QCrypt 2020: Industry Session
2020/08/12 Online Conference

Towards the Practical Space-Ground Integrated Quantum Communication Network

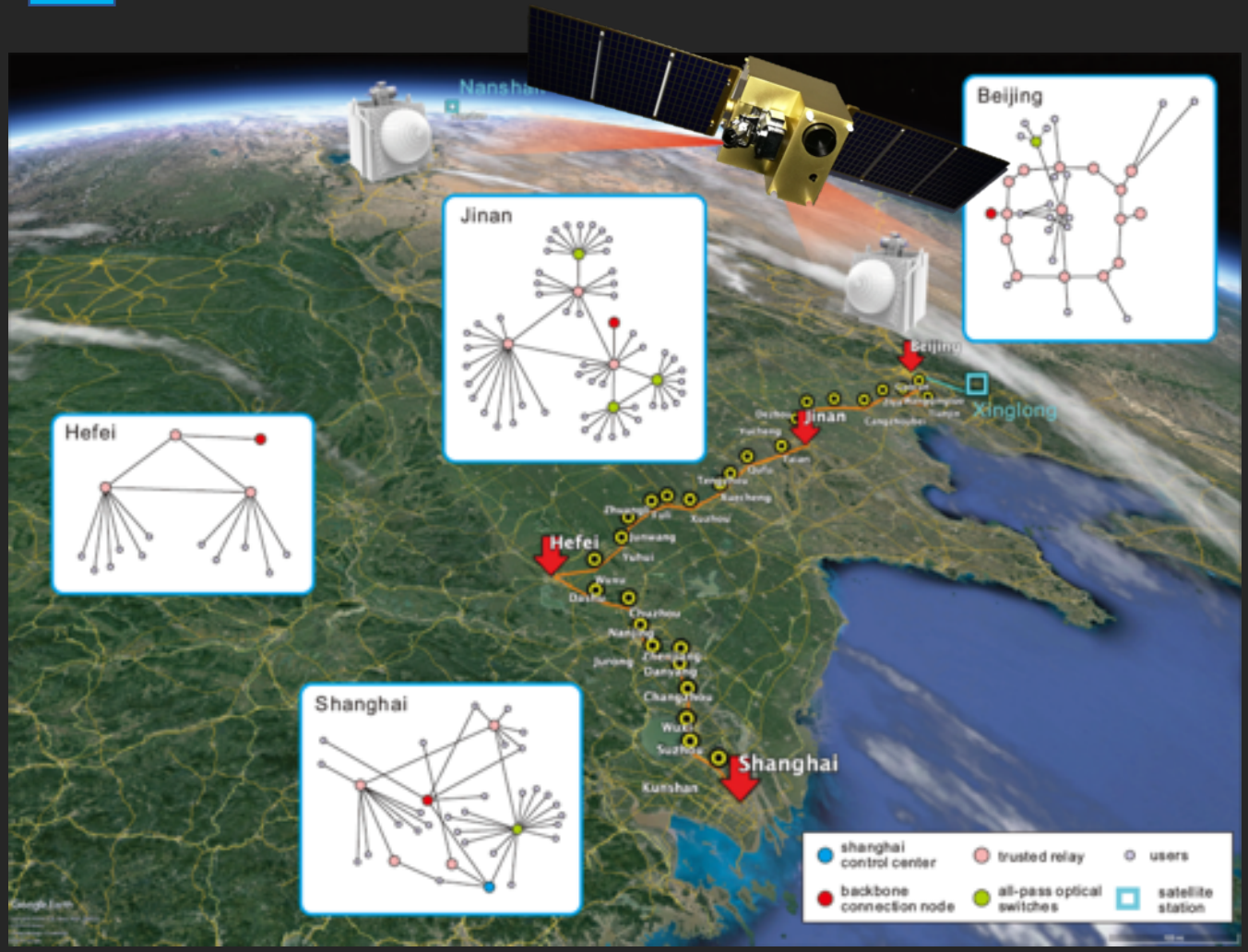
Cheng-Zhi Peng

CAS Center of Excellence in Quantum Information and Quantum Physics

University of Science and Technology of China

QuantumCTek Co., Ltd

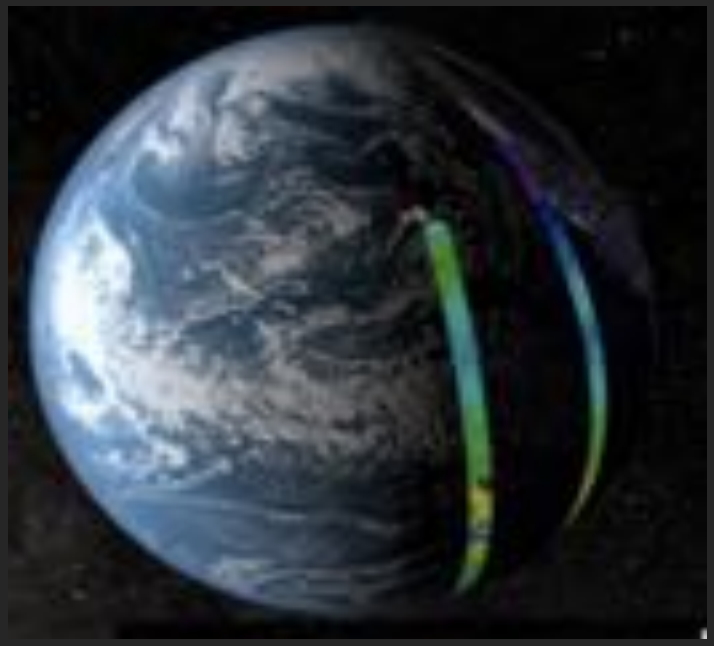
Background: Micius & Backbone Fiber Link



- Four quantum metropolitan area networks in Beijing , Jinan, Shanghai, Hefei with a backbone fiber link over 2000 km.
- Two ground-satellite links that connect Xinglong and Nanshan separated by 2600 km.
- Xinglong is further connected to the Beijing's fiber network.

Let us have a chance to show the feasibility of the global quantum network.

Challenges of Practical Global-Scale Quantum Network



The limitation of Micius

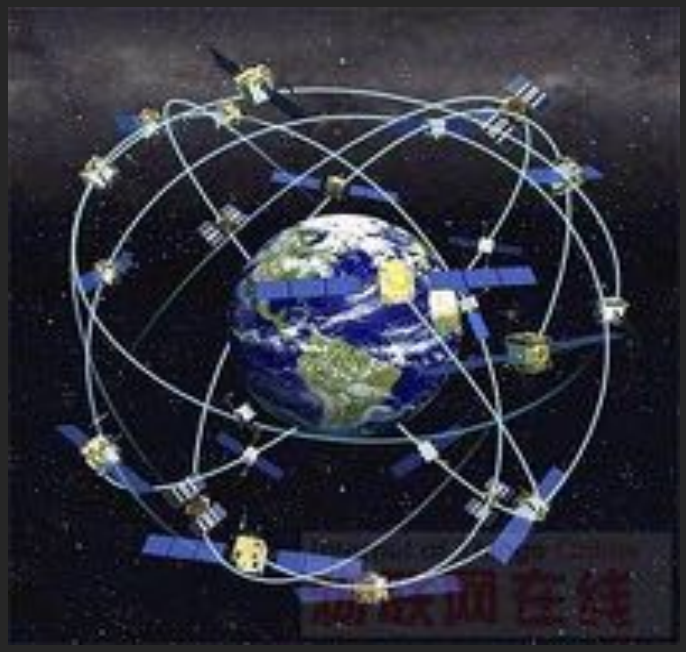
- **Experiment time is ~ 6 minutes for each pass**
- **Coverage range is about 500km (Radius)**
- **Have to be in the shadow of earth**

☑Quantum constellation with LEO nano satellites

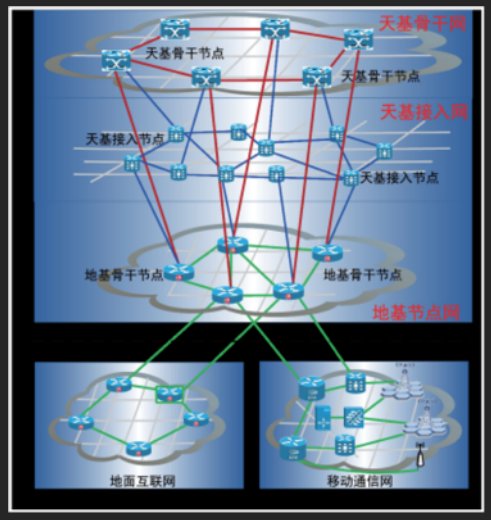
☑The MEO-to-GEO quantum satellite

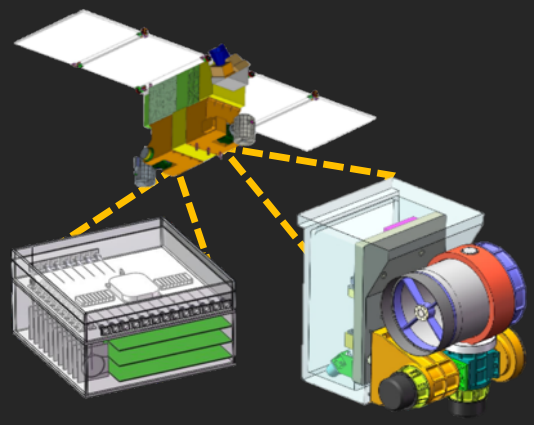
Building Quantum Constellation with Compact Payloads

"Quantum constellation"



Carried by standard Satellite and Nano Satellite





Develop a compact QKD payload (35 kg) carried by communication satellite

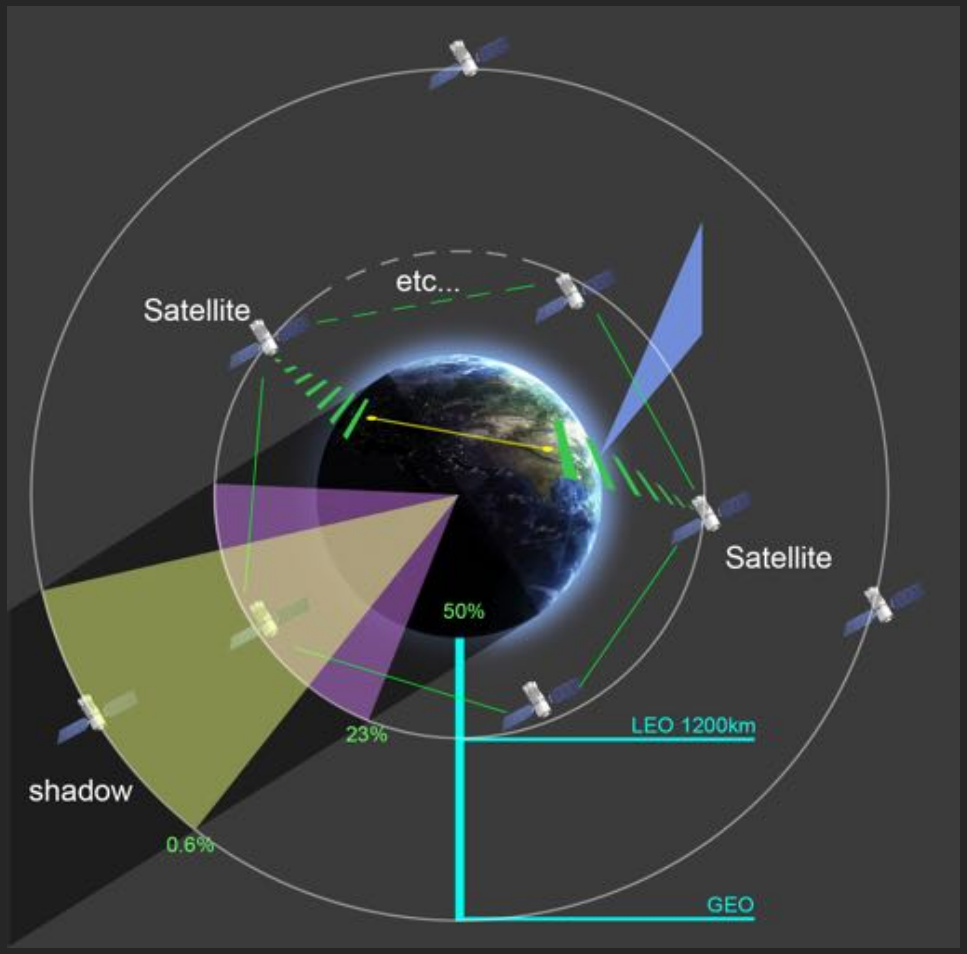
- ✓ **3 or 5 NanoSat in 5 years**
- ✓ **More than 100 users**
- ✓ **Key weekly update**
- ✓ **Deliver over 5 Gbits/year**

Compact and Movable Ground Station

☑Smaller, lighter and cheaper (280 mm diameter, 100 kg)

☑The sifted key rate is ~ **2k bps**.

The MEO-to-GEO Quantum Satellite



Focus on all-day quantum communications research and fundamental problems:

☑ Wider space scale

☑ 10000-36000km (all over)

☑ Longer experiment duration

☑ Form minutes to hours

☑ Breakthrough earth shadow limit

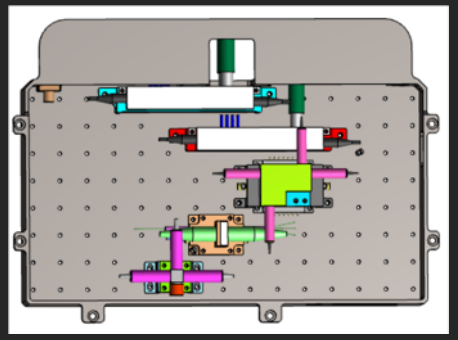
☑ Generate Key 24 hours

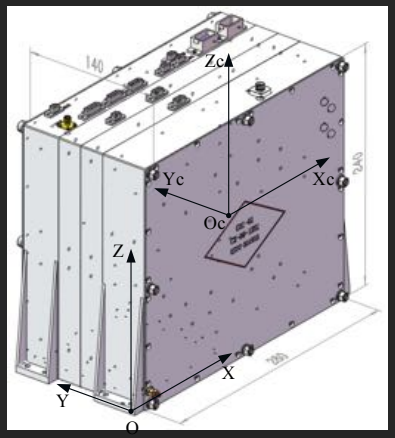
Key Technology for MEO-to-GEO Quantum Satellite

Satellite-borne high brightness quantum source

- Decoy-state source: single LD scheme
  - Repetition rate：1.25 Ghz
  - Spectral width： < 30pm
  - Intensity modulation：Sagnac+BS+PM
  - Polarization modulation：Sagnac+PM/PPLN

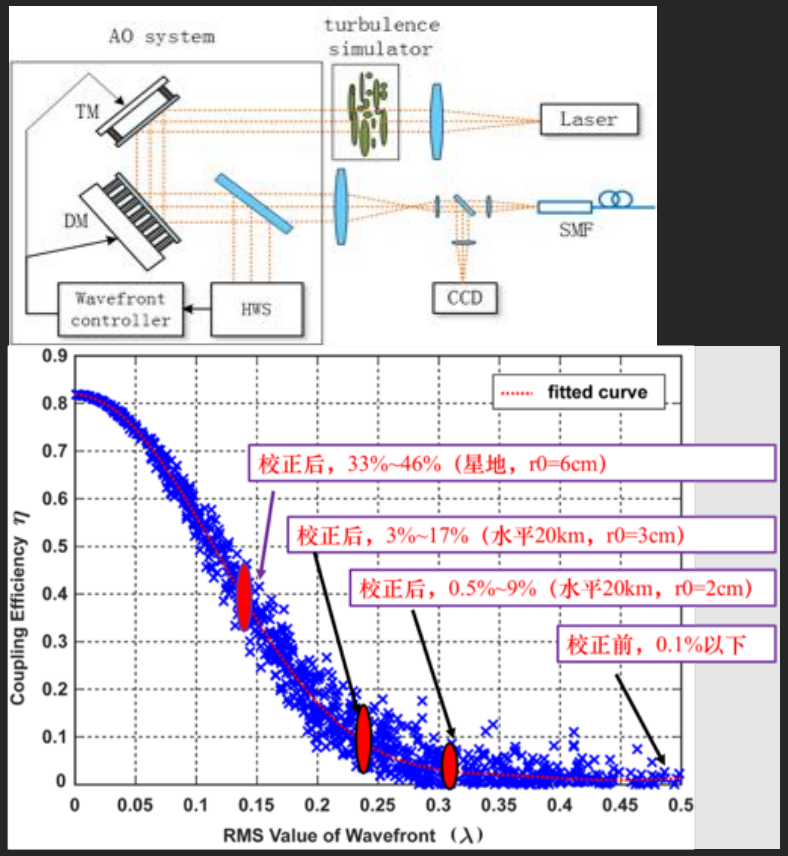
- Entangled photon source
  - Generation rate： > 10^9 pairs/s
  - Develop new methods to realize the ultra-stable quantum interference
  - Research on space adaptability

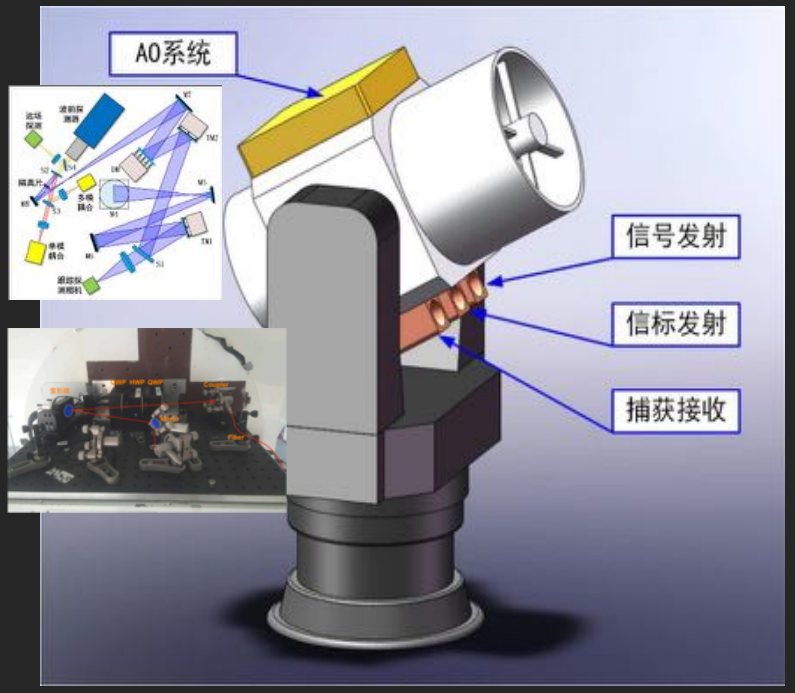




Key Technology for MEO-to-GEO Quantum Satellite

Develop adaptive optics to ground station
Breaking through the limitation of QKD only at night

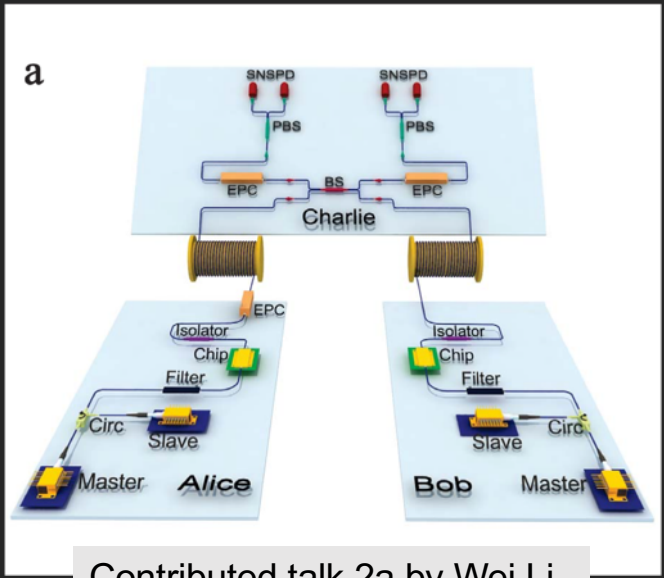




Upgrade the Current Fiber QKD Network in China

More safer, greater distance, and wider coverage

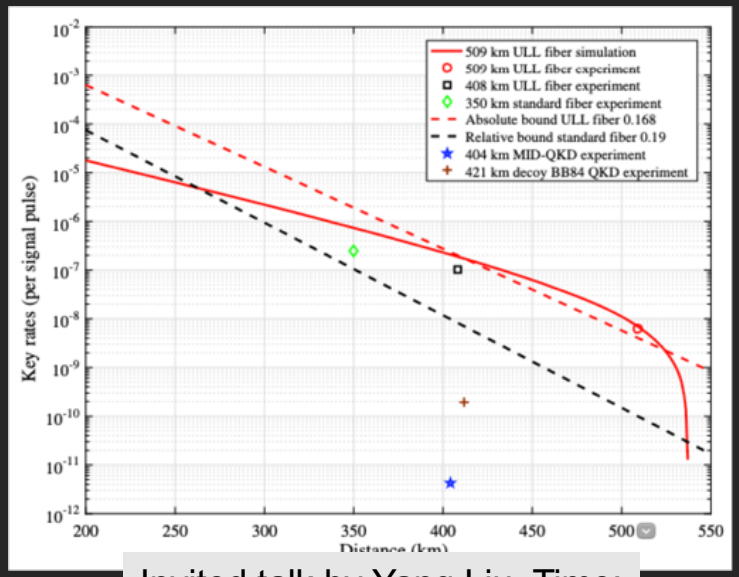
MDI QKD



Contributed talk 2a by Wei Li,
Time: Tue, 11 Aug, No.1

High-speed MDI QKD with integrated silicon photonics
[K. Wei, et al., Phys. Rev. X 10, 031030 (2020)

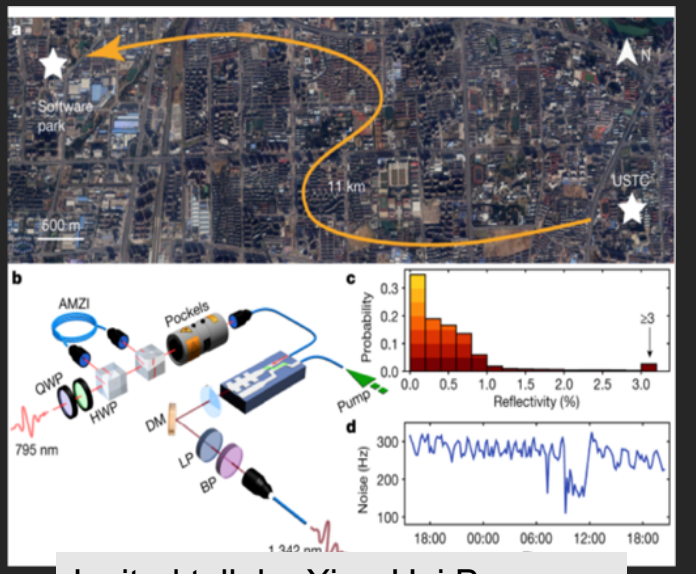
Twin-Field QKD



Invited talk by Yang Liu, Time:
Wed, 12 Aug, 16:15-17:00

509 km with low loss fiber.
[J.-P. Chen, et al., PRL 124, 070501 (2020)]
[X.-T. Fang, et al., Nat. Photonics 14, 422 (2020)]

Quantum Repeater

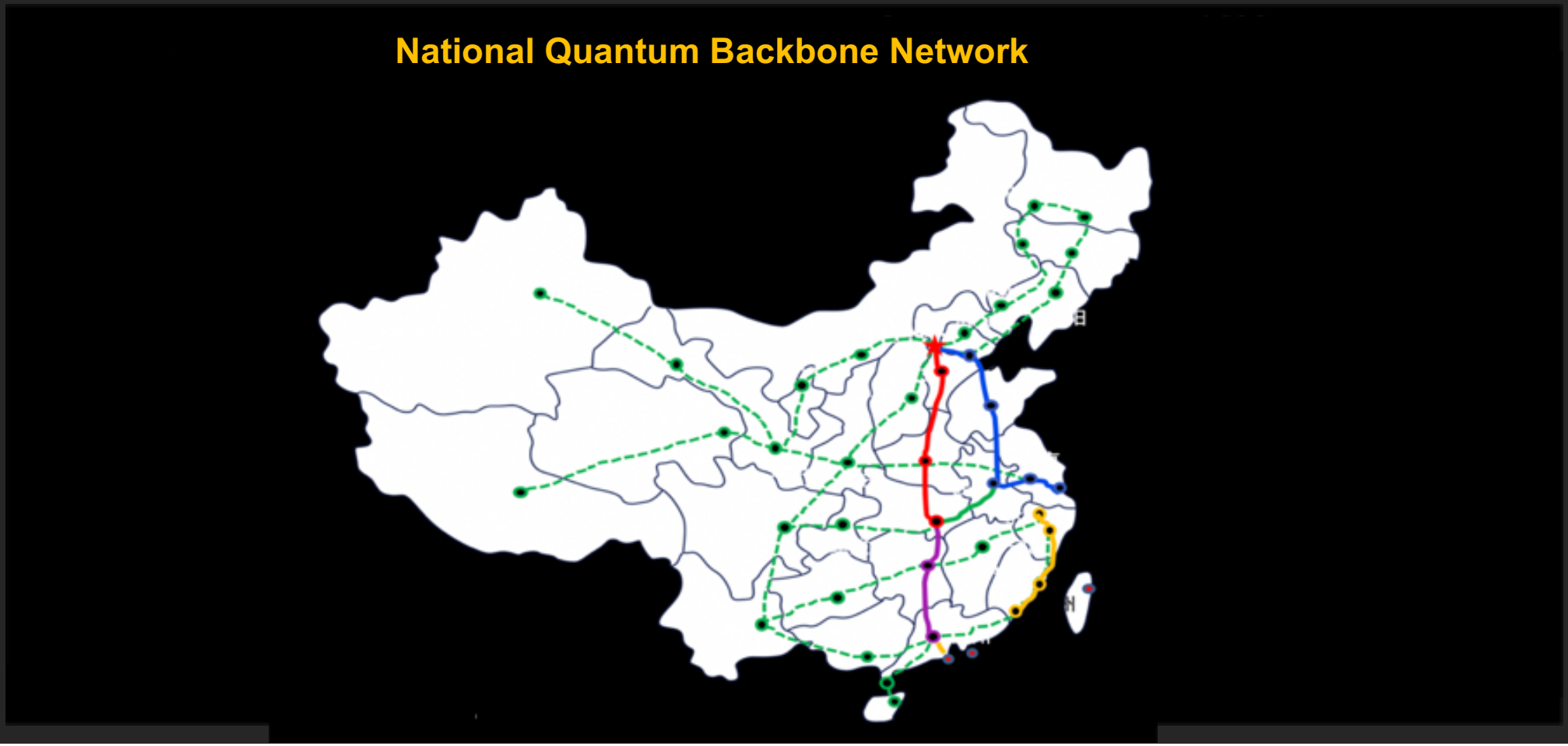


Invited talk by Xiao-Hui Bao,
Time: Thu, 13 Aug, 13:15-14:00

Entanglement of two quantum memories over 22 km.
[Y. Yong, et al., Nature 578, 240 (2020)]

Upgrade the Current Fiber QKD Network in China

More safer, greater distance, and wider coverage

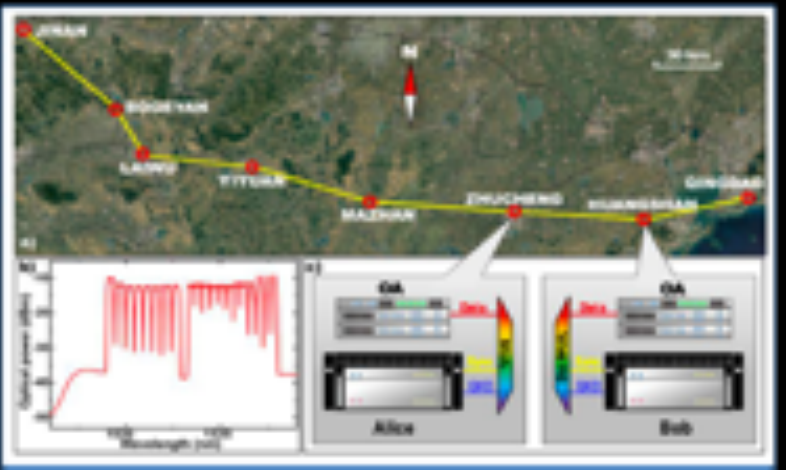


Upgrade the Current Fiber QKD Network in China

Channel Integration between QKD and Classical Communications

Mature and commercial available

- Deployed in Wuhan metropolitan quantum network since Nov. 2016, stable operating



- Channel integration between a commercial QKD system and a commercial 8Tbps WDM system over 110Km in Sept. 2017, together with China Telecom, ZTE, FiberHome, etc.

- First channel integration between a QKD system and a commercial backbone fiber network of 3.6Tbps classical data over 66Km at the end of 2017, together with China Unicom, published in Optics Express

Industrial Development

量子网络 CAS QUANTUMNET

Support by the CAS "Pioneer Initiative"

co-founded by the Chinese Academy of Sciences Holdings Co, Ltd. (CASH) and the University of Science and Technology of China (USTC)

Mission

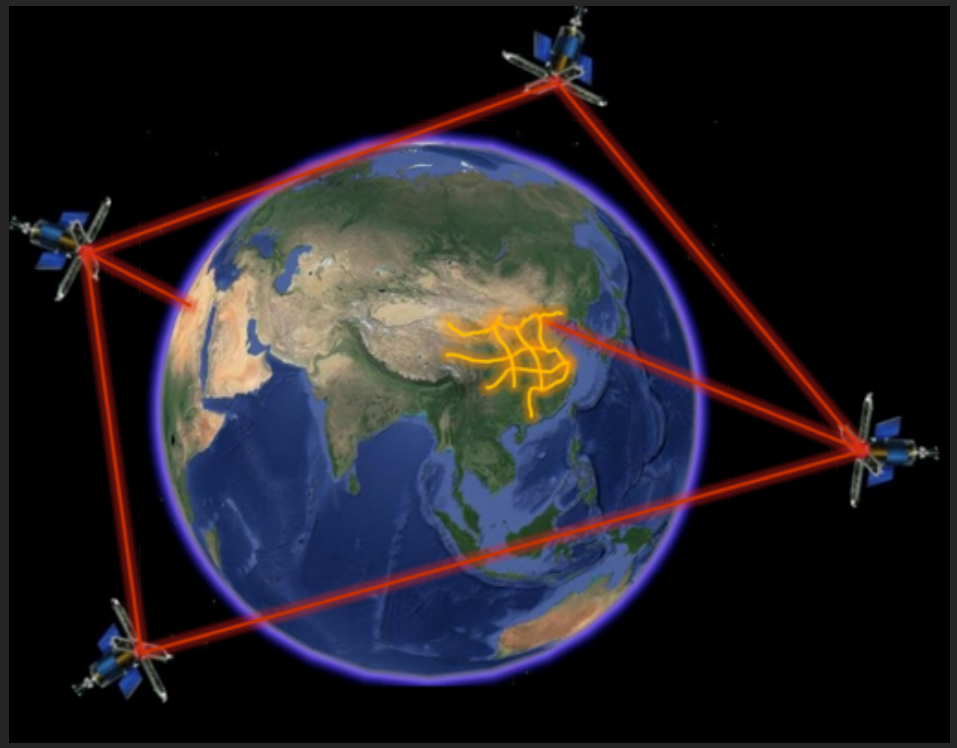
Focusing on quantum network construction and operation, and promoting the wide application of quantum safe technologies. It makes the standard of quantum-safe information technology in China.

国盾量子 QuantumCTek

Founded by the University of Science and Technology of China (USTC),

China's largest manufacturer of quantum communications equipment and systems service providers

Global Quantum Communication Network



- Quantum constellation: LEO/GEO
- Low cost LEO: NanoSat
- GEO: 24 hours online
- Ground: more small and cheap
- **< 10 cents/Kbits in global QKD**
- Much cheaper
- Much safer
- More convenient to use
- To be the best choice for future information security

Quantum Secure Every Bit

国盾量子
QuantumCTek

Homepage: http://www.quantum-info.com/English/

E-mail: Globalmarketing@quantum-info.com

HOMEPAGE

PRODUCTS


Thanks!
Q&A