Microdosimetry and nanodosimetry with silicon and GEMPIX detectors

GEMPIX is a new-concept detector which is made of three layers of gas electron multipliers (GEM). In such a detector, the ionizing charge is collected and read by a chip of 250,000 channels (Medipix). The total active area is 10 cm^2. The goal of the proposed experiment is to test the GEMPIX detector as microdosimeter, as interaction analyser and as a nanodosimeter.

In the case of microdosimetry, the detector will be supplied with a tissue-equivalent gas in order to measure the energy deposition in a material equivalent to 20-30 human cells. Thanks to the detector spatial resolution of 50 µm, a very accurate reproduction of the dose deposited inside a cell can be achieved. Tests will be done with a sample of real tissue inside the gas gap in order to study the use of GEMPIX as interaction analyser. The Medipix chip will be configured in such a way that both the spatial distribution of charged particles and their time of arrival are traced and analysed.

For the study of GEMPIX as interaction analyser, a sample of real tissue will be inserted in the gas gap. The charged particles produced by the interaction of neutrons with the sample will be reconstructed in 3D with a 50 µm resolution. The active volume of the detector is 40 cm3.

To assess the feasibility of using GEMPIX for nanodosimetry, the detector will be inserted in a vacuum chamber and irradiated with a proton beam. The mechanical resistance will be improved in order to use a tissue-equivalent gas with a very low pressure. By doing so, the resolution of the detector will be in the range from 20 to 50 nm, which should be adequate for nanodosimetry measurements. This measurement campaign will aim at counting the number of charges produced by delta rays, as a function of the distance from the trajectory. Results will be compared with those from other nanodosimeters, which were tested under similar irradiation conditions.