

Report on my stay at the Yukawa Institute for Theoretical Physics for the 2016-17 school year

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Abstract. This is a report on my first full school year as an Advanced Future Studies Senior Lecturer at the Yukawa Institute for Theoretical Physics. I describe my scientific activities during this period.

Keywords: Fault tolerant quantum computing, topological quantum error correction

1. Scientific Activity

I started working at the Yukawa Institute for Theoretical Physics on January 2016. What follows is an account of my scientific activities during the period extending from April 2016 to March 2017.

During this period I have published three papers, as follows:

- H. Bombín,
Dimensional Jump in Quantum Error Correction,
New J. Phys. 18, 043038 (2016)
- R.S. Andrist, H.G. Katzgraber, H. Bombín, M.A. Martin-Delgado,
Error tolerance of topological codes with independent bit-flip and measurement errors,
Phys. Rev. A 94, 012318 (2016)
- H. Bombín,
Resilience to time-correlated noise in quantum computation,
Phys. Rev. X 6, 041034 (2016).

The paper with the biggest impact is the third. It has been published in the highest impact journal of the American Physical Society, and I have been invited to present it at several international and national conferences and workshops. In particular, it was selected for a talk at Quantum Information Processing, the most important meeting for the whole area of Quantum Information.

From a purely scientific perspective, the papers that I have published this year pursue the same aim. Namely, to explore new approaches to the problem of fault-tolerant quantum computation, with the eventual goal of building a quantum computer. This topic is becoming very popular as experiments start to catch up with theory. In particular, very important experimental developments are expected for 2017.

During the last months, I have been working on a problem closely connected with such experiments. Namely, I am studying the most popular approach to fault-tolerant quantum computation in the context of permanent failures of some parts of the quantum device. The goal is to approach the problem both with mathematical rigor and with practical aspects in mind.

During this year I have participated in several conferences and workshops, as follows:

- Quantum Matter, Spacetime and Information, Kyoto, Japan, June 2016. In this international workshop I gave an invited talk with the title “Topological Quantum Error Correction”.
- Quantum Matter II, Benasque, Spain, June-July 2016. In this international workshop I gave an invited talk with the title “Confinement in topological codes”.
- Fault-Tolerant Quantum Technologies, Benasque, Spain, August 2016. In this international workshop I gave an invited talk with the title “Time-correlated noise in quantum computation”.
- Workshop at the National Institute of Informatics, Tokyo, Japan, March 2017. In this international workshop I gave an invited talk with the title “Time-correlated noise in quantum computation”.
- Time-correlated noise in quantum computation, QIP, Seattle, USA, January 2017. In this international conference I gave a contributed talk with the title “Time-correlated noise in quantum computation”.

In addition, I gave a seminar internally in a cross-disciplinary study group that has formed in Yukawa Institute in order to understand the topic of quantum entanglement by combining the perspectives of Quantum Information Theory, String Theory and Condensed Matter Theory. I am an active member of this study group.

2. Conclusion

During this year I have not only successfully continued to pursue my own line of research, but in addition I am starting to experience the scientific benefits of staying at the Yukawa Institute for Theoretical Physics.