

Development of microlens-enhanced SiPMs

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The LHCb experiment at CERN has been upgraded for the Run 3 operation of the Large Hadron Collider (LHC). A new concept of tracking detector based on Scintillating Fibres (SciFi) read out with multichannel silicon photomultipliers (SiPMs) was installed during its upgrade. One of the main challenges that the SciFi tracker will face during its operation is the high radiation environment due to fast neutrons. In view of LHCb Upgrade II in 2033, the radiation levels will increase significantly and the SciFi tracker must undergo a major upgrade. A novel concept of adding microlenses at the wafer level aligned to the SiPM pixelised structures has been developed. The microlens enhance the PDE of the SiPM significantly and reveal advantages for correlated noise and timing performance. A simulation to optimise the microlens implementation parameters has been validated. It allows us to evaluate the microlens performance as a function of incident light angular distribution and geometrical properties of the pixel implementation. An overview of the results obtained, the future possibilities, and an outlook of our activities with FBK and Hamamatsu are given

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Authors: CURRAS RIVERA, Esteban (EPFL - Ecole Polytechnique Federale Lausanne (CH)); ZAFFARONI, Ettore (EPFL - Ecole Polytechnique Federale Lausanne (CH)); RONCHETTI, Federico (EPFL - Ecole Polytechnique Federale Lausanne (CH)); ZUNICA, Gianluca (EPFL - Ecole Polytechnique Federale Lausanne (CH)); HAEFELI, Guido (EPFL - Ecole Polytechnique Federale Lausanne (CH)); LIBERADZKA-PORRET, Joanna (EPFL - Ecole Polytechnique Federale Lausanne (CH)); GEORGE, Morgan (EPFL - Ecole Polytechnique Federale Lausanne (CH)); TIMOTHEE, Perrin (EPFL - Ecole Polytechnique Federale Lausanne (CH)); HANNON, Sophie (EPFL - Ecole Polytechnique Federale Lausanne (CH))

Presenter: HAEFELI, Guido (EPFL - Ecole Polytechnique Federale Lausanne (CH))

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