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Parametrized simulation of the micro-RWELL response with PARSIFAL software

Monday 24 October 2022 16:10 (30 minutes)

PARSIFAL (PARametrized SImulation) is a software tool originally implemented to reproduce the complete response of a triple-GEM detector to the passage of a charged particle, taking into account the involved physical processes by their simple parametrization and thus in a very fast way.
Robust and reliable software, such as GARFIELD++, is widely used to simulate the transport of electrons and ions in the gas and all their interactions step by step, but it is CPU-time consuming. The implementation of PARSIFAL code was driven by the need to reduce the processing time, while maintaining the precision of a full simulation.
The software must be initialized with some parameters that can be extracted from the GARFIELD++ simulation, which must be run once-and-for-all. Then it can be run independently to provide a reliable simulation, from the ionization, to diffusion, multiplication, signal induction and electronics, only by sampling from a set of functions which describe the physical effects and depend on the input parameters.
The code has been thoroughly tested on triple-GEM detectors and the simulation was finely tuned to experimental data collected at testbeam.
Recently, PARSIFAL has been extended to another detector in the MPGD family, the micro-RWELL, thanks to the modular structure of the code. The main difference in the treatment of the physical processes is the introduction of the resistive plane and its effect on the formation of the signal. For this purpose, the charge spread on the resistive layer has been described following the work of M. S. Dixit and A. Rankin (NIM A518 (2004) 721-727, NIM A566 (2006) 281-285) and the electronics readout (APV-25) was added to the description.
A fine tuning of the simulation is ongoing to reproduce the experimental data collected during testbeams. A similar strategy already validated for the triple-GEM case is used: the variables of interest for the comparison of the experimental data with simulated results are the cluster charge, cluster size and the position resolution obtained by charge centroid and micro-TPC reconstruction algorithms. In this case, special attention must be paid to the tuning of the resistivity of the resistive layer.
An illustration of the general code, setting the focus on this latest implementation and the first comparison with experimental data from testbeam are the subject of this contribution.

Experiment context, if any

FCC-ee/CepC IDEA, EURIZON (EU H2020 project)

References

- PARSIFAL for triple-GEM was presented by R. Farinelli, “A fast and parametric digitization for triple-GEM detectors” ACAT 2019
- PARSIFAL for micro-RWELL was presented by R. Farinelli, “A parametric simulation of the micro-RWELL detector”, RD51 June 2022 Collaboration Meeting, CERN

Significance

PARSIFAL software has been originally developed for the simulation of the response of a triple-GEM, within the project for the development of a Cylindrical GEM Inner Tracker for the BESIII experiment. The code has been tested on triple-GEM detectors and the simulation was finely tuned to experimental data collected at testbeam.
Recently, PARSIFAL has been extended to micro-RWELL, due to the modular structure of the code, as they also are micro pattern gas detectors.
PARSIFAL important feature is that it allows for reliable simulations of a triple-GEM and of a micro-RWELL reducing significantly the CPU-time with respect to full physics simulators, as GARFIELD++.

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