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A Zero Ion Backflow electron multiplier operating in noble gases

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We present a new concept for the suppression of the secondary ions in gaseous detectors. The Zero Ion Backflow electron multiplier operates in a noble gas atmosphere and supress the ion backflow to the level of the primary ionization, totally blocking the secondary ions that are produced in the multiplier. This detector is composed by a proportional scintillation region, composed by two highly transparent meshes, followed by a gaseous photon-multiplier. The primary electrons drift through the proportional scintillation region under the influence of an electric field below the ionization threshold of the gas, emitting electroluminescence without the production of secondary ions. The electroluminescence signals are collected by the gaseous photon multiplier, composed by a gaseous electron multiplier coupled to a CsI phothocade, and further amplified by electron avalanche. The positive ions that result from electron avalanches in the gaseous photomultiplier are prevented from reaching the conversion region by an electrostatic separation between the proportional scintillation region and the gaseous photomultiplier. The ion back flow is therefore reduced to the level of the primary ionization and is totally independent on the electron avalanches that occur on the gaseous photomultiplier.

Summary

We present the results obtained with the Zero Ion Backflow electron multiplier operated in pure Xenon equipped with a proportional scintillation region of 6 mm. The gaseous photomultiplier is composed by a double GEM cascade coupled to a CsI photocathode, separated from the proportional scintillation region by an extraction region with 2 mm. The transference of the secondary ions from the gaseous photomultiplier to the proportional scintillation region is dependent on the electric field between these two regions, EExtraction, that also influences the photoelectron extraction from the CsI photocathode. We have determined the influence of this field on the levels of ion backflow and on the photo-electron extraction. A value between 0.1 and 0.2 kV/cm*bar was found to ensure simultaneously maximum relative photoelectron extraction and full ion backflow suppression. Energy resolution of 17% was measured when irradiating the detector with 5.9 keV x-rays.

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