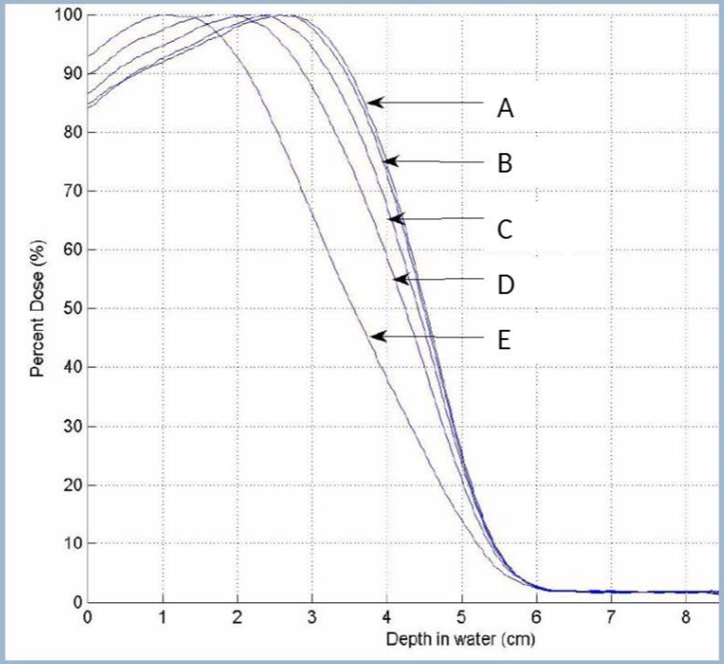
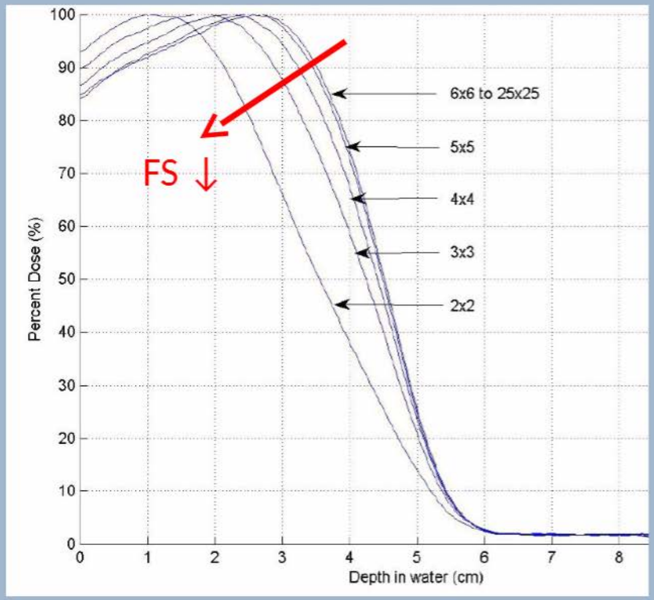
Discuss the following depth dose curves. What kind of beam are they from? What causes the difference among these curves?



Follow Up

- Discuss the surface dose characteristics of these PDDs. Which parameter gives you the highest surface dose? Why?
- How does d_{max} change with this parameter?
- What is the “tail” at the end of the curves (depth > 6 cm on the picture) due to?



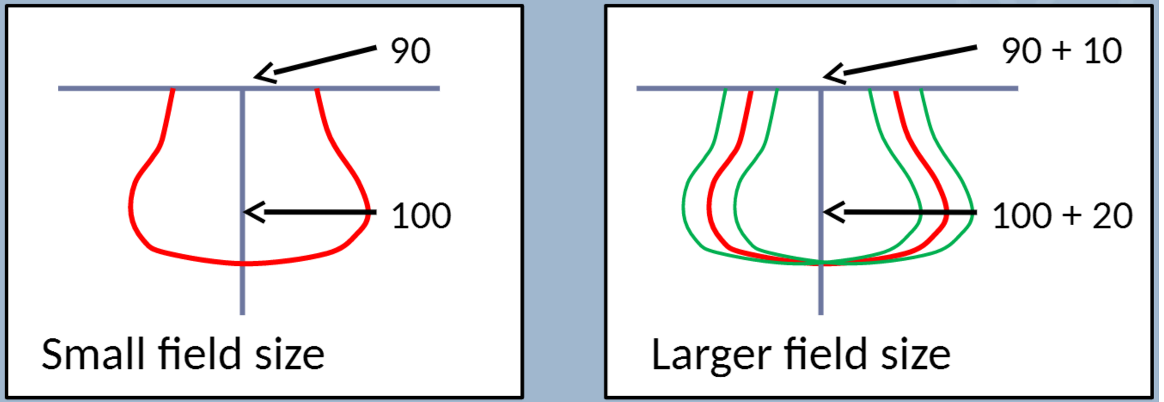
S. Zhang et al., J. Appl. Clin. Med. Phys., 10, 177-187 (2009)

- These are from 11 MeV electron beam
- This can be guessed from $R_p \approx 5.5$ cm
- Electron beam loses about 2 MeV/cm water so $E \approx 2 R_p$
- d_{max} ↑ as field size ↑

Which curve has the highest surface dose? Why?

- For electrons: Field size ↑ = Surface dose ↓
- This is the opposite behavior from photons. For photons, surface dose increases with field size.
- Surface dose goes down with increasing field size because of the dose kernel of electron beam bulges at depth.
- The kernel bulges because electron energy ↓ with depth and therefore the more electrons are scattered with large angles at deeper depth.

Why does surface dose go down with increasing field size?



(relative) surface dose

90/100 = 0.9

(relative) surface dose

100/120 = 0.83

- Photon dose kernel does not bulge so this does not apply to photons.

TG25: "The dependence of depth dose with field size is due to the lateral scattering of electrons. The central-axis depth-dose curve does not significantly change if the distance to any of the field edges (radius) is greater than one-half of the electron range. As the energy of the electron beam increases, the changes in the central-axis depth-dose curve with field size become more pronounced"

How does d_{max} change with field size?

- As we increase the field size, d_{max} goes deeper.
- The kernel bulge "fills up" the dose at depth.

What is the "tail" due to?

- The tail is due to bremsstrahlung photons.
- Bremsstrahlung = Electron gets turned around by positive nucleus and by momentum conservation photons are created to carry off the momentum in the original direction.

Which electron beam energy below will have the highest x-ray contamination?

- 12 MeV
- 9 MeV
- 6 MeV
- 15 MeV

Roughly how much lead would be required to shield 9 MeV electrons?

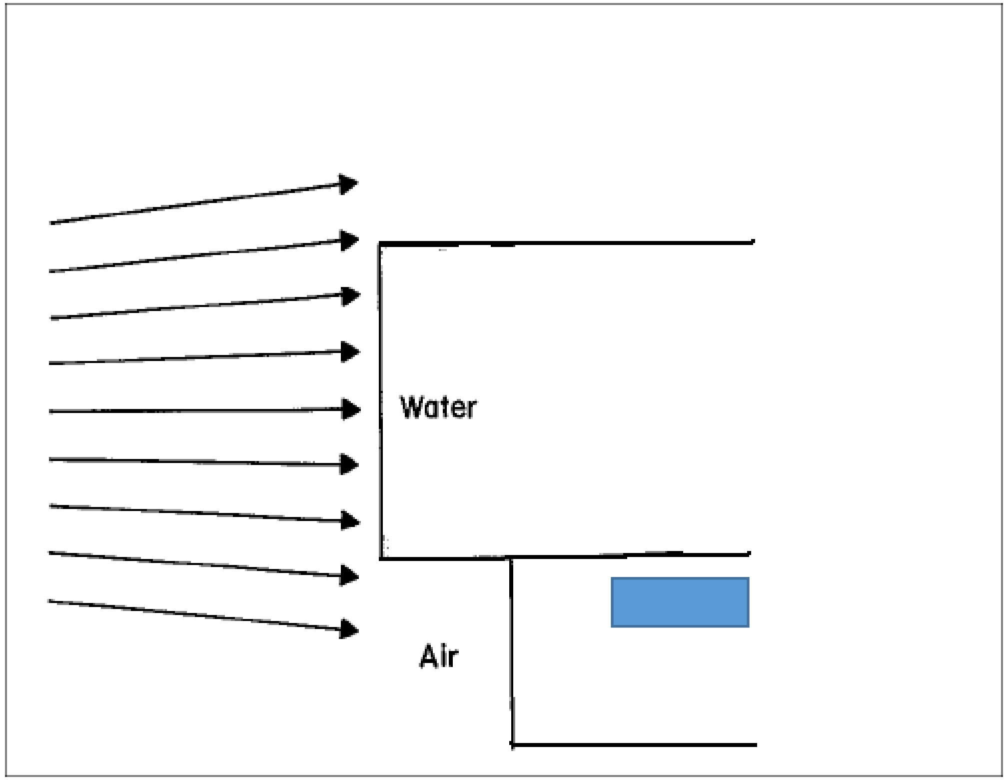
- 3 mm
- 7 mm
- 5 mm
- 1 mm

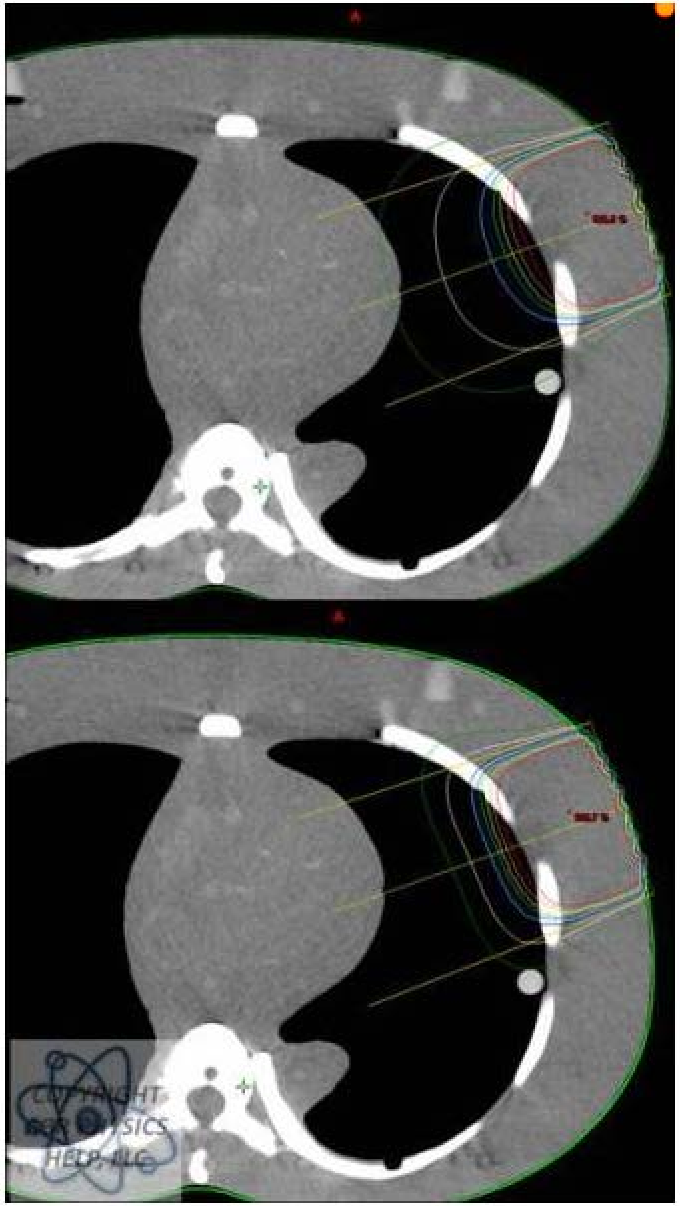
Why do we use electron cones during electron therapy instead of just using the collimators to define the beam? (Choose all that apply)

- By fixing the collimator jaws and varying the cone size the output is much more stable.
- The cone reaches nearer the surface of the patient which reduces the penumbra of the beam.
- If we used the collimators only, the x-ray contamination in the beam would be too high.
- The cone increases the %DD of the beam which allows deeper treatments.
- The cone is required to generate electrons for treatment.

Click on the plan that is most likely using heterogeneity corrections.

Please indicate where you would anticipate a hot spot in the following plan.





You need to treat a patient with a scalp lesion that has previously undergone brain surgery and now has a steel plate (Z_{eff} = 26) right behind the lesion. Approximately how much of an overdose would you anticipate when treating with an electron field of 6 MeV?

- 40%
- 150%
- 20%
- 80%

When electron beams are incident at an oblique angle, the depth of d_{max} shifts ______ while the practical range shifts ________?

- Deeper/Deeper
- Shallower/Deeper
- Deeper/Shallower
- Shallower/Shallower

As an electron field size increases the depth of d_{max} becomes shallower due to increased scatter.

- True
- False

Suppose that we have an 10x10 cm^2 electron cone whose output is 1 cGy/MU at an SSD of 100 cm. We wish to treat with an SSD of 110 cm given that the VSD is 80 cm and d_{max} is 1.2 cm deep would you expect the output to be higher or lower than that predicted by a standard inverse square relationship?

- Higher
- Lower

- **Due to the shortened VSD the effective inverse square relationship is stronger at 80 cm than at 100 cm**
- **Similar to the same reasoning as %DD curves increase as the SSD increases.**
- **The difference turns out to be around 3%.**