^{15}O Photon Activation and Perfusion Measurement

We report preliminary investigations into a new method of measuring tumour perfusion via in-situ activation of oxygen using a tuned Elekta SL25 accelerator. High-energy photons generate radioactive ^{15}O by the 'gamma, neutron' reaction. As most in-vivo oxygen is bound in water molecules, such activation is effectively a method of labeling water. Imaging of the ^{15}O distribution using a highly-sensitive positron-emission-tomography (PET) device can yield a 3D perfusion map. The aim of this investigation was to determine whether clinically useful amounts of ^{15}O could be generated by the Elekta SL25 after tuning the beam to give high energy photons. To be clinically useful, enough ^{15}O must be generated to enable measurement of washout. Our results define the performance limits of such imaging devices.

The activity produced per-unit-dose was measured by irradiating spheres of water to known dose, and then placing the sphere in coincidence-counting apparatus. Calibration data from counting measurements of solutions of known activity, in the same spheres, were used to calculate the activity generated by the tuned accelerator beam. A correction for the 'background' counts signal from the walls of the sphere was made to yield the counts signal arising solely from the activated water in the sphere. The tuned beam generated activity of 0.2-0.3μCi/cc/2Gy. Full results will be shown, including the effects of different linac tuning strategies, and images from a new portable PET device.