Lecture 7 – exercises

1. Calculate the overall resolution of a 800 mm diameter human PET scanner with scintillating crystals of diameter 5 mm, when performing a scan using FDG

2. Assume that the head is an ellipse with major dimensions 28 and 22 cm. The patient is placed within a head PET scanner with a circular arrangement, diameter 45 cm, of BGO detectors. What is the maximum time difference that can occur for an event between two detectors?

3. A patient is injected with 0.5 nanogrammes of FDG (molecular weight 181.15) and then immediately imaged using a PET scanner. The half-life of ^{18}F is 110 minutes.

   a) Calculate the activity of the injection.

   b) If the patient remains within the PET imager for 60 minutes, calculate the number of positron emissions in this time. Assume that ^{18}F decays via positron emission 96.7% of the time.

   c) The PET scanner consists of a single ring of 100 detectors that are placed edge-to-edge around the ring. Each detector is 2 cm wide along the axis of the scanner and the diameter of the ring of detectors is 80 cm. What is the rate of true coincidence detections for one detector pair at the start of the image acquisition? For this calculation, assume that all of the positrons are emitted from a point source in the centre of the detector ring and that the detection probability for a single detector is 60%.

   d) What is the singles (non-coincidence) count rate on each detector at the start of the image acquisition?

   e) If the pulse width from the detectors is 6 ns in duration, what is the rate of random coincidences on any detector pair?