Unidimensional two-way continuous-variable quantum key distribution

Yiming Bian (*bianyiming@bupt.edu.cn*), **Luyu Huang, and Yichen Zhang***

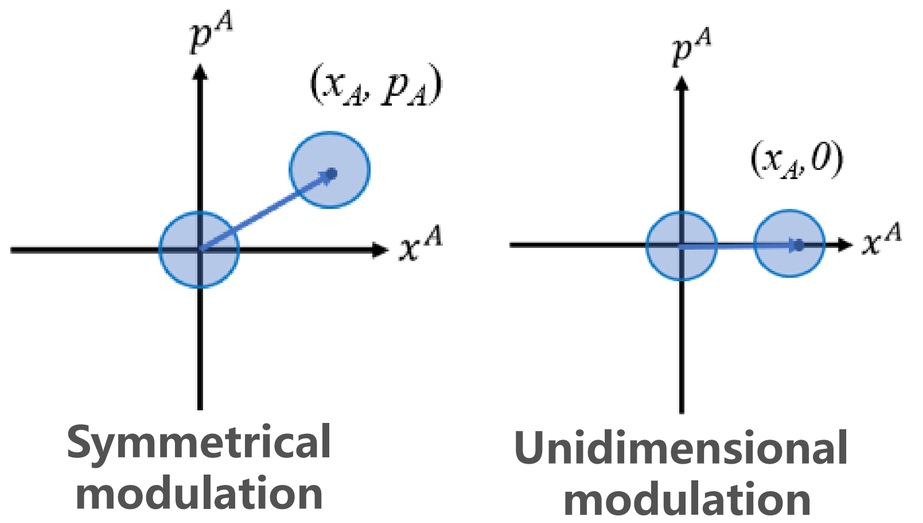
State Key Laboratory of Information Photonics and Optical Communications, School of Electronic Engineering, Beijing University of Posts and Telecommunications, Beijing 100876, China

*** Email:** *zhangyc@bupt.edu.cn*

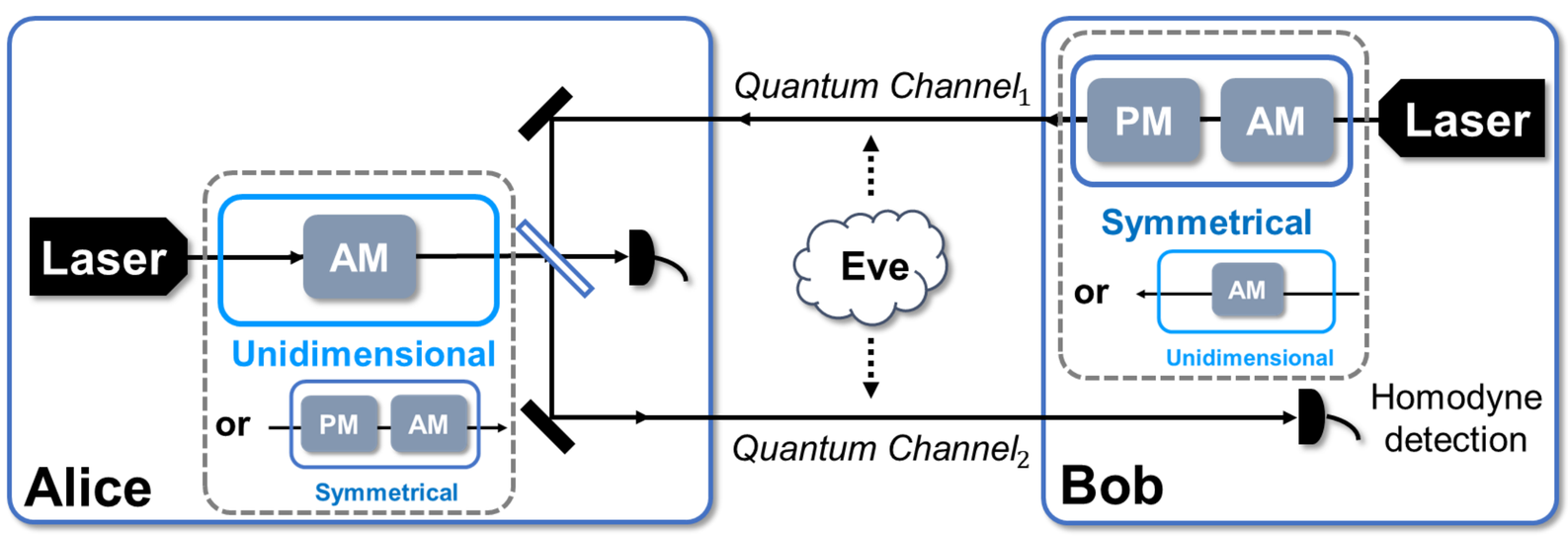
Introduction

Continuous variable quantum key distribution (CV-QKD) has been proposed as a promising alternative to discrete variable QKD, due to the advantages of using only standard telecom components [1].

Recently, we proposed a Unidimensional (UD) two-way CV-QKD protocol [2], which simplifies the two-way system while guaranteeing its performance to a certain extent.



Structure of the protocol

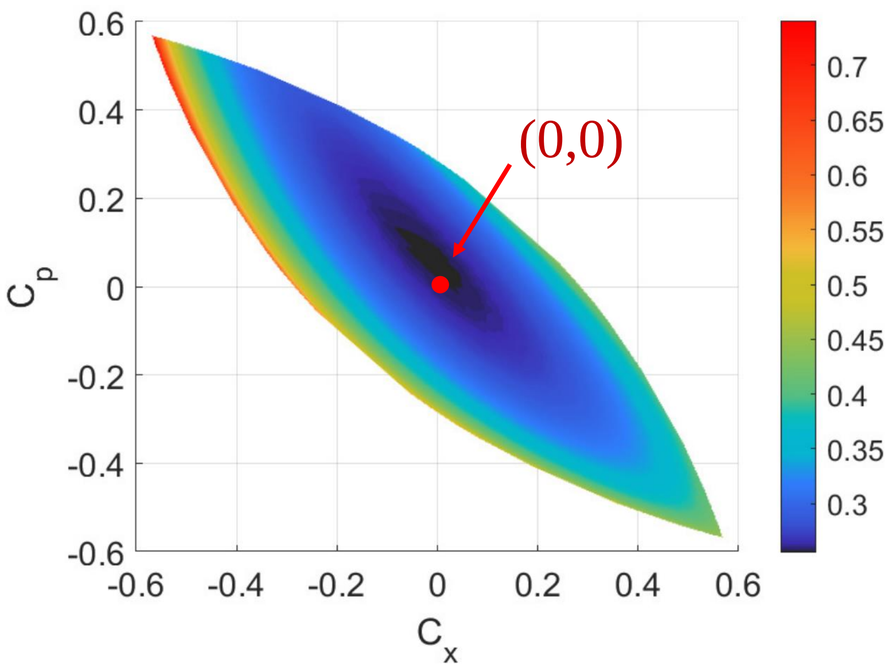


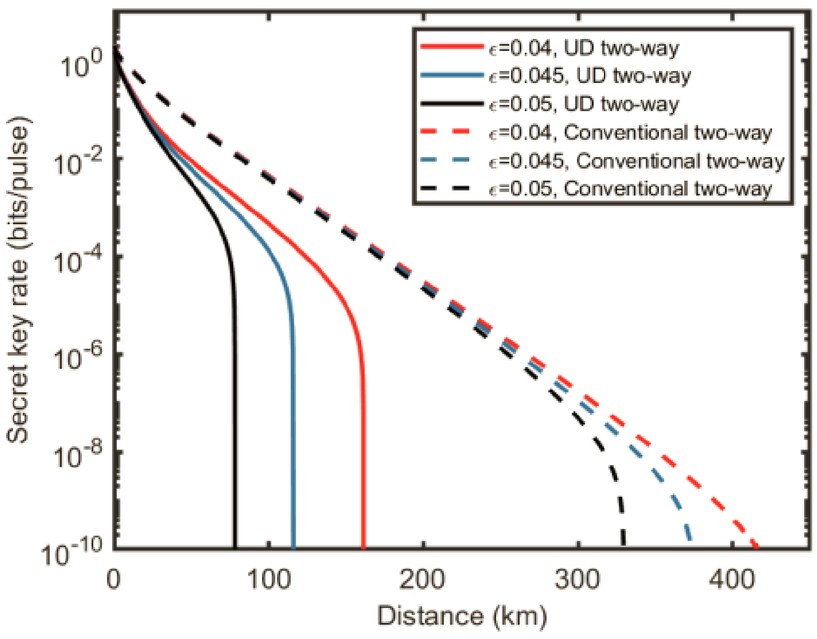
Unidimensional modulation [3] is used at Alice's side, while symmetrical modulation is used at Bob's side.

There are also other types of modulation strategy combinations, but the performance will be reduced.

Simulations and results

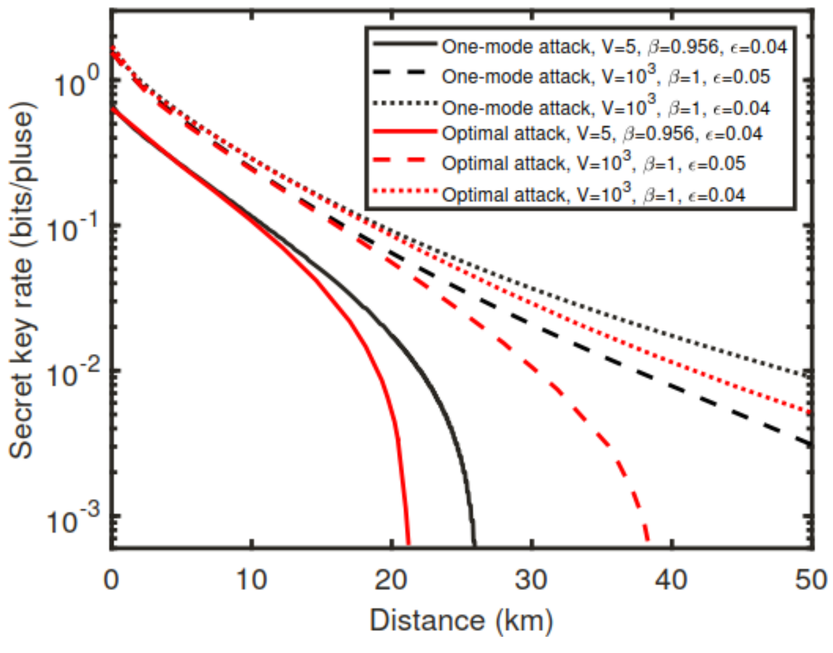
Heat map: Secret key rates of the UD two-way CV-QKD protocol against all accessible two-mode attacks under 5 km. Point (0,0) represents the one-mode attack ,which is the simplest form of the two-mode attack. The point with the lowest secret key rate is the optimal two-mode attack.





Under one-mode attack

The performance of the UD two-way protocol is reduced to some extent because of the missing of information in p quadrature. The closer the distance, the smaller the performance loss.



Under the optimal two-mode attack

When the transmission distance is close, even if the strength of the attack is strengthened, the performance degradation of the protocol is not obvious.

Results: Though the performance of the UD two-way protocol is partially reduced, as the price of the simplification, it is still acceptable compared to that of the symmetrical Gaussian modulated counterpart, especially at close distance.

Acknowledgment

This research is supported by the National Natural Science Foundation of China under Grants 61531003 and 62001044, and the Fundamental Research Funds for the Central Universities from China under Grant 2021RC11.

References

1. H. Guo et al., Fundam. Res. 1, 96-68 (2021).
2. Y. Bian et al., Entropy, 23, 294 (2021).
3. V. Usenko et al., Phys. Rev. A 92, 062337 (2015).