



Institute of
Advanced
Sciences

Yokohama National University



FACULTY
PROFILE

YNU

YOKOHAMA National University

The Positioning of the Institute of Advanced Sciences (IAS)

The Institute of Advanced Sciences (IAS) was founded in October 2014 to undertake research in the areas of safety engineering and risk (which are both areas where YNU is particularly strong), having been chosen to receive funding support under the Subsidies for Promotion of University Reform and Strengthening program initiated by Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT). Subsequently, during Phase 2, which covered the period from the 2018 academic year to the 2022 academic year, IAS accelerated the pace of cutting-edge research by bringing together YNU researchers in academic disciplines that have a major impact throughout the world, and by providing focused

support for their research. Not only has IAS seen innovative developments and advances in these specialist areas, it has also generated new academic fields through cross-disciplinary fusion, and has exploited new ways to innovate and create value. YNU decided that, viewed from this perspective, there was a real need for the university to play a role in generating new categories of academic study and in disseminating information about them to society. For this reason, in Phase 3, which began in the 2023 academic year, a new Institute for Multidisciplinary Sciences (IMS) was established in addition to the existing IAS. The IAS is promoting world-class research in cutting-edge fields.



Framework for Collaboration with External Partners

In recent years, the competition in the university sector to secure high-level international research talent has become increasingly intense, and the movement of research talent between countries has accelerated. Faced with this environment, the IAS has made the recruitment and securing of first-rate foreign researchers a priority, and has been proceeding with the putting in place of the necessary systems. It has been forging an international collaboration network with overseas companies, overseas universities, and other international

partner organizations, aimed at realizing the YNU's vision, and has been strengthening measures to build itself into an International Network Hub that will be at the center of innovative, high-level research activities. In addition, by implementing initiatives for ongoing strengthening of collaboration with non-academic bodies, including the local community and industry, the IAS is aiming both to enhance international research capabilities and promote the social implementation of research results.

Research Organization

The establishment of the Institute for Multidisciplinary Sciences (IMS) in April 2023 also represented a new start for the IAS. To drive world-class research in cutting-edge research fields, the IAS has adopted a structure that comprises two academic research centers – the Quantum Information Research Center and the Advanced Chemical Energy Research Center – and four research units led by outstanding researchers: Information

and Physical Security, Cell-based Bioassay, High Efficiency Electrical Energy Conversion, and Unconventional Magnonics. The aim is for the research results generated by these research units and research centers, together with those generated by the IMS, to contribute toward the building of new social and economic systems, toward the fostering of innovation, and toward the development of science and technology.



**YNU President,
Director of
IAS and IMS**

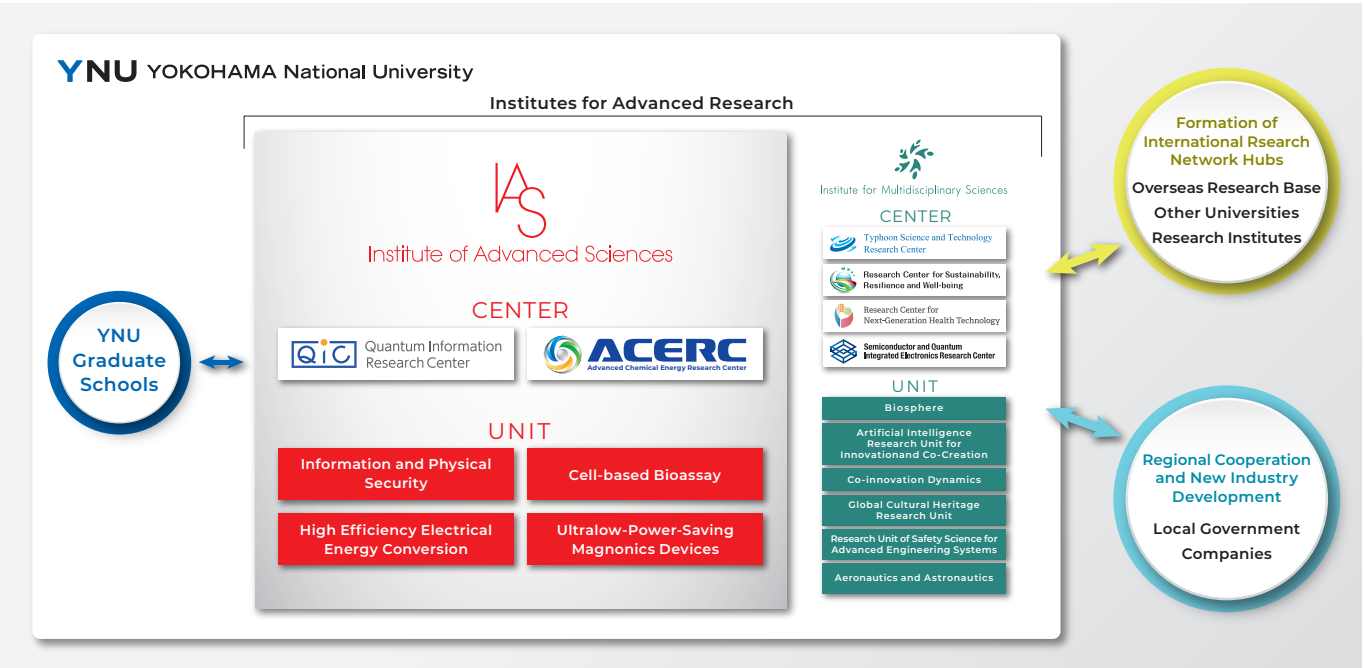
**UMEHARA
Izuru**



**Vice Director of
IAS and IMS**

**YOSHIKAWA
Nobuyuki**

IAS Organizational Structure



Research Support System

The IAS and the IMS bring together international researchers in a wide range of fields from both within and outside Japan to undertake high-level research projects. Dedicated research strategy planning managers and industry-university-government collaboration coordinator have been assigned to realize focused support not only for the putting in place of a leading-

edge research environment, external funding management, and research outreach activities (including research PR and science communication), but also for the building of a researcher network that links together the researchers at the IAS and the IMS across the boundaries of their respective research fields.



ABOUT

World First
Success in Generating Geometrical Quantum Entanglement of Electrons and Photons in a Diamond
Success in proof-of-principle of optical random-access quantum memory

Outstanding researchers in quantum information both in and outside Yokohama International University are gathered in the Center. The Center fosters an environment in which these researchers can routinely exchange information and create ideas, continuously launching joint research with high research value in a timely manner. The Center accepts national projects and participates as a nexus for international joint projects, earning the trust of outside parties as a suitable organization for tackling global top-level, large-scale research projects. As such, it was launched as a global research hub for advancing practical research in this field.

RESEARCH CONTENTS

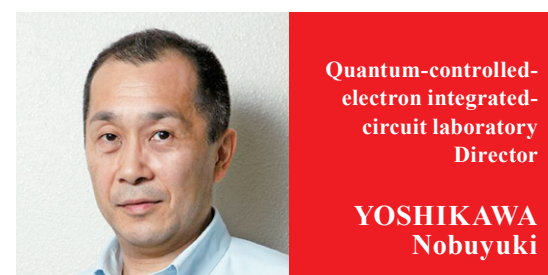
Two Large-Scale Projects

The Quantum Information Research Center is established within the Institute of Advanced Sciences. The Center incorporates three laboratories, a quantum information physics laboratory, a quantum-controlled-electron integrated-circuit laboratory and an integrated photonics laboratory.

1  **Research and Development for Building a Global Quantum Cryptography Communication Network**

 **Development of Quantum Interfaces for Building Quantum Computer Networks.**

2 **Ministry of Internal Affairs and Communications (MIC)**
 Research and Development toward the Realization of Quantum Internet.



ABOUT

Putting Chemical Energy to Effective Green Use in Pursuit of the SDGs

The aim of the Advanced Chemical Energy Research Center is to achieve a sustainable society by contributing to the construction of a carbon-free society that is no longer dependent on fossil fuels. Leveraging its strength in electrochemistry, the Advanced Chemical Energy Research Center is establishing itself as a new research hub related to chemical energy. The Center is a research hub that is building a network to bring academia, industry and government agencies together while conducting academic study and technological research related to new forms of chemical energy. By implementing the fruits of its research in society, the Center contributes to the efficient use of renewable energy and achievement of a carbon-neutral society.

RESEARCH CONTENTS

Two Laboratories

The Advanced Chemical Energy Research Center is established within the Institute of Advanced Sciences. The Center incorporates two laboratories, a green hydrogen research laboratory and an advanced energy storage research laboratory. The Center liaises with researchers inside and outside the Institute of Advanced Sciences to pursue research activities.



Green Hydrogen Research Laboratory



Advanced Energy-Storage Research Laboratory



UNIT
1

Information and Physical Security

VISION

We envision realizing “Society 5.0,” in which cyberspace and physical space are tightly integrated. We aim to achieve this goal by developing security solutions that are resilient against future threats, based on accurate understanding of current threat mechanisms.

RESEARCH CONTENTS

We research technology for observation and analysis of cyberattacks and malware, for detection and analysis of vulnerabilities, the human factor in security, cyber-threat ecosystems, and the possibilities for use and misuse of AI. Through these efforts, we obtain a deep understanding of the current state of threats and identify future security issues on that basis, thereby achieving early solutions.



Principal Investigator
YOSHIOKA
Katsunari

UNIT
2

Cell-based Bioassay

VISION

The goal of this unit is to develop cellular assay technologies to evaluate the safety of chemicals and drugs for humans. By so doing, this unit seeks to realize a safe and secure society in which people can live long and healthy lives while reducing the sacrifice of animals in scientific research.

RESEARCH CONTENTS

This unit develops cellular assays to evaluate various toxicities of chemicals, such as promotion of oncogenesis, developmental toxicity, neurotoxicity, and skin irritation and sensitivity. Furthermore, by combining these assays with AI-based image analysis technology, we study methodologies to develop international testing methods using these assays.



Principal Investigator
FUKUDA
Junji

Institute of Advanced Sciences INTRODUCTION OF THE UNIT

UNIT
3

High Efficiency Electrical Energy Conversion

VISION

We contribute to reducing CO2 emissions by applying electricity conversion technologies and electrical-mechanical energy conversion, made possible using power electronics.

RESEARCH CONTENTS

This unit researches elemental technologies that will form the heart of next-generation electricity conversion technologies. These include high-efficiency operation of EV power trains, wireless power transmission and noise-free inverters, made possible by high-efficiency electricity conversion technologies that use wide-band-gap semiconductors.



Principal Investigator
AKATSU
Kan

UNIT
4

Ultralow-Power-Saving Magnonic Devices

VISION

For the realization of a “trillion-sensor universe” fusing cyberspace and physical space, the research unit achieves the development of revolutionary devices for information processing, using the ubiquitous magnon in magnetic materials.

RESEARCH CONTENTS

This research unit controls spin flow and magnon flow in nanoscale structures not associated with electrical Joule heating. The purpose of this effort is to pioneer next-generation information-processing technologies, including ultra-energy-saving information processors required for sensor network terminals, neuromorphic processors, and Q-bits that can work at room temperature.



Principal Investigator
SEKIGUCHI
Koji



Institute of Advanced Sciences

Yokohama National University



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