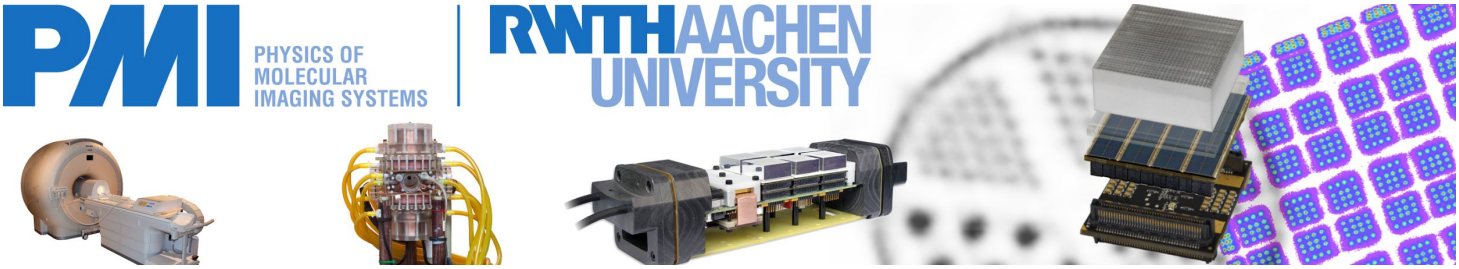
PMI PHYSICS OF MOLECULAR IMAGING SYSTEMS | RWTH AACHEN UNIVERSITY



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 or Master's Thesis: Development of a Dedicated Small Animal PET

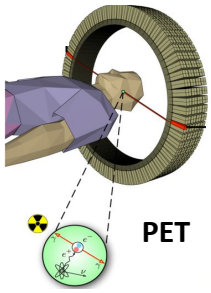


Fig. 1: In PET, two 511 keV gamma photons from a positron-electron annihilation have to be detected and correlated.

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.

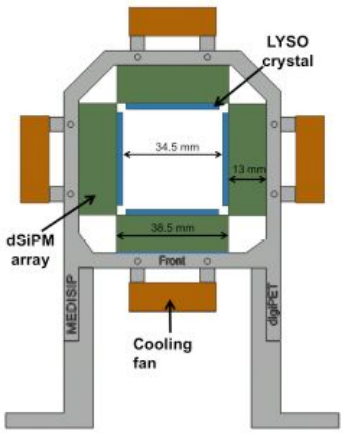


Fig. 2: Scheme of small animal PET system employing four digital SIPM sensors [1].

In biomedical and preclinical studies, the mouse model is widely used. PET enables to detect and quantify radiopharmaceuticals *in vivo* at molecular level. Thus, PET became well-established in preclinical pharmacology, genetics as well as pathology.

The goal is to develop and characterize a small-animal PET scanner based on a read-out architecture developed in this group (successor of [2]). The scanner architecture shall allow the study of different detector concepts such as segmented and monolithic scintillators and novel calibration procedures.

This thesis may include

- construction of the scanner mechanics and cooling
- simulation study of possible geometries and designs
- commissioning of the scanner and detectors
- study and characterization of suitable detector geometries
- calibration of the developed system
- characterization and optimization of the scanner
- image reconstruction

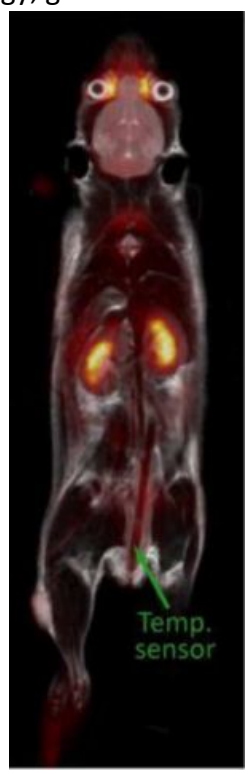


Fig. 3: Fused PET/MR image obtained with the Hyperion II^D PET insert built by this group [2].

Possible candidates may choose their special field of interest. If desired, the topic allows a collaboration between a group of students focussing on different aspects of the topic.

[1] España, S., et al.: DigiPET: sub-millimeter spatial resolution small-animal PET imaging using thin monolithic scintillators. *Physics in Medicine and Biology*, *59*(13), 3405. https://doi.org/10.1088/0031-9155/59/13/3405

[2] Weissler, B., et al: A Digital Preclinical PET/MRI Insert and Initial Results. *IEEE Transactions on Medical Imaging*, *34*(11), 1–1. https://doi.org/10.1109/TMI.2015.2427993

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