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Cover Letter

Dear Prof. Marcus Brüggen and Prof. Gregor Kasieczka

I am writing this letter to express my strong interest in the Ph.D. for the Project "PUNCH4NFDI" Machine Learning in Particle and Astrophysics.

I graduated last year with a Master's degree in "high energy physics, astrophysics and computational physics" from Cadi Ayyad University in Morocco.

I feel comfortable processing several challenging things at once. This ability helped me to be successful in my studies (2nd in my master's class) and acquire extra-curricular knowledge in the computer science field (about 5 years of experience with programming),

Since my childhood, I have always been interested in discovering how things work. So I chose to study physics, like many children. I always dreamed of winning a Nobel Prize in Physics, but as I grew up, I switched to a more realistic dream : to become a university researcher.

My interest in programming started about five years ago when I had my first contact with computer coding in school by creating a small website. From there, I gained extracurricular programming skills in C++ and Python, and I also gained skills in data analysis, machine learning, and lately in deep learning areas.

I worked on many research projects related to this thesis like Training a GAN neural network to produce events in conditions that replicate the proton-proton collisions at the Large Hadron Collider and the ATLAS detector. In this project, I consider a hypothetical analysis that uses $O(20)$ features of the final state of Drell-Yan events $Z \rightarrow \mu\mu$, e.g., lepton momentum vectors, isolation, and jet transverse moments. These events were generated using the PYTHIA8 event generator, then I used the GANs to learn the multidimensional distribution of these events and generate new events following the same distribution.

After the training, the module was successfully capable of generating events in less time than the normal MC generator. Generating the target dataset with PYTHIA and Delphes was $\sim$ 3600 times slower, and the Gan model is stored in a file of less than 10 MB, whereas the PYTHIA generated events occupy 2 GB, a reduction in the size of two orders of magnitude.

Unfortunately, I was not able to continue the project due to the lack of resources and support.

I was also involved in other projects related to particle physics and also astrophysics. Please find them on my attached CV

This thesis is an exact match to my research interests and the requirements for this Ph.D. thesis closely match my background and skills : machine/deep learning, data analysis, and particle physics. Also, I read some information and facts about the "PUNCH4NFDI" project and I discover that this is the place were I want to do my Ph.D. since the project targets a problem that I faced many times since the hep data is not optimal for modern deep learning tools like TensorFlow Keras and this project is the perfect solution and be part of a project like that is great motivation for me.

In addition, Hamburg University provides an ideal climate for me to develop my cross-disciplinary interests, particular in computer science and fundamental physics.

After completing my Ph.D., I plan to pursue a postdoc in the same field. My long-term goal is to be a tenured professor of machine learning in particle physics. With the help of my Ph.D., I am confident I will be prepared to become a leader in the field.

Thank you for considering my application. I look forward to hearing back from you.

Sincerely,