The Research Group

Elementary Particle Physics

has the honor to invite you to the public defense of the Ph.D. thesis of

Djunes Janssens

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:
Resistive Electrodes and Particle Detectors: Modeling and Measurements on Novel Detector Structures

Promotors:
Prof. dr. Jorgen D'Hondt

The defense will take place on

Monday, February 26, 2024 at 15h00 in auditorium L.2.04.

The defense can be followed through a live stream: contact djunes.janssens@vub.be for more information.

Members of the jury

Prof. dr. Michael Tytgat (VUB, chair)
Prof. dr. Jorgen D'Hondt (VUB, secretary)
Prof. dr. Frey Blekman (VUB)
Prof. dr. Thierry Gevaert (VUB)
Dr. Inna Makarenko (VUB)
Dr. Werner Riegler (CERN)
Dr. Victor Coco (CERN)
Dr. Paulo Jorge Ribeiro Da Fonte (Instituto

Curriculum vitae

Djunes Janssens graduated as a Master in Physics and Astronomy from the Vrije Universiteit Brussel in 2020. Within the context of the CERN doctoral student program, he subsequently started a Ph.D. in the CERN EP-DT-DD GDD team on the simulation and measurement of novel particle detectors containing resistive elements. This research resulted in four peer-reviewed publications in international journals, and he was awarded the 2022 Georges Charpak Young Scientist Award. During his Ph.D., he mentored CERN summer students and organized various laboratory workshops.

Abstract of the PhD research

Advancements in nuclear, particle, and astroparticle physics are intricately intertwined with technological progress in experimental instrumentation, particularly in the case of detectors used for precision measurements of the properties of particles. Furthermore, their use in radiation imaging fosters advancements in biomedical and material sciences. An emerging direction of development involves integrating resistive materials into detector architectures to enhance their performance and durability, thereby ensuring compliance with the stringent requirements for measurement precision and operation in more challenging conditions anticipated in future High Energy Physics (HEP) experiments.

Continuous advancements in modeling and simulation tools, such as Garfield(++), have guided the widespread development and understanding of detector structures. Since new sensor technologies are proposed regularly, with resistive detectors becoming an ever-increasing fraction of these, it is prudent to reflect this progress in the capabilities of the modeling tools. Up to now, the effects of components with finite conductivity have not been modeled adequately in the software tools that are used for simulating the signal in particle detectors. As part of this thesis, a new framework was developed that is applicable to the wide range of detectors that are inaccessible through analytical means. Laboratory and test beam measurements are used to adjust and validate the simulation framework. Subsequently, the methodology is employed to test and optimize the response of various innovative particle detector readout structures.

Through simulation and measurement, we have explored novel solutions in the field of Multi-gap Resistive Plate Chambers, Micro Pattern Gaseous Detectors, and solid-state sensors, arising from the implementation of materials with finite conductivity. In addition to deepening the understanding of existing structures, these studies are necessary for designing and optimizing the next generation of particle detectors and their application to specific needs driven by HEP experiments and other applications.