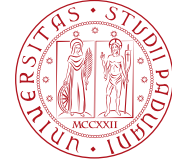




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DI PADOVA

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

Annual report

Name and surname: Ammad UI Islam
Cycle and a.a.: XXXIX 2023-2024
Supervisor: Andrea Fabbri

- **Research activity carried out during the year**

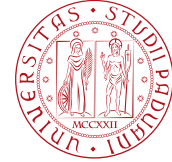
Most pattern recognition applications are computationally intensive and due to sequential nature of conventional processors slowdowns the performance. Different computations in processing limits parallelization while in most of the applications specifically, in high energy physics experiments real time performance is required. Field Programmable Gate Arrays(FPGAs) are very commonly used in real time performance experiments due to its reconfigurability, flexibility, processing speed due to more raw computational power and the ability to implement parallel architectures and more shorter cycles. The proposed project aims to implement pattern recognition algorithms based on artificial intelligence on latest generation FPGA devices. The proposed algorithms will be deployed on the data acquired from experimental setup of Jiangmen Underground Neutrino Observatory (JUNO)/Taishan Antineutrino Observatory (TAO).

During the first year the focus was on visa, courses and literature review. While in Parallel some steps were taken to understand the experiment thoroughly. In the first step I have learned about the experimental setup, basic structure and configuration of the JUNO/TAO full chain prototype. Also I studied and learned about the JUNO/TAO experimental site, the detector will be placed inside a Nuclear Power Plant.

In the second step data were acquired from a mock-up realized at Roma Tre for signal processing on a single channel of TAO. The data will be used to investigate optimal filtering



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solution to improve energy resolution and signal to noise ratio. Noise rejection techniques will be applied in parallel with trigger algorithms when more channels will be taken into account. The optimal solution tested on single channel data will be further expanded to the whole 8100 channels. The challenges that may be faced while expanding to the whole channels will be optimized by introducing new methods to mitigate the dark noise coming from the SiPM sensors that cannot be neglected when 11 squared meter will be considered.

- **List of attended courses and passed exams**

- Machine Learning for Physics
- High Energy Particle Physics Detectors in Space



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

- PhD Educational Week
 - RESEARCH, INTELLECTUAL PROPERTY AND EXPLOITATION: THE PHD PERSPECTIVE
 - BUSINESS INCUBATOR AND STARTUP ACCELERATOR PROGRAMS: UNIVERSITY-BORN ENTERPRISES
 - HOW TO THRIVE IN YOUR CAREER OUTSIDE: ORIENTEERING FOR PHD IN THE EXTRA-ACADEMIC JUNGLE
 - FUNDING OPPORTUNITIES FOR POSTDOCS WITH A FOCUS ON MSCA-PF
 - TOP TIPS TO ACCESS TODAY'S LABOUR MARKET: PERSONAL BRANDING, SOCIAL RECRUITING AND AI
 - MANAGING THE COMPANY OF THE FUTURE: MANAGEMENT, STRATEGIC AND ORGANIZATIONAL SKILLS
 - WRITING A CV OUTSIDE THE ACADEMIA
 - STRATEGIES AND TOOLS FOR CAREER DEVELOPMENT IN RESEARCH: THE NEW EUROPEAN CHARTER FOR RESEARCHERS, EURAXESS, INTERNATIONAL FOUNDATIONS
- PhD Kick Off Meeting

• **List of published papers/proceedings**

• **Thesis title (even temporary)**

- Pattern recognition development on FPGA through AI in harsh environment

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Date, ... 10/09/2024

Signature...

Seen, the supervisor