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Radiation hardness study of the Philips Digital Photon Counter with 800 MeV/c protons

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The Philips Digital Photon Counter (DPC) is considered as a possible photon sensor in RICH detector for Forward spectrometer of PANDA experiment at FAIR. Known issue of Geiger-mode APD is its radiation ageing. Two DPC tiles were tested using 800 MeV/c protons. Increase of dark counting rate with proton fluence up to 4*10^11 cm^-2 has been measured as well as a probability of single event effects. The dependencies of dark counting rate on the temperature before and after irradiation have been compared.

Summary

Digital Photon Counter (DPC) developed by Philips Digital Photon Counting combines array of Geiger-mode avalanche photodiodes and readout electronics on a silicon die using convetional CMOS process technology. Readout chain includes TDC with 20 ps bin and 4 counters for measurement of fired cells numbers as well as logic for event trigger. An array of 4x4 dies is mounted on a tile PCB equipped with an FPGA for event processing and an SPI flash memory for storage of calibration parameters. One of the main advantages of the DPC is a possibility to disable noisy cells.
We consider DPC as a promising photon sensor for aerogel RICH detectors for the Forward spectrometer of the PANDA experiment at FAIR and for the Super Charm-Tau factory project at BINP (Novosibirsk). Known issue of Geiger-mode APDs is an increase of dark counting rate under irradiation. We tested radiation hardness of DPC using a proton beam facility at the COSY accelerator.
Two DPC-3200-22-44 tiles were irradiated by protons with 800 MeV/c momenta up to the fluence of 4*10^11 protons per square cm. Increase of dark counting rate by 4 orders of magnitude has been observed. The dependencies of dark counting rate on the temperature before and after irradiation have been compared. A probability of readout errors induced by radiation (single event effects) has been measured.

Autore principale: Sig. BARNYAKOV, Mikhail (Budker Institute of Nuclear Physics)

Coautore: Dr. DEGENHARDT, Carsten (Philips Digital Photon Counting); KUYANOV, Ivan (Budker Institute of Nuclear Physics); Sig. KONONOV, Sergey (Budker Institute of Nuclear Physics SB RAS); Dr. FRACH, Thomas (Philips Digital Photon Counting); PRISEKIN, Vyacheslav (Budker Institute of Nuclear Physics)

Relatore: Sig. BARNYAKOV, Mikhail (Budker Institute of Nuclear Physics)

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