Field implementation of continuous-variable quantum key distribution network in Shanghai

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The distribution of quantum signals over a metropolitan distance via quantum key distribution (QKD) represents a crucial step towards future global quantum network. Recently the impressive progress of discrete-variable QKD network raised optimism to realize such a global platform. However, QKD network based on continuous-variable (CV) systems has not been reported so far. Here we report the first field implementation of a metropolitan CV-QKD network in Shanghai. Four nodes are deployed on standard communication infrastructures connected with the commercial telecom optical fiber. Reliable key exchange is achieved in the wavelength-division-multiplexing QKD network. We expect that the features implemented in our field CV-QKD network could be important building blocks for the future quantum network.

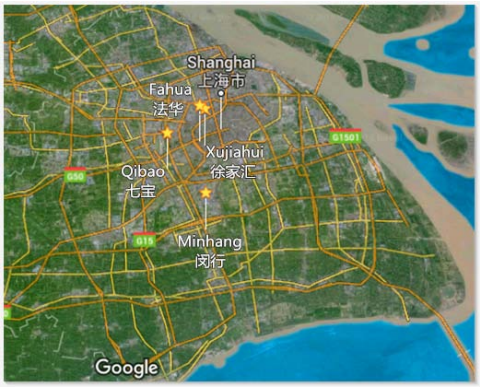

FIG. 1. Map of the CV-QKD network. The four nodes (Minghang, Qibao, Xujiahui, and Fahua) are located in the city of Shanghai.

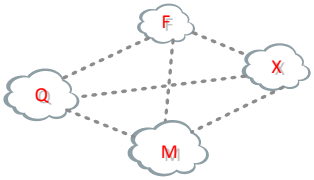

FIG. 2. Topology of the full-mesh metropolitan area CV-QKD network. M: Minhang, Q: Qibao, X: Xujiahui, F: Fahua.

TABLE I. **Link characteristics of CV-QKD network.**

Link	M-Q	M-X	M-F	Q-X	Q-F	X-F
Distance (km)	19.92	35.35	37.44	15.34	17.52	2.08
loss (dB)	5.70	13.90	15.10	6.20	10.25	3.21

In recent years, researchers have demonstrated a point-to-point CV-QKD field link [1, 2]. However, all of the reported QKD networks are implemented with quantum discrete variables [3]. It perhaps owing to the fact that the CV-QKD initially plagued with various problems [4].

Here we report the first field implementation of a metropolitan CV-QKD network in Shanghai. As shown in Fig. 1, four QKD nodes with point-to-point configuration are deployed on four different campuses of Shanghai Jiao Tong University, which includes Minhang, Qibao, Xujiahui, and Fahua. The topology of the network is shown in Fig. 2. In this full-mesh metropolitan area CV-QKD network, each node has a direct physical link to every other node. Table I shows the link characteristics of the network.

Based on our previous works [5–7], we can estimate and control some of excess noise, and reliable key exchange is achieved. The impact of complex and volatile field environment on the excess noise is investigated, since excess noise controlling and reduction is arguably the major issue pertaining to distance and the key rate. For more details please refer to the Ref. [8].

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