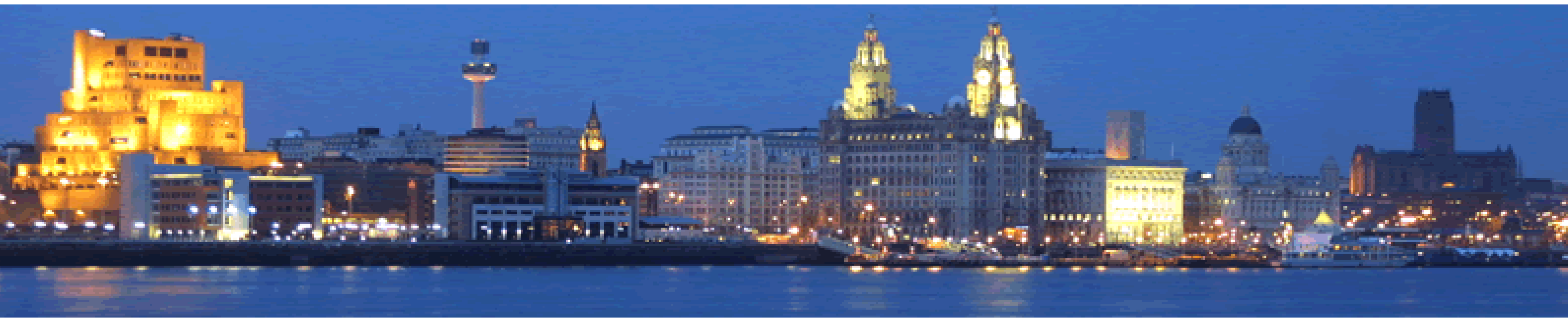


School of Health Sciences

Directorate of Medical Imaging and Radiotherapy

RADT722 201718

Science for Radiotherapy 2

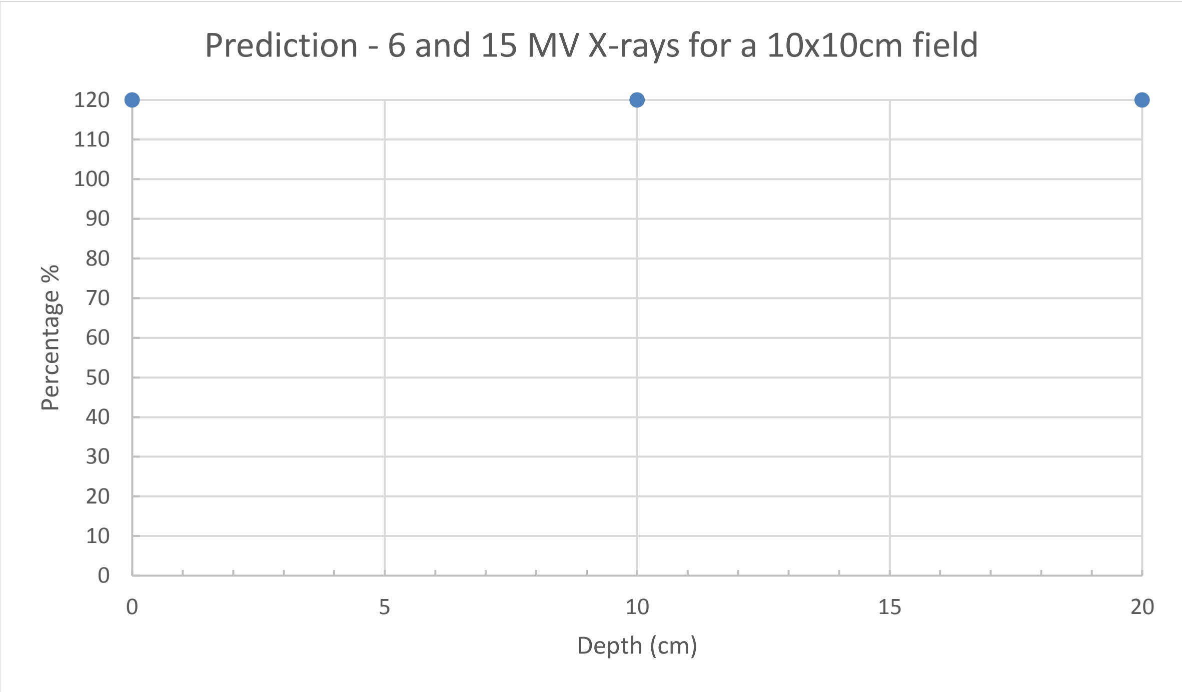
RADT722 201718 VERT PHYSICS Session

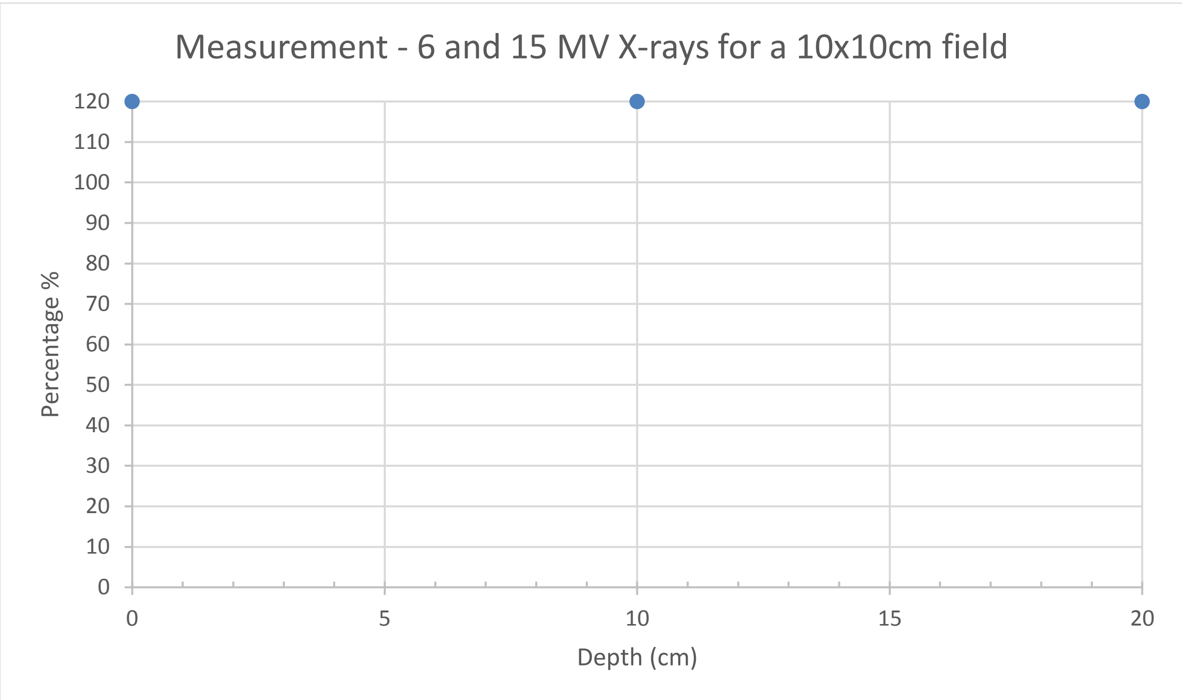
26th March 2018

I - Prediction and Demonstration of Percentage Depth Dose Curves

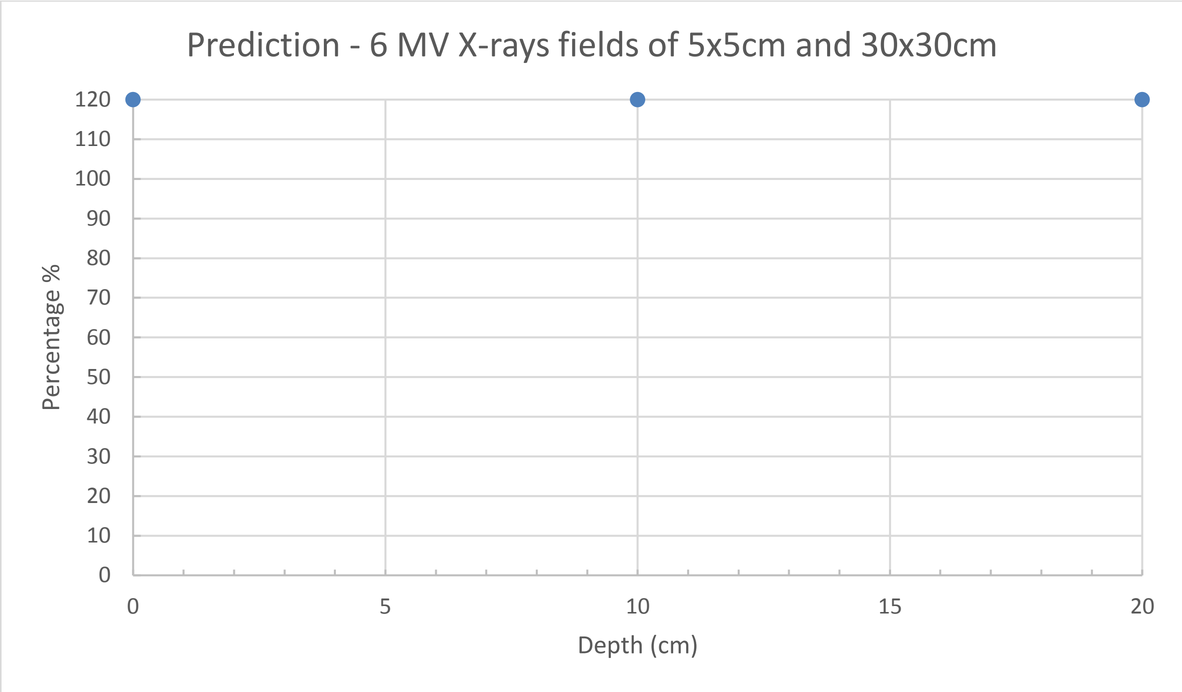
The central axis percentage depth dose (PDD) curve is one of the most fundamental aspects of photon treatment fields and dose deposition in external beam radiotherapy. The plotting tank (as demonstrated by the lecturer using VERT Physics) is the primary way that we measure such curves in commissioning a linear accelerator. Dividing the group into two teams, one team use VERT Physics to measure percentage depth dose curves, whilst the other team predicts what the curves should look like.

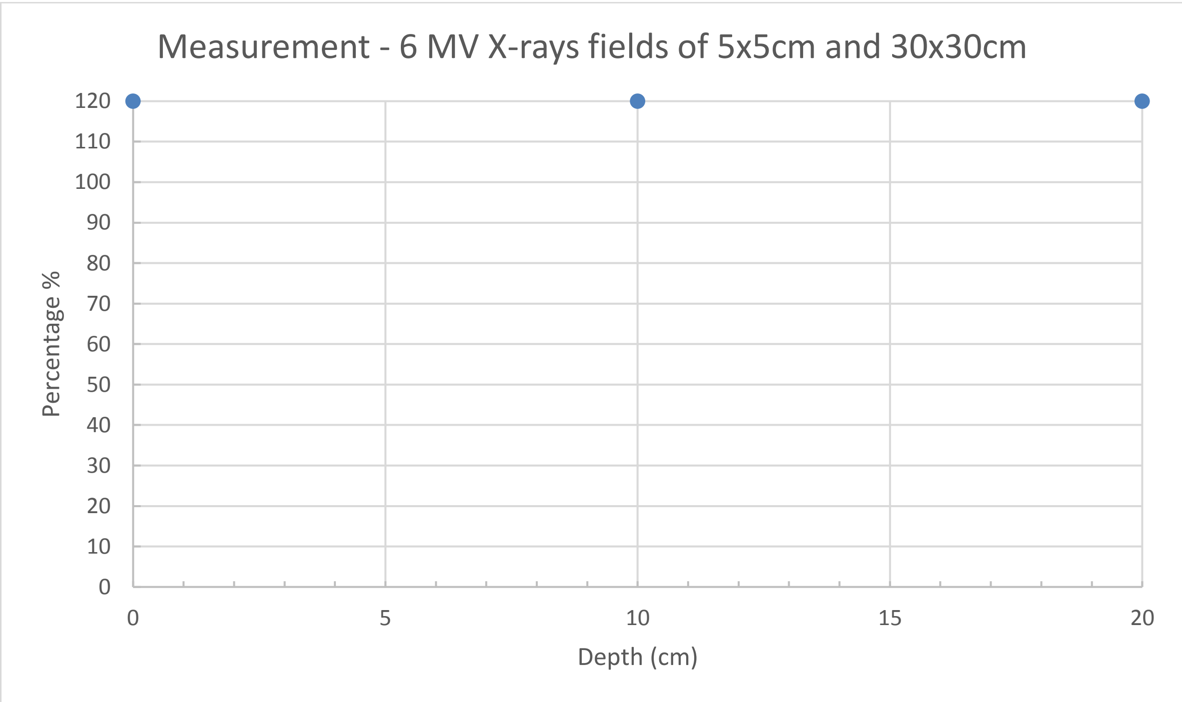
DIFFERENT ENERGIES – Predict and measure the PDD Curves for 6 & 15 MV X-rays, for a 10x10 cm field



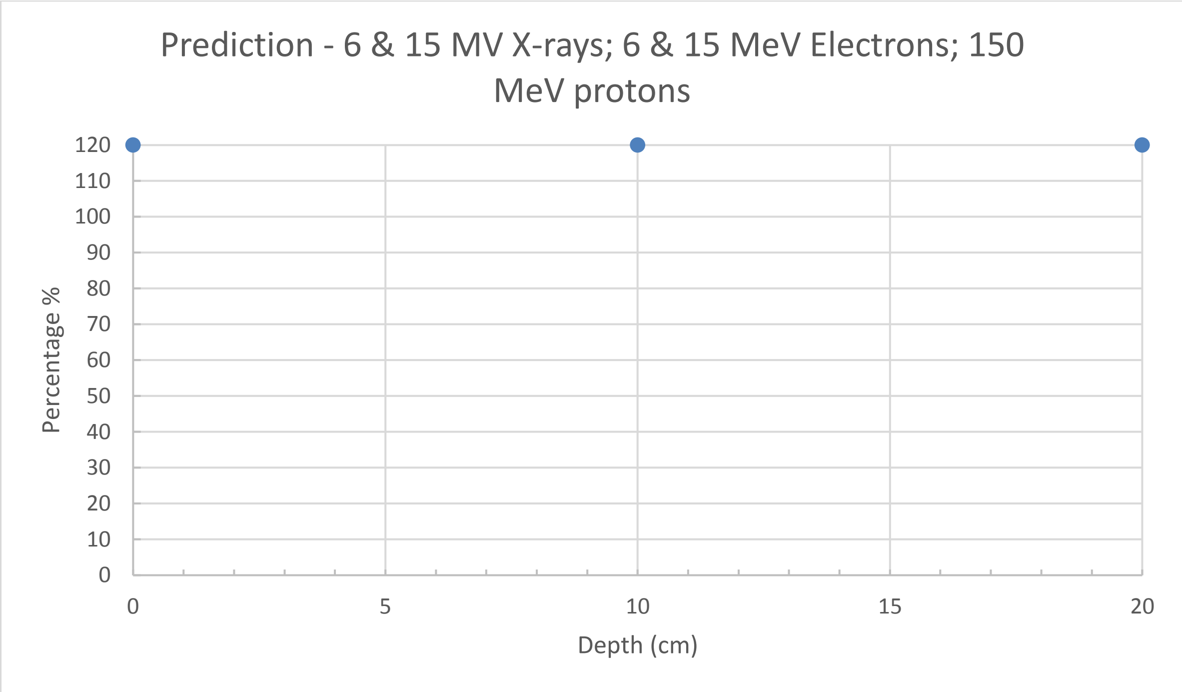


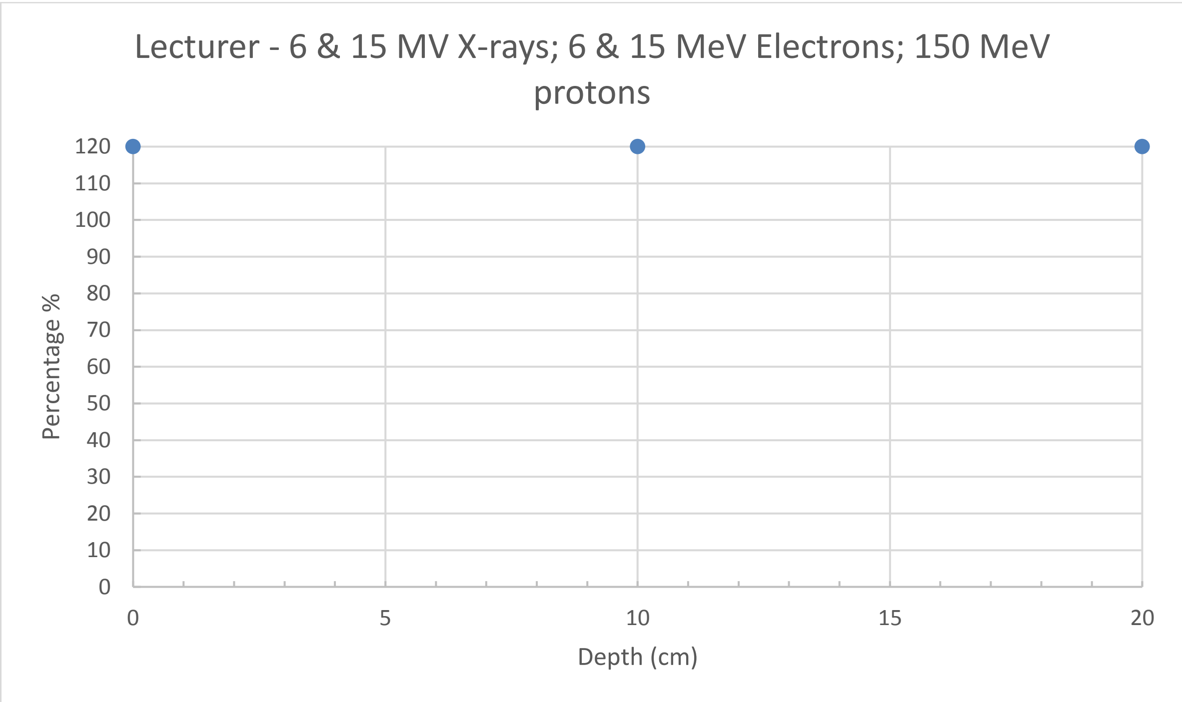
DIFFERENT FIELDSIZES – Predict and measure the PDD Curves for 6 MV X-rays, for fields of 5x5cm and 30x30cm





DIFFERENT MODALITIES – From the results above, draw PDD Curves for 6 and 15 MV X-rays, for a field of 10x10cm; then try to predict curves for 6 and 15 MeV electrons (knowing that Rp is ~ 0.5 x E) and 150 MeV protons on the same plot





II – Inverse Square Law and delivered dose

One of the advantages of in vivo dosemeters placed on the skin surface, is that they can easily measure the dosimetric error involved in an error in SSD for a field set-up. But we can also predict what that error might be, using the inverse square law

Planned Prescription – 100 cm SSD, 15 x 15 fieldsize (jaws), Gantry angle 0, Collimator angle 0, prescription point is 5 cm deep; 8Gy single fraction treatment

Complete the table below, working as two teams – one to set up the phantom on the couch as the patient; one team to perform the mathematics; swap over for the different energy

		6 MV				15 MV		
SSD		ISL Factor	100 MU measured dose (Gy)	100 MU expected dose (Gy)		ISL Factor	100 MU measured dose (Gy)	100 MU expected dose (Gy)
100								
95								
105								

WORKSPACE

III – Beam Energy Specification

As detailed in class, MV X-ray beams are best most accurately specified in terms of energy by using the PDD rather than the nominal energy (i.e. 6 MV, 10 MV etc. specifiers are not accurate enough for accurate dosimetry in radiotherapy). In this experiment we will measure a particular method of specifying the energy – measuring the doses at 5 cm and 15 cm deep and taking the ratio as the specifier

Beam setup for each energy – 100 cm SSD, 10 x 10 fieldsize (jaws), Gantry angle 0, Collimator angle 0. Measure the doses at 5 cm deep and 15 cm deep for each energy. The expected values are detailed in the table – these have been derived as the mean of a number of experiments during the commissioning of the linac. Calculate the 5-to-15 ratio in each case, (Reading at 5 cm deep / Reading at 15 cm deep)

Complete the table below, working as two groups – one to set up the phantom on the couch; one group to perform the mathematics;

	6 MV	15 MV
5 cm DEEP		
15 cm DEEP		
RATIO		
EXPECTED	**1.73**	**1.53**
% diff		

WORKSPACE

Additional Query:
If we did the experiment at 120 SSD, would we expect the ratios to increase or decrease? Why?

IV – Field Size Factors

We have seen where in the radiation head the monitor ion chamber is placed – it cannot therefore measure the changes in output which are caused by the changes in scatter at different fieldsizes. We therefore need data to relate the output (dose per monitor) at different fieldsizes to that for our calibration fieldsize on the linac – a 10 x 10 field. The fieldsize factor for a 10 x 10 field must therefore be 1.000 and we need factors to relate other fieldsizes to this standard.

Beam setup for each energy – 100 cm SSD, various fieldsize (jaws), Gantry angle 0, Collimator angle 0, measured at the depth of maximum dose for each energy. Fill in the table below and try to calculate what the other fieldsize factors must be from the data. Remember the factor for a 10 x 10 field must be 1.000, and all the other data must relate to this. *HINT – look at the doses measured and calculate how the multiplication factor which would give the doses at the different fieldsizes when compared to that for the 10 x 10 field.*

Complete the table below, working as two groups – one to set up the phantom on the couch; one group to perform the mathematics; swap over for the different energy

		10X10	15X15	20X20	25X25	30X30
6 MV Measured data						
6 MV FSFs		1.000				
15 MV Measured data						
15 MV FSFs		1.000				

WORKSPACE