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Tuesday, 18 Dec 2018, 11:30
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Emergent classicality: Exploring quantum Darwinism with a collision model

Abstract:

Quantum Darwinism [1] aims to explain the emergence of a classical objective reality from the underlying open quantum system dynamics. This is achieved by elevating the role of the environment to a measurement device. Consider how we often acquire information: rarely do we directly measure a system, but rather we indirectly learn about it. For example, when reading our eyes detect scattered photons from the page that carry the information about what is written. Notice that we do not need to intercept every photon scattered in order to know what we are reading, typically only a tiny fraction is required. Furthermore, the information carried by any photon should be the same so that two observers intercepting different fractions of the scattered photons agree on what is on the page. Considering all the scattered photons as an environment, in order for such an "objective reality" to emerge the information must be redundantly encoded in the individual constituents of the environment.

In this talk we will examine quantum Darwinism in a collision model framework [2]. Collision models are ideally suited to this pursuit as the environment is already broken up into smaller fragments. We will explore when classical objectivity arises and the constraints on the system-environment couplings/environment size to witness a Darwinistic behaviour.

[1] W. H Zurek, Quantum Darwinism, Nature Physics 5, 181-188 (2009)
[2] S. Campbell, B. Çakmak, Ö. E. Müstecaplıoğlu, M. Paternostro, and B. Vacchini, in preparation.

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