AbstractID: 4955 Title: Dosimetry of Small Lung Lesions with EGSnrc Monte Carlo and Treatment Planning Systems

Background: The ability to deliver a homogenous dose distribution to small lung lesions is usually affected by the surrounding less dense normal lung. In low-density tissue, there is increased transmission of photons relative to that in tissue. The lateral scatter of electrons out of the beam can lead to loss of field flatness and increased penumbral width. The magnitude of these effects is known to be very significant at high energies. Some commonly used radiotherapy treatment planning systems have had limited success in predicting accurately the dose distribution under these inhomogeneous conditions.

Purpose: The purpose of this work is to study the magnitude of these effects using the EGSnrc/BEAMnrc Monte Carlo code on a typical patient CT dataset and to assess the limitations in treatment planning of such lung tumours with three Treatment Planning Systems (TPS); ADAC Pinnacle III v7.4, Varian Eclipse IMX and MDS Nordion Theraplan Plus v3.8.

Methods: Small lung tumours (GTV) of diameter (3cm and 5cm) were simulated as water equivalent volumes and graphically inserted into the CT dataset at three different locations (Anterior, Central and Posterior) in the right lung. Using 6MV and 15MV beams, modelled for a Varian 21EX with the BEAMnrc Monte Carlo dose distributions were simulated using a Parallel Opposed Pairs (POP) technique. The field sizes were varied such that the distance from GTV to field edge was 1.0cm, 1.5cm and 2.0cm.

Results and Discussion: Compared to the Monte Carlo calculated dose distribution, considerable and unique differences were observed in predicted dose by the TPS around the periphery of tumour and in the lung. These differences can be attributed to changes in the electron transport in lung, which are not adequately taken into account. The severity of these uncertainties, increases with photon energy, and decreases with field size for all planning systems.