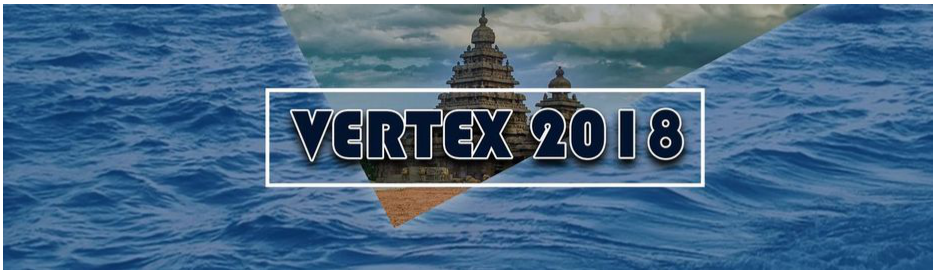

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Radiation tolerance and time resolution of depleted CMOS sensors

Depleted CMOS sensors, also known as Depleted Monolithic Active Pixel Sensors (DMAPS), are extremely attractive for particle physics experiments. As the sensing diode and readout electronics can be integrated on the same silicon substrate, DMAPS suppress the need for hybridization and this results in thin detectors with reduced production time and costs. High Resistivity (HR) substrates and High Voltage (HV) processes are used to manufacture these detectors and thus achieve high radiation tolerance and speed. Today's most performant DMAPS in HR/HV-CMOS are 50 µm thick, with 5 x 10^{15} 1MeV n_{eq}/cm^2 radiation tolerance and 15 ns time resolution. These detectors have been adopted as the sensor technology of choice for the Mu3e experiment and are under consideration for the planned Phase-II Upgrade of the ATLAS experiment at the Large Hadron Collider (LHC).

In spite of the major improvements demonstrated by DMAPS, further research to achieve even more performant sensors is needed to realize the full potential of the extremely challenging particle physics experiments planned and foreseen for the future. In this context, the CERN-RD50 collaboration has identified the study of depleted CMOS sensors as one of its main priorities. Key areas explored within RD50 focus on radiation tolerance and time resolution. Measurements done within the collaboration show that thin DMAPS with backplane processing to apply the HV to the substrate present improved performance after irradiation. Apart from this, and following from work in the wider community, specific developments within RD50 have already started with the prototyping of DMAPS in the 150 nm HV-CMOS technology from LFoundry S.r.l. A large area demonstrator with several matrices of pixels is currently being designed. Amongst other features, the matrices implement novel methods to improve the time resolution of the sensor to ideally the sub-nanosecond range. Targeting a radiation tolerance beyond 10^{16} 1MeV n_{eq}/cm^2, an extensive irradiation campaign is foreseen to evaluate the performance of the demonstrator manufactured in different substrate resistivities with standard topside and post-processed backside biasing. Further details will be provided during the workshop.

Primary authors: VILELLA FIGUERAS, Eva (University of Liverpool (GB)); RD50 COLLABORATION (RD50)

Presenter: VILELLA FIGUERAS, Eva (University of Liverpool (GB))