Performances of a GEM-based TPC prototype for new high-rate particle experiments

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Abstract

The main aim of AMADEUS is to confirm or deny the existence of kaonic cluster, studying it in the formation and decay processes. Either situations: existence or non-existence of the deeply bound kaonic nucleus will have strong impact in kaon-nucleon/nucleus physics.

The Gas Electron Multiplier (GEM) detector has been successfully used as a central tracker at the 11th Pisa Meeting of particle physics detectors. Despite the high energy of the beam, the GEM detector has shown good performance in terms of spatial resolution and charge collection. The results are compatible with those simulated with Garfield 2.0, a Monte Carlo simulation program for detector design.

Conclusions

The R&D activity on TPC detector equipped with GEMs for the inner part of the AMADEUS experiment is ongoing. A prototype with a reduced drift gap has been successfully tested at the BTF facility with Ar/CO$_2$/CF$_4$ gas mixture and successfully tested at the BTF facility with Garfield. A good resolution along the beam direction (z-coordinate), sufficient for a large scale TPG in AMADEUS, is achieved.

Simulation Studies: gas mixtures & field cage design

The choice of the gas mixture plays an important role in the TPG resolution, which is a compromise between high drift velocity, low electron diffusion, high radiation X$_0$, and no ageing. Drift velocity, longitudinal and transverse diffusion have been simulated for different gas mixtures.

To provide a highly uniform electric field in the drift region, the design and the electrical properties of the Field Cage have been simulated with Garfield. The first design has been tested at BTF + LNF.

Conclusions

The R&D activity on TPC detector equipped with GEMs for the inner part of the AMADEUS experiment is ongoing. A pre-existing TPG prototype with a reduced drift gap has been successfully tested at the BTF facility with Ar/CO$_2$/CF$_4$ gas mixture and successfully tested at the BTF facility with Garfield. A good resolution along the beam direction (z-coordinate), sufficient for a large scale TPG in AMADEUS, is achieved.

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