

Semiconductor quantum technologies for communications and computing

Dirk Englund

MIT

The Internet is among the most significant inventions of the 20th Century. We are now poised for the development of a quantum internet to exchange quantum information and distribute entanglement among quantum memories (and ultimately quantum computers) that could be great distances apart. This kind of quantum internet would have a range of applications that aren't possible in a classical world, including long-distance unconditionally-secure communication, certain types of precision sensing and navigation, and distributed quantum computing. But we still need to develop or perfect many types of components and protocols to build such a quantum internet. This talk will consider some of these components, focusing on photonic integrated circuits, diamond spin-based quantum memories, and prototype networks. Specifically, the first part of this talk will review our recent progress in adapting one of the leading PIC architectures—silicon photonics—for different types of quantum secure communications protocols. The second part of the talk will consider how photonic integrated circuits technology may extend the reach of quantum communications through all-optical and memory-based quantum repeaters, as well as extensions to modular quantum computers.