Santhad Phithakwongsaphorn 2009: Experimental Studies of Quantum Cryptography in Optical Fiber. Master of Science (Physics), Major Field: Physics, Department of Physics. Thesis Advisor: Assistant Professor Surasak Chiangga, Dr.rer.nat. 64 pages.

A quantum key distribution (QKD) system can create a shared secret cryptographic key over an unsecured optical link. These systems use the fundamental quantum properties of single photons to guarantee the security of the shared key, which is commonly called the net key. The net keys generated in this manner, and at sufficiently high rates, make use of a one-time-pad cipher for encryption of broadband communications links. A number of groups have developed experimental QKD systems operating in both free-space and optical fiber.

The goal of this thesis was to design and construct the optical fiber quantum cryptographic system based on the B92 protocol over the standard telecommunications fiber. The transmitter employed two 850-nm wavelength vertical-cavity surface-emitting lasers, which were directly modulated its injection current by applying a train of 2 ns electrical pulses at a repetition rate of 10 KHz. The output laser pulses were reduced the intensity to a mean photon number of 0.5 photons per pulse. Each sequence of pulses was then assigned by the passive optics at the transmitter to one of two polarization states: horizontal; H, and right circular; R. Our receiver contained a fiber polarization controller to recover the photon's polarization state, and two avalanche photodiodes operating in Geiger mode were used to detect single photons. We observed the visibility of the transmitter for the H and R which were 0.97 and 0.99 respectively. The visibility of the receiver for the H and R which were 0.38 and 0.69 respectively. These visibilities indicated that the quantum-bit errors were approximately 50.39%.

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