Final report for scholarship no. PD/BD/52652/2014

Name of the student: Chrysoula Vlachou

Scholarship number: PD/BD/52652/2014

Supervisor: Prof. Paulo Mateus

Co-supervisor: Dr. Nikola Paunkovic

I have successfully concluded my PhD with distinction, on 7th September 2018, with the public presentation of the thesis entitled: “Quantum walks in cryptography and finite-temperature topological phase transitions”, which is attached along this report.

During the period of this scholarship from 1st September 2014 to 31st August 2018, I have completed the following courses along with the corresponding grades:

- Physics of Classical and Quantum Information: 18
- Quantum Information Technologies: 17
- Physics of Condensed Matter: 10
- Physics Seminar: 19
- Computability, Complexity and Information Theory: 18

The research work carried out during the aforementioned scholarship yielded the following publications:

1) **Reference:** C. Vlachou, J. Rodrigues, P. Mateus, N. Paunkovic and A. Souto, Quantum walks public-key cryptographic system, International Journal of Quantum Information **13**(6), 1550050 (2015).

URL: https://www.worldscientific.com/doi/abs/10.1142/S0219749915500501

2) **Reference:** B. Mera, C. Vlachou, N. Paunkovic and V. R. Vieira, The Uhlmann connection in fermionic systems undergoing phase transitions, Physical Review Letters **119**, 015702 (2017).

URL: https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.119.015702

3) **Reference:** B. Mera, C. Vlachou, N. Paunkovic and V. R. Vieira, Boltzmann-Gibbs states in topological quantum walks and associated many-body systems: Fidelity and Uhlmann parallel transport analysis of phase transitions, Journal of Physics A: Mathematical and Theoretical 50, 365302 (2017).

URL: http://iopscience.iop.org/article/10.1088/1751-8121/aa820e/meta

4) **Reference:** B. Mera, C. Vlachou, N. Paunkovic, V. R. Vieira and O. Viyuela, Dynamical phase transitions at finite temperature from fidelity and interferometric Loschmidt echo induced metrics, Physical Review B **97**, 094110 (2018).

URL: https://journals.aps.org/prb/abstract/10.1103/PhysRevB.97.094110

5) **Reference:** C. Vlachou, W. O. Krawec, P. Mateus, N. Paunkovic and A. Souto, Quantum key distribution with quantum walks, Quantum Information Processing **17**: 288 (2018).

URL: https://link.springer.com/article/10.1007%2Fs11128-018-2055-y

6) **Reference:** S. T. Amin, B. Mera, C. Vlachou, N. Paunkovic and V. R. Vieira, Fidelity and Uhlmann connection analysis of topological phase transitions in two dimensions, Physical Review B **98**, 245141 (2018).

URL: https://journals.aps.org/prb/abstract/10.1103/PhysRevB.98.245141

As part of this scholarship I have also visited the group of Marcus Huber at the Institute for Quantum Optics and Quantum Information (IQOQI) in Vienna (Austria) from the 1st October 2017 to 31st December 2017 and the Theoretical Physics Research Group at the University of Leeds (Leeds, United Kingdom) from the 1st May 2018 to 31st July 2018.