Multiphysics Studies for the Micromegas Detector

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Abstract

The "Micromegas" (Micro-MEsh Gaseous Structure) detector is a gaseous particle detector, developed by G.Charpak and I.Giomataris, is mainly used in experimental physics and in particular for the detection of ionizing particles. This gas volume is divided by a metallic micro-mesh placed between 25 μm and 150 μm of the readout electrode strips. Owing to it its unique characteristics the Micromegas has been selected as one of the two detector technologies that will be deployed in the New Small Wheel upgrade project of the ATLAS experiment at CERN LHC. The Micromegas will be primarily used as a precision chamber and will also provide triggering information. A charged particle passing through the chamber's volume ionizes the gas consequently causing an avalanche of charged particles (ion-electron pairs). The energy that deposited on the strips is affected from the two main operational parameters, the electric field and the gas gain which play an important role on the detector's efficiency. Here we present studies of the electric field configuration that guides the electrons to the strips through the mesh and its importance. Furthermore analysis of the gas propagation inside the chamber for different gas distribution schemes has been done. Micromegas uses a new technique for the gas distribution, the so called buffer zones. These areas are the "vestibule" of the gas mixture distribution inside the volume of the detector, providing the correct conditions in order to have a laminar flow. This configuration will firstly ensure the complete fill of the detector's volume and secondly to avoid "inefficient areas" which will cause a decrease in the detector's efficiency. All the various studies which have been crosschecked with the COMSOL Multiphysics® software, are in a good agreement with the predicted theoretical models.