### Physics 6423: Radiation Therapy Physics

### Laboratory 2: Beam Quality Measurement

The dosimetry and characterization of radiation therapy beams is required for treatment planning purposes as well as for ongoing quality assurance. In this laboratory you will perform percent depth doses (PDD) for a photon (6 or 10 MV) and an electron ( 9 MeV electron) beams, as well as characterizing a number of electron parameters.

1. **Percentage depth dose (PDD):**

Using 3-D water scanning phantom, an ionization chamber, and the appropriate chamber shift (0.6 rcav; where rcav = 3mm. Discuss this shift in your report. Why do we apply it?) , measure a photon 6 MV PDD between 0 and 30 cm depth at 90 cm SSD for a 10x10 cm2 field (at isocentre). Report the depth of dmax and D10/D20 for this beam. Repeat your measurement for 105 cm SSD, keeping the field size on the surface the same. In you report, discuss the differences between the two curves. Given one of the curves, how could you derive the other?

1. **Beam uniformity: Flatness and symmetry:**

For a 10 MV beam and 90 cm SSD, measure the beam profile at the depth of 3 cm (dmax for 10 MV = 2.2 cm) and 10 cm in the cross-plane (transverse) only. Determine the two beam profiles flatness and symmetry and discuss the difference between the two profiles.

1. **Relative dose factors (RDFs)**

For 90 cm SSD and depth = 10 cm, measure RDF for 4x4, 20x20 and 40x40 cm2 square field sizes (both energies). Compare your result with the treatment planning system data given below:

4x4 20x20 40x40

6 MV 0.863 1.106 1.186

10 MV 0.885 1.082 1.148

1. **Electron Percent Depth-Ionization (PDI):**

Using 3-D water scanning phantom and an ionization chamber measure the electron PDI at various depths for 9 MeV, use a 10x10 applicator. Convert this PDI to PDD by first applying appropriate chamber shift (0.5 rcav, discuss this shift) and then using tables from TG-25, apply any other depth dependent factors as needed.

Report the depth of dmax R90, R80, R50 and Rp for your electron beam. Calculate the magnitude of the Bremsstrahlung contribution to the dose for your electron beam. Also using Rp, calculate the most probable energy and the mean energy of the electron beam incident on the phantom surface.

Please write your lab report in scientific paper format with no more than 5 pages.

References:

1. E.B. Podgorsak, Radiation Oncology Physics: A Handbook for Teachers and Students (IAEA, Vienna, Austria, 2005) [http://www-pub.iaea.org/mtcd/publications/pdf/pub1196\_web.pdf].
2. AAPM Task Group 51 (TG-51), “AAPM’s TG-51 protocol for clinical reference dosimetry of high-energy photon and electron beams” Medical Physics, Vol. 29 (9), 1847-1870, September 1999
3. AAPM Task Group 25 (TG-25), “Clinical Electron Beam Dosimetry” Medical Physics, Vol. 18 (1), 581-618, January 1991
4. AAPM Task Group 21 (TG-21), “A protocol for the determination of absorbed dose from high-energy photon and electron beams” Medical Physics, Vol. 10, 741-771, 1983