

## MOQS – MOLEcular Quantum Simulations

<b>Topic title</b>	Strongly correlated models on quantum computers
<b>Main host institution</b>	IBM Research, Switzerland <a href="https://www.zurich.ibm.com">https://www.zurich.ibm.com</a>
<b>Supervisor</b>	Dr. Ivano Tavernelli <a href="mailto:ita@zurich.ibm.com">ita@zurich.ibm.com</a>
<b>Co-Supervisor</b>	Dr. G. Pupillo (UNISTRA) <a href="mailto:pupillo@unistra.fr">pupillo@unistra.fr</a>
<b>Mentor<sup>1</sup></b>	Dr. T. Prosen (UL) <a href="mailto:tomaz.prosen@fmf.uni-lj.si">tomaz.prosen@fmf.uni-lj.si</a>
<b>Secondment institutions</b>	University of Saarland / FZJ, Germany (4 Months) University of Aquila, Italy (2 Months)
<b>Preferred starting date</b>	Upon agreement, latest possible starting date Oct. 2021
<b>Topic description</b>	
<p>This project will address the study of strongly correlated systems on a quantum computer. Among others, we will focus on the following points: <i>i</i>) Devise variational forms for VQE for the solution of classically intractable lattice models (fermions and frustrated bosons on lattices of different geometries) using quantum circuits inspired by tensor-network or neural-network states; <i>ii</i>) Investigate the advantage of the use of transcorrelated Hamiltonians and their efficient implementations in hardware calculations; <i>iii</i>) Investigate different quantum algorithms for the study of the dynamics of coupled fermion-boson models (in first and/or second quantization); <i>iv</i>) explore extensions to perform dynamics in the excited states.</p>	
<b>Recommended applicant's profile</b>	
<p>We are looking for a candidate with a five-year BSc+MSc degree in physics, quantum chemistry or applied mathematics. The candidate should have a good working knowledge of theoretical, mathematical, or computational quantum physics and/or quantum chemistry and at least some past exposure to quantum computing. An outstanding candidate will also have some background in at least one of the areas of programming (advanced Python), numerical simulation.</p>	

<sup>1</sup> Mentor: The primary role of the mentors will be to identify and facilitate specific training objectives, advise on any problems faced by the ESR, including career matters with an external perspective and provide mediation in the case of disputes.