Purpose: To devise a technique of 3D relative dosimetry using an ion chamber array with solid phantom to significantly reduce overall measurement time needed for photon beam modeling.

Methods: Measurement setup of the array was determined by comparison of acquired profiles in the array and in a water tank. Software was developed to queue measurements in step-and-shoot sequences and process the resulting IC array data. Beam profiles and PDDs necessary for beam modeling were acquired with the IC array for 18 MV. A model was created with the IC array data using the Pinnacle TPS and compared to a model created from water tank measurements. Both models were first compared by measuring differences between profiles and PDDs. Secondly, 3D dose distributions predicted by both models were compared using a gamma metric for a pair of treatment plans.

Results: The IC array model was found to match the water tank model for most profiles. Due to fixed chamber depth in the IC array, PDDs near the surface differed in the IC array model from the water tank model. For a prostate case treatment plan, comparison of 3D dose distributions from both models showed that 90.4 % of voxels agreed within a gamma of (1%, 1 mm). This tolerance was violated near air-tissue interfaces due to differences in the measured PDDs between both models. The devised technique allowed most measurements necessary for beam modeling, except for output factors, to be made for a single energy in under 8 hours.

Conclusions: The IC array with solid phantom setup allows substantially faster beam acquisition than a water tank. Further investigation is required for measuring exact PDDs in the IC array setup. Future work will study lower photon energies and electron beam modeling with IC array acquisitions.

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