

Electro-optical characterization of the first RGB-UHD SiPMs for improved radiation hardness

We characterized the RGB SiPMs with Ultra-High-Density cells (RGB-UHD) manufactured at Fondazione Bruno Kessler (FBK), Trento. The devices feature circular cells, with a pitch of 7.5 μm , 10 μm and 12.5 μm , corresponding to a cell density of 20500, 11500 and 7400 cells/mm², respectively. Depending on different layout splits that we tested, the fill factor (FF) of the cells varies between 33% and 57%, for the 7.5 μm cell, and between 47% and 68%, for the 10 μm cell. These cells have a very small capacitance and gain, thus featuring very fast recovery time, lower correlated noise and less sensitivity to radiation damage, when compared to larger cells built with a similar technology. Such characteristics are of great interest in applications that require high dynamic range and/or good resistance to radiation damage, such as the CMS ECAL upgrade. We tested samples of the UHD-SiPM technology, featuring a circular active area with 1.5 mm diameter. The experimental characterization showed that all the cell sizes and layout splits were working and capable of single-photon resolution. The microcell recharge time constant was 3.5 ns and 4.5 ns, for the 7.5 μm and 10 μm cells, respectively. At an overvoltage of 6 V, we measured an Excess Noise Factor below 1.1 for all cells and a DCR in the order of 200 KHz/mm². The PDE at 515 nm was 22%, 26% and 29%, for the 7.5 μm , 10 μm and 12.5 μm cells, respectively, which are very high values, considering the small cell sizes.

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