ATTACHMENT 1: Profile and Detailed Achievements of the Group A Recipients of the 2023 C&C Prize

Dr. Yasunobu Nakamura

Current Positions:
Director, Riken Center for Quantum Computing
Professor, Department of Applied Physics, Graduate School of Engineering, The University of Tokyo

Personal History (born in 1968):

1992	M.S. Superconductivity Research Course, The University of Tokyo
1992-1997	Researcher, Fundamental Research Laboratories, NEC Corporation
1997-2001	Senior Researcher, Fundamental Research Laboratories, NEC Corporation
2001-2004	Principal Researcher, Fundamental Research Laboratories, NEC Corporation
2001-2002	Visiting Researcher, Department of Applied Physics, Delft University of Technology
2002-2007	Researcher, Frontier Research System, Riken
2005-2007	Research Fellow, Fundamental and Environmental Research Laboratories, NEC Corporation
2007-2010	Research Fellow, Nanoelectronics Research Laboratories, NEC Corporation
2008-2013	Researcher, Advanced Science Institute, Riken
2010-2012	Research Fellow, Green Innovation Research Laboratories, NEC Corporation
2011	Ph.D. in Engineering, Department of Applied Physics, The University of Tokyo
2012-2012	Professor, Department of Applied Physics, Graduate School Engineering, The University of Tokyo
2012-2022	Professor, Research Center for Advanced Science and Technology, The University of Tokyo
2013-2014	Researcher, Riken Center for Emergent Matter Science
2014-2020	Team Leader, Riken Center for Emergent Matter Science
2020-2021	Group Director, Riken Center for Emergent Matter Science
2021-	Director, Riken Center for Quantum Computing
2022-	Professor, Department of Applied Physics, Graduate School of Engineering, The University of Tokyo

Major Awards:

1999	Young Scientist Presentation Award, Japan Society of Applied

Physics
1999 Sir Martin Wood Prize
1999 Nishina Memorial Prize
2003 TR100, Technology Review Magazine, MIT
2004 Agilent Technologies Europhysics Prize (with Michel Devoret, Daniel Esteve, and Hans Mooij)
2008 Simon Memorial Prize (with Jaw-Shen Tsai)
2014 2014 Thomson Reuters Highly Cited Researcher
2014 Leo Esaki Prize (with Jaw-Shen Tsai)
2018 Superconductivity Science and Technology Award (with Kunihiro Inomata, Zhirong Lin, Kazuki Koshino, and Tsuyoshi Yamamoto)
2019 JSAP Outstanding Achievement Award, Japan Society of Applied Physics
2020 JSAP Award for Best Review Paper, Japan Society of Applied Physics (with Dany Lachance-Quirion, Yutaka Tabuchi, Arnaud Gloppe, and Koji Usami)
2020 APS Fellow
2021 Asahi Prize (with Jaw-Shen Tsai)
2021 Clarivate Highly Cited Researchers 2021
2022 Micius Quantum Prize (with John Clarke and Michel Devoret)
2023 Japan Academy Prize (with Jaw-Shen Tsai)
2023 Hattori Hoko Award (with Jaw-Shen Tsai)

Prof. Tsai Jaw-Shen

Current Positions:
Professor, Tokyo University of Science
Team Leader, Riken Center for Quantum Computing

Personal History (born in 1952):
1983 PhD in Physics, Department of Physics, State University of New York at Stony Brook
1983-1985 Research Scientist, Microelectronics Research Laboratories, NEC Corporation
1985-1990 Supervisor, Fundamental Research Laboratories, NEC Corporation
1990-1993 Research Manager, Fundamental Research Laboratories, NEC Corporation
1993-1996 Principal Researcher, Fundamental Research Laboratories, NEC Corporation
1996-2001 Senior Principal Researcher, Fundamental Research Laboratories, NEC Corporation
2001-2007 Fellow, Fundamental Research Laboratories, NEC Corporation
2001-2012 Team Leader, Riken Macroscopic Quantum Coherence Team

2007-2014 Fellow, Nano Electronics Research Laboratories, NEC Corporation
2012-2012 Group Director, Riken Single Quantum Dynamics Research Group
2013-2014 Team Leader, Macroscopic Quantum Coherence Research Team, Quantum Information Electronics Division, Riken Center for Emergent Matter Science
2014- Team Leader, Superconducting Quantum Simulation Research Team, Quantum Information Electronics Division, Riken Center for Emergent Matter Science
2015- Professor, Tokyo University of Science

Major Awards:

2004 Nishina Memorial Prize
2008 Simon Memorial Prize (with Yasunobu Nakamura)
2013 Quantum Innovator Award
2014 JSAP Award for Best Review Paper, Japan Society of Applied Physics
2014 Japan Society of Applied Physics, Superconductivity Division Paper Award (with O. V. Astafiev, L. B. Ioffe, S. Kafanov, Yu. A. Pashkin, K. Yu. Arutyunov, D. Shahar, O. Cohen)
2014 Distinguished Award on Superconductivity Science and Technology, Society of Non-Traditional Technology
2014 Leo Esaki Prize (with Yasunobu Nakamura)
2018 Medal with Purple Ribbon
2021 Asahi Prize (with Yasunobu Nakamura)
2023 Japan Academy Prize (with Yasunobu Nakamura)
2023 Hattori Hoko Award (with Yasunobu Nakamura)

Achievements

Quantum information technology, which applies the principles and phenomena of quantum mechanics to information processing, is a rapidly progressing field that covers a broad range of subjects, including quantum communications, quantum computing, quantum measurement, and quantum sensing. Quantum computers, which hold promise in efficiently solving problems that are difficult for conventional supercomputers, have been attracting much attention in recent years, and competition in their development has been intense.

In 1999, Dr. Nakamura and Prof. Tsai were the first to achieve a superconducting qubit, the basic element of superconducting quantum computers. They have been leaders in research and development in the field, and the technology has come to be applied to the development of

quantum computers at several companies. Additionally, in March 2023, Dr. Nakamura put Japan's first quantum computer into operation.

Dr. Nakamura entered NEC in 1992 after graduating from university and was assigned to the Fundamental Research Laboratories. He undertook research on the quantum state control of nanoscale superconducting devices together with Prof. Tsai, his superior at that time. In 1999, they controlled the superposition of the ground and excited states of a qubit based on a superconducting circuit containing Josephson junctions, a tunneling junction device. They observed the quantum oscillations between the two states. The circuit they used is called a Cooper-pair box in which a single Cooper pair (a pair of electrons) tunnels in and out of a small superconducting electrode. This was the moment in which a qubit, the basic element of a superconducting computer, was demonstrated for the first time on a solid-state device favorable to integration.

This achievement opened up the way for many researchers around the world to enter this newly created field. Dr. Nakamura and Prof. Tsai demonstrated two-bit gate control between superconducting qubits, quantum entanglement generation between them, quantum logic circuits, and quantum universal gates. They became pioneers in this research field through these achievements, which have become the foundation of quantum computer development in recent years. The qubits used in the quantum annealing machine commercialized in 2011 by D-Wave Quantum Systems Inc. in Canada were superconducting qubits. The quantum computer developed by Google in 2019 also used superconducting qubits.
Since taking up his post as professor at the Research Center for Advanced Science and Technology, The University of Tokyo, in 2012, Dr. Nakamura has been engaged with his colleagues in research targeting the generation, control, and measurement of quantum entanglement between a superconducting qubit and a microwave photon within a microwave cavity. They have also achieved coherent coupling between a superconducting qubit and a magnon, an elementary magnetic excitation in ferromagnetic material, and succeeded in controlling single magnons using quantum entanglement. These achievements constitute quantum-limit experiments in magnetism and spintronics and have the possibility of becoming new information processing technologies that can lead to applications such as quantum sensing and a quantum information interface between microwaves and light.

Dr. Nakamura joined the Riken Center for Emergent Matter Science (CEMS) in 2013. In 2021, he was appointed the founding Director of the Riken Center for Quantum Computing (RQC). In this capacity, he has been overseeing quantum computer research and promoting the research and development of quantum computers with collaborating institutions in the

Quantum Leap Flagship Program (Q-LEAP) of the Japan Science and Technology Agency (JST). In March 2023, these efforts culminated in operating Japan's first quantum computer based on a superconducting system and launching a quantum computation cloud service.

Prof. Tsai participated in the quantum information science research initiated by Riken in 2001 and became Team Leader of the Macroscopic Quantum Coherence Research Team, guiding the launching of this research. Since 2015, he has also held the post of Professor at Tokyo University of Science, where he has been promoting the study of superconducting quantum circuits based on Josephson junctions. Achievements coming out of this research include the direct observation of the coherent quantum phase slip (CQPS), on-demand tunable microwave single-photon source, and the construction of a system for detecting a single microwave photon propagating through a waveguide. These achievements are expected to lead to diverse applications besides quantum computers in superconducting electronics, quantum sensing, and quantum communications.

Dr. Nakamura and Prof. Tsai were the first to create a superconducting qubit as the basic element of superconducting quantum computers. Many research achievements through their efforts as pioneers and front-runners of quantum information technologies have contributed to the development of quantum computers that impact society in diverse ways. In view of their many and outstanding achievements, Dr. Nakamura and Prof. Tsai are deserving recipients of the C&C Prize.