## Abstract

This dissertation contains a detailed research of new types of Silicon Photomultipliers which have been developed at the beginning of this century. The author was responsible for measuring new types of silicon photomultipliers (SiPM) which were planned to be used as photosensors in the new calorimeter—ECAL0 in COMPASS experiment in CERN. The prototype of the calorimeter was equipped with Micropixel Avalanche Photodiodes (MAPD detectors from Zecotek), the final detector uses MPPC S12572-010 photosensors from Hamamatsu.
First chapter contains a detailed description of both detectors and examples of their usage in high energy physics experiments. To perform measurements and simulations of detectors, a special automated system with low noise front-end electronics has been designed. The thesis contains a description of the system which consists of three subsystems: low noise front-end electronics with data acquisition system, light source and light spot positioning system and temperature regulation system. Work contains a detailed description and schematic of discrete-elements-based charge sensitive amplifier (CSA). Electrical models of both MAPD and MPPC detectors have been proposed and confirmed with electrical measurements of impedance. A set of histogram based measurements has been performed. The main measured parameters are: electron gain, dark rate, relative photon detection efficiency and correlated noise. A new quenching mechanism of MAPD detector was a motivation to measure and analyse the recovery time. The results have shown that MAPD has very long recovery time and non-exponential recovery characteristic. Electron gain measurements showed that electron gain calculated from dark pulses is smaller due to long recovery time. A special care has been taken to measure the parameters uniformity of detectors. One chapter contains results of spacial distribution of parameters measured with both CSA and fast amplifier. Results of scans with histogram collection showed that the PDE (Photon Detection Efficiency) of MAPD is changing over the surface of the detector. Scans of signal shape revealed that the shape of the MAPD signal is dependent on the position of light flux due to thin contact layer. The simulation of contact layer has been performed and compared with measurement data. A big part of this thesis is a model description and Monte Carlo simulations of Geiger discharge probability in SiPM detector. The model has been based on the MPPC detector. The simulation results contain Geiger discharge probability dependency on the applied supply voltage and the position of primary charge and spectral sensitivity simulation of the model. The results of this work could be very useful for experiments willing to use new types of SiPM photosensors in new detectors systems.