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## Polarization-independent subcarrier quantum communication system and its application in ITMO University quantum network

A quantum key distribution system based on the subcarrier wave modulation method has been demonstrated which employs the BB84 protocol with a strong reference to generate secure bits at a rate of 16.5 kbit/s with an error of 0.5% over an optical channel of 10 dB loss, and 18 bits/s with an error of 0.75% over 25 dB of channel loss. To the best of our knowledge, these results represent the highest channel loss reported for secure quantum key distribution using the subcarrier wave approach. A passive unidirectional scheme has been used to compensate for the polarization dependence of the phase modulators in the receiver module, which resulted in a high visibility of 98.8%. The system is thus fully insensitive to polarization fluctuations and robust to environmental changes, making the approach promising for use in optical telecommunication networks. Further improvements in secure key rate and transmission distance can be achieved by implementing the decoy states protocol or by optimizing the mean photon number used in line with experimental parameters. The system was used in deployment of ITMO University quantum network in Saint Petersburg, Russia, where a polarization independent subcarrier wave quantum key distribution operation with sifted bitrate 250 kbit/s was for the first time demonstrated in metropolitan telecommunication network channel composed of standard SMF-28e fibers with 1.5 dB loss.

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