



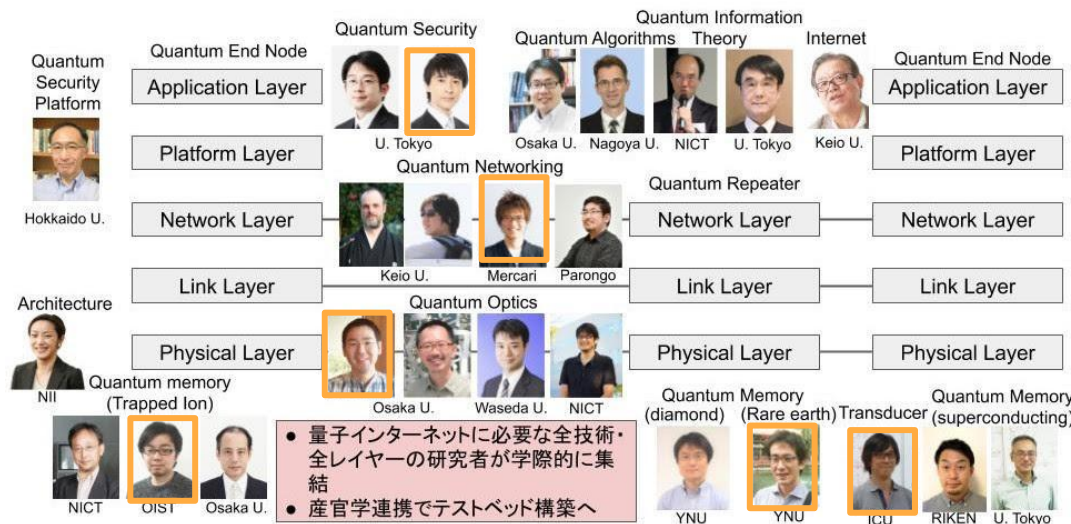
# Quantum Internet Testbed Efforts in Japan (overview)

Shota Nagayama

Global Quantum  
Internet

# Quantum Internet Task Force

- Contribution to achieve **global quantum network!**
- establish a community for interdisciplinary collaboration from hardware to application
  - 2018~ Preparation started from
  - 2019~ Voluntary organization
  - 2021~ Consortium (office at Keio Univ.)
- Steered by Young researchers (responsible for 30 yrs later~)
  - Rikizo Ikuta (Osaka Univ.)
  - Toshihiko Sasaki (The Univ. of Tokyo./WIDE)
  - Takahiko Satoh (Keio Univ./WIDE)
  - Yoshiaki Tsujimoto (NICT)
  - Shota Nagayama (Keio Univ./Mercari, Inc./WIDE, Representative)
  - Tomoyuki Horikiri (Yokohama National Univ.)
  - Rekishu Yamazaki (International Christian Univ.)
- Supported by well-experienced advisory boards
  - Nobuyuki Imoto (The Univ. of Tokyo)
  - Hideo Kosaka (YNU)
  - Kae Nemoto (OIST)
  - Rodney Van Meter (Keio Univ./WIDE)
  - Jun Murai (Keio Univ./WIDE)
  - Takashi Yamamoto (Osaka Univ.)



ホワイトペーパー

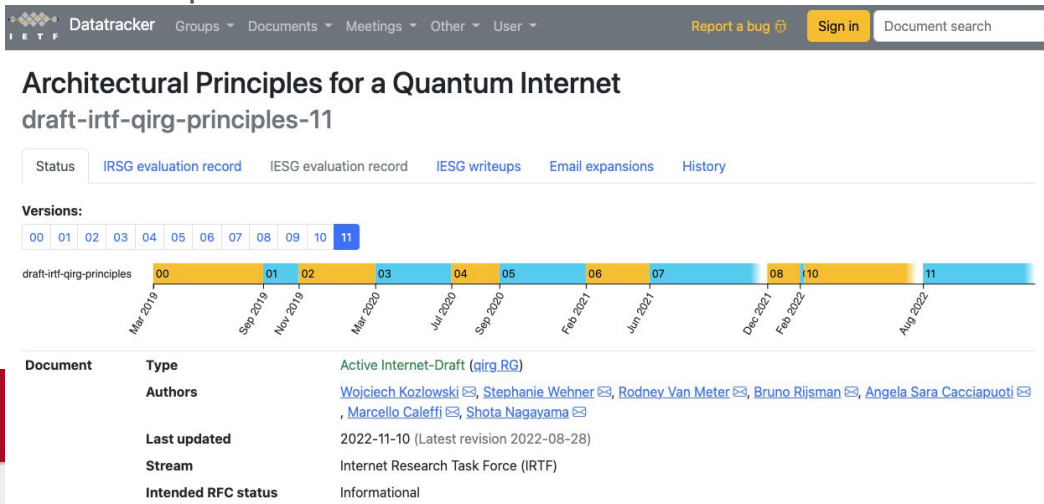
## “The” 量子インターネット

-この宇宙の物理法則に許されるサイバー空間の極致-

産官学連携研究開発コンソーシアム  
量子インターネットタスクフォース

# Quantum Internet

- PoC of “quantum repeating” started to be achieved.
- “Internet Architecture Philosophy” should live in transferring Quantum data
- Effort at IETF/IRTF
  - Quantum Internet Research Group @IRTF
  - The first RFC has been approved. Should be published before IETF116.



The screenshot shows the IETF Datatracker interface for the document 'Architectural Principles for a Quantum Internet draft-irtf-qirg-principles-11'. It includes navigation tabs for Status, IRSG evaluation record, IESG evaluation record, IESG writeups, Email expansions, and History. A 'Versions' section shows a timeline from 00 to 11, with version 11 highlighted in blue. Below the timeline is a table with the following details:

Document	Type	Value
	Type	Active Internet-Draft ( <a href="#">qirg.RG</a> )
	Authors	<a href="#">Wojciech Kozłowski</a> , <a href="#">Stephanie Wehner</a> , <a href="#">Rodney Van Meter</a> , <a href="#">Bruno Rijsman</a> , <a href="#">Angela Sara Cacciapuoti</a> , <a href="#">Marcello Caleffi</a> , <a href="#">Shota Nagayama</a>
	Last updated	2022-11-10 (Latest revision 2022-08-28)
	Stream	Internet Research Task Force (IRTF)
	Intended RFC status	Informational

arXiv > quant-ph > arXiv:2112.07185

Quantum Physics

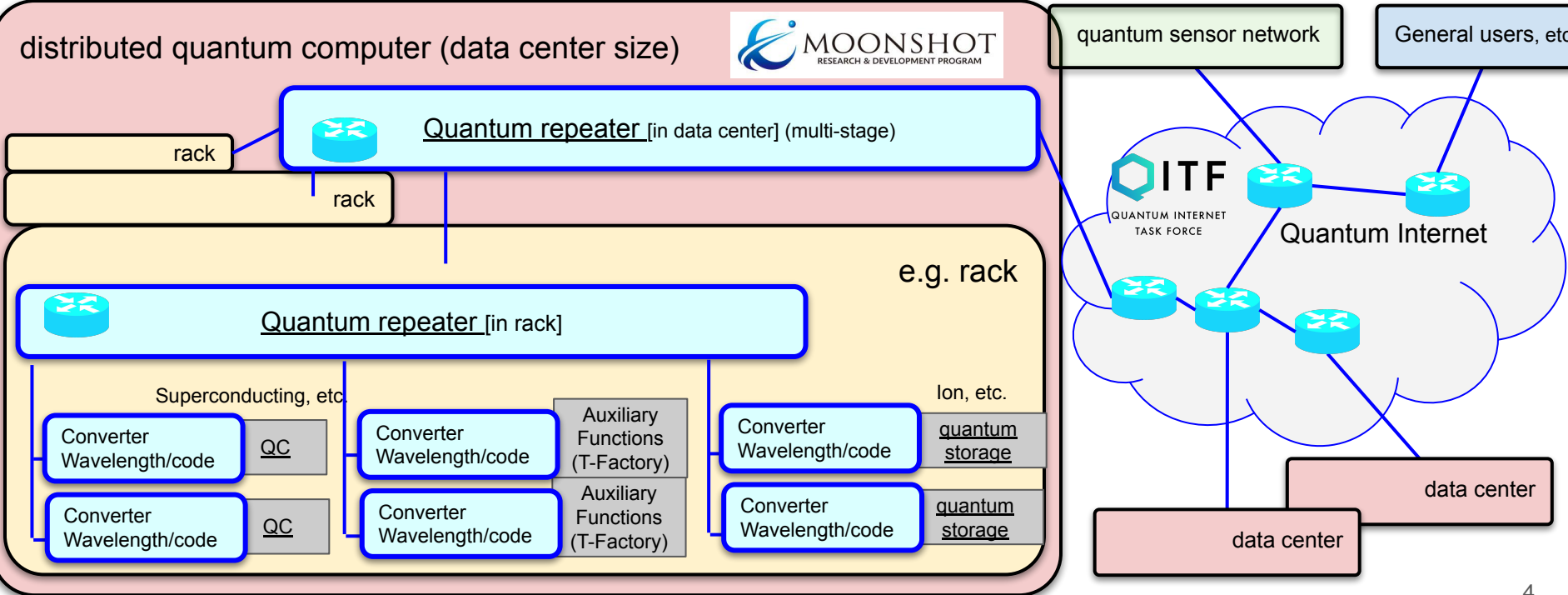
[Submitted on 14 Dec 2021]

## Towards End-to-End Error Management for a Quantum Internet

Shota Nagayama

Vision of society: **Quantum computer networks** achieves the paradigm where quantum data is at will generated, communicated, and processed over the world.

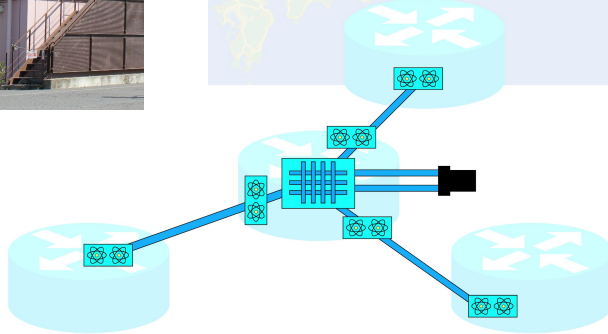
**Infrastructure for generation, distribution, and processing of quantum information is needed = Distributed quantum computers and quantum Internet, both based on quantum networks.**



# Testbed plan in Japan

# Concept 1: Lab-area Network


## Short Range Quantum Computer Network (Intranet)



- A laboratory at Shinkawasaki-city (Tokyo-area)
  - construct a 4-node star network
  - Realize the entire network system, including routing, etc.

## Demonstration of full system of quantum network by integrating various elemental technologies to be researched (Moonshot Goal6 Nagayama PJ)

Here begins our new MIRAI



Japan Science and Technology Agency

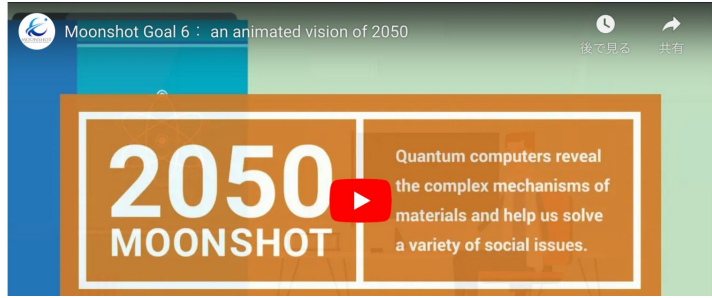
About Program Applications News Publications 日本語

Moonshot R&D TOP > Program > Moonshot Goal 6

### Program

Moonshot Goal 6  
Realization of a fault-tolerant universal quantum computer that will revolutionize economy, industry, and security by 2050.

Moonshot Goal 6 : an animated vision of 2050



2050 MOONSHOT

Quantum computers reveal the complex mechanisms of materials and help us solve a variety of social issues.

Videos

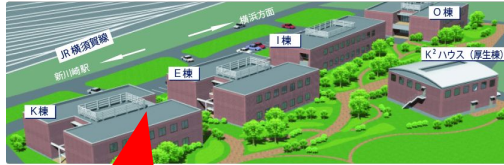
- Animation
- Commentary

Illustrations

- Wide view (677KB)
- Close-up 1 (749KB)
- Close-up 2 (773KB)
- Close-up 3 (579KB)

# Concept 2: Campus Network

## On-campus field experiment (Internet)



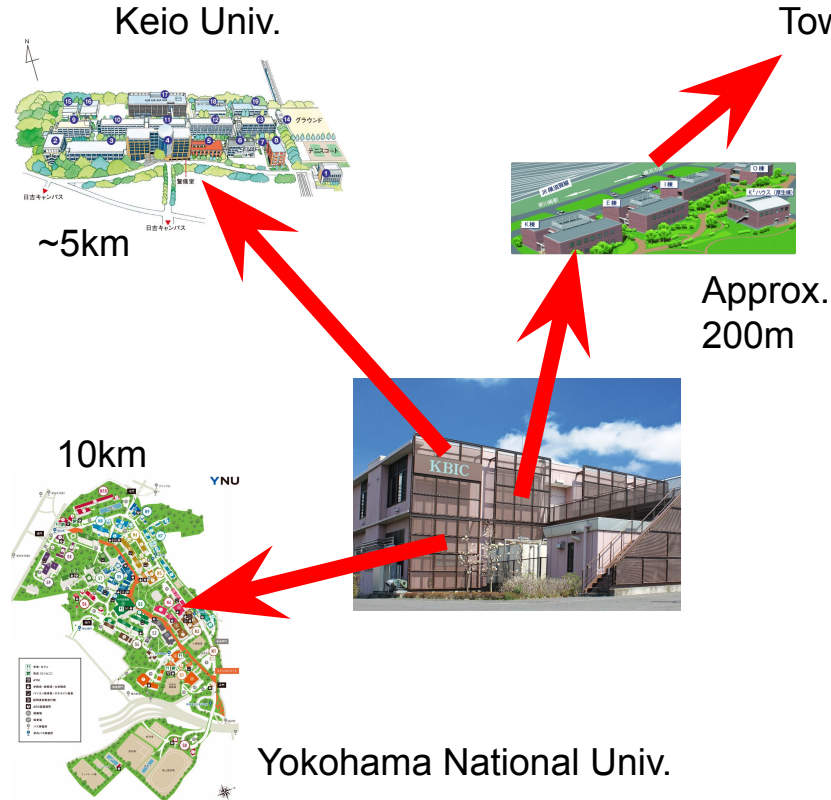
Approx.  
200m



- A laboratory at Shinkawasaki-city (Tokyo-area)
  - construct a 4-node star network
  - Realize the entire network system, including routing, etc.
- Keio University Shin-Kawasaki Campus
  - Elemental Research on Quantum optical technologies @ Moonshot

# Concept 3: Inter-Campus network

## Inter-campus field experiment (Internet)



- A laboratory at Shinkawasaki-city (Tokyo-area)
  - construct a 4-node star network
  - Realize the entire network system, including routing, etc.
- Keio University Shin-Kawasaki Campus
  - Elemental Research on Quantum optical technologies @ Moonshot
- Keio University Yagami Campus
- Yokohama National University
- Further Expansion





QUANTUM INTERNET  
TASK FORCE

WIDE

PROJECT

# The Future & Roadmap to the Quantum Internet - Testbed Efforts in Japan -

Shota Nagayama & Rodney Van Meter

Date: 11:45-12:45, Thursday, March 30, 2023

Venue: G303

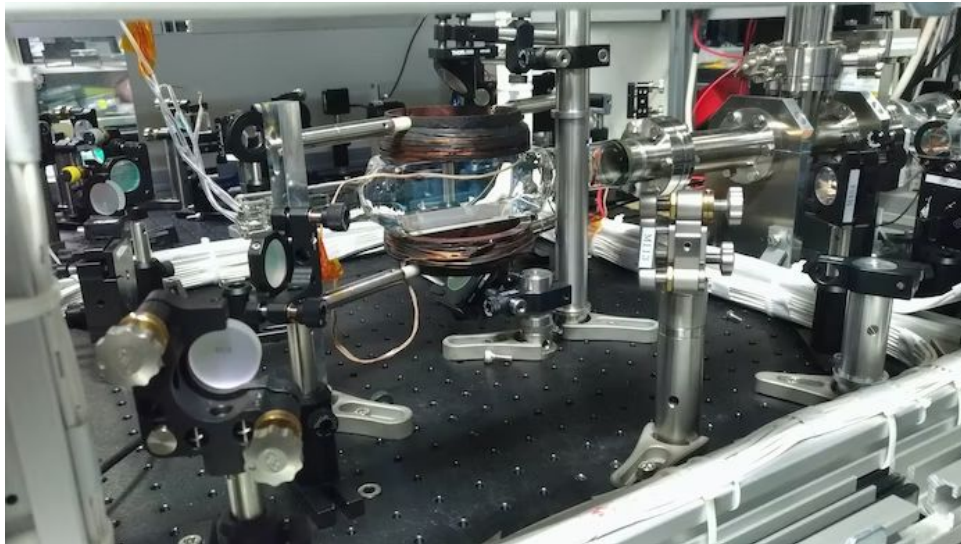
✂Lunch will be provided. (First come, first served.)

Global Quantum  
Internet

# | Lab Tour

Lab Tour to Yokohama National University Friday, 1400~1630.

Apologies to those we had to cut from the list! Capacity overflowed before we cut off registration.



picture by Osaka univ.