Title: Introduction to quantum error correction and fault-tolerance

Daniel Kyungdeock Park

Korea Advanced Institute of Science and Technology (KAIST)

kpark10@kaist.ac.kr ; kdpspin@gmail.com

Abstract:

The theory of quantum information processing promises to accelerate certain computational tasks substantially. However, when theoretical ideas meet real physical systems, the power of quantum computation can quickly diminish due to intrinsic and extrinsic errors to which the quantum system is exposed. Quantum error correction (QEC) and fault-tolerant quantum computation (FTQC) aim to bridge this gap, and have emerged as one of the most vital aspects of quantum information science. Ever since QEC was first introduced in 1995, QEC and FTQC have grown to a much larger field with various techniques and methodologies. In this talk, I will give an introduction to the theory of QEC and FTQC, assuming no prior background. The talk will focus on the basic notions of quantum error correcting codes, stabilizer codes, fault-tolerance, and the surface code. I will also introduce some elementary definitions that often appear in the field. This talk is aimed to provide the audience with conceptual backgrounds on the aforementioned topics so that one may be equipped for more advanced studies on QEC and FTQC in the future.

References:

[1] S. J. Devitt, W. J. Munro, and K. Nemoto, *Quantum error correction for beginners*, Report on Progress in Physics **76** 076001 (2013).

[2] B. M. Terhal, *Quantum error correction for quantum memories*, Rev. of Modern Physics **87** 307 (2015).

[3] A. G. Fowler, M. Mariantoni, J. M. Martinis, and A. N. Cleland, *Surface codes: Towards practical large-scale quantum computation*, Physical Review A **86** 032324 (2012).