Citation

For distinguished and pioneering accomplishment in quantum optics / quantum information processing, and outstanding contributions to the development of this field

Dr. Yoshihisa Yamamoto

Positions and Organizations :
Professor, Stanford University
Professor, National Institute of Informatics

Doctorate : Ph.D. (Univ. of Tokyo, 1978)

Date of Birth : November 21, 1950

Brief Biography :

1973	B. E., Tokyo Institute of Technology
1975	M.E., University of Tokyo
1978	Ph.D., University of Tokyo
1978	Scientist, NTT Basic Research Laboratories
1992	Professor of Applied Physics and Electrical Engineering, Stanford University
1999	NTT R&D Fellow
2001	Honorary Professor, Chiao Tung University, Taiwan
2003	Professor, National Institute of Informatics

Main Awards and Honors :

1992	Carl Zeiss Research Award
1992	Nishina Memorial Prize
1995	Research Commendation by Minister of Science and Technology Agency
1995	Fellowship, Optical Society of America
2000	IEEE/LEOS Quantum Electronics Award
2005	Medal with Purple Ribbon, Japanese Cabinet
2006	Shida Rinzaburo Prize
2007	Fellowship, American Physical Society
2010	Hermann Anton Haus Lecturer (MIT)

Main Achievements :

Professor Yoshihisa Yamamoto earned a PhD in 1978 at the University of Tokyo Graduate School of Engineering, and began working in the Basic Research Laboratories of Nippon Telegraph and Telephone Public Corporation (now NTT) the same year. During his tenure at NTT he also served as a visiting scientist at the Massachusetts Institute of Technology, Sweden's Royal Institute of Technology, and the AT&T Bell Laboratories. In 1992 he became professor of Applied Physics and Electrical Engineering at Stanford University. Since 2003 he has also served as professor in the National Institute of Informatics, Tokyo, as a Japanese scientist leading the quantum computer research world.

The key paper proposing the idea of a quantum computer was published by Oxford University's David Deutsch in 1985. A quantum computer represents information using quantum properties such as photon polarization or electron spin. It is not limited to the ones or zeros of digital computers (bits) but can in theory represent any superposition of both these values (qubits, units of computer information in quantum computing). Because there can be infinite quantum states, the qubit has the potential for multiple information processing to be performed simultaneously; and as the number of qubits increases, super-fast computing becomes possible.

Dr. Yamamoto's initial research took up coherent communication, one of the technologies for achieving high-speed optical communication over long distances. Using semiconductor lasers as light sources, this method sends and receives multiple carrier waves at once using light of slightly different frequencies. The laser light noise was an undesired property because it causes frequency instability. However, it resembles the "quantum fluctuation" that allows the electron spin to take the ground state and the first excitation state at the same time. By taking advantage of this "quantum fluctuation" and actually controlling the fluctuation, high-speed computation can be made possible. In his pioneering quantum computer research, Dr. Yamamoto therefore worked on such techniques as using a laser beam to change the orientation and phase of electron spin as a way of performing gate operations.

When Dr. Yamamoto was given the appointment at Stanford University, he was the top choice among 50 elite researchers around the world. His research at Stanford has been centered on the following three major themes.

1) "Cavity QED," the interactions among atoms, artificial atoms, and light (including Bose-Einstein condensation of exciton-polaritons).
2) Controlling quantum states of light by a single photon (that is, by placing one photon on one light pulse).
3) Quantum information processing, including quantum cryptography, quantum repeaters and quantum computers.

With these as pillars, he has energetically pursued world-leading research in this field.

While retaining his position at Stanford, in 2003 he became professor in Japan's National Institute of Informatics and in 2003 supervisor of the "Creation of New Technology Aiming for the Realization of Quantum Information Processing Systems" project conducted under the Core Research for Evolutional Science and Technology (CREST) program of the Japan Science and Technology Agency. Through these responsibilities, besides carrying out his own research, he has contributed significantly to educating young researchers.

In 2009, the Funding Program for World-Leading Innovative R&D on Science and Technology (FIRST program) was created by the Japanese government aimed at advancing leading research and development that will strengthen Japan's international competitiveness and achieve world leading performance over the next three to five years. The Quantum Information Processing Project led by Dr. Yamamoto was selected as one of the 30 FIRST projects. Born of his strong desire to bring together individual research efforts on quantum information processing under a "national team," the project aims to define the specific form of quantum computer realization four years down the road. It is currently being carried out by a total of 300 persons, concentrating resources on semiconductors and superconductors which are the solid-state devices.

These are examples of Dr. Yamamoto's numerous world-leading achievements through his pioneering studies on use of quantum optics, his studies demonstrating quantum encrypted communication by means of a single-photon light source, his fundamental research on quantum information processing using an atomic nucleus or electron spin, and his basic research on Bose-Einstein condensation of exciton-polaritons.

For distinguished and pioneering accomplishment in quantum optics / quantum information processing, and outstanding contributions to the development of this field, Dr. Yoshihisa Yamamoto is hereby awarded the Okawa Prize.