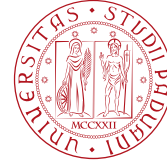




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PhD course of National Interest in Technologies for
Fundamental Research in Physics and Astrophysics

Annual report

Name and surname: Saba Imtiaz
Cycle and a.a.: 38th Cycle
Supervisor: Paolo Soffitta & Fabio Muleri

Describe the aim of the project (very briefly), discuss the research activity carried out during the year mentioning the difficulties encountered until now and the actions taken to face them. (1 page max in total).

“Improving and expanding the capabilities of X-ray Polarimetry beyond IXPE (The imaging X-ray Polarimetry Explorer)”

Aim of the Project:

The aim of this research is to improve and expand the capabilities of X-ray polarimetry beyond the capability of IXPE, to develop a photoelectric polarimeter suitable for space applications by studying the physics and readout electronics of a gas detector based on the TimePIX3 ASIC. The research focuses on advancing the understanding and perform simulation of detector system, comparing the simulated with real calibration data to enhance accuracy. We are seeking to explore photon detection technique, particularly using gas detectors and application-specific integrated circuits (ASICs), to improve the efficiency and reliability of X-ray polarimetry.

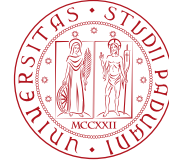
Research Activities carried out

I have conducted the detailed review of the relevant literature to deepen my understanding of the topic. Additionally, I will perform extensive data analysis using python to interpret experimental results effectively.

To foster my research, I tried to understand GEANT4 interface in order to



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understand simulations about behavior of photo-electron track in details.

Difficulties Encountered

After reading the literature, I was facing some misconceptions and questions about the project. Secondly as a newcomer to programming, I encountered challenges in interfacing with GEANT4 and coding in python. The learning curve was steep. its was difficult to effectively integrate these tools into my research initially.

Action takes to face difficulties

To address these challenges, Under the kind supervision of Paolo Soffitta and Fabio Muleri, who provided exercises and tasks that helped me grasp the basics of GEANT4. I also relied on additional materials and slides they shared, which were instrumental in enhancing my understanding. We have conducted several meetings and discussion sessions to discuss about the articles and literature survey, which improve my deep understanding about project



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List of attended courses and passed exams

Course Title	Credit Hours.	Status
1. Front end electronics and DAQ system for radiation detection HE5	1.5	passed
2. Advanced Electronics Sensing Devices	2	passed
3. Gaseous detector for experimental particle physics	2.5	continue
4. Machine Learning programming in physics	2.5	start from 1 st oct
Additional Courses		
● Design of readout integrated circuits for particle detector	2.5	start from Nov 4 th
● Italian language Course	-----	continue

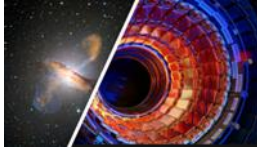
List of attended conferences, workshops and schools, with mention of the presented talks

> **Attended conferences**

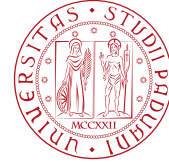
- (I) INAF/OAPD Seminar
- (ii) Bologna Joint Astrophysical Colloquium
- (iii) Astrometing Seminar OACN
- (iv) Osservatorio Astronomico di Roma

> **Summer School**

I plan to attend a summer school on "X-Polarimetry" in May 2025, which will be held in L'Aquila.



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List of published papers/proceedings

Soffitta, P., Costa, E., De Angelis, N., Del Monte, E., Desch, K., Di Marco, A., ... & Weisskopf, M. C. (2024). Considerations on Possible Directions for a Wide Band Polarimetry X-ray Mission. *Galaxies*, 12(4), 47. <https://doi.org/10.3390/galaxies12040047>

Thesis title (even temporary)

Thesis entitled as: Improving and expanding the capabilities of X-ray Polarimetry with the IXPE (2-8 keV Low energy Polarimeter LEP)”

.....

Date, 3-09-2024

Signature

Research Group Head Signature:

Supervisor Signature :