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Introduction to quantum versus stochastic processes on complex networks

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Abstract

In this introductory survey talk, I will outline some recent developments towards a new theory of “quantum complex networks”. The story will begin by comparing stochastic and quantum processes occurring on networks. To do this, we first will need to make stochastic mechanics look as close as possible to quantum mechanics, so we can pinpoint some of the key differences among the two theories. After contrasting these two theories, we will then explain what a complex network is, and consider several properties, such as degree distribution, that relate and contrast quantum and stochastic mechanics. The talk will close with a brief survey of other work being conducted in this theme.

Parts of this talk presents joint work with John Baez (UCR and CQT), Ville Bergholm (ISI), Mauro Faccin (ISI), Tomi Johnson (Oxford and ISI) and Piotr Migdal (ICFO and ISI) [1,2].

[1] http://arxiv.org/pdf/1305.6078.pdf, to appear in PRX

[2] http://arxiv.org/pdf/1209.3632.pdf, to appear in Oxford University Press

The Author

Jacob Biamonte has worked towards understanding the absolute limits that quantum mechanics places on information processing, and how to exploit quantum effects for computing. This includes his research on the universality of the adiabatic model of quantum computation, merging methods from modern mathematics, in particular category theory, with the field of tensor network states and work in the new field uniting quantum physics and complex network science. He obtained his PhD at the University of Oxford, held research and teaching positions at several institutions including Harvard, Oxford and IQC and currently directs the research activity of the quantum science and mathematics of networks division at the Institute for Scientific Interchange Foundation in Torino.