Short Course 6
Biomedical Applications of Particle Detectors

Monday, October 18, 08:30 - 12:00 Room Tarragona

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The course starts with the discussion of the concept of basic properties for the detection of X-rays in various particle detectors. The relevant quantities are the conversion probability of photons into charged particles (quantum efficiency), the signal to noise ratio, the spatial resolution, the point spread function and the noise power spectrum. These considerations result in a characteristic 'detective quantum efficiency DQE' for a detector.
In the following these concepts are applied to examples like

non invasive coronary angiography

bronchography

multi energy tomography

mammography

Special emphasis will be placed on the digital subtraction technique to obtain images of suitable contrast allowing a reliable diagnosis. The detector types used for these applications are segmented ionization chambers, Si(Li) drift detectors, segmented 'edge on' silicon detectors and germanium detectors.

Course Contents

1.0 The concept of spatial frequency detective quantum efficiency DQE for imaging detectors with x-rays

1.1 Quantum efficiency, direct conversion of photons in charges

1.2 Noise considerations, Signal to noise ratio

1.3 Zero spatial frequency DQE(f=0,g=0) for integrating detectors and single photon counters

1.4 Spatial resolution and Fourier Transformation

1.5 Point spread function and Modulation Transfer Function

1.6 Noise power spectrum

1.7 DQE(f,g)

2.0 Biomedical application of particle detectors

2.1 Non invasive coronary angiography

2.1.1 The subtraction technique

Separation into iodine, water and bone images

2.1.2 Design considerations on

Spatial resolution

Noise

Dynamic / flux

Integration time

DQE

Readout concepts

2.1.3 Examples:

Segmented double line Ionization chamber (Siegen, Hamburg)

Segmented double line Li drifted Si detector (Berkeley, Brookhaven)

Segmented double line Ge detector (Strasbourg ESRF)

2.2 Bronchography

2.3 Multi energy tomography

2.4 Mammography

2.4.1 Design considerations on

Spatial resolution

Noise

Dynamic / flux

Integration time

DQE

Readout concepts

2.4.2 Examples:

Segmented 'edge on' silicon detector (INFN, University Trieste)