# AbstractID: 12674 Title: Dosimetric variations due to the photon beam energy in Monte Carlo dose calculation using sub-millimeter voxels

**Purpose:** This study investigates dosimetric variations in Monte Carlo calculation using sub-millimeter voxels due to the photon beam energy and presence of inhomogeneity. The bone dose enhancement due to the photoelectric effect for the kilovoltage (kV) photon beams was evaluated using Monte Carlo simulation.

**Methods and Materials:** Three Monte Carlo phantoms namely, inhomogeneous, homogeneous and bone homogeneous using the same mouse CT image set were used. These phantoms were generated by overriding the relative electron density of no voxel (inhomogeneous), all voxel (homogeneous) and the bone voxel (bone homogeneous) to one. The 360 deg photon arcs with beam energies of 50, 100, 150, 200, 250, 300 and 1250 keV were used in the dose calculations. Doses in the above phantoms were calculated using the EGSnrc-based DOSXYZnrc code through DOSCTP.

**Results:** For the inhomogeneous mouse phantom, increasing the photon beam energy from 50 keV to 1250 keV increased seven times the dose deposited at the isocenter based on the same number of history in Monte Carlo simulations. For the bone dose enhancement, the mean dose was 2.7 times higher when the bone inhomogeneity was not neglected using the 50 keV photon beams. However, the effect of the presence of the lung inhomogeneity on the variation of the mean dose was only within ±5% for the photon beams with energies in the range of 50 - 1250 keV.

**Conclusions:** Bone dose enhancement affecting the mean dose in the mouse irradiation can be found in the photon beams with energy range of 50 – 200 keV, and the dose enhancement decreases with an increase of the beam energy. When keV photon beam is used in the dose calculation, the increase of the mean dose due to the bone dose enhancement may be a dosimetric concern.