Quantum
Physics & Quantum Information

Quantum Network in China

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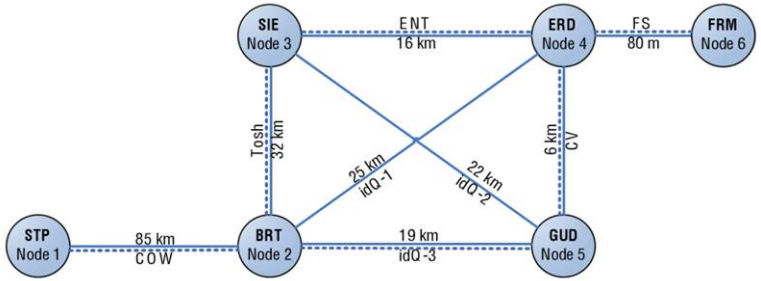
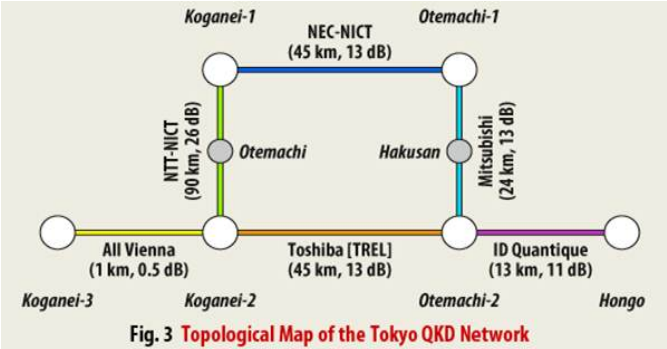
USTC

Worldwide quantum network



SECOQC Network (Europa)

Peev *et al.*, New J. Phys. 11, 075001 (2009)



Tokyo QKD Network (Japan)

Sasaki *et al.*, Opt. Express (2011)

DARPA Network (2009)

HYPOSWISS PRIVATE BANK

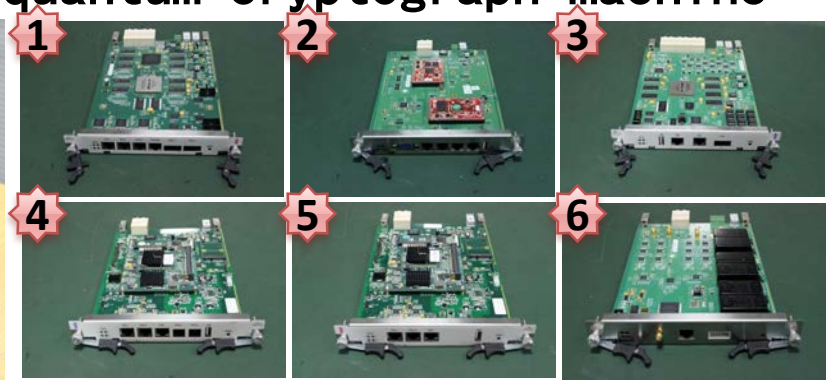
NOTENSTEIN PRIVATE BANK

QKD for financial information security (Switzerland , 2011)

Hefei Intracity Quantum network

46 Nodes Quantum Network

The 4th generation quantum cryptograph machine



Jinan Quantum Communication Network

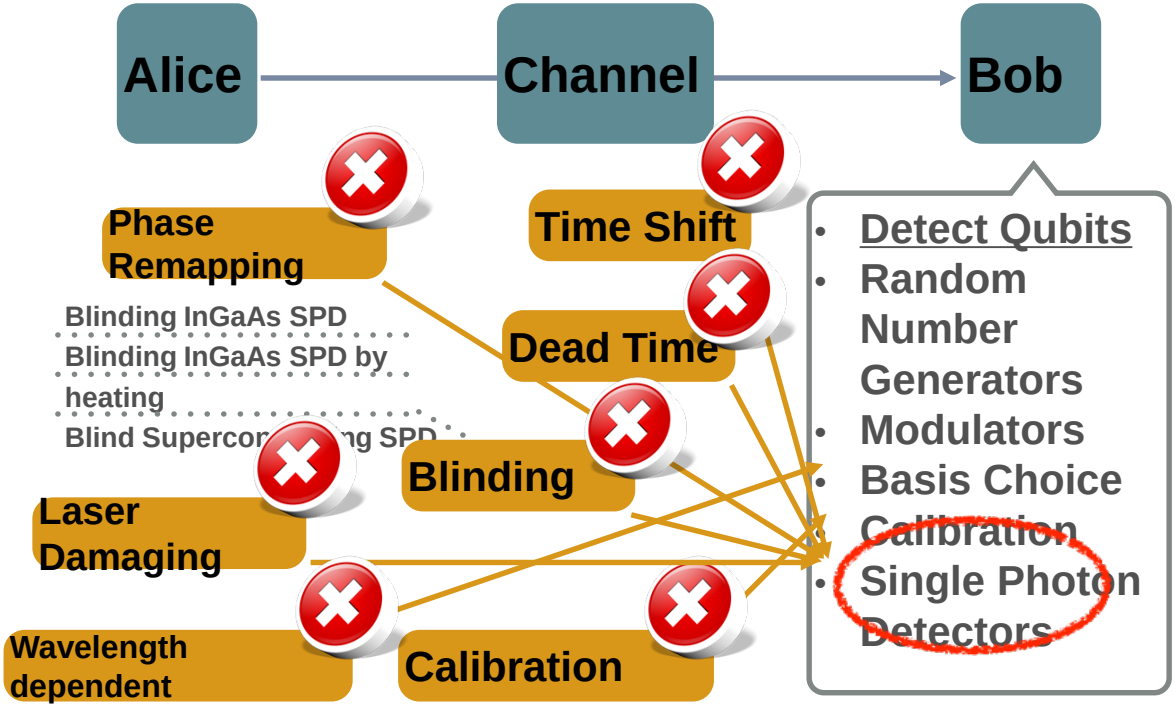
Curtsey of Shandong Institute of Quantum Sci. & Tech. Co., Ltd. (SIQST)

- **JQCN aims to bring quantum cryptography and multimedia internet technology together.**
- **A metropolitan QKD network with 50 nodes, 28 institutions, 90 users and over 70 km^2 covering area has been well established.**

Trustable Relay Approach

	A	Relay	B
Initial	K_{AR}	K_{AR}、K_{RB}	K_{RB}
Step 1		Announce $K_{AR} \oplus K_{RB}$	
Step 2			$K_{AR} \oplus K_{RB} \oplus K_{RB}$
Final	K_{AR}		K_{AR}

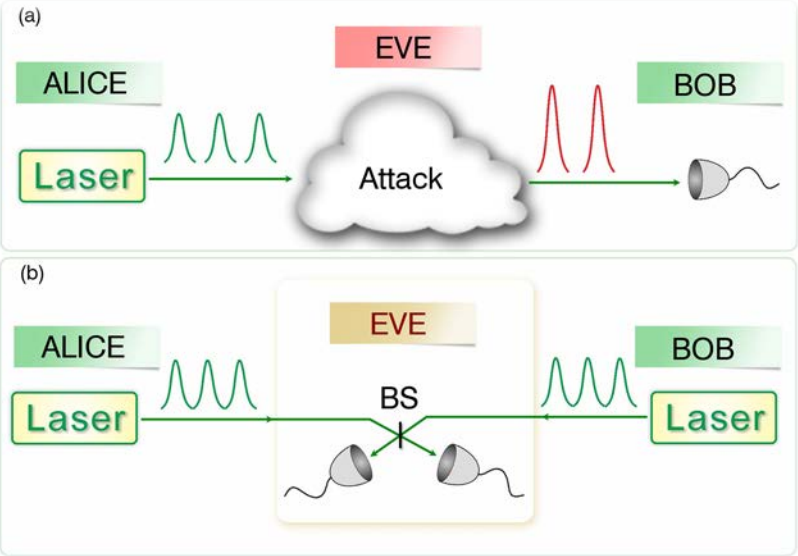
Attack against detector



Measurement Device Independent-QKD

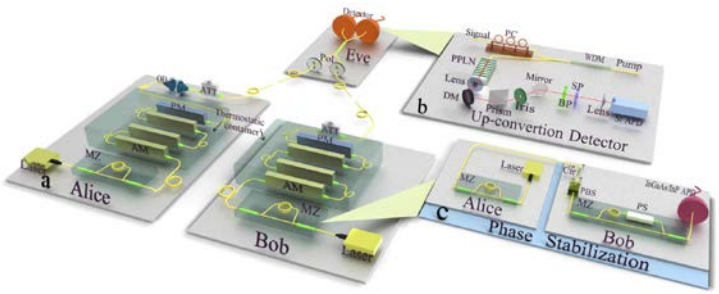
Immune to any attacks on detector

Scheme: Lo *et al.*, PRL 108, 130503 (2012)

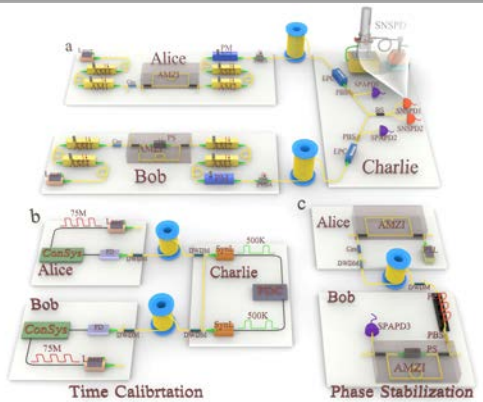


- ☑ **Security: against detection loophole**
- ☑ **Practice: 200 km with weak coherent laser source**
- ☑ **Scalability: Naturally fits "star" type network**

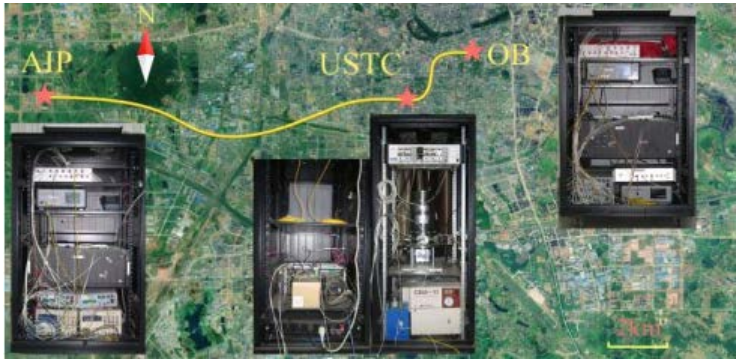
Implementation of MDI-QKD



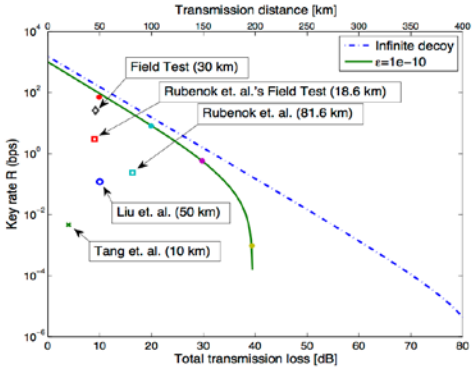
Proof of Principle demonstration
[Liu *et al.*, PRL 111, 130502 (2013)]
Tittel group, Weid group, Lo group



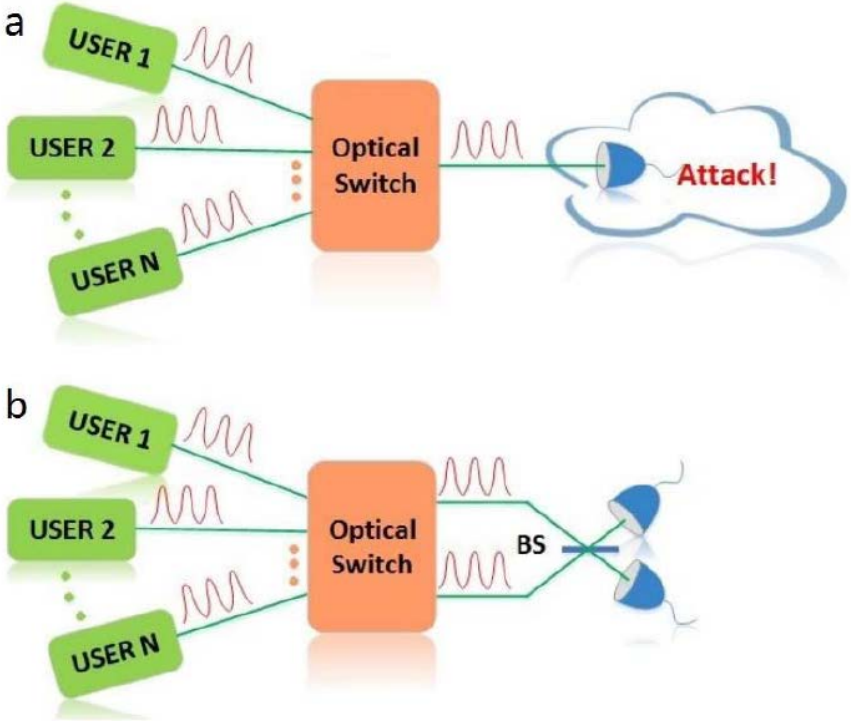
200 km demonstration
[Tang *et al.*, PRL 113, 190501 (2014)]



Field test
[Tang *et al.*, IEEE JSTQE 21, 6600407(2015)]

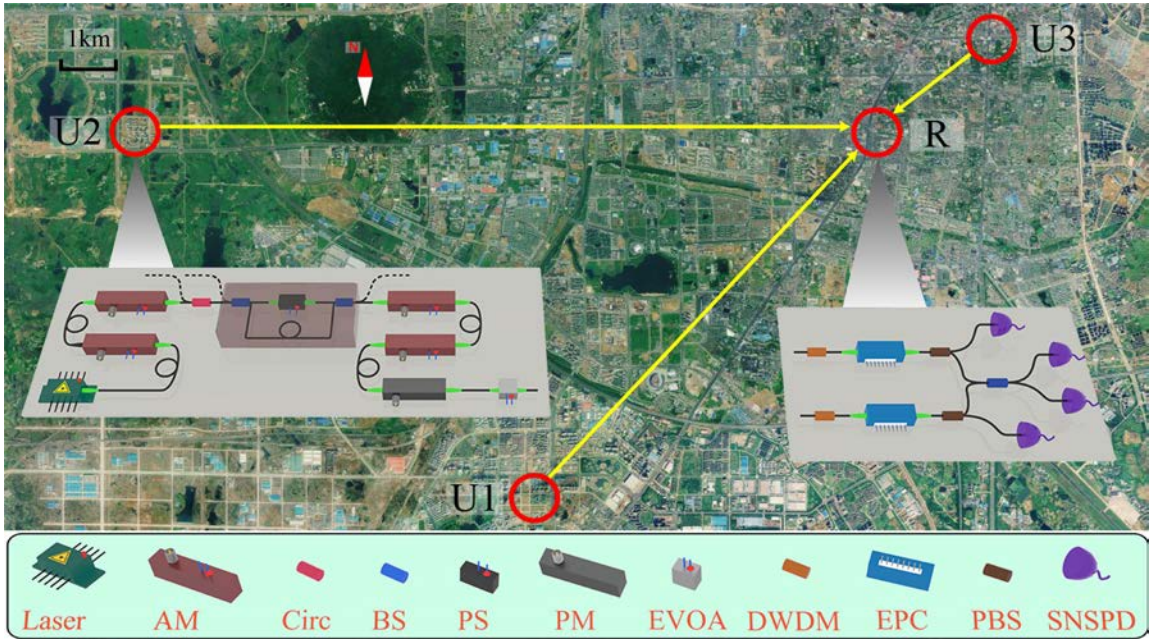


MDI-QKD Network Scheme



[Froehlich, Nature 501, 609 (2013)]

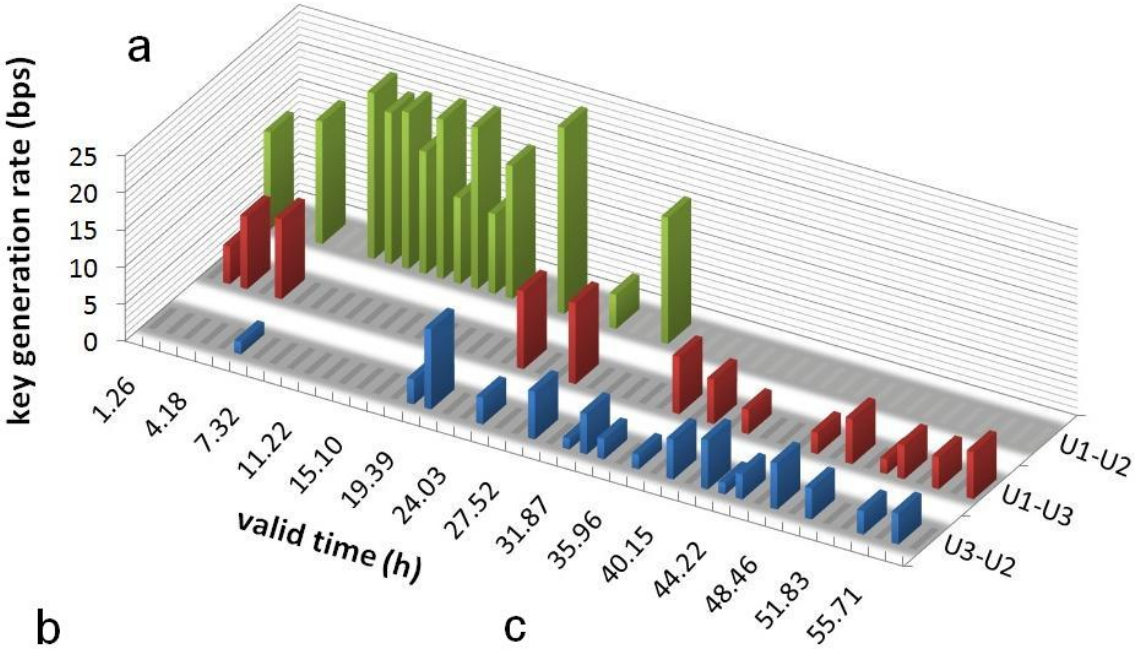
MDI-QKD Network



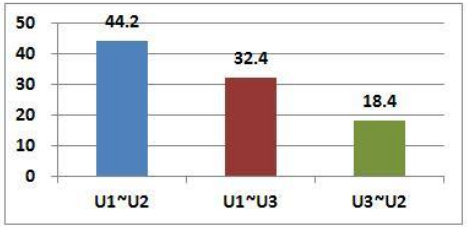
AC: 9.2 dB, 25 km; BC: 5.1 dB, 17 km; DC: 8.1 dB, 30 km (with fiber spool).

Opt. Switch: 8X4, 1 dB. EPC&BS, 2dB.

MDI-QKD Network Result



b



c

Client pair	U1~U2	U1~U3	U3~U2
fiber length(km):	17+25	17+30	30+25
fiber loss(dB):	5.1+9.2	5.1+8.1	8.1+9.2
connection loss(dB):	6.2	7	6.2
accumulated time(h):	17.4	14.2	26.9
secure key(b):	2.76E+06	1.65E+06	1.78E+06
secure key rate(bps):	44.2	32.4	18.4

Quantum Backbone

Quantum Backbone

- Total Length 2000 km
- Metropolitan networks

  Existing: Hefei, Jinan

  New: Beijing, Shanghai
- Customer: China Industrial & Commercial Bank; Xinhua News Agency; CBRC

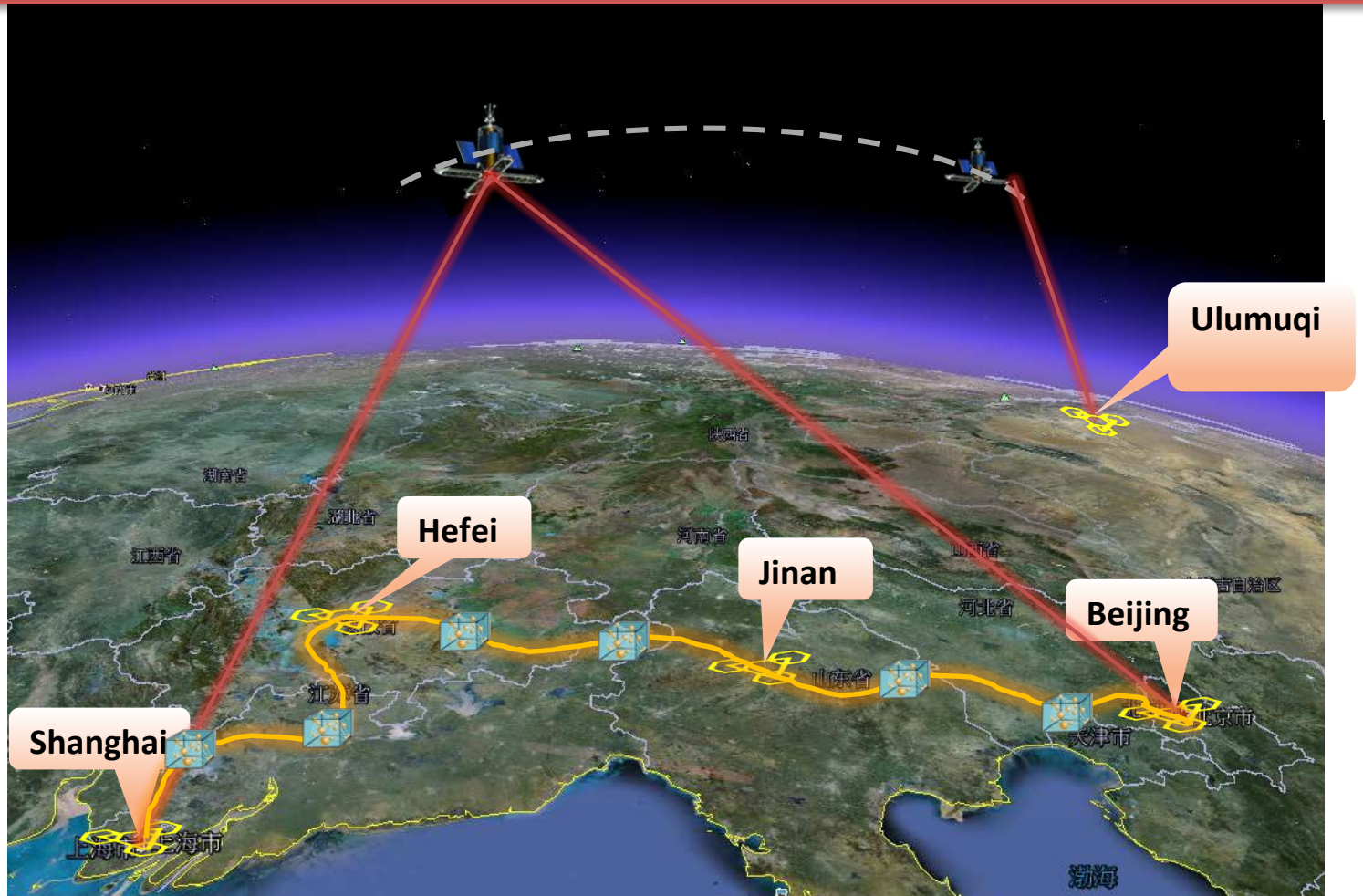
Quantum Backbone: Status

Phase 1 : Approval Test of Quantum Product
We invite ID Quantique, QuantumCtek, Qasky, Roi Optoelectronics

Phase 2 : Indoor System Debugging

Phase 3: Deployment

Future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Thanks for your attention!

Trust Worth Quantum Information II

July USTC Shanghai

PI: Jian-Wei Pan