

Project Summary

Project titled “**Developing Stage of Gas-Filled Detectors for High Energy Physics Using Simulation Packages and Machine Learning Techniques.**”

Project Summary

- The project aims to develop new tools and methodologies in the field of high energy physics that would help in the study of unanswered questions in particle physics and cosmology.
- “Lots of these unanswered questions can be addressed by identification of particles that are produced in particle colliders.”
- “By studying the effect of the new particles on the particle detectors through simulations, we can infer the possibility of detection of these particles in the experiments which would help the scientific community in solving problems that remain unsolved till today.”
- “Particle identification is achieved using some specific instrumentations named particle detectors as an example for these detectors, the thick GEM, which is an up-to-date detector that is currently being developed through many laboratories experimental work.”
- “The use of advanced computational techniques is a basic requirement regarding this development.”
- “Compared to the laboratory experimental work, computer simulations help in making these developments more economical yet less time consuming.”

Objectives

- “In this project we are proposing the development of two types of state-of-art detectors for specific applications.”
- “Thick GEM, which is a newly proposed detector for Muography applications due to its rigidity and physical strength.”
- “The other type is the improved RPC (iRPC).”
- “Our study proposes measuring the response of the iRPC to a type of undiscovered particles called ‘Fractionally charged particles’.”
- “Since the project aims to study new physical phenomena that are yet to be discovered, one way we could do this is through searching for new particles in particle accelerators.”
- “This is by analyzing the data that comes from particle physics experiments like the CMS experiment.”
- “The tools used for this objective are computational tools like Monte-Carlo simulations and optimization algorithms like machine learning.”
- “In this context, the objective of this project is to enhance the performance of the reinforcement learning algorithm by incorporating a balanced exploration-exploitation with mirror descent policy optimization method.”

Funding Agency STDF

Expected Outcomes

From an academic point of view, we are expecting that this project with its students would graduate with a total number of three thesis, one PhD thesis and two MSc theses. The PhD would publish at least two international journal articles, and the MSc would publish at least one international journal article for the aim of graduation. This gives a total of four international journal articles, three in the theoretical physics field, and one in computer science field.

Otherwise, the analysis part expected to perform number of three papers, by the rate of one paper per year. The THGEM task could provide a number of two papers among the duration of the three years.

This project could be considered as a multidisciplinary and cross-institutional research work, it is compressing computational physics techniques with the brunch of machine learning to provide an economic and waste-less resources strategy for the development of radiation detection instrumentation. This serves the enhancement of our eco-environment global goal.

This project is relevant to the technical and intellectual development of society from the perspective of encouraging the concept of pre-developing stage. A workshop planned to approach an efficient spreading of knowledge.

This project serves the encouragement of the substitution of computational research tools by the pure laboratory techniques in a nonfunded and time restricted research environments, a mentioned earlier, radiation detection instrumentation development is considered as an expensive, man-effort and resource wasting field. This project utilizes several simulation packages to perform such studies in the most economical manner.

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