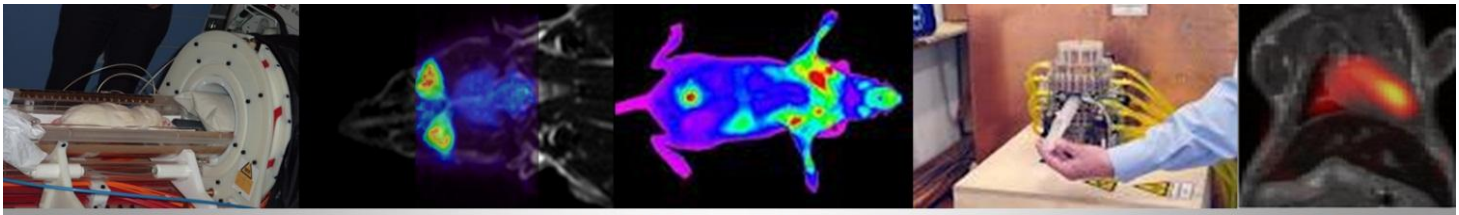


PMI Physics of Molecular Imaging Systems

HELMHOLTZ-INSTITUT FÜR BIOMEDIZINISCHE TECHNIK

RWTH

Research focus of the department of “Physics of Molecular Imaging Systems” (**PMI**) is on exploring the physical limits of current and future molecular imaging technologies. These areas range from simulations of new detector concepts, hardware prototypes, high speed data processing, image reconstruction algorithms and applications using our research imaging prototypes. Our group consists of students and researchers from different disciplines: physics, engineering, computer science and medicine. PMI is part of a large international network with a close link to industry, especially Philips Research.

Optical simulations of a scintillating PET detector

Positron Emission Tomography

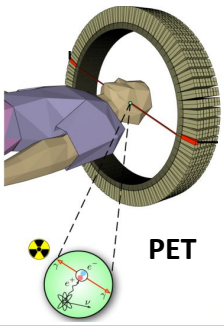
In Positron Emission Tomography (PET) imaging, a patient or animal is injected with a radioactive substance emitting positrons during decay. The positron annihilates with an electron from the patient’s body, thus producing two gammas which propagate through the body in opposite directions. These gammas are detected outside the body using a ring of PET detectors. From the detection points a line of response can be assumed along which the annihilation took place.

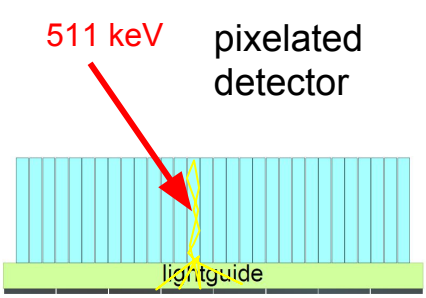
Scintillation Detectors for PET

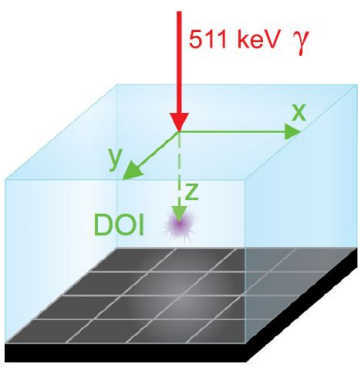
PET detectors mostly use scintillators which are readout by photosensors. A PET detector has to measure the the position, energy and timing information with high precision. Besides the classical approach to segment the scintillator and identify the crystal element that has been hit by the gamma, novelle detectors use a larger monolithic crystal which is read out by multiple photosensor channels. From the measured light distribution on the photosensors the 3D position of the scintillation event position inside the crystal volume can be deduced.

Your Thesis

In this master’s thesis the candidate will implement Monte Carlo simulations of scintillating PET detectors. The main challenge will be to simulate all the relevant optical processes: from the creation of the scintillation light, the propagation in the scintillator and lightguide to the absorption in the photo detector. The simulations will be implemented using the GEANT4 and GATE simulation frameworks. Additionally, existing lab setups will be used to verify the simulation results. Once a good simulation has been established, this simulation will be used to explore different detector and light guide geometries for future PET detectors. Good programming skills are preferred as well as the motivation and creativity to invent new detector geometries.







Van Dam, H. T. et al. (2011). “A practical method for depth of interaction determination in monolithic scintillator PET detectors”. Phys. Med. Biol., 56 (13), 4135–4145. doi:10.1088 /0031-9155/56/13/025

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