# Conducting Next Generation Research for Our Health

## RIKEN Center for Integrative Medical Sciences (IMS)

December 2nd, 2019

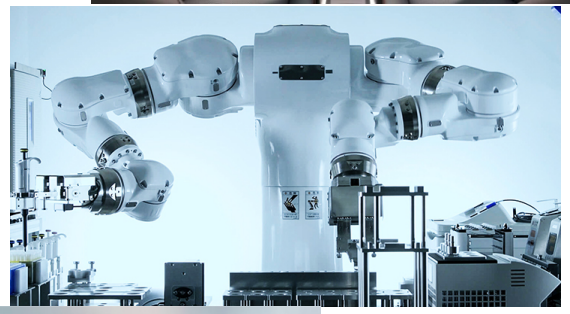
Director, Tadashi Yamamoto

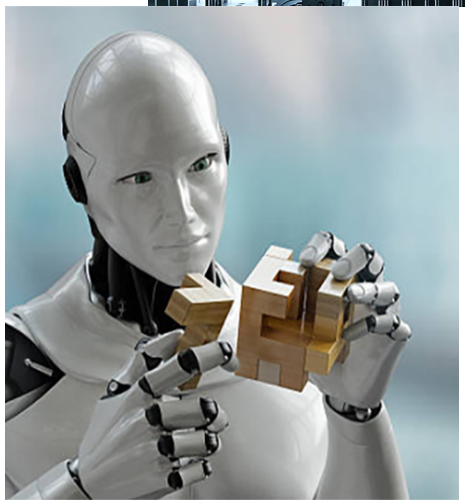
# Mission and goal

## 4th Industrial Revolution -> Society 5.0

- The technological revolution is already affecting every part of our lives in every society: research, business, industry, and medical care.

- Thereby, in the next 30-50 years, human beings will encounter great transitions that no other generation has ever had to face.





# Mission and goal

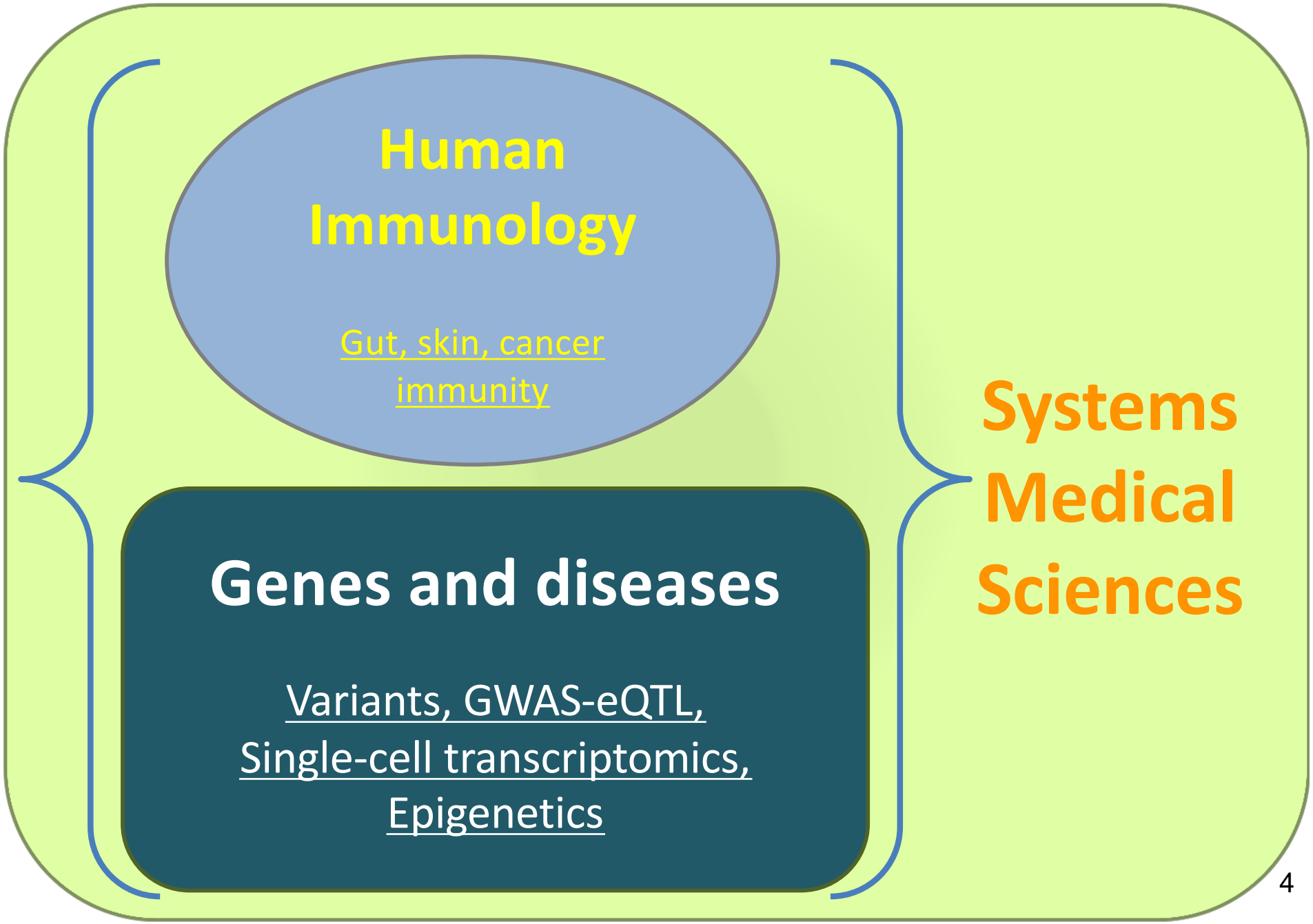
Present

Genetic system
(epigenetic, transcriptomic, genomic)
&
Immune system
(interactions with endocrine/nervous systems, etc.)

Future

**Towards Life-Long Health!**

# Mission and goal



# Organization

**Director**

Tadashi Yamamoto

**Deputy Directors**

Piero Carninci

Kazuhiko Yamamoto

Haruhiko Koseki

**Senior Advisor**

Shizuo Akira

- **Division of Genomic Medicine** (21 laboratories)
- **Division of Human Immunology** (11 laboratories)
- **Division of Disease System Biology** (11 laboratories)
- **Division of Cancer Immunology** (5 laboratories)
- **Genome Immunobiology RIKEN Hakubi Research Team**
- **Young Chief Investigator Program**
- **Office of the Center Director**

**Personnel** (as of Oct 1, 2019)

Total **403**

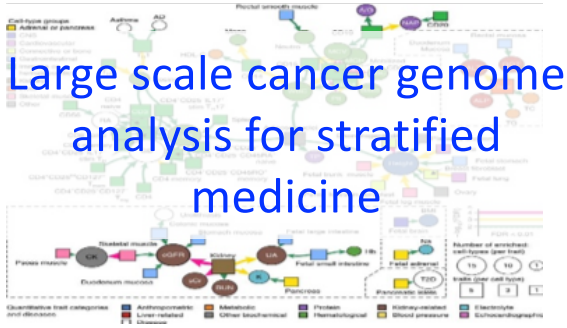
- **43** PIs
- **168** Researchers

Foreigners: **23%**
Females: **26%**

- **156** Technical staff
- **36** Administrators

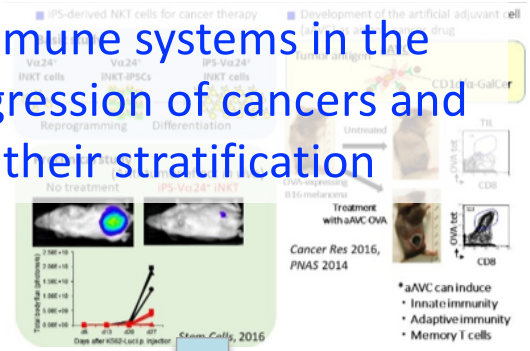
# Center projects for Systems Medical Sciences

## Cancer Genetics



Large scale cancer genome analysis for stratified medicine

## Cancer Immunology

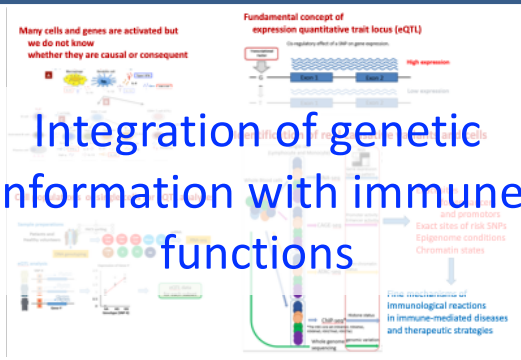


Immune systems in the progression of cancers and their stratification

## Modeling Skin Homeostasis

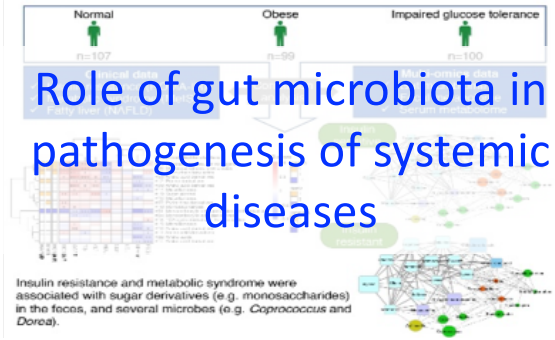
Systems biology that bridges atopic dermatitis in mouse and human

## eQTL

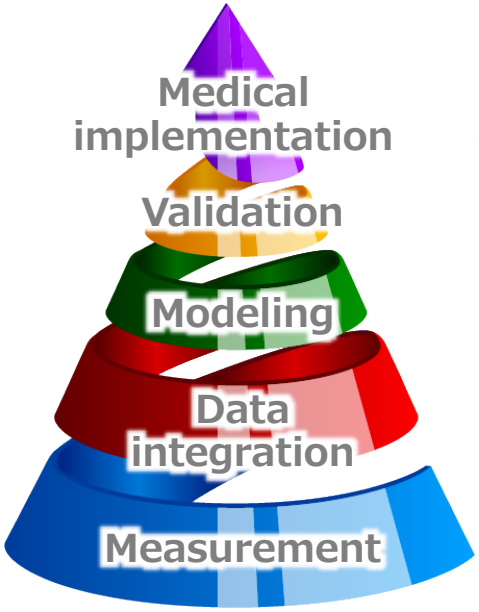


Integration of genetic information with immune functions

## Mucosal Homeostasis



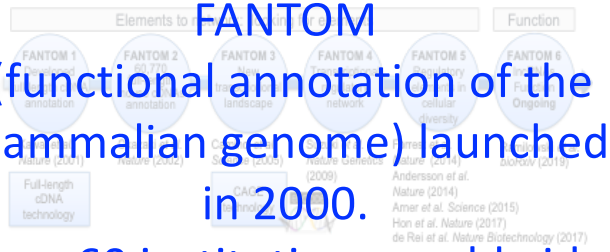
Role of gut microbiota in pathogenesis of systemic diseases




## Human Cell Atlas (HCA)

IMS as a hub for Asia (65 countries, 1021 institutions worldwide)

## FANTOM



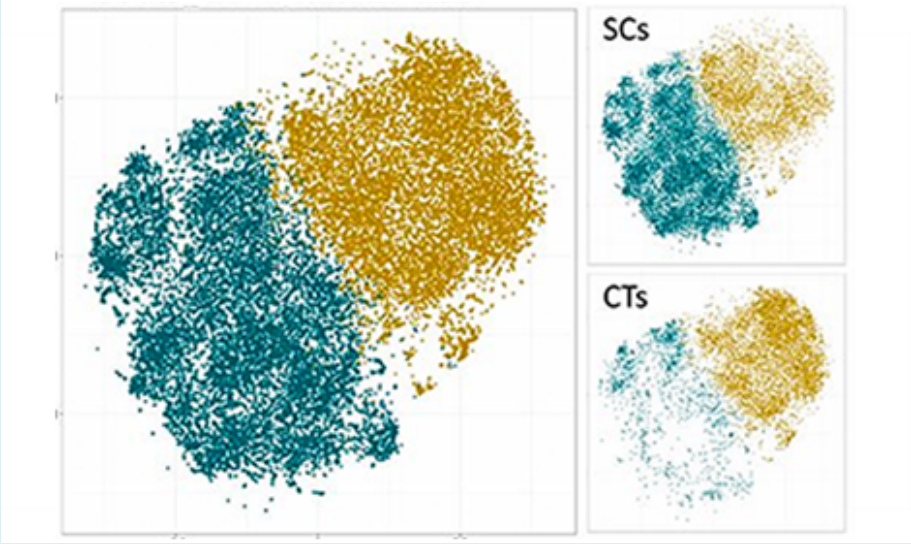
FANTOM (functional annotation of the mammalian genome) launched in 2000.

Over 60 institutions worldwide

# New Medical Science in RIKEN

## Could cytotoxic T-cells be a key to longevity?

Single-cell RNA analysis revealed that supercentenarians have an excess amount of cytotoxic CD4 T-cells.

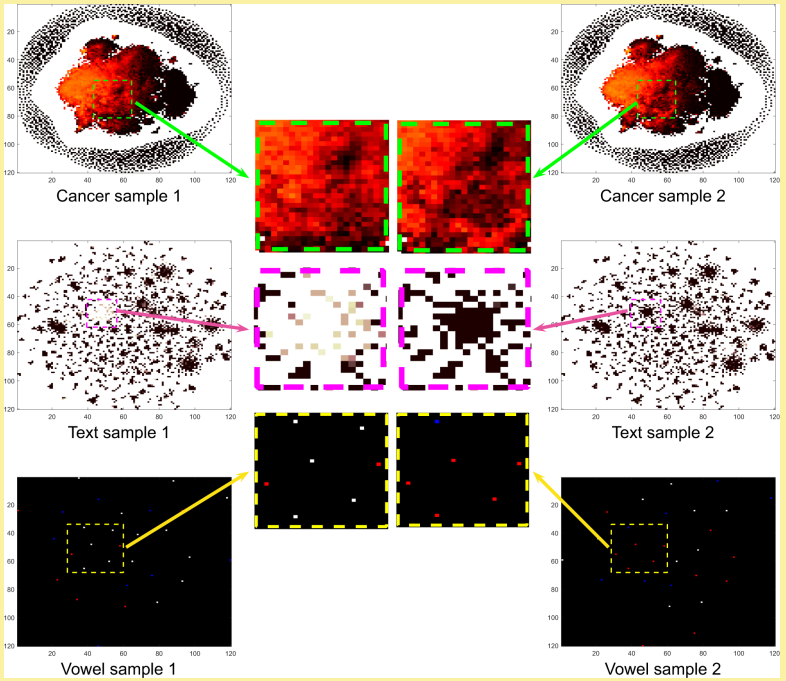



The blue cells (cytotoxic T-cells) are increased in supercentenarians (top right).

*Proc Natl Acad Sci USA* 2019

## Establishing cancer precision medicine with trans-omics and deep-learning

***DeepInsight***: A methodology for transforming non-image data to image data for deep-learning.



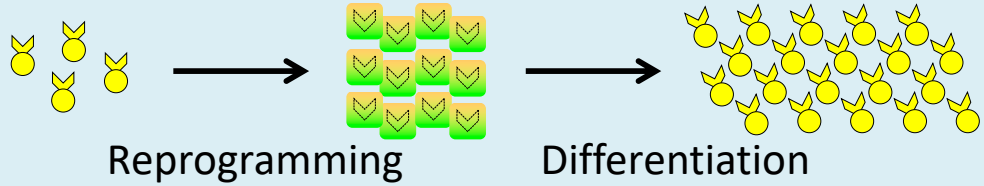

The transformed images of two types of cancer by DeepInsight reveal dissimilarities, and captured extraction was used for classification.

*Scientific Reports* 2019

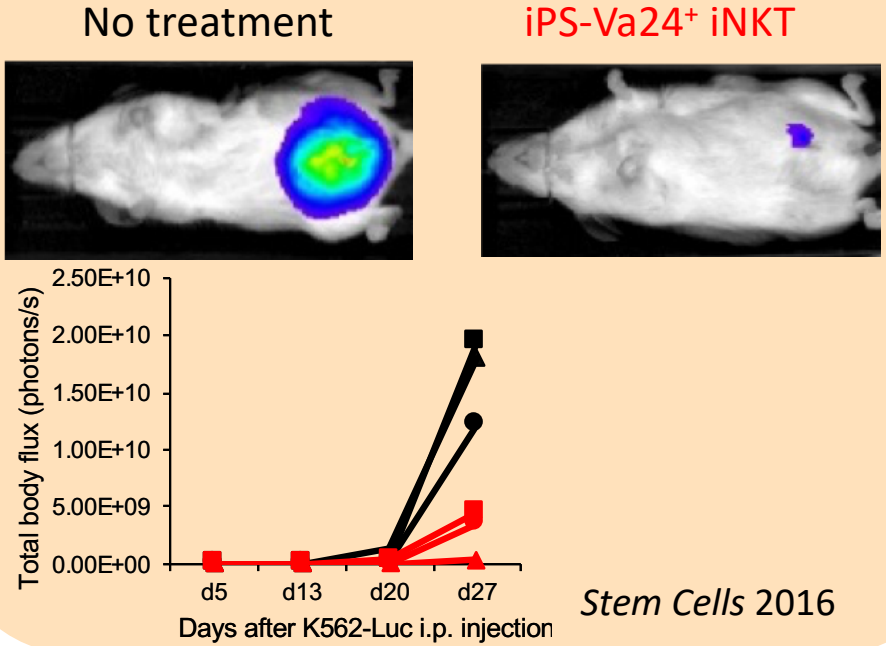
# Bench to bedside research at IMS

## iPS-derived NKT cells for cancer therapy

### Basic study

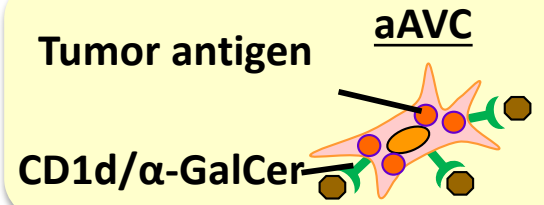



### Preclinical study (Anti-tumor effect *in vivo*)

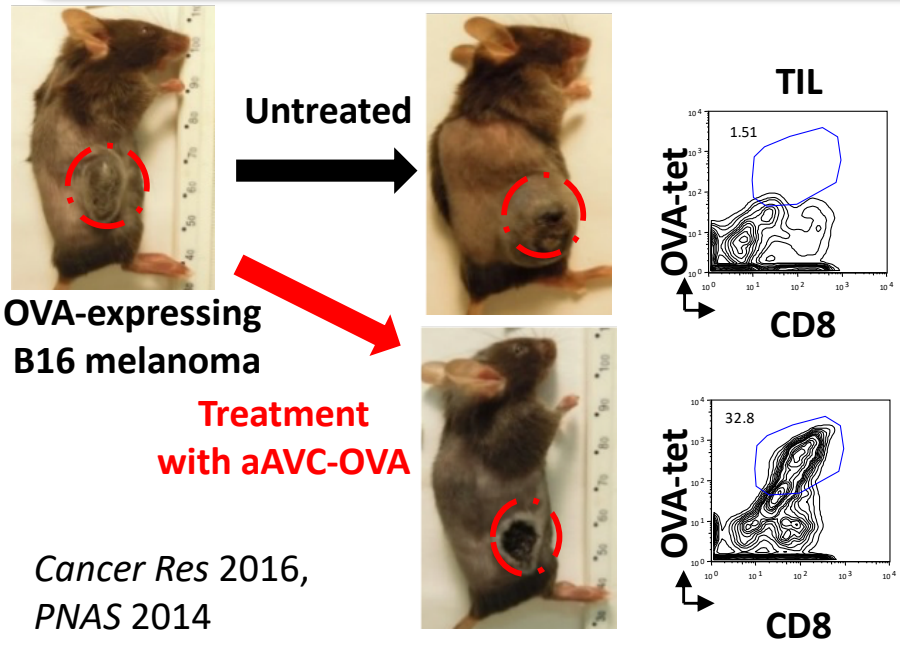



*Stem Cells* 2016

## Development of the artificial adjuvant vector cell (aAVC) as an anti-cancer drug




*aAVC can induce
- Innate immunity
- Adaptive immunity
- Memory T cells




*Cancer Res* 2016,
*PNAS* 2014

**Clinical trial** started in 2018 in collaboration with the University of Tokyo Hospital

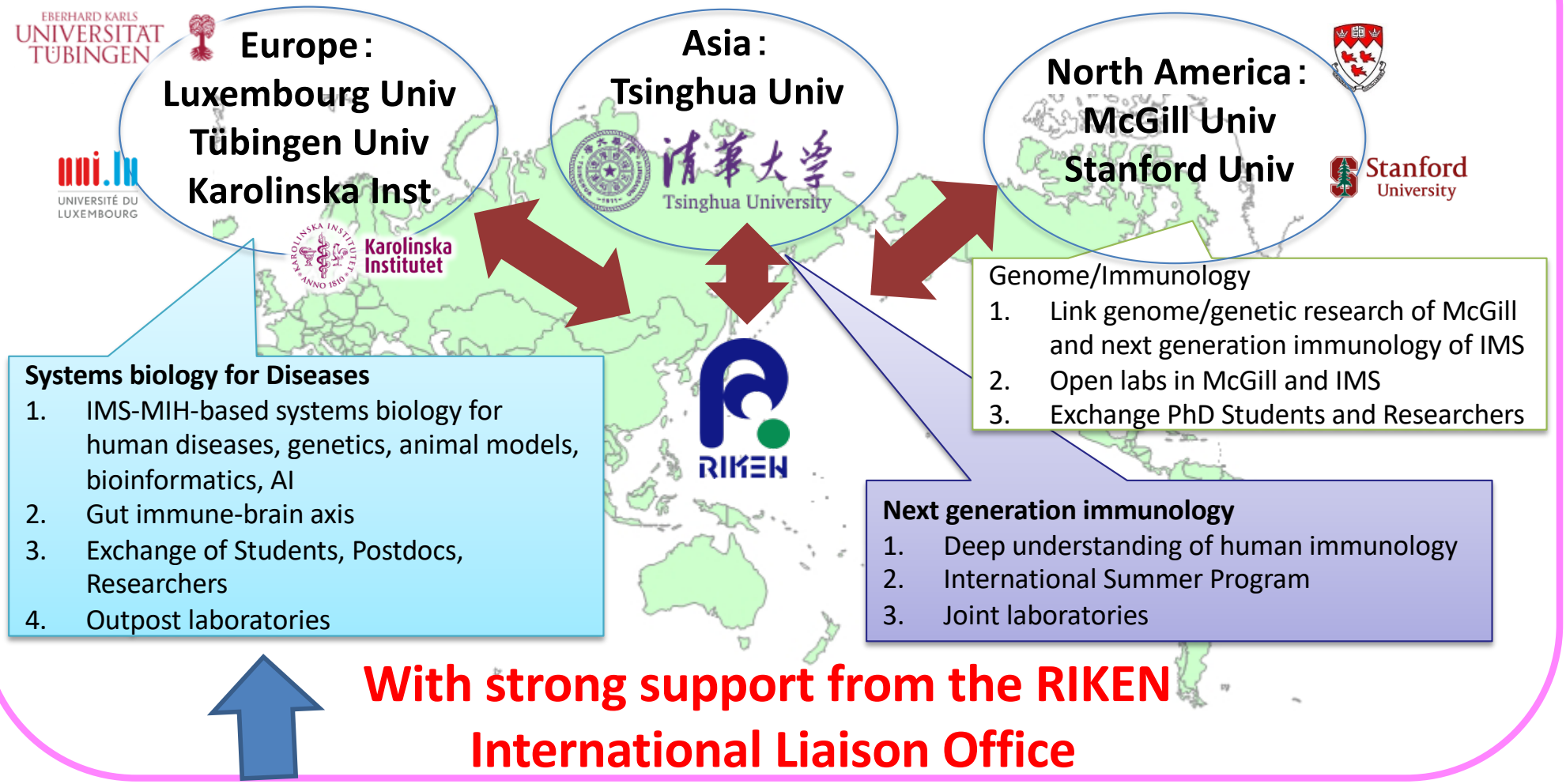
# Internationalization

**Environment in the Center**

**130 non-Japanese PIs, researchers and students in IMS**
**23% of IMS researchers are non-Japanese.**

## International collaboration

**IMS Open lab: Promote collaboration and exchange of human resources as a hub of networks with institutions in Europe, North America and Asia**




**Systems biology for Diseases**

1. IMS-MIH-based systems biology for human diseases, genetics, animal models, bioinformatics, AI
2. Gut immune-brain axis
3. Exchange of Students, Postdocs, Researchers
4. Outpost laboratories

Genome/Immunology

1. Link genome/genetic research of McGill and next generation immunology of IMS
2. Open labs in McGill and IMS
3. Exchange PhD Students and Researchers

**Next generation immunology**

1. Deep understanding of human immunology
2. International Summer Program
3. Joint laboratories

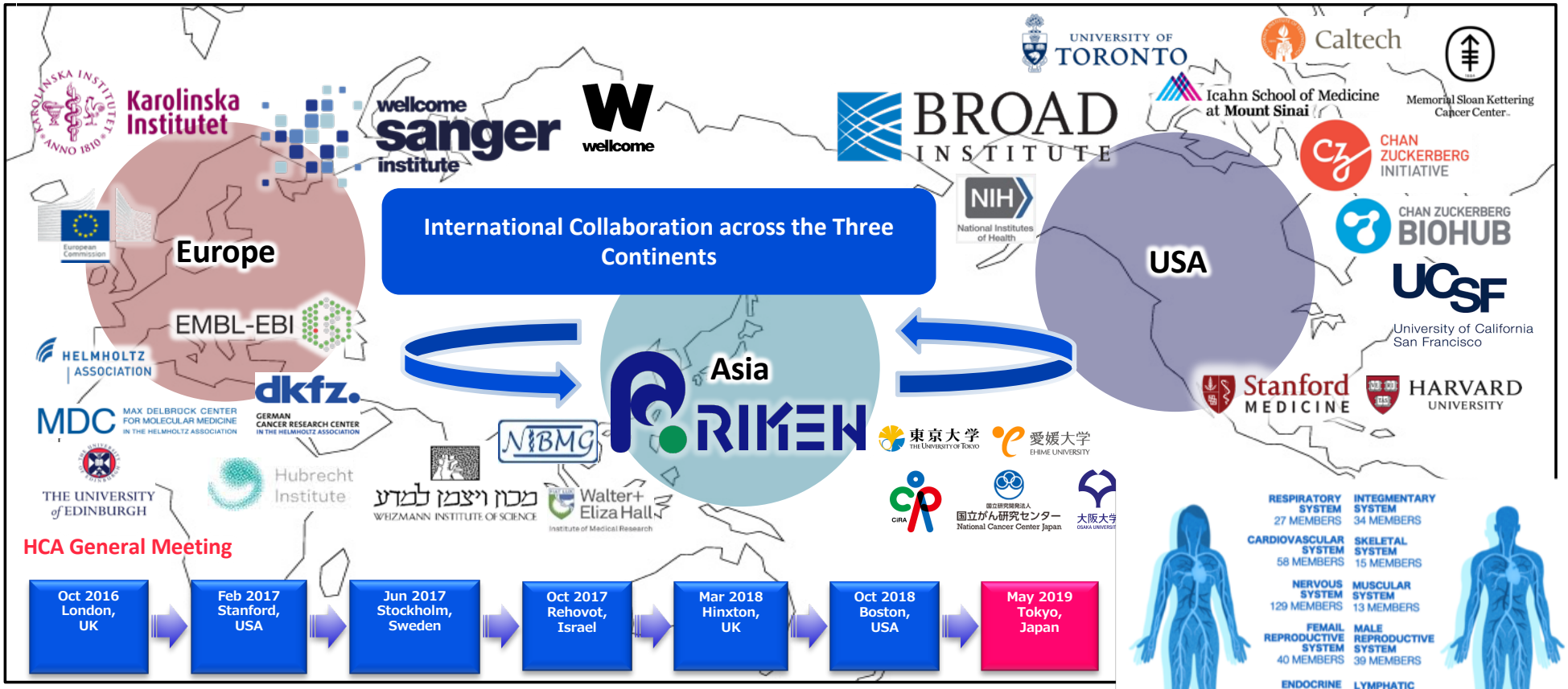
**With strong support from the RIKEN International Liaison Office**

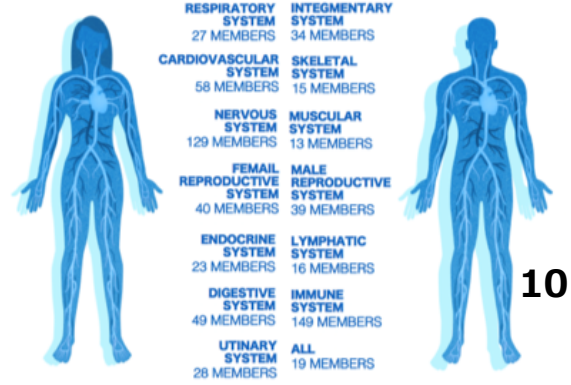
# The Human Cell Atlas (HCA) Project

A catalogue of all cell types (3.5 trillion cells in human) including a map of the location, cell state, characteristics and lineage

**Project Members**

**68 countries, 1012 institutions, 1,625 researchers (as of November, 2019)**



# International Programs for Graduate Students and Young Postdocs

1. **Internship Program**

**1-3 month internship program** is granted for selected students
Periods: **Jan-Mar & Jun-Aug every year**
<https://www.ims.riken.jp/english/jobs/internship.php>

2. **RIKEN-Tsinghua International Summer Program**

**Jun 12-19, 2020,** at IMS in RIKEN Yokohama Campus
Application deadline: **Jan 9, 2020**
<https://www.ims.riken.jp/english/jobs/summer_program.php>