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 Thesis: Channel-threshold optimization for the TOFPET2 ASIC**

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 patient’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 coupled to photosensitive detectors.

In recent years, analogue SiPMs have seen big improvements with the newest generation being promising candidates to build photosensitive and MRI-compatible PET detectors. With the large variety of different geometrical layouts, analogue SiPMs can be specifically selected for the targeted application. To digitize the analogue electronic SiPM signals, a dedicated application-specific integrated chip (ASIC) is needed which accurately measures the height of the SiPM signal and assigns a high-resolution timestamp (picosecond range) to it. The company PETsys (www.petsyselectronics.com) recently announced the latest generation of their TOFPET2 ASIC specifically designed for time-of-flight PET.

The candidate will develop a protocol to select channel-specific trigger thresholds for multi-channel experiments with the TOFPET2 ASIC (Fig. 2), and thus, improve the timing resolution of the circuit. The candidate will establish a software framework allowing the automatic generation of the desired channel-threshold configuration register. Furthermore, the candidate will quantify the performance gain in experiments with the present benchtop setup for arrays of analogue SiPMs from different vendors.

**Fig. 1:** Schematic drawing of a PET gantry (a) and PET image of the human pelvis (b).


**Fig. 2:** Dedicated benchtop setup for multi-channel experiments featuring the TOFPET2 ASIC.


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