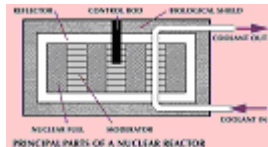


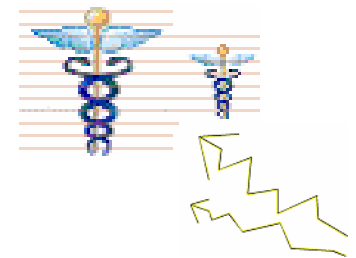
Comparison of Predictions by MCNP and EGSsrc of Radiation Dose

 imparted to various Material Targets by
Beams and small volumetric Sources.

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The main target and the objectives

- MCNP simulations of beams electrons and photons are compared to the corresponding simulations via EGSnrc.
- The beam is transversely shaped as a square whose length of a side is 1.6 cm.
- The target is a cubic water-like material with the dimensions of 5cm by 3cm by 6cm. The beam targets the middle of this ‘soft tissue’.
- The objective is to compare the time durations, the ease of operation, plausibility of results, and degree of agreement of results between MCNP and EGSnrc

The main target and the objectives

- A brief example of comparison is also given of a point source emitting the ‘strong’ γ -ray of Cs-137 toward the end of these slides.
- Note that the two computers used for respective comparisons between MCNP and EGSnrc are both Dells with the single Intel Pentium(R) 4M CPU.

Geometry of beam simulations:

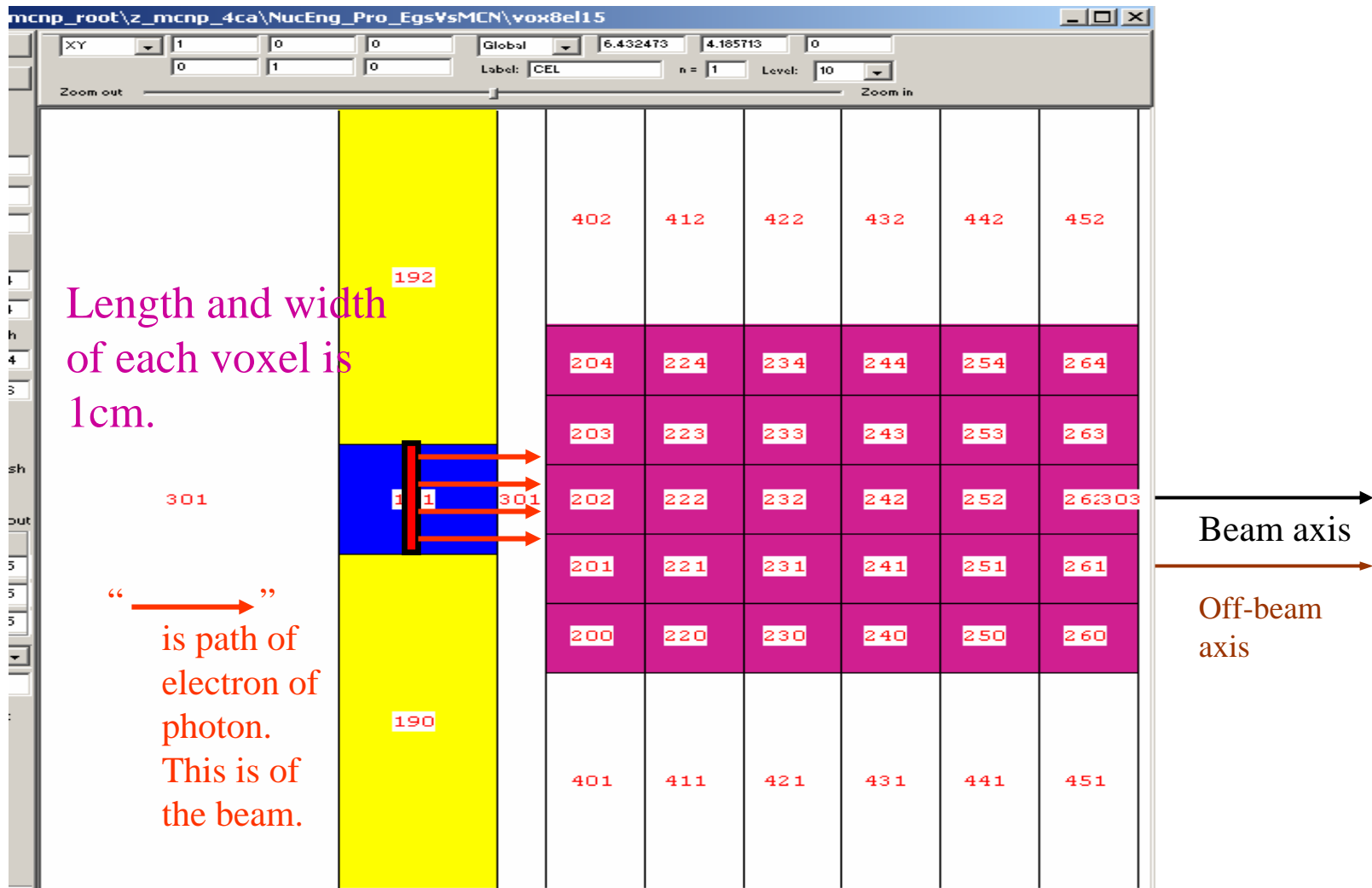



Figure (1)

Description of contents of (1)

- Note that cells 202, 222, 232, 242, 252, and 262 of Figure (1) lie direct on the axis of the beam of radiation, which emerges from inside the blue cell 101. This axis was defined as the X-axis.
- All of the cells consisting of H₂O or soft tissue appear as  in Figure (1). These cells have density of 1.00 gm/cm³.

Choices for Beam

- In Figure (I) and in all of the beam simulations of this paper, the beam is rectangularly shaped. The beam traverses along the X-axis.
- The beam has width-y of 1.6cm and width-z of 1.6cm.
- The beam was populated either by monoenergetic electrons and photons.
- 700,000 monoenergetic particles were initiated per simul..
- The choices of energy for the initially monoenergetic were .5MeV, 1MeV, 6MeV, and finally 18MeV.
- These simulations were conducted with both MCNP and EGSnrc, using 700,000 source particles.

Duration of dose simulation as a function of energy and code.

E of particles from beam	Simulation time via MCNP (min)	Simulation time via EGSnrc (min)	Simulation time via MCNP (min)	Simulation time via EGSnrc (min)	Simulation time via MCNP (min)
Particle of or by the beam	electron (e)	electron (e)	photon (p)	photon (p)	Secondary* e's generated from p's
0.5 MeV	59.5	1.11	0.6	0.31	about 10
1 MeV	110.88	1.88	0.57	0.42	21.3
6 MeV	586.2	8.96	0.54	0.91	54
18 MeV	1425.4	17.4	0.59	1.19	105

* Secondary e's are consequential to a percentage of energy lost by the primary photons.

Table I

Observations from Table I

- EGSnrc simulations of electrons are much faster than MCNP simulations of electrons, often by more than 40 fold.
- Plain photon simulations via MCNP are almost as fast as those of EGSnrc, so long as doses and scalar fluxes due to secondary electrons are not evaluated and computationally recorded.
- At energies above 1 MeV for photons, dose contributions due to secondary electrons cannot be ignored. Therefore an MCNP simulation in primary photon mode plus a 2nd MCNP simulation in the (p-e) mode should be carried out - if the photon beam energy exceeds 1 MeV.

contd. - Observations from Table I

- The p-mode simulations take only 1 minute approximately, but the (p-e) mode simulations to include secondary electrons (e.g. p collision daughters) endure for more than 20 minutes. The times of these two distinct simulations need to be added to get the realistic duration of a complete dose simulation for beams above 1 MeV.

- The purple cells in Figure (1) are of H₂O or soft tissue, with a density of 1.00 gm/cm³.
- Dosimetric Results of beam Monoenergetic Electrons hitting rectangular target of “soft tissue” are given in the next few slides.
- Note that soft tissue consists of 80% H₂O and of organics. Soft tissue is equivalent to water in terms of dosimetry, attenuations, and stopping powers.

Doses of Voxels which are on the beam axis.

Initial Energies: - .5MeV thru 1MeV

x-mcell (cm)	DosemnpElectrish [OnbeamX]	Fluctuati nmcnp Electrish[Onbeam X]	"DoseElectrish [OnbeamX]"	Fluctuatio n Electrish[O nbeamX]	Eatbeam (MeV)
3.	3.080000e-11	0.00171	3.7416401e-11	0.001452	0.5
4.	0.	0	8.4273091e-16	0.1151	0.5
5.	0.	0	2.6252445e-16	0.17607	0.5
6.	0.	0	1.26143e-16	0.27086	0.5
7.	0.	0	2.5876721e-17	0.40368	0.5
8.	0.	0	0	1.00	0.5
3.	6.1916800e-11	.00160	7.5226918e-11	0.0013726	1
4.	0.	0	3.4370879e-15	0.0717	1
5.	0.	0	1.3232981e-15	0.13635	1
6.	0.	0	7.3522008e-16	0.20126	1
7.	0.	0	5.654705e-16	0.24714	1
8.	0.	0	0	1.00	1

Table II

Unit (Gray/disnt) is Grays per disintegration.

Key to labels in Table II

X-mcell is the x coordinate of the middle of the cell which receives dose.

DosemncpElectrish[OnbeamX] is the dose imparted to the given cell (or 1cm³ voxel) due to beam electrons, scattered electrons, and liberated electrons via MCNP.

DoseElectrish[OnbeamX] is the dose imparted to the given cell of 1cm³ due to electrons via EGSnrc.

FluctuationmncpElectrish[OnbeamX] is the fluctuation of the value of the MCNP generated dose.

FluctuationElectrish[OnbeamX] is the fluctuation of the value of the EGSnrc generated dose. The values of fluctuation are given as decimals, not percentages.

Eatbeam is the energy of each original photon while it is in the original beam trajectory.

These labels in boxes mirror the boxes of Table (II) in previous slide.

x-mcell (cm)	DosemncpElectrish [OnbeamX] (Gray/disnt)	Fluctuationmncp Electrish [OnbeamX]	DoseElectrish [OnbeamX] (Gray/disnt)	Fluctuation Electrish [OnbeamX]	Eatbeam (MeV)
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Contd. - Key to labels in Dose Tables

In the label DosemcpElectrish[OnbeamX], the nom. expression in brackets, [OnbeamX], indicates that voxels exposed are all centered in line with the particle beam axis.

The center of an [OnbeamX] voxel is located at $(x,y,z) = (x-mcell, 0cm, 0cm)$.

In the label DosemcpElectrish[OffbeamX], the nom. expression in brackets, [OffbeamX], indicates that voxels exposed are laterally centered one cm away from the particle beam axis.

The center of an [OffbeamX] voxel is located at $(x,y,z) = (x-mcell, 1cm, 0cm)$.

x-mcell (cm)	DosemcpElectrish [OnbeamX] (Gray/disnt)	Fluctuationmcp Electrish [OnbeamX]	DoseElectrish [OnbeamX] (Gray/disnt)	Fluctuation Electrish [OnbeamX]	Eatbeam (MeV)
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Doses of Voxels which are on the beam axis.
Initial Energies: - 6MeV thru 18MeV

x- mcell (cm)	DosemcnpElectris h [OnbeamX] (Gray)	Fluctuation mcnp Electrish[O nbeamX]	DoseElectrish [OnbeamX] (Gray)	Fluctuation Electrish[Onbea mX]"	Eatbeam (MeV)
3.	3.07142400e-10	0.00038630	1.5183653e-10	0.0013858	6
4.	2.21326400e-10	0.0007726	1.3486142e-10	0.0015752	6
5.	6.933456e-11	0.0023731	4.9928864e-11	0.002751	6
6.	1.662784e-12	0.010982	8.8169044e-13	0.014128	6
7.	0.	0	6.5683555e-14	0.054512	6
8.	0.	0	4.3334757e-14	0.066699	6
3.	1.36532640e-10	0.0025861	1.4613965e-10	0.0014701	18
4.	1.36261280e-10	0.0023872	1.5233602e-10	0.0014438	18
5.	1.24488e-10	0.0023872	1.4021076e-10	0.0015506	18
6.	9.60563200e-11	0.0026259	1.0866666e-10	0.0018599	18
7.	6.43345600e-11	0.0031829	7.3191358e-11	0.0023833	18
8.	3.913744e-11	0.0040582	4.5205904e-11	0.0031365	18

Table III

Doses of Voxels which are 1cm off-beam

Initial Energies: 0.5MeV thru 1MeV

x-mcell (cm)	DosemnpElectrish [OffbeamX]	Fluctuati nmnp Electrish[Offbeam X]	DoseElectrish [OffbeamX]	Fluctuatio n Electrish[Of fbeamX]"	Eatbeam (MeV)
3.	9.2194400e-12	0.003808	1.11574e-11	0.003203	0.5
4.	0.	0	4.266882e-16	0.13456	0.5
5.	0.	0	2.1718938e-16	0.20684	0.5
6.	0.	0	2.104271e-16	0.30325	0.5
7.	0.	0	4.6722077e-17	0.35941	0.5
8.	0.	0	0	1.00	0.5
3.	1.855568e-11	0.003587	2.2495524e-11	0.003042	1
4.	0.	0	2.0114871e-15	0.10827	1
5.	0.	0	9.4053665e-16	0.15866	1
6.	0.	0	7.5625754e-16	0.22162	1
7.	0.	0	3.4580439e-16	0.41496	1
8.	0.	0	1.4263875e-16	0.23503	1

Doses of Voxels which are 1cm off-beam

Initial Energies: - 6MeV thru 18MeV

x- mcell (cm)	DosemnpElectris h [OffbeamX] (Gray)	Fluctuation mnp Electrish[Of fbeamX]	DoseElectrish [OffbeamX] (Gray)	Fluctuation Electrish[Offbea mX]	Eatbeam (MeV)
3.	1.992576e-12	0.014073	4.7348459e-11	0.002974	6
4.	3.120048e-11	0.0039183	5.6711974e-11	0.002770	6
5.	2.6551520e-11	0.0040839	2.566277e-11	0.003908	6
6.	3.0429760e-13	0.023731	3.8215494e-13	0.020945	6
7.	0.	0	3.7377969e-14	0.065566	6
8.	0.	0	3.1756024e-14	0.080313	6
3.	4.1034560e-11	0.0052519	4.4027332e-11	0.003195	18
4.	4.2245440e-11	0.0047744	4.7050318e-11	0.003087	18
5.	4.23696e-11	0.0045357	4.9010101e-11	0.003044	18
6.	4.0918240e-11	0.0043765	4.7964401e-11	0.003076	18
7.	3.47854400e-11	0.0044959	4.0913062e-11	0.0033434	18
8.	2.63825600e-11,	0.0050131	3.0634533e-11	0.0038958,	18

Table of Doses - .5MeV thru 1MeV

x- mcell (cm)	DosemcpElectris h [OnbeamX]	DoseElectrish [OnbeamX]	DosemcpElectri sh [OffbeamX]	DoseElectrish [OffbeamX]	Eatbeam (MeV)
3.	3.080000e-11	7.8665621e-11	9.2194400e-12	2.3457729e-11	0.5
4.	0.	1.7717885e-15	0.	8.9708500e-16	0.5
5.	0.	5.5194108e-16	0.	4.5662695e-16	0.5
6.	0.	2.6520770e-16	0.	4.4240970e-16	0.5
7.	0.	5.44041729e-17	0.	9.8230216e-17	0.5
8.	0.	0	0.	0	0.5
3.	6.1916800e-11	1.58159844e-10	1.855568e-11	4.7295418e-11	1
4.	0.	7.22626029e-15	0.	4.2290246e-15	1
5.	0.	2.78215079e-15	0.	1.9774189e-15	1
6.	0.	1.54575381e-15	0.	1.5899837e-15	1
7.	0.	7.8665621e-11	0.	7.2703191e-16	1
8.	0.	1.7717885e-15	0.	2.9988896e-16	1

Table of Doses - 6MeV thru 18MeV

x- mcell (cm)	DosemnpElectrish [OnbeamX] (Gray)	DoseElectrish [OnbeamX] (Gray)	DosemnpElectrish [OffbeamX]	DoseElectrish [OffbeamX]	Eatbeam (MeV)
3.	3.07142400e-10	3.19226724e-10	1.992576e-12	9.9547146e-11	6
4.	2.21326400e-10	2.83537613e-10	3.120048e-11	1.1923334e-10	6
5.	6.933456e-11	1.04972284e-10	2.6551520e-11	5.3954353e-11	6
6.	1.662784e-12	1.85369848e-12	3.0429760e-13	8.0345664e-13	6
7.	0.	1.38095527e-13	0.	7.8584821e-14	6
8.	0.	9.11085912e-14	0.	6.6765035e-14	6
3.	1.36532640e-10	3.07249397e-10	4.1034560e-11	9.2564685e-11	18
4.	1.36261280e-10	3.20276865e-10	4.2245440e-11	9.8920322e-11	18
5.	1.24488e-10	2.94784261e-10	4.23696e-11	1.0304064e-10	18
6.	9.60563200e-11	2.28464793e-10	4.0918240e-11	1.0084212e-10	18
7.	6.43345600e-11	1.53880209e-10	3.47854400e-11	8.60171301e-11	18
8.	3.913744e-11	9.50425598e-11	2.63825600e-11,	6.44071708e-11	18

Comment on e-p mode when simulating electron beams

Note that the dose×volume deposited in (elec-photo) mode tends to be almost the same (slightly less than) the dose×volume deposited in electron mode in the cases of .5MeV beam and 18 MeV beam , for voxels on the beam axis. This is especially true in the cells where the journey of e is more than 1/2 completed.

- Dosimetric Results of beam Monoenergetic Photons hitting rectangular target of “soft tissue” are given in the next few slides.

Doses of Voxels which are on the beam axis.

Initial Energies: - .5MeV thru 1MeV

x- mcell (cm)	DosemncnpPhotoni c [OnbeamX] (Gray/disnt)	Fluctuatio nmncnp Photonic [Onbeam X]	DosePhotonic [OnbeamX] (Gray/disnt)	Fluctuatio n Photonic [OnbeamX] "	Eatbeam (MeV)
3.	1.02792e-12	0.0015	1.230281e-12	0.0071076	0.5
4.	9.62808e-13	0.0016	1.18276215e-12	0.0072383	0.5
5.	8.861744e-13	0.0017	1.0884958e-12	0.0075525	0.5
6.	8.102192e-13	0.0018	9.80913452e-13	0.0079619	0.5
7.	7.38104e-13	0.0019	9.02594429e-13	0.0082969	0.5
8.	6.700832e-13	0.002	8.14896442e-13	0.0087448	0.5
3.	1.927888e-12	0.0015	2.14209776e-12	0.0081977	1
4.	1.839616e-12	0.0015	2.21444424e-12	0.0079823	1
5.	1.734608e-12	0.0016	2.12395133e-12	0.008183	1
6.	1.627424e-12	0.0017	1.95102057e-12	0.0085311	1
7.	1.5209008e-12	0.0018	1.86924655e-12	0.0087573	1
8.	1.419352e-12	0.0019	1.73595706e-12	0.0090895	1

Unit (Gray/disnt) is Grays per disintegration.

Key to labels in Table (N)

X-mcell is the x coordinate of the middle of the cell which receives dose.

DosemcpPhotonic[OnbeamX] is the dose imparted to the given cell (or 1cm³ voxel) due to photons via MCNP.

DosePhotonic[OnbeamX] is the dose imparted to the given cell (or voxel) due to photons via EGSnrc.

FluctuationmcpPhotonic[OnbeamX] is the fluctuation of the value of the MCNP generated dose.

FluctuationPhotonic[OnbeamX] is the fluctuation of the value of the EGSnrc generated dose. The values of fluctuation are given as decimals, not percentages.

Eatbeam is the energy of each original photon while it is in the original beam trajectory.

These labels in boxes mirror the boxes of Table (N) in previous slide.

x-mcell (cm)	DosemcpPhotonic [OnbeamX] (Gray/disnt)	Fluctuationmcp Photonic [OnbeamX]	DosePhotonic [OnbeamX] (Gray/disnt)	Fluctuation Photonic [OnbeamX]	Eatbeam (MeV)
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Doses of Voxels which are on the beam axis.

Initial Energies: - 6MeV thru 18MeV

x-mcell (cm)	DosemcnpPhotonic [OnbeamX] (Gray/disnt)	Fluctuation mcnp Photonic [OnbeamX]	DosePhotonic [OnbeamX] (Gray/disnt)	Fluctuation Photonic[OnbeamX]"	Eatbeam (MeV)
3.	6.834256e-12	0.0015	2.31514287e-12	0.013148	6
4.	6.70744e-12	0.0015	5.50972604e-12	0.0091624	6
5.	6.56128e-12	0.0015	6.46691524e-12	0.0084225	6
6.	6.406032e-12	0.0016	6.46042827e-12	0.0084133	6
7.	6.247024e-12	0.0016	6.33955129e-12	0.0085342	6
8.	6.088192e-12	0.0016	6.06212758e-12	0.0087017	6
3.	1.673392e-11	0.0015	1.91000969e-12	0.016501	18
4.	1.648368e-11	0.0015	5.34654721e-12	0.010714	18
5.	1.622672e-11	0.0015	7.96849338e-12	0.0086607	18
6.	1.5963776e-11	0.0016	9.57619066e-12	0.0077933	18
7.	1.5696896e-11	0.0016	1.03401675e-11	0.0074643	18
8.	1.5427264e-11	0.0016	1.06294255e-11	0.0072964	18

Doses of Voxels which are 1cm off-beam

Initial Energies: .5MeV thru 1MeV

x- mcell (cm)	DosemncnpPhotonic [OffbeamX] (Gray/disnt)	Fluctuati nmncnp Photonic[Offbeam X]	DosePhotonic [OffbeamX] (Gray/disnt)	Fluctuatio n Photonic[Of fbeamX]"	Eatbeam (MeV)
3.	3.136016e-13	0.0032	3.73969226e-13	0.012853	0.5
4.	2.991328e-13	0.0033	3.61152556e-13	0.013053	0.5
5.	2.79496e-13	0.0034	3.45025877e-13	0.013347	0.5
6.	2.57768e-13	0.0035	3.09734512e-13	0.014072	0.5
7.	2.363424e-13	0.0037	2.96630162e-13	0.014445	0.5
8.	2.147904e-13	0.0039	2.55712085e-13	0.015543	0.5
3.	5.82672e-13	0.0032	6.65687734e-13	0.014623	1
4.	5.63224e-13	0.0033	6.88107634e-13	0.014282	1
5.	5.36432e-13	0.0034	6.60692535e-13	0.014483	1
6.	5.078688e-13	0.0035	6.15087244e-13	0.014979	1
7.	4.775472e-13	0.0036	5.88413493e-13	0.015403	1
8.	4.460336e-13	0.0037	5.51509738e-13	0.015877	1

Doses of Voxels which are 1cm off-beam

Initial Energies: - 6MeV thru 18MeV

x- mcell (cm)	DosemcnpPhotonic [OffbeamX] (Gray/disnt)	Fluctuation mcnp Photonic[Of fbeamX]	DosePhotonic [OffbeamX] (Gray/disnt)	Fluctuation Photonic[Offbea mX]	Eatbeam (MeV)
3.	2.051008e-12	0.0033	7.27773335e-13	0.023098	6
4.	2.017312e-12	0.0033	1.8587304e-12	0.015484	6
5.	1.980608e-12	0.0033	2.35633788e-12	0.013834	6
6.	1.939952e-12	0.0034	2.37631276e-12	0.01365	6
7.	1.897696e-12	0.0034	2.31539739e-12	0.01385	6
8.	1.852144e-12	0.0035	2.23479117e-12	0.014087	6
3.	5.018608e-12	0.0033	5.76594515e-13	0.029344	18
4.	4.946976e-12	0.0033	1.71344415e-12	0.018408	18
5.	4.87256e-12	0.0033	2.67448209e-12	0.014544	18
6.	4.797568e-12	0.0034	3.42607808e-12	0.01275	18
7.	4.721424e-12	0.0034	3.91356702e-12	0.011838	18
8.	4.645664e-12	0.0034	4.1618545e-12	0.011389	18

- In the next few tables, dose contributions from monoenergetic photons with scattered photons and dose contributions from secondary electrons from the photons will be considered.

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Key to lables in Table (Q)

X-mcell is the x coordinate of the middle of the cell which receives dose.

DosemncnpPhotonic[OnbeamX] is the dose imparted to the given cell (or voxel) due to photons via MCNP.

DosemncnpPhotonic[OnbeamX] [fileNumber+100,ini] is the dose imparted to the given cell (or voxel) due to secondary e's and tertiary electrons resulting from the photons, via modelling and choice of modes in MCNP.

DosePhotonic[OnbeamX] is the dose imparted to the given cell (or vox) due to photons via EGSnrc.

FluctuationmncpPhotonic[OnbeamX] is the fluctuation of the value of the MCNP modelled dose.

FluctuationPhotonic[OnbeamX] is the fluctuation of the value of the EGSnrc generated dose.

x-mcell (cm)	DosemncnpPhotonic [OnbeamX] (Gray/disnt)	DosemncnpPhotonic [OnbeamX] [fileNumber+100,ini] (Gray/disnt)	DosePhotonic [OnbeamX] (Gray/disnt)	FluctuationmncpPhotonic [OnbeamX]	Fluctuation Photonic [OnbeamX]	Eatbeam (MeV)
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These labels in boxes mirror the boxes of Table (Q) in next slide and then next slide.

Doses of Voxels which are on the beam axis.

Initial Energies: - .5MeV thru 1MeV

x- mcell (cm)	DosemcpnPhoton ic [OnbeamX] (Gray/disnt)	DosemcpnPhoton ic [OnbeamX] [fileNumber+100,ini] (Gray/disnt)	DosePhotonic [OnbeamX] (Gray/disnt)	Fluctuationm cnpPhotonic [OnbeamX]	Fluctuation Photonic [OnbeamX]	Eatbeam (MeV)
3.	1.02792e-12	1.00673120e-12	1.230281e-12	0.0015	0.007108	0.5
4.	9.62808e-13	9.61854400e-13	1.18276215e-12	0.0016	0.007238	0.5
5.	8.861744e-13	8.47724800e-13	1.0884958e-12	0.0017	0.007553	0.5
6.	8.102192e-13	8.41809600e-13	9.80913452e-13	0.0018	0.007962	0.5
7.	7.38104e-13	6.93230400e-13	9.02594429e-13	0.0019	0.008297	0.5
8.	6.700832e-13	6.880704e-13	8.14896442e-13	0.002	0.008745	0.5
3.	1.927888e-12	1.7638400e-12	2.14209776e-12	0.0015	0.008198	1
4.	1.839616e-12	1.845744e-12	2.21444424e-12	0.0015	0.007982	1
5.	1.734608e-12	1.718752e-12	2.12395133e-12	0.0016	0.008183	1
6.	1.627424e-12	1.633792e-12	1.95102057e-12	0.0017	0.008531	1
7.	1.5209008e-12	1.518658e-12	1.86924655e-12	0.0018	0.008757	1
8.	1.419352e-12	1.406464e-12	1.73595706e-12	0.0019	0.009089	1

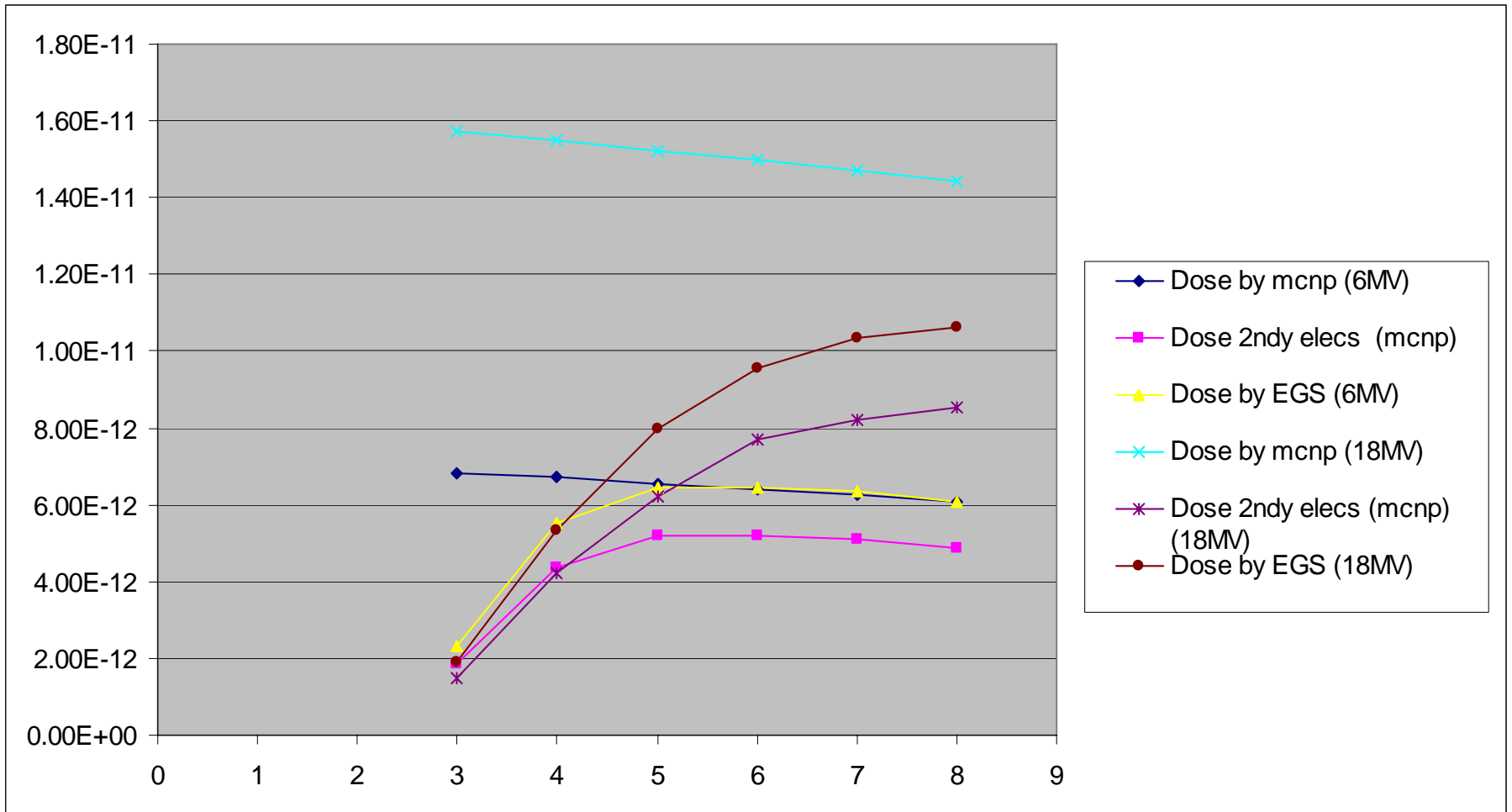
Table Q

Doses of Voxels which are on the beam axis.
Initial Energies: - 6MeV thru 18MeV

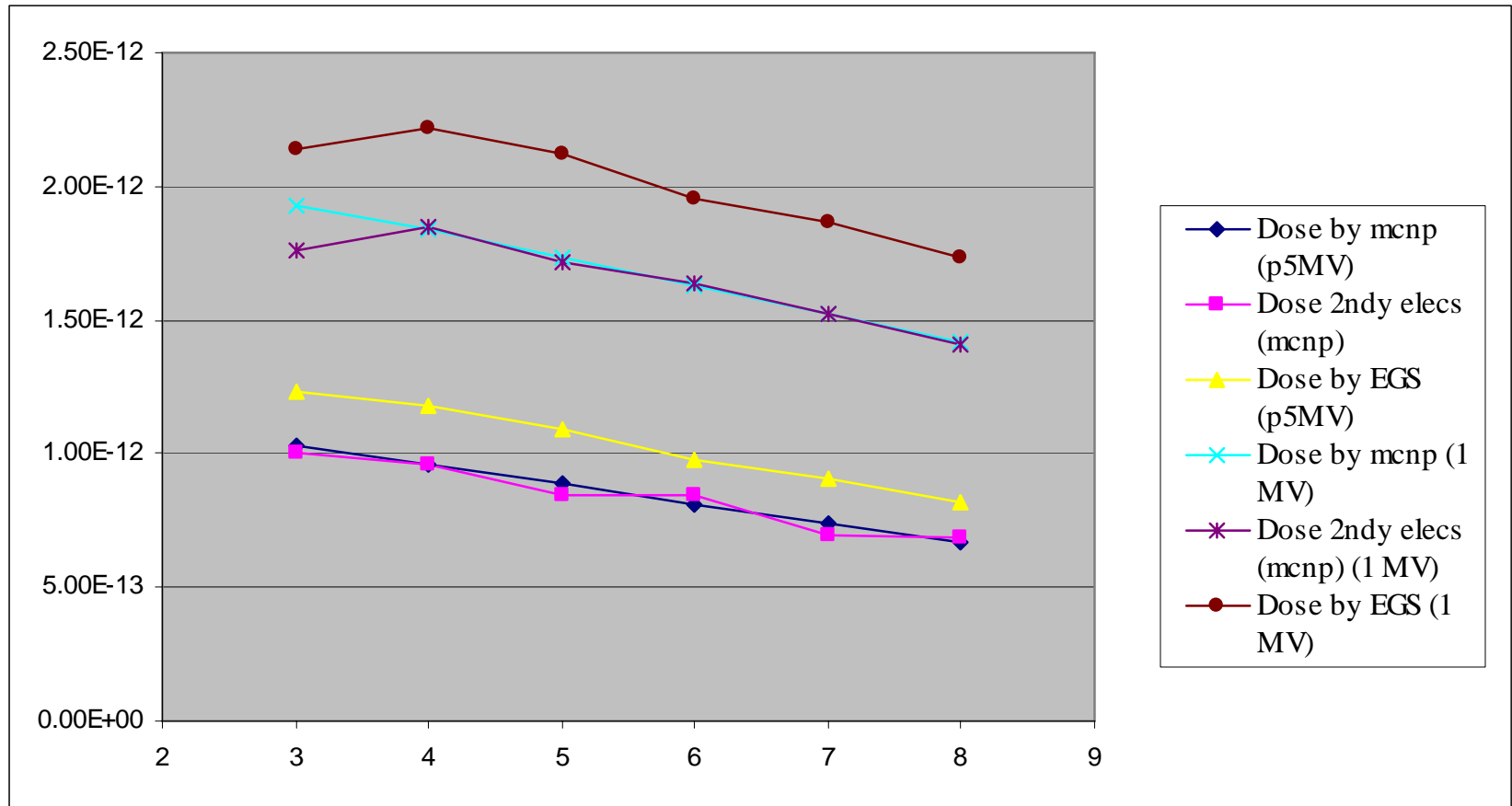
x- mcell (cm)	DosemncpPhoto nic [OnbeamX] (Gray/disnt)	DosemncpPhotoni c [OnbeamX] [fileNumber+100,ini]	DosePhotonic [OnbeamX] (Gray/disnt)	Fluctuationm cnp Photonic [OnbeamX]	Fluctuation Photonic[Onb eamX]	Eatbea m (MeV)
3.	6.834256e-12	1.851936e-12	2.31514287e-12	0.0015	0.013148	6
4.	6.70744e-12	4.36096e-12	5.50972604e-12	0.0015	0.0091624	6
5.	6.56128e-12	5.201008e-12	6.46691524e-12	0.0015	0.0084225	6
6.	6.406032e-12	5.179616e-12	6.46042827e-12	0.0016	0.0084133	6
7.	6.247024e-12	5.082896e-12	6.33955129e-12	0.0016	0.0085342	6
8.	6.088192e-12	4.851648e-12	6.06212758e-12	0.0016	0.0087017	6
3.	1.673392e-11	1.4964416e-12	1.91000969e-12	0.0015	0.016501	18
4.	1.648368e-11	4.242624e-12	5.34654721e-12	0.0015	0.010714	18
5.	1.622672e-11	6.231712e-12	7.96849338e-12	0.0015	0.0086607	18
6.	1.5963776e-11	7.705024e-12	9.57619066e-12	0.0016	0.0077933	18
7.	1.5696896e-11	8.234368e-12	1.03401675e-11	0.0016	0.0074643	18
8.	1.5427264e-11	8.54688e-12	1.06294255e-11	0.0016	0.0072964	18

Table Q+1

Graph of Doses from Table Q+1, Comparison of Doses by main photons by MCNP and Doses due to secondary mediating electrons -- Figure (2)



Graph of Doses from Table Q, Comparison of Doses by main photons by MCNP and Doses due to secondary mediating electrons (0.5 and 1MeV)-- Figure (3)



Doses of Voxels which are 1cm off-beam


Initial Energies: .5MeV thru 1MeV

x- mcell(cm)	DosemcnpPhotonic [OffbeamX] (Gray/disnt)	DosemcnpPhotonic [OffbeamX] [fileNumber+100,ini]	DosePhotonic [OffbeamX]	Fluctuation mcnp Photonic[Of fbeamX]	Fluctuation Photonic[Off beamX]	Eatbeam (MeV)
3.	3.136016e-13	almost same	3.73969226e-13	0.0032	0.012853	0.5
4.	2.991328e-13	almost same	3.61152556e-13	0.0033	0.013053	0.5
5.	2.79496e-13	almost same	3.45025877e-13	0.0034	0.013347	0.5
6.	2.57768e-13	almost same	3.09734512e-13	0.0035	0.014072	0.5
7.	2.363424e-13	almost same	2.96630162e-13	0.0037	0.014445	0.5
8.	2.147904e-13	almost same	2.55712085e-13	0.0039	0.015543	0.5
3.	5.82672e-13	5.3605440e-13	6.65687734e-13	0.0032	0.014623	1
4.	5.63224e-13	5.6814560e-13	6.88107634e-13	0.0033	0.014282	1
5.	5.36432e-13	5.3969120e-13	6.60692535e-13	0.0034	0.014483	1
6.	5.078688e-13	4.9910720e-13	6.15087244e-13	0.0035	0.014979	1
7.	4.775472e-13	4.8464480e-13	5.88413493e-13	0.0036	0.015403	1
8.	4.460336e-13	4.4794400e-13	5.51509738e-13	0.0037	0.015877	1

Doses of Voxels which are 1cm off-beam

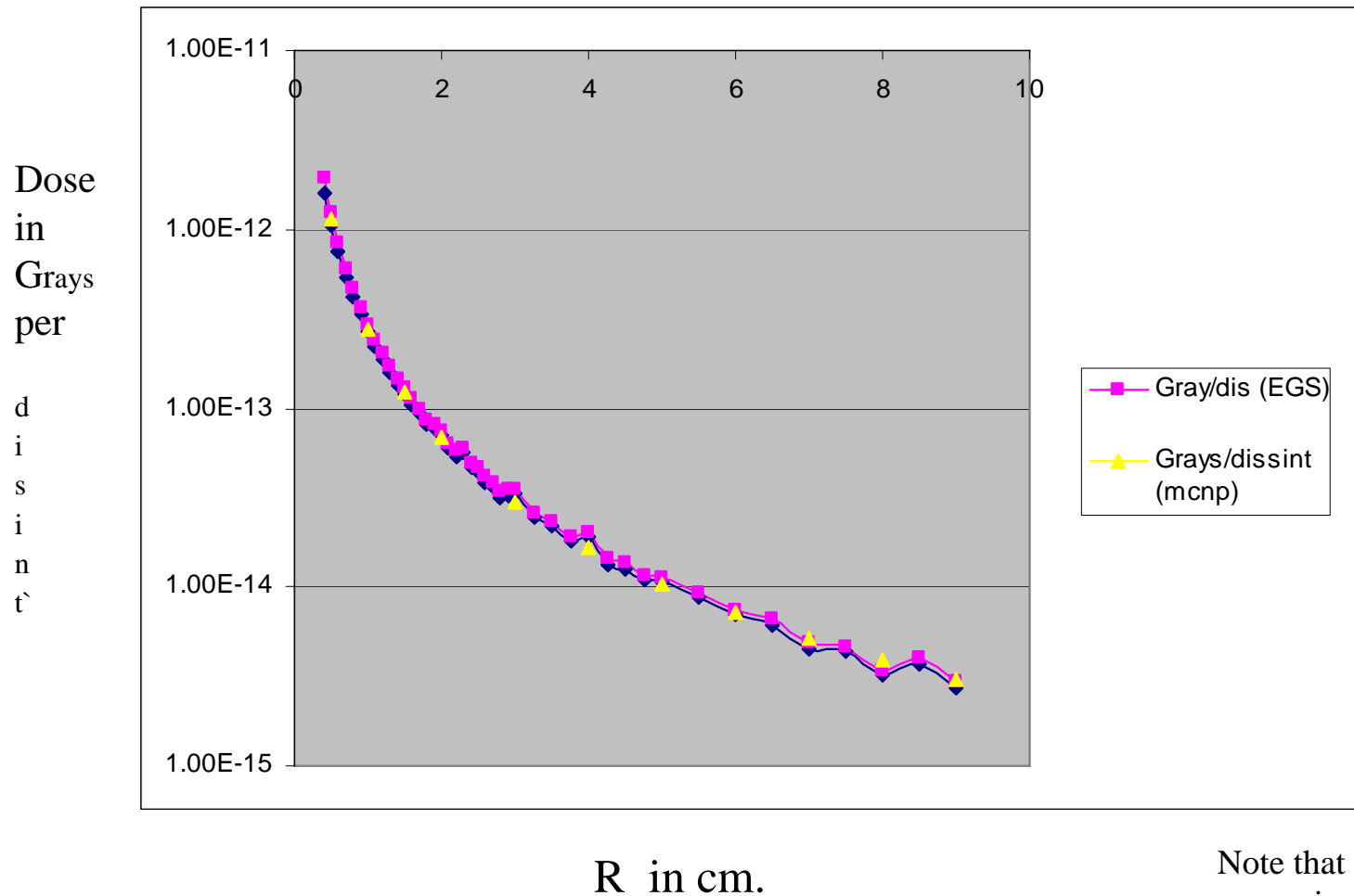
Initial Energies: - 6MeV thru 18MeV

x- mcell(cm)	DosemcnpPhotonic [OffbeamX] (Gray/disnt)	DosemcnpPhotonic [OffbeamX] [fileNumber+100,ini]	DosePhotonic [OffbeamX] (Gray/disnt)	Fluctuation mcnp Photonic [OffbeamX]	Fluctuation Photonic[Offbeam X]	Eatbeam m (MeV)
3.	2.051008e-12	5.909088e-13	7.27773335e-13	0.0033	0.023098	6
4.	2.017312e-12	1.541384e-12	1.8587304e-12	0.0033	0.015484	6
5.	1.980608e-12	1.929008e-12	2.35633788e-12	0.0033	0.013834	6
6.	1.939952e-12	1.931152e-12	2.37631276e-12	0.0034	0.01365	6
7.	1.897696e-12	1.882576e-12	2.31539739e-12	0.0034	0.01385	6
8.	1.852144e-12	1.8492e-12	2.23479117e-12	0.0035	0.014087	6
3.	5.018608e-12	4.652624e-13	5.76594515e-13	0.0033	0.029344	18
4.	4.946976e-12	1.4620208e-12	1.71344415e-12	0.0033	0.018408	18
5.	4.87256e-12	2.2312e-12	2.67448209e-12	0.0033	0.014544	18
6.	4.797568e-12	2.559152e-12	3.42607808e-12	0.0034	0.01275	18
7.	4.721424e-12	3.120976e-12	3.91356702e-12	0.0034	0.011838	18
8.	4.645664e-12	3.454656e-12	4.1618545e-12	0.0034	0.011389	18

Point source of photonic Cs-137 surrounded
by soft tissue 

Consider good agreement between photon simulations of MCNP and EGS for spherical phantom with 9cm radius.

Dose per disint` versus r from Cs-137 source in H₂O



Note that EGS geometry is approximately a sphere.

- Now let us look at the profile of the photonic dose kernel generated by static isotropic point source of Cs-137 on the following page.

Early Conclusions

- EGSNrc is much faster than MCNP at modelling primary electrons.
- MCNP is more versatile than EGSnrc
 - (only dose and fluctuations recorded by EGSnrc)
 - (only electrons and photons, Protons not coming in EGS)
 - (EGSnrc internally is most reliable for rectangular geometries).
- EGSnrc can read spectra and geometry and compositions from external files. - contributing to convenience. MCNP when specialized can read external geometry.
- The (p-e) mode simulations of photons should be done within MCNP in additon to the (p) mode simulation. A study of the tables makes this clear.

Conclusions

- A thorough study of the tables given for the dosimetry of photon targeted Figure (1) makes it very apparent that the dose values in (p-e) mode of MCNP are almost consistently closer to the dose values in (p) mode of EGSnrc.
- Moreover, the dose distributions as a function of beam depth from EGSnrc and MCNP in (p-e) mode match the dosimetric beam profiles given in the graphs of the text The Physics of Radiation Therapy (Third Ed., pg. 163) by Kahn. On the other hand, the dose distribution by MCNP simulation in purely (p) mode fails to account for significant build up and the graphs published in Kahn's book.
- The agreement between the dose table of values from MCNP's (p-e) mode and the values of EGSnrc are reasonably close.