

JST and A*STAR (Singapore) jointly to fund 10 research projects in the “Quantum” field under the NEXUS program

The Japan Science and Technology Agency (JST) has approved funding for 10 new international joint research projects under the framework of Networked Exchange, United Strength for Stronger Partnerships between Japan and ASEAN (NEXUS^{*1}), “Japan-Singapore international joint research” in the field of Quantum (Appendix 1).

NEXUS is a flexible and multi-layered cooperative framework, leveraged by the long history of science and technology cooperation between Japan and ASEAN. It is aimed to further strengthen the cooperative research relationship between Japan and ASEAN as partners in co-creating innovations in science and technology.

One of the initiatives, “International Joint Research,” NEXUS supports international joint research in common priority challenges between both sides.

In collaboration with the Agency for Science, Technology and Research (A*STAR^{*2}), JST has conducted a call for proposals for international joint research projects (Appendix 2).

We received 27 applications for this call, and after evaluation by experts from both countries and consultations between JST and A*STAR, we have decided to select 10 projects for funding.

The research period is planned for three years (36 months).

*1 NEXUS: <https://www.jst.go.jp/aspire/nexus/en/index.html>

*2 A*STAR: <https://www.a-star.edu.sg/>

Appendices

Appendix 1 Abstracts of selected projects

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“Empowering Science, Inspiring Futures”

Our world faces unprecedented global challenges — such as climate change, energy crises, and emerging infectious diseases — that demand innovative solutions. JST will rise to these challenges through “Science and Technology,” as a national research and development agency that plays a central role in implementing Japan’s science, technology, and innovation policy. We support fundamental research and startups to create new value, develop R&D strategies, foster the next generation of talent, disseminate vital information, and manage the Japan University Fund. Like a compass guiding ships through turbulent waters, JST will chart the way towards a vibrant and secure future by empowering science through a multifaceted approach.

Abstracts of selected projects

No.	Title	Principal Investigator (Japan side)	Research Abstract
		Principal Investigator (Singapore side)	
1	Rare-earth Magnet Based Networking Quantum Memory	IWAHARA Naoya (Assistant Professor, Graduate School of Engineering, Chiba University)	This collaborative research aims to develop a highly-efficient quantum hybrid device with functions of quantum memory and transducer between the optical and superconducting q-bits. The Japanese team will theoretically unravel the microscopic picture of the optical and magnetic properties of the erbium doped gadolinium compounds, determine the magnetic interactions between the magnon of the gadolinium compounds and the quantum states of erbium, and develop the theoretical framework to control the quantum states of erbium by using the microwave via the magnon. The Singaporean team will measure the optical and magnetic data of the compounds, evaluate the coherence time of the erbium memory, and manipulate the quantum states of erbium ion via microwave. Through the collaboration, we will achieve the record-long coherence time of the erbium ion and efficient transducer between the optical and superconducting q-bits.
		Jian-Rui SOH (Senior Scientist I, Quantum Innovation Centre, A*STAR)	

No.	Title	Principal Investigator (Japan side)	Research Abstract
		Principal Investigator (Singapore side)	
2	Extracting Perfect Entangled States from Unknown Sources: An Agentic Approach	TAKAGI Ryuji (Associate Professor, Graduate School of Arts and Science, The University of Tokyo)	Quantum entanglement is an essential foundational resource for all forms of quantum information processing. However, entangled states that can be prepared in practice are often imperfect, and obtaining high-quality entanglement requires a technique known as entanglement distillation. This research aims to develop adaptive methods for distilling entangled states under realistic constraints in which no prior knowledge of the quantum state is available. Specifically, the Japanese team will develop state-agnostic entanglement distillation methods based on quantum resource theories and symmetry principles, while the collaborating team will devise memory-efficient approaches grounded in learning theory. Through joint efforts by the two research teams, the project aims to enable the high-fidelity generation of entangled states under practical conditions— a development that is expected to significantly advance next-generation quantum technologies, including quantum key distribution, distributed quantum computation, and the quantum internet.
		Mile GU (Associate Professor, School of Physical and Mathematical Sciences, Nanyang Technological University)	

No.	Title	Principal Investigator (Japan side)	Research Abstract
		Principal Investigator (Singapore side)	
3	Enabling A Disruptive Chiral Quantum Optical Sensor (CQOS) Technology Based on Innovative Highly Oriented Single Crystalline Gold Quantum Dots (HOSG-QDs)	<p>TAKAHASHI Yukiko (Director, Research Center for Magnetic and Spintronic Materials, National Institute for Material Science)</p>	<p>This collaborative research aims to realize a non-destructive quantum optical sensor capable of detecting molecular-level chirality by stacking FePt thin films on highly oriented single-crystal gold quantum dot chips to enhance spin sensitivity. Specifically, the Japanese team will stack FePt granular thin films on the highly oriented single-crystal gold quantum dot chips provided by the partner team, and will conduct microstructural observations and magnetic property measurements. The partner team will fabricate the high-quality gold chips and perform chirality measurements on the chips with FePt granular thin films supplied by the Japanese team. Through this international collaboration, it is expected that a high-sensitivity chirality sensing technology integrating quantum optics and spintronics will be established, contributing not only to industrial applications in pharmaceuticals and functional materials but also to the advancement of academic knowledge and future social implementation.</p>
		<p>Andrivo RUSYDI (Director/Associate Professor, Advanced Research Initiative for Correlated Electron System (ARICES), National University of Singapore)</p>	

No.	Title	Principal Investigator (Japan side)	Research Abstract
		Principal Investigator (Singapore side)	
4	Levitated Quantum Rotor for Precision Navigation and Quantum Sensing via the London Effect	<p>TWAMLEY Jason (Professor, Quantum Machines Unit, Okinawa Institute of Science and Technology Graduate University)</p>	<p>This research aims to develop a levitated gyroscope for use in ultra-precise navigation. The partner and the Japanese teams will initially develop the levitated gyroscope operating at room temperature driving it to high spinning speed with active control. The Singapore team will primarily develop the electrical drive which can spin-up the levitated gyroscope to high rotational speeds. The Japanese team will transfer the levitated gyroscope and drive to a low temperature fridge and they will arrange for the rotor to be spun up to high rotational speed in vacuum using the electrical drive. Both teams will work together to develop high-precision measurement of the gyroscope's rotational speed using a quantum-limited SQUID. Unlike traditional mechanical gyroscopes, our levitated gyroscope is well isolated from friction and thermal noise, which significantly improves their performance and measurement accuracy. Both the Japanese and partner team will work together to develop the proposed low-temperature levitated gyroscope as a next-generation quantum sensor, enabling more precise navigation and positioning.</p>
		<p>Xianfeng CHEN (Scientist, Quantum Innovation Centre, A*STAR)</p>	

No.	Title	Principal Investigator (Japan side)	Research Abstract
		Principal Investigator (Singapore side)	
5	Quantum Reservoir Computing for Dynamics Modeling and Forecast	NAKAJIMA Kohei (Associate Professor, Graduate School of Information Science and Technology, The University of Tokyo)	This project aims to establish a theoretical foundation for quantum reservoir computing (QRC) and to realize quantum advantage in temporal learning tasks. It analyzes how QRC processes and retains time-dependent information, focusing on expressiveness, fading memory properties, and learnability under stochastic and dynamic conditions. The Japanese team investigates QRC from the perspective of dynamical systems theory, while the counterpart team explores its theoretical properties based on universal approximation capabilities. By integrating quantum information theory, dynamical systems, and statistical learning theory, the project employs newly introduced concepts such as the nonstationary echo state property and dynamic quantum kernels to advance theoretical understanding and algorithm design. Through collaborative efforts between the two teams, the project aims to construct a comprehensive framework for optimizing QRC to handle complex real-world learning tasks.
		Juan-Pablo ORTEGA (Professor, School of Physical and Mathematical Sciences, Nanyang Technological University)	

No.	Title	Principal Investigator (Japan side)	Research Abstract
		Principal Investigator (Singapore side)	
6	Artificial Intelligence by and for Quantum Computers	<p>MITARAI Kosuke (Associate Professor, Center for Quantum Information and Quantum Biology, The University of Osaka)</p>	<p>This collaborative research aims to develop practical and theoretically grounded quantum AI technologies by integrating quantum computing and artificial intelligence through quantum feature maps. Specifically, research teams from Japan and Singapore will jointly construct a novel machine learning framework based on quantum feature maps and leverage large language models (LLMs) to automate the design of quantum computing algorithms. Through close international collaboration, this project is expected to accelerate practical quantum machine learning in fields such as quantum chemistry and materials science, significantly lowering barriers to the adoption of quantum technologies. Furthermore, by openly disseminating research outcomes and fostering collaboration with industries and other research institutions, the project aims to contribute to the growth of an international quantum technology community, particularly in Asia. Ultimately, this initiative will reinforce the global leadership positions of both Japan and Singapore in quantum AI.</p>
		<p>Yuxuan DU (Assistant Professor, College of Computing and Data Science / School of Physical and Mathematical Science, Nanyang Technological University)</p>	

No.	Title	Principal Investigator (Japan side)	Research Abstract
		Principal Investigator (Singapore side)	
7	Enabling Macroscopic Quantum Systems through Advanced Vibration Damping Technology	<p>MICHIMURA Yuta (Associate Professor, Graduate School of Science, The University of Tokyo)</p>	<p>This research aims to develop advanced vibration damping technologies essential for realizing macroscopic quantum systems. Specifically, the Japanese team will work on the development of vibration isolation systems based on technologies cultivated through gravitational wave detection, the realization of optically levitated mirrors, and quantum metrology experiments using suspended mirrors. The Singapore team will focus on the precise control of superconducting magnetically levitated particles and the development of spin-based quantum measurement techniques.</p> <p>Through joint research between the two teams, optical and magnetic levitation technologies will be integrated to reduce a wide range of vibrational and thermal noise sources. This will enable the realization of the quantum ground state and high-precision quantum sensing, contributing not only to fundamental physics experiments such as tests of the quantum nature of gravity and dark matter searches, but also to the development of measurement devices including high-sensitivity gravimeters, magnetic sensors, and inertial sensors.</p>
		<p>Tao WANG (Senior Scientist II, Quantum Innovation Centre, A*STAR)</p>	

No.	Title	Principal Investigator (Japan side)	Research Abstract
		Principal Investigator (Singapore side)	
8	Diamond Nitrogen Vacancy Centers Integrated with Moiré Metasurface for Optically Detected Magnetic Resonance	MURAI Shunsuke (Lecturer, Graduate School of Engineering, Osaka Metropolitan University)	This collaborative research aims to achieve optically detected magnetic resonance (ODMR) for quantum sensing by integrating a moiré metasurface and a diamond NV center. Based on the initial design discussed across the teams, the Japanese team will fabricate moiré metasurfaces using a nanofabrication process, while the Singapore team will perform optically detected magnetic resonance measurements using the samples. Through collaborative research between the research teams of both countries, it is expected that highly efficient and compact quantum magnetic field sensing will be realized and its application to environmental measurement will be achieved.
		Zhaogang DONG (Associate Professor, Science, Mathematics and Technology, Singapore University of Technology and Design)	

No.	Title	Principal Investigator (Japan side)	Research Abstract
		Principal Investigator (Singapore side)	
9	Quantum Learning of Open Quantum Systems	MURAO Mio (Professor, Graduate School of Science, The University of Tokyo)	<p>This project aims to realize efficient quantum learning for open quantum systems by analyzing them using quantum computers, a task that has been challenging under conventional approaches. The Japan-based team will develop quantum learning algorithms for fault-tolerant quantum computation (FTQC) by leveraging advanced techniques such as higher-order quantum operations and quantum singular value transformation. The Singapore-based team will design quantum learning algorithms tailored to noisy intermediate-scale quantum (NISQ) devices and validate and analyze them through classical simulations based on tensor networks. Through close collaboration between the two teams, the project will address the same target systems from both the NISQ and FTQC perspectives and establish new theories and methodologies that seamlessly bridge these two regimes. At the same time, the project will contribute to strengthening the international talent base that will lead the development of next-generation quantum technologies.</p>
		Kavan MODI (Professor, Science, Mathematics and Technology, Singapore University of Technology and Design)	

No.	Title	Principal Investigator (Japan side)	Research Abstract
		Principal Investigator (Singapore side)	
10	Ultra-robust Quantum Information Enabled by Higher-Dimensional Photonic Topologies	LIN Wenbo (Assistant Professor, Institute of Integrated Research, Institute of Science Tokyo)	This research aims to establish an integrated photonic technology platform that protects fragile quantum states using topological structures, such as skyrmions and hopfions, with the goal of enabling stable and high-speed optical quantum communication. The Japanese team will develop on-chip devices to control the topological properties of photons by leveraging their expertise in topological photonics and advanced nanofabrication/hybrid integration technologies. Meanwhile, the Singapore team will explore novel topological quantum states of light, such as quantum optical hopfions, drawing on their rich expertise in free-space optical systems, and provide feedback to the Japanese side. Through this international collaboration, the project seeks to realize and integrate sophisticated topological structures onto chips, thereby establishing a robust foundational technology for quantum information protection.
		Yijie SHEN (Assistant Professor, School of Physical and Mathematical Sciences, Nanyang Technological University)	

Abstract of the joint call for proposal**(1) Partner funding agency**

Organization name: Agency for Science, Technology and Research (A*STAR)

URL: <https://www.a-star.edu.sg/>

(2) Research field

Quantum

(3) Researcher eligibility

Any independent researcher personally affiliated with a domestic Japanese research institution, including universities, independent administrative institutions, national/public testing and research institutions, specially authorized corporations, public-service corporations, and enterprises.

(4) Research duration

Three years (36 months)

(5) Funding amount (by JST, per project)

- Direct expenses for international joint research: up to 30 million Japanese Yen
- Indirect expenses: 30% of direct expenses

(6) Evaluation procedure

- Evaluation by independent committees consisting of experts from both countries.
- Discussion and decision by JST and A*STAR based on evaluation result.

(7) Evaluation criteria

- Capability of PIs
- Expected scientific results
- Expected economic and social impact
- Synergy effects of international collaboration
- Consistency with the research field of this grant call and feasibility of implementation (given proposed plan, participants, budget, facilities, means of cooperation, etc.)

Experts for the evaluation (JST side)

Name	Position and organization	Role
TOMITA Akihisa	Distinguished Researcher, Quantum ICT Collaboration Center, National Institute of Information and Communications Technology (NICT)	Program Officer
AOKI Takao	Professor, Faculty of Science and Engineering, Waseda University	Advisor
OKUBO Tsuyoshi	Project Associate Professor, Graduate School of Science, The University of Tokyo	Advisor
KADOWAKI Tadashi	Joint Appointed Fellow, Global R&D Center for Business by Quantum-AI Technology, National Institute of Advanced Industrial Science and Technology	Advisor
KAWABATA Shiro	Professor, Faculty of Computer and Information Sciences, Hosei University	Advisor
KOSHINO Kazuki	Associate Professor, Institute for Liberal Arts, Institute of Science Tokyo	Advisor
SOEDA Akihito	Associate Professor, National Institute of Informatics, Research Organization of Information and Systems	Advisor
TAKEOKA Masahiro	Professor, Faculty of Science and Technology, Keio University	Advisor
TOKURA Yasuhiro	Professor, Institute of Pure and Applied Sciences, University of Tsukuba	Advisor
MORI Takahiro	Research Team Leader, Semiconductor Frontier Research Center, National Institute of Advanced Industrial Science and Technology	Advisor

(Advisors are listed in order of the Japanese syllabary.)
(Position and organization are as of the time of evaluation.)