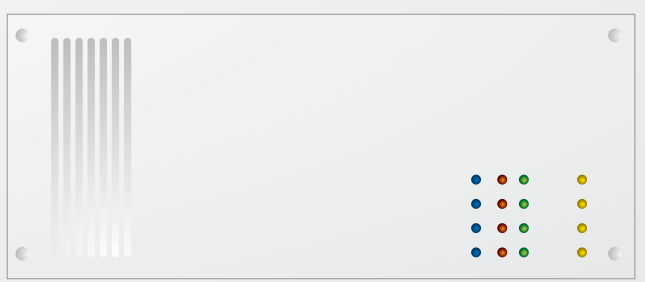
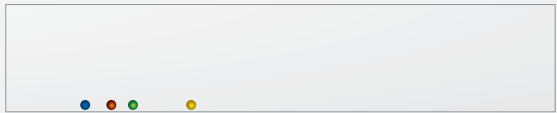


Promotion of molecular imaging research



Enlighten Life with Molecular Imaging



The question "What is Life?" has been considered by almost every person that has ever lived. One of the most famous attempts to answer the question is in a book entitled "What is Life?" written by Erwin Schrodinger (1944), where he argued that life is based on the interactions between molecules. Recent progress in molecular and cellular biology has in principle clarified this. However, it is still difficult to observe the behavior and role of single molecules in living systems.

Molecular imaging (MI) is a relatively new research field created to investigate and visualize the molecular and cellular processes in biological systems. The field is based around various imaging technologies such as positron emission tomography (PET), magnetic resonance imaging (MRI) and optical imaging. It is anticipated that combining these technologies will bring us new insights into what life is because each modality has different characteristics in terms of sensitivity, time and spatial resolution and what type of subjects it can be applied to.

The Molecular Imaging Center at National Institute of Radiological Sciences (MIC-NIRS) is funded by the Japanese Government as an advanced MI research center. It utilizes state-of-the-art MI research facilities and plays a major role in MI research in Japan. The people at MIC-NIRS are working on a wide range of projects ranging from basic to clinical research. The main target of MIC-NIRS is to become a major center promoting translational research in the MI community and related areas.

Director **Yasuhisa Fujibayashi**



● Director Yasuhisa Fujibayashi

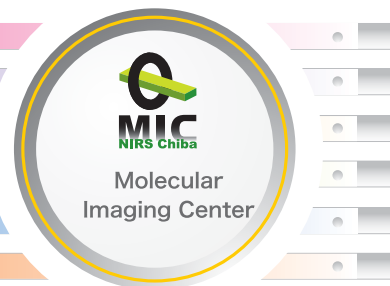
● Planning and Promotion Unit

● Diagnostic Imaging Program

● Molecular Neuroimaging Program

● Molecular Probe Program

● Biophysics Program



Facilities and equipment supporting research

Clinical PET
Clinical PET/CT

Medium-animal PET

Small-animal PET

Clinical 3T-MRI

NIRS's original 7T-Animal MRI

NIRS's original Automated-synthesizer

GMP oriented Hot Laboratory

Large cyclotron

Small cyclotron

Laboratory animal facility

- **World-leading PET fundamental technology**
- **Open research support system**
- **R&D and improve the health of the nation**
 - Organize RI use and safe management system
 - Analyze data obtained from Japanese subjects
 - Foster human resources
 - Ready for the clinical systems
 - Collaboration among various fields of research

Planning and Promotion Unit

Unit director

Yasuhisa Fujibayashi, Ph.D., D.Med.Sci.

Research Promotion and Administration Section

Head Kumiko Saegusa, Ph.D.

Standardization Section

Head Yuichi Kimura, Ph.D., D.Med.Sci.

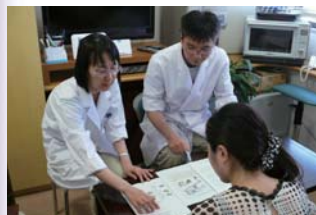
Clinical Research Support Section

Head Harumasa Takano, M.D., Ph.D.

Imaging Experiment Facilities Administration Section

Head Kumie Nojima

Research Promotion and Administration Section performs fund-raising, mounting public relation activities, external affairs for collaborative research and coordinating arrangements associated with IP. Clinical Research Support Section has Clinical Research Coordinators (CRC) and doctors at the core and maintains the support system for clinical research. Standardization Section promotes to create standard of technologies for production of molecular probe and radiation measurement. Imaging Experiment Facilities Administration Section maintains and improves experimental facilities for researchers. Each section has experts whose professional backgrounds lie in variety of fields and supports the activities of this center.



Coordination for Clinical Research
(Giving informed consent)

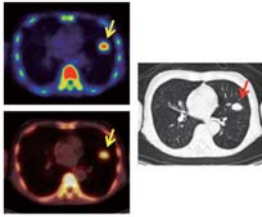


Dissemination of Research Result
(Symposium 2010)

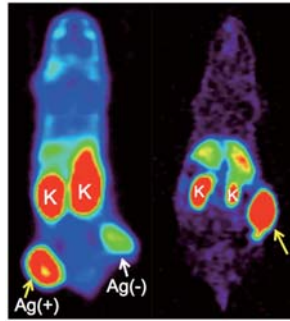
Diagnostic Imaging Program



This program focuses on research of cancer imaging using functional imaging modalities such as PET. We are aiming to develop and establish molecular probes to clarify the pathophysiological processes in cancers and other diseases and to evaluate their clinical usefulness. We are also developing probes that can detect the expression of various molecular targets in cancer cells and multifunctional probes equipped with multiple functionalities.



Imaging of cellular proliferation activity of lung cancer by FLT (^{18}F -fluorothymidine) PET/CT. FLT-PET/CT is expected to contribute for the evaluation of malignant grade, treatment response and prognosis prediction.

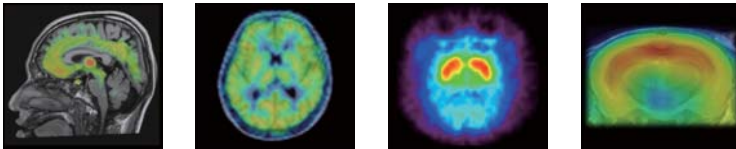


PET imaging of molecular target expression in cancer by ^{64}Cu -labeled antibody fragment (left) and peptide (right). (K: kidney, Ag: antigen)

Molecular Neuroimaging Program



Our research is directed toward understanding the neurobiology of neuropsychiatric disorders such as schizophrenia, depression and Alzheimer's diseases, and optimal treatment of these disorders. Clinical and basic approaches are integrated using in vivo and in vitro imaging techniques. We aim to identify diagnostic molecular markers for neuropsychiatric disorders, leading to drug discovery and novel therapeutic treatments.



Brain permeability of antipsychotics and the side-effects. Glial activation in the cerebral cortex of Alzheimer's disease. Primate models of human diseases and brain function. Amyloid imaging by transgenic model of Alzheimer's disease.

Director

Tsuneo Saga, M.D., Ph.D.

Pathophysiology Imaging Team

Leader Takako Furukawa, Ph.D.

Molecular Targeted Imaging Team

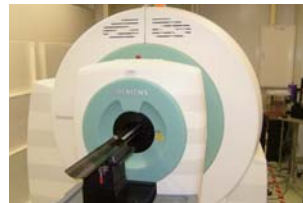
Leader Atsushi Tsuji, Ph.D.

Multimodal Molecular Imaging Team

Leader Ichio Aoki, Ph.D.



Clinical PET/CT



Small Animal PET/CT



Director

Tetsuya Suhara, M.D., Ph.D.

Clinical Neuroimaging Team

Leader Tetsuya Suhara, M.D., Ph.D.

Neuromolecular Dynamics Team

Leader Makoto Higuchi, M.D., Ph.D.

Neuroinformation Team

Leader Takafumi Minamimoto, Ph.D.



Clinical PET
Small Animal PET



Molecular Probe Program

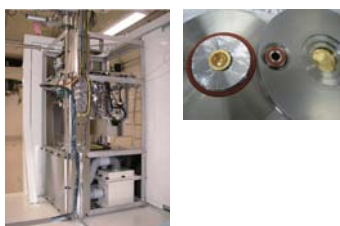


Main tasks of this program are development and routine production of useful PET probes for clinical diagnosis and bio-functions. To achieve our task, we have been developing versatile automated synthesis system and integrated production system to produce safe PET probe with less radiation exposure to personnel. Additionally new labeling techniques available for the development of novel PET probe that can image biological function quantitatively have been developed.

We set out to establish standard production method for clinical application of useful molecular probes and expand it to domestic and international facilities.



Tumor bearing mice imaging of using ^{11}C -thiothymidine developed in our research program.



Irradiation port by vertical beams has been developed to produce medium half-life positron emitters such as ^{124}I and ^{76}Br with high efficiency.

Director
Toshimitsu Fukumura, Ph.D.

Molecular Probe Chemistry Team

Leader Ming-Rong Zhang, Ph.D.

Radiopharmaceutical Production Team

Leader Kazunori Kawamura, Ph.D.



Automated probe synthesizer



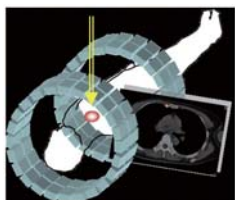
Hot Lab.2



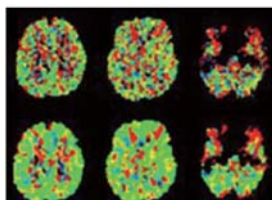
Biophysics Program



Department of Biophysics program consists of two teams, one is to develop next-generation PET equipments and another one is to develop methods for imaging data analyses. We aim to develop ultra-high resolution PET camera and new concept PET camera "OpenPET[®]", and to develop the methods for quantitative analyses of in vivo imaging obtained from PET, MRI, and two-photon microscopy. Using these techniques, we will measure physiological parameters in vivo as a basis of diagnosis and treatment.



The concept of "OpenPET[®]". Heavy ion radiotherapy can be monitored using OpenPET[®].



Noise reduction of PET images by wavelet denoising.

Director
Hiroshi Ito, M.D., Ph.D.

Imaging Physics Team

Leader Taiga Yamaya, Ph.D.

Imaging Physiology Team

Leader Hiroshi Ito, M.D., Ph.D.



Clinical PET



DOI detector



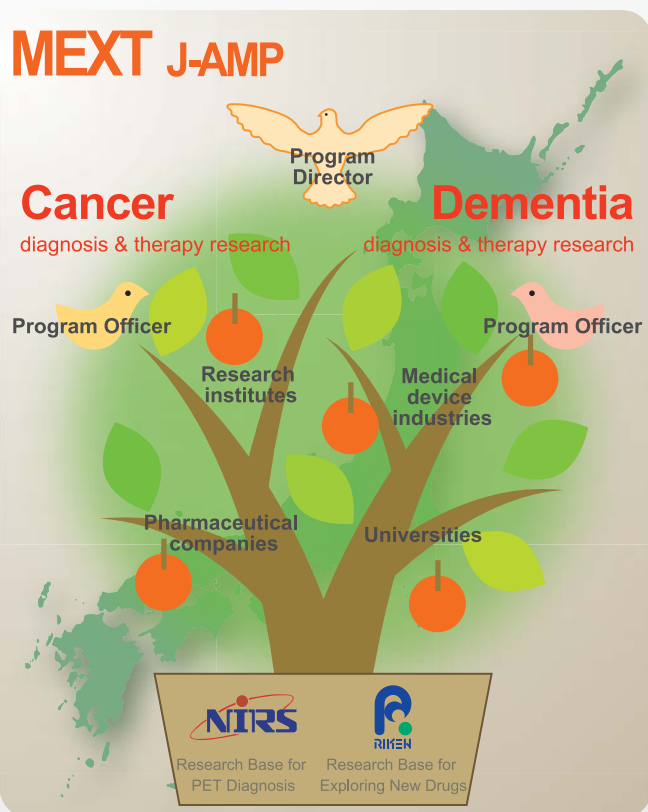
Research Base for PET Diagnosis

NIRS was selected as the "Research Base for PET Diagnosis" in the Molecular Imaging Research Program supported by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) in 2005. At the same time, RIKEN was selected as the "Research Base for Exploring New Drugs". NIRS established synthesis technology for ultra-high specific radioactivity, for the development of molecular probes with medium half-life radionuclides, and for the development and assessment of biomarkers for dementia or cancer imaging.

In 2010 the MEXT has launched its second program, the "J-AMP; Japan Advanced Molecular Imaging Program", using the center that had been established and equipped in the course of the first program. This is because the results of the first program should be quickly followed by experimental verification based on clinical studies and practical application. In the second program, research is undertaken focusing on the cancer and dementia fields to contribute to an improvement in the level of the nation's medical services. In particular, NIRS studies hypoxia-related recalcitrant cancer and neurodegenerative dementia.

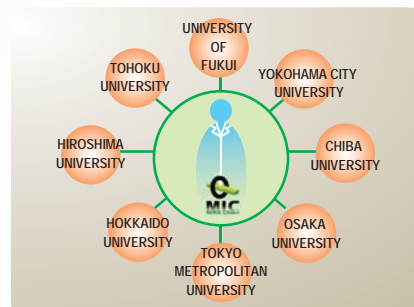


J-AMP; Japan Advanced Molecular Imaging Program



Fostering Specialized Researchers and Technologists

Fostering human resource in the research field of molecular imaging is one of the important missions of NIRS. We promote efficient training in collaboration with several universities in multiple fields such as medicine, pharmacology, biology, chemistry, and physics, in order to develop human resources in the molecular imaging field.



History

- 1957: establishment of NIRS
- 1973: Japan's first medical cyclotron was installed
- 1976: trial production of RI started
- 1977: development of high-speed positron camera was successful
- 1980: development of technology to produce ligands labeled with short-lived RI
- 1996: establishment of research station for advanced diagnosis function
- 2000: completion of GMP-capable hot lab for production of radioactive agents
- 2002: installation of Japan's first PET/CT machine
- 2004: development of 7T MRI machine, Clinical trial of new antidepressant agent using PET
- 2005: NIRS was adopted as Research Base for PET Diagnosis of the Molecular Imaging Research Program, Establishment of Molecular Imaging Center
- 2008: world's first proposal of open PE geometry
- 2010: NIRS was adopted as Research Base for PET Diagnosis of J-AMP

 **National Institute of Radiological Sciences**
An Independent Administrative Institution

 **Molecular Imaging Center**

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