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ICFO
The Institute
of Photonic
Sciences



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Master in Photonics – “PHOTONICS BCN” Master ERASMUS Mundus “EuroPhotonics”

MASTER THESIS PROPOSAL

Dates: April 2023 – July or September 2023

Laboratory: Quantum Optics Theory

Institution: ICFO – The Institute of Photonic Sciences

City, Country: Barcelona Spain

Title of the master thesis: Variational Quantum Simulations of quantum many-body systems

Name of the master thesis supervisor and co-supervisor:

Prof. Maciej Lewenstein

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Keywords: quantum many-body systems, entanglement, quantum correlations, tensor networks, deep learning, quantum circuits

Summary of the subject (maximum 1 page):

Objectives:

The objective of the project is to study quantum correlations in many-body quantum systems. The project will be devoted to application of variational methods for the classification of many-body systems with respect to depth of entanglement and Bell correlations in spin chain models.



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During the project Student will have possibility to familiarize with the state of the art computational methods, i.e. tensor networks, quantum machine learning (variational quantum circuits) and deep learning, necessary to accomplished research task belonging to the most forefront research directions in modern quantum sciences. The aquired set of skills will allow to apply for Ph.D. program in the field of quantum simulators, quantum machine learning and quantum technologies.

Additional information (if needed):

* Required skills:

- quantum mechanics
- scientific programming skills (Python/Julia)
- basics of neural networks and deep learning (familiar with PyTorch/Keras/Tensorflow libraries)
- basics of quantum circuits libraries (Qiskit/PennyLane/CIRQ)

* Miscellaneous: