Brock University

Physics Department Seminar

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Photonic Quantum Computing: Finding Science behind the Engineering

There is currently a race to build useful quantum devices, such as quantum computers or quantum communication systems, which promise to accomplish certain tasks in a way that classical systems cannot. For example, companies such as Google and IBM are pursuing quantum computers based on superconducting qubits, while Psi Quantum and Xanadu are attempting the same with photonic devices. In this presentation, I will review the physical requirements of quantum computing and discuss the pros and cons of the photonic approach. While some aspects of realizing a full-scale photonic quantum computer are well-understood and entering the realm of engineering, many interesting scientific questions remain. Some of these topics must be addressed to enable quantum computing, and others are of fundamental interest. To this end, I will present our recent work developing single-photon sources using ultra- thin nonlinear media [1,2], and, if time permits, present a recent line of research exploring alternative models of quantum computation based on superpositions of quantum processes [3,4]. Both of these research directions have potential applications, but they also highlight that the fields quantum information and quantum optics contain many open scientific questions.