Photonics Center
Osaka University

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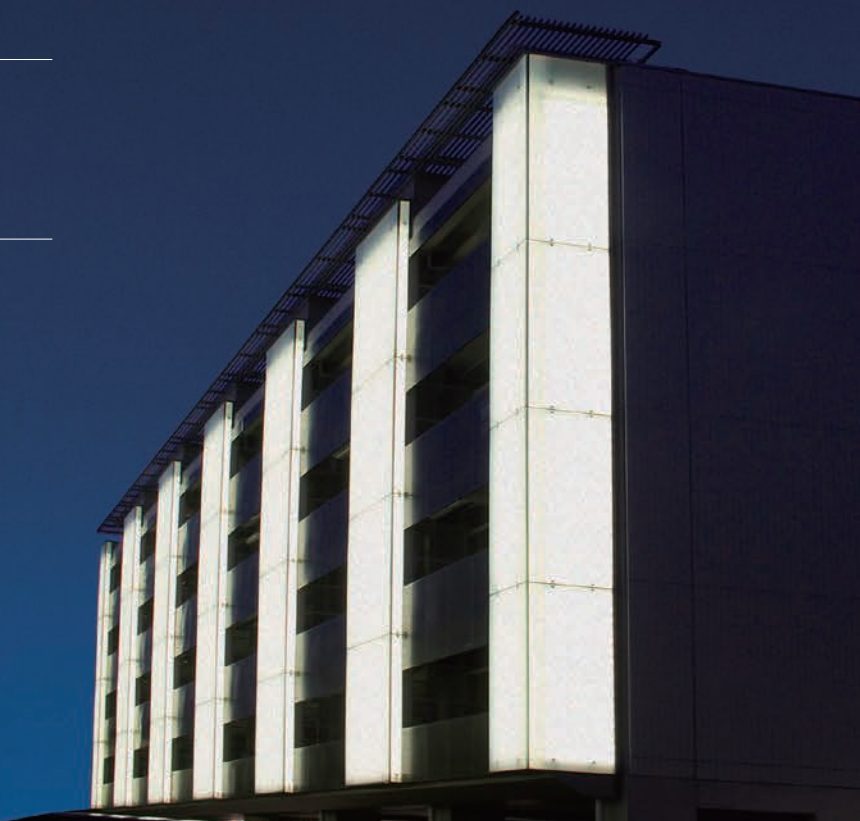


Expectations for the Innovation Center to Promote Advanced Interdisciplinary Research

Osaka University is known as the heart of world-leading photonics research and boasts the most researchers focused on optics and photonics in Japan.

Today's society is confronted with many complicated problems, such as energy issues, a declining birthrate, and an aging population. Finding solutions to these problems will require more than the development of leading research in individual fields, but will necessitate transdisciplinary collaboration among them. Against this backdrop, Osaka University established the Photonics Advanced Research Center (PARC) in 2007.

Unlike electrons, light does not carry an electric charge. Light possesses a quality that is gentle to humans and can propagate through living organisms as well as the atmosphere. In my research field, information science, we hope to use these features of light not only for playing key roles in information and communications technology, image recognition, and the Internet of Things, but also to expand the application of light to a wide range of fields, including energy and environment, industrial technology, and medical care for the development of new industries. Indeed, one could argue that photonics may constitute the scientific and technological foundation of 21st century society.

The interdisciplinary collaboration driven by this center is expected to inspire the creation of numerous innovations and to nurture personnel who will set the course for the next generation.

Executive Supervisor of PARC
Shojiro Nishio
President
Osaka University

Photonics Establishing a New Scheme of Industry-Academia Collaboration and Human Resources Development

Photonics is the science and technology concerned with interactions between light and matter. Seeing is the practice of photonics, that is, sensing light with the eyes is caused by interactions between light and photoreceptor cells. Products of photonics are ubiquitous in our everyday lives. In fact, we are all familiar with the science and technology of photonics through such products as cameras, optical disks, liquid crystal displays, solar cells, photocatalysts, and optical telecommunication system.

There are currently more than one hundred photonics-related labs at Osaka University. Over the years, numerous faculty, researchers, and students have pioneered cutting-edge photonics sciences and conducted their technological development. Owing to these advanced research activities and the on-campus transdisciplinary project called the Nanophotonics Research Initiative, in July 2007 MEXT selected Osaka University to head the Program for the Creation of Innovation Centers for Advanced Interdisciplinary Research Areas subsidized by special coordination funds for promoting science and technology. Under this program, Osaka University established the Photonics Advanced Research Center (PARC) through which the university and five photonics-related companies conduct wide-ranging interdisciplinary research based on nanophotonics, and plasmonics in particular, aimed at developing industrial innovations. In April 2011, construction of the Photonics Center Building was completed through a subsidy from METI. The building was configured with R&D labs for partner companies, with the goal of establishing a new model of industry-academia collaboration that we call an "interpenetrating partnership," whereby the university and companies share physical space and the latest information on photonics science and technologies.

In addition to collaborating on projects with the five partner companies, the Photonics Center takes steps to ensure that research achievements produced at the center contribute to society. Machinery and software for the production of prototypes, including design, machining, trial production, analysis, observation, and evaluation, have been installed at the center as common facilities. Nicknamed the "Photonics Cannery," these facilities are available for use by all members and companies active at the Photonics Center. We have also launched a unique project to assist researchers in developing their own products or starting a business. Start-up companies have been established for the planning, production, and sales of developed products, and some products developed jointly with partner companies have been placed on the market.

We are also working with overseas photonics-related research centers to build a network for pioneering advanced research and development. By conducting international exchange and collaboration on research through the deployment and acceptance of young researchers and graduate students in particular, we are working to develop global human resources capable of shouldering the next generation. By carrying out various R&D, human resources development, and other activities at these research centers, we hope to create an international hub for photonics education and research, transforming the hills of Senri into the "Photonics Hills" where photonics industries can spontaneously produce new innovations.

Director of PARC
Yasushi Inouye
Professor
Graduate School of Frontier Bioscience
Osaka University

Photonics Center

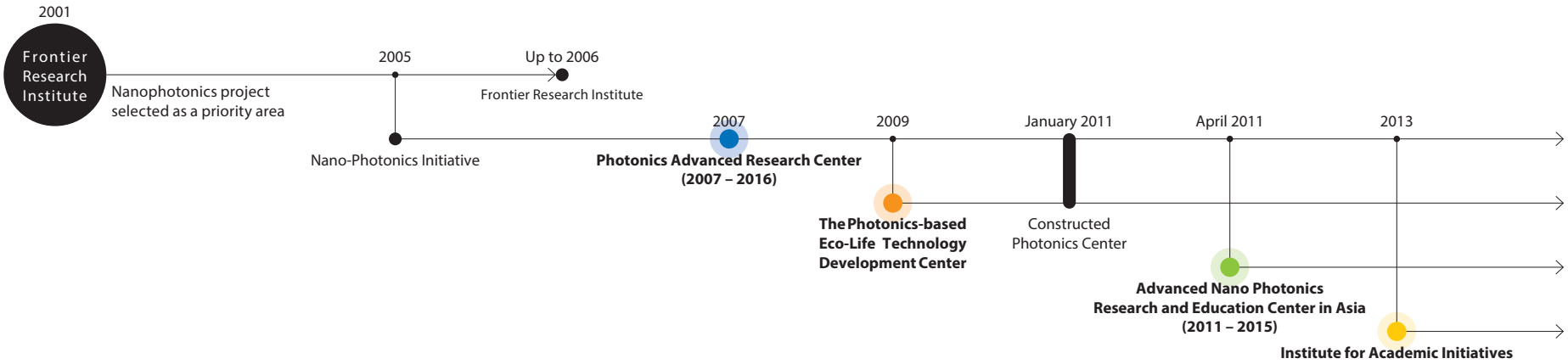
Osaka University

Osaka University is the key photonics research centers in the world, having hosted a number of photonics research projects with many of its faculties and schools conducting research and education from basic to applied levels and thereby producing numerous talented engineers. From 2001 to 2006, its Graduate School of Engineering pursued the "Frontier Research Institute," a program for "Fostering Strategic Centers of Excellence under the Special Coordination Funds for Promoting Science and Technology," in which a nanophotonics project was selected as one of the priority areas.

Under the framework of this program, aggressive efforts were made to establish photonics as an academic discipline and interconnect it with other disciplines, and also to promote industry-academia collaboration through, for example, joint research via matching funds with various businesses. It was in the spirit of such endeavors that in 2005 the Nano-Photonics Initiative was formed as an independent multidisciplinary research institution, gathering together researchers of electric and electronics engineering and applied physics. This research institution has since committed itself to the advancement of nanophotonics research, creation of new industries, and human resources development through a variety of initiatives, which include the startup of three venture businesses under the lead of the university, sponsorship of three rounds of the "International Nanophotonics Symposium Handai" convention, e-learning courses for working adults, and publication of an academic books (*Handai Nanophotonics Book Series Vol. 1, 2, 3, Elsevier*).

Originally a virtual organization within Osaka University, the Photonics Center is carrying on the mission of this Nano-Photonics Initiative, providing opportunities for researchers in this broad-based discipline to engage in education, research, and information sharing. With the completion of the Photonics Center in 2011, the Center has further consolidated its foundations.

There are currently more than twenty research labs, not restricted to specific graduate courses and major subjects, and numerous businesses at the Photonics Center conducting research on photonics as a base science and technology for the 21st century. Through such projects as the Photonics Advanced Research Center (2007–2016), the Photonics-based Eco-Life Technology Development Center (2009–present), the JSPS Advanced Nano Photonics Research and Education Center in Asia (2011–2015), and the succeeding Global Nano-Photonics (Core-to-Core Program 2016–2020), the Photonics Center carries out advanced scientific research on nanophotonics and plasmonics and their application and industrialization, development of photonics-based eco-life technology and support for its industrialization, and projects for international exchange and human resources development.



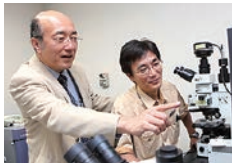
Innovation Activities for Photonics Industrialization

With twenty-one Osaka University laboratories and five private enterprises participating, PARC was established in 2007 to explore a broad range of photonics research seeds, which were then narrowed down to nanophotonics and plasmonics by 2009. Following the 2010 review of the PARC project, the operational framework was realigned to include nine laboratories and five companies in order to place greater focus on plasmonics innovation. The year 2011 saw completion of the Photonics Center building, a physical base for the virtual organization to that time.

In the following year of 2012, the Photonics Center began inviting novel ideas for its Entrepreneurial/Productization Project in a bid to assist University researchers and students in their efforts to start up their own businesses and bring the outcomes of their research to the market. Four projects were selected in fiscal 2012, followed by three in fiscal 2013, two in 2014 and two in 2015 and 2-years support is offered to them.

In addition to the five member companies, the "Photonics Cannery" has been arranged and expanded to invite partners aiming to develop photonics-related products or enter the photonics business, ranging from small and medium enterprises (SMEs) from diverse industrial sectors to individuals, in an attempt to further accelerate the creation of innovation. As its name suggests, Photonics Cannery compares the Photonics Center to a canning factory where one new photonics product after another is born. To this end, the "factory" is fully equipped to perform research, evaluation, and prototype production, with staff members standing by to offer technical support, so that SMEs and individuals may work on the development of new photonics products without being forced to bear the heavy burden of capital investment.

In order to spread word about the "Photonics Cannery" to the general public, SMEs taking an interest in the photonics business were invited to attend a series of events on "Photonics Day," which was hosted by the University. A symposium was also held in Higashi Osaka City – a central hub for SMEs – in order to increase recognition of the Photonics Cannery there.

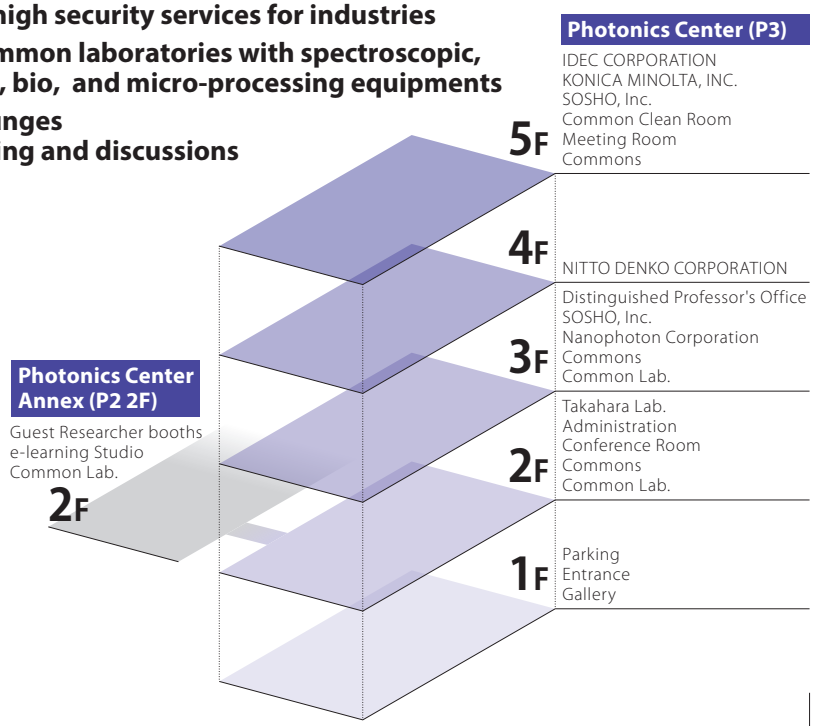


In addition, the contents of ongoing activities such as colloquia, symposia, and other events, as well as e-learning, which originally focused on "Introduction to the Center's Advanced Research," have expanded to include "Promotion of Innovation and Entrepreneurship." To support this new initiative, efforts are being made to inspire people to start their own businesses and develop new products in the realm of photonics. For example, we have invited numerous entrepreneurs and investors, including Dr. Thomas M. Baer, Executive Director of the Stanford Photonics Research Center, to speak about their experience in starting up businesses and supporting entrepreneurs by the university, and brought in patent lawyers to lecture on indispensable rules of patent for start-ups as well.

Photonics Center Building (P3)

Five-floor building with 4,900 m^2 of floor space, constructed in 2011

- **Provide high security services for industries**
- **Open common laboratories with spectroscopic, chemical, bio, and micro-processing equipments**
- **Open lounges for meeting and discussions**



Industrial innovation program

Photonics Advanced Research Center (PARC)

URL http://www.parcjp.org/

Interpenetration between university and industry partners is the key to industrial innovation.

Multifaceted project frameworks through winning combinations, between the university and various partners from different sectors.

- **Applications of core technologies in nanophotonics and plasmonics**

  Through the application of core technologies in nanophotonics and plasmonics, we aim for the creation of industries in the areas of information technology (IT), energy, security/safety, and analytical instrumentation.

- **Horizontal cooperation in materials, thin films, production lines, analysis, and devices**

  Infrared imaging, reagents, security, biosensors and high-density optical recording, etc.

- **A breakthrough in one field triggers a chain of breakthroughs in others.**

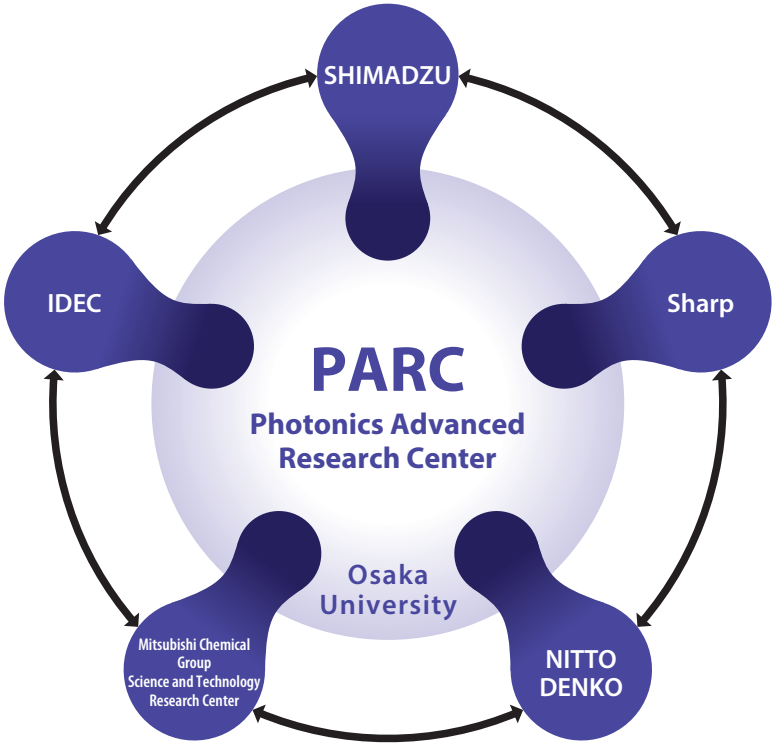
Launching industrialization projects to utilize accumulated research results for creation of new businesses/products

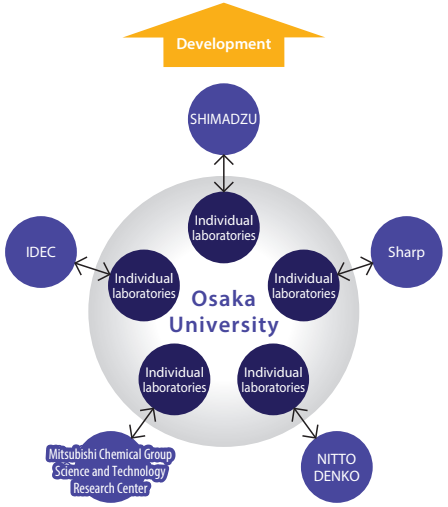
In addition to innovative industrialization through partnerships with member businesses, we have begun encouraging entrepreneurship and productization based on a wealth of research achievements as we continue upgrading facilities/equipment for creation of photonics product prototypes.

Interpenetrating partnership system

【Industry on campus model】

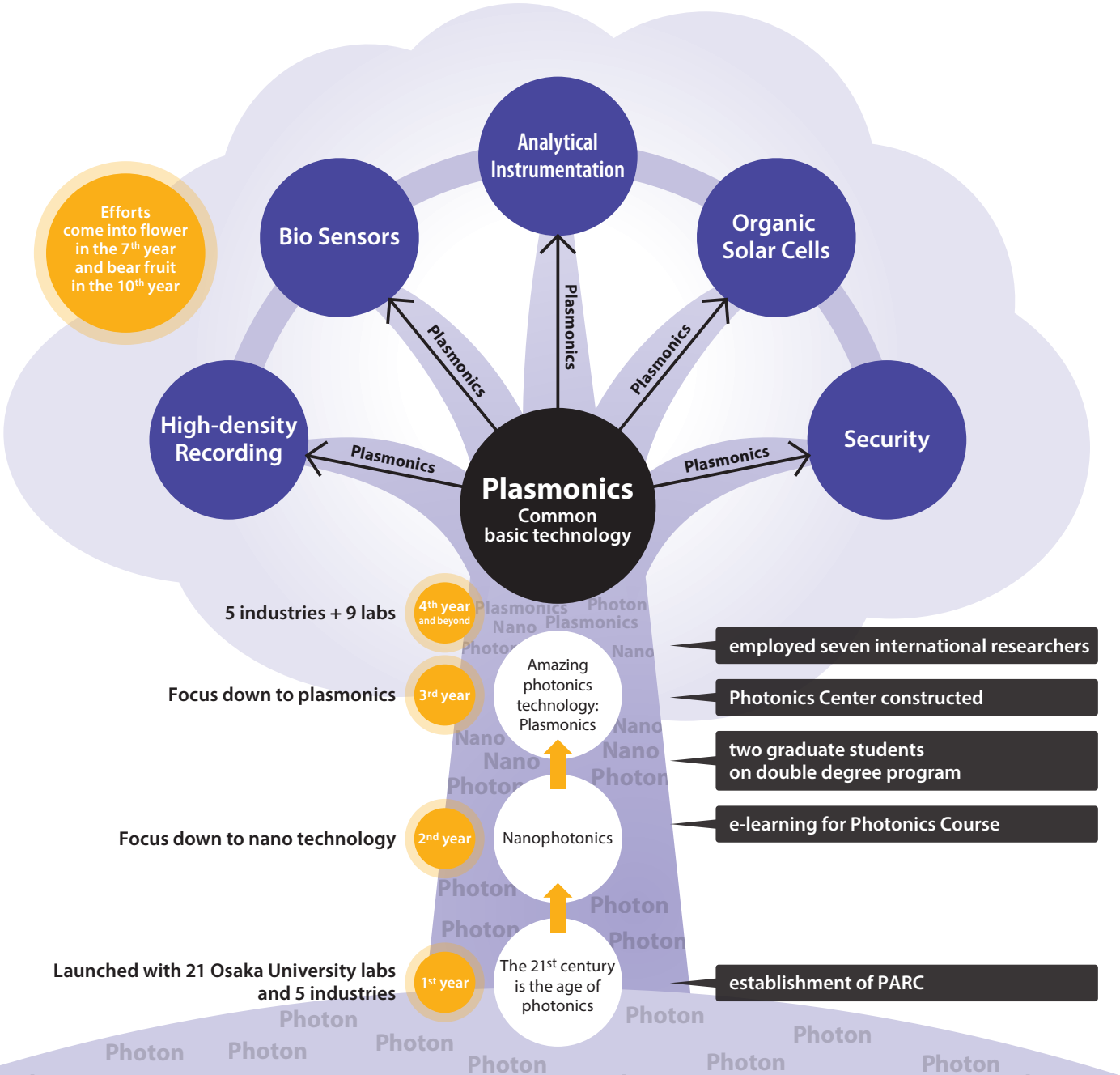
Core technologies + Partners from different sectors

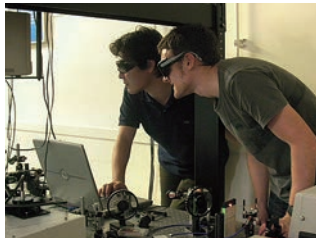


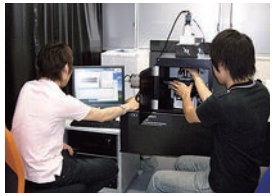


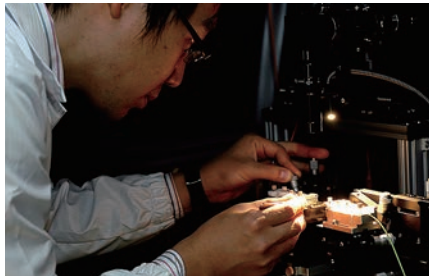
Conventional industry-academia cooperation model

(Nano+Photonics) + "Plasmonics"









Entrepreneurial/Productization Project

In order to realize its mission of "creation of innovation," the Photonics Center is inviting researchers to come up with ideas for business startups and productization using photonics-related technology. Outstanding ideas will receive various forms of support from the Center. Applicants to this Project are screened by external screening committee members.

Proposal requirements

- **Proposal to realize business startup / productization must be achievable within two years.**
- **Proposal must be for business startups / productization related to photonics.**

Data on results

Entrepreneurial/Productization Project

Fiscal 2012 Selected proposals: 4 / Applications: 18

[Selected proposals]

- Commercialization of tip-enhanced Raman scattering microscope and creation of a startup company
- Perfect crystallization technology for nonlinear optical material $CsLiB_6O_{10}$
- Productization of plasma photonics detectors for gas chromatography
- Development of eco lamps

Fiscal 2013 Selected proposals: 3 / Applications: 18

[Selected proposals]

- Commercialization of a Portable Electrochemical Luminescence Meter
- A Rapid and Easy POCT System Using Optics and PCR Technology to Detect Pathogens and Infectious Diseases
- The World's Highest Quality GaN Wafers for Improved Characteristics of Nitride Devices

Fiscal 2014 Selected proposals: 2 / Applications: 17

Proposals selected for fiscal 2014 project have not yet been made public.

Fiscal 2015 Selected proposals: 2 / Applications: 6

Proposals selected for fiscal 2015 project have not yet been made public.

Number of patent applications

- **144 (patents applied for)** *as of June 2013

Commercialization of tip-enhanced Raman scattering microscope

The project succeeded in product development of tip-enhanced Raman scattering microscope that utilizes light intensity enhancement by plasmon resonance. The product is now to be sold from a startup company. The technology has been under basic research for 20 years. The manufacturing technique of sharp nano-structured metal probes is the key technology.

TERSsense

Development of wavelength conversion crystals for UV light sources (CLBO)

Using high-quality CLBO crystal growth technology, the project successfully extended the lifetime of crystal devices. At present, preparations are being made to set up a venture business within the Photonics Center to start producing what is being called Osaka-CLBO by the end of fiscal 2014. Through partnerships with manufacturers of lasers and laser beam machines, the project aims to develop UV lasers and UV laser beam machines using CLBO crystals.

High-quality CLBO crystal
(Osaka-CLBO, 85×85×46mm)

Productization of gas chromatograph systems

Together with Shimadzu Corporation, one of the member companies, this project pursued applied research on plasma photonics to develop the Tracera gas chromatograph, which features significantly enhanced sensitivity and is now marketed throughout the world by Shimadzu Corporation. The system is capable of handling more samples than conventional detection methods with high sensitivity.

Tracera

Development of eco lamps

This project succeeded in developing incandescent lamps that can regulate thermal radiation spectra. They demonstrated that spectra would change depending on the size of tiny holes made on the surface of the incandescent lamp filament. Our goal is to realize more efficient full-spectrum light sources.

Prototype of eco lamp

Commercialization of a Portable Electrochemical Luminescence Device

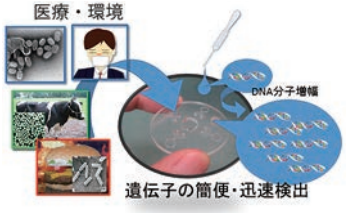
The Photonics Center has developed a commercial version of a Portable Electrochemical Luminescence Device in partnership with Biodevice Technology, Ltd. It is suitable for use in both chemical- and bio-sensors, cell measurement, and in research on antioxidant or luminescent materials. The use of electrochemical luminescence gives the device a large detection range with high sensitivity and high signal-to-noise ratio for counting photons. In conjunction with Osaka University's microfluidic chip design technology, the device can be customized to suit the measurement target and has potential for further business development.

Portable Electrochemical Luminescence Device

A Rapid and Easy POCT System Using Optics and PCR Technology to Detect Pathogens and Infectious Diseases

A Rapid and Easy POCT System Using Optics and PCR Technology to Detect Pathogens and Infectious Diseases

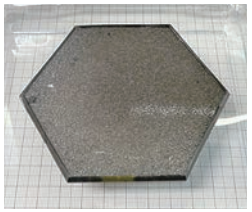
A rapid and highly sensitive polymerase chain reaction (PCR) point-of care testing (POCT) system was realized using a patented technology of centrifugation-assisted thermal convection. The system performs on-chip DNA amplification when the user simply injects a fluid specimen. Used in medical settings or other workplace environments, such as food-processing factories and restaurants, this system enables rapid highly sensitive detection and diagnosis of a variety of pathogens, including methicillin-resistant staphylococcus aureus (MRSA), influenza and norovirus, and enterohemmorhagic E. coli.



POCT PCR DNA Detection System

The World's Highest Quality GaN Wafers for Improved Characteristics of Nitride Devices

Perfect (i.e., distortion-free and strain-free) gallium nitride (GaN) crystals that have been nonexistent outside of silicon crystals were successfully grown for the first time using a liquid phase epitaxy process on GaN in a sodium flux. High quality GaN wafers can be used to implement optical devices such as LEDs for high-intensity lighting and laser diodes with high output power in the red-to-ultraviolet range, including green lasers that are indispensable for laser light shows; power devices having less than one-tenth the power loss of silicon devices; and energy-saving optoelectronic devices such as ultrahigh-speed transistors capable of achieving one-thousand times the speed and transmission capacity of cell phones.



Large-diameter GaN Crystal

Venture businesses launched from Osaka University

Nanophoton Corporation

http://www.eng.nanophoton.jp/products/

Established	February, 2003
Addresses	Umeda 1-3-267, Kita-Ku, Osaka, 530-0001, Japan
	Tokyo Showroom 4F Mastlife Nishishinbashi Bldg., 3-6-10 Nishi-Shimbashi, Minato-Ku, Tokyo, 105-0003, Japan
	Osaka R&D Center 321 Photonics Center, 2-1 Yamadaoka, Suita, Osaka, 565-0871, Japan
Chairman and Representative	Satoshi Kawata
President and Representative Director	Michael B. Verst

Details of business

- **High performance Analytical- and Imaging Instruments with major focus on innovatinve RAMAN systems using most updated nano- and photonics technology.**
- **Laser Raman Microscope "RAMANforce"**
- **Wide-Field Raman Scope "RAMANview"**
- **Tip-enhanced Raman scattering microscope etc. "TERSsense"**

SOSHO, Inc.

http://www.so-sho.jp/

Established	July 1, 2005
Addresse	Minoh City, Osaka
	Laboratory and Office 313 Photonics Center, 2-1 Yamadaoka, Suita, Osaka, 565-0871, Japan
President and Representative Director	Hiroaki Adachi
Representative Director	Yusuke Mori

Details of business

- **Crystallization of candidate drug compounds (organic low-molecular compounds) and proteins**
- **X-ray crystal structure analysis**
- **Development, production, and sales of crystal-related tools, etc.**

SOSHO CHOKO Inc.

Established	March 1, 2016
Addresse	Minoh City, Osaka
	Laboratory 521 Photonics Center, 2-1 Yamadaoka, Suita, Osaka, 565-0871, Japan
President and Representative Director	Hiroaki Adachi
Representative Director	Yusuke Mori

Details of business

- **Development, production, and sales of Osaka-CLBO™ crystal**

Biodevice Technology Ltd. (venture business collaborating with Osaka University)

http://www.biodevicetech.com/

Established	July, 2003
Addresse	Ishikawa Create Lab 106, 2-13 Asahidai, Nomi City, Ishikawa, 923-1211, Japan
President and Representative Director	Eiichi Tamiya
Representative Director (person-in-charge on-site)	Hiromi Ushijima

Details of business

- **Manufacturing and selling of screen-printed electrodes suitable for biosensor chips**
- **Development of biosensor chips with improved sensitivity of immunochromatography**
- **Design, development, prototyping, sales, and consultation for various biosensor-related devices**

Metalumina, LLC.

Established	July, 2014
Addresse	2 -26-1 Nishiokamoto, Kobe, Hyogo, 658-0073, Japan
Representative	Junichi Takahara

Details of business

- **Planning, production, and sales of lighting equipment**
- **Planning, production, and sales of photonics products**
- **Consulting on photonics**

Photonics Cannery

The "Photonics Cannery" is the nickname given to the building in the hopes that "new products will be born one after another as if coming out of a canning factory."

Since the beginning of fiscal 2012, the Photonics Cannery has been inviting new "partners" in addition to the five member companies to avail themselves of the Center's resources in order to bring about innovation together. The followings are available for the partners.

- **Equipments for research, evaluation and prototype production**
- **Technical support from staff members on the use of equipment**
  Our technical staff members are happy to offer support and consultation services on the use of open facilities and equipment so that any first-time users can operate the equipment without any concerns.
- **To participate in various networking / information gathering events**
- **E-learning videos on the "Photonics Course" and "Photonics Entrepreneurship Course"**
- **Arrangement of partners-matching for joint research and technical consultation**
- **Student's CVs**

Main open facilities and equipment

Design

Optical Design Software
Zemax LCC

Structural Design Software (3D CAD)
Dassault Systèmes

CNC Programing Software
Gibbs and Associates

Prototyping

3D Printer
Stratasys

3D Scanner
Artec

Numerically Controlled Machining
FANUC

Vibration-Testing Machine
IDEX

Microfabrication

Focused Ion Beam System
Hitachi High-Technologies

lectron Beam Lithography System
Elionix

Maskless Lithography
Nano System Solutions

Compact Sputter
ULVAC

Nanoimprint System
MEISYO KIKO

Plasma Etcher
FEMTO SCIENCE

Wire Bonder
West·Bond

Spectrometer

Confocal Laser Scanning Microscope
Nikon

UV-VIS-NIR Spectrophotometer
Shimadzu

Multichannel Spectrophotometer
Ocean Photonics

Microplate Reader
Thermo Scientific

Digital Microscope
HIROX

Laser Raman Microscope
Nanophoton

Wide-Field Raman Microscope
Nanophoton

Ellipsometer
J.A.Woollam

FT-IR Microscope
Bruker

Spectrofluorometer
JASCO

Fluorescence Microscope
OLYMPUS

Surface Profiler & Microscope

Laser Interferometer
ZYGO

Surface Profiler
KLA-Tencor

Scanning Probe Microscope
Hitachi High-Tech Science Corporation

Analysis

Ultra Performance Liquid Chromatography-Mass Spectrometry
Waters

High Performance Liquid Chromatography
Waters

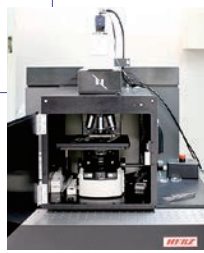
DNA Sequencer
Applied Biosystems

Thermal Cycler
Applied Biosystems

Zeta Potential and Nano Particle Size Analyzer
Malvern

SEM-EDX
KEYENCE

Potentiostat/Galvanostat
Autolab



Photonics Partner

SHIMADZU
三菱化学 Good "Chemistry" for Tomorrow
nano photon
UENO 上野製薬株式会社
三菱電機株式会社 先端技術総合研究所
シャープ株式会社
IDEC
KONICA MINOLTA
ジュラロン工業株式会社 JURARON INDUSTRIES INC.
ShinMaywa
Nitto
創晶 SOSHO
ARCO

Development for eco-life technology

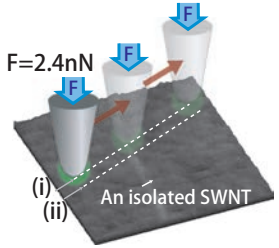
The Photonics-based Eco-Life Technology Development Center

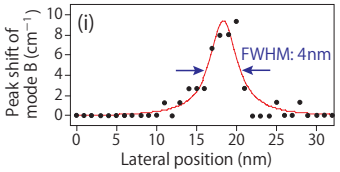
Under the framework of this subsidized project, the Photonics Center has been constructed in order to conduct joint R&D for practical application / industrialization of photonics-based eco-life technology.
Tapping into its advanced technology in the fields of photonics, Osaka University teams up with private businesses to conduct work on fusion projects in such areas as health/environmental analysis, healthcare, environment, and energy.

Photonics-based eco-life target technologies

Nano Molecular Imaging Technology

Photon measurement/imaging technology (key to bio-information and environmental analysis). The world's first nano optical microscope, 3D molecular imaging technology.





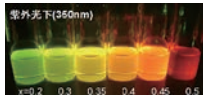
Succeeded in developing the world's first nano molecular imaging

LED lighting for comfortable lifestyles

To realize a "photonics-based eco-life," efforts are underway to develop LED lighting technology for energy conservation, low-cost performance, and comfortable lifestyles.

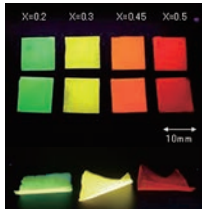
Comfortable Color Rendering

LED Wavelength Conversion Technology / Non toxic Semiconductor Quantum Dots



$(AgIn)_x Zn_{(1-2x)}S$ nano particle

Non toxic and quantum efficiency of 40% or higher



Application to security codes

Ergonomics + Ecology + Psychology

Lighting that changes according to the season, time of the day, emotion, preference, type of work, level fatigue, health condition, age

Human resources development

Osaka University and private businesses join together to develop doctors for the future. (Industry on campus model)

Expected outcomes/impact

Create a photonics-based eco-life industry estimated to be ¥1,400 billion market

Human Resource Development / Activities

Asia Student Photonics Conference (ASPC)

Under joint sponsorship by the OSA/SPIE Student Chapter and the Photonics Center, ASPC is held as a part of the program, Advanced Nano Photonics Research and Education Center in Asia (JSPS). Science students from Asian countries gather together for international exchange by presenting their research findings and engaging in scientific discussions with a view toward strengthening mutual networks while improving their skills.

[Held 4 times since 2012] *as of September 2016

OSA/SPIE Student Chapter

The Osaka University OSA/SPIE student chapter is a community of Osaka University students specializing in optics research. The chapter is engaged in such outreach activities as invited lectures, joint workshops with other university chapters, science cafes, and the regionally oriented Science School for Kids aimed at expanding our student network beyond the laboratory, the university, and the nation. We have built an international network with more than 200 student chapters active around the world.

Super HIKARI JUKU

As a part of the Photonics Center's outreach activities, this science class is held annually for fourth- through sixth-grade elementary school students. Under the guidance of student volunteers from the University, participating students learn about the fascinating properties of light as they enjoy experimenting with it and learning about the distinctive characteristics of the forms of light found in their everyday lives.

[Held 6 times since 2010] *as of September 2016

Photonics Colloquium

On the first Monday of every even-numbered month, various guests are invited to speak at this lecture meeting. We deliberately call these gatherings "colloquia" – from the Latin meaning "to talk together" – in the hopes that it will provide opportunities for experts from many different fields to learn from each other through frank and candid discussions.

[49 sessions held since 2007] *as of September 2016

Photonics Day

Photonics Day is held at Osaka University campus annually . Every year, guest speakers on chosen themes are invited to share their thoughts and the Photonics Center opens its doors to visitors.

[Held 8 times since 2008] *as of September 2016

TMT (Tuesday Morning Tea)

At 10:30 AM every Tuesday, a café is reserved exclusively for Photonics Center staff members, who can compare notes and discuss with each other over coffee and sweets.

Photonics Symposium

A group of researchers engaged in advanced photonics research encompassing a broad range of disciplines, including physics, chemistry, medical science, and electric engineering, gather together from around the world at this annual event. This symposium aims to develop global leaders in photonics research for future generations through promotion of networking among international researchers hailing from various cultural/social backgrounds.

1st	December 18, 2007 [Hotel Hankyu Expo Park, Osaka]
2nd	February 29, 2008 The Dawn of Photonics [Toranomon Pastoral Hotel, Tokyo]
3rd	December 12, 2008 Science and Industry as Created by Optical and Nano Technologies [Otemachi Sankei Plaza, Tokyo]
4th	November 18, 2009 Photonics, Nano-Photonics, and Beyond... [Otemachi Sankei Plaza, Tokyo]
5th	September 7-8, 2010 5th PARC Symposium: Photonics in Asia [Shima Kanko Hotel the Classic, Mie]
6th	September 20-21, 2011 6th Photonics Center Symposium: Nanophotonics in Asia 2011 [Shima Kanko Hotel the Classic, Mie]
7th	September 18-19, 2012 7th Photonics Center Symposium: Nanophotonics in Asia 2012 [Kanazawa Excel Hotel Tokyu, Ishikawa]
8th	December 10-11, 2015 8th Photonics Center Symposium: Nanophotonics in Asia 2015 [Nakanoshima Center, Osaka]

Photonics Symposium in Higashi Osaka

May 21, 2013
[Creation Core Higashi Osaka]










e-learning

https://el.parc.osaka-u.ac.jp/en/ on public in part

One of the missions upheld by the Photonics Center is to develop young researchers who seek the fusion of advanced technologies with photonics serving as a core. Accordingly, the Photonics Center has organized an e-learning Photonics Course with the goal of developing future researchers.

Merits of the e-learning Photonics Course

Advanced Content

Attractive scenarios for learners, experienced faculty teaching staff, and exhaustive information that merit repeated study—all of these factors serve to stimulate learners' desire to "look again and delve further."

Video Library

Being on the "cutting edge" of advanced fusion fields, there are only a limited number of chances to learn about such pioneering subjects. As a learning tool, the video library will provide such opportunities and enhance the learning experience.

Interdisciplinary

Learners encounter researchers from many other academic disciplines. This course encourages learners to discover for themselves research themes that cannot be solved with knowledge from a single field or areas that need to be fused together, thereby cultivating their competency as independent researchers.

Any time, as many times as you need

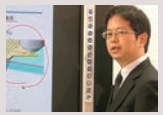
Learners may access the course online at any time of the day. Since the videos are segmented into less than 20 minute sections, learners will not grow tired of repeated studying.

Course menu

Introduction to Plasmonics

Graduate School of Engineering, Osaka University
Professor **Junichi TAKAHARA**

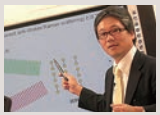
Overviewing the history and current status of metal photonics researches, the lecturer explains what is "plasmonics". This lecture gives an introduction into the basics of plasmonics and nanoplasmonics. The forefront of research on plasmonic device is also introduced.



Introduction to Raman Scattering Microscopy

Graduate School of Engineering Science, Osaka University
Associate Professor **Mamoru HASHIMOTO**

This lecture starts to explain one of the greatest advantages of Raman spectroscopy: it is capable of identifying the molecular species and distribution in living tissues in vivo without any preparation. Then, its principle, instrumentation, and application research are explained. The lecturer also introduces his recent research on CARS microscopy that enables real-time imaging.



Influenza Virus Sensor

Graduate School of Engineering, Osaka University
Associate Professor **Yoshinori YAMAGUCHI**
Assistant Professor **Masato SAITO**

This lecture takes a deeper look into molecular biological understanding of influenza, and provides an overview regarding the principle and practice of microchips which enable the rapid and sensitive diagnosis of influenza, as well as the latest research on extremely highly sensitive measurement methods exploiting plasmonics.

Liquid Crystal Photonics

Graduate School of Engineering, Osaka university
Assistant Professor **Hiroyuki YOSHIDA**

The fascinating property of liquid crystals is their ability to form various higher-order structures with outstanding photonic functions, by applying varying external electric field and temperature. This lecture focuses on the world of attractive liquid crystals with great potential.

Bioimaging with Molecular Probes

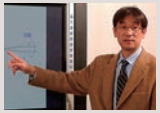
Graduate School of Engineering, Osaka University
Professor **Kazuya KIKUCHI**

Almost 30 years passed since discovery of the GFP in 1962 until actual application of the GFP started in 1994. What kinds of studies were made in this "blank" period? Let's look back to the recent history of research activities in the field of chemical biology for imaging, and you also learn the organic molecular probes as well as on the fluorescent protein probes through this lecture.

Near Field Optical Microscopy

Graduate School of Frontier Biosciences, Osaka University
Professor **Yasushi INOUYE**

This lecture provides principle and practice on "near-field optical microscopy" that has capability to observe samples at a nanometric-scale spatial resolution. It is worth to watch the animated illustration explaining the principle of the phenomenon called "diffraction limit".



Semiconductor Nanoparticle (Quantum Dot)

Graduate School of Engineering, Osaka University
Professor **Susumu KUWABATA**
Assistant professor **Taro UEMATSU**

Semiconductor nanoparticles (quantum dots) have many intriguing properties, like size tunable optical properties and fluorescence at room temperature. This lecture looks into the physics of quantum dots, as well as recent advances in the synthesis and potential application to optoelectronic devices.

Basics of Magnetic Materials and Their Application to Information Industry

Graduate School of Engineering, Osaka University
Professor **Ryoichi NAKATANI**

This course starts with the topics such as familiar magnetic materials found in our daily lives and the properties and history of magnets which are interesting for everybody. This informative course also covers origin of magnetic moment and the properties of various magnetic materials.

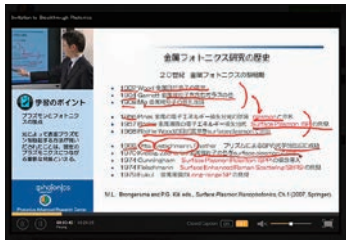
*17 Photonics Courses, 6 Photonics Entrepreneurship Courses, 23 Courses in total are posted on the website at the moment. Incoming courses will be released one after another.

*"How to use the PARC open facilities and equipment course" is open to public. → http://ma.parc.osaka-u.ac.jp/en/

English Version

All content also comes with English subtitles*, which are offered as a tool that we hope will lead to the creation of a photonics training center for Asia.

*Mobile version is dubbed in English.



Mobile Learning

Cutting-edge learning on your mobile device!

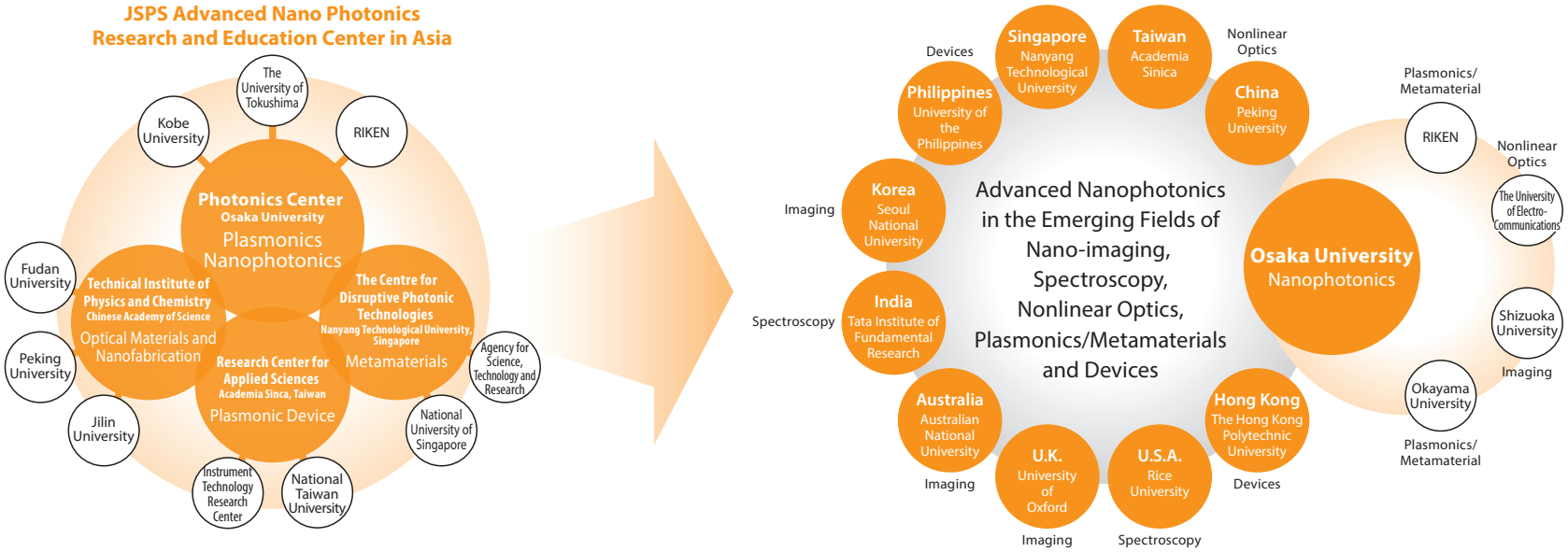
The e-learning Photonics Course now supports iPad, iPhone, and Android terminals.

◀Mobile Version

Advanced Research Networks (2016-2020)
JSPS Core-to-Core Program

Advanced Nanophotonics in the Emerging Fields of Nano-imaging, Spectroscopy, Nonlinear Optics, Plasmonics/Metamaterials and Devices

Based on the previous Asian CORE Program: Advanced Nano Photonics Research and Education Center in Asia, we aim to construct a global network on emerging nonophotonics for research collaboration and fostering younger researchers. We extended from the 4 Asian nations (Japan, China, Taiwan and Singapore) to 11 nations with newly participating Australia, Hong Kong, Philippines, Korea, India, USA and UK.



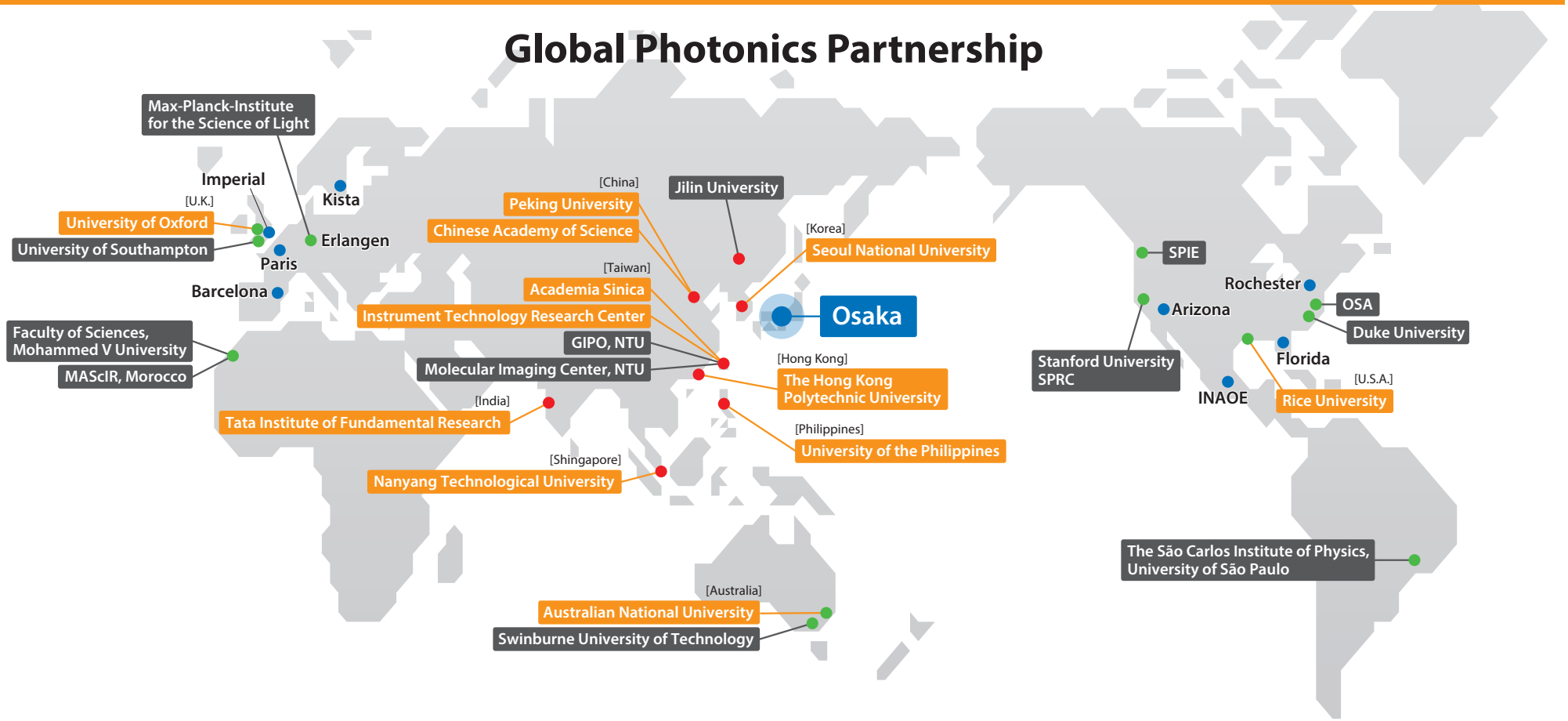
International Joint Research Promotion Program, Osaka University (2014-2016)

Nano-functional Photonics

Study of new nano optical/photonic functions originating from the interaction of photon and nano-structured materials

Project leader, Prof. Satoshi Kawata of Osaka University and Prof. Zhouheir Sekkat of the Moroccan Foundation for Advanced Science, Innovation and Research (MAScIR) promote joint research on Nano-functional Photonics in the field of physics, chemistry, biotechnology, electrotechnology and devices. Thus, we build research and educational networks to foster young talented nano-photonics researchers as a first step to establish an international joint lab.

Global Photonics Partnership



MoU Partners in Asia*

- Peking University
- Jilin University
- Chinese Academy of Science
- Academia Sinica
- Instrument Technology Research Center
- Graduate Institute of Photonics and Optoelectronics, NTU
- Molecular Imaging Center, NTU
- Nanyang Technological University
- University of the Philippines
- Seoul National University
- Tata Institute of Fundamental Research
- The Hong Kong Polytechnic University

* Including MoUs in progress

MoU Partners in the World*

- Stanford Photonics Research Center
- OSA[The Optical Society]
- Duke University
- SPIE
- Australian National University
- Swinburne University of Technology
- University of Oxford
- University of Southampton
- Rice University
- Max Planck Institute for the Science of Light
- Faculty of Sciences, Mohammed V University
- Optics & Photonics Center, MAScIR
- The São Carlos Institute of Physics, University of São Paulo

* Including MoUs in progress

Photonics Centers in the World

- Osaka [2007]
- Erlangen [2003]
- Kista [2002]
- Barcelona [2002]
- Imperial College London [2001]
- SPRC [2000]
- Florida [1986]
- INAOE, Mexico [1971]
- Arizona [1964]
- Rochester [1929]
- Paris [1917]

Photonics Center, Osaka University

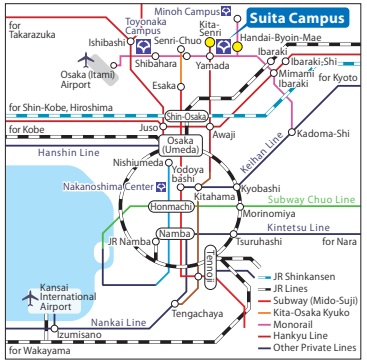
Photonics Center, P3, Suita, Osaka 565-0871 Japan
TEL : +81-6-6879-7927
FAX : +81-6-4864-2695
Email : parchq@parc.osaka-u.ac.jp
URL : http://www.parcjp.org/

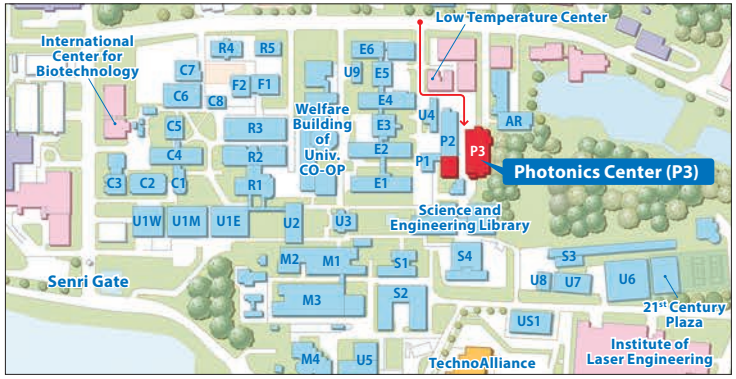
Access

- **From Shin-Osaka Station (Shinkansen)**
  Take the Subway Midosuji Line and get off at Senri-Chuo Station.
  Change to taxi or the Hankyu Bus bound for "Handai-honbu-mae" or "Ibaraki Mihogaoka".
- **From Kansai International Airport**
  Get off at JR Osaka Station, and change to the Subway Midosuji Line bound for Senri-Chuo Station.
  Get off at Senri-Chuo Station and take to taxi or the Hankyu Bus bound for "Handai-honbu-mae" or "Ibaraki Mihogaoka".
- **From Osaka International Airport (Itami Airport)**
  Take the Osaka Monorail, and get off at Handai-byoin-mae Station.

From the nearest station or bus stop

- 15min taxi from "Senri-Chuo Station"
- 15min walk from "Kita-Senri Station", Hankyu-Senri Line
- 10min walk from "Handai-byoin-mae", Osaka monorail
- 5min walk from the bus stop "Handai-Honbu-mae"





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