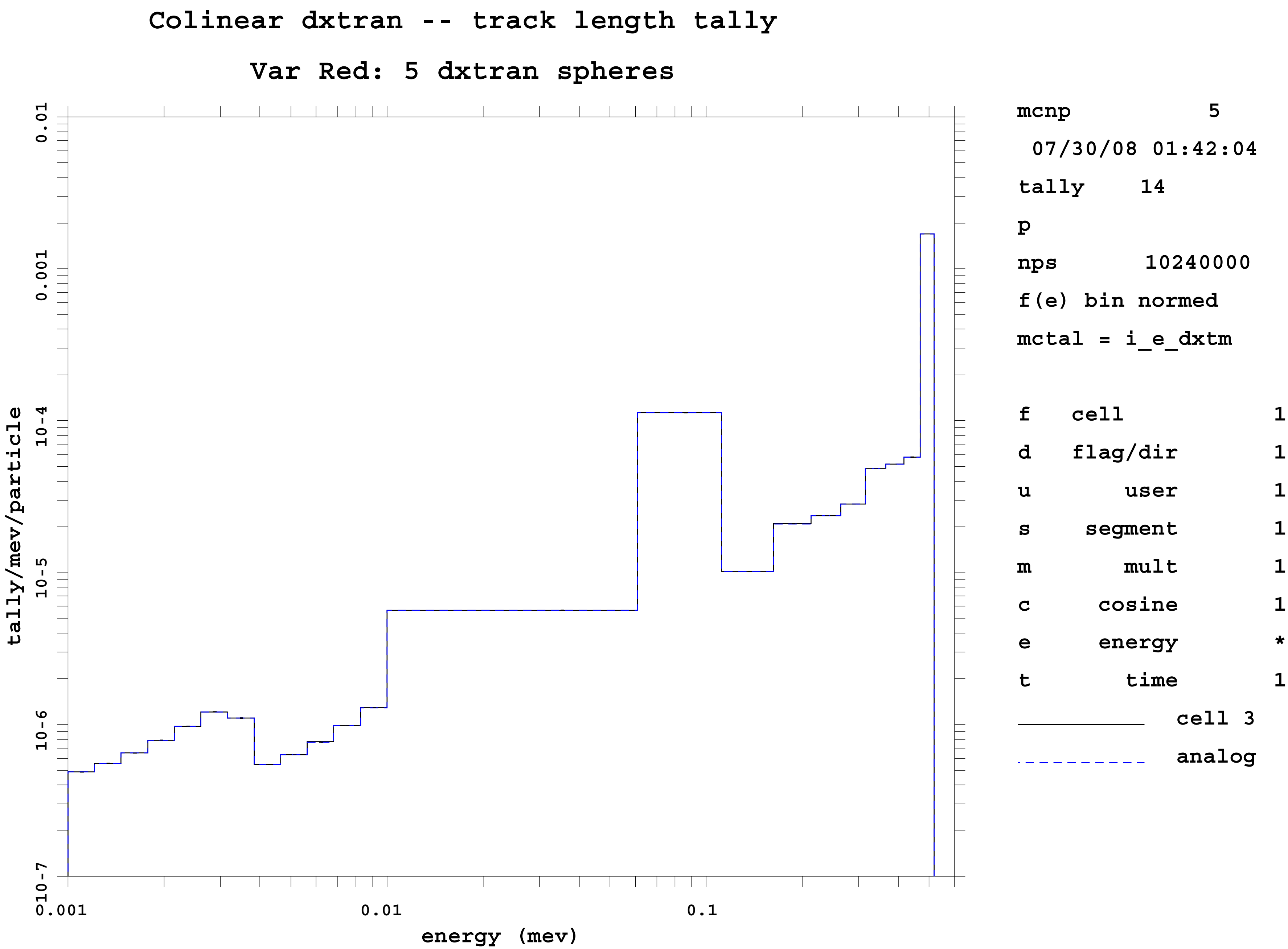


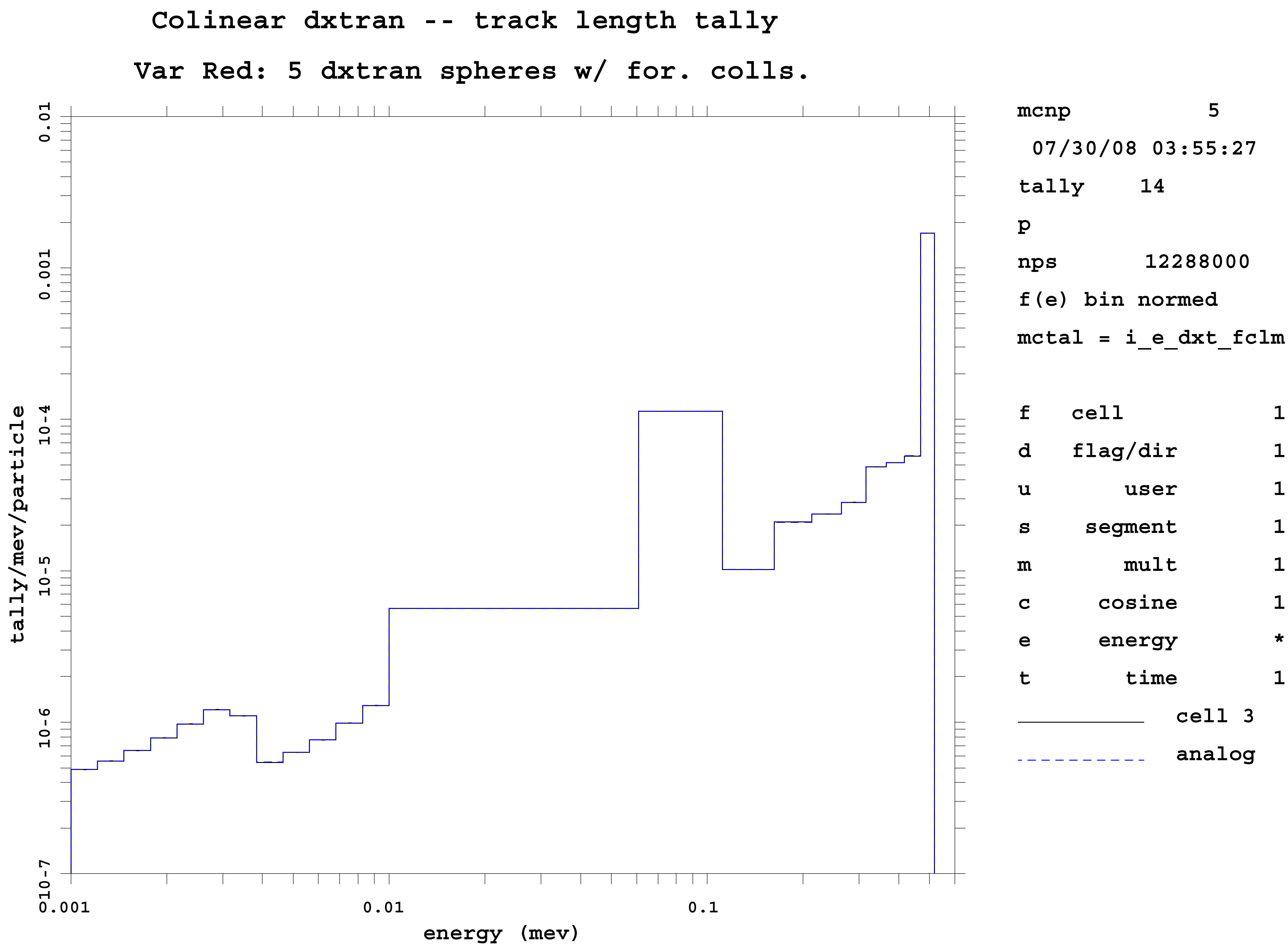
Colinear dxtran -- track length tally
Var Red: dxt sphere around cell 1 only
tally/mev/particle
energy (mev)
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
mcnp 5
07/29/08 11:47:52
tally 14
p
nps 22528000
f(e) bin normed
mctal = i_e_1_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 3
analog

Colinear dxtran -- track length tally

Var Red: dxt sphere around cell 4 only



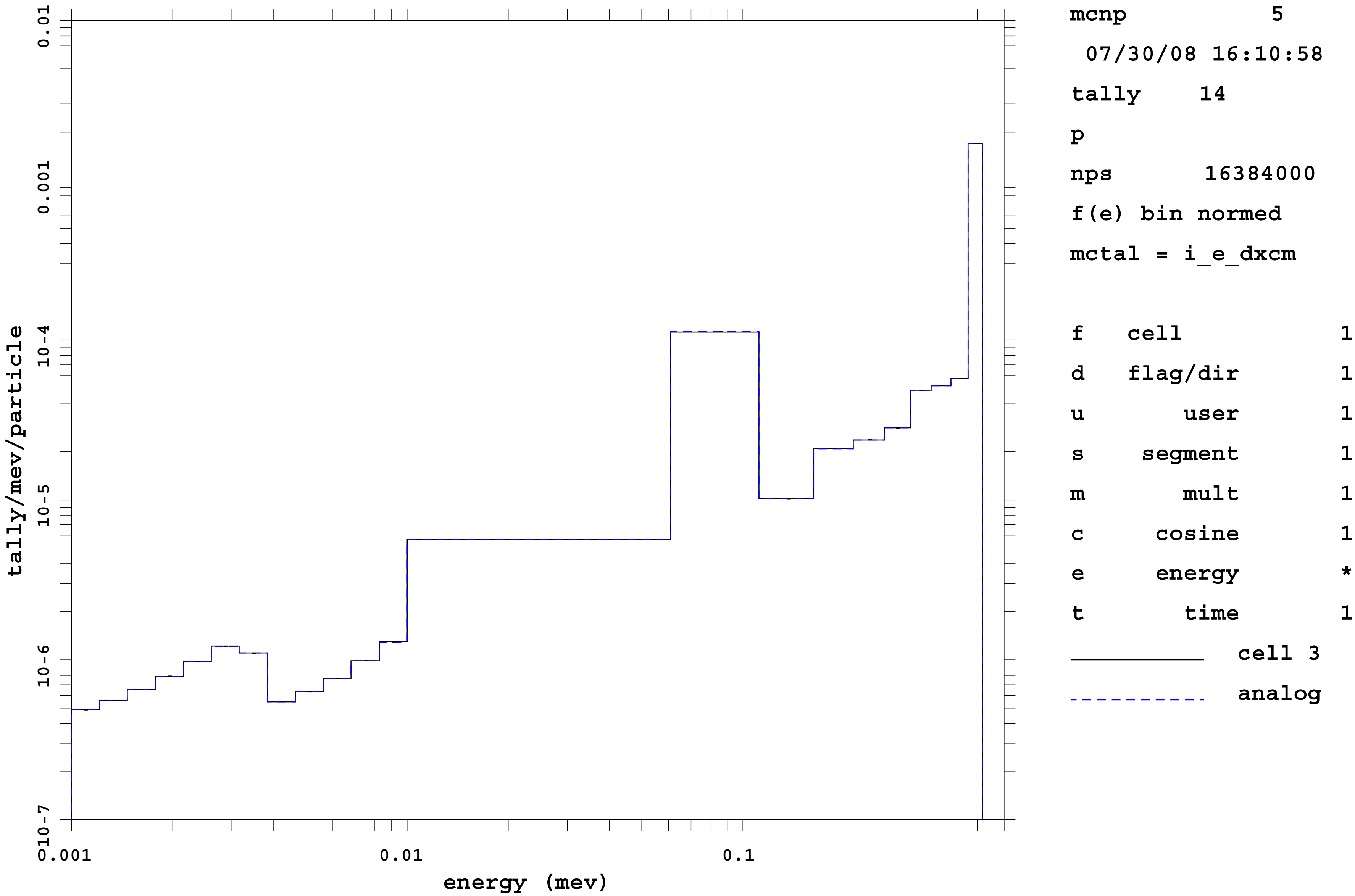

Colinear dxtran -- track length tally
Var Red: 5 dxtran spheres
tally/mev/particle
energy (mev)
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
mcnp 5
07/30/08 01:42:04
tally 14
p
nps 10240000
f(e) bin normed
mctal = i_e_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 3
analog



Colinear dxtran -- track length tally
Var Red: 5 dxtran spheres w/ for. colls.
tally/mev/particle
energy (mev)
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
mcnp 5
07/30/08 03:55:27
tally 14
p
nps 12288000
f(e) bin normed
mctal = i_e_dxt_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 3
analog

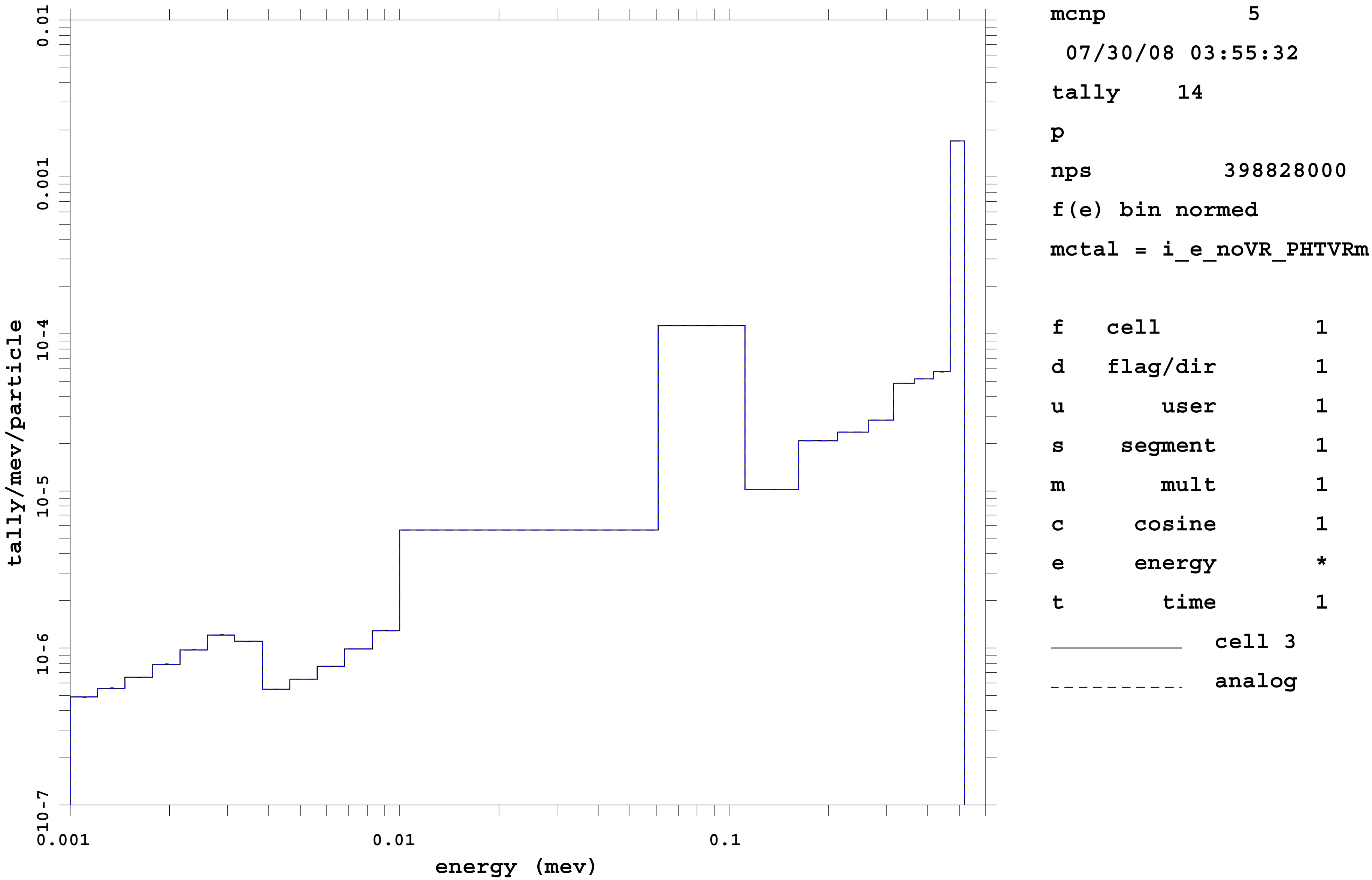
Colinear dxtran -- track length tally

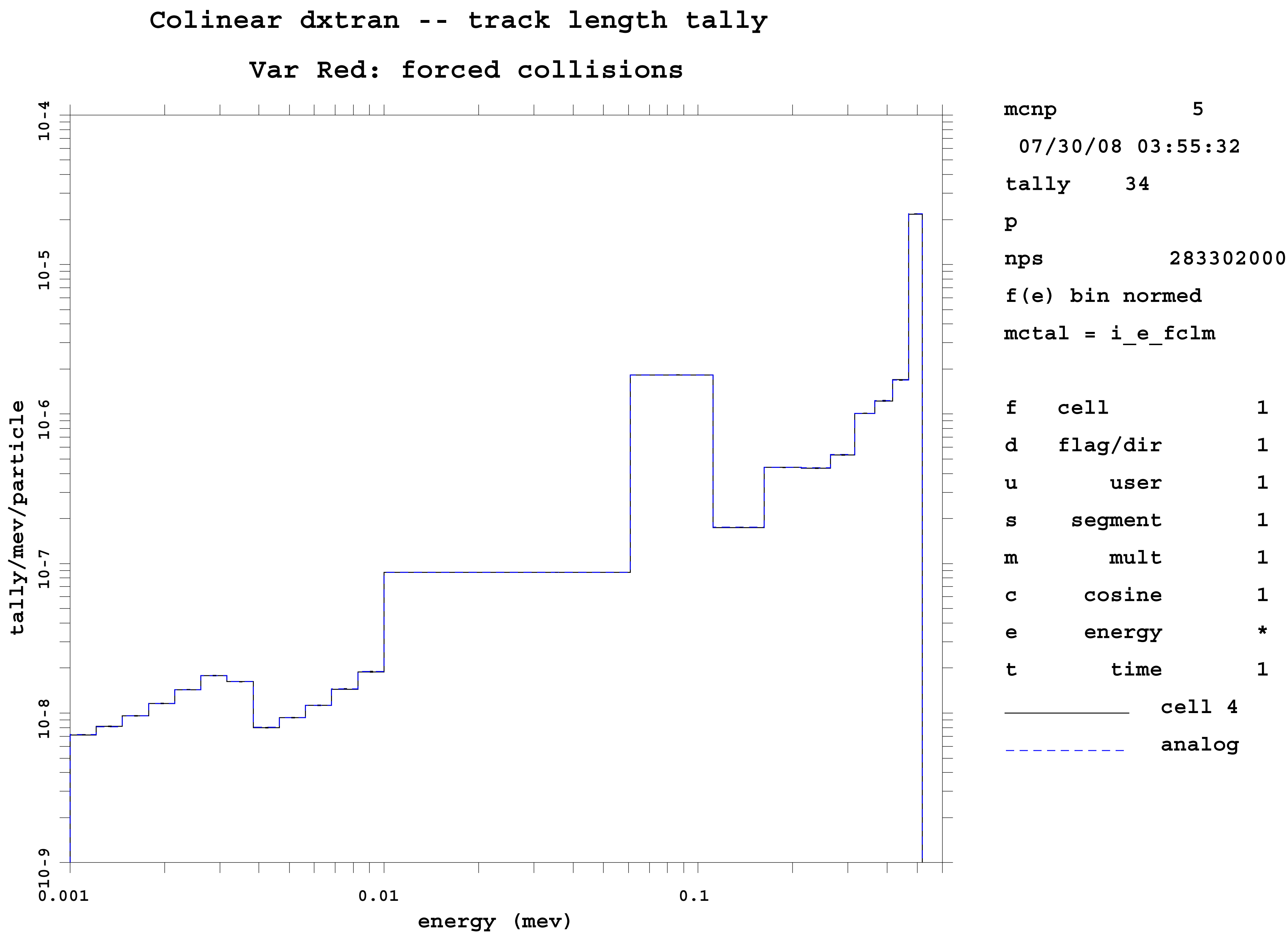
Var Red: 5 dxtran spheres w/ dxc cards

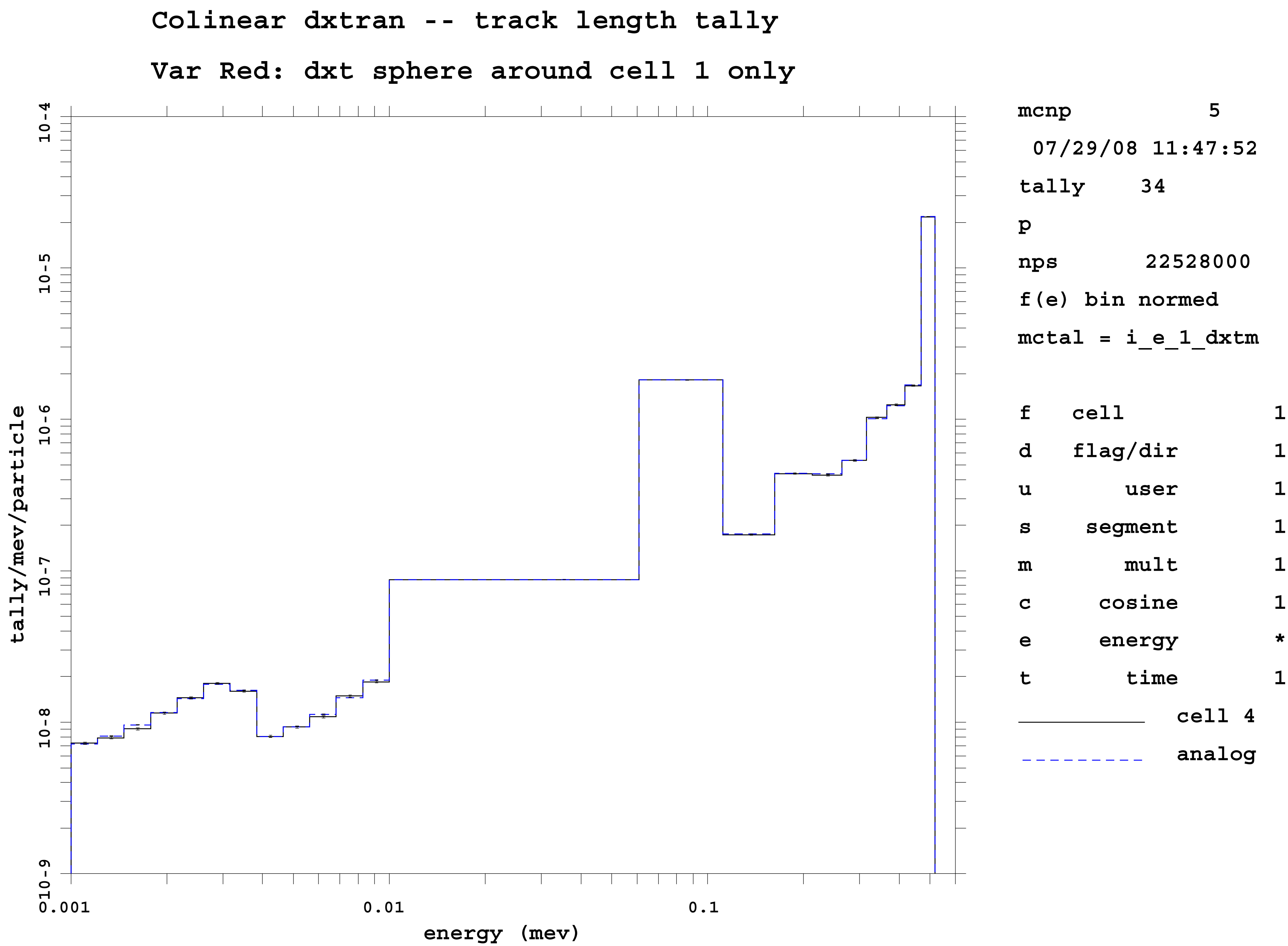


Colinear dxtran -- track length tally

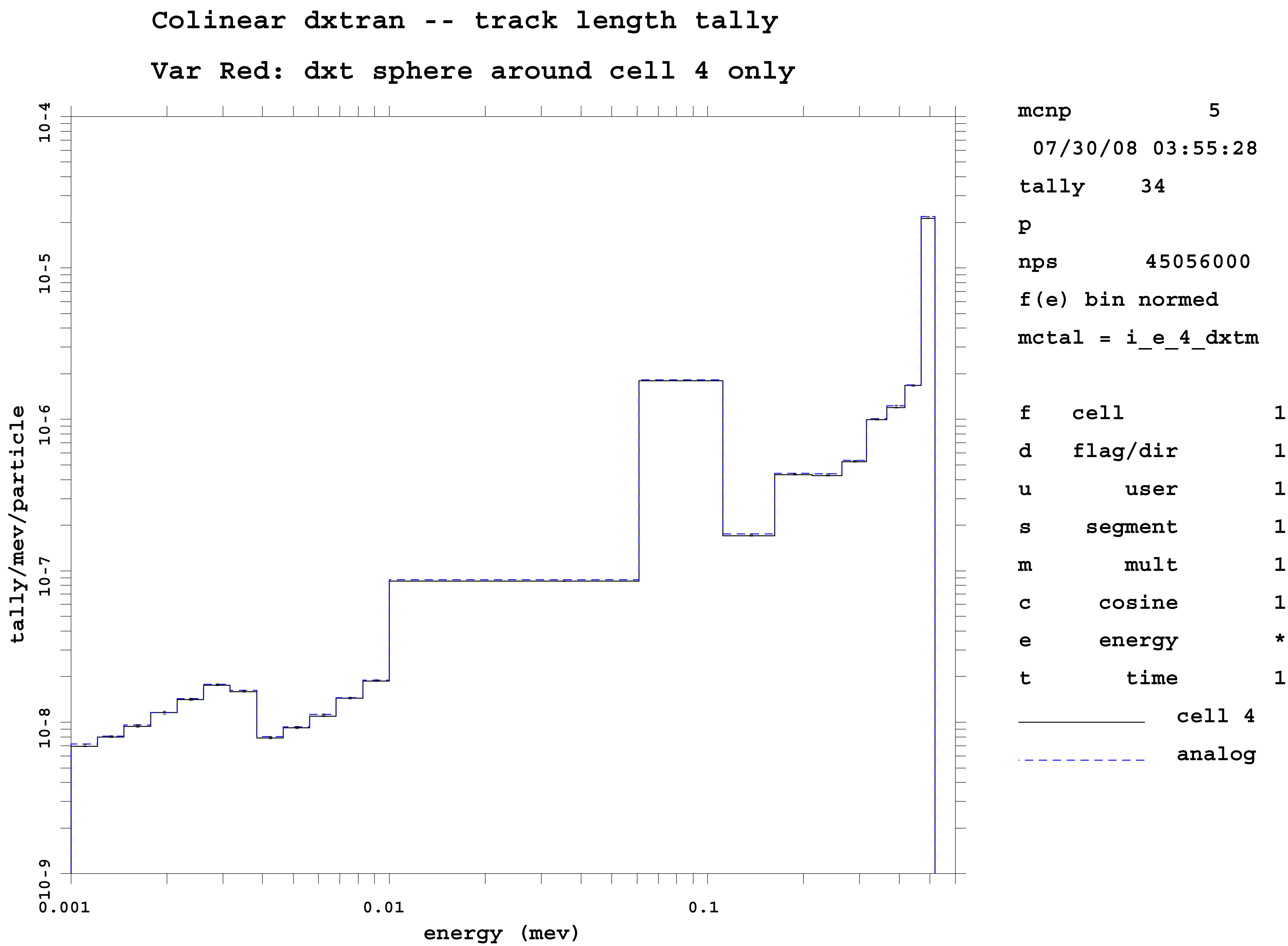
Analog with PHTVR

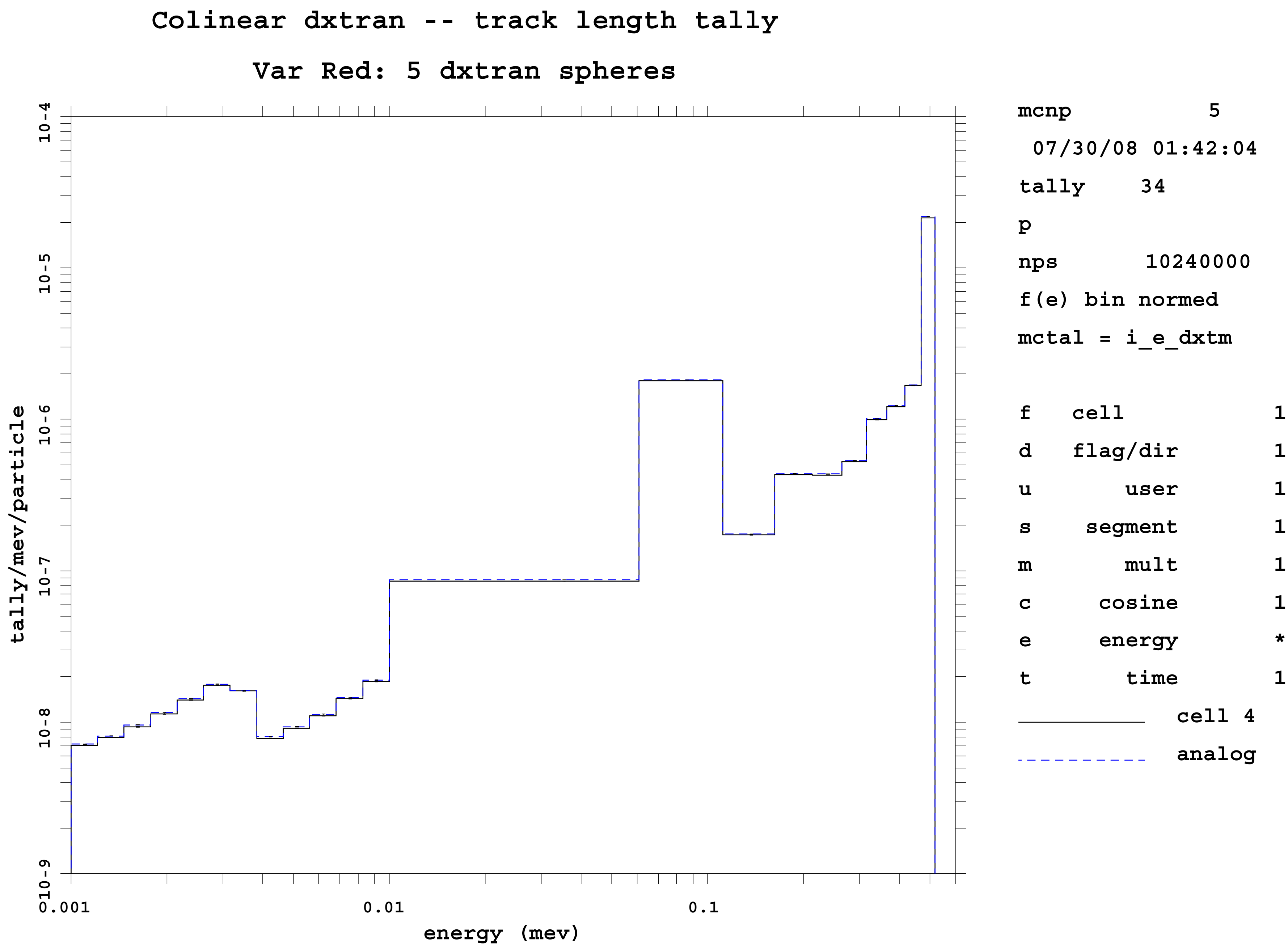



Colinear dxtran -- track length tally
Var Red: forced collisions
tally/mev/particle
energy (mev)
10-4
10-5
10-6
10-7
10-8
10-9
0.001
0.01
0.1
mcnp 5
07/30/08 03:55:32
tally 34
p
nps 283302000
f(e) bin normed
mctal = i_e_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 4
analog



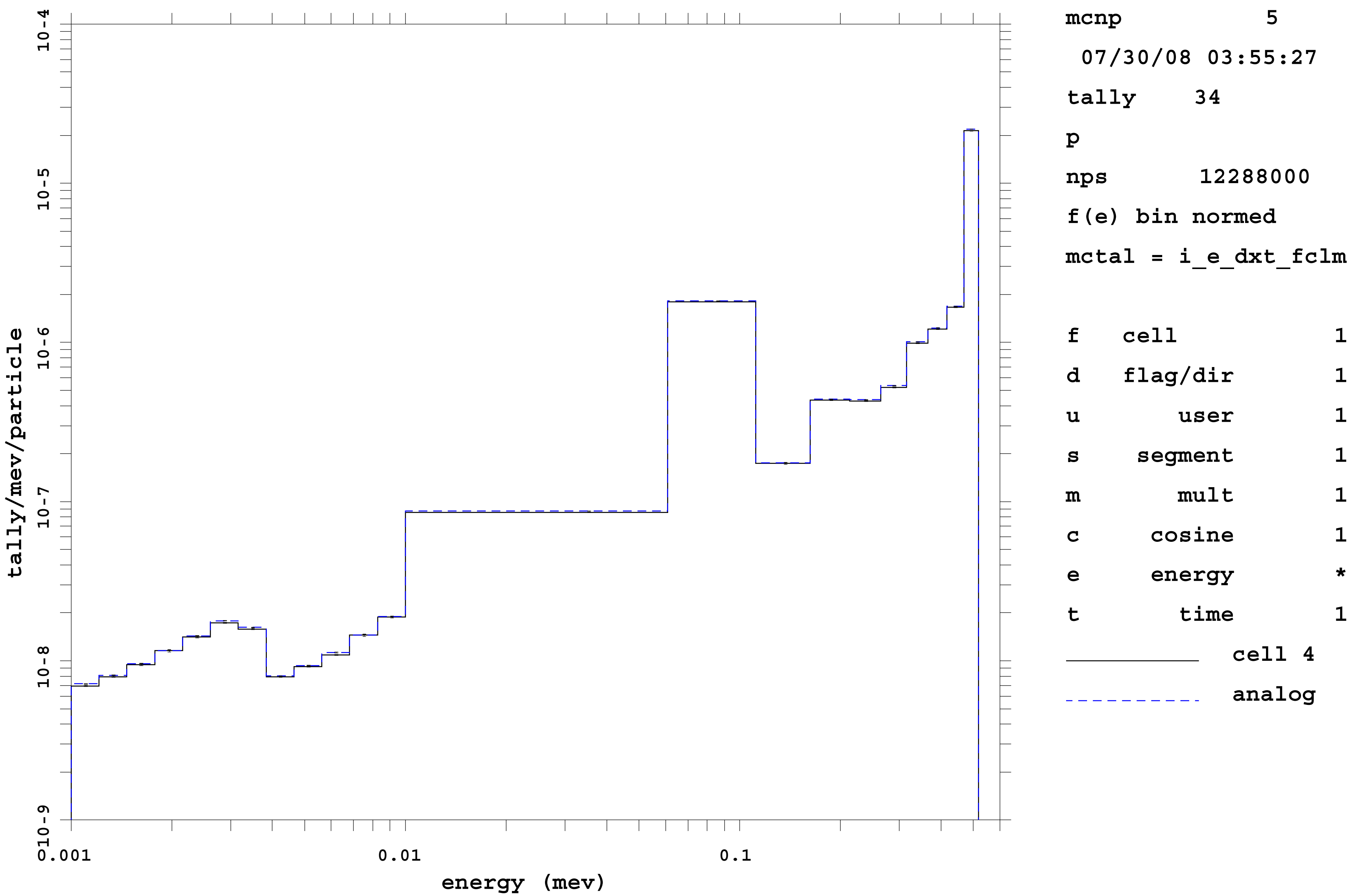
Colinear dxtran -- track length tally
Var Red: dxt sphere around cell 1 only
mcnp 5
07/29/08 11:47:52
tally 34
p
nps 22528000
f(e) bin normed
mctal = i_e_1_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 4
analog
tally/mev/particle
energy (mev)
10-4
10-5
10-6
10-7
10-8
10-9
0.001
0.01
0.1


Colinear dxtran -- track length tally
Var Red: dxt sphere around cell 4 only
tally/mev/particle
10-4
10-5
10-6
10-7
10-8
10-9
0.001
0.01
0.1
energy (mev)
mcnp 5
07/30/08 03:55:28
tally 34
p
nps 45056000
f(e) bin normed
mctal = i_e_4_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 4
analog


Colinear dxtran -- track length tally
Var Red: 5 dxtran spheres
tally/mev/particle
energy (mev)
10-4
10-5
10-6
10-7
10-8
10-9
0.001
0.01
0.1
mcnp 5
07/30/08 01:42:04
tally 34
p
nps 10240000
f(e) bin normed
mctal = i_e_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 4
analog

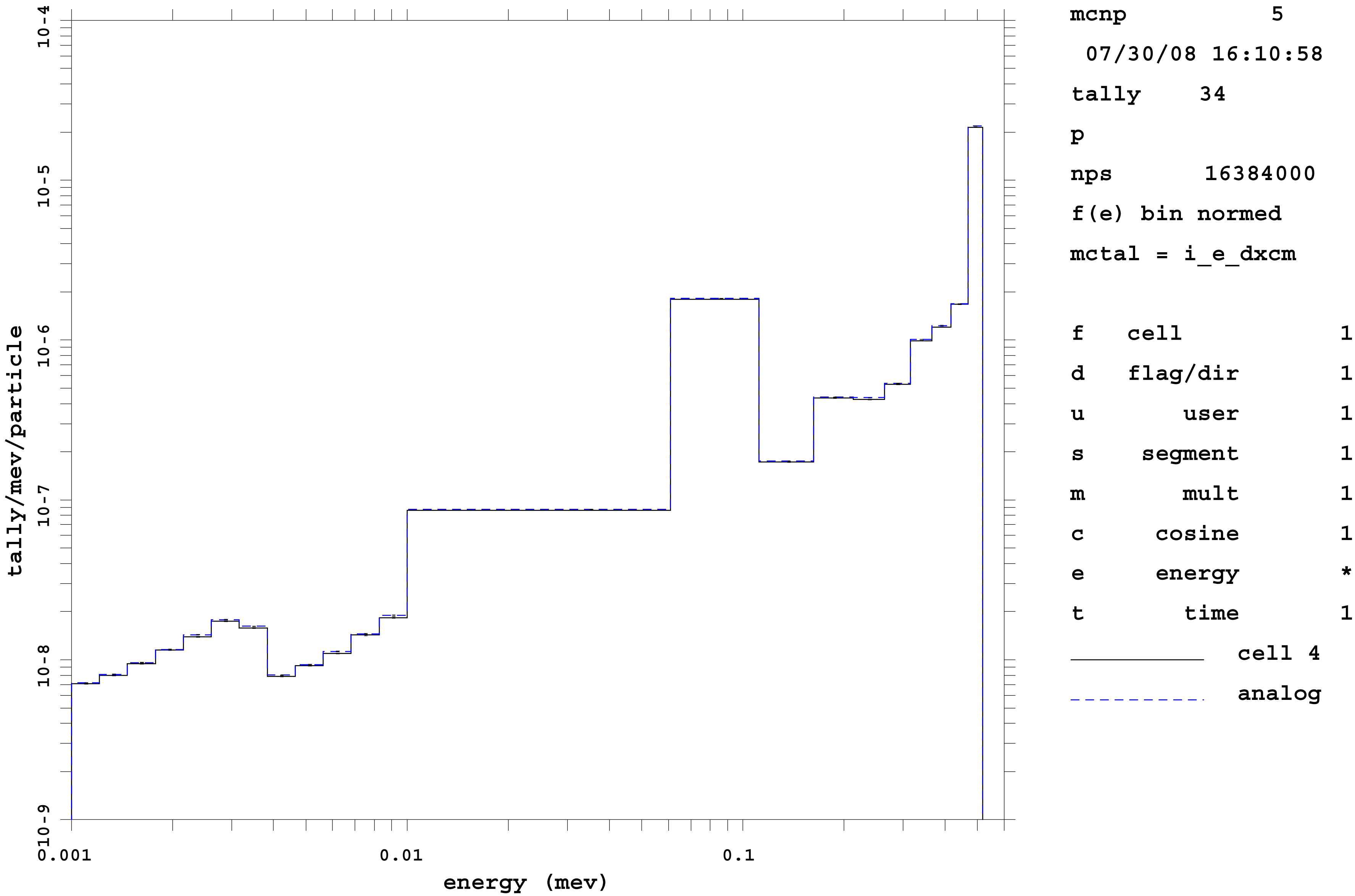
Colinear dxtran -- track length tally

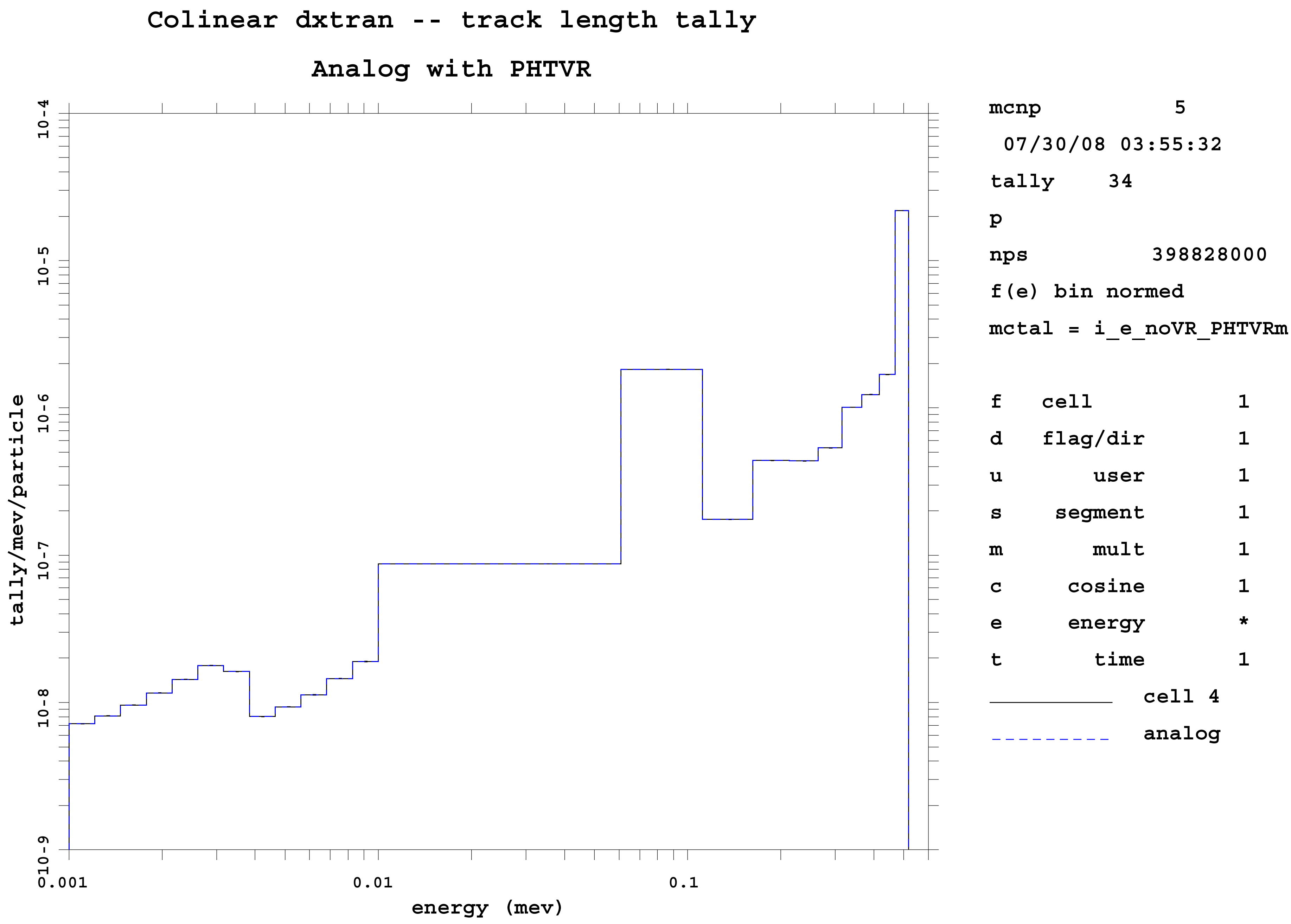
Var Red: 5 dxtran spheres w/ for. colls.



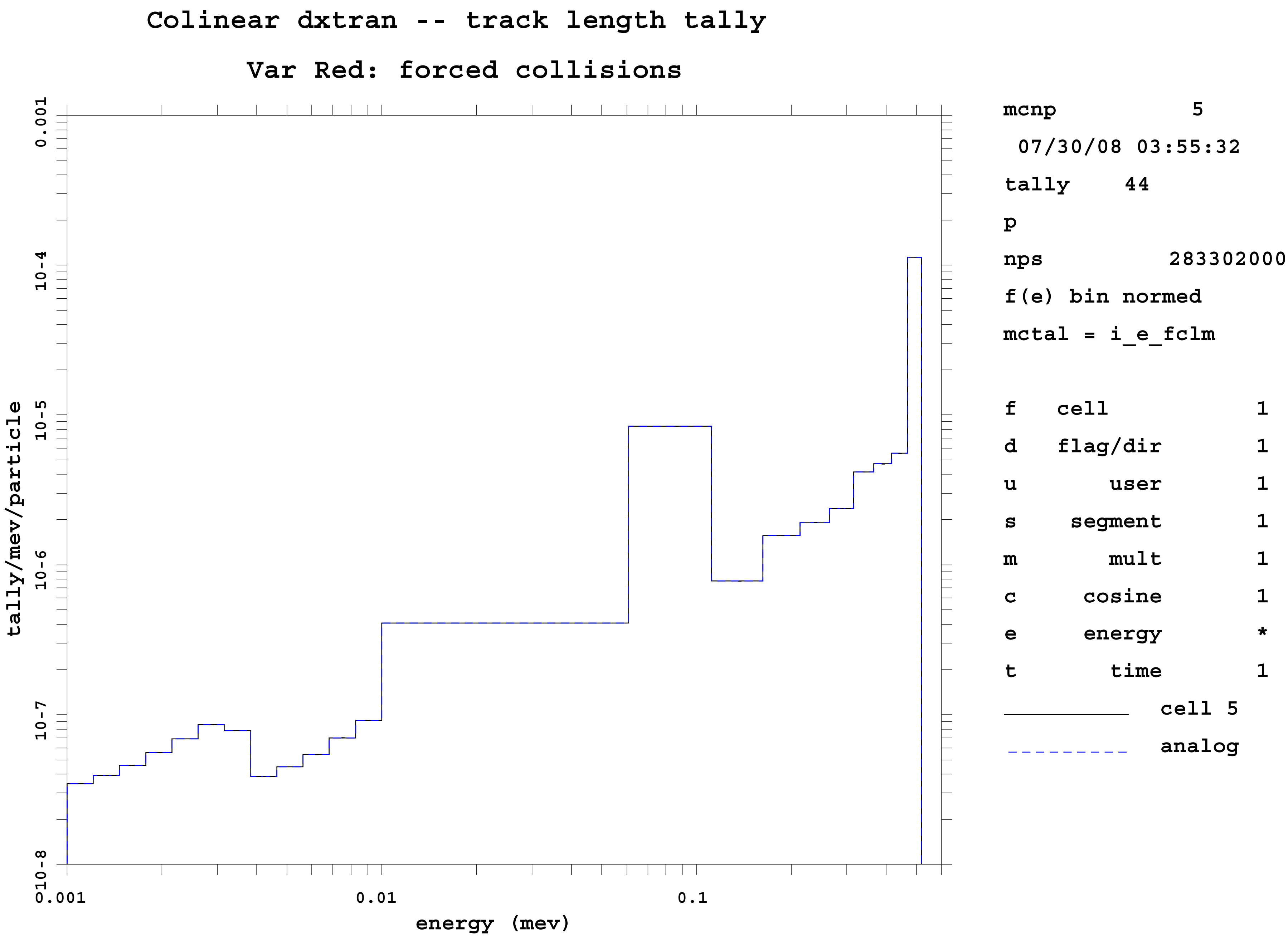
Colinear dxtran -- track length tally

Var Red: 5 dxtran spheres w/ dxc cards

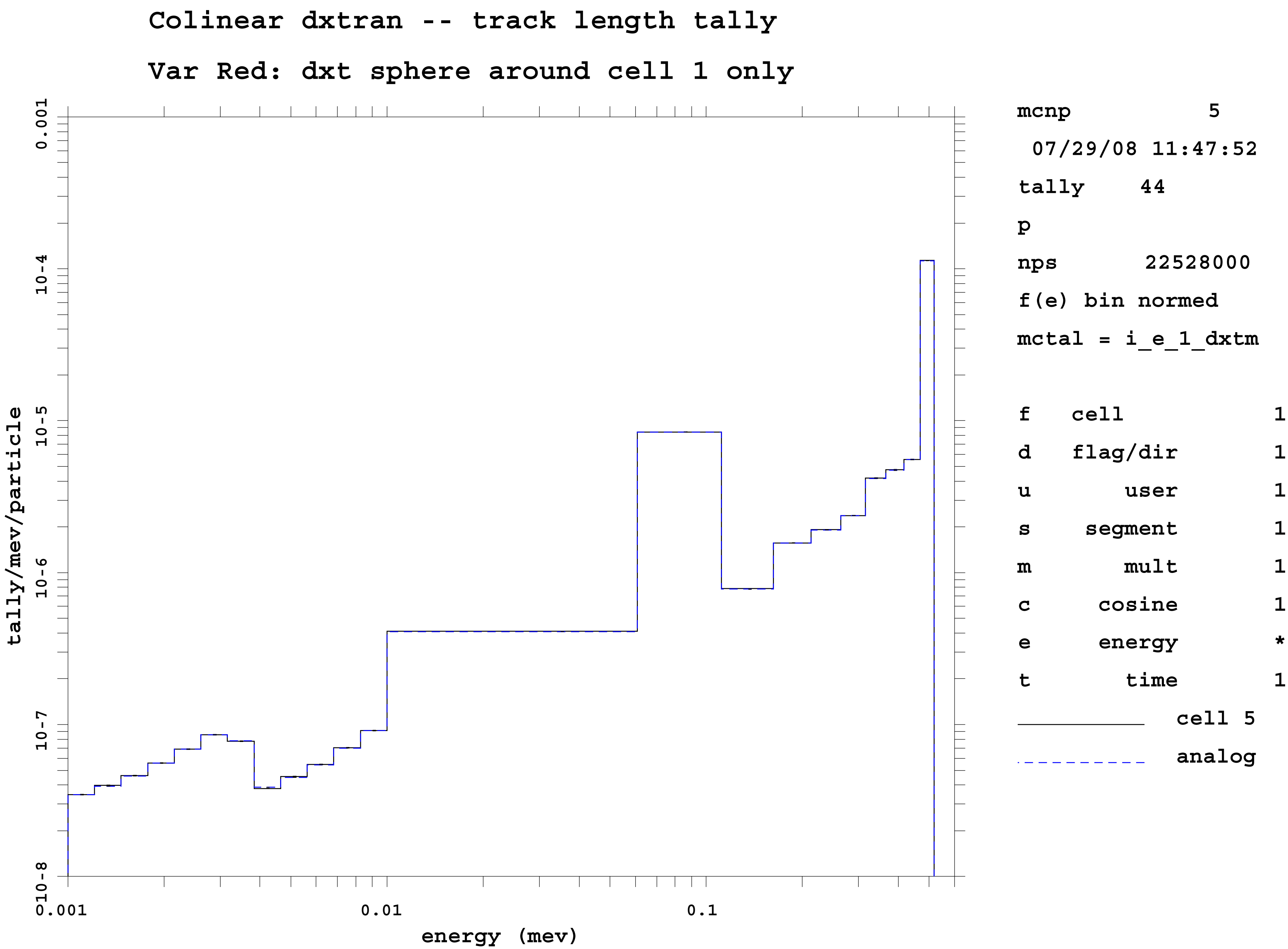




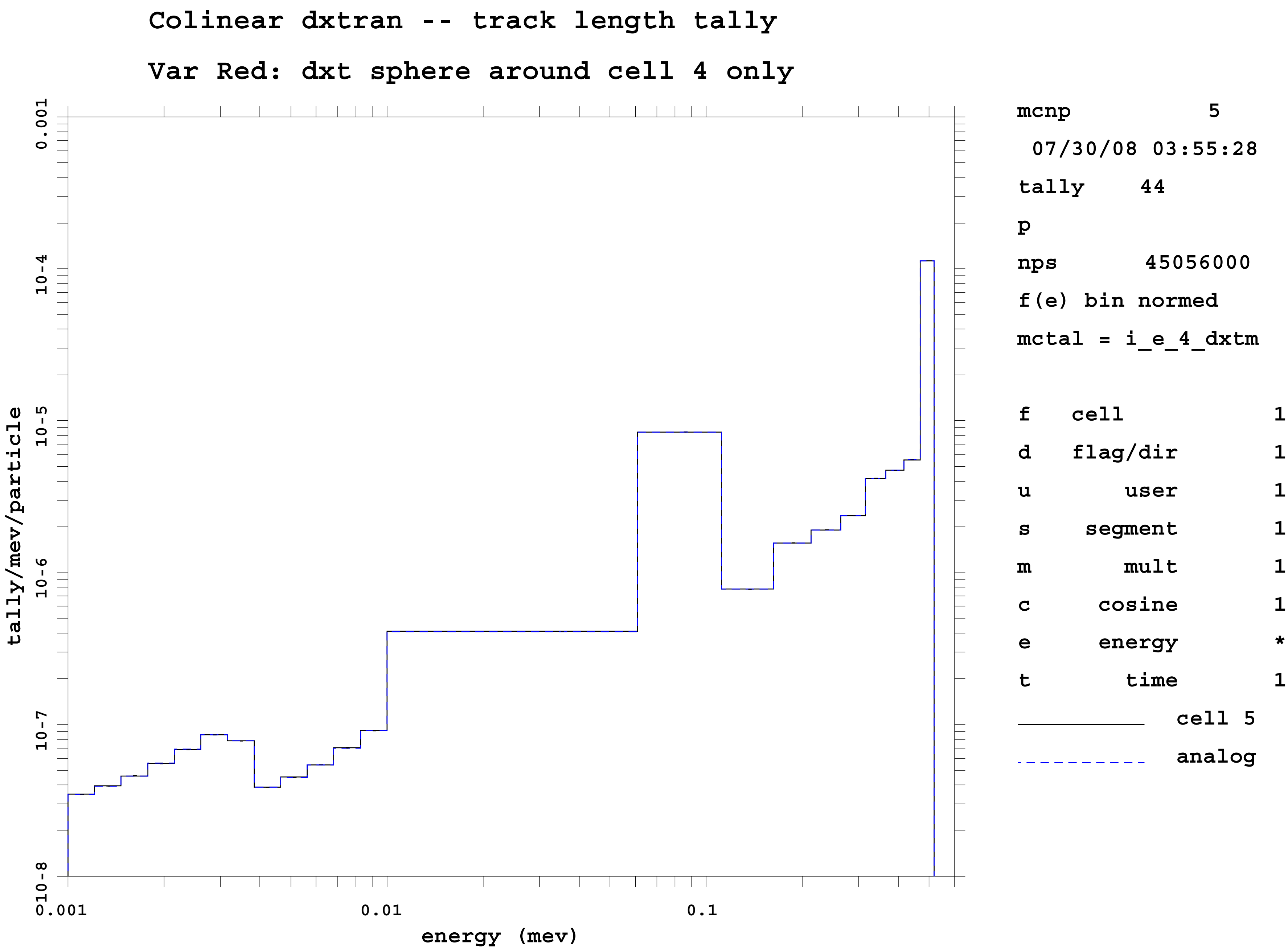
Colinear dxtran -- track length tally
Analog with PHTVR
mcnp 5
07/30/08 03:55:32
tally 34
p
nps 398828000
f(e) bin normed
mctal = i_e_noVR_PHTVRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 4
analog
tally/mev/particle
10-4
10-5
10-6
10-7
10-8
10-9
0.001
0.01
0.1
energy (mev)



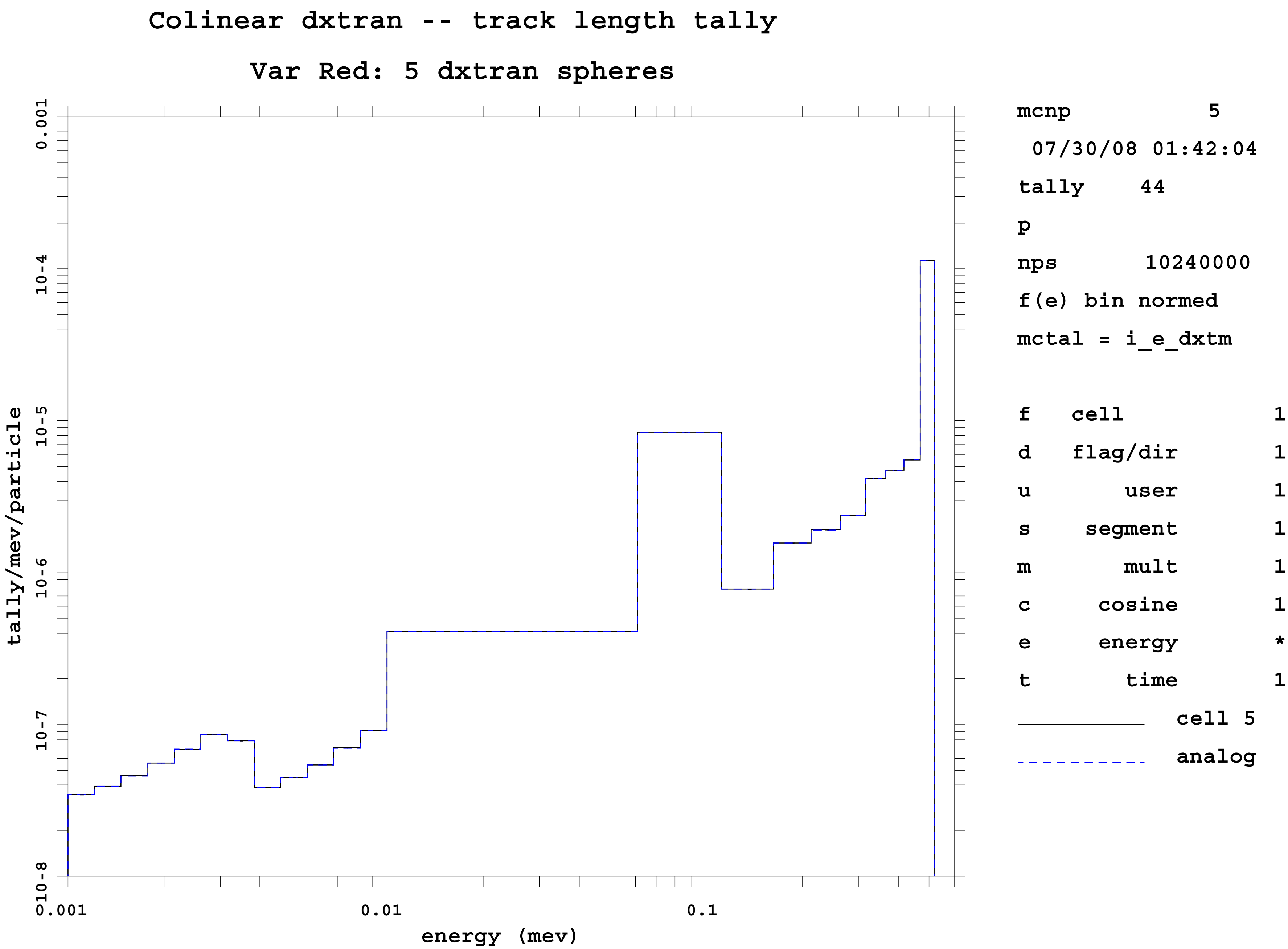
Colinear dxtran -- track length tally
Var Red: forced collisions
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
0.001
0.01
0.1
energy (mev)
mcnp 5
07/30/08 03:55:32
tally 44
p
nps 283302000
f(e) bin normed
mctal = i_e_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 5
analog

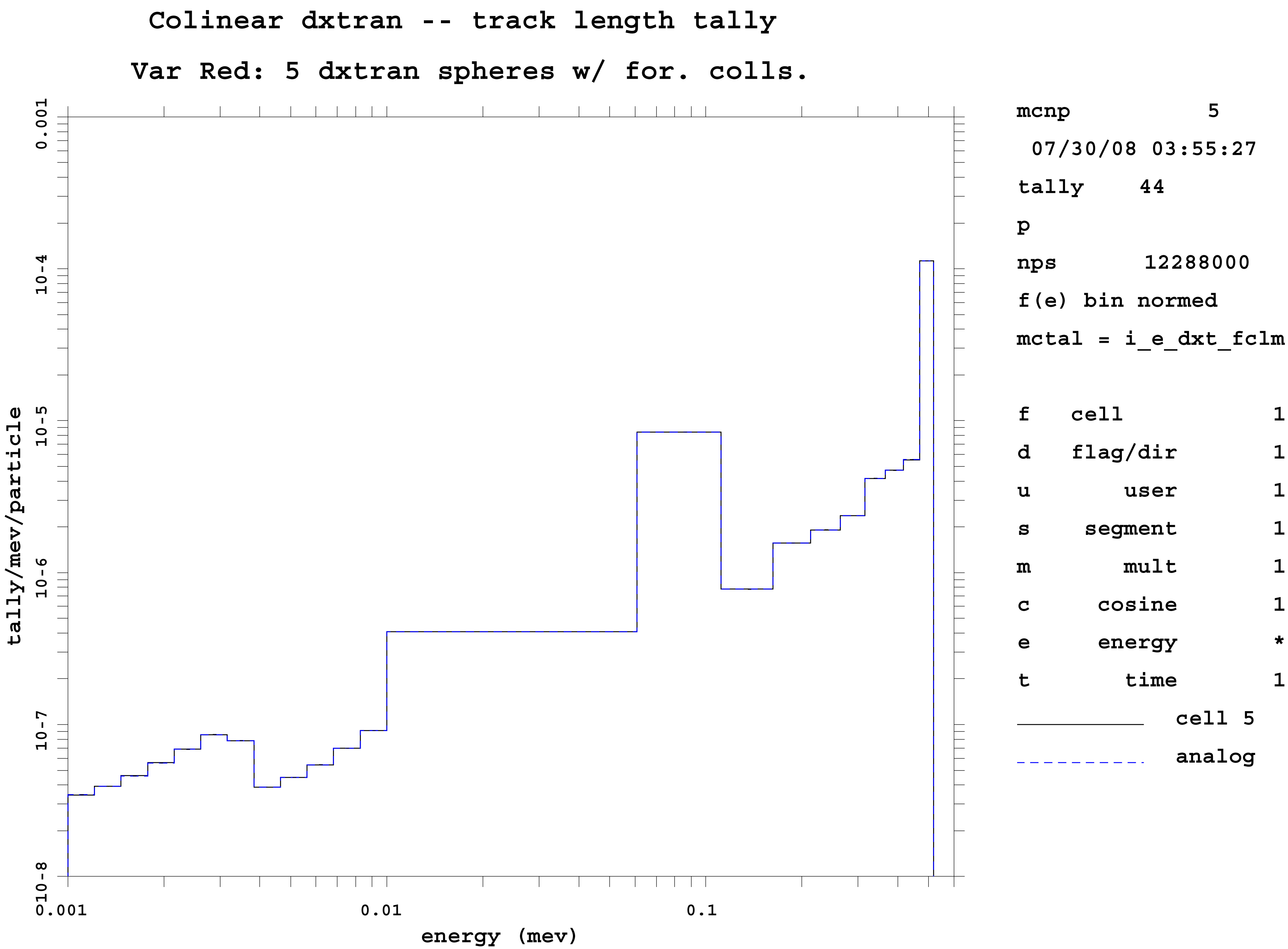


Colinear dxtran -- track length tally
Var Red: dxt sphere around cell 1 only
0.001
10-4
10-5
10-6
10-7
10-8
tally/mev/particle
0.001
0.01
0.1
energy (mev)
mcnp 5
07/29/08 11:47:52
tally 44
p
nps 22528000
f(e) bin normed
mctal = i_e_1_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 5
analog

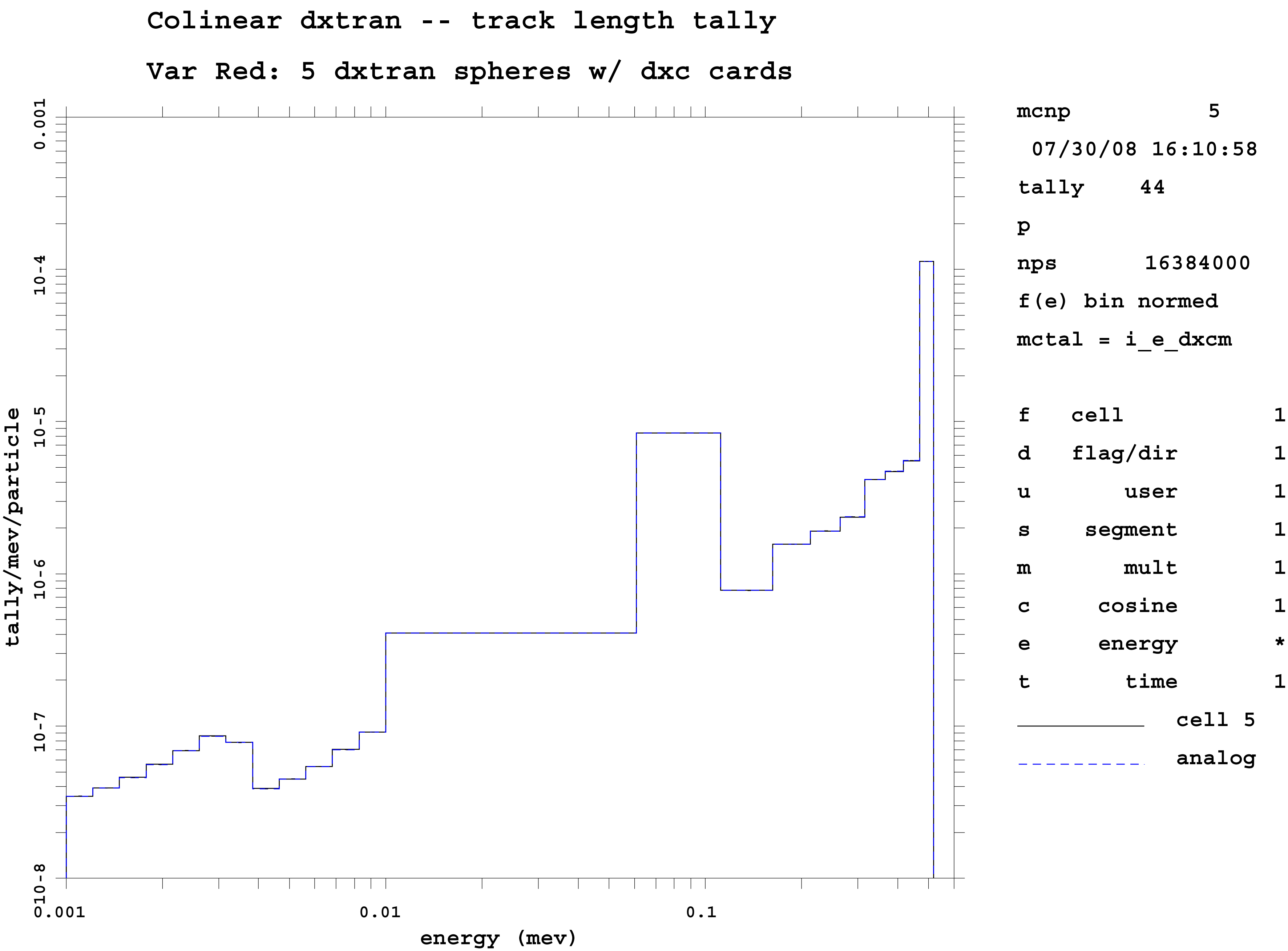


Colinear dxtran -- track length tally
Var Red: dxt sphere around cell 4 only
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
0.001
0.01
0.1
energy (mev)
mcnp 5
07/30/08 03:55:28
tally 44
p
nps 45056000
f(e) bin normed
mctal = i_e_4_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 5
analog

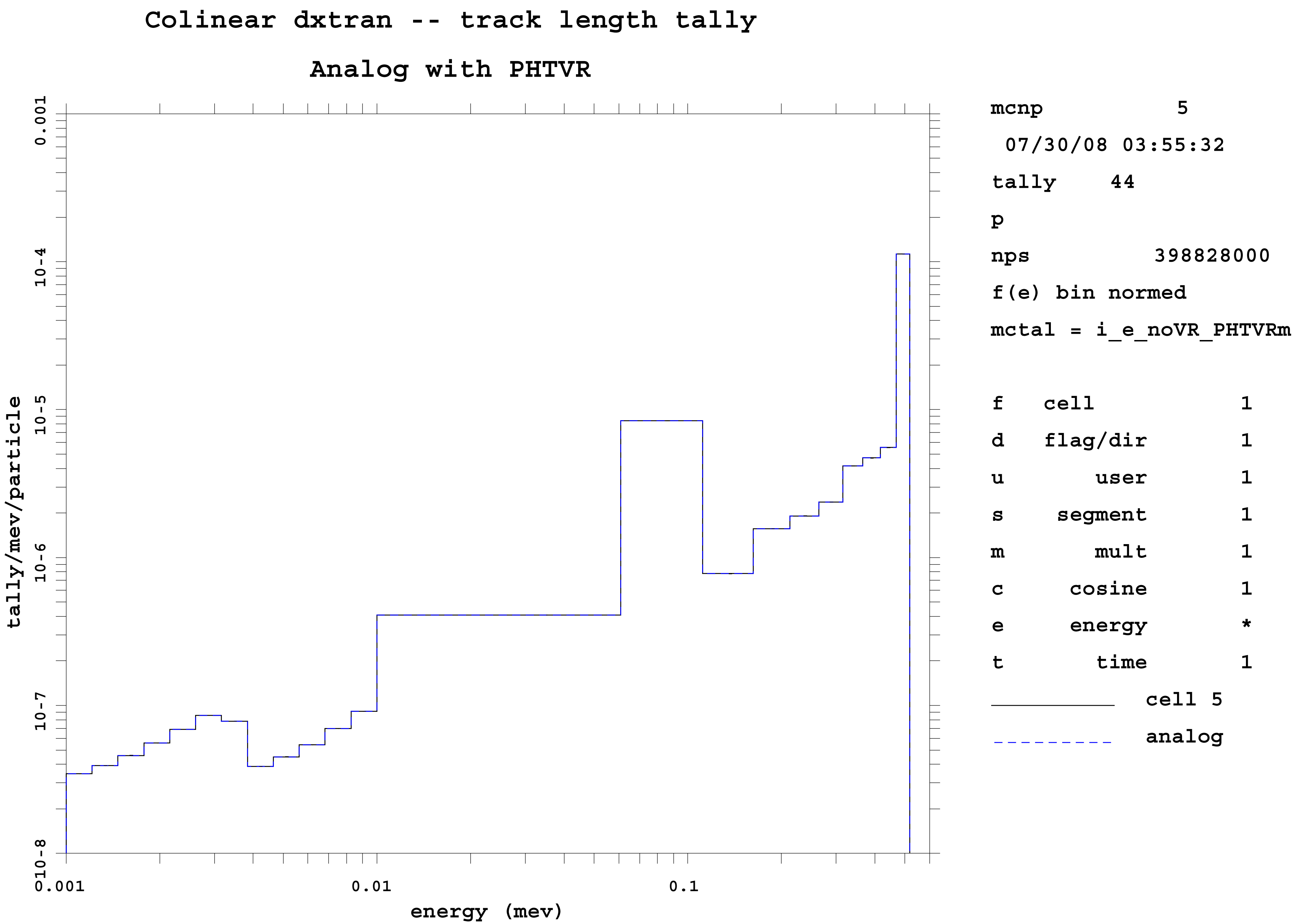

Colinear dxtran -- track length tally
Var Red: 5 dxtran spheres
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
0.001
0.01
0.1
energy (mev)
mcnp 5
07/30/08 01:42:04
tally 44
p
nps 10240000
f(e) bin normed
mctal = i_e_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 5
analog



Colinear dxtran -- track length tally
Var Red: 5 dxtran spheres w/ for. colls.
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
0.001
0.01
0.1
energy (mev)
mcnp 5
07/30/08 03:55:27
tally 44
p
nps 12288000
f(e) bin normed
mctal = i_e_dxt_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 5
analog



Colinear dxtran -- track length tally
Var Red: 5 dxtran spheres w/ dxc cards
tally/mev/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
0.001
0.01
0.1
energy (mev)
mcnp 5
07/30/08 16:10:58
tally 44
p
nps 16384000
f(e) bin normed
mctal = i_e_dxcm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 5
analog



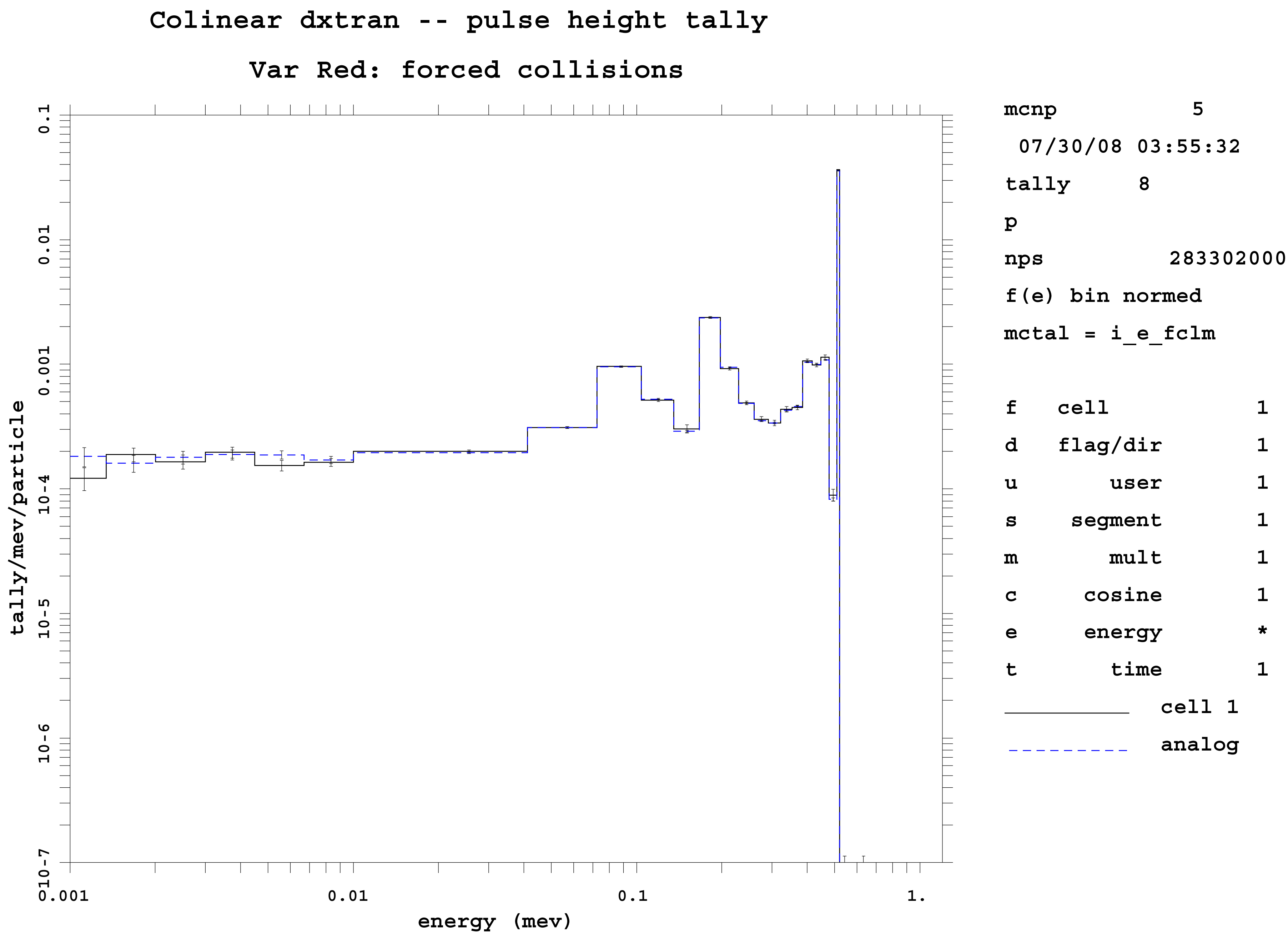
Colinear dxtran -- track length tally
Analog with PHTVR
tally/mev/particle
0.001
10-4
10-5
10-6
10-7
10-8
0.001
0.01
0.1
energy (mev)
mcnp 5
07/30/08 03:55:32
tally 44
p
nps 398828000
f(e) bin normed
mctal = i_e_noVR_PHTVRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 5
analog

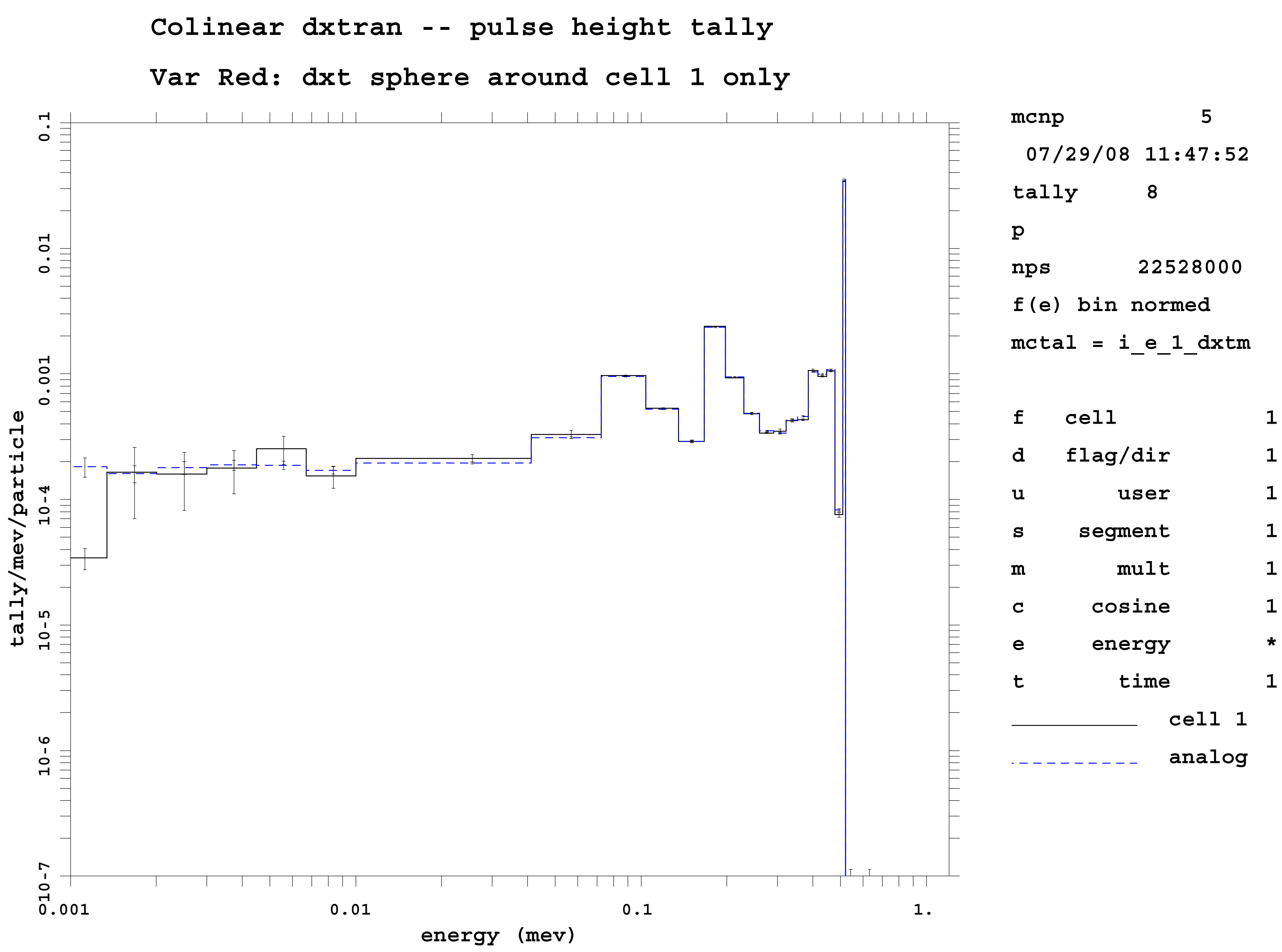
Appendix C.2

Collinear DXTRAN Spheres

Pulse Height Tally Spectra

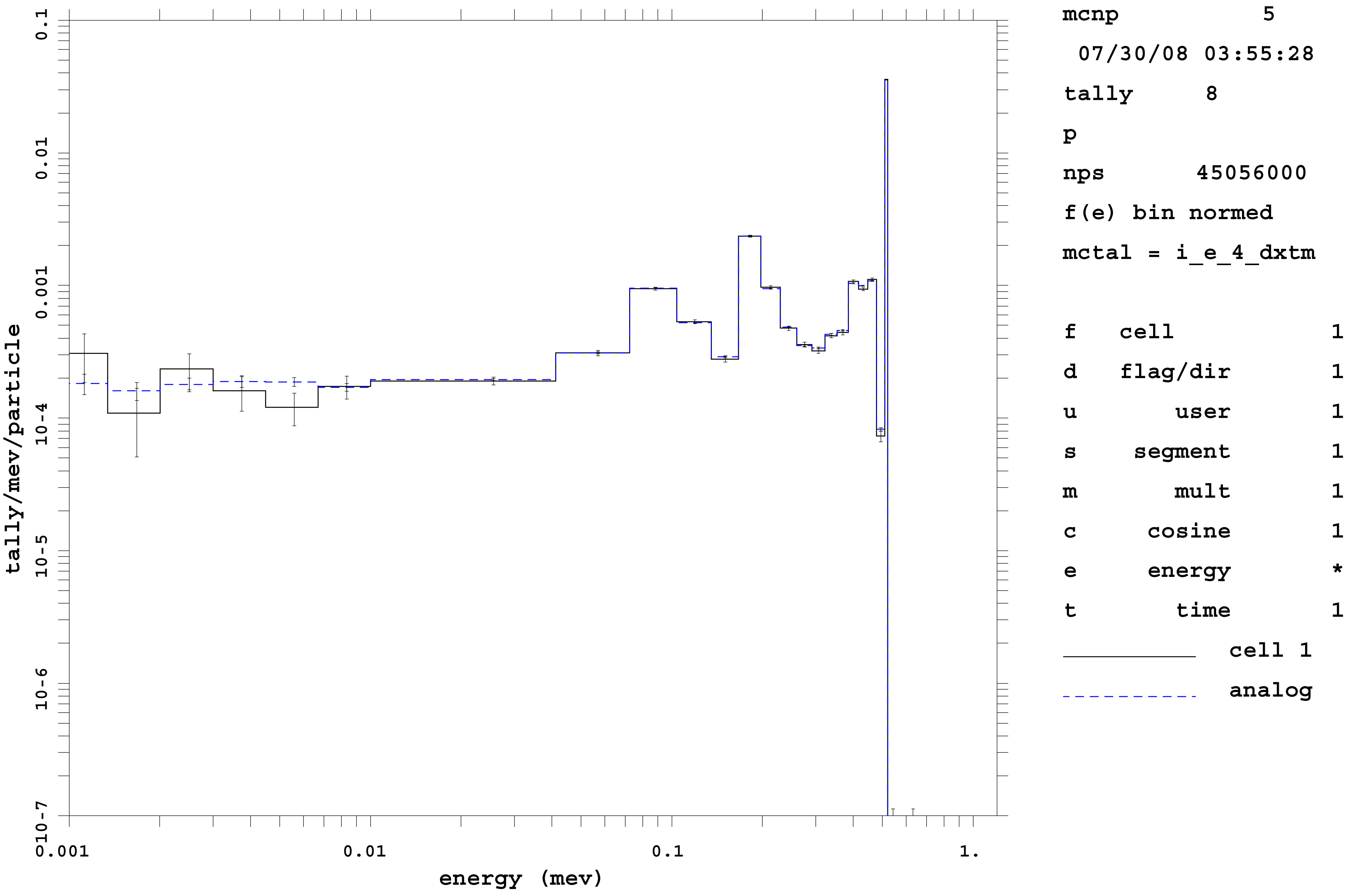
Plot Number	Plot Title
	Cell 1
1	Var Red: forced collisions
2	Var Red: dxt sphere around cell 1 only
3	Var Red: dxt sphere around cell 4 only
4	Var Red: 5 dxtran spheres
5	Var Red: 5 dxtran spheres w/ for. colls.
6	Var Red: 5 dxtran spheres w/ dxc cards
7	Analog with PHTVR
	Cell 2
8	Var Red: forced collisions
9	Var Red: dxt sphere around cell 1 only
10	Var Red: dxt sphere around cell 4 only
11	Var Red: 5 dxtran spheres
12	Var Red: 5 dxtran spheres w/ for. colls.
13	Var Red: 5 dxtran spheres w/ dxc cards
14	Analog with PHTVR
	Cell 3
15	Var Red: forced collisions
16	Var Red: dxt sphere around cell 1 only
17	Var Red: dxt sphere around cell 4 only
18	Var Red: 5 dxtran spheres
19	Var Red: 5 dxtran spheres w/ for. colls.
20	Var Red: 5 dxtran spheres w/ dxc cards
21	Analog with PHTVR
	Cell 4
22	Var Red: forced collisions
23	Var Red: dxt sphere around cell 1 only
24	Var Red: dxt sphere around cell 4 only
25	Var Red: 5 dxtran spheres
26	Var Red: 5 dxtran spheres w/ for. colls.
27	Var Red: 5 dxtran spheres w/ dxc cards
28	Analog with PHTVR
	Cell 5
29	Var Red: forced collisions
30	Var Red: dxt sphere around cell 1 only
31	Var Red: dxt sphere around cell 4 only
32	Var Red: 5 dxtran spheres
33	Var Red: 5 dxtran spheres w/ for. colls.
34	Var Red: 5 dxtran spheres w/ dxc cards
35	Analog with PHTVR

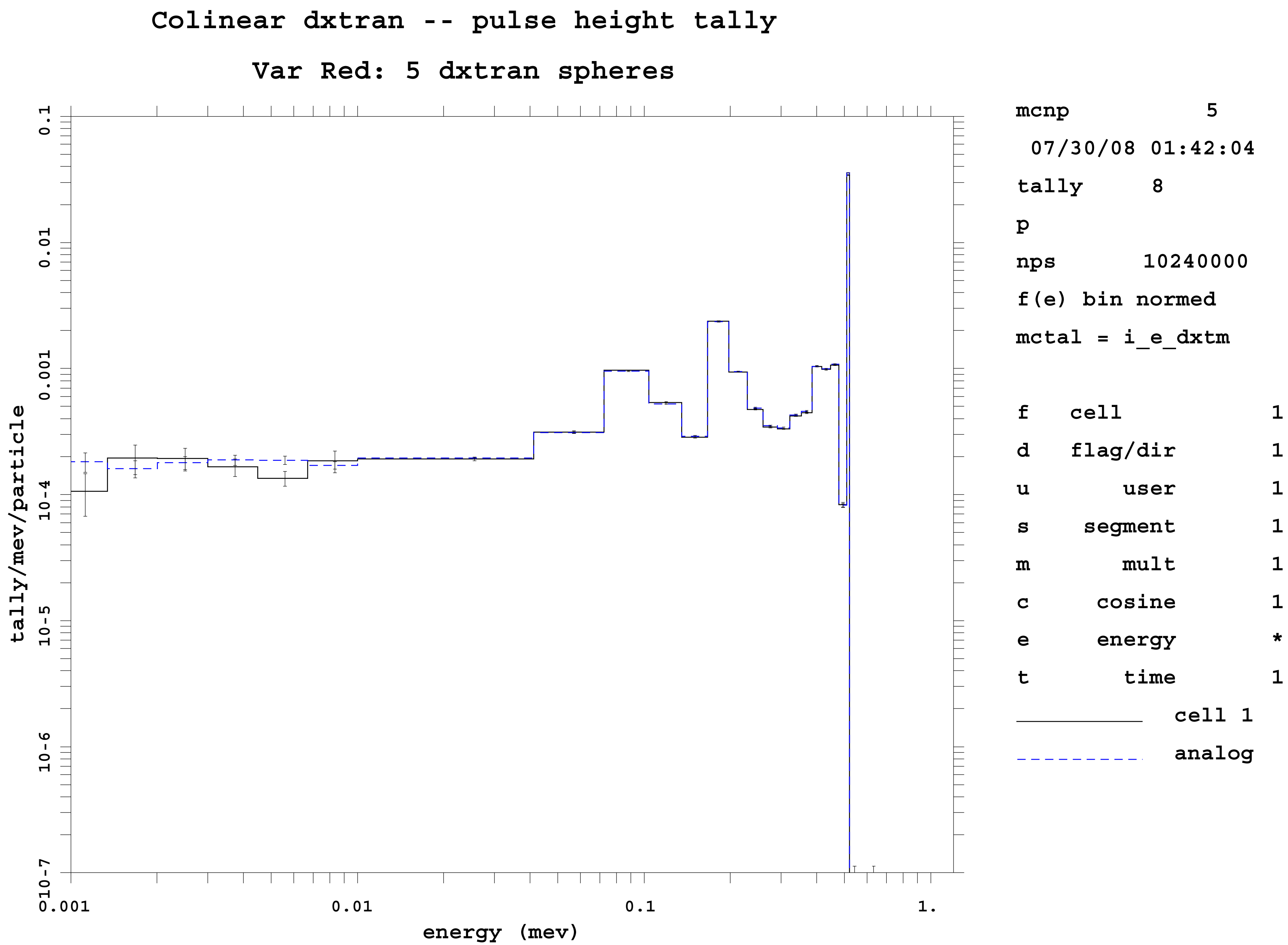

Colinear dxtran -- pulse height tally
Var Red: forced collisions
tally/mev/particle
energy (mev)
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
1.
mcnp 5
07/30/08 03:55:32
tally 8
p
nps 283302000
f(e) bin normed
mctal = i_e_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 1
analog


Colinear dxtran -- pulse height tally
Var Red: dxt sphere around cell 1 only
tally/mev/particle
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
1.
energy (mev)
mcnp 5
07/29/08 11:47:52
tally 8
p
nps 22528000
f(e) bin normed
mctal = i_e_1_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 1
analog

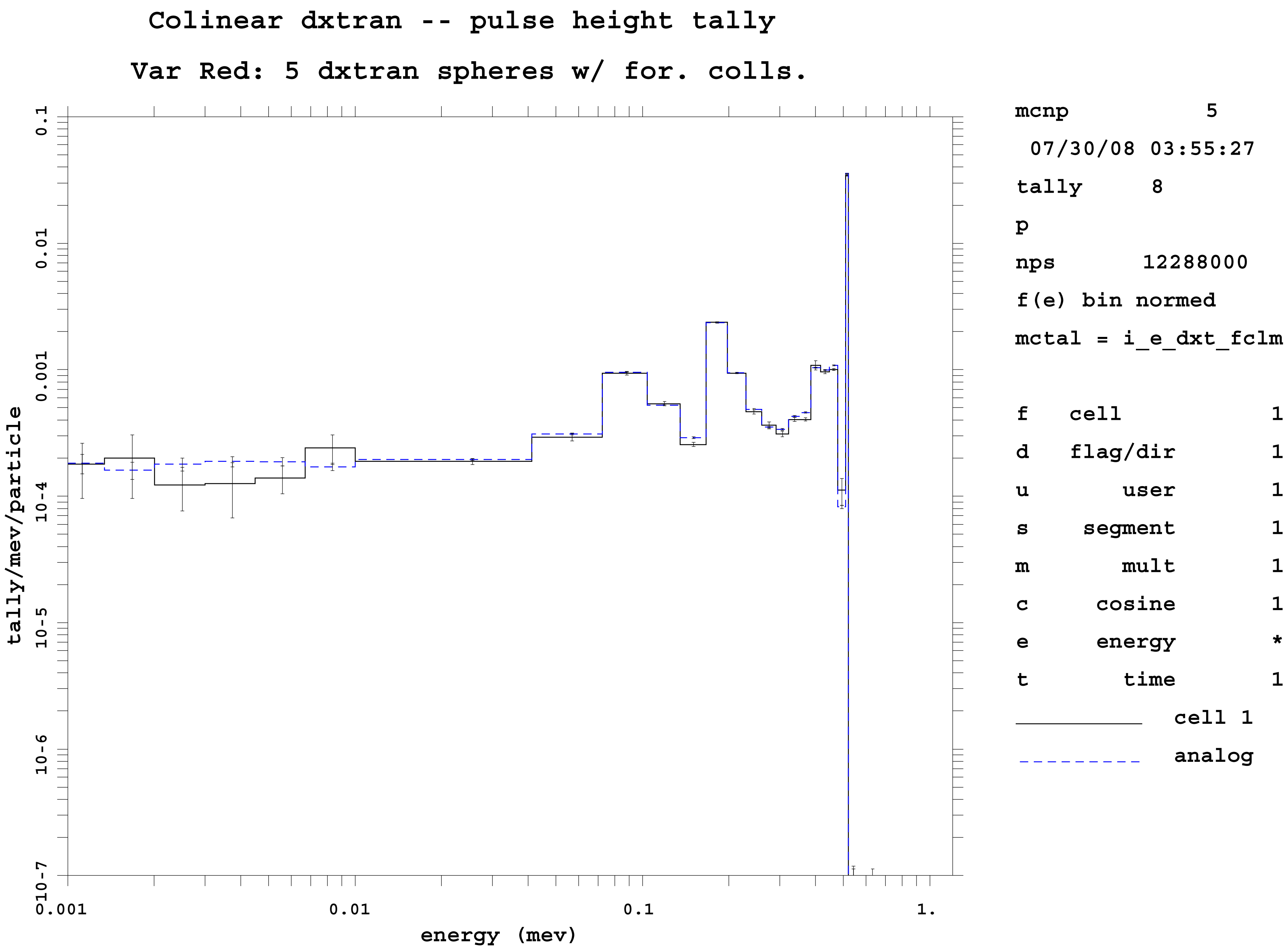
Colinear dxtran -- pulse height tally

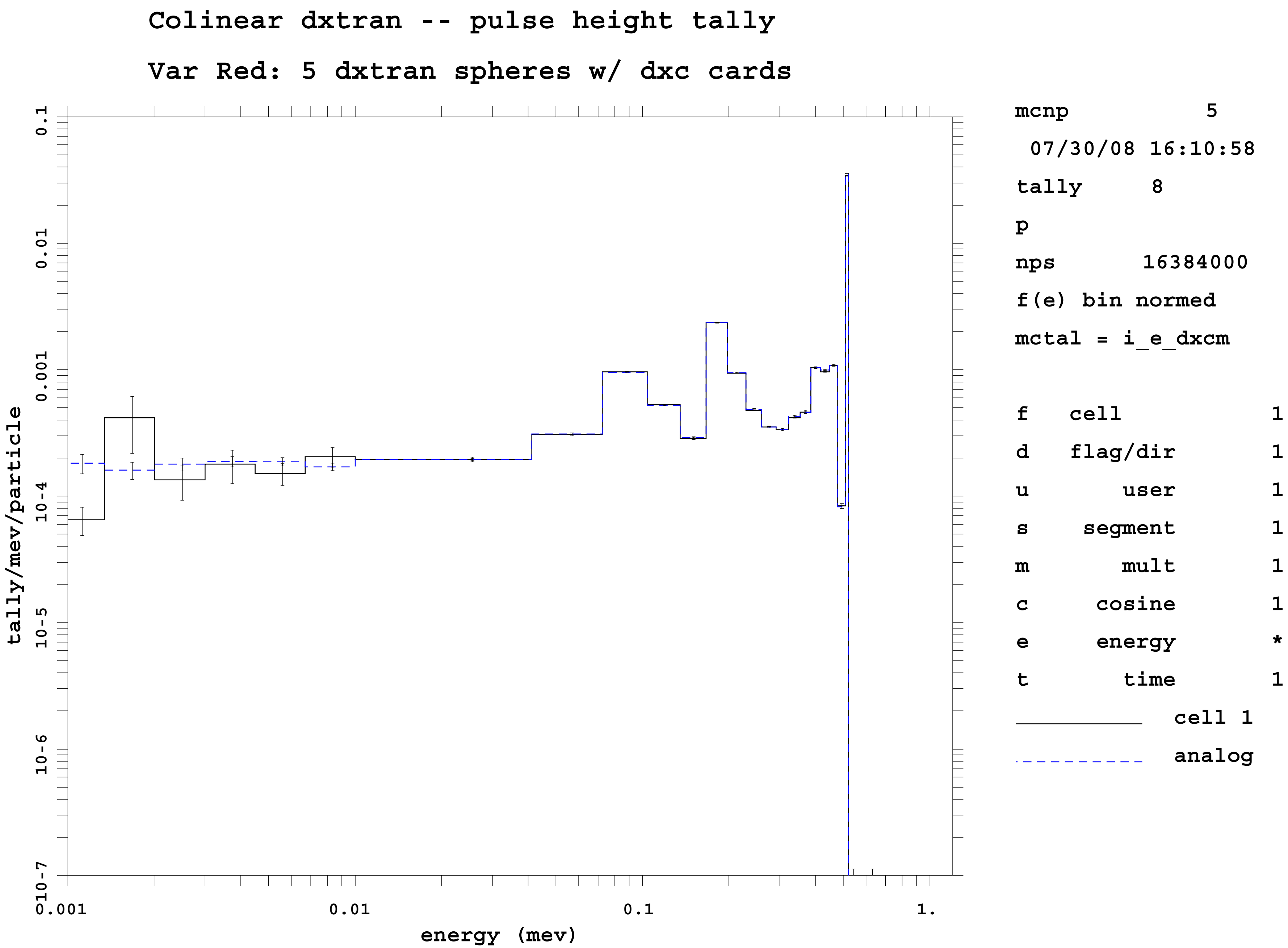
Var Red: dxt sphere around cell 4 only





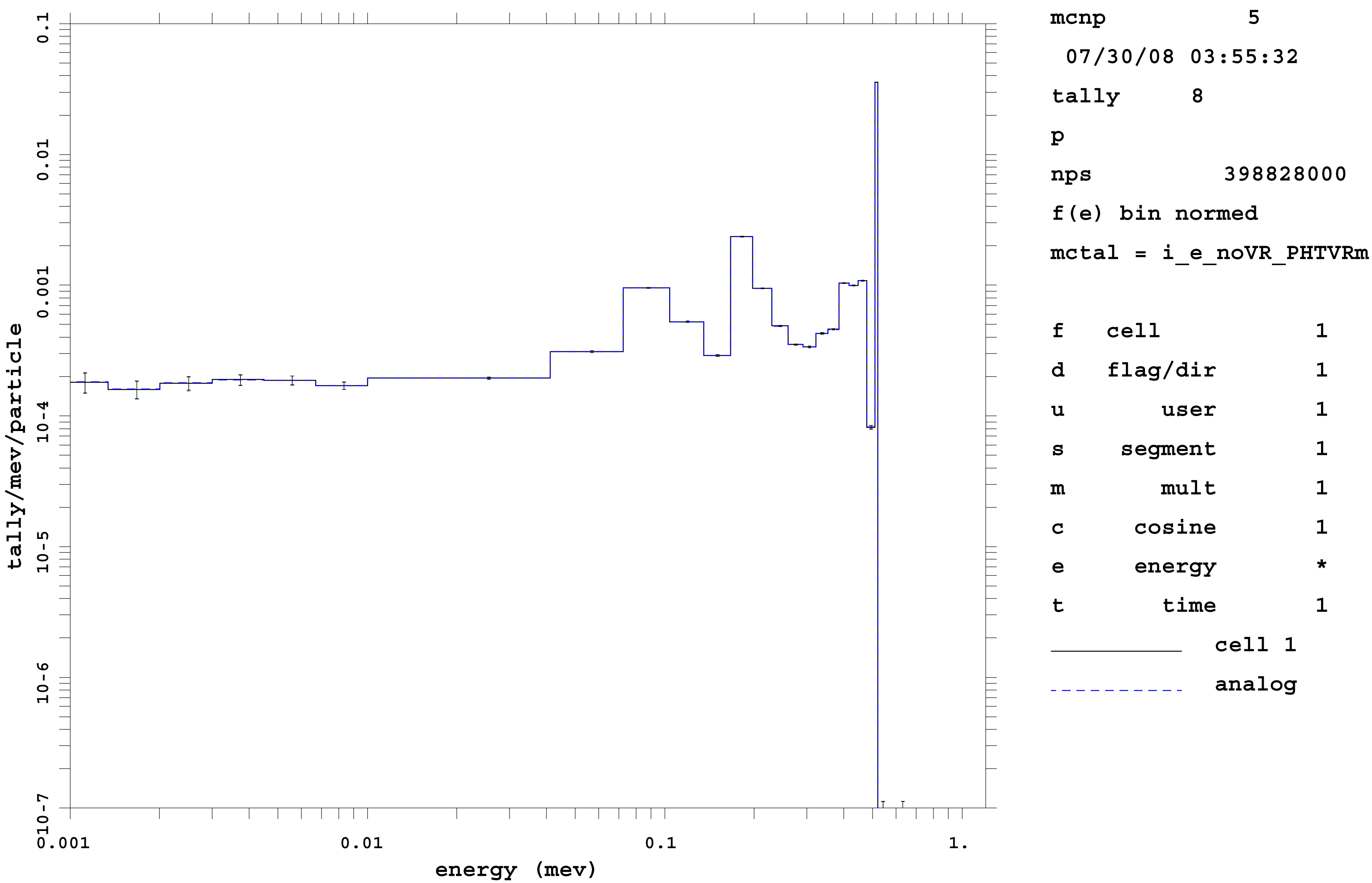
Colinear dxtran -- pulse height tally
Var Red: 5 dxtran spheres
tally/mev/particle
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
1.
energy (mev)
mcnp 5
07/30/08 01:42:04
tally 8
p
nps 10240000
f(e) bin normed
mctal = i_e_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 1
analog

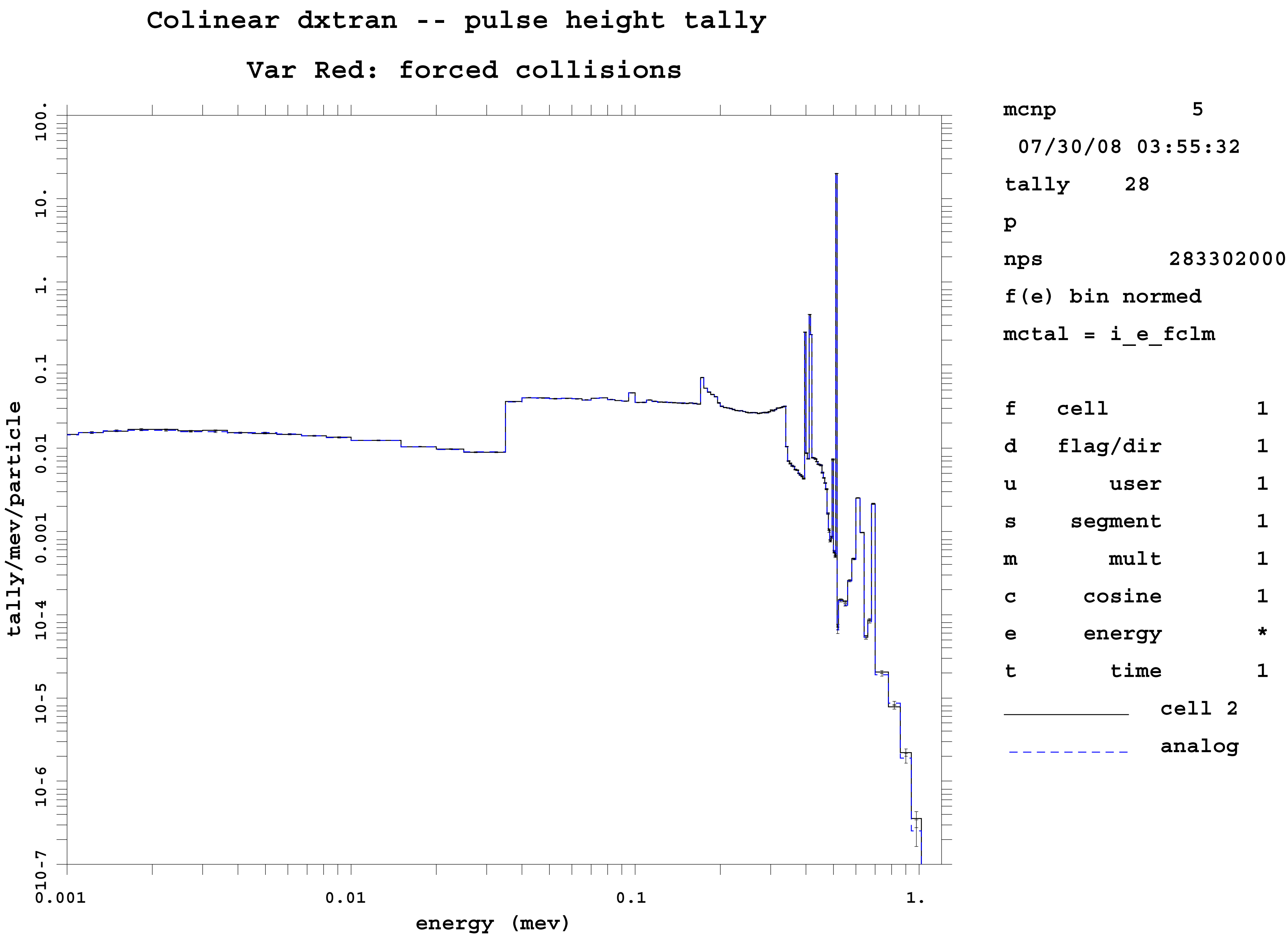

Colinear dxtran -- pulse height tally
Var Red: 5 dxtran spheres w/ for. colls.
tally/mev/particle
energy (mev)
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
1.
mcnp 5
07/30/08 03:55:27
tally 8
p
nps 12288000
f(e) bin normed
mctal = i_e_dxt_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 1
analog

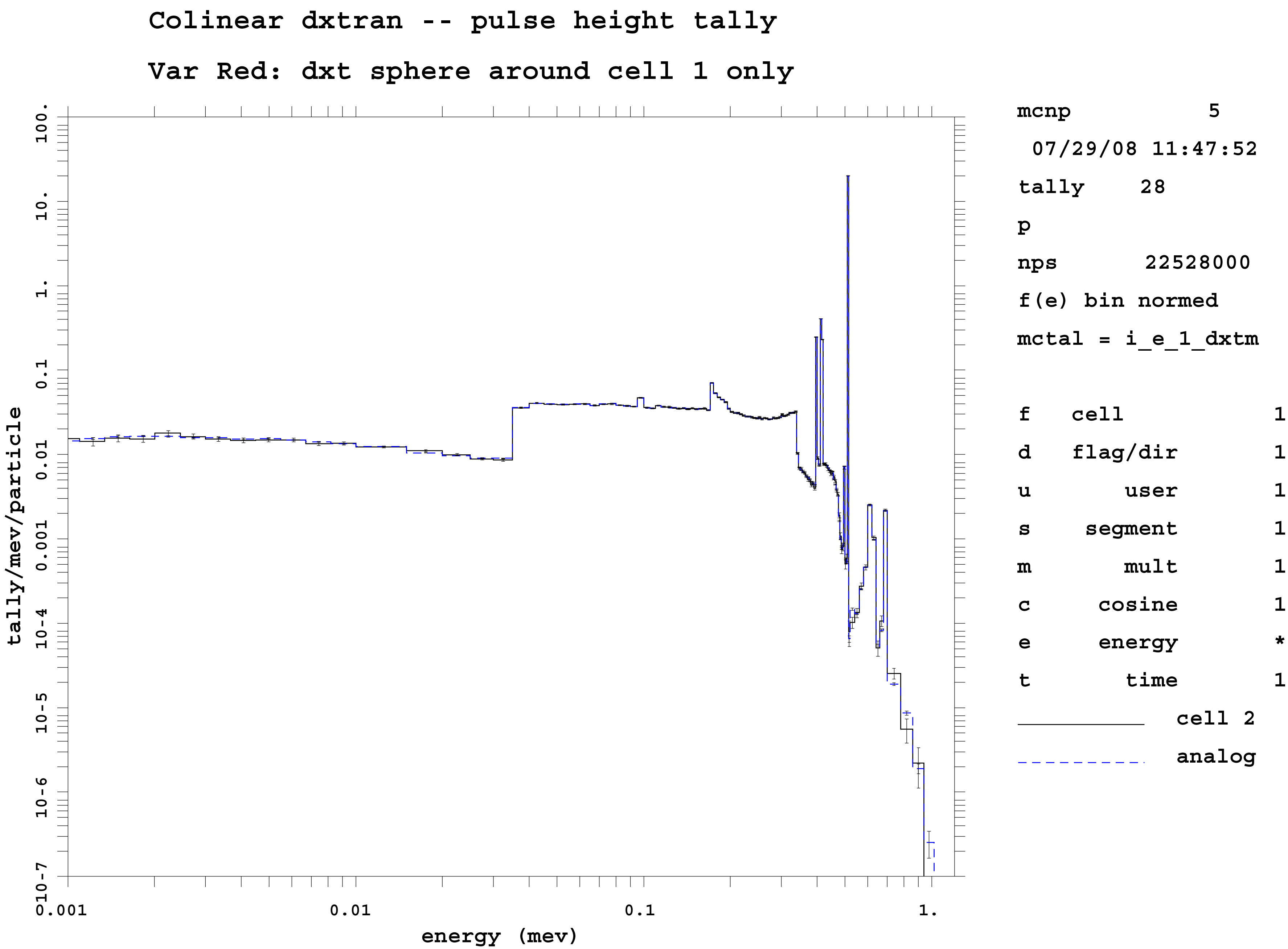

Colinear dxtran -- pulse height tally
Var Red: 5 dxtran spheres w/ dxc cards
tally/mev/particle
energy (mev)
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
1.
mcnp 5
07/30/08 16:10:58
tally 8
p
nps 16384000
f(e) bin normed
mctal = i_e_dxcm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 1
analog

Colinear dxtran -- pulse height tally

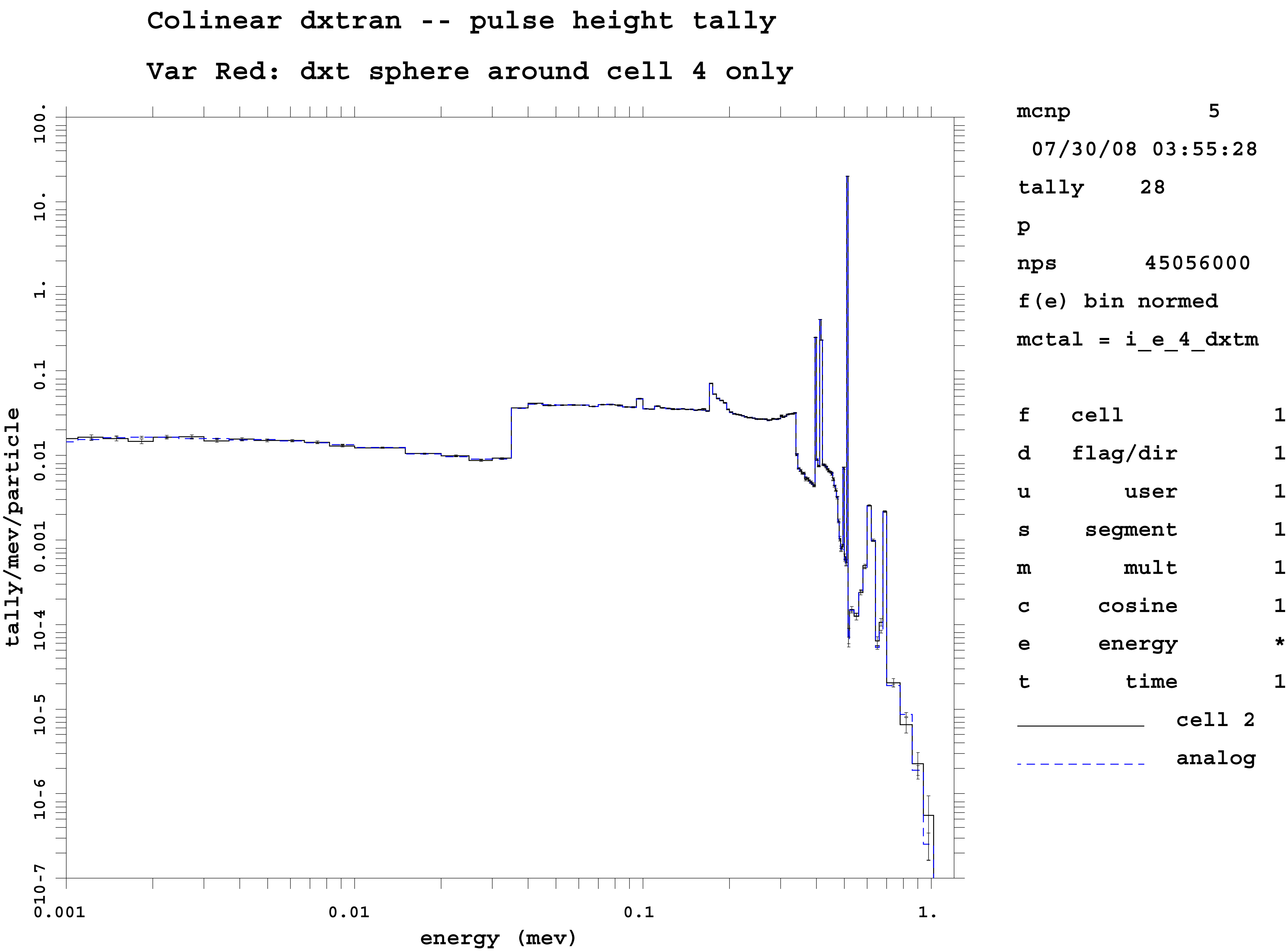
Analog with PHTVR

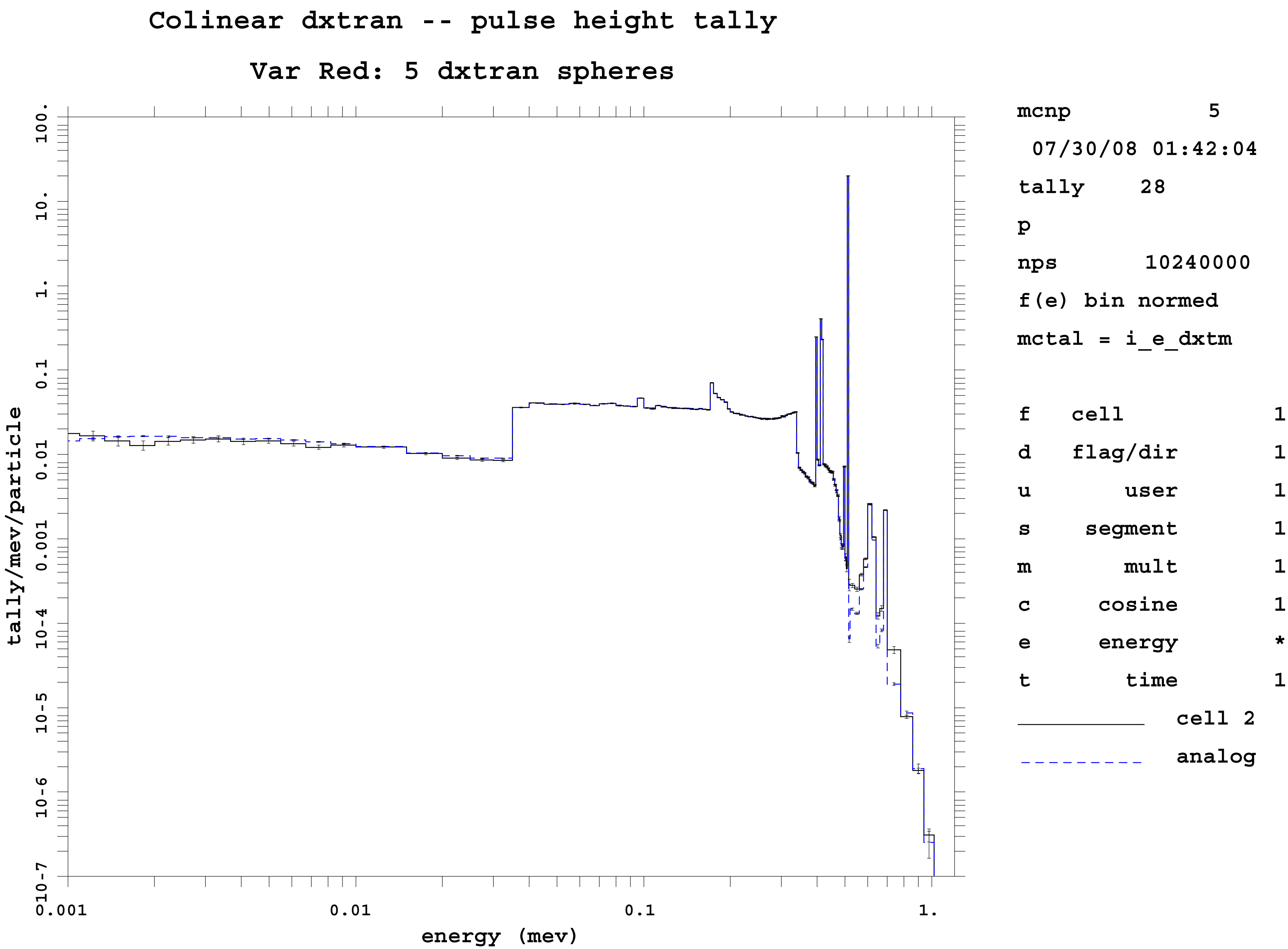



Colinear dxtran -- pulse height tally
Var Red: forced collisions
tally/mev/particle
100.
10.
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
1.
energy (mev)
mcnp 5
07/30/08 03:55:32
tally 28
p
nps 283302000
f(e) bin normed
mctal = i_e_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 2
analog

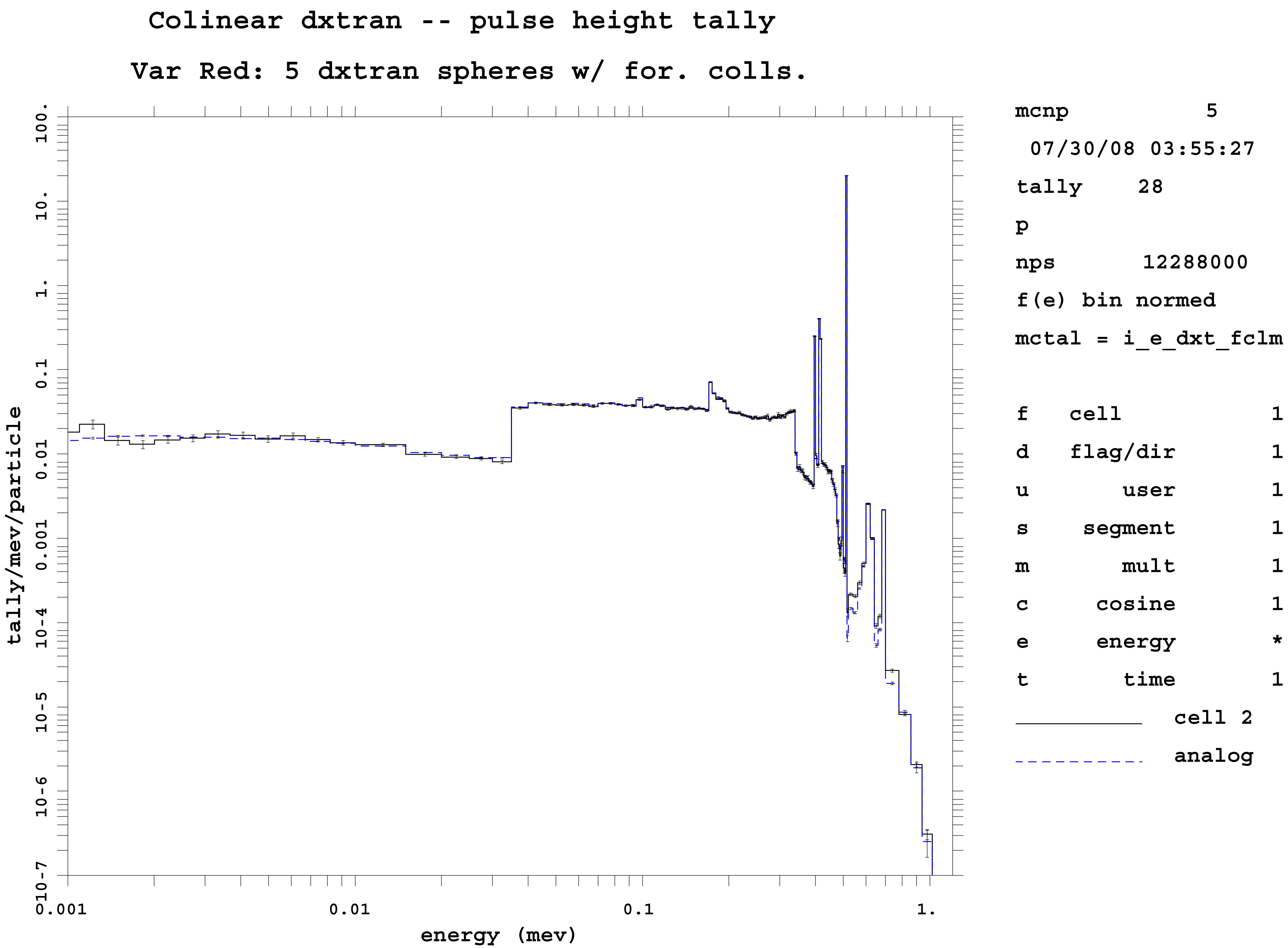


Colinear dxtran -- pulse height tally
Var Red: dxt sphere around cell 1 only
tally/mev/particle
energy (mev)
0.001
0.01
0.1
1.
100.
10.
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
mcnp 5
07/29/08 11:47:52
tally 28
p
nps 22528000
f(e) bin normed
mctal = i_e_1_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 2
analog

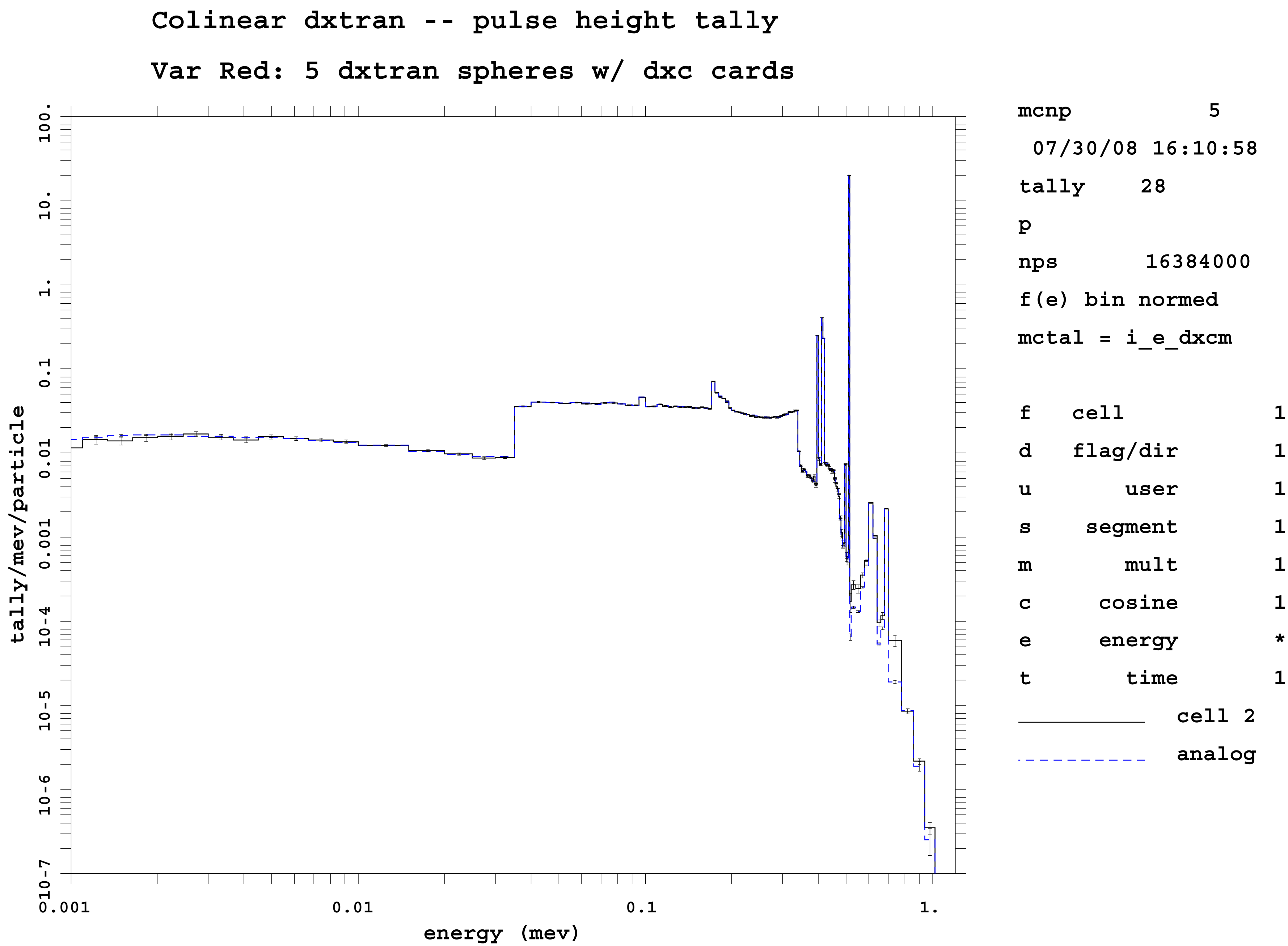

Colinear dxtran -- pulse height tally
Var Red: dxt sphere around cell 4 only
tally/mev/particle
energy (mev)
0.001
0.01
0.1
1.
100.
10.
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
mcnp 5
07/30/08 03:55:28
tally 28
p
nps 45056000
f(e) bin normed
mctal = i_e_4_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 2
analog

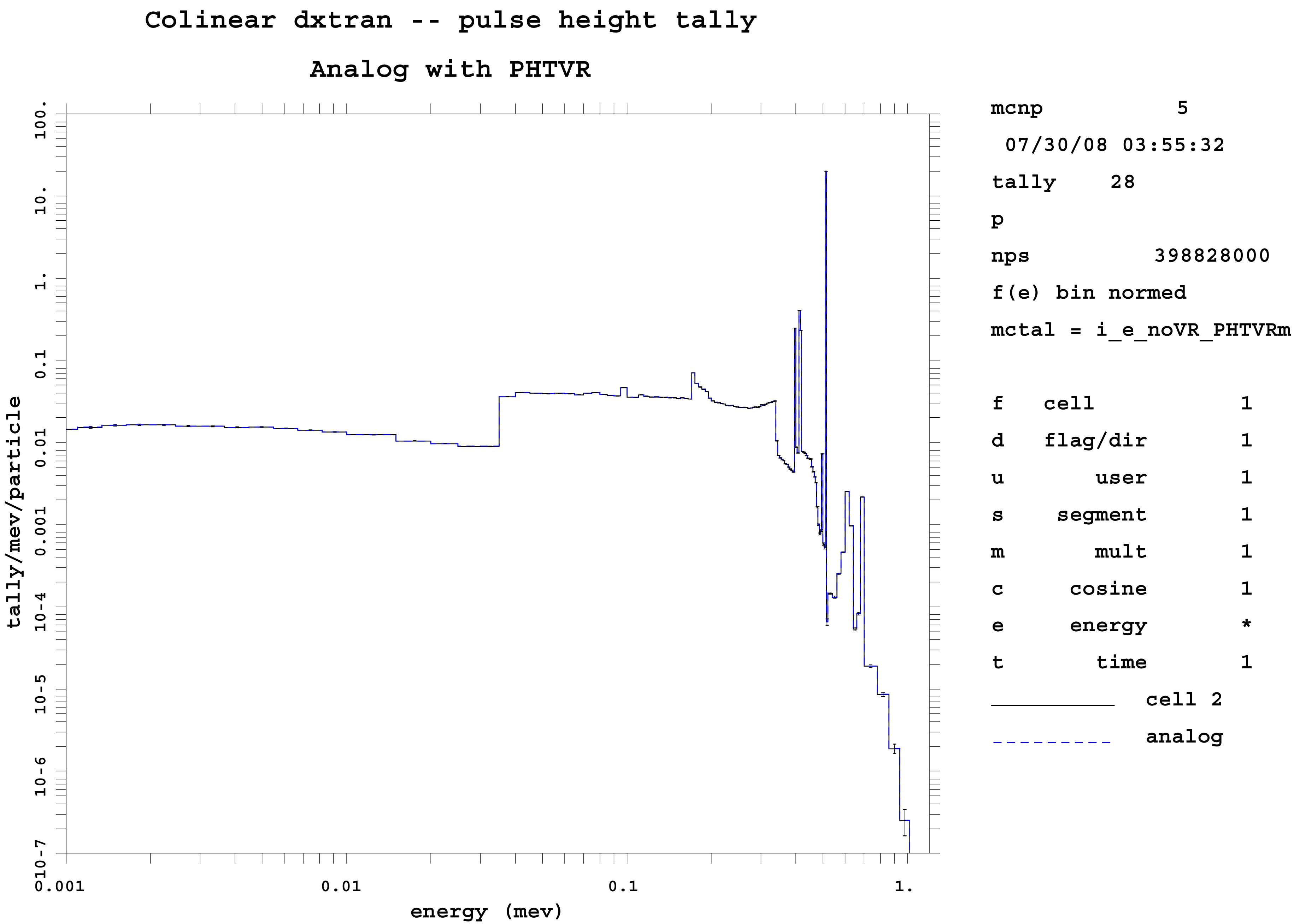


Colinear dxtran -- pulse height tally
Var Red: 5 dxtran spheres
tally/mev/particle
energy (mev)
100.
10.
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
1.
mcnp 5
07/30/08 01:42:04
tally 28
p
nps 10240000
f(e) bin normed
mctal = i_e_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 2
analog



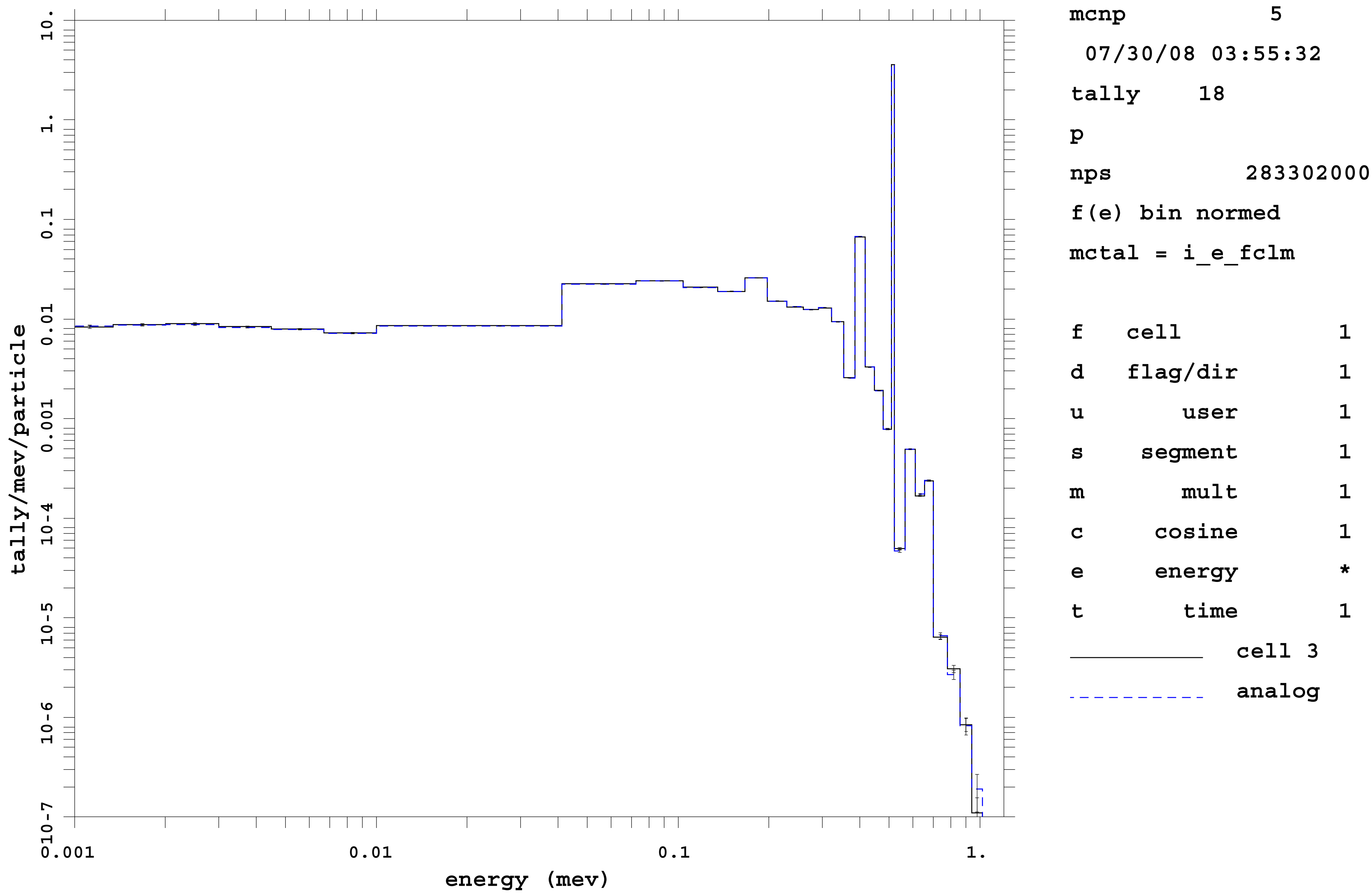
Colinear dxtran -- pulse height tally
Var Red: 5 dxtran spheres w/ for. colls.
100.
10.
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
tally/mev/particle
0.001
0.01
0.1
1.
energy (mev)
mcnp 5
07/30/08 03:55:27
tally 28
p
nps 12288000
f(e) bin normed
mctal = i_e_dxt_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 2
analog


Colinear dxtran -- pulse height tally
Var Red: 5 dxtran spheres w/ dxc cards
tally/mev/particle
energy (mev)
0.001
0.01
0.1
1.
100.
10.
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
mcnp 5
07/30/08 16:10:58
tally 28
p
nps 16384000
f(e) bin normed
mctal = i_e_dxcm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 2
analog


Colinear dxtran -- pulse height tally
Analog with PHTVR
mcnp 5
07/30/08 03:55:32
tally 28
p
nps 398828000
f(e) bin normed
mctal = i_e_noVR_PHTVRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 2
analog
tally/mev/particle
energy (mev)
0.001
0.01
0.1
1.
100.
10.
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7

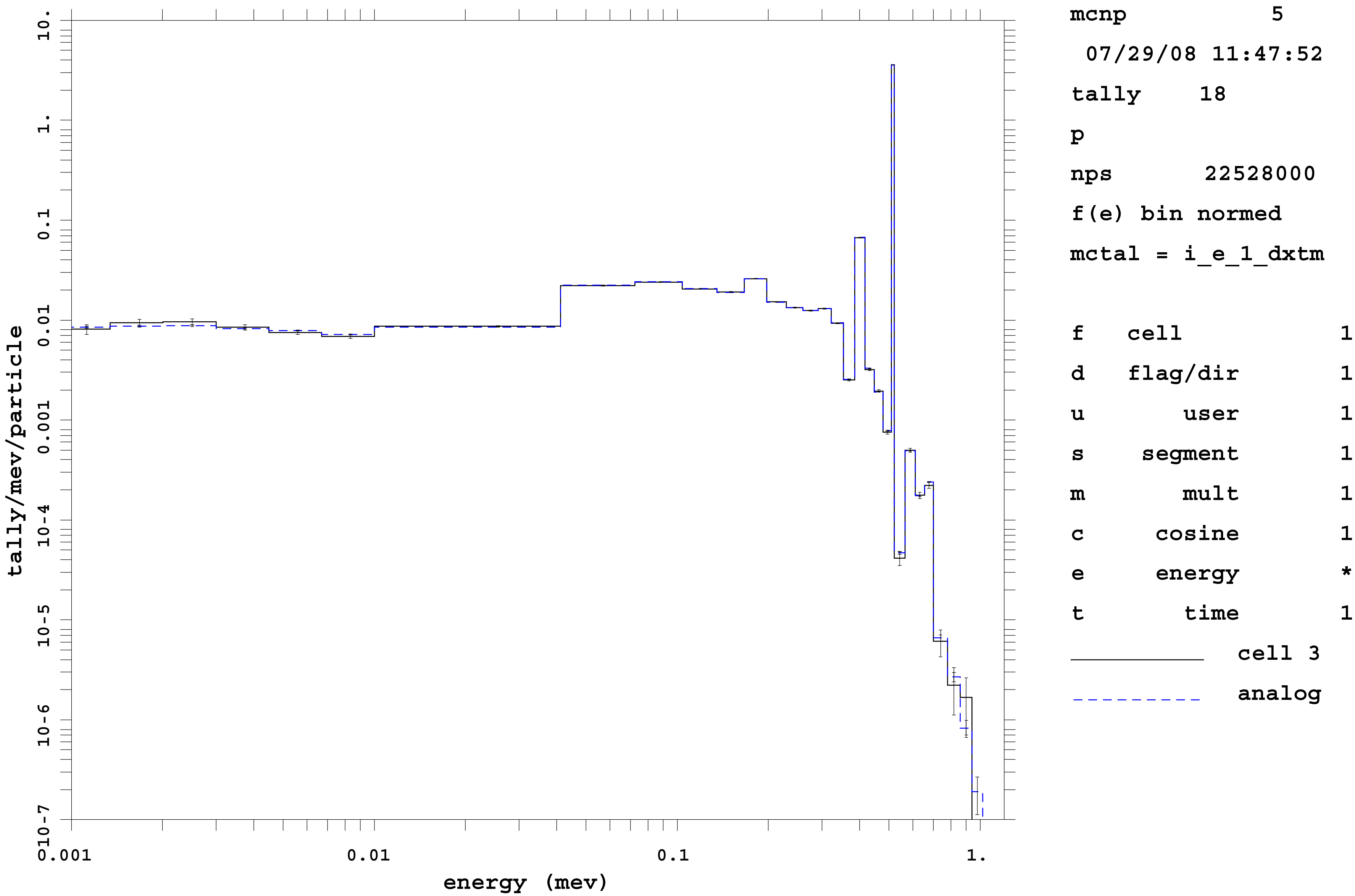
Colinear dxtran -- pulse height tally

Var Red: forced collisions



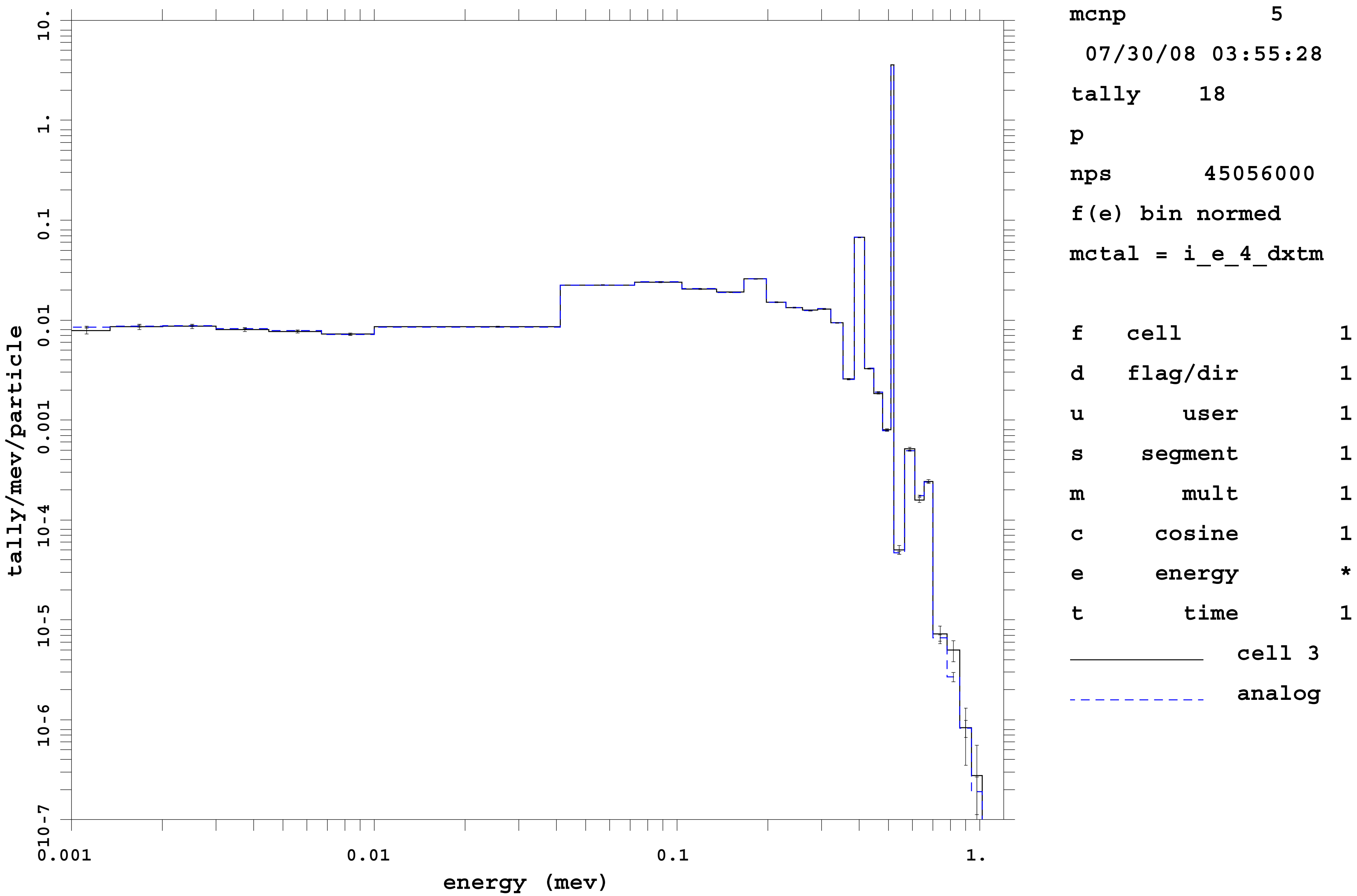
Colinear dxtran -- pulse height tally

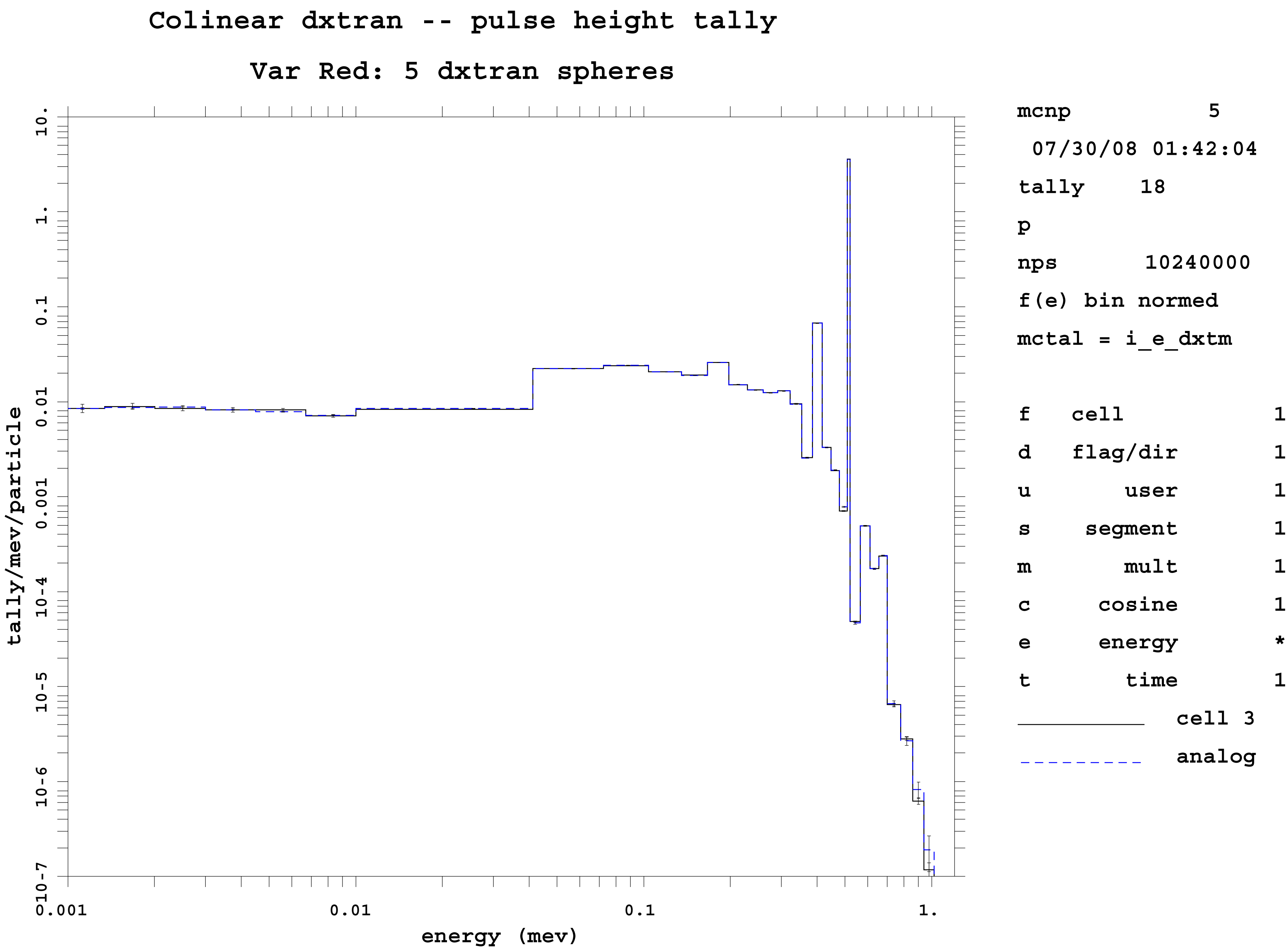
Var Red: dxt sphere around cell 1 only

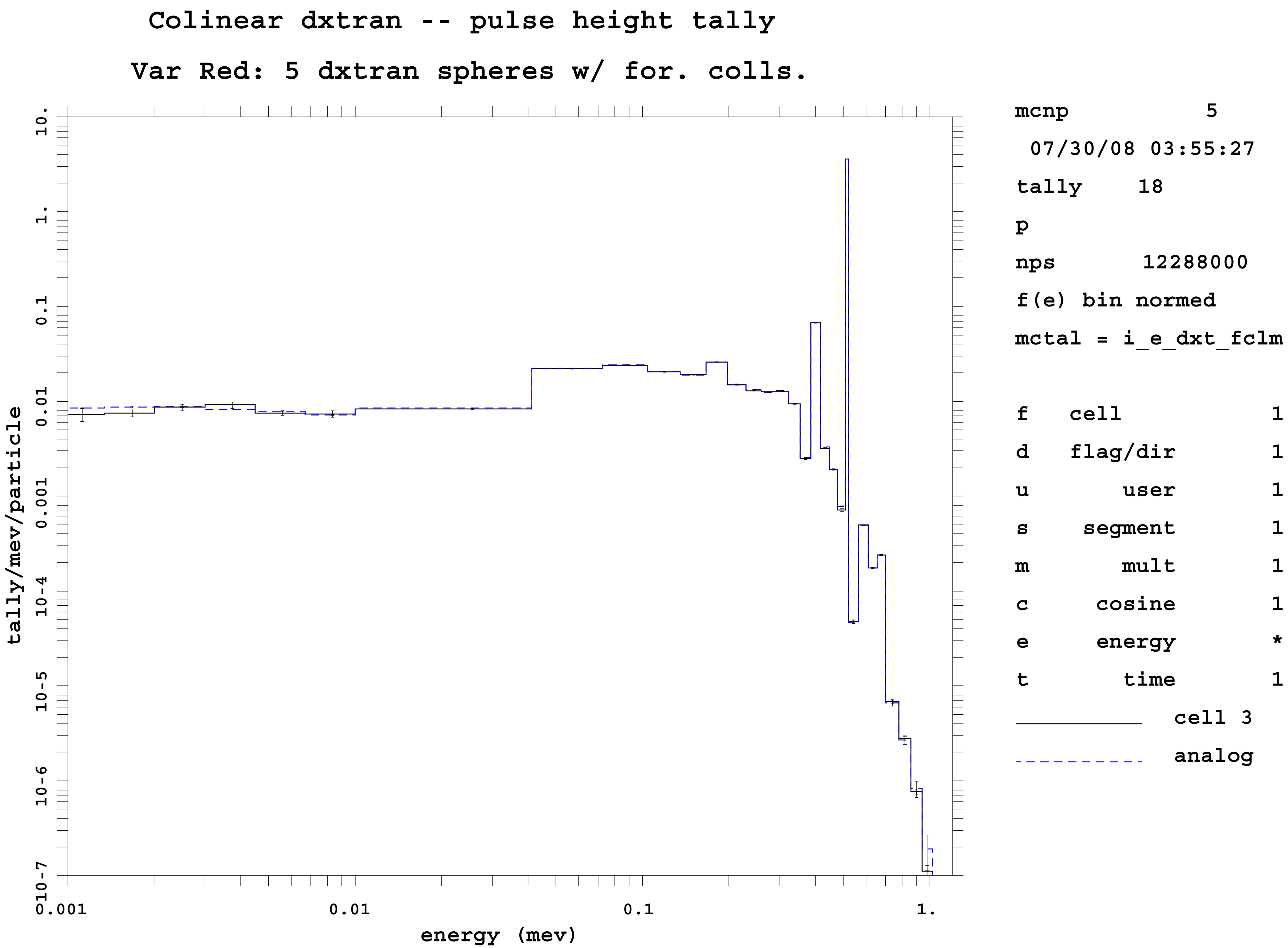


Colinear dxtran -- pulse height tally

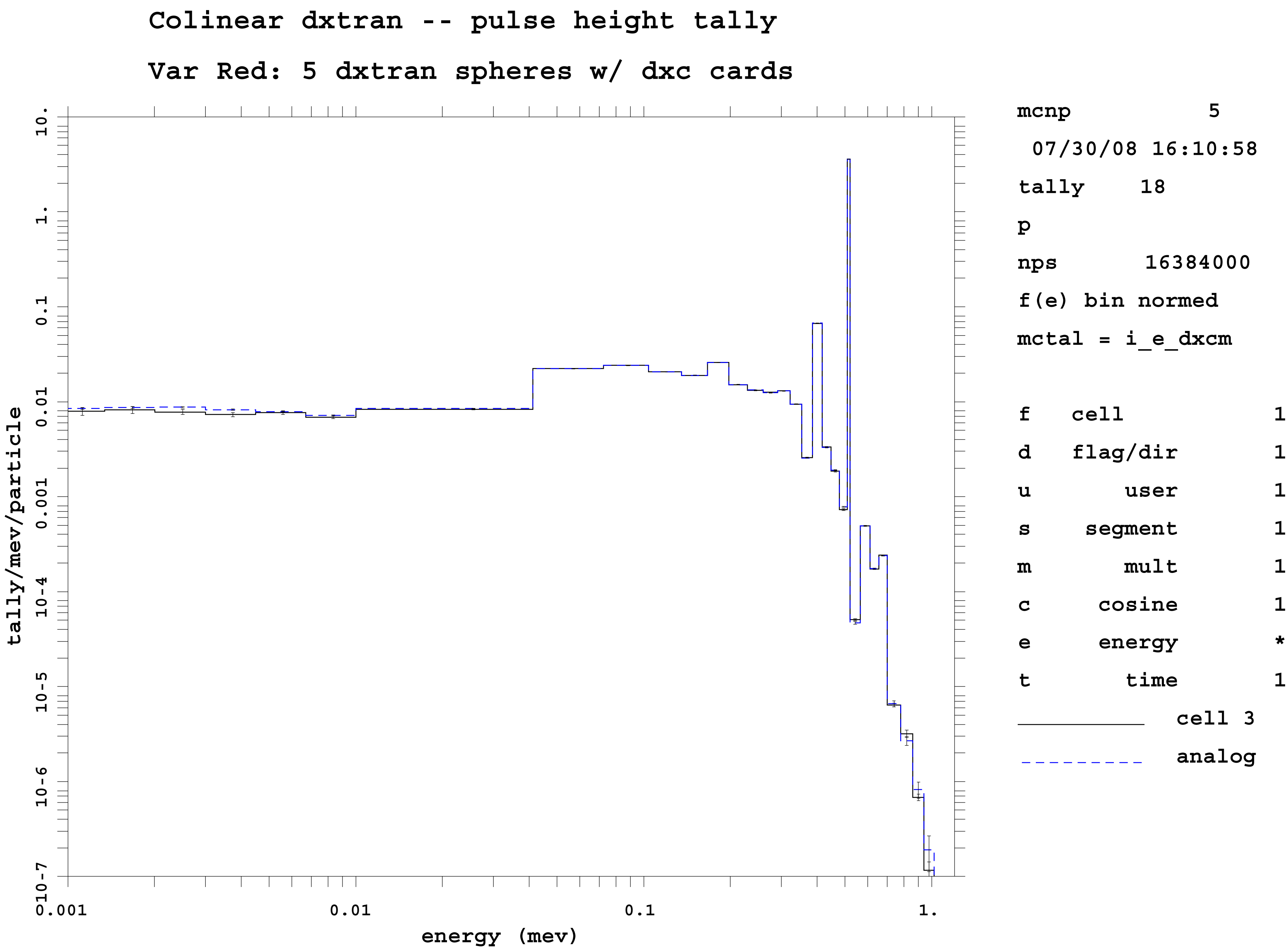
Var Red: dxt sphere around cell 4 only

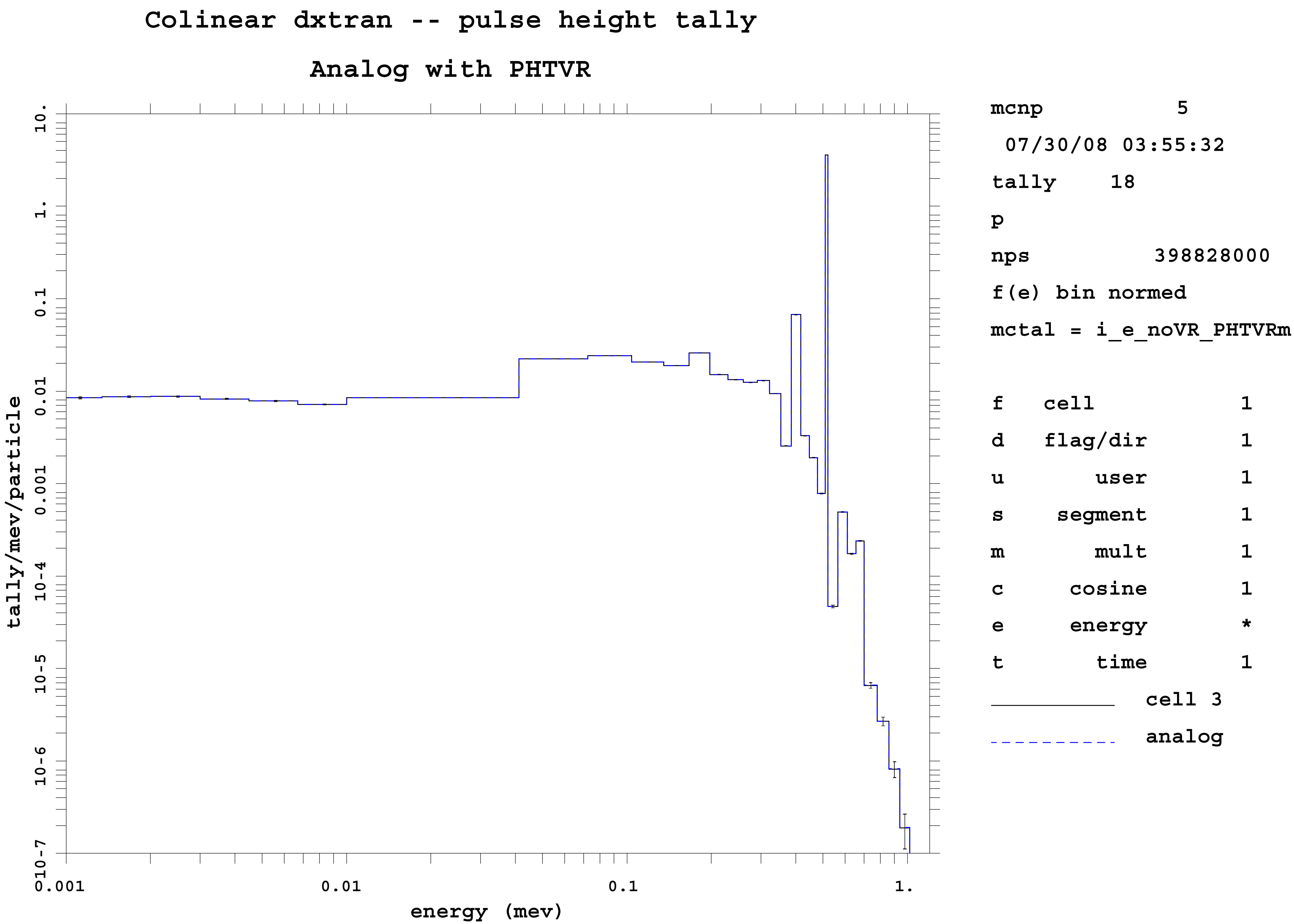



Colinear dxtran -- pulse height tally
Var Red: 5 dxtran spheres
tally/mev/particle
energy (mev)
mcnp 5
07/30/08 01:42:04
tally 18
p
nps 10240000
f(e) bin normed
mctal = i_e_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 3
analog

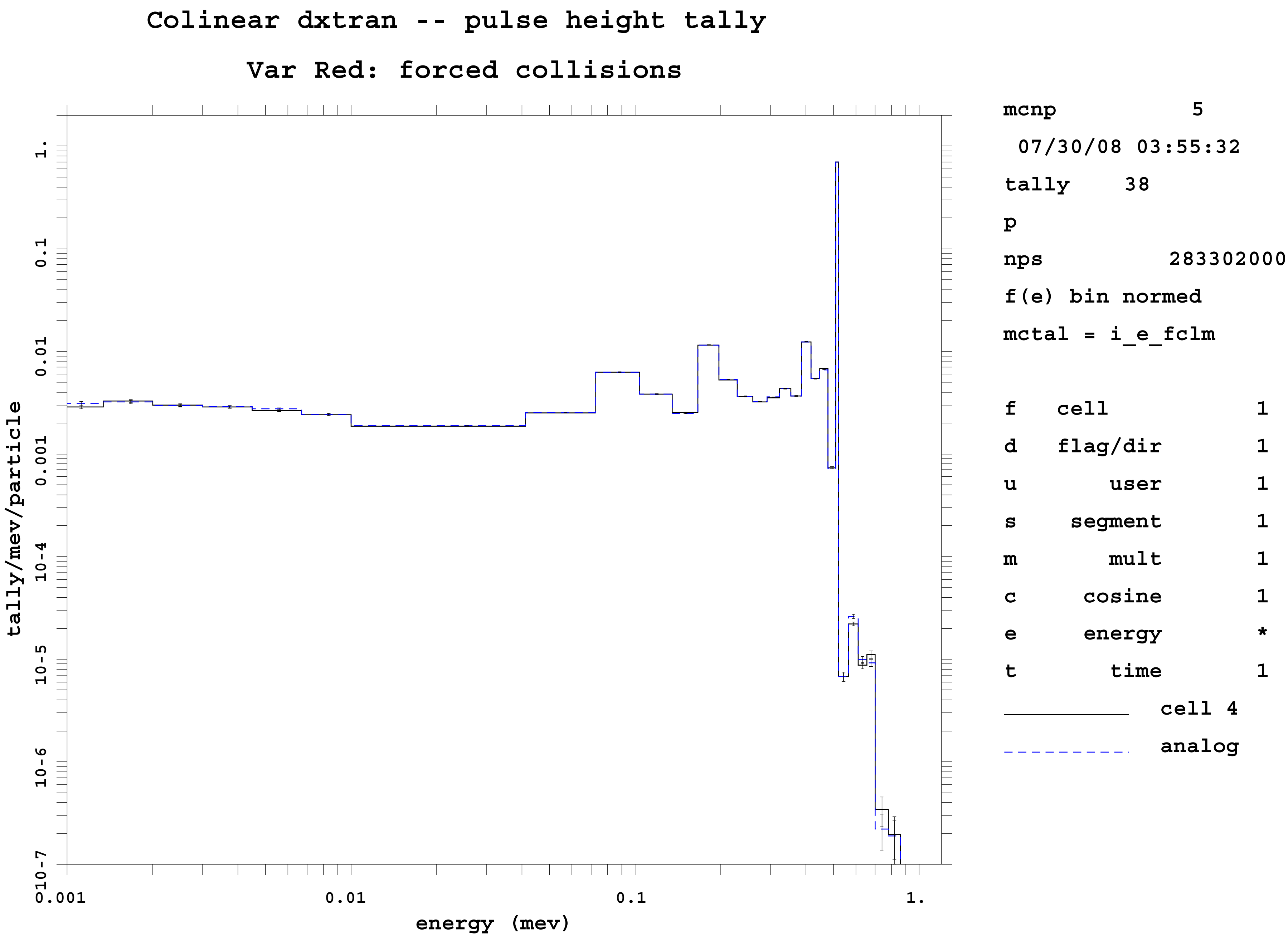


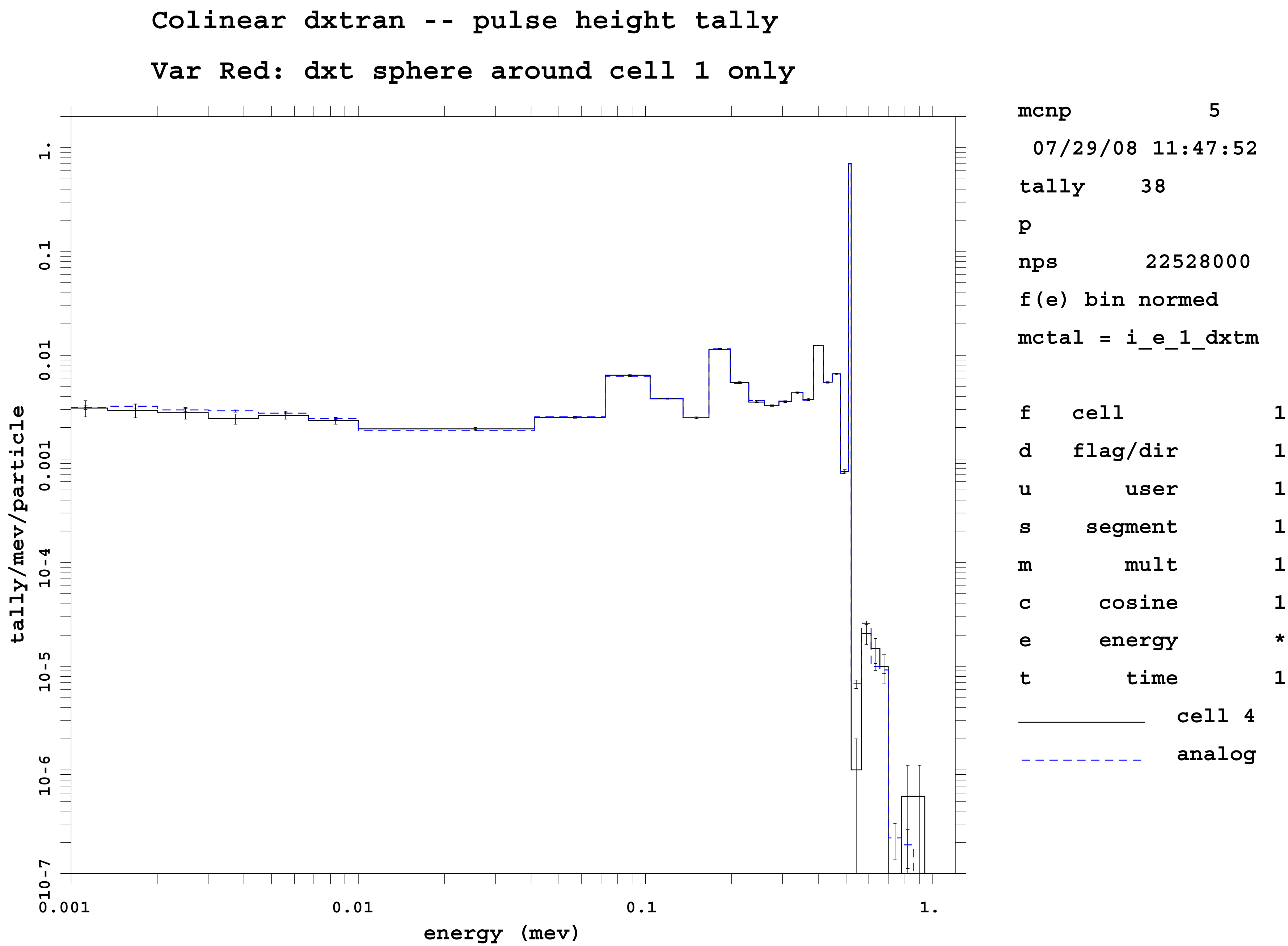
Colinear dxtran -- pulse height tally
Var Red: 5 dxtran spheres w/ for. colls.
tally/mev/particle
10.
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
1.
energy (mev)
mcnp 5
07/30/08 03:55:27
tally 18
p
nps 12288000
f(e) bin normed
mctal = i_e_dxt_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 3
analog


Colinear dxtran -- pulse height tally
Var Red: 5 dxtran spheres w/ dxc cards
tally/mev/particle
10.
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
1.
energy (mev)
mcnp 5
07/30/08 16:10:58
tally 18
p
nps 16384000
f(e) bin normed
mctal = i_e_dxcm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 3
analog

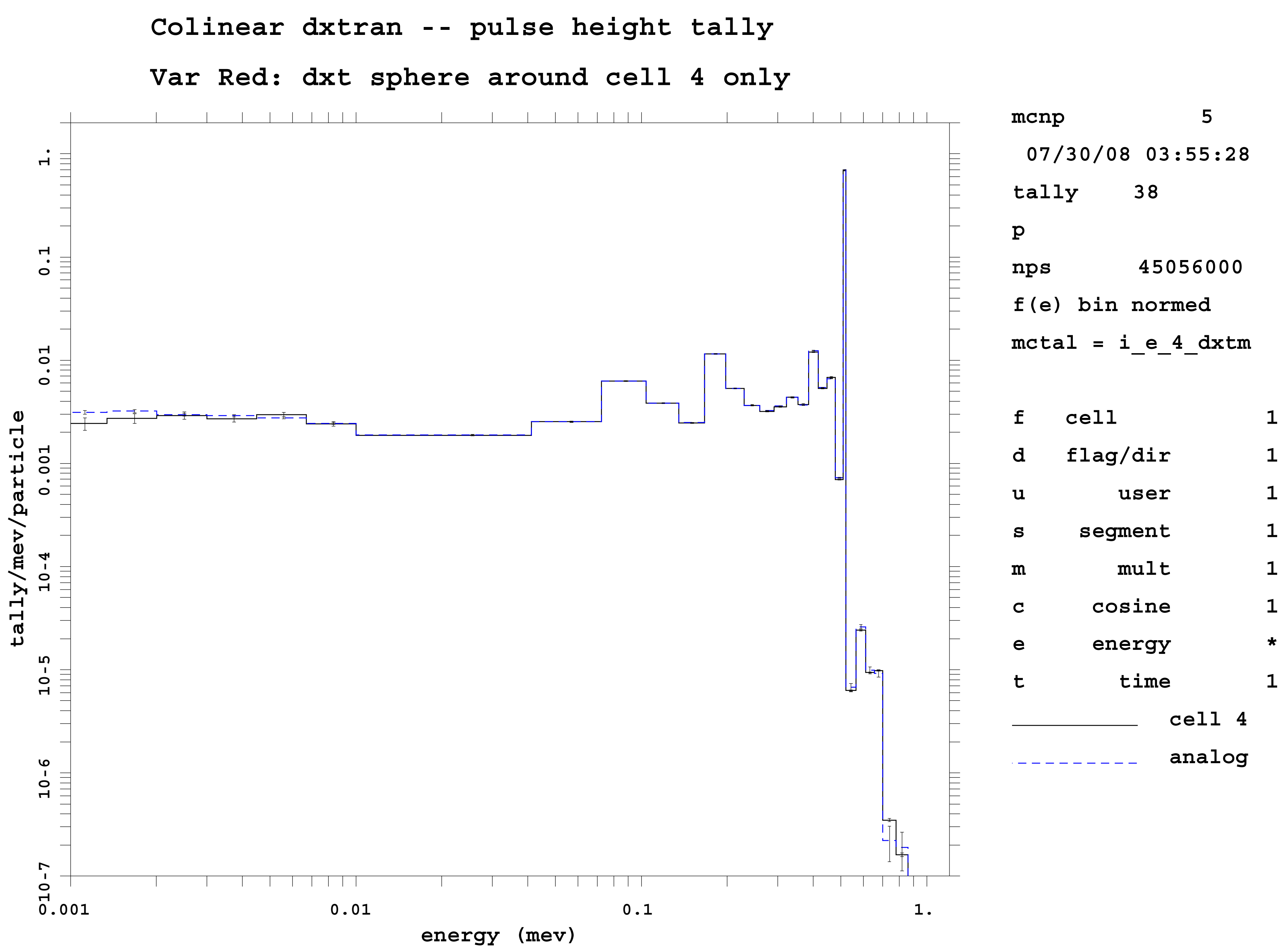


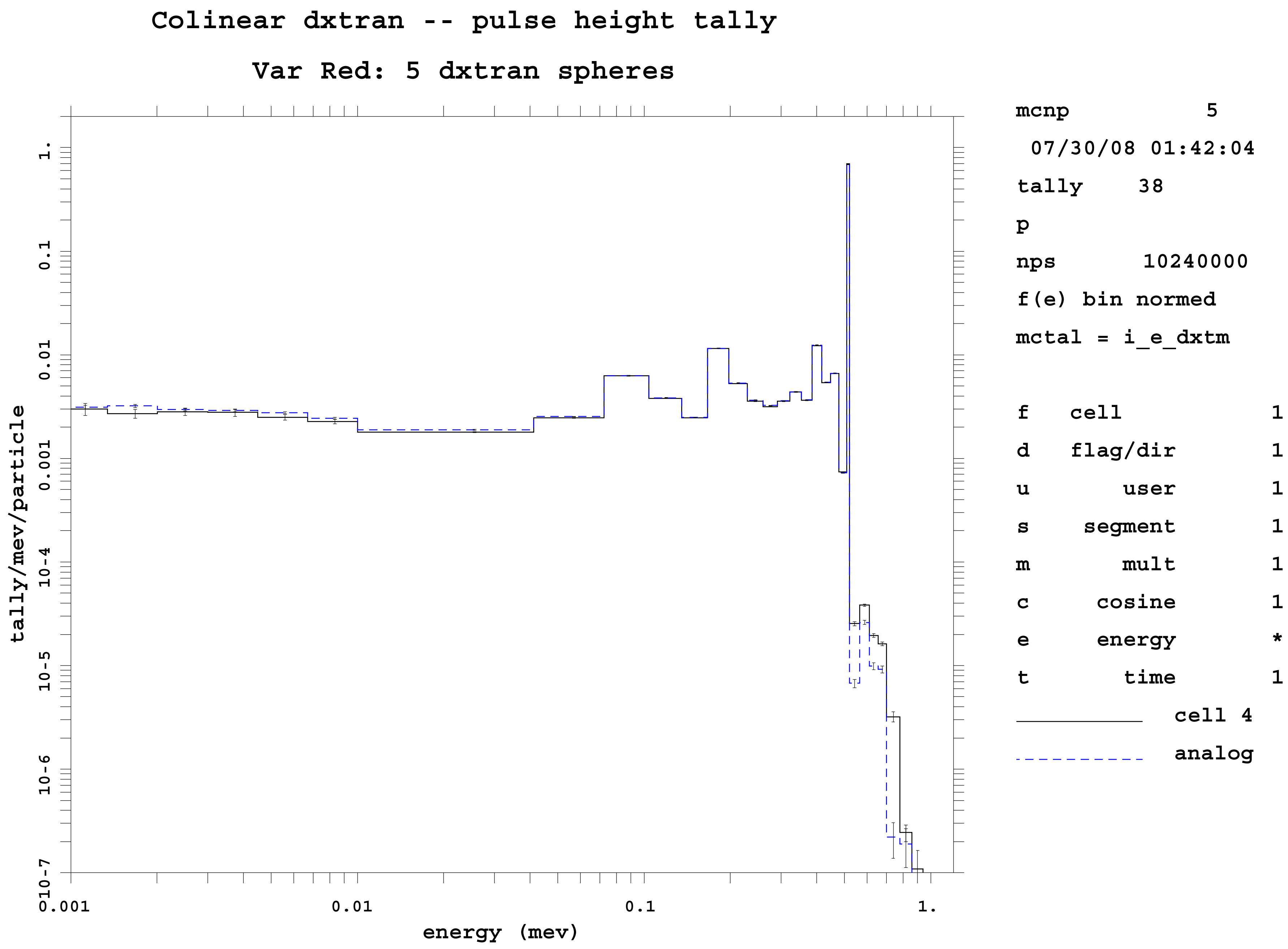
Colinear dxtran -- pulse height tally
Analog with PHTVR
tally/mev/particle
energy (mev)
10.
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
1.
mcnp 5
07/30/08 03:55:32
tally 18
p
nps 398828000
f(e) bin normed
mctal = i_e_noVR_PHTVRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 3
analog

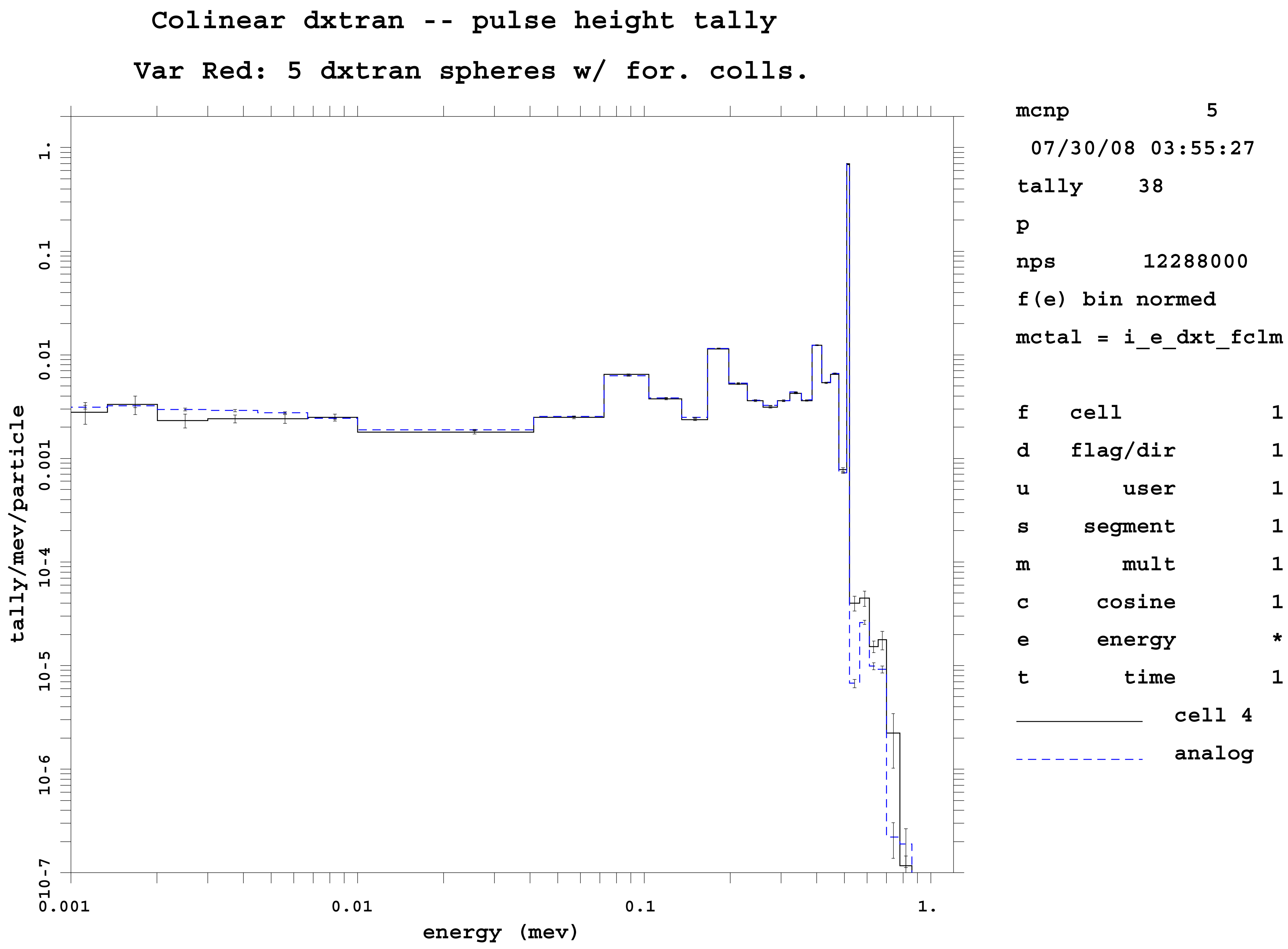

Colinear dxtran -- pulse height tally
Var Red: forced collisions
mcnp 5
07/30/08 03:55:32
tally 38
p
nps 283302000
f(e) bin normed
mctal = i_e_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 4
analog
tally/mev/particle
energy (mev)
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
1.

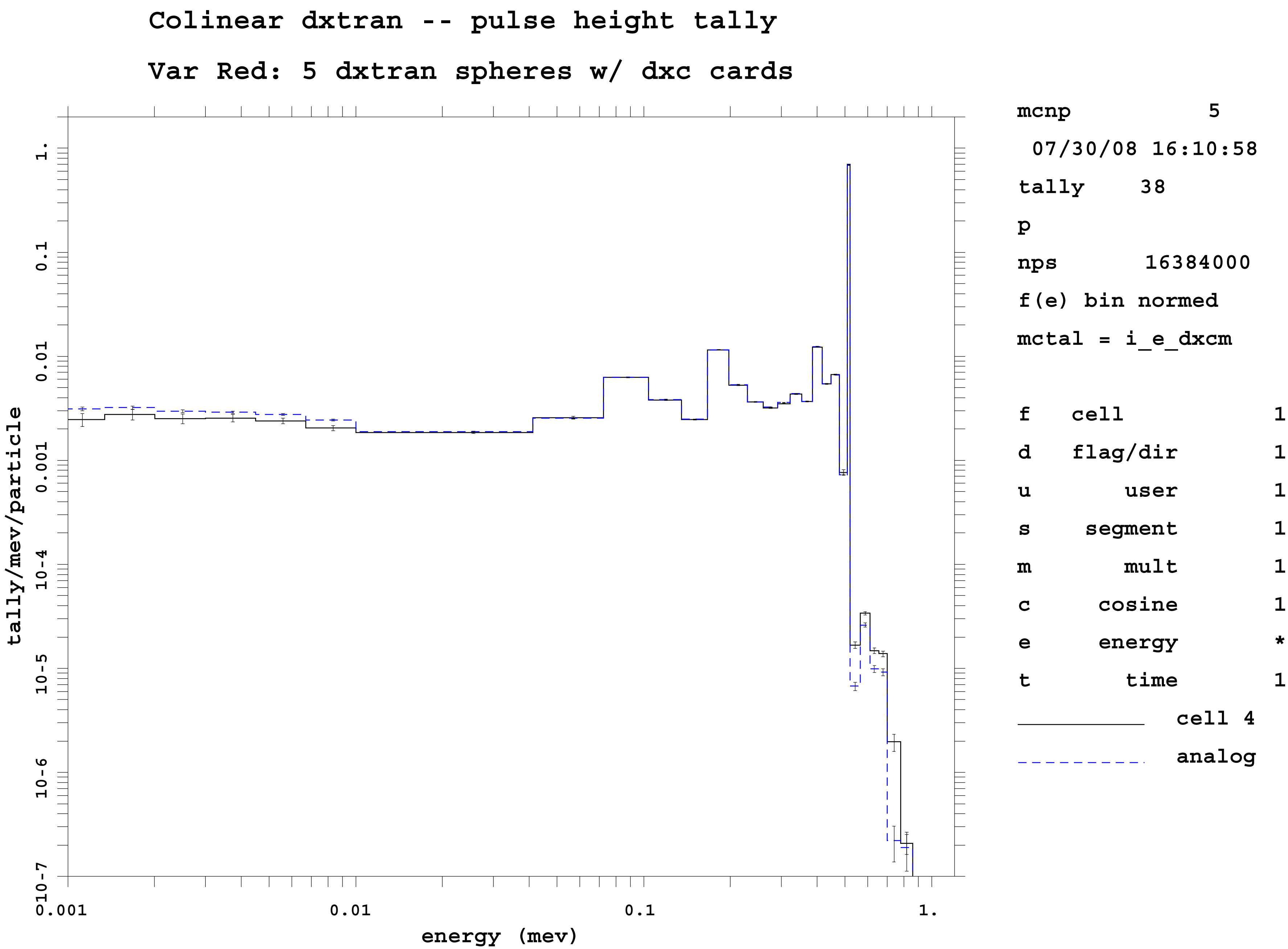


Colinear dxtran -- pulse height tally
Var Red: dxt sphere around cell 1 only
tally/mev/particle
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
1.
energy (mev)
mcnp 5
07/29/08 11:47:52
tally 38
p
nps 22528000
f(e) bin normed
mctal = i_e_1_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 4
analog

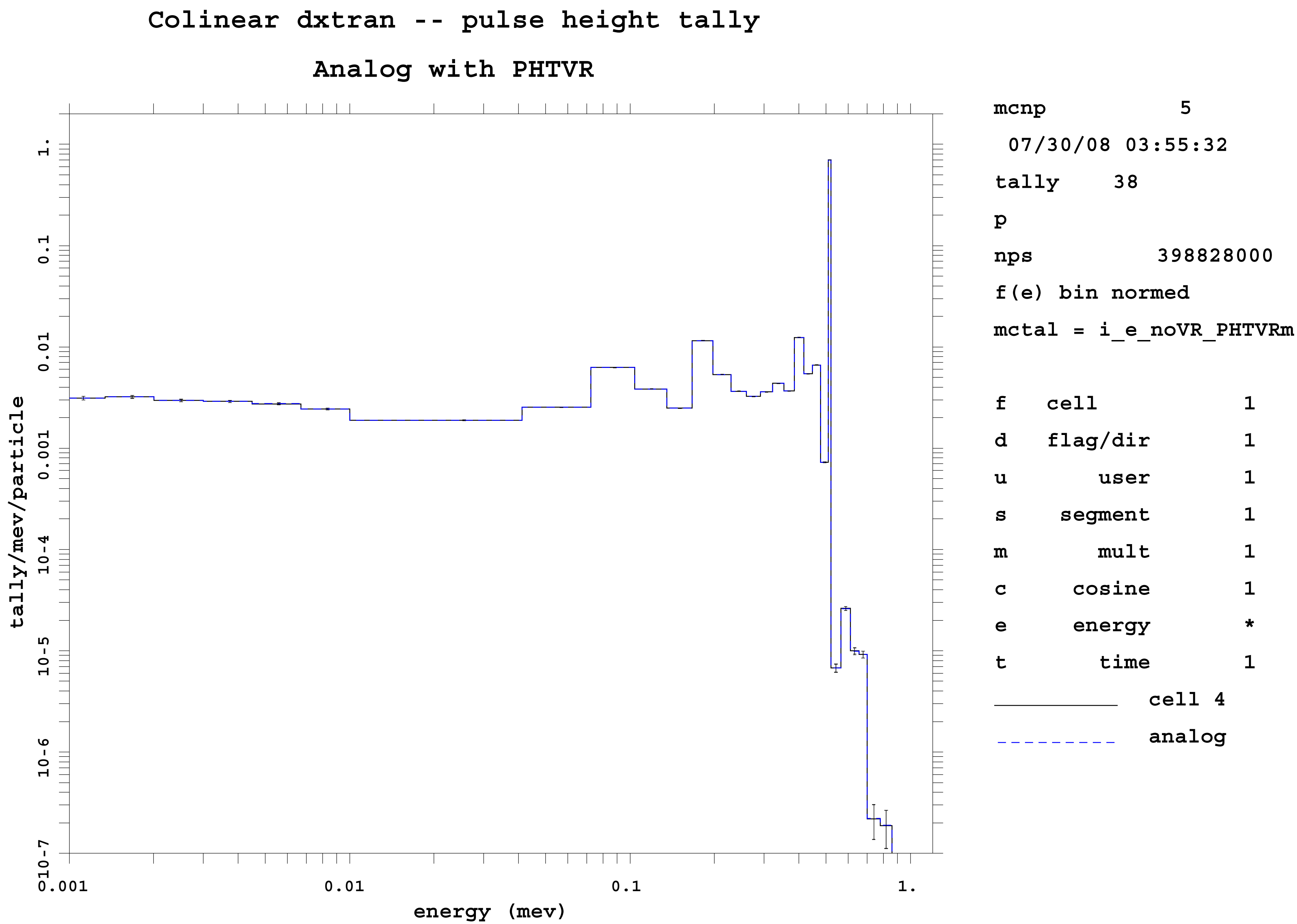

Colinear dxtran -- pulse height tally
Var Red: dxt sphere around cell 4 only
tally/mev/particle
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
1.
energy (mev)
mcnp 5
07/30/08 03:55:28
tally 38
p
nps 45056000
f(e) bin normed
mctal = i_e_4_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 4
analog


Colinear dxtran -- pulse height tally
Var Red: 5 dxtran spheres
tally/mev/particle
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
1.
energy (mev)
mcnp 5
07/30/08 01:42:04
tally 38
p
nps 10240000
f(e) bin normed
mctal = i_e_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 4
analog

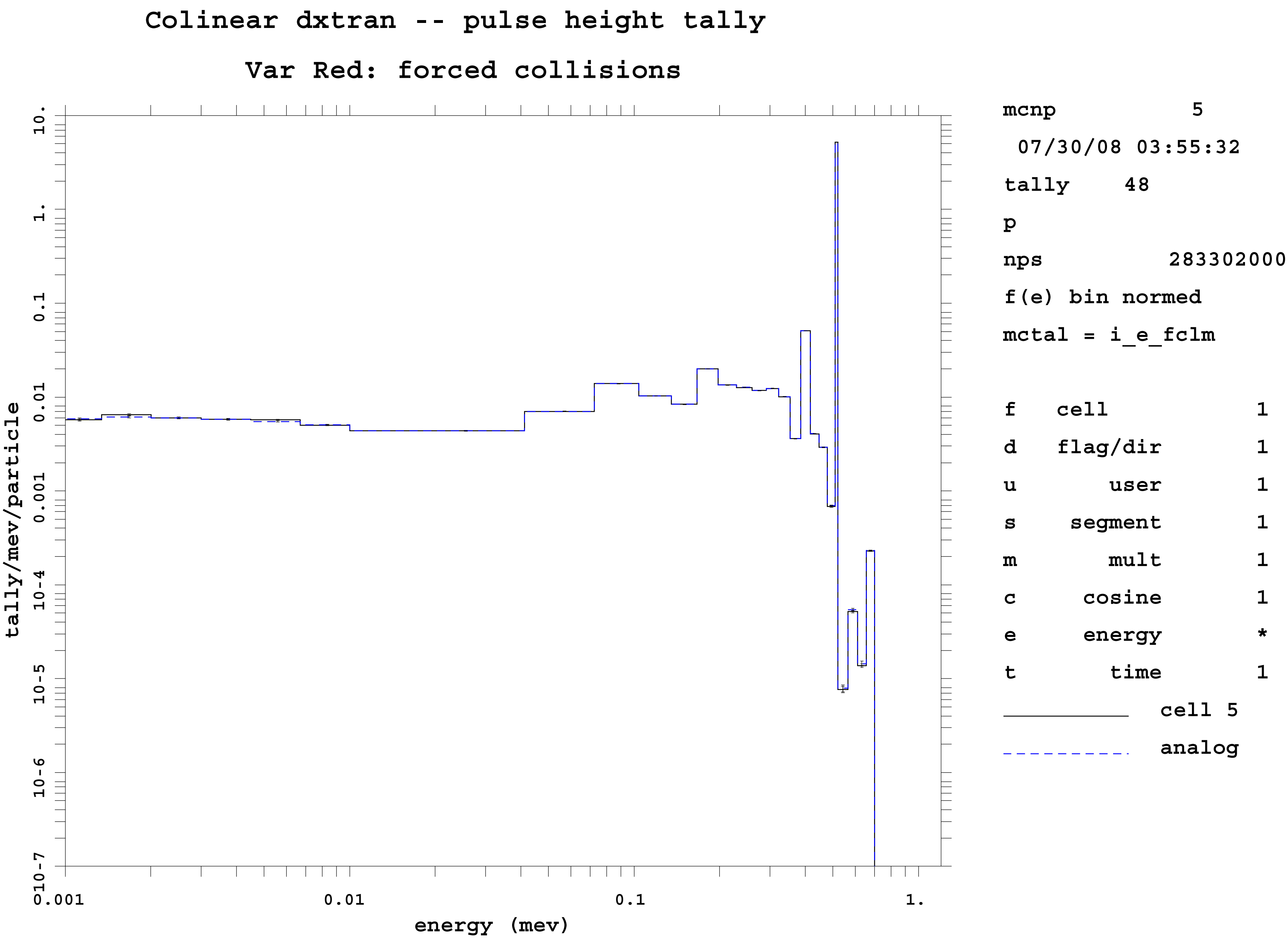

Colinear dxtran -- pulse height tally
Var Red: 5 dxtran spheres w/ for. colls.
tally/mev/particle
energy (mev)
0.001
0.01
0.1
1.
10-7
10-6
10-5
10-4
0.001
0.01
0.1
1.
mcnp 5
07/30/08 03:55:27
tally 38
p
nps 12288000
f(e) bin normed
mctal = i_e_dxt_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 4
analog

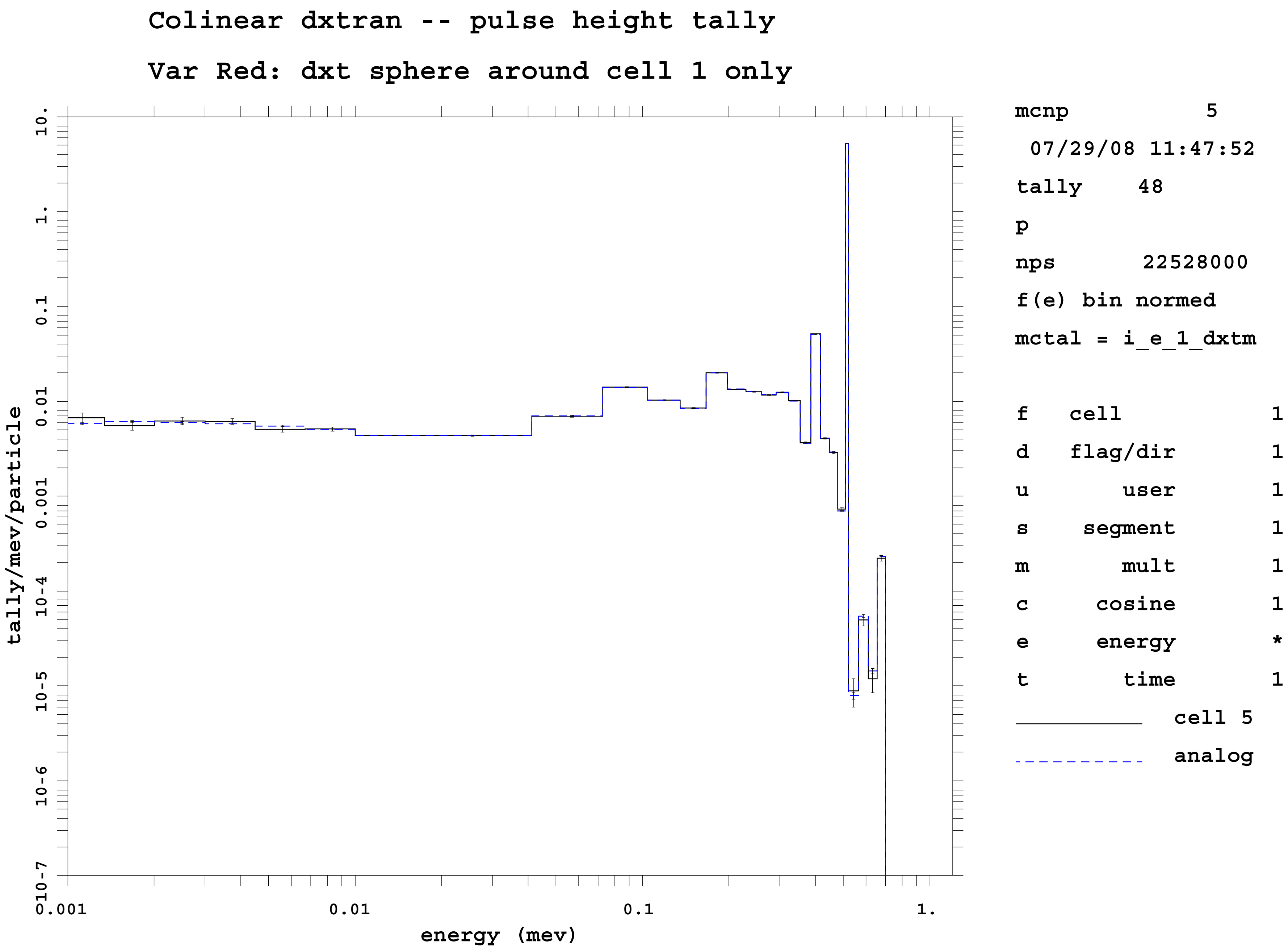


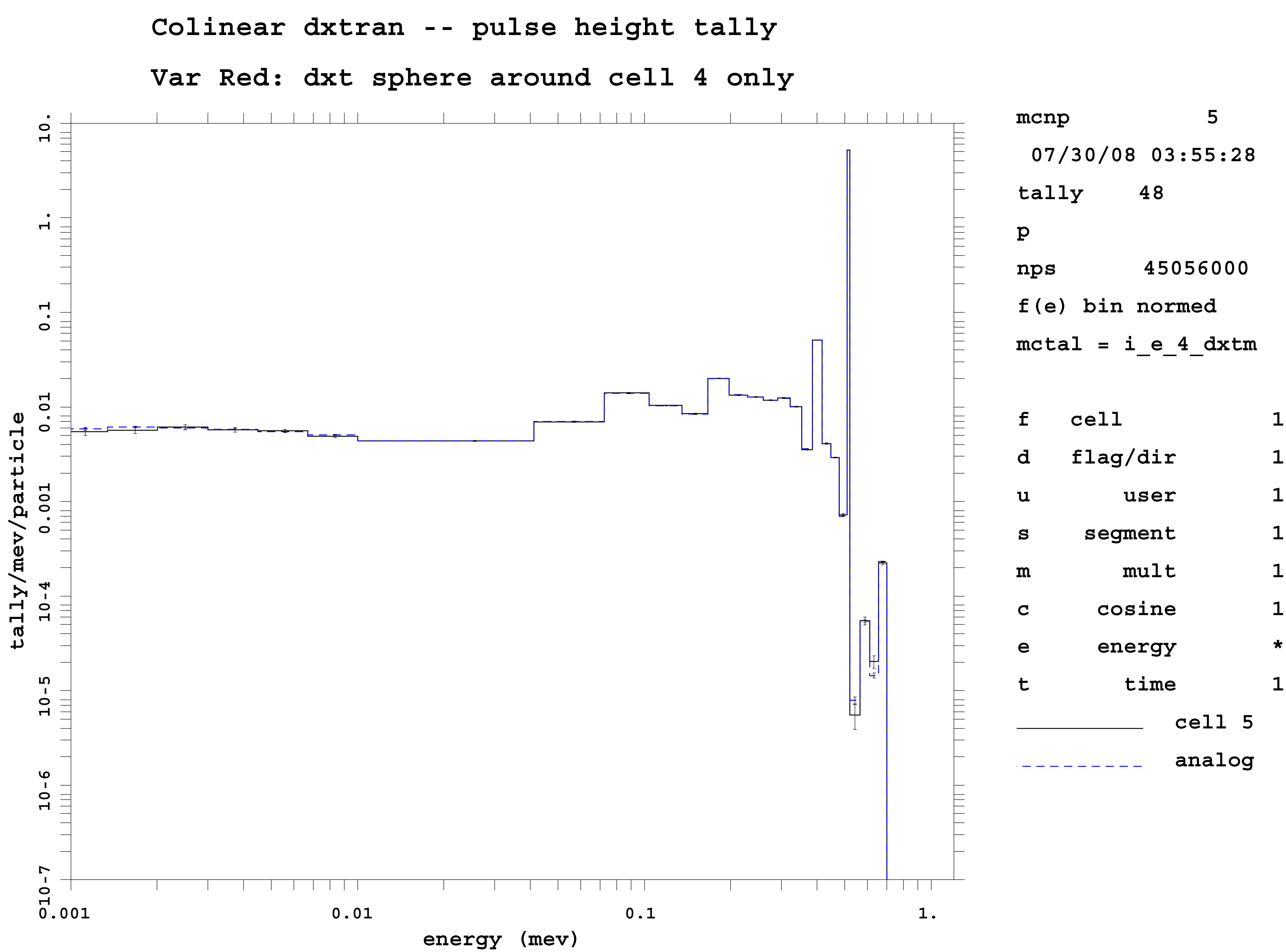
Colinear dxtran -- pulse height tally
Var Red: 5 dxtran spheres w/ dxc cards
tally/mev/particle
energy (mev)
0.001
0.01
0.1
1.
10-7
10-6
10-5
10-4
0.001
0.01
0.1
1.
mcnp 5
07/30/08 16:10:58
tally 38
p
nps 16384000
f(e) bin normed
mctal = i_e_dxcm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 4
analog



Colinear dxtran -- pulse height tally
Analog with PHTVR
tally/mev/particle
energy (mev)
0.001
0.01
0.1
1.
10-7
10-6
10-5
10-4
0.001
0.01
0.1
1.
mcnp 5
07/30/08 03:55:32
tally 38
p
nps 398828000
f(e) bin normed
mctal = i_e_noVR_PHTVRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 4
analog

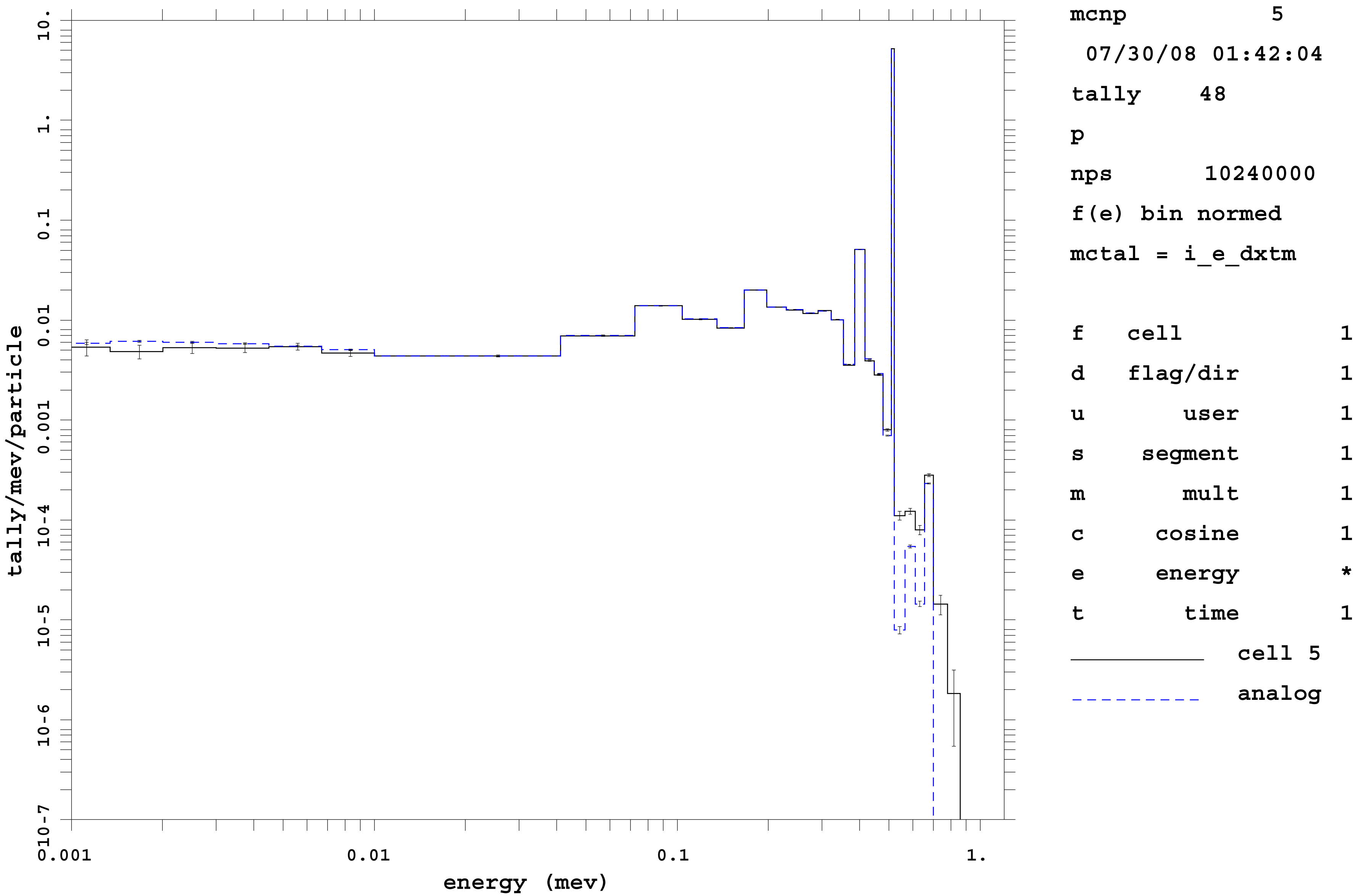

Colinear dxtran -- pulse height tally
Var Red: forced collisions
tally/mev/particle
energy (mev)
0.001
0.01
0.1
1.
10.
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
mcnp 5
07/30/08 03:55:32
tally 48
p
nps 283302000
f(e) bin normed
mctal = i_e_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 5
analog

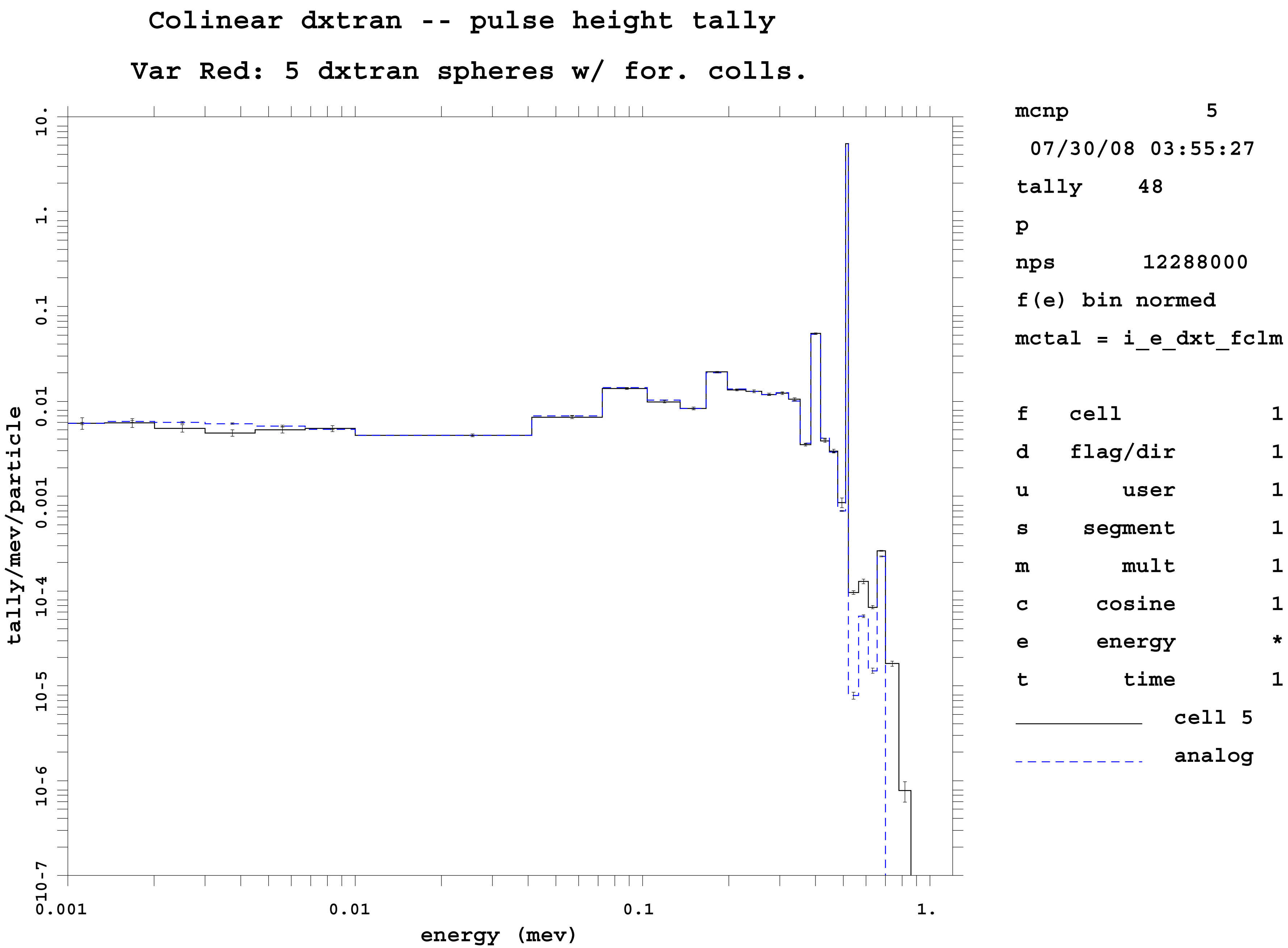

Colinear dxtran -- pulse height tally
Var Red: dxt sphere around cell 1 only
10.
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
tally/mev/particle
0.001
0.01
0.1
1.
energy (mev)
mcnp 5
07/29/08 11:47:52
tally 48
p
nps 22528000
f(e) bin normed
mctal = i_e_1_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 5
analog


Colinear dxtran -- pulse height tally
Var Red: dxt sphere around cell 4 only
tally/mev/particle
10.
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
1.
energy (mev)
mcnp 5
07/30/08 03:55:28
tally 48
p
nps 45056000
f(e) bin normed
mctal = i_e_4_dxtm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 5
analog

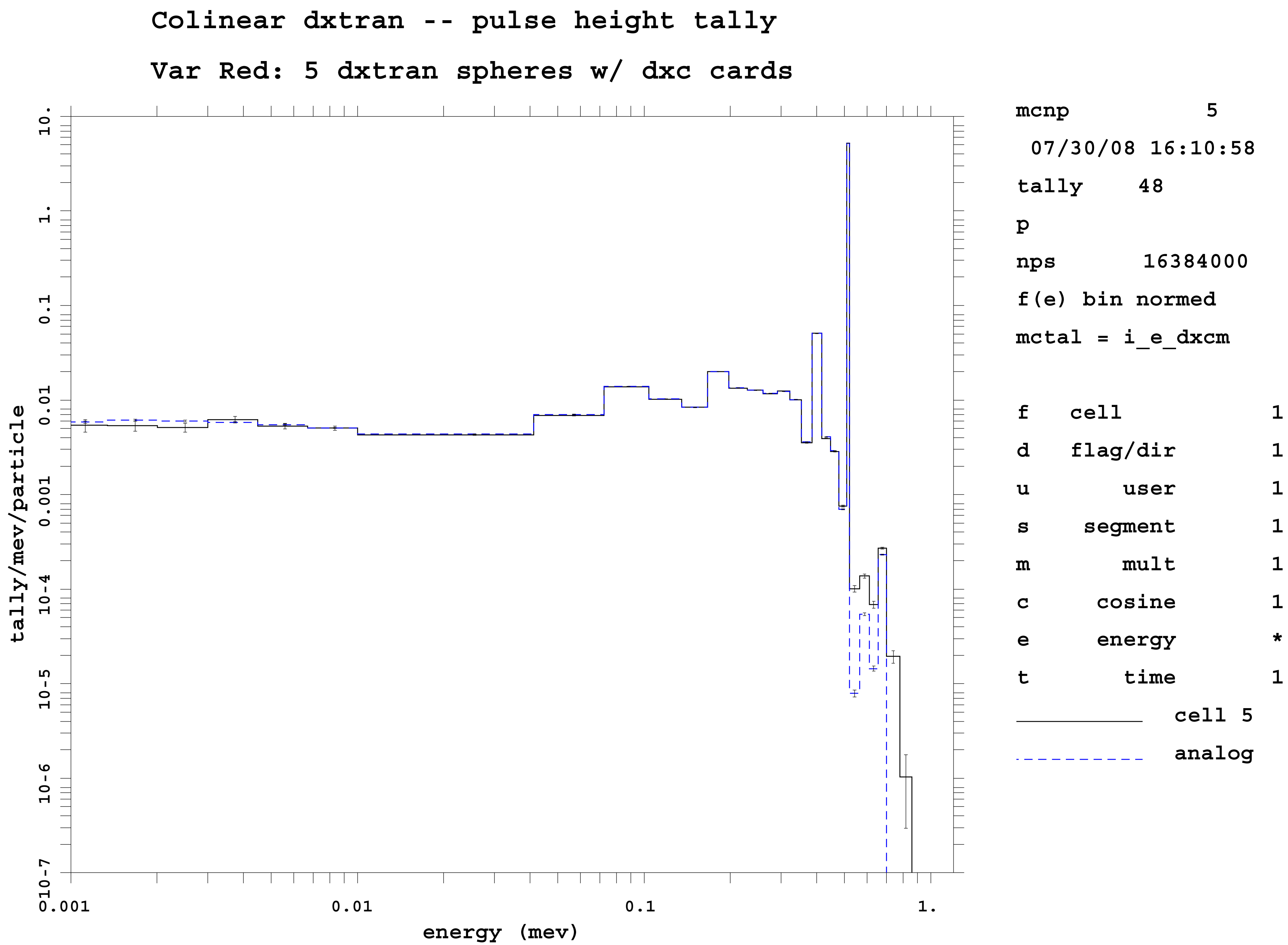
Colinear dxtran -- pulse height tally

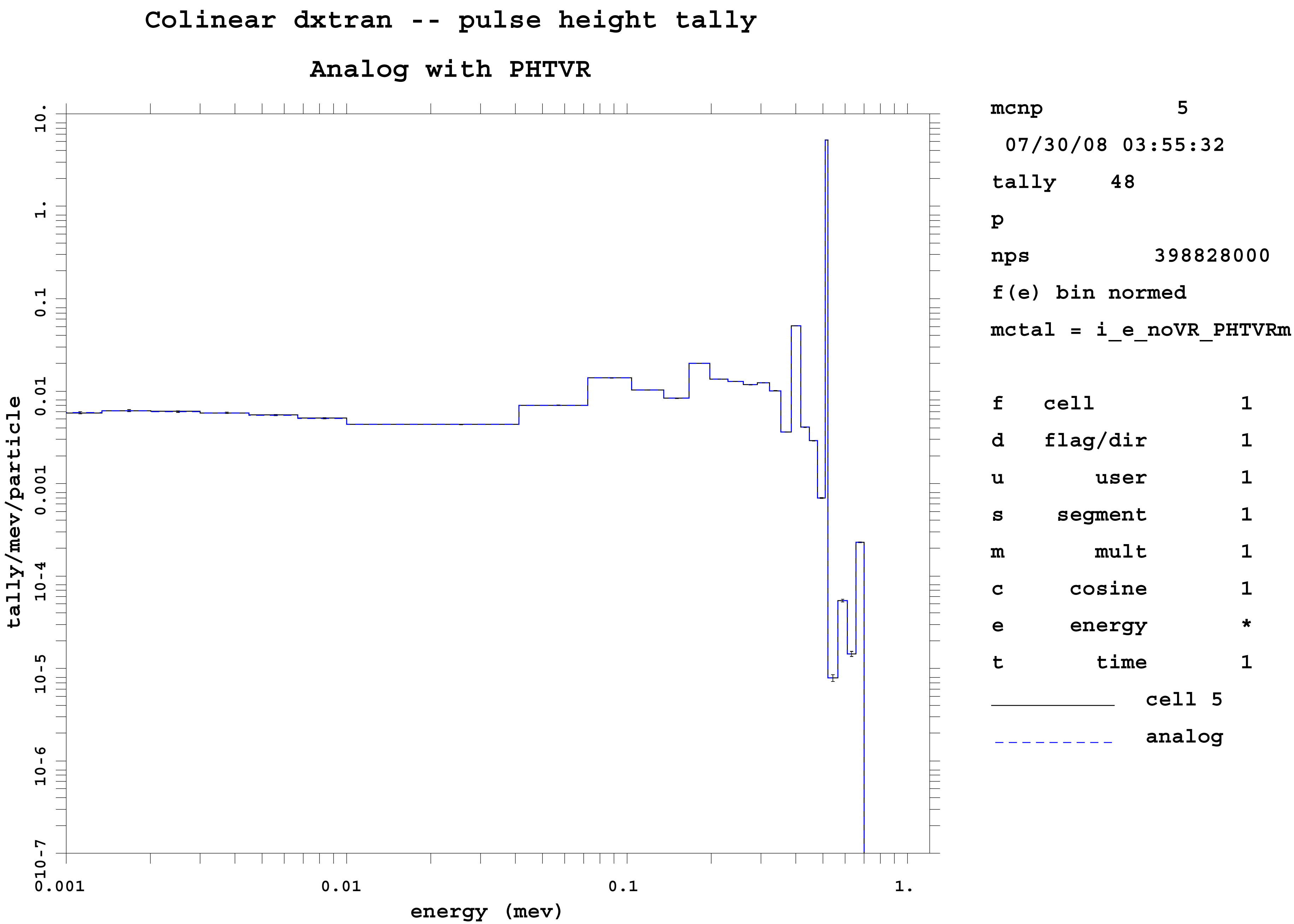
Var Red: 5 dxtran spheres





Colinear dxtran -- pulse height tally
Var Red: 5 dxtran spheres w/ for. colls.
tally/mev/particle
10.
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
1.
energy (mev)
mcnp 5
07/30/08 03:55:27
tally 48
p
nps 12288000
f(e) bin normed
mctal = i_e_dxt_fclm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 5
analog


Colinear dxtran -- pulse height tally
Var Red: 5 dxtran spheres w/ dxc cards
tally/mev/particle
energy (mev)
0.001
0.01
0.1
1.
10.
10-4
10-5
10-6
10-7
mcnp 5
07/30/08 16:10:58
tally 48
p
nps 16384000
f(e) bin normed
mctal = i_e_dxcm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 5
analog


Colinear dxtran -- pulse height tally
Analog with PHTVR
tally/mev/particle
energy (mev)
10.
1.
0.1
0.01
0.001
10-4
10-5
10-6
10-7
0.001
0.01
0.1
1.
mcnp 5
07/30/08 03:55:32
tally 48
p
nps 398828000
f(e) bin normed
mctal = i_e_noVR_PHTVRm
f cell 1
d flag/dir 1
u user 1
s segment 1
m mult 1
c cosine 1
e energy *
t time 1
cell 5
analog