Supplementary material

Further development of the preceding Gaussian-pencil-beam-model used for calculation of the in-water dose caused by clinical electron-beam irradiation

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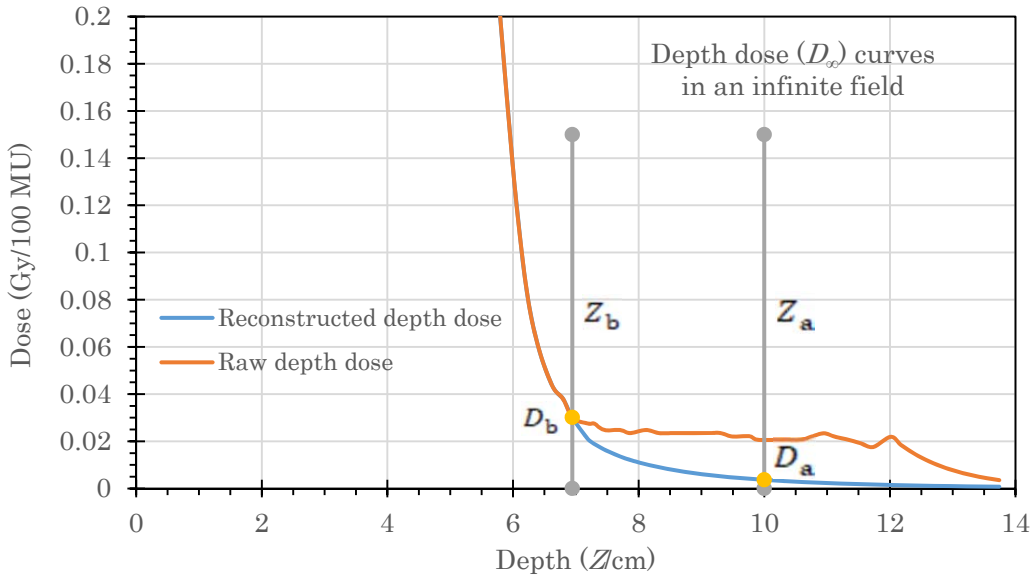
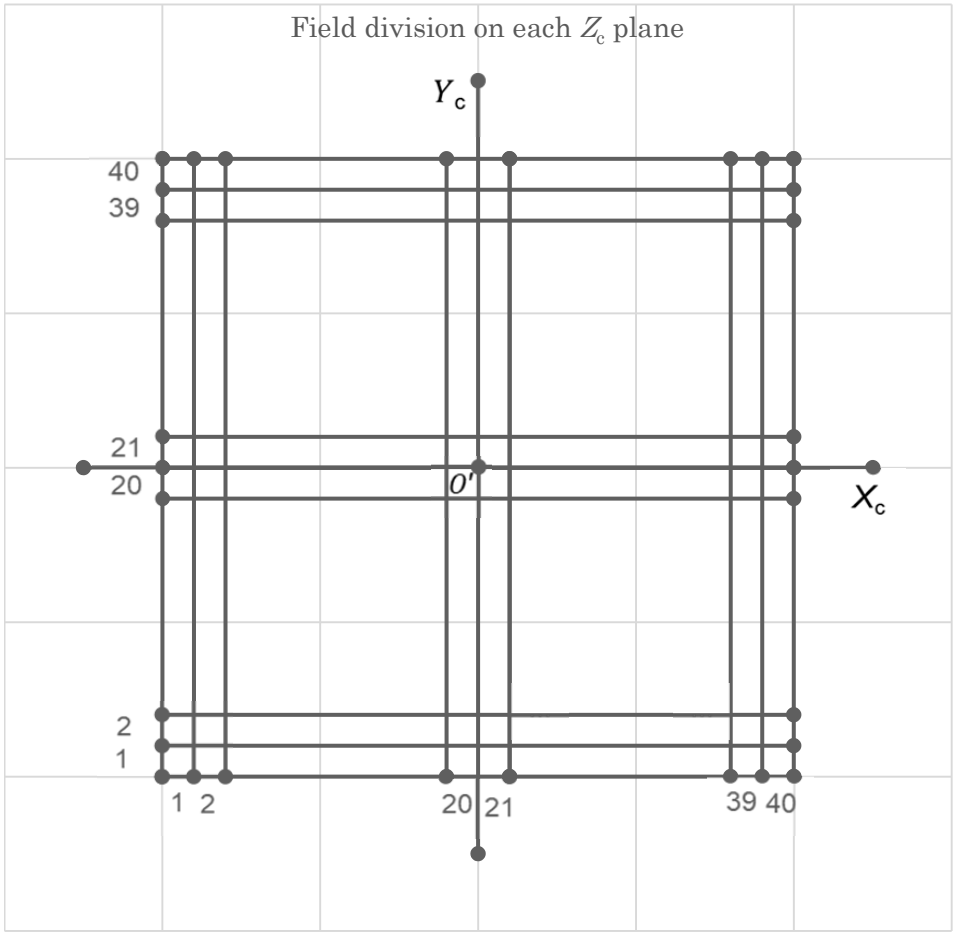
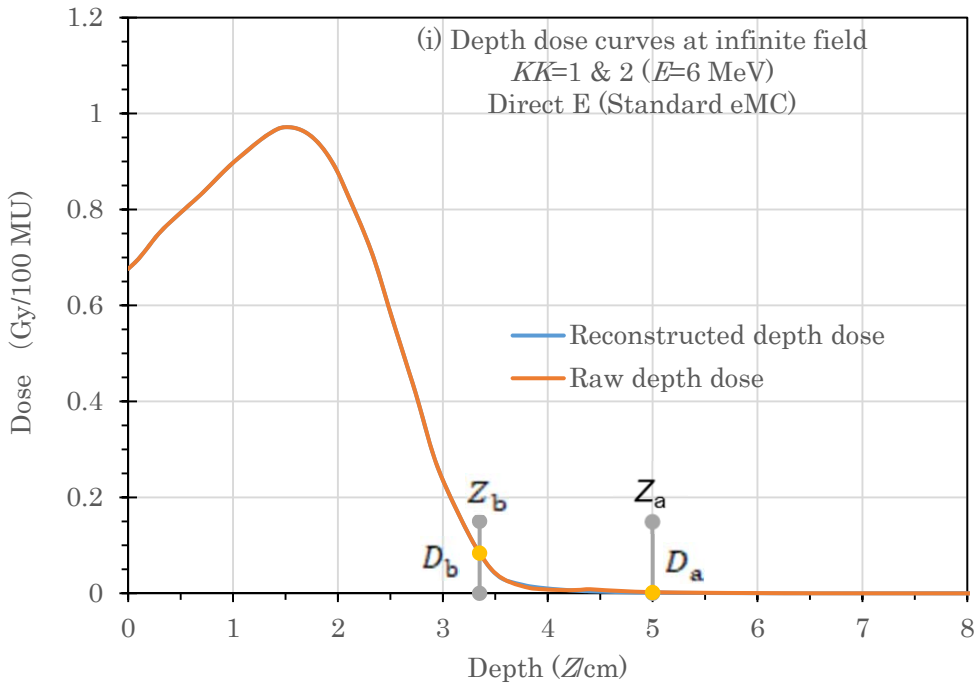
Supplementary Figures (Supp. Fig.)

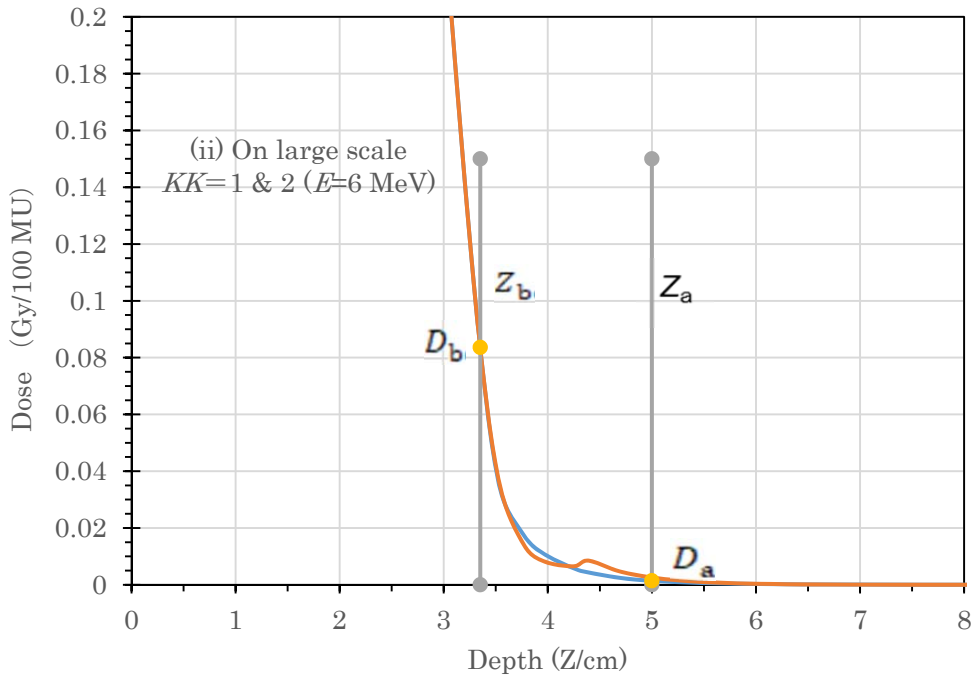


Supp. Fig. 1 Diagram showing how to reconstruct a reasonable set of doses (D_∞) at deep depths in an infinite field (in blue line) at depths of $Z \geq Z_b$, as expressed using equation 1 with datasets of (D_a and Z_a) and (D_b and Z_b). The orange line illustrates the corresponding set of raw depth-doses.

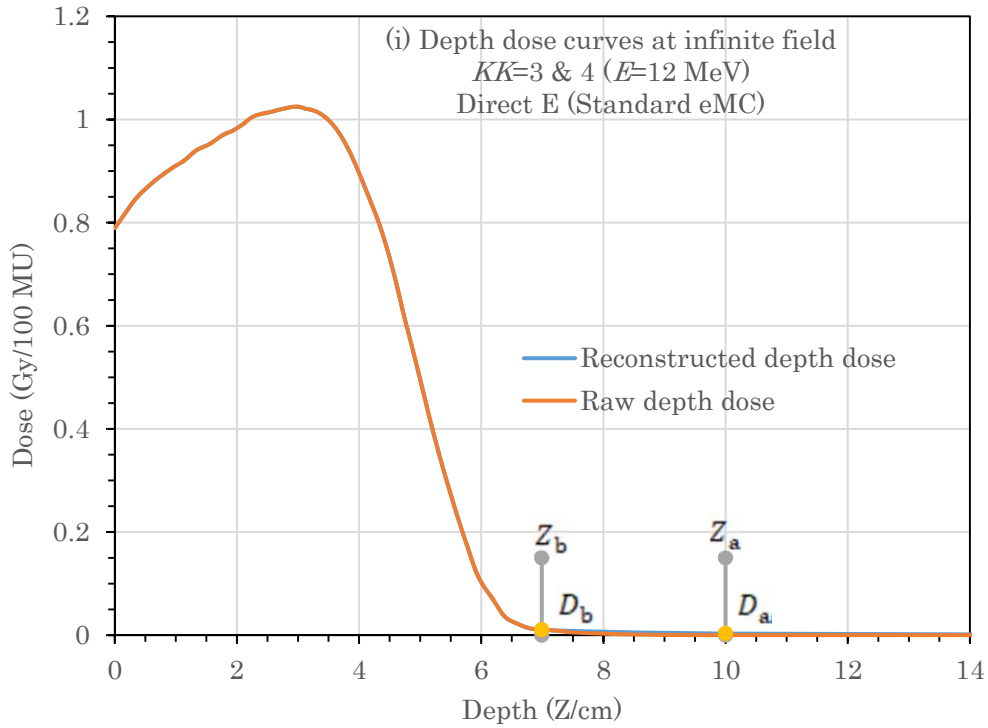


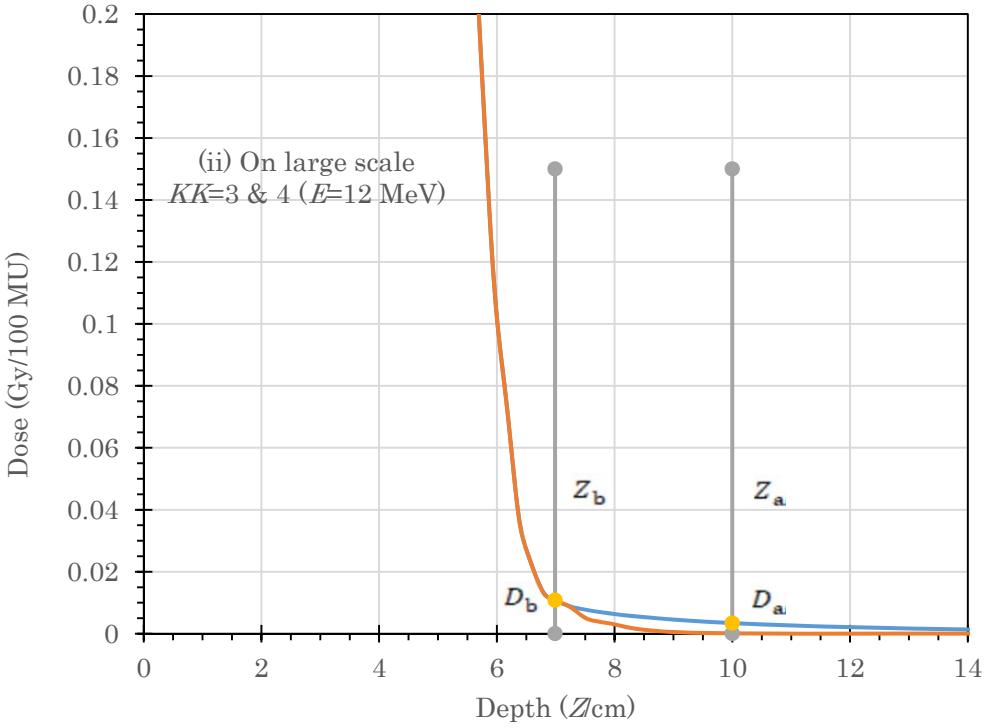
Supp. Fig. 2 Diagram showing how the effective square field ($A_c^{eff} = S_c^{eff} \times S_c^{eff}$) at each dose calculation depth (Z_c), as shaped using a square electron applicator (A_{appl}), is divided equally into small sections of 40×40. The specific four sections surround the center (O') of the filed as illustrated.


(i) Depth dose curves at infinite field
KK=1 & 2 (E=6 MeV)
Direct E (Standard eMC)
Reconstructed depth dose
Raw depth dose
Z_b
Z_a
D_b
D_a
Dose (Gy/100 MU)
Depth (Zcm)

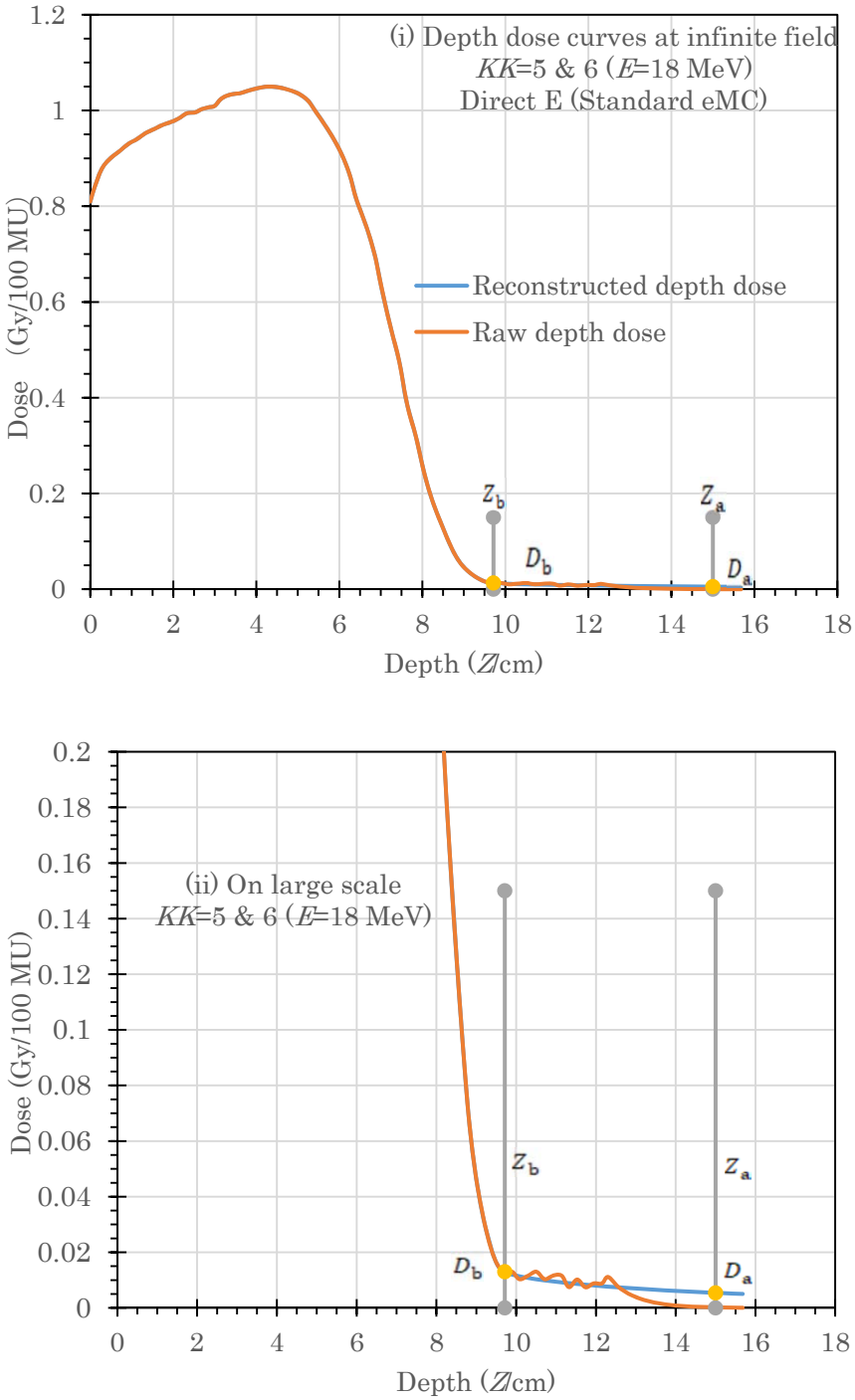

(ii) On large scale
KK=1 & 2 (E=6 MeV)
Z_b
Z_a
D_b
D_a
Dose (Gy/100 MU)
Depth (Z/cm)

Supp. Fig. 3a


(i) Depth dose curves at infinite field
KK=3 & 4 (E=12 MeV)
Direct E (Standard eMC)
Reconstructed depth dose
Raw depth dose
Dose (Gy/100 MU)
Depth (Z/cm)
Z_b
Z_a
D_b
D_a

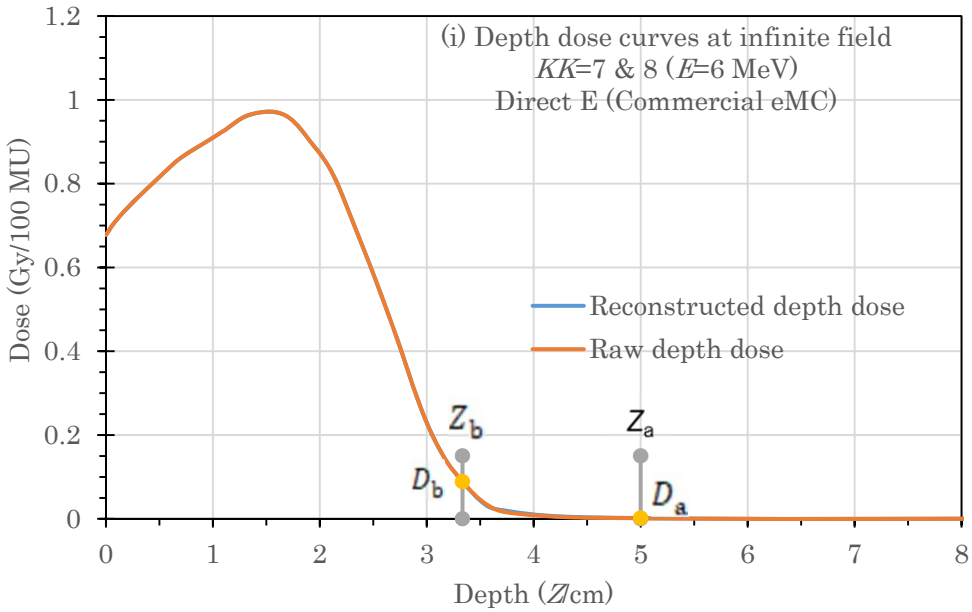

(ii) On large scale
KK=3 & 4 (E=12 MeV)
Dose (Gy/100 MU)
Depth (Z/cm)
Z_b
Z_a
D_b
D_a

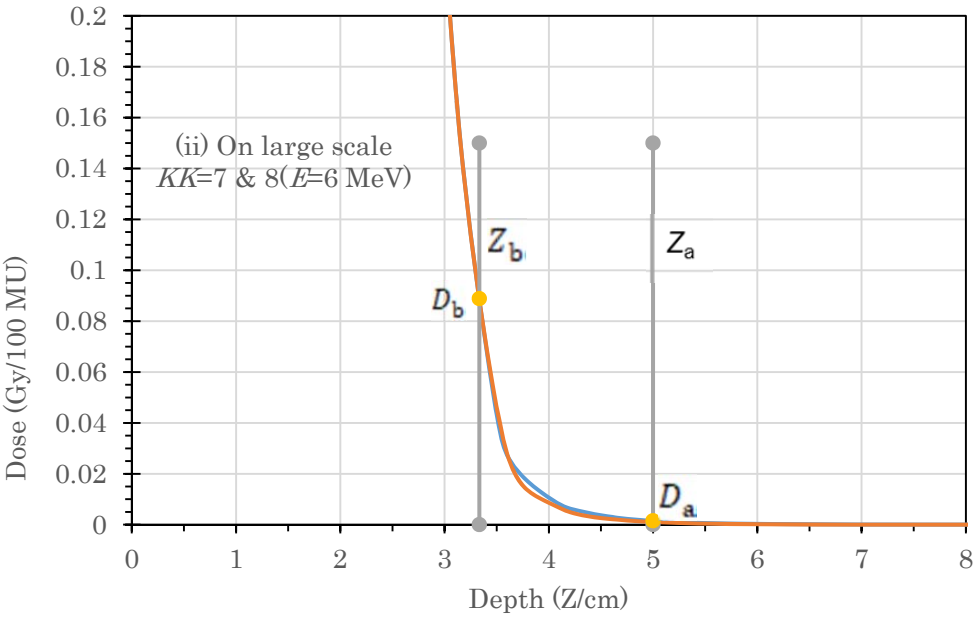
Supp. Fig. 3b



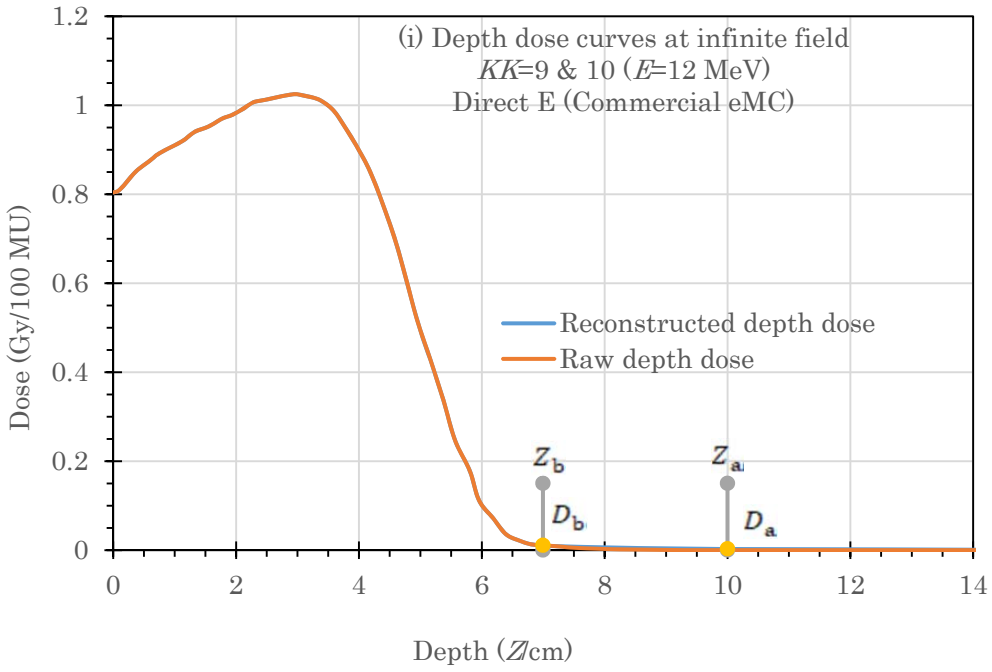
Supp. Fig. 3c

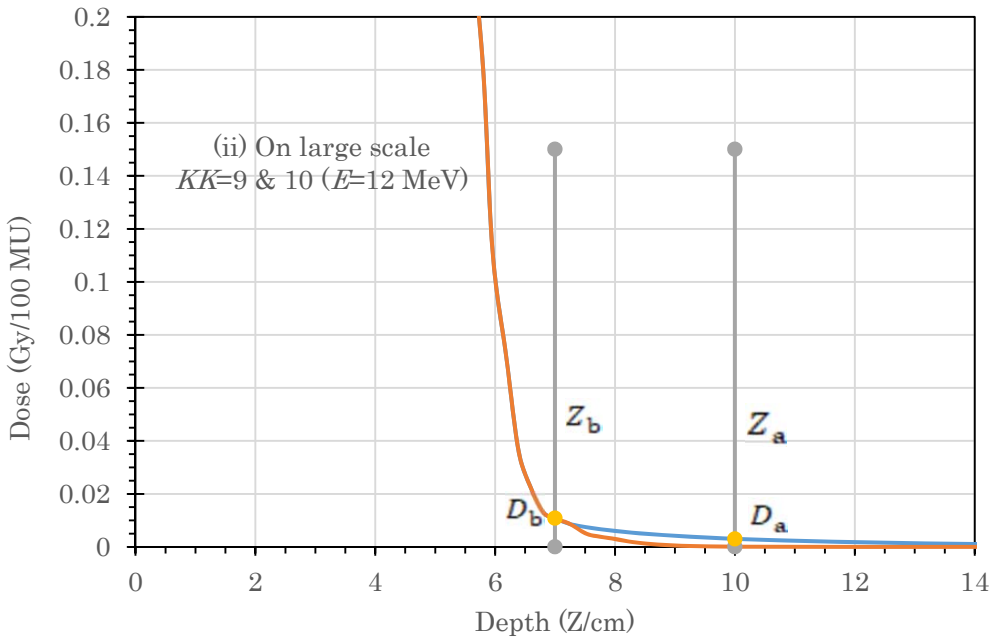
Supp. Fig. 3a-c Each set of diagrams showing how to reconstruct reasonable sets of doses (D_∞) at deep depths in an infinite field (in blue line) at depths of $Z \geq Z_b$ using datasets of (D_a and Z_a) and (D_b and Z_b) for (a) *KK*=1 & 2 (6 MeV), (b) *KK*=3 & 4 (12 MeV), or (c) *KK*=5 & 6 (18 MeV), produced for *direct electron* beams on the *standard* eMC.


(i) Depth dose curves at infinite field
KK=7 & 8 (E=6 MeV)
Direct E (Commercial eMC)
Reconstructed depth dose
Raw depth dose
Z_b
Z_a
D_b
D_a
Dose (Gy/100 MU)
Depth (Zcm)

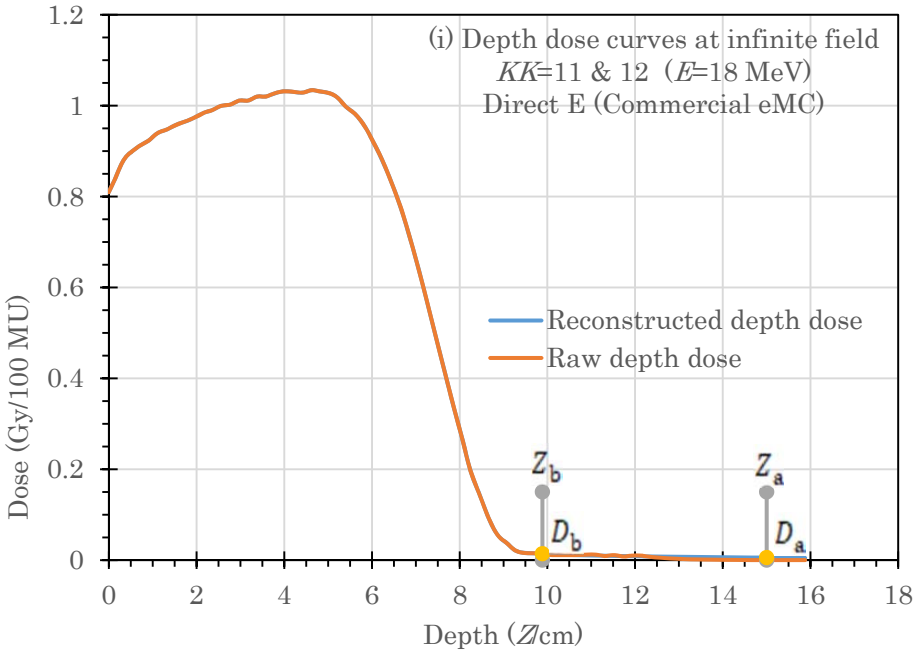

(ii) On large scale
KK=7 & 8(E=6 MeV)
Z_b
Z_a
D_b
D_a
Dose (Gy/100 MU)
Depth (Z/cm)

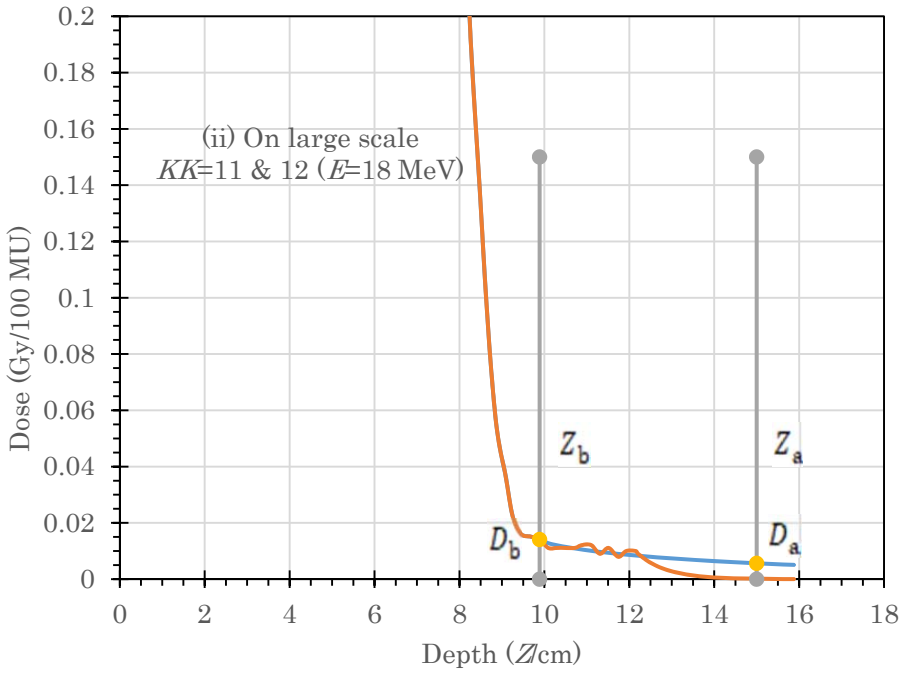
Supp. Fig. 4a


(i) Depth dose curves at infinite field
KK=9 & 10 (E=12 MeV)
Direct E (Commercial eMC)
Reconstructed depth dose
Raw depth dose
Dose (Gy/100 MU)
Depth (Z/cm)
Z_b
Z_a
D_b
D_a
1.2
1
0.8
0.6
0.4
0.2
0
0
2
4
6
8
10
12
14


(ii) On large scale
KK=9 & 10 (E=12 MeV)
Dose (Gy/100 MU)
Depth (Z/cm)
Z_b
Z_a
D_b
D_a
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
2
4
6
8
10
12
14

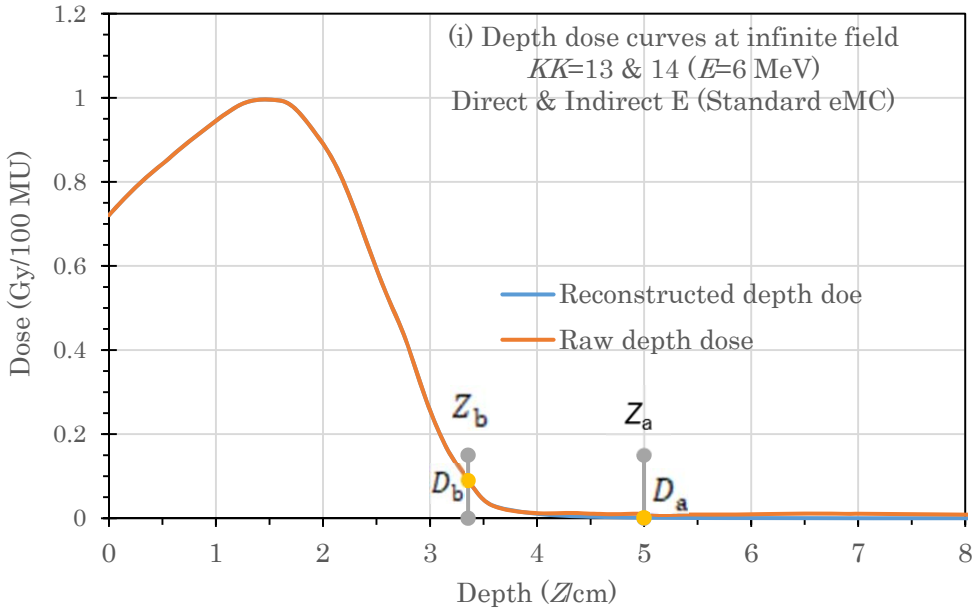
Supp. Fig. 4b

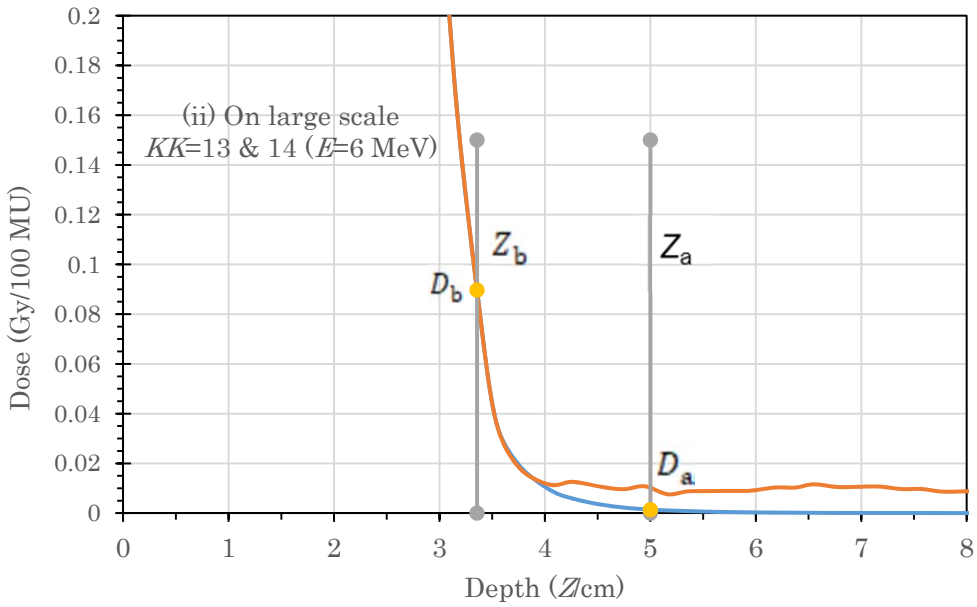




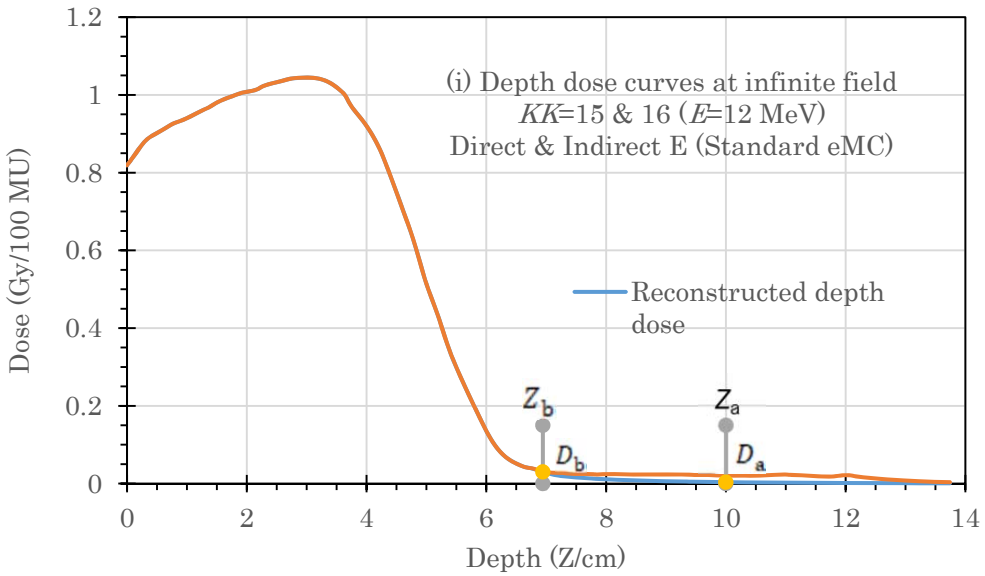
Supp. Fig. 4c

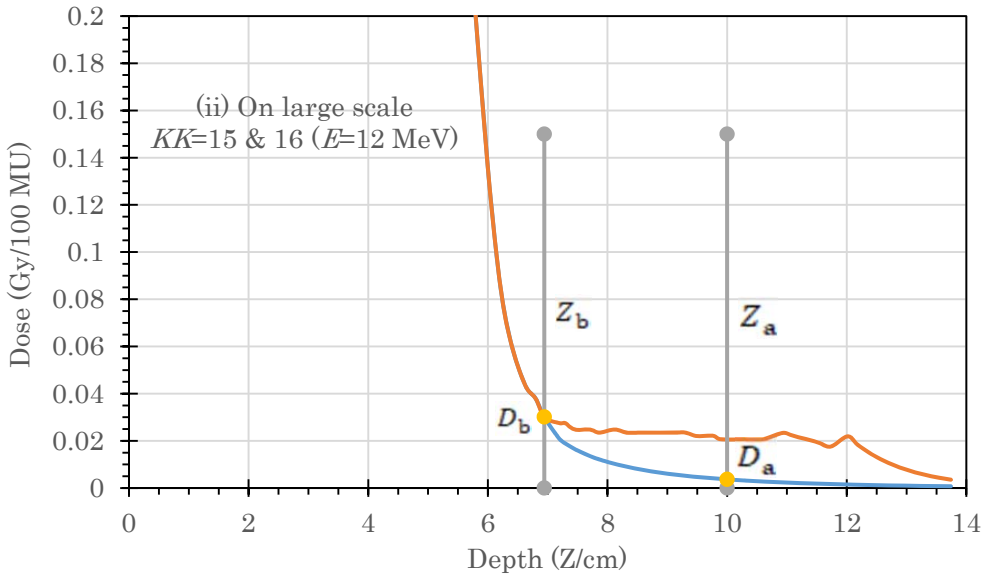
Supp. Fig. 4a-c Each set of diagrams for (a) *KK*=7 & 8 (6 MeV), (b) *KK*=9 & 10 (12 MeV), or (c) *KK*=11 & 12 (18 MeV), produced for *direct electron* beams on the *commercial* eMC using the same way as in Figure 3.


(i) Depth dose curves at infinite field
KK=13 & 14 (E=6 MeV)
Direct & Indirect E (Standard eMC)
Reconstructed depth doe
Raw depth dose
Z_b
Z_a
D_b
D_a
Dose (Gy/100 MU)
Depth (Zcm)

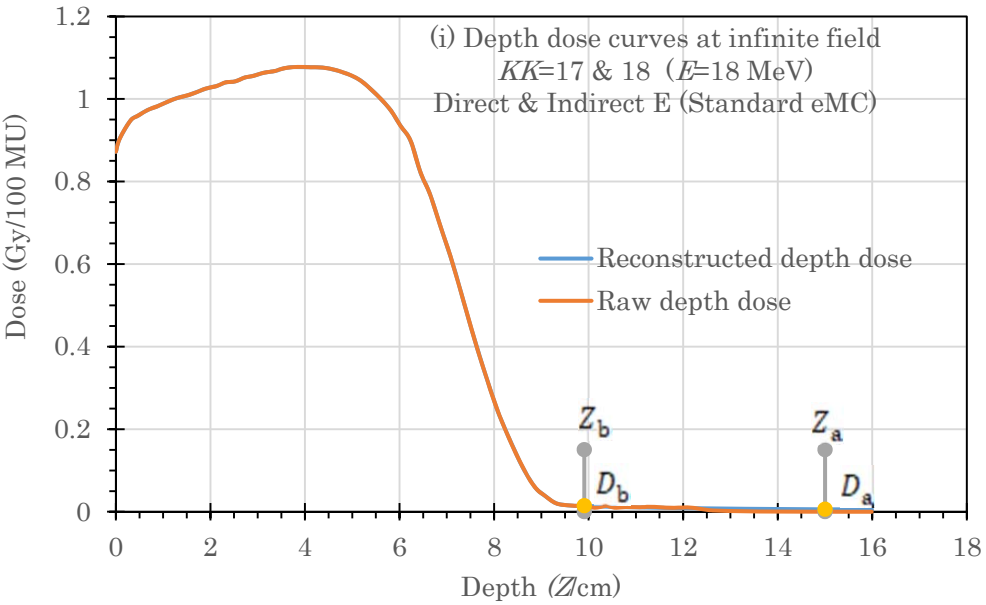

(ii) On large scale
KK=13 & 14 (E=6 MeV)
Z_b
Z_a
D_b
D_a
Dose (Gy/100 MU)
Depth (Zcm)

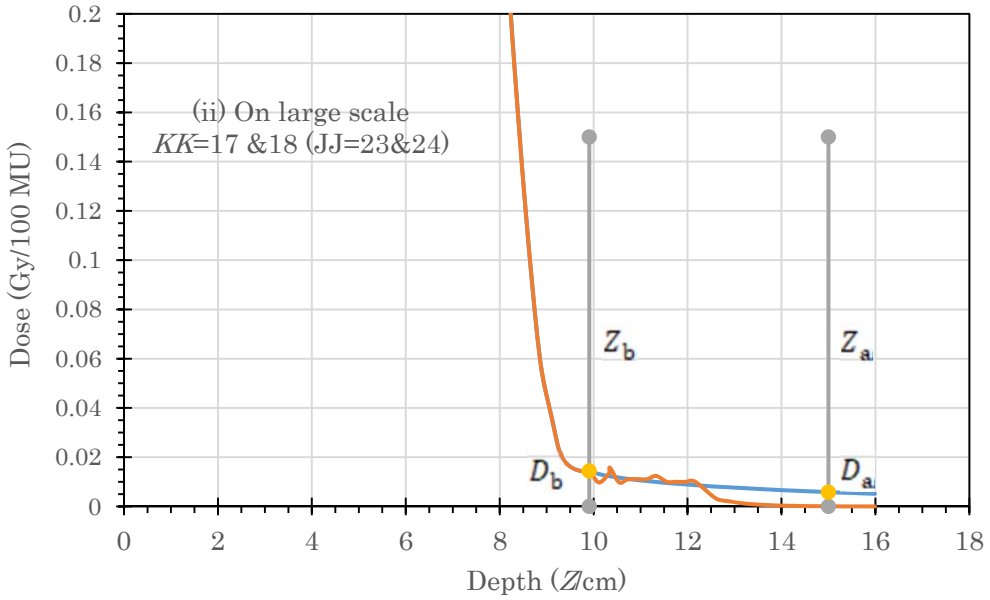
Supp. Fig. 5a


(i) Depth dose curves at infinite field
KK=15 & 16 (E=12 MeV)
Direct & Indirect E (Standard eMC)
Reconstructed depth dose
Z_b
Z_a
D_b
D_a
Dose (Gy/100 MU)
Depth (Z/cm)
1.2
1
0.8
0.6
0.4
0.2
0
0
2
4
6
8
10
12
14


(ii) On large scale
KK=15 & 16 (E=12 MeV)
Z_b
Z_a
D_b
D_a
Dose (Gy/100 MU)
Depth (Z/cm)
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
2
4
6
8
10
12
14

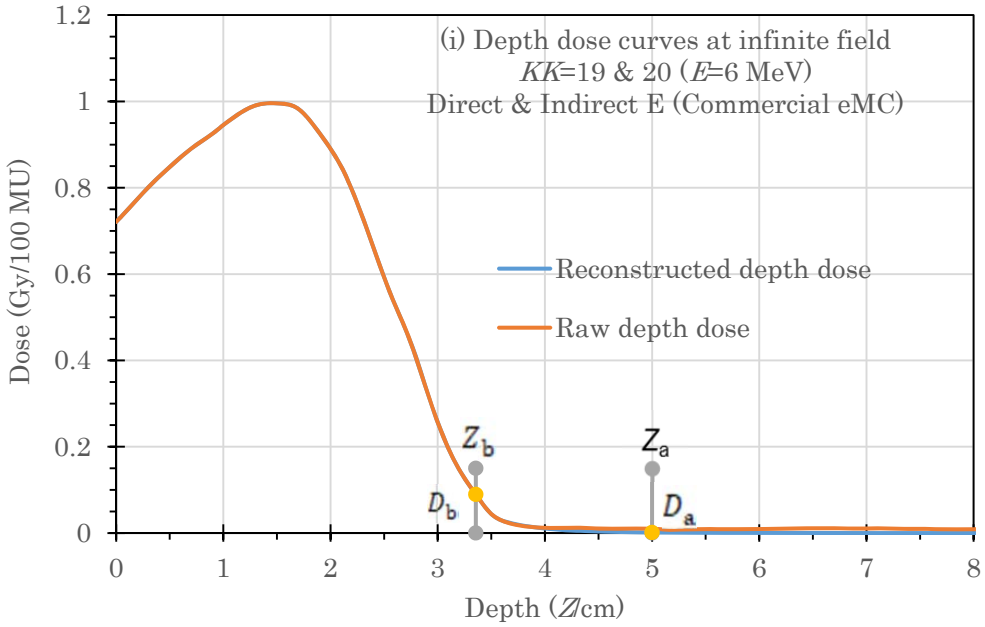
Supp. Fig. 5b

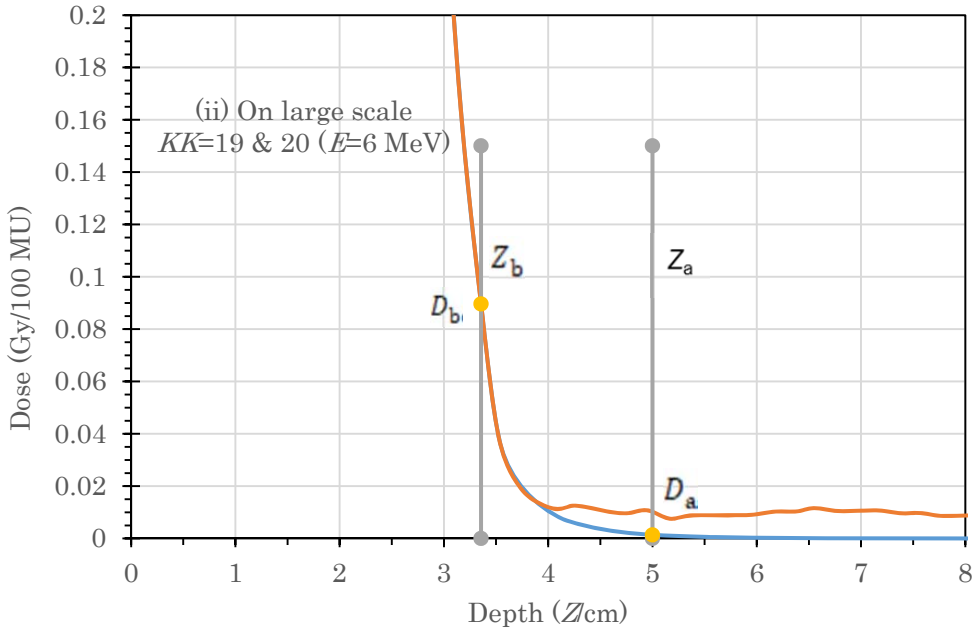




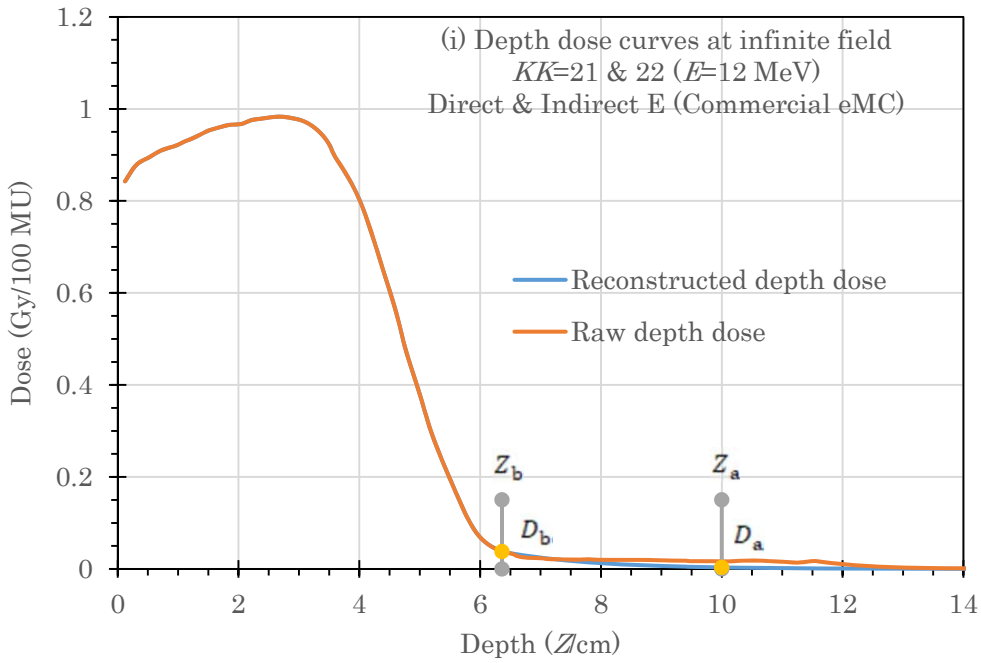
Supp. Fig. 5c

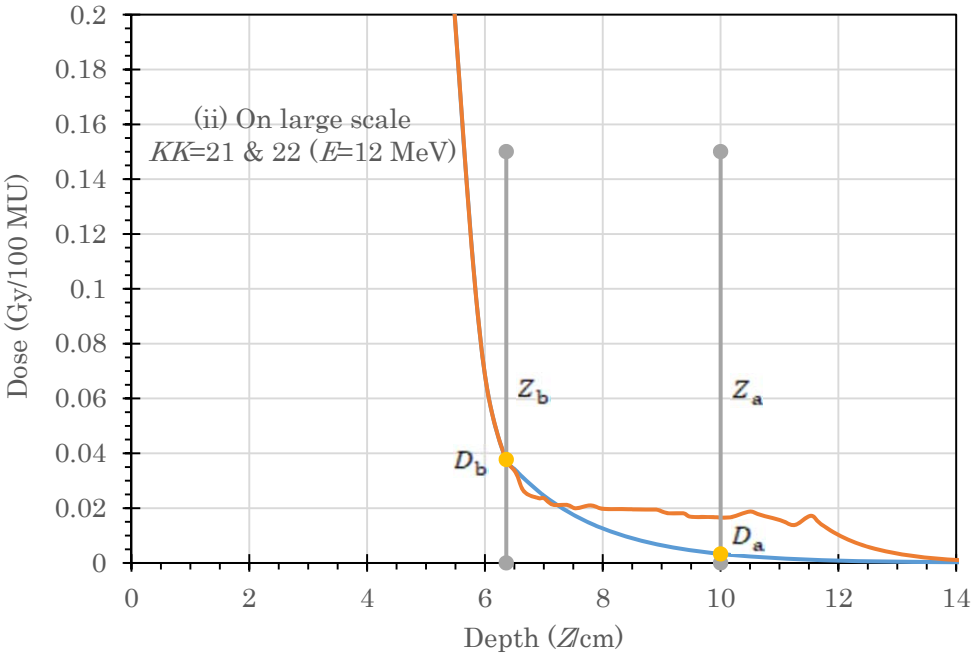
Supp. Fig. 5a-c Each set of diagrams for (a) *KK*=13 & 14 (6 MeV), (b) *KK*=15 & 16 (12 MeV), or (c) *KK*=17 & 18 (18 MeV), produced for *direct & indirect electron* beams on the *standard* eMC using the same way as in Figure 3.


(i) Depth dose curves at infinite field
KK=19 & 20 (E=6 MeV)
Direct & Indirect E (Commercial eMC)
Reconstructed depth dose
Raw depth dose
Dose (Gy/100 MU)
Depth (Zcm)
Zb
Za
Db
Da

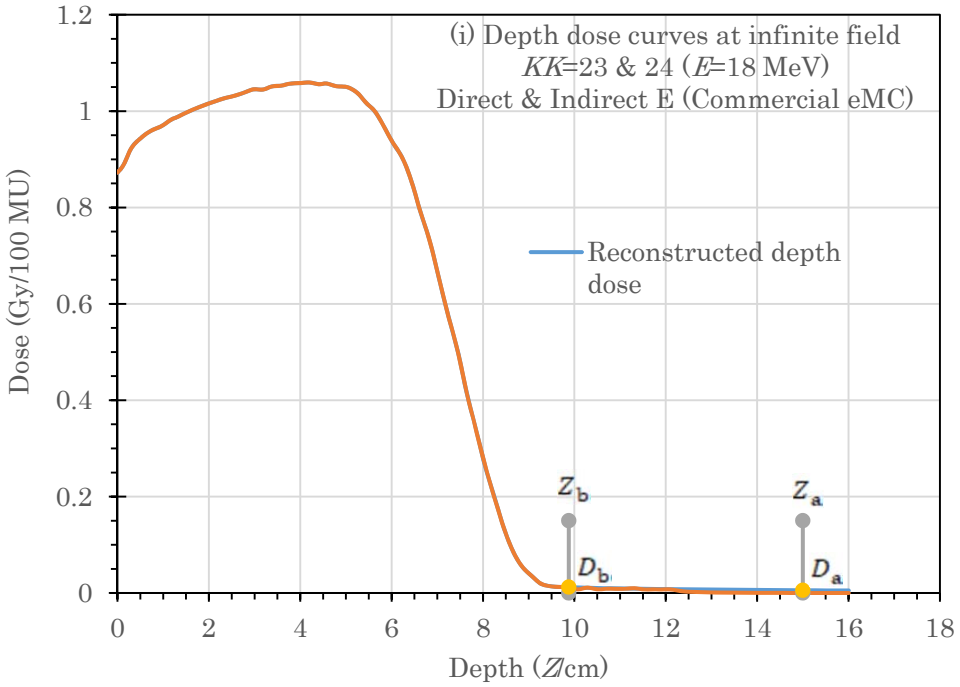

(ii) On large scale
KK=19 & 20 (E=6 MeV)
Dose (Gy/100 MU)
Depth (Zcm)
Zb
Za
Db
Da

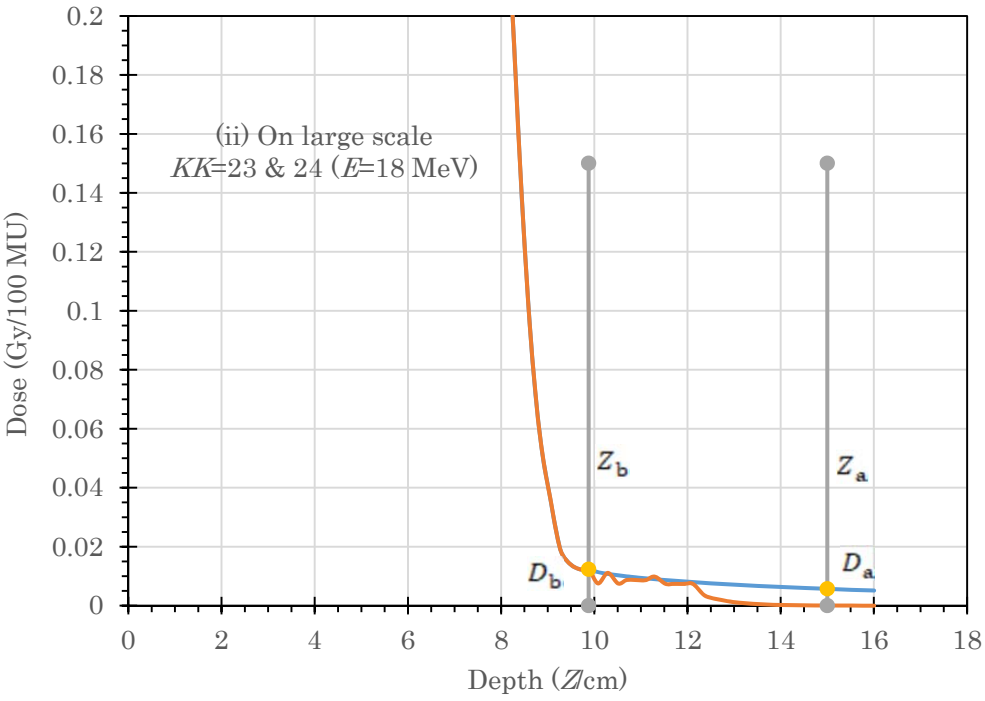
Supp. Fig. 6a


(i) Depth dose curves at infinite field
KK=21 & 22 (E=12 MeV)
Direct & Indirect E (Commercial eMC)
Reconstructed depth dose
Raw depth dose
Dose (Gy/100 MU)
Depth (Zcm)
Z_b
Z_a
D_b
D_a
1.2
1
0.8
0.6
0.4
0.2
0
0
2
4
6
8
10
12
14


(ii) On large scale
KK=21 & 22 (E=12 MeV)
Dose (Gy/100 MU)
Depth (Zcm)
Z_b
Z_a
D_b
D_a
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
2
4
6
8
10
12
14

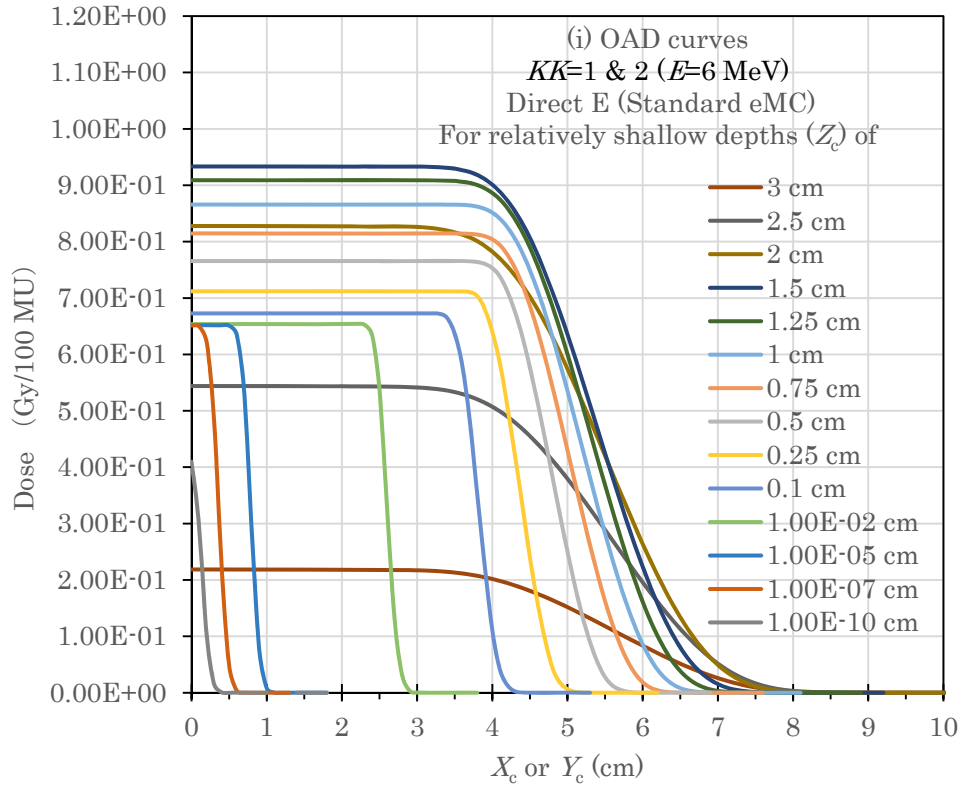
Supp. Fig. 6b

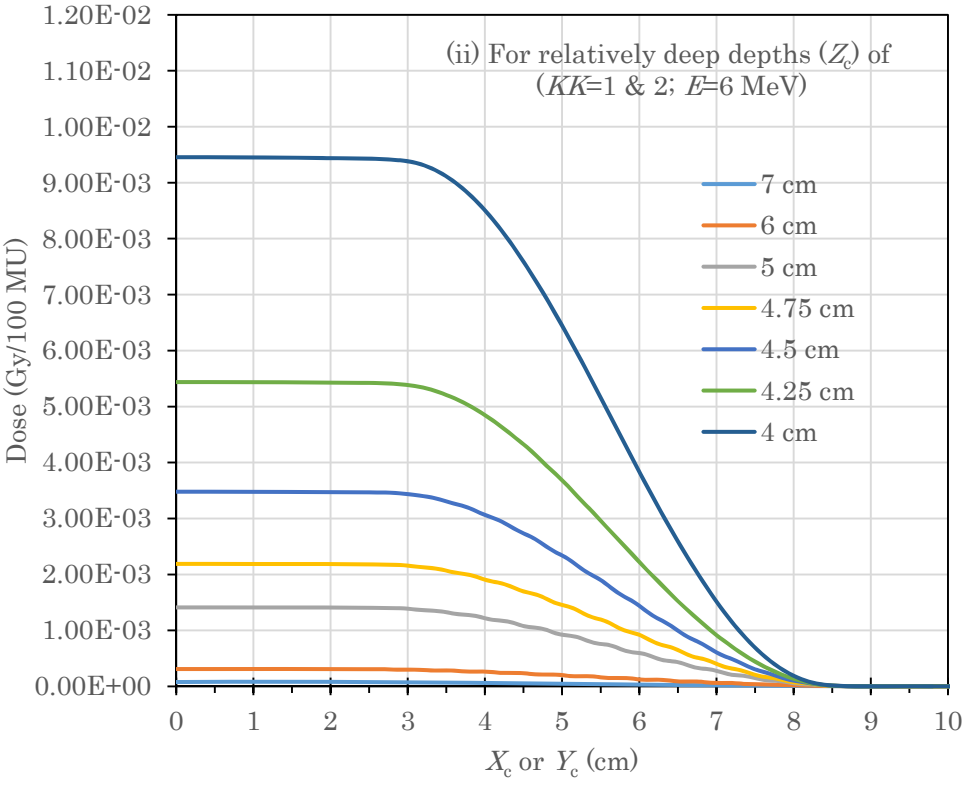




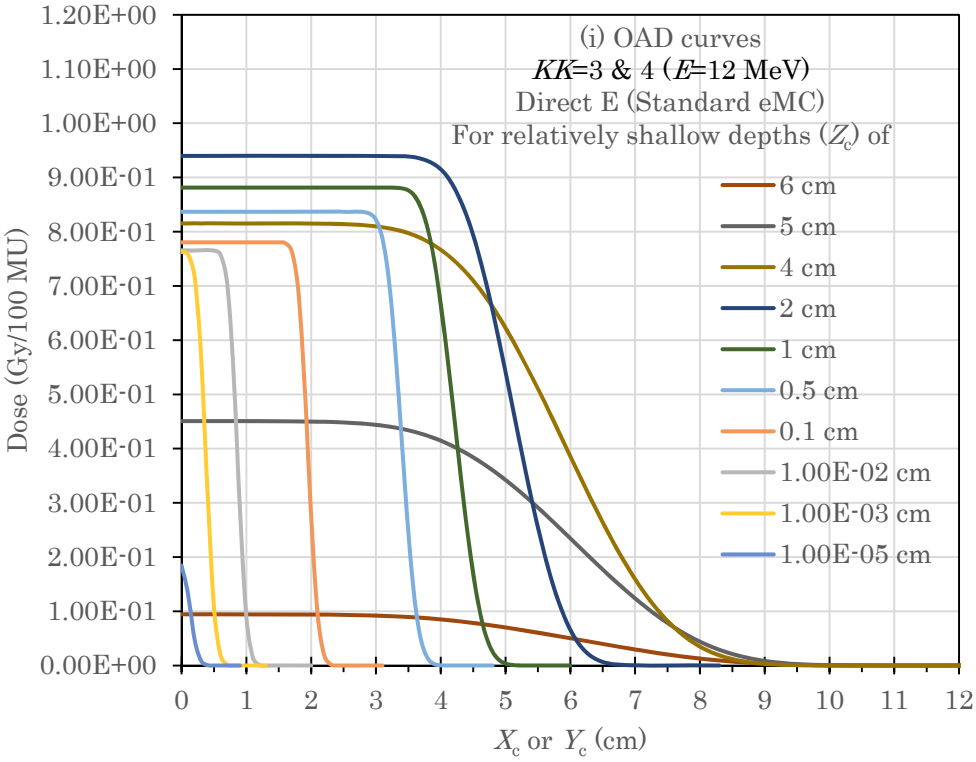
Supp. Fig. 6c

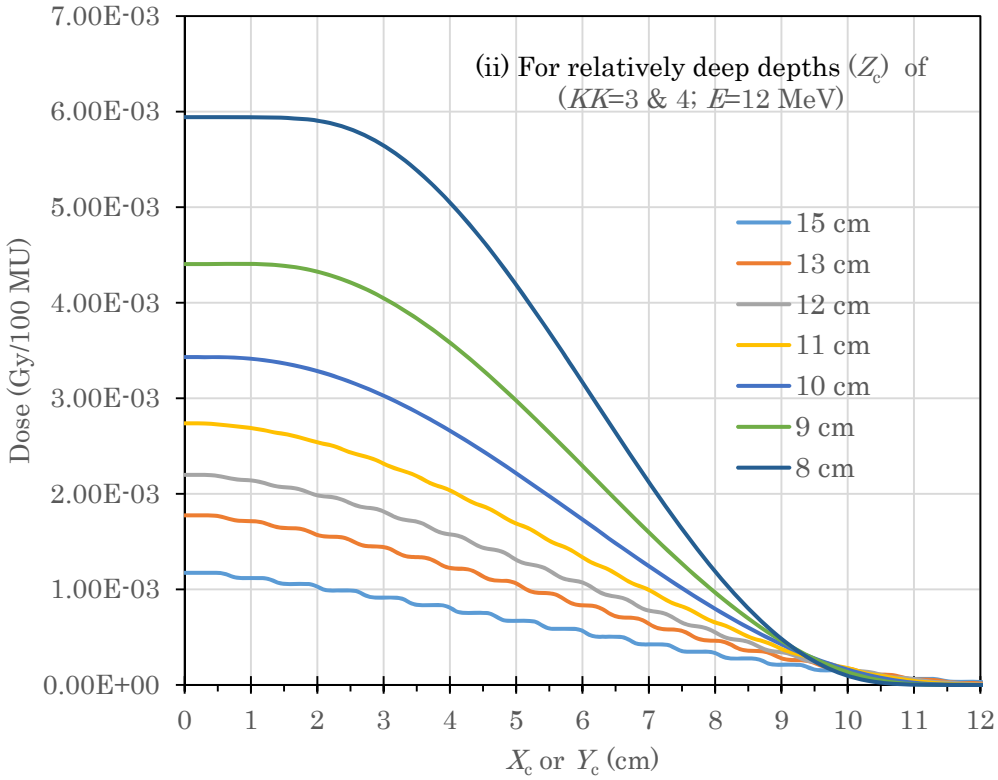
Supp. Fig. 6a-c Each set of diagrams for (a) *KK*=19 & 20 (6 MeV), (b) *KK*=21 & 22 (12 MeV), or (c) *KK*=23 & 24 (18 MeV), produced for *direct & indirect electron* beams on the *commercial* eMC using the same way as in Figure 3.


(i) OAD curves
KK=1 & 2 (E=6 MeV)
Direct E (Standard eMC)
For relatively shallow depths (Zc) of
3 cm
2.5 cm
2 cm
1.5 cm
1.25 cm
1 cm
0.75 cm
0.5 cm
0.25 cm
0.1 cm
1.00E-02 cm
1.00E-05 cm
1.00E-07 cm
1.00E-10 cm
Dose (Gy/100 MU)
Xc or Yc (cm)

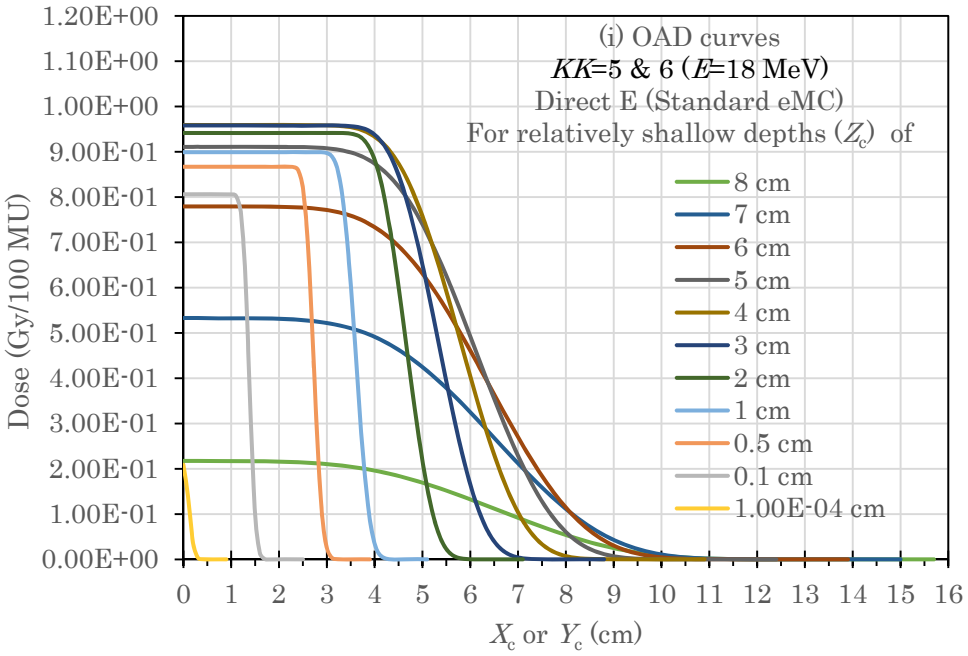

(ii) For relatively deep depths (Zc) of
(KK=1 & 2; E=6 MeV)
7 cm
6 cm
5 cm
4.75 cm
4.5 cm
4.25 cm
4 cm
Dose (Gy/100 MU)
Xc or Yc (cm)

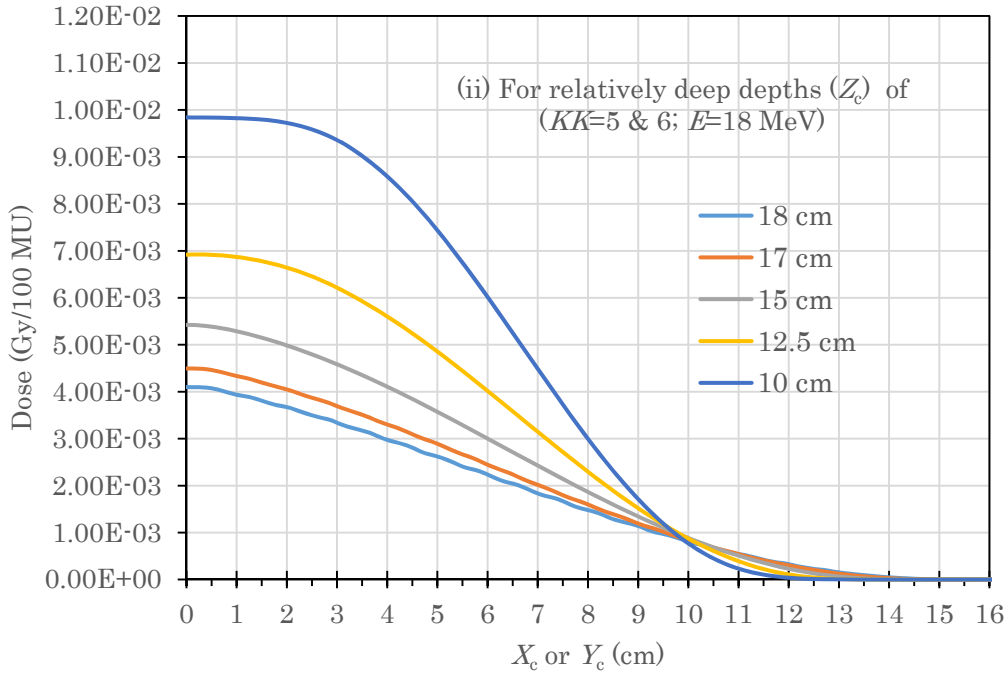
Supp. Fig. 7a


(i) OAD curves
KK=3 & 4 (E=12 MeV)
Direct E (Standard eMC)
For relatively shallow depths (Zc) of
6 cm
5 cm
4 cm
2 cm
1 cm
0.5 cm
0.1 cm
1.00E-02 cm
1.00E-03 cm
1.00E-05 cm
Dose (Gy/100 MU)
Xc or Yc (cm)


(ii) For relatively deep depths (Zc) of
(KK=3 & 4; E=12 MeV)
15 cm
13 cm
12 cm
11 cm
10 cm
9 cm
8 cm
Dose (Gy/100 MU)
Xc or Yc (cm)

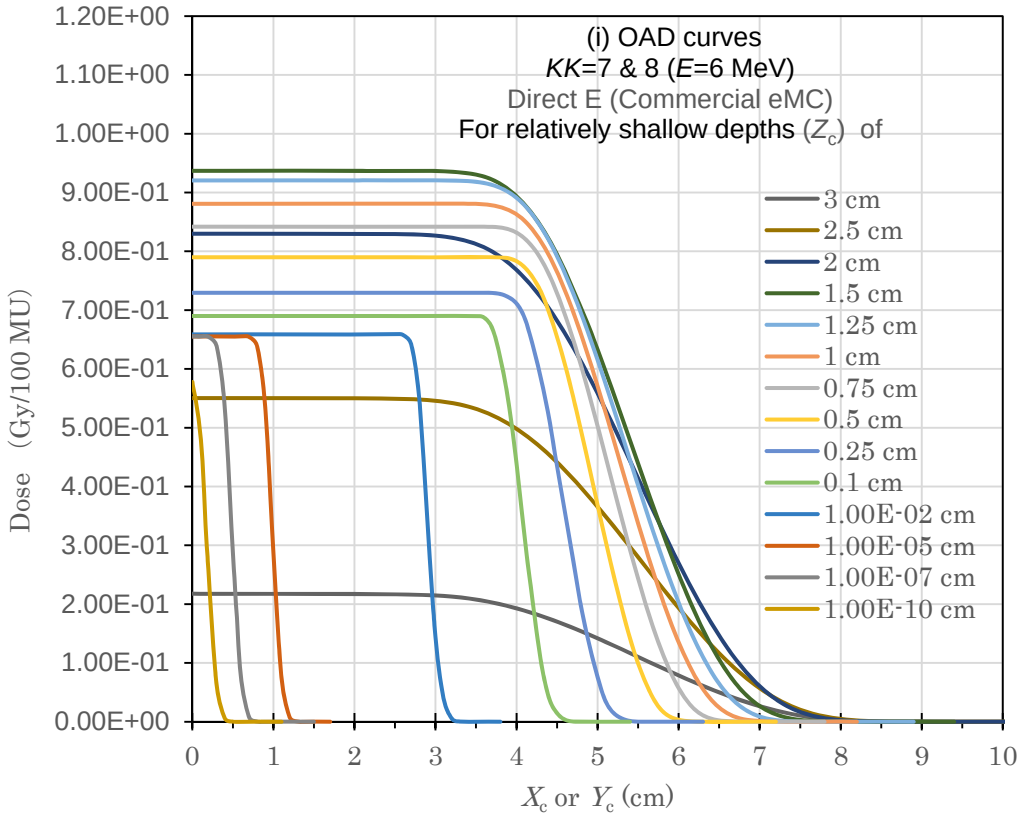
Supp. Fig. 7b

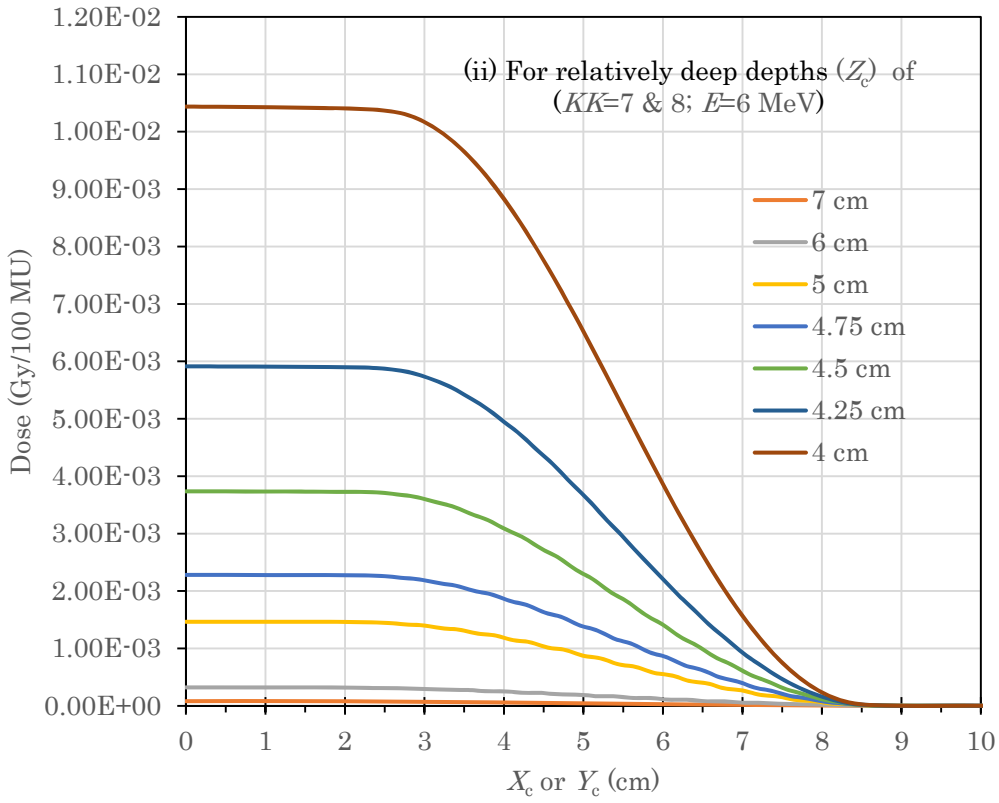




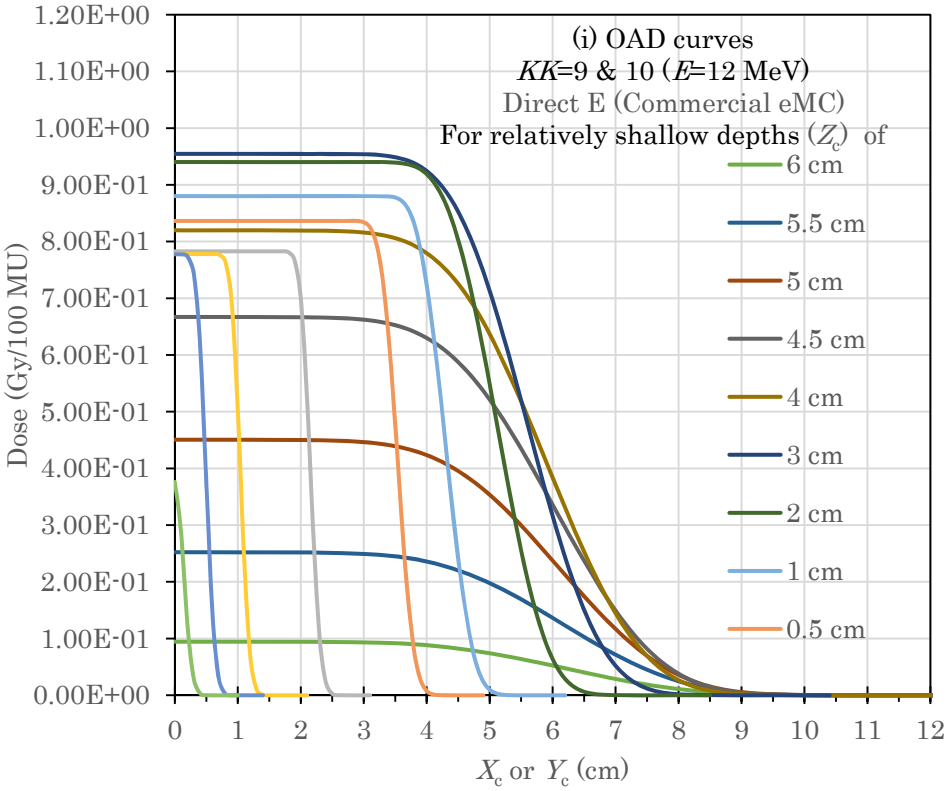
Supp. Fig. 7c

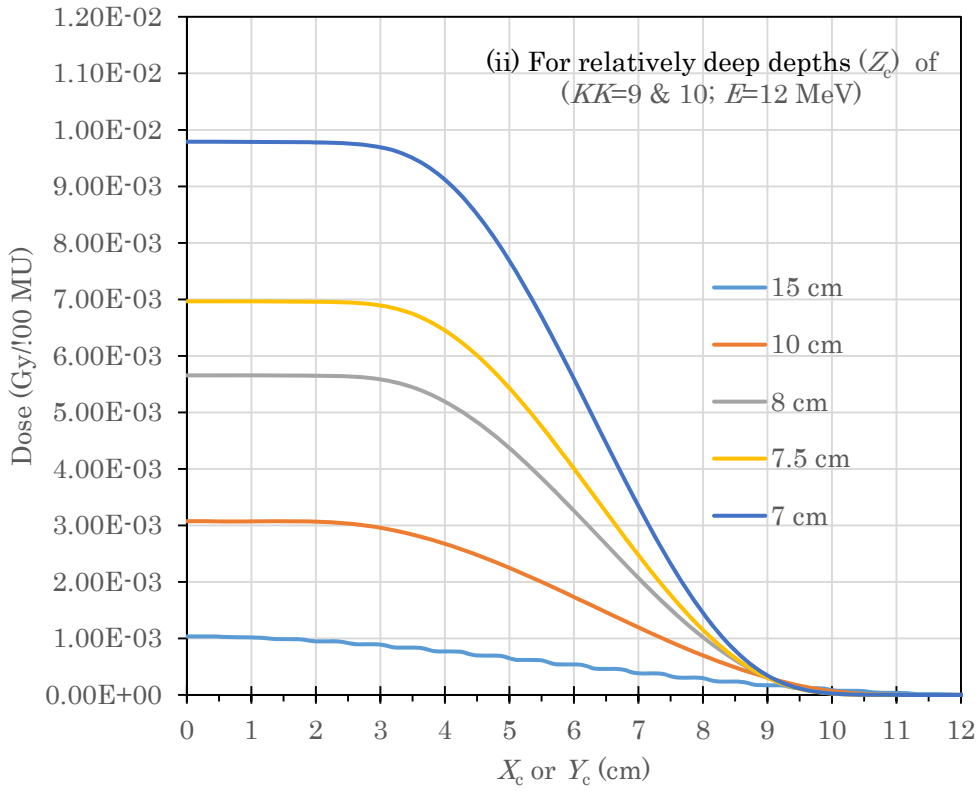
Supp. Fig. 7a-c Each set of diagrams showing how the OAD dataset varies with the X_c or Y_c distance on each horizontal surface for (a) *KK*=1 & 2 (6 MeV), (b) *KK*=3 & 4 (12 MeV), or (c) *KK*=5 & 6 (18 MeV), produced for d*irect Electron* beams on the *standard* eMC. The datasets are divided into two groups of (i) and (ii) according to the Z_c depth.


(i) OAD curves
KK=7 & 8 (E=6 MeV)
Direct E (Commercial eMC)
For relatively shallow depths (Zc) of
3 cm
2.5 cm
2 cm
1.5 cm
1.25 cm
1 cm
0.75 cm
0.5 cm
0.25 cm
0.1 cm
1.00E-02 cm
1.00E-05 cm
1.00E-07 cm
1.00E-10 cm
Dose (Gy/100 MU)
Xc or Yc (cm)

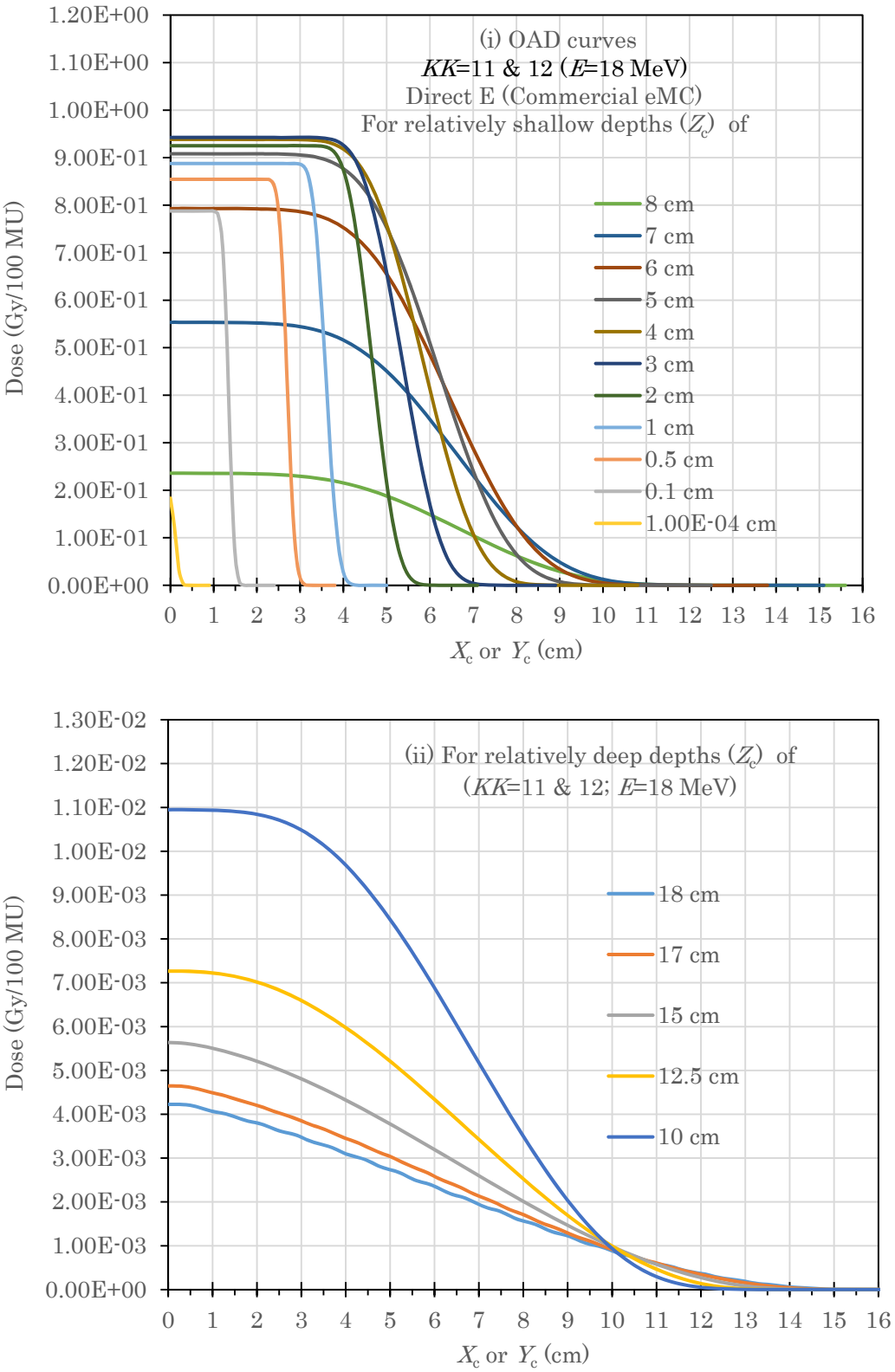

(ii) For relatively deep depths (Zc) of
(KK=7 & 8; E=6 MeV)
7 cm
6 cm
5 cm
4.75 cm
4.5 cm
4.25 cm
4 cm
Dose (Gy/100 MU)
Xc or Yc (cm)

Supp. Fig. 8a


(i) OAD curves
KK=9 & 10 (E=12 MeV)
Direct E (Commercial eMC)
For relatively shallow depths (Zc) of
6 cm
5.5 cm
5 cm
4.5 cm
4 cm
3 cm
2 cm
1 cm
0.5 cm
Dose (Gy/100 MU)
1.20E+00
1.10E+00
1.00E+00
9.00E-01
8.00E-01
7.00E-01
6.00E-01
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
0 1 2 3 4 5 6 7 8 9 10 11 12
Xc or Yc (cm)

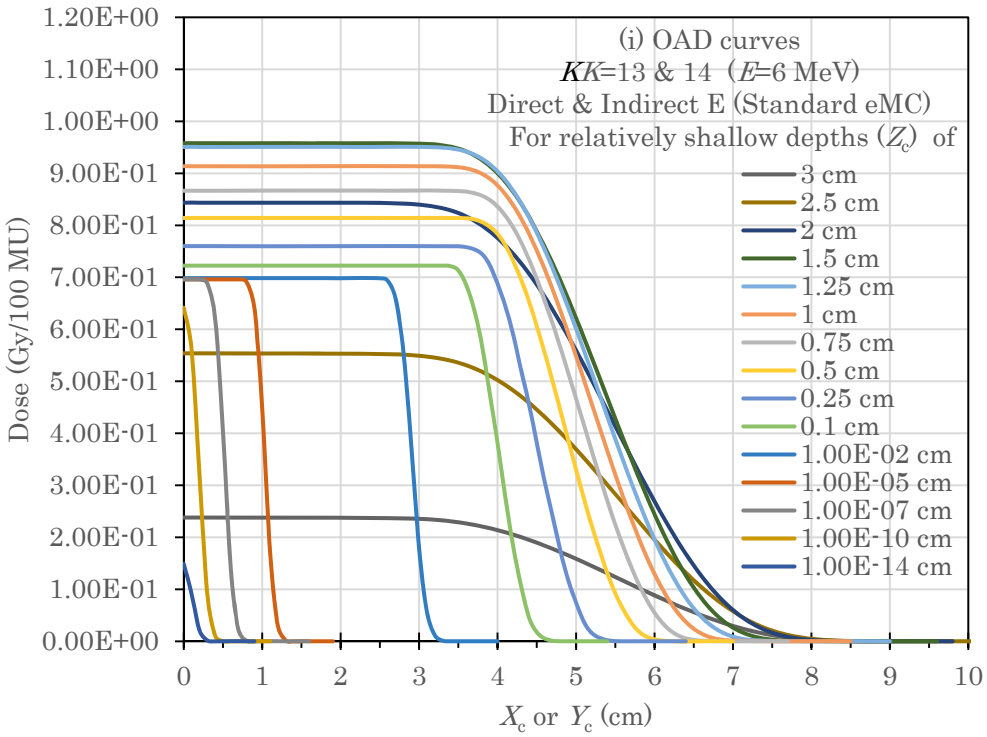

(ii) For relatively deep depths (Zc) of
(KK=9 & 10; E=12 MeV)
15 cm
10 cm
8 cm
7.5 cm
7 cm
Dose (Gy/!00 MU)
1.20E-02
1.10E-02
1.00E-02
9.00E-03
8.00E-03
7.00E-03
6.00E-03
5.00E-03
4.00E-03
3.00E-03
2.00E-03
1.00E-03
0.00E+00
0 1 2 3 4 5 6 7 8 9 10 11 12
Xc or Yc (cm)

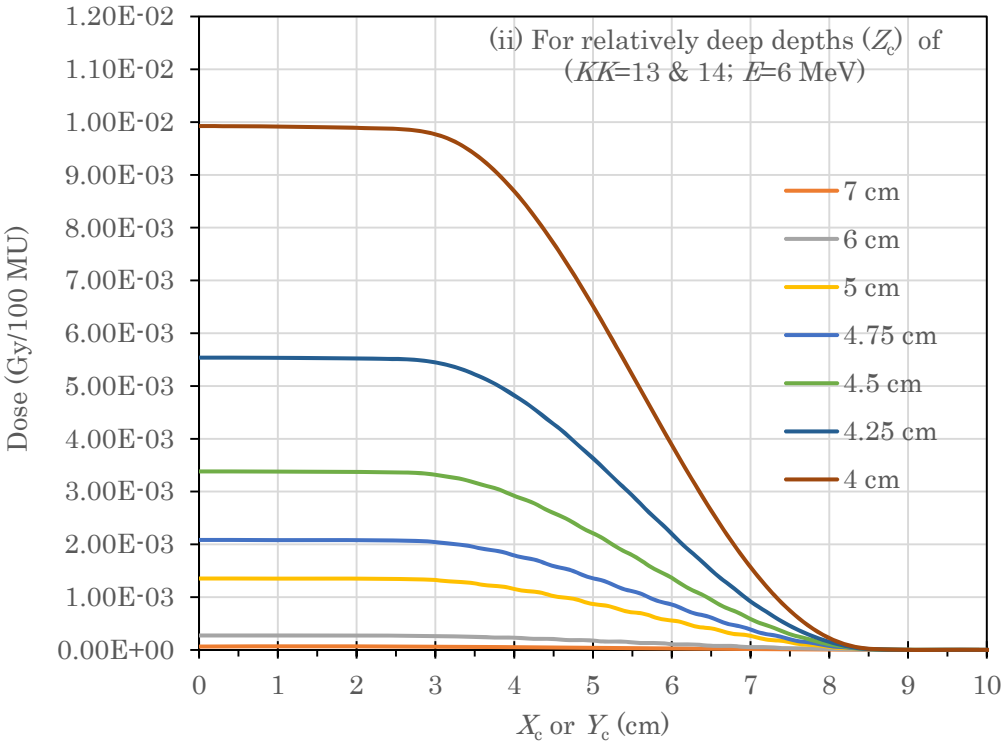
Supp. Fig. 8b



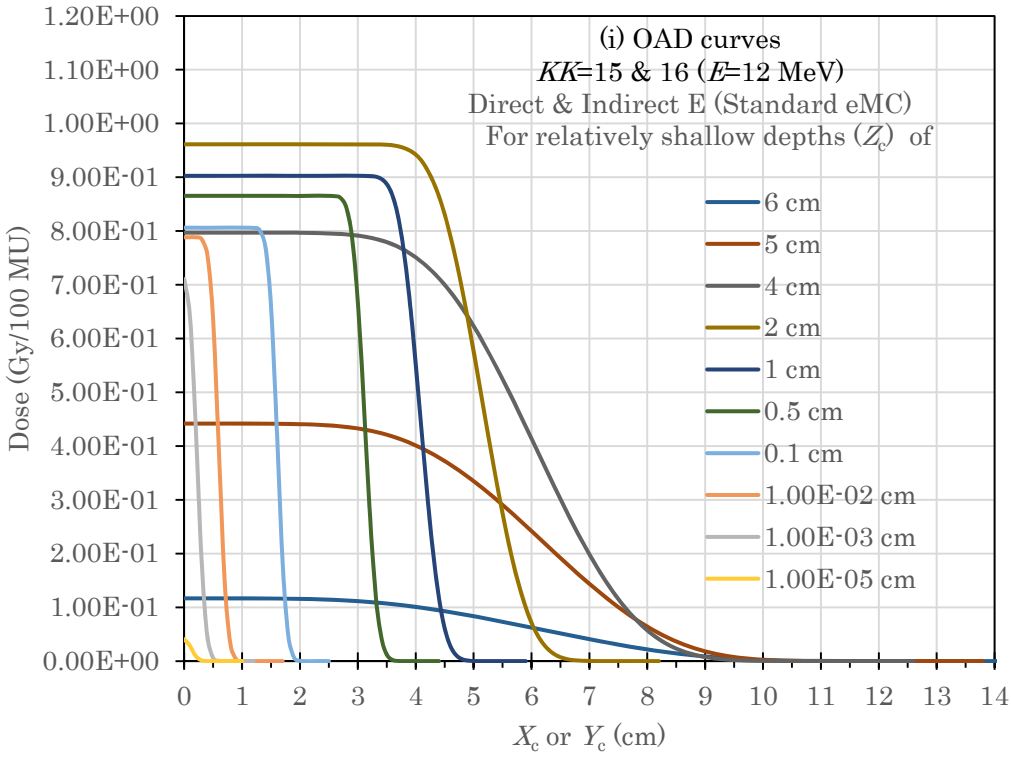
Supp. Fig. 8c

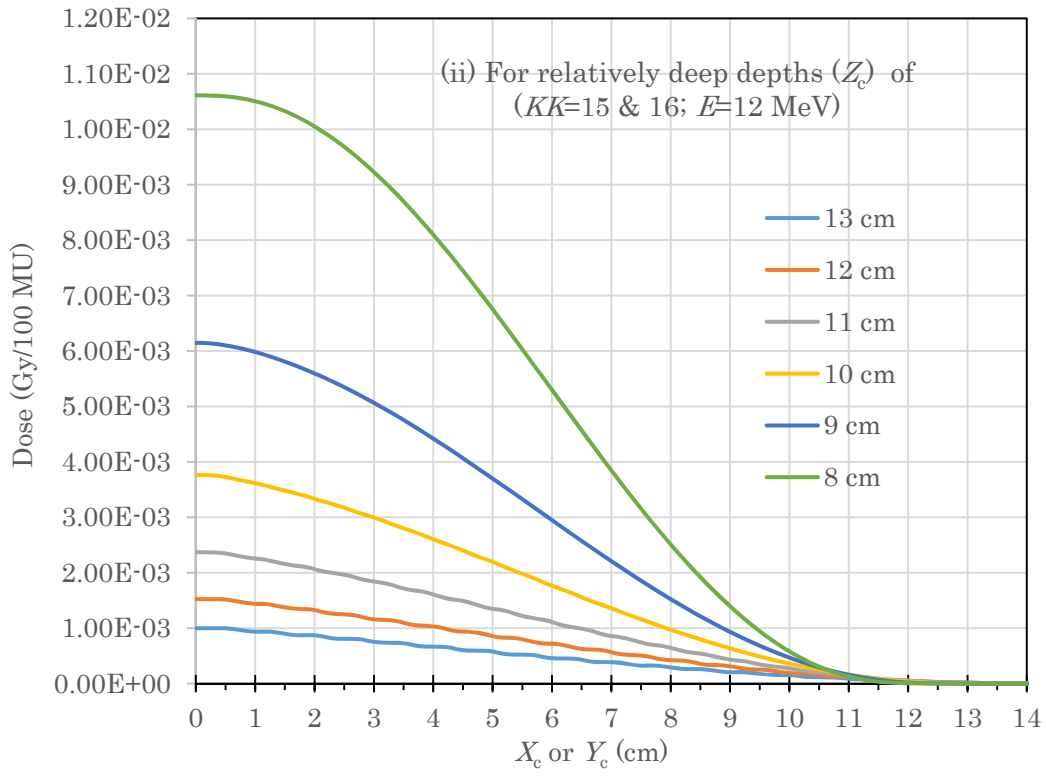
Supp. Fig. 8a-c Each set of diagrams for (a) *KK*=7 & 8 (6 MeV), (b) *KK*=9 & 10 (12 MeV), or (c) *KK*=11 & 12 (18 MeV), produced for *direct electron* beams on the *commercial* eMC using the same way as in Figure 7.


(i) OAD curves
KK=13 & 14 (E=6 MeV)
Direct & Indirect E (Standard eMC)
For relatively shallow depths (Zc) of
3 cm
2.5 cm
2 cm
1.5 cm
1.25 cm
1 cm
0.75 cm
0.5 cm
0.25 cm
0.1 cm
1.00E-02 cm
1.00E-05 cm
1.00E-07 cm
1.00E-10 cm
1.00E-14 cm
Dose (Gy/100 MU)
Xc or Yc (cm)

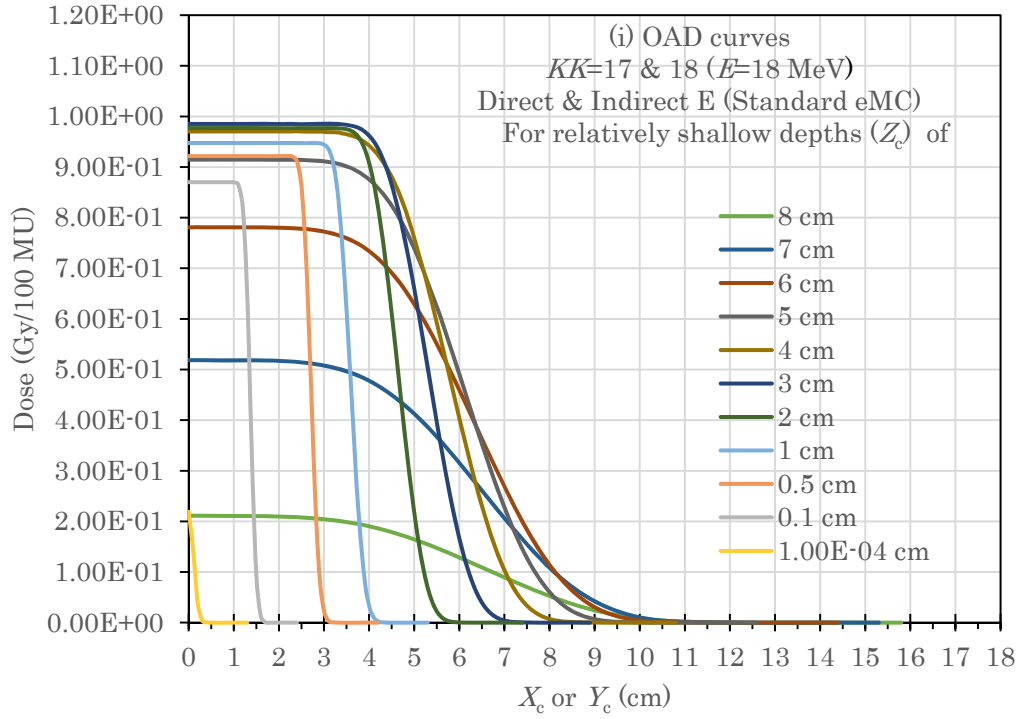

(ii) For relatively deep depths (Zc) of
(KK=13 & 14; E=6 MeV)
7 cm
6 cm
5 cm
4.75 cm
4.5 cm
4.25 cm
4 cm
Dose (Gy/100 MU)
Xc or Yc (cm)

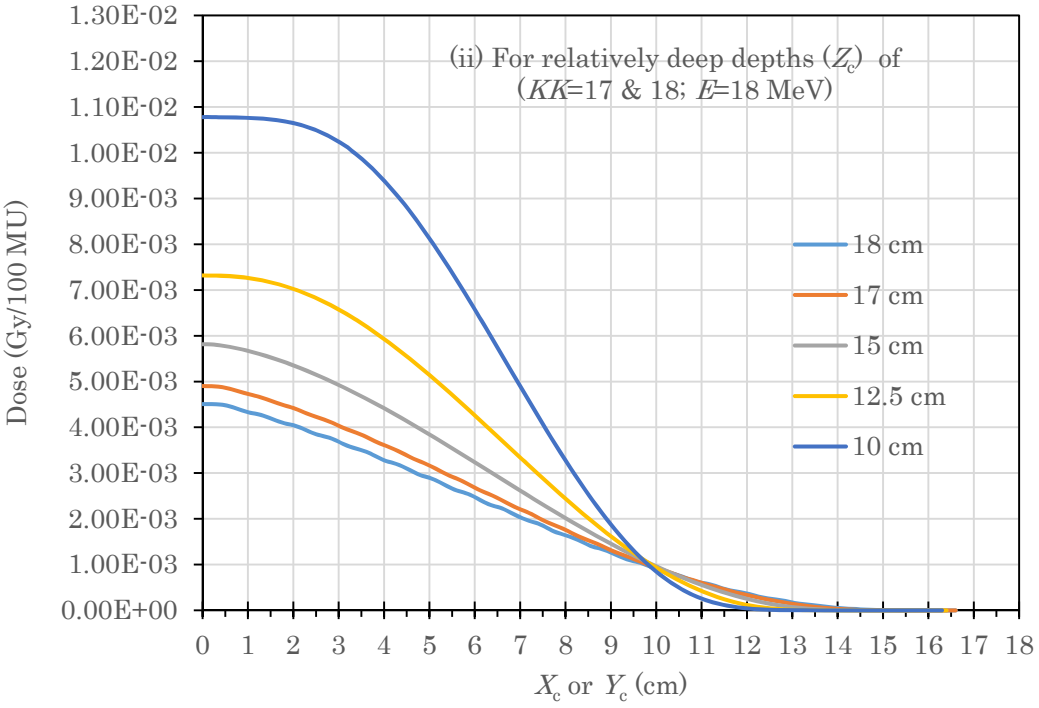
Supp. Fig. 9a


(i) OAD curves
KK=15 & 16 (E=12 MeV)
Direct & Indirect E (Standard eMC)
For relatively shallow depths (Zc) of
6 cm
5 cm
4 cm
2 cm
1 cm
0.5 cm
0.1 cm
1.00E-02 cm
1.00E-03 cm
1.00E-05 cm
Dose (Gy/100 MU)
Xc or Yc (cm)


(ii) For relatively deep depths (Zc) of
(KK=15 & 16; E=12 MeV)
13 cm
12 cm
11 cm
10 cm
9 cm
8 cm
Dose (Gy/100 MU)
Xc or Yc (cm)

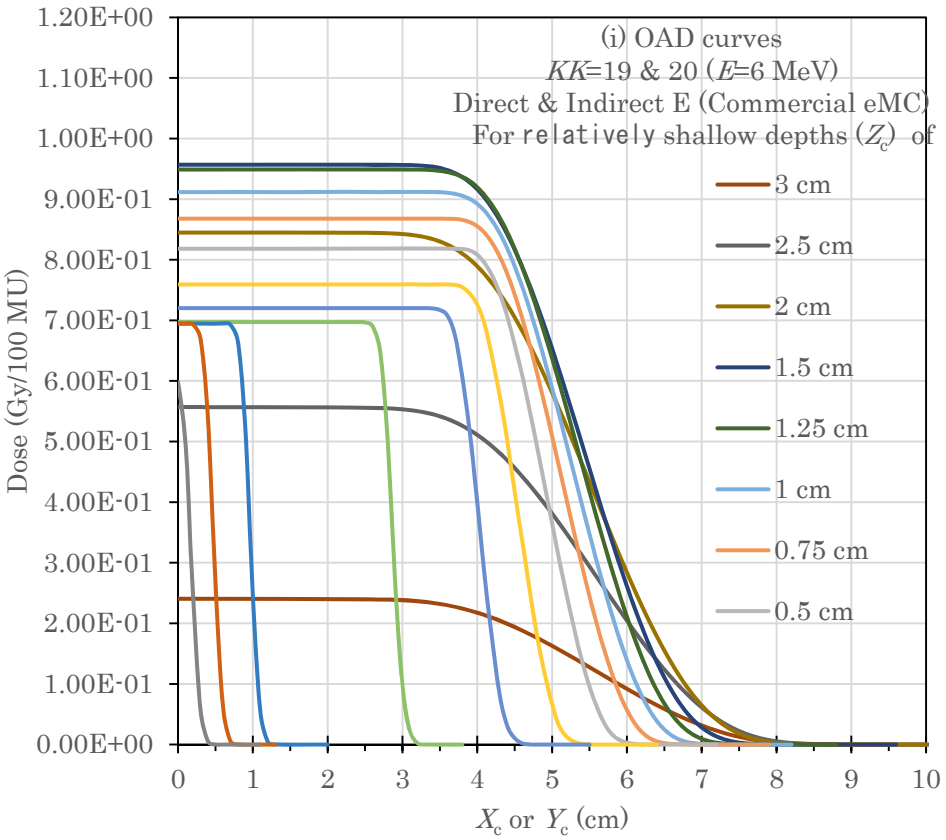
Supp. Fig. 9b

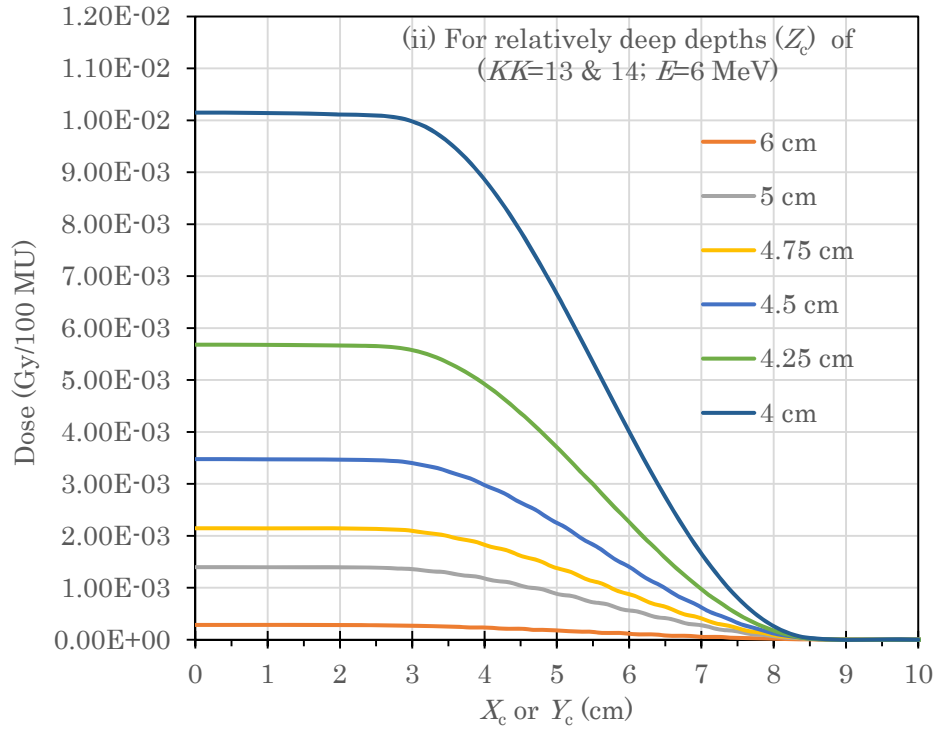




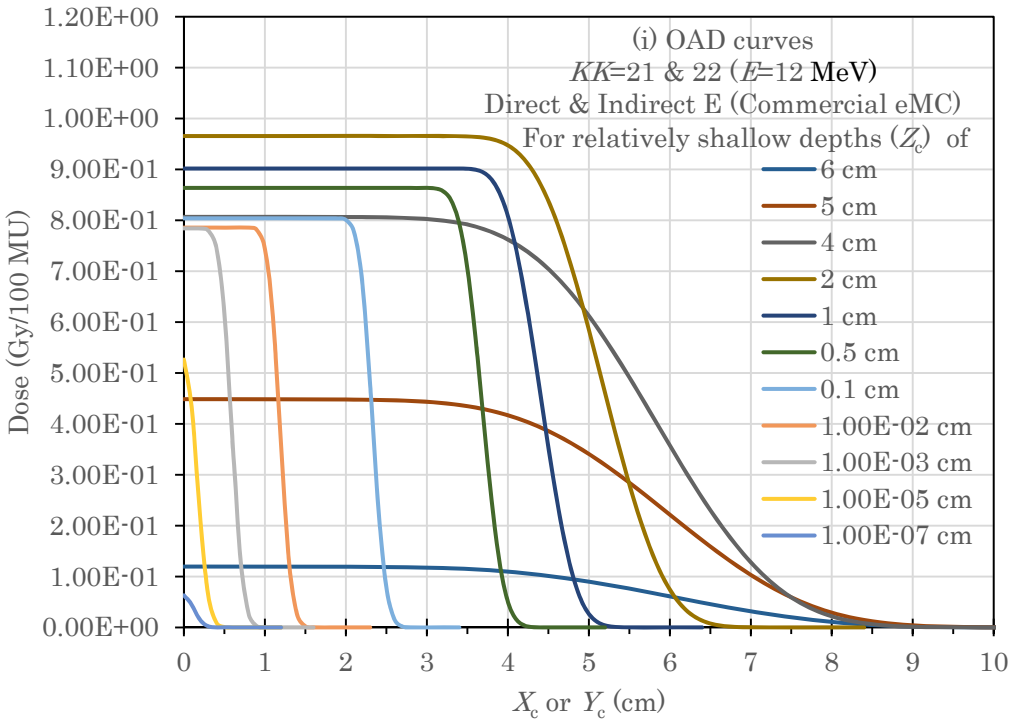
Supp. Fig. 9c

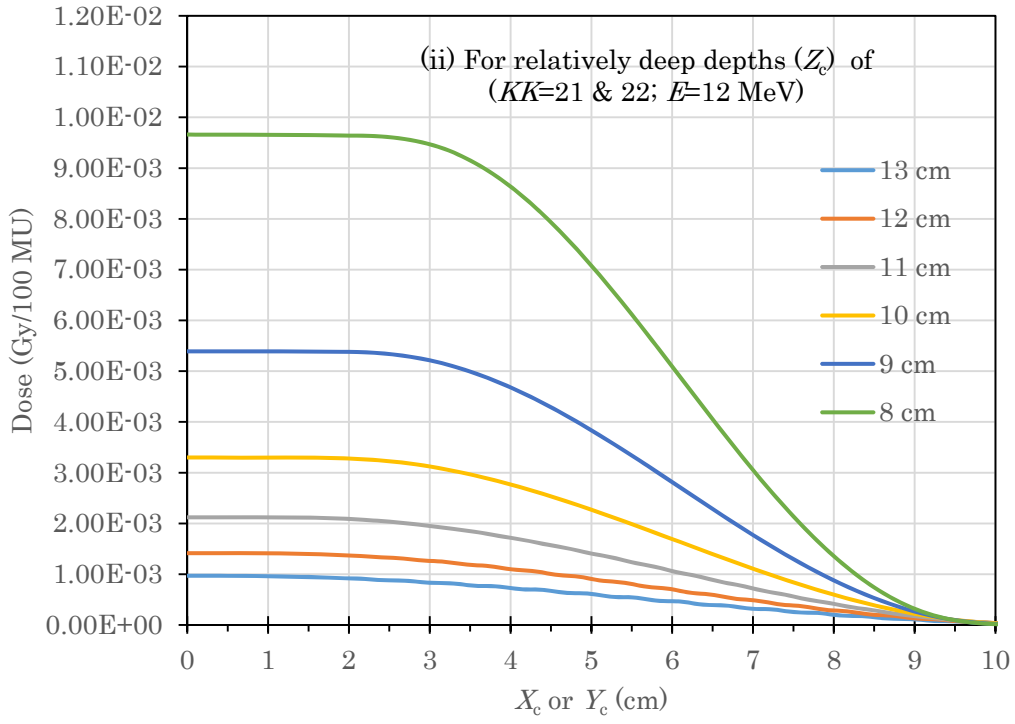
Supp. Fig. 9a-c Each set of diagrams for (a) *KK*=13 & 14 (6 MeV), (b) *KK*=15 & 16 (12 MeV), or (c) *KK*=17 & 18 (18 MeV), produced for *direct & indirect electron* beams on the *standard* eMC using the same way as in Figure 7.


(i) OAD curves
KK=19 & 20 (E=6 MeV)
Direct & Indirect E (Commercial eMC)
For relatively shallow depths (Zc) of
3 cm
2.5 cm
2 cm
1.5 cm
1.25 cm
1 cm
0.75 cm
0.5 cm
Dose (Gy/100 MU)
Xc or Yc (cm)

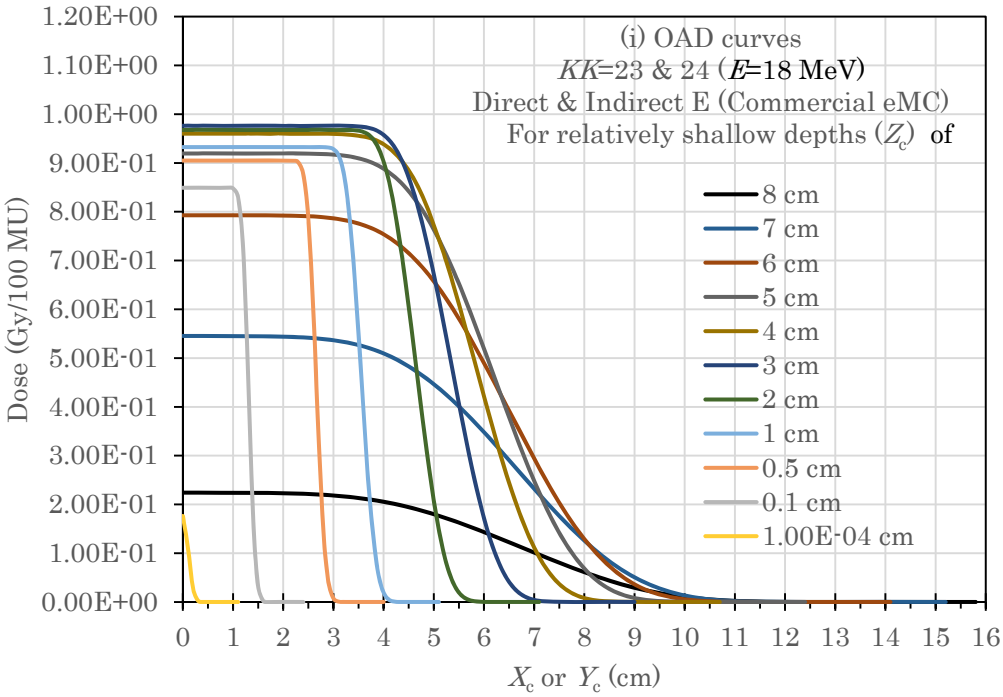

(ii) For relatively deep depths (Zc) of
(KK=13 & 14; E=6 MeV)
6 cm
5 cm
4.75 cm
4.5 cm
4.25 cm
4 cm
Dose (Gy/100 MU)
Xc or Yc (cm)

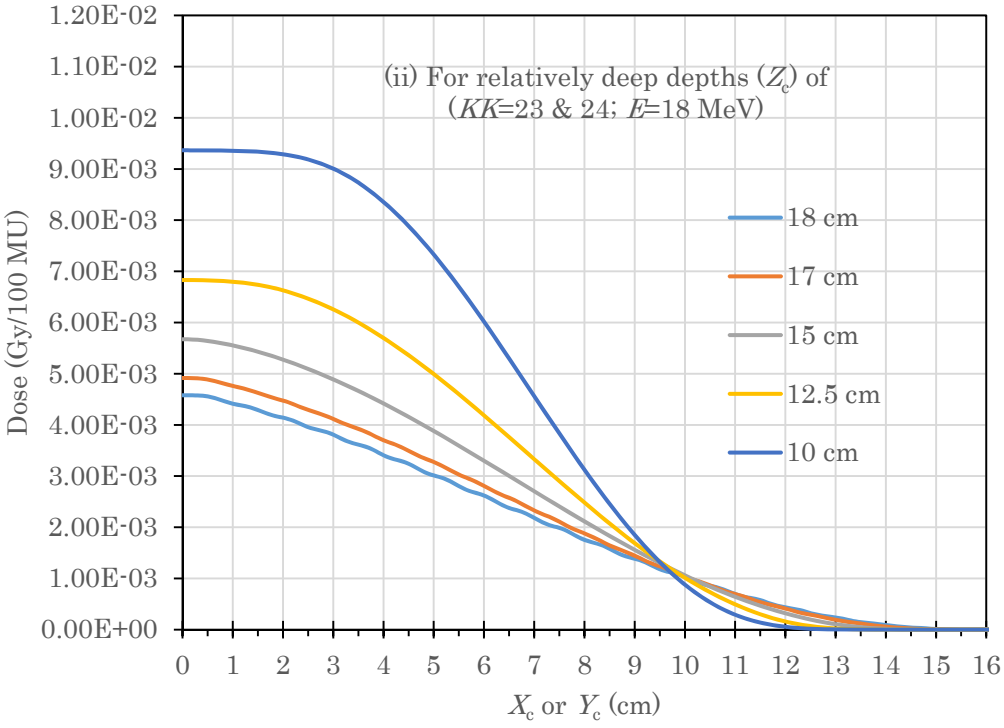
Supp. Fig. 10a


(i) OAD curves
KK=21 & 22 (E=12 MeV)
Direct & Indirect E (Commercial eMC)
For relatively shallow depths (Zc) of
6 cm
5 cm
4 cm
2 cm
1 cm
0.5 cm
0.1 cm
1.00E-02 cm
1.00E-03 cm
1.00E-05 cm
1.00E-07 cm
Dose (Gy/100 MU)
Xc or Yc (cm)


(ii) For relatively deep depths (Zc) of
(KK=21 & 22; E=12 MeV)
13 cm
12 cm
11 cm
10 cm
9 cm
8 cm
Dose (Gy/100 MU)
Xc or Yc (cm)

Supp. Fig. 10b





Supp. Fig. 10c

Supp. Fig. 10a-c Each set of diagrams for (a) *KK*=19 & 20 (6 MeV), (b) *KK*=21 & 22 (12 MeV), or (c) *KK*=23 & 24 (18 MeV), produced for *direct & indirect electron* beams on the *commercial* eMC using the same way as in Figure 7.