Scientific Area	High Energy Physics		
Project Title	Higgs to bb tagging		
Recruiting Institution	Humboldt University of Berlin		
PhD awarding Institution	Humboldt University of Berlin	**PhD Duration**	36 Months
Supervisor/Institution	Prof. Dr. Cigdem Issever / Humboldt University of Berlin		
Co-Supervisor/Institution	Prof. Dr. Simone Montangero / University of Padova		
Secondment(s)	University of Padova		

Project Description

At the Higgs mass of 125GeV the bb decay channel has the largest branching ratio. It is therefore a standard candle to Higgs tagging and hence extremely important to search for new physics and rare processes. Due to huge background that can mimic a Higgs boson decaying into a b-quark pairs the identification of a Higgs → bb process is challenging. Current Higgs taggers rely both on jet and particle track reconstruction, as well as more and more on machine learning techniques. The huge amount of data and non-collision backgrounds expected in the next data taking runs of the LHC, it is of utmost importance to use novel computational techniques to analyze the data. The potential of quantum computing for this purpose will be explored. To this end we will, depending on the most promising tagging method, construct a target Hamiltonian which in turn defines a cost function which is to be optimized.

Project Objectives

- Understand the major tagging methods for Higgs to bb employed by LHC experiments and benchmark their performance with simulations.
- Select the optimal tagging method which is suitable to be implemented for Quantum Computer Application
- Develop the Hamiltonian as the cost function for the selected tagging method.
- Run the problem on a quantum computer simulator without noise and with noise switched on.
- Run the problem on a real quantum computer.

Secondment: Training on Hamiltionian approaches using quantum computers at University of Padova

Required Candidate Qualifications

- Background in experimental particle physics.
- Programming experience, preferably in Python.
- Experience with simulations and/or HEP data analysis.
- Ideally initial knowledge in Quantum Computing.