



Contribution ID: 15

Type: **Lecture**

Comparison of different detectors for small field output factor measurements in photon radiotherapy with a focus on long rectangular fields

In the Varian environment (TrueBeam linear accelerator and Eclipse treatment planning system, Varian Medical Systems, Palo Alto, USA), beam data acquisition for radiation fields smaller than 3 cm x 3 cm involves measurements of long and narrow rectangular fields such as 1 cm x 40 cm. The beams must be collimated by jaws with fully retracted MLC (multileaf collimator). Output factors (OF) of such small fields are not comprised in the standard golden beam data package. There is very little literature on OF measurements in small rectangular fields and the IAEA document TRS 483 does not report correction factors for OF measurements in narrow rectangular fields collimated by jaws. In our clinic, we use this type of long, narrow fields for breast treatment plans (two IMRT tangential fields with jaw tracking) and stereotactic radiation therapy plans. There was a need to measure the small field beam data carefully and evaluate the impact on patient plans.

We compared three commercially available detectors that can be used for small field OF measurement: plastic scintillation detector Exradin W1 (Standard Imaging, Inc., Middleton, WI, USA), ionization chamber PinPoint 3D (PTW Freiburg, Germany) and ionization chamber IBA Razor Nano Chamber (IBA Dosimetry GmbH, Schwarzenbruck, Germany). We studied the effect of detector orientation and the collimator exchange effect in order to obtain accurate output factors into the beam data table. We considered the plastic scintillator as reference and we aimed to determine correction factors for OF measurements for the other two detectors including long and narrow rectangular fields collimated by jaws. These are not reported in the IAEA TRS 483 recommendation.

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Session Classification: Technical workshop part IA