A Few Conceptual Questions

Q1. Emission tomography

Emission tomography (ET) typically refers to two imaging modalities: *Single Photon Emission Computed Tomography (SPECT)* and *Positron Emission Tomography (PET)*.

Could you explain how do SPECT and PET work?

Q2. Tomographic image formation

Many radiological imaging modalities, such as X-ray computed tomography (CT) and positron emission tomography (PET), physically measure the so-called *line integral* of certain properties of the object and then use this data to generate tomographic images.

Could you use your own words, drawings, and/or equations to explain what is the *line integral* being measured during CT and PET imaging?

Q3: Structure and Functional imaging

Could you use a few examples to explain the difference between *structural imaging* and *functional imaging* techniques?

Q4. Tracer Principle

a. Could you explain what is the *tracer principle*?

b. What are the major attractions of emission tomography techniques, such as PET, that are based on the tracer principle?

Q5. Radioisotopes for emission tomography and nuclear medicine.

a. What are the underlined desired properties of the radioisotopes for use in emission tomography? You could use Tc-99m as an example.

b. In positron emission tomography (PET), there are several physical effects, such as *positron range* and *non-collinearity of annihilation gamma rays*, that degrade the imaging resolution attainable with PET. (i) What is the *positron range,* and what is the *non-collinearity of annihilation gamma-rays*?

(ii) How do these effects degrade the imaging resolution of PET?

Q6: X-ray sources

With a commonly used X-ray tube, please plot the the <u>energy distributions for X-rays</u> that are

a. emitted through the Bremsstrahlung process?

b. leaving the anode?

c. leaving the X-ray tube (passing through a thin Beryllium window)?

d. penetrate through an object?

Please plot the corresponding X-ray spectra within a single graph and explain what causes the changes between the energy spectra (a-d).