JST Program on Open Innovation Platform with Enterprises, Research Institute and Academia (OPERA)

"Interdisciplinary Optics-Photonics Initiative for Life-Saving Early Diagnosis and Prevention Technology"

Reference Document:

All-University Open Call for Tenure-track faculty positions

Overview of JST's OPERA

(Program on Open Innovation Platform with Enterprises, Research Institute and Academia)

(1) Basic Overview

➢ Create a consortium including universities and private-sector companies and, through efforts such as joint industry–academia research in non-competitive fields* and educating and training doctoral students, achieve a system of genuine inter-organizational collaboration between industrial and academic parties while driving open innovation.

➢ JST utilizes a matching fund approach to provide financial support (in the form of research outsourcing fees) to universities in amounts equal to joint research funds contributed by private-sector companies.

* Non-competitive fields: basic, fundamental research fields. Information on research results can be shared within the consortium.

(2) OPERA: Developing Co-creation Platform Type

➢ The feasibility study (FS) phase has been established for thorough deliberation on the possibility of implementation, and the full implementation (FI) phase for full-fledged efforts toward implementation. Inspection by a JST-established committee is required when transitioning from the FS phase to FI phase.

Note: In case of TUAT, the decision to move to the FI phase starting April 2020 has been finalized.

	Max. Outsourcing Fees Paid by JST
FS phase (2 years)	Research fees: ¥25 million (For consortium as whole)
FI phase (4 years)	Research fees: ¥100-150 million (For consortium as whole)

(3) Conditions for Move from FS to FI Phase (FY 2020–)

1. At least 5 R&D topics　2. At least 3 participating universities and/or similar institutions, and at least 10 participating companies
3. Obtainment of at least ¥100 million in total funding from private sector
4. Hiring of at least 10 doctoral students as research assistants (RAs)

TUAT's OPERA Goals

Background

Health and medical care service needs are on the rise as Japan continues its transition to an aged society.

TUAT has determined seven key technologies (KTs) in the life science and veterinary medicine fields that link directly to further achievement of early-stage diagnoses and preventive measures.

Mission 1
Carry out joint research with corporations in existing industrial fields based on established KTs.

Mission 2 Utilize global cutting-edge technologies from the optical-photonic science field (marker-free biomolecule detection technologies), produced through novel and ambitious academic endeavors, as the framework for open innovation, and interlink life science and veterinary science field KTs in pursuit of broad-ranging practical applications in order to serve as a global pioneer proposing innovative new technologies.

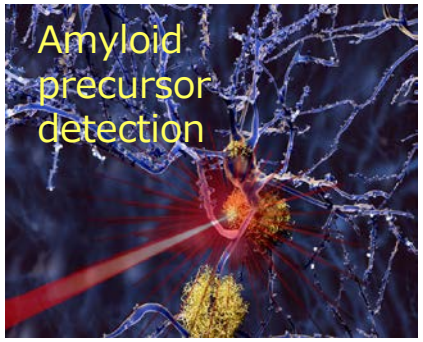
Mission 3
Create new markets via international standard establishment for technologies created through cross-field efforts together with optical-photonic science.

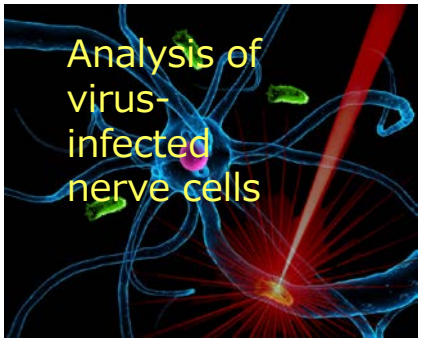
Goals

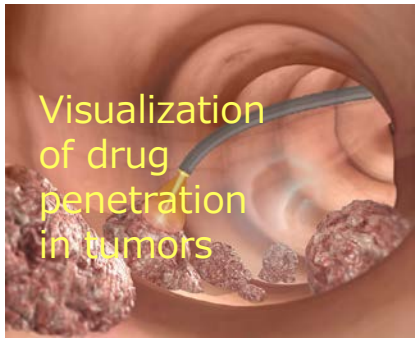
(1) Pursue R&D aimed at the creation of innovative Japanese pharmaceutical products, medical devices, functional food products and similar.

(2) Bring about major changes in industrial structures through the establishment of systems for cross-disciplinary fusions between fields (i.e., widespread dissemination of these systems throughout society).

(3) Create a human resources cultivation system that encourages new, ambitious academic and scientific endeavors among young researchers and graduate school students and thus creates human resources with high inter-filed mobility.







Key Technologies (KTs)

- KT1: Marker-free detection for biomolecules
  - International standard establishment for technologies (Hitotsubashi University)
- Establish cooperative frameworks with members of academic associations and similar for each KT
- KT2: Epigenetic sensing
- KT3: Prediction-technology development regarding diseases caused by homeostatic failure
- KT4: Optolipidomics and food-derived nutrition
- KT5: Prediction of the future of infectious diseases/illnesses and preventive measures
- KT6: Cancer cell imaging informatics
- KT7: Agricultural production and quality assessment method technological development (newly established KT in FY 2020)

Benchmarks for Primary Bioimaging Technologies

JST CRDS Research and Development Panoramic View Report: Life Sciences and Clinical Medicine (2017)

- Advantages of optical imaging over other imaging technologies:
  - ✓ Convenient and easy to use for bedside scans, medical checkups, etc.
  - ✓ Greater real-time results thanks to high temporal and spatial resolution
  - ✓ Marker-free, nondestructive analysis possible for molecular structures present in living cells and tissue

	CT	MRI	PET	Ultrasound	MS	**Optical**
Spatial resolution	0.5 mm	0.1–1 mm	Under several mm	< 1 mm	5 μm	< 1 μm
Detectable molecular concentration level	–	μm	pm–nm	–	pm–nm	pm–nm (fluorescent) / several mm (Raman)
Temporal resolution	1–10 sec.	Up to 1 sec.	In minutes	In milliseconds	0.1–1 sec.	In milliseconds
Probes	Marker-free	Contrast media	Radioisotopes	Marker-free	Marker-free	Fluorochrome Marker-free
Information collected	Forms	Probe distributions	Probe distributions	Forms	Molecular structures	Molecular structures
Primary equipment	X-ray source	Superconducting magnets	Photomultiplier tubes	Piezoelectric device	Laser, vacuum equipment	Laser
Nondestructive testing	✓	✓	✓	✓	X	✓
Deep body imaging	✓	✓	✓	✓	X	X

Benchmarks and International Standard Comparisons for Primary Optical Imaging Technologies

JST CRDS Research and Development Panoramic View Report: Nanotechnology and Materials (2017)

- Advantages of Raman spectroscopy over other imaging technologies:
  - ✓ Marker-free, nondestructive analysis possible for molecular structures present in living cells and tissue
  - ✓ Possible to differentiate between molecules via time-resolved measurements using ultrashort light pulses

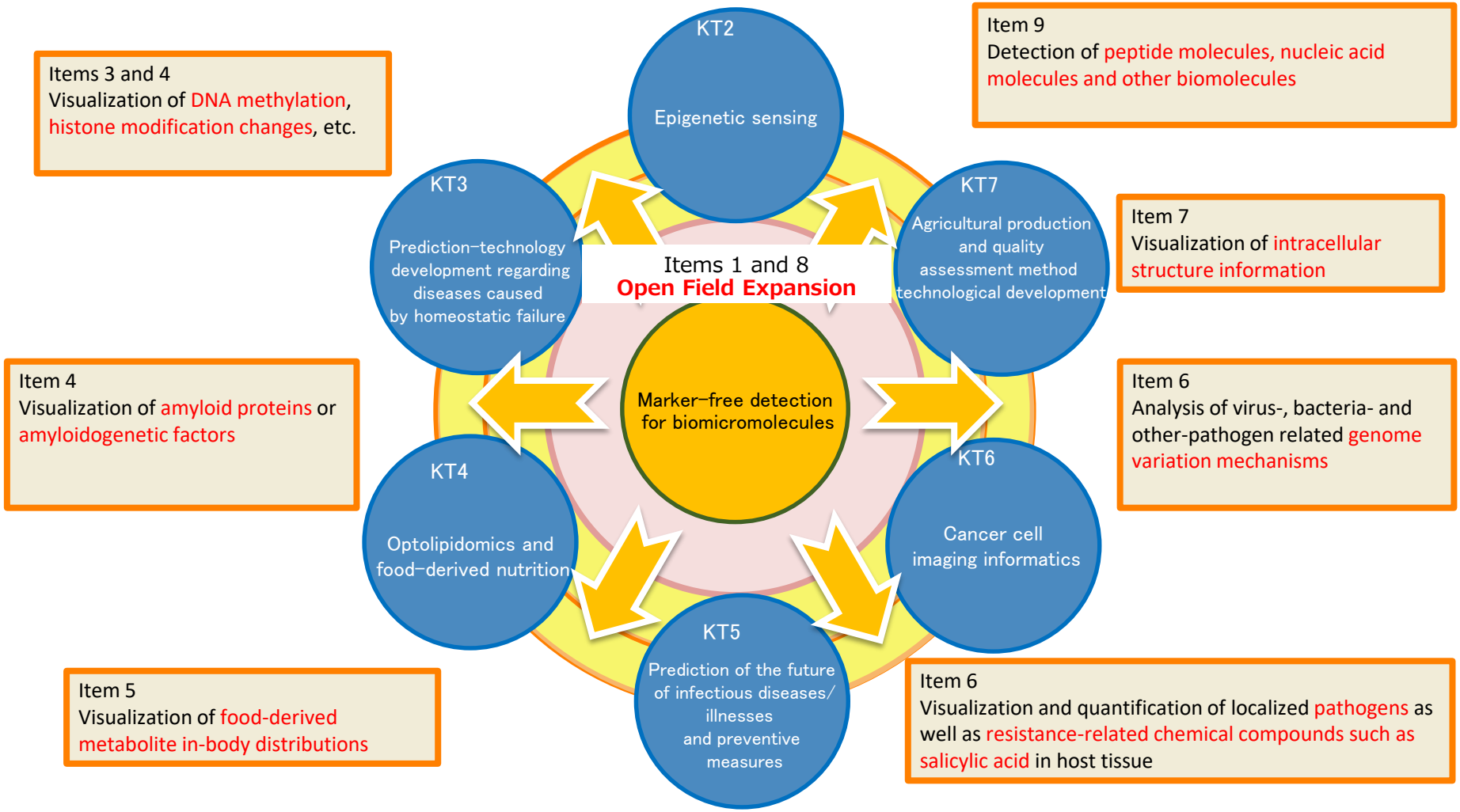
➡ Development support required to achieve highly user-friendly measurement/analysis equipment for non-specialist researchers

	Fluorescent	OCT	Photoacoustic	**Raman spectroscopy**
Information collected	Dyed molecule concentrations	Forms	Light-absorbing material distributions	Molecular structures, targeted molecule concentrations
Probes	Fluorochrome	Marker-free	Contrast media Marker-free	Marker-free
Deep body imaging	1 mm	1 mm	≤ 5 cm	Several hundred μm

- International comparisons:

	USA	Europe	China	**Japan**
Basic research	Smooth coordination with other research fields	Well-established basic research; Germany particularly strong	Rapidly increasing numbers of paper/report and result publications	Trailing just behind leaders (USA, Europe)
Applied research, development	Firm, steady performance in commercialization of cutting-edge results	Particularly strong performance in recent years for commercialization of cutting-edge results	Has some particularly strong fields, but their main strength is component technologies	Not sufficiently skilled at turning multiple component technologies into systems

➢ Establishment of target substances for visualization in fields interfacing with other KTs
➢ Plan to increase development-use equipment for item 1 in laboratories handling other items



Intellectual Property Handling Rules

1. Open Fields

(Marker-free biomolecule detection technologies (Raman))

- ✓ Sole patent ownership by TUAT for core technologies
- ✓ Unlimited use permitted within consortium

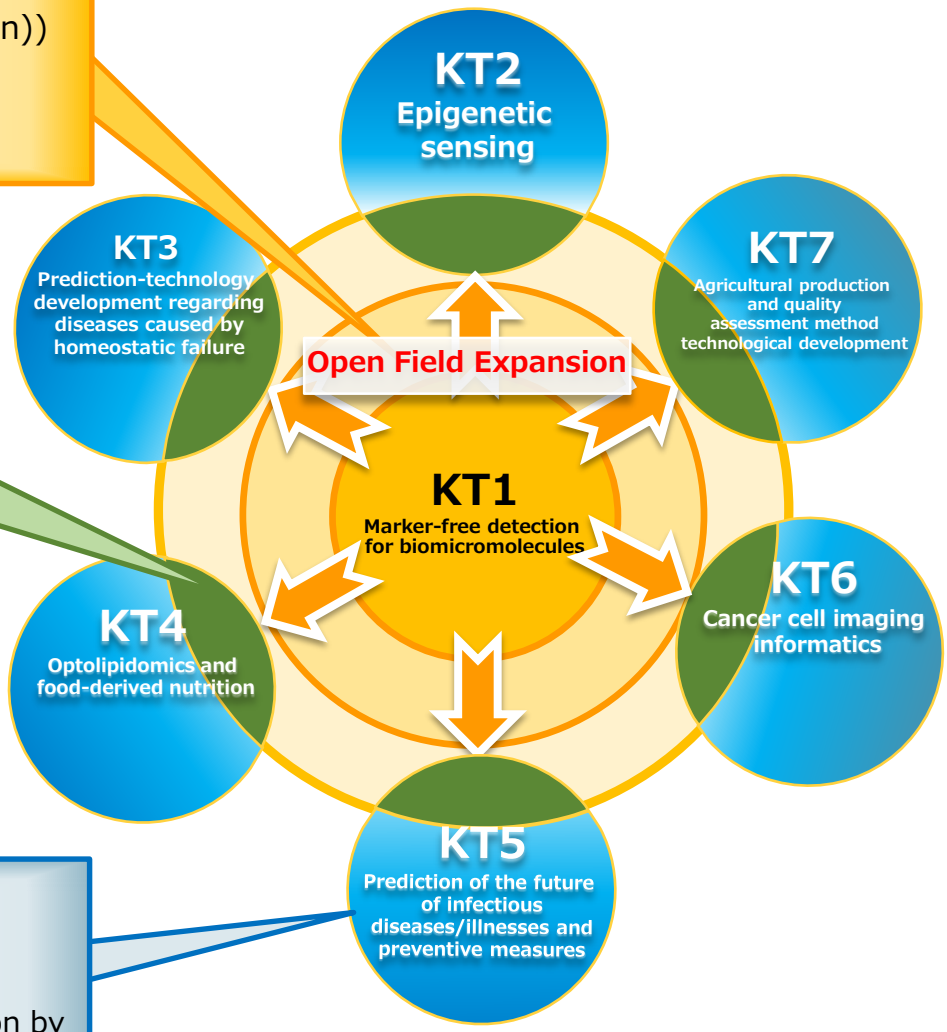
2. Technology fields (interface fields) that connect Raman spectroscopy core technologies and individual-substance measurement methods

- ✓ TUAT and corporations apply jointly in regard to results related to technologies customized for individual KTs
- ✓ Licensing arrangements made with appropriate pricing as necessary in response to consortium company needs

3. Closed fields

(Commercialization of detection results)

- ✓ Joint application by TUAT and companies, or sole application by companies
- ✓ Licensing arrangements made within consortium as necessary



Consortium Expansion Strategy

FY 2020 Efforts Regarding Move to FI Phase (As of Mar. 2020)

Participating companies: 13 (FY 2019) ➢ **28** expected (FY 2020)

Private-sector funding: ¥44.9 million (FY 2019) ➢ more than **¥168.1 million** (planned, FY 2020)

Toward further expansion

During the FS phase, we will hold symposiums, participate in overseas exhibitions, and other such events to widely showcase the effectiveness of **measurement services provided via development-use equipment that has already been commercialized**, and thus encourage participation by even more companies and organizations.

World of LASER PHOTONICS

World's leading trade fair and congress for components, systems and applications of optical technologies