Project: Pixel detector Medipix MX-10

1. Introduction

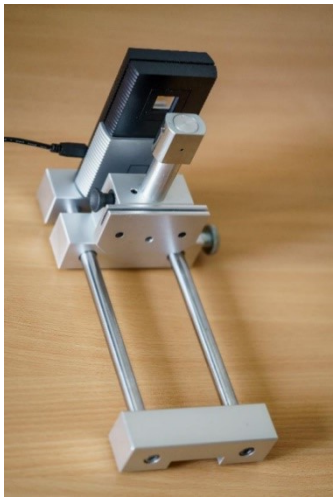
The project focuses on the advanced technology of pixel detectors. Medipix is a family of readout chips and detector assemblies for particle detection and imaging developed by the Medipix Collaborations (https://medipix.web.cern.ch). The original concept of Medipix is that it works like a camera, detecting and counting each individual particle hitting the pixels when its electronic shutter is open. This enables high-resolution, high-contrast, low noise images — making it unique for imaging applications. Pixelman software for control and evaluation of Medipix/Timepix detectors was developed and licensed by the Institute of Experimental and Applied Physics (IEAP) of the Czech Technical University in Prague. The R/O interface MX-10, based on the Medipix/ Timepix detector, is produced by the Czech company Jablotron in cooperation with IEAP.

Students will learn how to work with a pixel detector, set the measurement parameters, and evaluate their own measurements. The basic types of radiation of several emitters will be distinguished according to the measured tracks. Students will also examine the radiation background including cosmic rays (muons). They will learn how to build simple experiments for the examination of the properties of radioactivity.

2. Description

Students' workplaces will be equipped with a MX-10 Edukit set. At first, students will learn how to control the pixel detector, understand the measured data, and draw charts under the guidance of a supervisor. Afterwards, they will independently perform their own experiments.

Students will present the results of their own measurements during the final presentation.



3. Practice plan

- Introduction
  - Theory
  - Medipix MX-10
  - Weak radiation sources: uranium glass, thorium rod, potassium sulfate
- Alpha radiation from ^{241}Am source
  - Introduction to ^{241}Am, particle beam collimation
  - Alpha particles energy loss in air
  - Alpha particles energy loss in matter
- Gamma radiation from ^{241}Am source
  - Spectrum, cross-section, energy loss in air
  - Energy loss in matter, radiography, X-ray fluorescence
- Natural background radiation, radon
- Preparation of the final presentation

4. Prerequisites

- Knowledge of school mathematics and physics.
- Basics of computer knowledge: MS Windows, MS Office (especially PowerPoint), plotting charts in MS Excel or Origin (desirable).
- If possible, to have a personal laptop with MS Windows, Office, and Origin installed.

5. Recommended number of participants

4 persons recommended, 8 persons maximum (2 persons per one detector kit in this case).

6. Supervisors

Dr Kirill Gikal, senior engineer of the Scientific-Engineering Group of the JINR University Centre.
Mr Lev Pavlov, engineer of the Scientific-Engineering Group of the JINR University Centre.
Mr Konstantin Timoshenko, engineer of the Scientific-Engineering Group of the JINR University Centre.

7. Recommended literature

[1] V. Vicha. Experiments Using Pixel Detectors in Teaching Nuclear and Particle Physics.
[2] F. Knoll. Radiation detection and measurement.