

Scientific Area	High Energy Physics		
Project Title	Simulating Lattice Field Theories with Quantum Hardware		
Recruiting Institution	DESY Zeuthen		
PhD awarding Institution	Humboldt University of Berlin	PhD Duration	36 Months
Supervisor/Institution	Prof. Dr. Karl Jansen / DESY Zeuthen		
Co-Supervisor/Institution	Prof. Dr. Simone Montangero / University of Padova		
Secondment(s)	University of Padova		
Project Description			
<p>Variational quantum algorithms for addressing lattice field theories in 1+1, 2+1 and higher dimensions in regimes which are inaccessible with the conventional Monte Carlo approach will be developed. This concerns non-zero matter density, topological terms and possibly real time evolutions such as scattering processes. The focus lies on finding approaches suitable for noisy, intermediate-scale quantum devices, which in combination with suitable error mitigation methods allow for robust and scalable simulations of the Hamiltonian formulation. Simulations will be benchmarked on currently existing quantum hardware, such as IBM's superconducting quantum devices.</p>			
Project Objectives			
<ul style="list-style-type: none"> • Develop the Hamiltonian formulation for addressing lattice field theories in 1+1, 2+1 and higher dimensions in regimes which are inaccessible with the conventional Monte Carlo. • Run the problem on a quantum computer simulator without noise and with noise switched on. • Run the problem on a real quantum computer. <p>Secondment: Training on Hamiltonian approaches using quantum computers at University of Padova</p>			
Required Candidate Qualifications			
<ul style="list-style-type: none"> • Background in experimental particle physics. • Programming experience, preferably in Python. • Experience with simulations and/or HEP data analysis. • Ideally initial knowledge in Quantum Computing. 			