



Positron Emission Tomography

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- Userguide for the lab course -

Location:
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1. Abstract

Introduction Positron-Emission-Tomography or short PET is the state-of-the-art technique for imaging physiological processes inside humans or animals. This happens in a noninvasive fashion as the distribution of a radioactive, positron emitting radiopharmaceutical inside the body is monitored by surrounding detectors. With the help of mathematical algorithms, the tracer distribution is reconstructed to an image. PET has become an indispensable tool for ensuring the correct treatment of patients and assured diagnostics by the attending doctor, e.g. for cancer treatment. PET is heavily used in medicine, biology, neurology and pharmaceutical research as e.g. brain activity, blood flow or glucose flow can be monitored. Several interdisciplinary fields are merged within a running PET system, ranging from physics, communication technology, electrical engineering and image reconstruction up to the application in medicine. Thus there is a need for modern physicists to understand not only the underlying physics but also how the system works and is operated.

Motivation The one day laboratory course gives an introduction to PET, starting from the physical background up to the image reconstruction. An insight is given to detector techniques, modern readout electronics, data acquisition and analysis. Furthermore a short introduction to some standard tools in particle physics, e.g. Linux or the data analysis framework ROOT are part of this course. The PET scanner

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is a refurbished former small animal prototype, featuring 96 readout channels and set up with an up to date readout system. Data analysis and image reconstruction is done using a standard PC. The radioactive distributions which have to be reconstructed are different symbols milled in plexiglass, which are filled with a β^+ decaying radionuclide. The available radioactive tracers are either ^{18}F or ^{22}Na .

Guideline for Students The userguide consists mainly of two parts: Before the lab course, it is essential to read and understand in every case the *Introduction* and the *Basics for the Image Reconstruction* part of the userguide (\rightarrow sec.2-4). The second part about *PET System Commissioning* and the *Tasks* (\rightarrow sec.5, 6) maybe cannot be fully understood without having the scanner in front of you, but is your guideline through the lab course. Nevertheless it must be read before. Most of the work is done during the lab course and you get the highest benefit for your knowledge, if you prepare yourself carefully. The evaluation should be the presentation of your results and must contain the answers to the questions given in your tasks (\rightarrow sec.6, p.40). It should be kept short. For taking your data with you, please bring a USB stick with a minimum capacity of 4 GB.

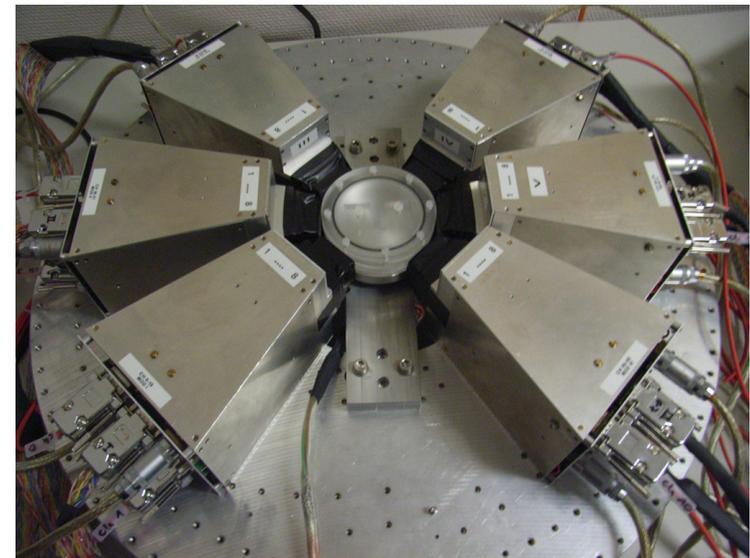


Figure 1: Image of the PET scanner for the lab course.