

Scientific Area	High Energy Physics		
Project Title	Variational quantum computer simulations for quantum systems and optimization problems		
Recruiting Institution	DESY-Zeuthen		
PhD awarding Institution	Humboldt University Berlin	PhD Duration	36 Months
Supervisor/Institution	Dr. Karl Jansen/DESY-Zeuthen		
Co-Supervisor/Institution	Prof. Dr. Cigdem Issever/Humboldt University Berlin		
Secondment(s)	The Cyprus Institute		
Project Description			
<p>Robust and scalable optimization and error mitigation algorithms will be explored to perform practical quantum computations for models in high energy physics using QC infrastructure such as the ones at IBMQ or Rigetti. The error mitigation will be performed through analytical models that we have partly already developed for measurement errors and which can be extended to other sources of qubit errors, e.g. decoherence or depolarization. The models to be considered are abelian and non-abelian gauge theories coupled to fermionic matter with topological terms and chemical potentials added.</p>			
Project Objectives			
<ul style="list-style-type: none"> i) Extend error mitigation to other sources such as depolarization and decoherence ii) Formulate Hamiltonian of abelian and non-abelian gauge theories in $D=2+1$ dimension adding a topological and a chemical potential term. iii) Implement these models in IBM's Qiskit (or, alternatively, Rigetti's pyquil) library and test programme on the simulator iv) Execute programme on the real hardware device at IBMQ v) Publish results and write thesis 			
Required Candidate Qualifications			
<ul style="list-style-type: none"> • Background in theoretical high energy or condensed matter physics. • Programming experience, preferably in Python. • Experience with simulations. • Ideally initial knowledge in Quantum Computing. 			