Evaluation of ultra-low loss optical fiber connector loss for quantum components and applications

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Quantum photonics has emerged as a rapidly advancing field with enormous potential for applications such as quantum computing, quantum sensing, and quantum communication. These applications though, are exquisitely sensitive to optical loss. For instance, some of these applications have loss threshold levels below which the application fails completely and because amplification of a quantum state necessarily adds noise, there is no easy fix to address the problem of optical loss. Thus hard work is required to push existing losses to levels as low as possible. And to achieve that, we must have tools to measure low losses with high accuracy and with confidence in the measurement results. We present the results of 2 independent measurement setups measuring fiber-to-fiber connector losses of 4 batches of fiber patch cables with fiber connectors designed specifically for low loss. Our measurements are made at two wavelengths and show average connector losses as low as 0.39(21) % for 1550 nm fibers and 0.94(46) % for 800 nm fibers. And we see excellent agreement between the two independent measurement setups with a mean difference of less than 0.1 % and a mean standard deviation of 0.5 % for all connector measurement differences. Finally, comparing the results for two different fiber types at 1550 nm we find that bend-insensitive fiber decreases the loss of the connection by 50%. These encouraging results indicate that the fiber loss metrology can achieve uncertainties low enough to push the development of even lower loss fiber connectors.