

FY2012

JSPS Core-to-Core Program
-Strategic Research Networks-
Research Report

Project No.	21001
Research Theme	Collaborative Research Center on Ultrahigh-speed Optical Communication
Duration of Project	April 1, 2011 – March 31, 2014
Core Institution in Japan	Research Institute of Electrical Communication, Tohoku University

Implementing Organizations

Country	Japan
Core Institution	Research Institute of Electrical Communication, Tohoku University
Co-Chair (name and title)	Masataka NAKAZAWA, Professor
Number of Cooperating Institutions	3
Cooperating Institutions	Graduate School of Engineering, Tohoku University National Institute of Information and Communication Technology National Institute of Advanced Industrial Science and Technology

Country	Germany
Core Institution	Heinrich-Hertz Institute
Co-Chair (name and title)	Colja SCHUBERT, Group Leader
Number of Cooperating Institutions	0
Cooperating Institutions	
Matching Fund	①FhG-MPG cooperation projects ②Semiconductor Nanophotonics: Materials, Models, Devices ③7th Framework Programme, Information and Communication Technologies

Country	U.K.
Core Institution	University of Southampton
Co-Chair (name and title)	David RICHARDSON, Professor
Number of Cooperating Institutions	0
Cooperating Institutions	
Matching Fund	①EPSRC ②EPSRC ③Framework 7 ④Framework 7

Country	Denmark
Core Institution	Technical University of Denmark
Co-Chair (name and title)	Palle JEPPESEN, Professor
Number of Cooperating Institutions	0
Cooperating Institutions	
Matching Fund	①Villum Fonden (private Danish Foundation) ②European Research Council (ERC) ③Research Council for Technology and Production Sciences

Result of Program Implementation

We proposed a novel optical pulse which we named "optical Nyquist pulse," which is expected to realize ultrahigh-speed and high spectral efficiency simultaneously. In order to clarify the advantage of optical Nyquist pulse transmission, we undertook an ultrahigh-speed long-haul transmission at a symbol rate of 160–640 Gbaud over 500 km, and demonstrated that the system tolerance to chromatic dispersion and polarization-mode dispersion is greatly improved compared to a conventional Gaussian or sech optical pulse.

We also organized "Ultrafast Photonics Symposium," which was held in Tokyo on November 5, and "Post-ECOC Workshop," which was held in Eindhoven, the Netherlands, on September 21. These events contributed to stimulate discussion and clarify future directions in the field of ultrafast photonics, ranging over different areas from materials and fundamental devices to biophotonics, nano technology, and terahertz photonics.

Achievements in FY2012 (Self Review)

Through the research activities, it has been widely recognized that the increase in spectral efficiency is a very important subject in ultrahigh-speed transmission, not only in terms of increasing the transmission capacity within a given bandwidth, but also improving system tolerance to chromatic dispersion and polarization-mode dispersion, as well as reducing power consumption. As we demonstrated through the transmission experiments, optical Nyquist pulses that we proposed is found to be very promising to meet these demands. This technique has also attracted a lot of attention among collaborators in Europe and Japan, and several new results, including large tolerance to narrowband optical filtering at the optical network nodes, have already been obtained.

As regards the collaborative research framework, ISUPT has been taking initiative in the field of ultrafast photonics. The next ISUPT will take place in University of Rochester, USA, in October 2013. ISUPT is playing a role as a center of worldwide research network, and expected to grow on a global scale.

Future Plan (Measures toward Achieving Research Objectives)

Through the collaborative framework, we will explore the realization of ultrahigh-speed and highly spectral-efficient transmission by using optical Nyquist pulses and combining with multi-level modulation format. It is also a very important to subject to integrate ultrafast optical devices to reduce size and power consumption, which is indispensable to increase the feasibility of ultrahigh-speed transmission systems. To achieve this goal, we will strengthen the collaboration with industry and expand the collaboration partnership to a global scale especially in the US.