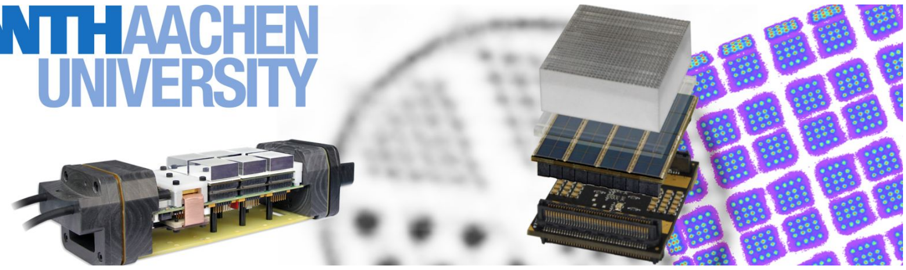
PMI PHYSICS OF MOLECULAR IMAGING SYSTEMS | RWTH AACHEN UNIVERSITY



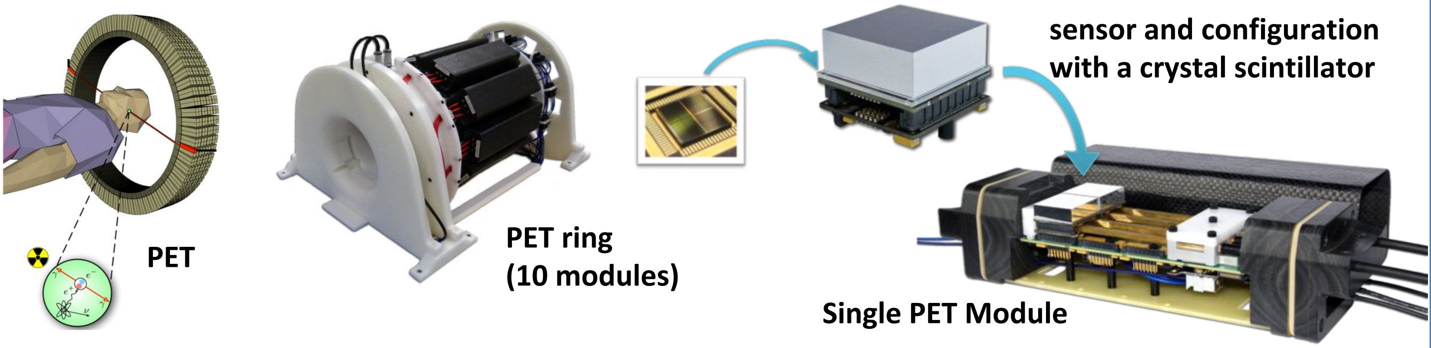
Research focus of the department of “Physics of Molecular Imaging Systems” (**PMI**) is on exploring the physical limits of current and future molecular imaging technologies. These areas range from simulations of new detector concepts, hardware prototypes, high speed data processing, image reconstruction 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, particularly to Philips Research.

Bachelor’s / Master’s Thesis: Data Processing for a Fully Digital PET Insert

In Positron Emission Tomography (PET) imaging (Fig. 1), a patient or animal is injected with a radioactive substance emitting positrons during decay. The positron annihilates with an electron from the subject’s body, thus producing two photons which propagate through the body in opposite directions. These photons are detected outside the body using a ring of PET detectors. These PET detectors are typically scintillators, converting the 511 keV gamma photon to a high number of optical photons, which are detected by underlying photosensitive detectors.

Our group developed the world’s first preclinical PET/MRI insert on basis of fully digital Silicon Photomultipliers (dSiPM) [1]. A preclinical high resolution PET Scanner uses crystal scintillators with a very small pitch. Lightsharing over a larger area of the sensor tile is employed to identify the crystal rod in which the gamma scintillated. Photon counts and time stamps are collected from several sensors and have to be combined to obtain a measure of the location, time and energy of the gamma. We are constantly developing calibration methods and crystal identification algorithms [2,3]. Several crystal configurations with emphasis on different performance parameters are being investigated. High tracer activity in the scanner might lead to pile-up of gamma events interacting with the same detector block. It is important to reduce this pile-up by accounting for multiple interaction events. At the same time, a single gamma might interact multiple times with the detector block (compton scattering). Compton-scattered events have to be identified and filtered out [4].

The candidate will work with a processing and calibration environment, which is implemented in a multi-threaded C++/Qt/ROOT environment. Good programming skills are preferred as well as a good understanding of statistical data analysis. A wide range of topics is available from characterization, algorithmic development to investigations of novel crystal and readout configurations.



[1] B. Weissler *et al.*, 2015, *IEEE TMI 34 11 2258*, doi: 10.1109/TMI.2015.2427993
[2] D. Schug *et al.*, 2015, *IEEE TNS 62 3 669*, doi: 10.1109/TNS.2015.2420578
[3] N. Gross-Weege *et al.*, 2016, *Med. Phys. 43 3049*, doi: 10.1118/1.4950719
[4] C. Ritzer et al., 2017, *IEEE TRPMS 1 2 191*, doi: 10.1109/TNS.2017.2664921

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