

**2011 MEXT Program for Leading Graduate Schools**



**GUNMA UNIVERSITY**

**Program for Cultivating Global Leaders  
in Heavy Ion Therapeutics and Engineering**




2013

Message from  
**President**



President  
**Kuniaki Takata**



Heavy ion cancer therapy is a state-of-art technology originally developed in Japan. It offers patients a high quality of life, because heavy ion beam bombs the targeted cancer cells with devastating effect while minimally affecting the healthy part of the body. Gunma University has constructed the world's first miniaturized practical heavy ion therapy device that serves as a prototype for commercially-available machines. Further development of the machine is also going on now.


We have treated more than 700 cancer patients using this machine since it began operation in 2010. The procedure of the treatment is highly sophisticated and requires cooperation of a wide range of professionals. In addition to the physicians, radiologists and nurses, heavy ion cancer therapy requires several specialists, including medical physicists to conduct an ion dose distribution simulation, technicians to control the accelerator and ion beam, and radiation biologists to investigate the biological action of the heavy ions.

We have launched a new graduate course program, "Program for Cultivating Global Leaders in Heavy Ion Therapeutics and Engineering". In this program, we provide unique education programs and various research opportunities concerning heavy ions and their use in medicine. We welcome the enrollment of young students from all over the world with diverse backgrounds, such as doctors, engineers, physicists etc. We hope that this program will provide core human resources of this marvelous technology that serve as leaders who will promote heavy ion cancer therapy globally.

Message from  
**Executive Director  
of Research and Planning**



Vice President  
**Hiroshi Hiratuka**



The program of Gunma University, titled as "Program for Cultivating Global Leaders in Heavy Ion Therapeutics and Engineering", was adopted in "Only-one type" category as one of 21 programs for "Leading Graduate Schools Program" launched by MEXT in 2011. Our program is one of a few programs submitted by regional national universities and has attracted high expectations from Japan and overseas.

In Japan, heavy ion cancer therapy has been conducted by the National Institute of Radiological Sciences and the Hyogo Ion Beam Medical Center. However, Gunma University is the only institution currently developing human resources through the heavy ion treatment, education, and research. In the world, only few universities, such as Heidelberg University, have heavy ion treatment facilities and we may expect further installation of such facilities going forward around the world. Thus, development of globally competent human resources who can lead the heavy ion cancer therapy has become an urgent priority.

At Gunma University, we have been working in the field of heavy ion medicine and technology at the forefront of cancer treatment. These activities have mainly been focused on our medical research departments, affiliated hospital, and the Organization for Promotion of Heavy Ion Medicine; we have produced valuable results in both treatment and research. I hope that the Leading Graduate Schools Program of our university will not only advance the research and treatment capabilities, but also develop globally competent human resources in heavy ion therapeutics and engineering to deliver new innovation.

Message from  
**Program Director**



Dean  
Graduate School of Medicine  
**Takashi Izumi, M.D., Ph.D.**

The Program for Cultivating Global Leaders in Heavy Ion Therapeutics and Engineering is one of Leading Programs in Doctoral Education (Only-One Category: Programs that would produce leaders with a clearly defined specialty) supported by Ministry of Education, Culture, Sports, Science and Technology, which was adopted in 2011. Gunma University Graduate School of Medicine established the Heavy Ion Medical Engineering Course as a doctoral degree program combining medical science and engineering, and started accepting students in April 2012. The program provides education and research in heavy ion medical science and biology, and advanced clinical practice using heavy ion, fostering global leaders in research and development of advanced medical equipment and related operation technologies. For this reason, Graduate School of Engineering and related organizations in Japan and overseas are involved in the course, as well as manufacturers of medical equipment, to offer education that goes beyond the respective special fields covered. Graduates of the course are expected to contribute to medical innovation through heavy ion therapeutics and engineering, a field that is expected to see global expansion.

Message from  
**Program Coordinator**



Director of the Heavy Ion Medical  
Research Center  
Professor of Department of  
Radiation Oncology  
**Takashi Nakano, M.D., Ph.D.**

While Japan seeks to be a “nation oriented on creation of science and technology” , there is a concern that Japan lags behind America and Europe in the development of science and technologies in many medical fields. Against this background, the” Program for Cultivating Global Leaders in Heavy Ion Therapeutics and Engineering” at Gunma University is intended to overcome its international inferiority in the development of medical science and technologies and to allow Japan as a presumptive leader in science and technology.

Gunma University is the only University which has its own heavy ion therapy equipment among universities in Japan , and conducts postgraduate education and research concerning heavy ion radiotherapy under the auspices of the Heavy Ion Medical Research Center. Furthermore, at the education and research center established through the 21st Century Center Of Excellence Program using accelerator technology, we have accumulated technologies and experience in heavy ion radiotherapy engineering, heavy ion microsurgery system, medical Compton cameras, clinical practice using heavy ion radiotherapy and so on.

In this way, we aim to foster outstanding leaders in heavy ion medical science who can play an active role across various fields of specialization, as globally respected leader scientists who can take lead of radiation oncology and physical engineering and medical biology in the field of heavy ion radiotherapy, or as leaders of research and development at companies developing the equipment for heavy ion therapy.



## Outline and Objective

**Outline and Objective** The overall aim/objective of the Program this project is to provide training for developing global leaders of radiation oncologists, physical engineering researchers, medical biologists, and researchers at companies developing the equipment for heavy ion medicine, who can support the promotion and development of the heavy ion radiation therapy.

The Program involves establishing a leading cooperative training course of the heavy ion medical engineering course combining medical science/therapeutics and engineering in the Program for Cultivating Global Leaders in Heavy Ion Therapeutics and Engineering, which provides education in the basics of the heavy ion medicine and biology, advanced clinical research in the heavy ion medicine, and both the development and operation technologies of advanced medical equipments. In this way, we aim to foster globally respected radiation oncologists, leaders in physical engineering and the medical biology field, and leaders of research and development at companies developing the equipment for heavy ion medicine, who can support the implementation and development of the heavy ion radiotherapy field.

## Content of Degree Program

The Program for Cultivating Global Leaders in Cooperative Course on Heavy Ion Medical Engineering (L-PhD) of the Graduate School of Medicine is a doctoral program aiming to foster leaders in radiation oncology, physical engineering research, medical physics, and medical biology research. Students of the graduate school of medicine are required to study common subjects in lower level and specialized subjects of each major field at a higher level. A total of 30 units are required for completion. L-PhD students need to complete 30 units. 14 units of common subjects are required including 3 units in Series of Lectures for Basic Medicine (more than 1 unit in L-PhD lectures) and 3 units in Course of Basic Techniques for Medical Researches (2 units in L-PhD lectures). In addition, specialized subjects are required including 8 units from the major subject and 8 units from L-PhD special subject.

In the L-PhD Medical Engineering Course, 10 new subjects were established. Moreover 11 subjects in the Course of Medical Sciences curriculum were upgraded. These changes were done to provide a substantial graduate school education. Internship in institutes in industry, government, and academia and on-the-job training in associate institutes in Japan and abroad, were introduced as well. Additionally, a rotation system enabling students to take a number of lectures for coursework beyond their specialized field was put in place. Moreover, Common Specialist Subjects in Medical Engineering, lectures beyond the conventional boundaries of each course, was established and made available for students of the Graduate School of Medicine and the Graduate School of Science and Technology. The doctoral program in the graduate school of medicine provides an education system that exceeds the boundaries of the specialized field. The L-PhD medical engineering cooperative course provides the opportunity to acquire knowledge and methodology of integrated medicine and engineering about heavy ion physical engineering and heavy ion biology as well as heavy ion radiotherapy. The L-PhD Research Fund is provided for outstanding research projects proposed by L-PhD student; thereby, cultivating students' ability to accomplish their research goals independently and authentically.



### L-PhD Medical Engineering Course

#### (Elective Specialized Subjects in Medical Science)

Lectures Provided by Each Department	Improvement of [Radiation Oncology] and [Medical Physics for heavy ion therapy]
Tutorial Seminar	<b>Establishment of Medical Physics of Ion Beam Therapy Tutorial Seminar (NEW)</b> Radiation Oncology Therapeutics and Multidisciplinary Treatment of Cancer using the PBL method
Technical Courses for Special Fields	<b>Establishment of internship (NEW)</b> <b>Implementation of training in education and research partners in Japan and abroad</b>

#### (Special Lectures on Engineering Based Medicine) NEW

Lectures provided by each department	<b>Advanced engineering on charged beam for cooperation of medicine and engineering, advanced course</b> <b>Radiation control and measurement for cooperation of medicine and engineering, advanced course</b> <b>Advanced engineering on ion beam application for cooperation of medicine and engineering, advanced course</b> <b>Advanced engineering on system and control for cooperation of medicine and engineering, advanced course</b>
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#### (Common Specialized Subjects in Medical Science)

Series of Lectures for Basic Medicine	<b>Establishment of [Heavy Ion Engineering] and [Heavy Ion Therapeutics] (NEW)</b>
Course of Basic Techniques for Medical Research	<b>Establishment of Basic Techniques for Measuring Radioactivity (NEW)</b> Improvement of Radiobiology Course and How to Write a Scientific Paper (Small-Group Instruction)
Seminar on Dealing with Experimental Data	Introduction of a rotation system
Seminar for Presentation and Discussion	Implementation of QE advised by International Advisory Board
ERSC Lecture	Invitation of lecturers from international education and research partners Improvement of the Research Activity Promotion Program Implementation of the International Workshop led by graduate students

# System of the Program

Besides the foundations of heavy ion therapeutics and engineering, this Program provides lectures and training related to a wide range of related scientific fields. In addition, the students have opportunities of internships at companies and related medical institutions to establish a career path after graduation. Furthermore, in order to develop a broad perspective on heavy ion medical science, the graduate students attend to international conferences and join research activities in foreign research institutions (international educational training) to develop young researchers internationally playing an active role.

This Program develops international leaders in radiation oncology, physical engineering, and medical biology, and provides high-quality researchers and developers to radiation and heavy ion research centers and heavy ion radiation therapy facilities in Japan and overseas. The curriculum allows highly capable students to complete graduate school in three years.

## Enrollment

For this program, we select highly capable students from clinical residency, schools of medicine, dentistry, pharmaceuticals, veterinary, as well as from other master courses.

## First year

Students learn through training in basic medical technologies and basic lecture courses. Additionally, students participate as necessary in the rotation of seminars for discussing research results.

## Second and third year

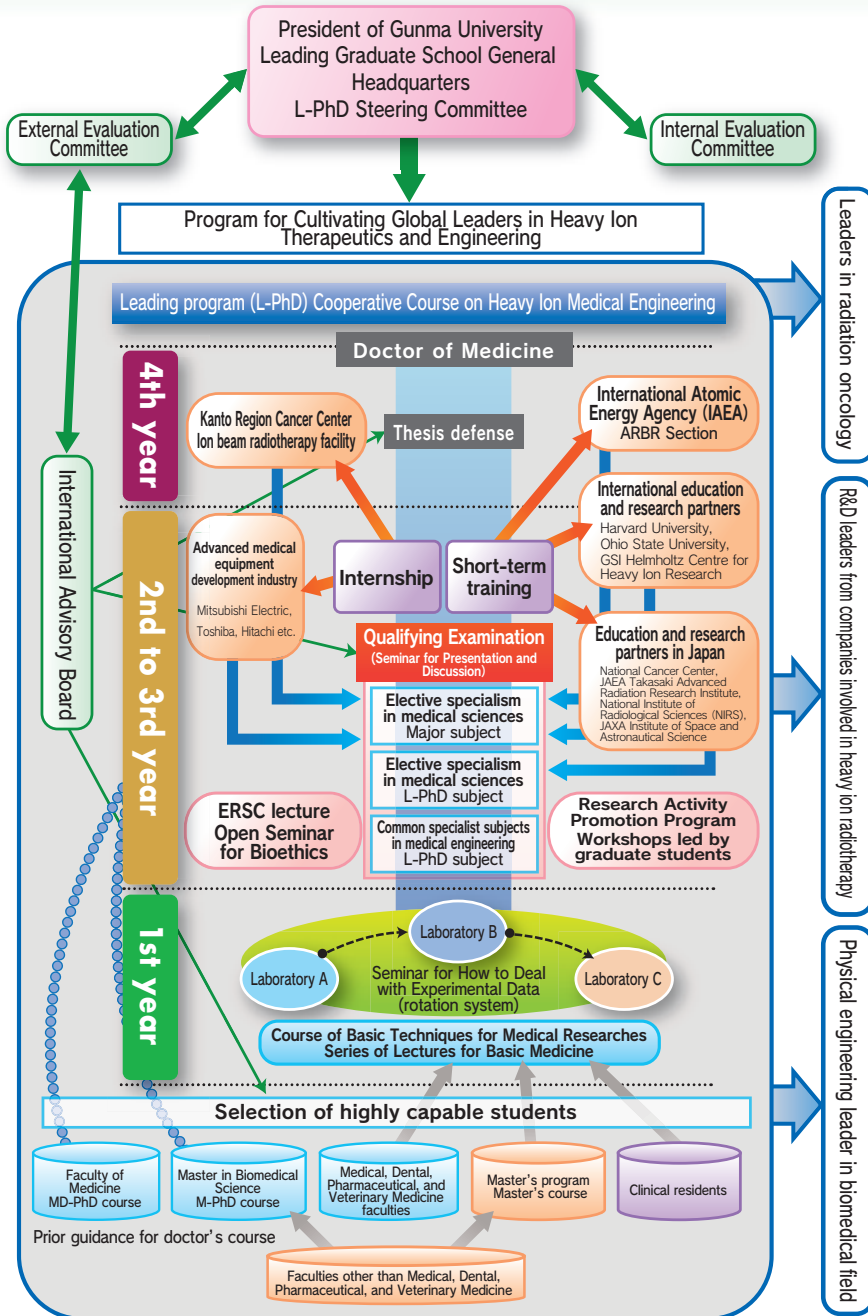
Students study major subjects and major specialist subjects in medical science and therapeutics/engineering leading graduate school. In addition, basic research ability is tested through Qualifying Examinations (seminars for the research presentation and discussions). Students also participate in public seminars in bioethics, and workshops led by graduate students as part of the Research Activity Promotion Program. Internships in the advanced medical equipment development industry, Cancer Centers in the Kanto region and particle therapy facilities are also available, as well as short term training at education and research related facilities in Japan and overseas, and at the International Atomic Energy Agency (IAEA).

## Fourth year (or third year)

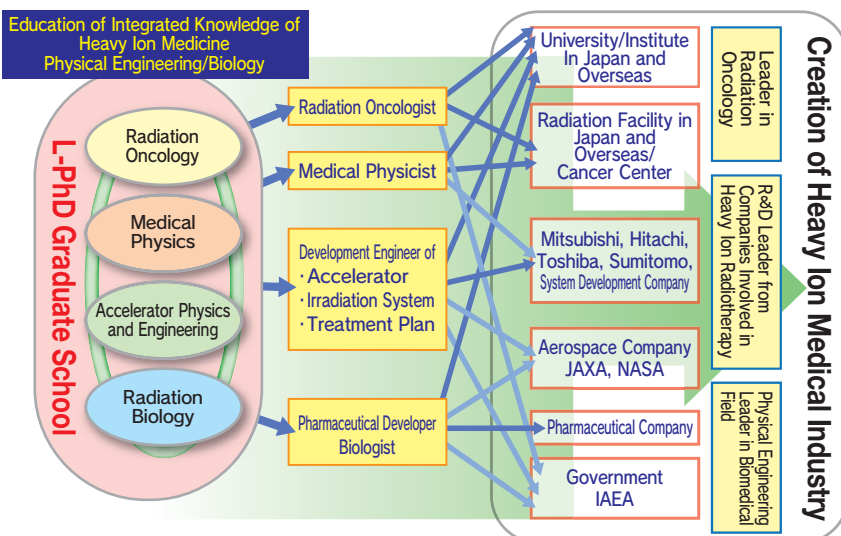
Students write a thesis of the research results. The Ph.D. degree will be given when completing the required credits and passing the thesis defense.

Students have possible opportunities to have research supervision from an international advisory board of internationally prominent researchers.

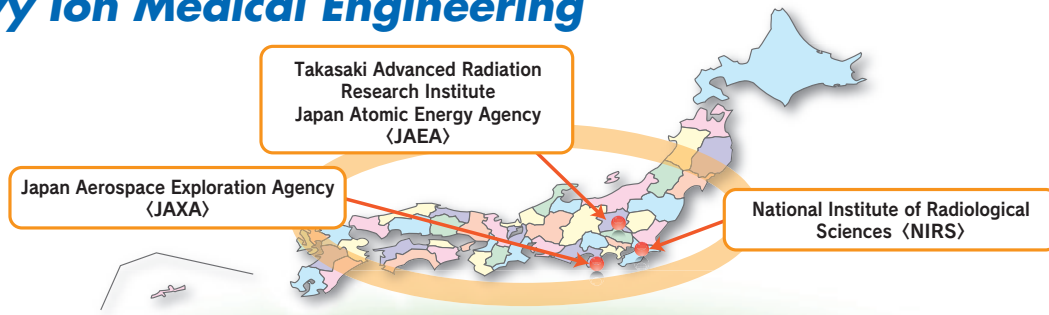
## Conceptual Diagram



## Career Paths for Postgraduates



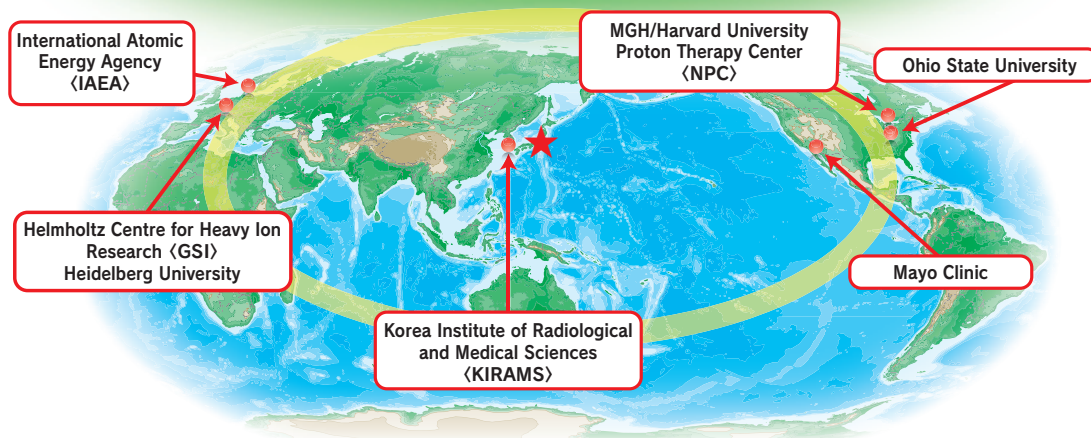
# Cooperation System for Cultivating Global Leaders in Heavy Ion Medical Engineering



## International Education Research Network

Education Outside the Frame of Conventional Major Goes Beyond the Specialized Fields  
Establish the International and Interdisciplinary Collaborative Course on Heavy Ion Medical Engineering by Research Organization Consortium in Japan and Abroad

Traverse the Boundaries and Unify Accelerator Physical Engineering, Medicine, Engineering, Astrophysics, and Heavy Ion Medicine



## Faculties and Staff

(As of Sep. 2013)

### Program Director

Takashi Izumi, M.D., Ph.D.  
Dean of Graduate School of Medicine

### Program Coordinator

Takashi Nakano, M.D., Ph.D.  
Professor, Department of Radiation Oncology

### Graduate School of Medicine

Yoshihisa Nojima, M.D., Ph.D.	Medicine and Clinical Science	Professor
Yasuki Ishizaki, M.D., Ph.D.	Molecular and Cellular Neurobiology	Professor
Tomoaki Shirao, M.D., Ph.D.	Neurobiology and Behavior	Professor
Yuchio Yanagawa, M.D., Ph.D.	Genetic and Behavioral Neuroscience	Professor
Masami Murakami, M.D., Ph.D.	Clinical Laboratory Medicine	Professor
Tetsunari Oyama, M.D., Ph.D.	Diagnostic Pathology	Professor
Hiroshi Koyama, M.D., Ph.D.	Public Health	Professor
Kazuhiro Suzuki, M.D., Ph.D.	Urology	Professor
Takashi Minegishi, M.D., Ph.D.	Obstetrics and Gynecology	Professor
Hiroyuki Kuwano, M.D., Ph.D.	General Surgical Science	Professor
Hirokazu Arakawa, M.D., Ph.D.	Pediatrics	Professor
Satoshi Yokoo, M.D., Ph.D.	Stomatology and Maxillofacial Surgery	Professor
Izuho Hatada, Ph.D.	Laboratory of Genome Science	Professor
Tatsuaki Kanai, Ph.D.	Heavy Ion Medical Research Center	Professor
Satoru Yamada, Ph.D.	Heavy Ion Medical Research Center	Special Duty Professor
Tatsuya Ohno, M.D., Ph.D.	Heavy Ion Medical Center	Professor

### Faculty of Science and Technology

Osamu Hanaizumi, Ph.D.	Division of Electronics and Informatics	Professor
Sumio Hosaka, Ph.D.	Division of Electronics and Informatics	Professor
Hiroshi Sakurai, Ph.D.	Division of Electronics and Informatics	Professor
Kou Yamada, Ph.D.	Division of Mechanical Science and Technology	Professor
Yoshiki Yamakoshi, Ph.D.	Division of Electronics and Informatics	Professor

### Partner Institutions

Hideyuki Sakurai, M.D., Ph.D.	Faculty of Medicine, University of Tsukuba	Professor
Takashi Kohno, M.D., Ph.D.	National Cancer Center Research Institute	Chief
Hiroshi Tsuji, M.D., Ph.D.	National Institute of Radiological Sciences	Program Leader
Tadayuki Takahashi, Ph.D.	Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency	Professor
Yasuhiko Kobayashi, Ph.D.	Japan Atomic Energy Agency	Senior Principal Researcher
Tomihiko Kamiya, Ph.D.	Takasaki Advanced Radiation Research Institute, Japan Atomic Energy Agency	Senior Principal Researcher
Yoshio Tamaki, M.D., Ph.D.	Faculty of Medicine, University of Tsukuba	Professor
Chihiro Tsukishima, Ph.D.	Power Systems Works, Mitsubishi Electric Corporation	General Manager
Michitaka Ono, Ph.D.	Nuclear Energy Systems & Services Division, Toshiba Corporation Power Systems Company	Senior Manager
Hiroshi Akiyama, Ph.D.	Hitachi, Ltd. /Power Systems Company	Senior Engineer
Jay S. Loeffler, M.D., Ph.D.	Massachusetts General Hospital, USA	Chief
Marco Durante, Ph.D.	Biophysics Field, GSI Helmholtz Centre for Heavy Ion Research, Germany	General Manager
Arnab Chakravarti, M.D., Ph.D.	The Ohio State University, USA	Chair and Professor
Koji Noda, Ph.D.	National Institute of Radiological Sciences	General Manager

# Radiation Oncology and Heavy Ion Medicine Outline



In addition to treating more than one thousand cancer patients a year with radiation therapy, the department of radiation oncology and Heavy Ion Medical Center also teach students of the Faculty of Medicine and Postgraduate School of Medicine and promote various research in basic, translational and clinical medicine. It also collaborates with domestic and overseas leading institutions such as Harvard University/Mass. General Hospital, Heidelberg University/GSI, Mayo clinic and the International Atomic Energy Agency (IAEA), contributing to promote and raise awareness of radiation therapy and heavy ion radiotherapy.

## Members

Title	Name	Department
Professor	Takashi Nakano, M.D., Ph.D.	Department of Radiation Oncology
Professor	Tatsuya Ohno, M.D., Ph.D.	Heavy Ion Medical Center
Associate Professor	Yoshiyuki Suzuki, M.D., Ph.D.	Department of Radiation Oncology
Associate Professor	Yoshinori Koyama, M.D., Ph.D.	Department of Radiation Oncology
Associate Professor	Jun-ichi Saitoh, M.D., Ph.D.	Department of Radiation Oncology
Associate Professor	Shin-ei Noda, M.D., Ph.D.	Department of Radiation Oncology
Assistant Professor	7 Ph.D.s	



## Clinical research

- 1) Research on the safety and effectiveness of carbon ion therapy (prostate cancer, liver cancer etc.)
- 2) Development of new brachytherapy for uterine cancer
- 3) Research on the reaction of normal cells and tissue after radiation therapy (bone density measurement etc.)

## Basic research

- 1) Research into the cancer related genes, proteins and signaling involved in radiosensitivity
- 2) Research on antitumor immunity induced by radiation therapy and hyperthermic potentiation
- 3) Research on the sensitizing effects of carbon ion beams
- 4) Development of new nuclear medicine diagnostic devices and methods

## Faculty of Medicine education

Students study radiobiology and radiation oncology through lectures and training to acquire the basic knowledge of radiology required of a physician.

## Graduate education

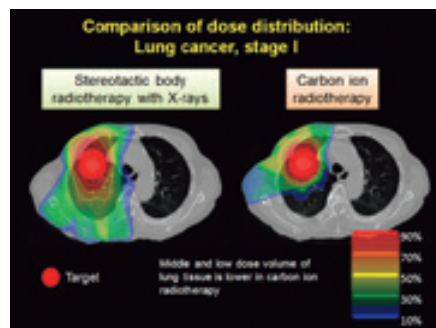
We offer education in a wide range of fields related to oncology, such as pathology and molecular biology with a focus on radiobiology and radiation oncology, fostering researchers and specialists in the field of radiation oncology. In particular, we pursue advanced research in heavy ion radiotherapy.

## Clinical practice work

- 1) Radiation therapy: We provide conventional radiation therapy to over 9 hundred malignant tumor patients a year (brain tumor, head and neck tumors, lung cancer, breast cancer, esophageal cancer, prostate cancer, uterine cancer, lymphoma etc.) . (A) External irradiation with three linear accelerators (3D conformal radiation therapy, Intensity-modulated radiation therapy, stereotactic radiotherapy), (B) Image-guided adaptive brachytherapy for gynecological and prostate cancers), (C) Treatment of thyroid disease using radioactive iodine, etc.
- 2) Heavy ion radiotherapy: Starting in March 2010, currently we provide treatment for head and neck tumors, lung cancer, liver cancer, prostate cancer, bone and soft tissue tumors, pancreas cancer, and uterine cervical cancer with more than 20 clinical protocols.
- 3) Hospital care: In addition to radiation therapy, we provide chemotherapy and palliative care.

## Social contribution

- 1) Cooperation with the International Atomic Energy Agency (IAEA) : We hold periodic workshops and from 2003, Dr. Nakano has served as an IAEA executive in the medical and health fields in the Asian region.
- 2) Forum for Nuclear Cooperation in Asia (FNCA) : We contribute the FNCA as a representative of Japan. In this activity, clinical trials and workshop have been carried out among Bangladesh, Indonesia, Japan, Kazakhstan, Korea, Malaysia, Mongolia, The Philippines, Thailand and Viet Nam etc. in order to establish standardized cancer treatment with radiotherapy in Asia.
- 3) As the executive office for the Austral-Asian Journal of Cancer, we contribute to the development of cancer research.
- 4) As the executive office for the Gunma Conference for Therapeutic Radiology & Oncology, we contribute to the development of regional radiation oncology and cancer research.



# Education and Research Support Center Division of Heavy Ion Therapeutics and Engineering

## Members

Title	Name	Department
Professor	Takashi Nakano, M.D., Ph.D.	Director, Division of Heavy Ion Therapeutics and Engineering, Education and Research Support Center
Assistant Professor	5 Ph.D.s	
Researcher	8 Ph.D.s	

## Medical Physics Outline

The Physics Group provides the medical physics services in the heavy ion and photon beam facilities, as a part of the treatment team. The service includes facility maintenance, treatment planning, quality assurance of the therapeutic devices, and others.. Specifically in the heavy ion radiation therapy, we are responsible for the overall operation and the maintenance of the treatment facilities to ensure the smooth and stable treatment delivery. We are responsible for the medical physics course, which is a part of the Master Course in Biomedical Sciences. This course aims to develop the medical physicists. In the Doctor Course, we accept doctoral students and develop research physicists for developing heavy ion radiation therapy devices, as well as the radiobiologists in cooperation with the Biology Group. We are actively working to meet the needs by doctors and therapists, pursuing research and development for the heavy ion radiation therapy and advanced X - ray therapy while undertaking operations and education.

### Members

Title	Name	Department
Professor	Tatsuaki Kanai, Ph.D.	Physics Division, Heavy Ion Medical Research Center
Special Duty Professor	Satoru Yamada, Ph.D.	Physics Division, Heavy Ion Medical Research Center
Visiting Professor	Kazuo Arakawa, Ph.D.	Physics Division, Heavy Ion Medical Research Center
Assistant Professor	11 Ph.D.s	



The technology for heavy ion radiotherapy contributes to the evolution and improvement of radiation therapy, but it is still a young field with much room for development. It is important to develop new irradiation methods using the characteristics of heavy ion beams and improving the accuracy of the irradiation to reduce the dose to the normal tissue around the tumor, which result directly in successful treatment. Many developments are required for the new irradiation methods: accelerator science for providing a stable beams; optimum methods for efficient and accurate patient positioning; optimum irradiation methods based on analysis of therapeutic effect, and so on. The range of endeavor is very broad, from accelerator science to image processing for dose measurement, calculation and

positioning, and analysis of therapeutic effect. Our current target is to improve the efficiency of the various treatment processes coping with a significant increase of patients without losing accuracy. This includes developing the treatment planning technique for creating optimal treatment plans and methods for omitting or facilitating the dose calibration and verification of the dose distribution that are currently performed for each patient. In addition, we are pursuing a variety of research and development including methods of accurately irradiating internal moving organs, technologies for accurately irradiating very small targets, and achieving new irradiation treatments using scanning devices. We also carry out research and development for efficient irradiation and accurate treatment with X - ray therapy. In the development of new irradiation methods, it is essential to confirm the biological effects, in collaboration with the Biology Group as the final step. Analysis of the results of treatment is also important, and we undertake joint research in close cooperation with various researchers such as the physicians and biologists. We are pursuing research to contribute to advances in heavy ion radiation therapy and X-ray radiation therapy for the benefit of society.



## Radiation Biology Outline

We conduct research from a radiobiological point of view, which forms the basis of heavy ion and photon beam radiotherapy for cancer. To understand the fundamental concepts of radiation therapy, it is important to study the findings of biology and physics in an integrated manner. The findings of the Biology Group concerning the radiation response mechanism of normal cells and cancer cells studied at the molecular, cell and tissue level are analyzed in combination with the findings of the Physics Group with the aim of verifying and optimizing radiation therapies. Our ultimate aim is to clarify the radiation response of hard-to-treat refractory cancers and the mechanism by which they acquire radiation resistance, and apply the findings to radiation therapy. The aim of our postgraduate education is to give students a taste of the profundity of radiation biology. At the same time, we seek to foster researchers who always consider how their research contributes to society. We welcome people from within and outside the university who want to pursue basic research into cancer and radiation, people who want to consolidate their knowledge towards playing an active role as a clinician, and people who are interested in biology and biophysics.

### Members

Title	Name	Department
Visiting Professor	Koichi Ando, D.D.S., Ph.D.	Medicine & Biology Division, Heavy Ion Medical Research Center
Visiting Professor	Yasuhiko Kobayashi, Ph.D.	Medicine & Biology Division, Heavy Ion Medical Research Center
Assistant Professor	1 Ph.D.	
Collaborative Department		
Associate Professor	Akihisa Takahashi, Ph.D.	Advanced Scientific Research Leaders Development Unit



### Verification and optimization of radiation therapy methods

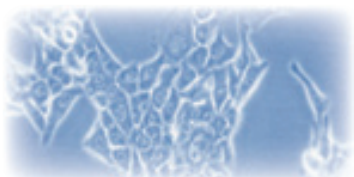
Radiation therapy uses an irradiation method called fractionated irradiation which reduces side effects by exploiting the difference in the radiation response of normal cells and cancer cells. The Biology Group uses heavy ion beams and X-rays to investigate the radiation response of cells and tissues with fractionated irradiation. Through analysis of the effects of fractionated irradiation, we aim to contribute to optimizing radiation therapy methods.

### Elucidation of the radiation response and molecular mechanism of refractory cancer

We aim to clarify the radiation response of intractable cancer cells and the mechanism by which they acquire radiation resistance, as well as the combined effects of radiation and medication and the relevant molecular mechanisms, and to apply the findings to radiation therapy.

### Elucidation of the interaction between normal cells and cancer cells

There are always normal cells surrounding cancer cells. We aim to clarify the interaction of both types of cell in response to radiation, to reduce the damage to normal cells, and improve the therapeutic effect against cancer cells.







## Activity Report 1



### Heavy Ion Science Symposium = At Dalian Medical University, China =

We held the Heavy Ion Beam Science Symposium for the purpose of recruiting students and explaining the outline of our doctoral course for the Program for Leading Graduate Schools.



- Date: January 10, 2012
- Venue: Lecture Hall at Dalian Medical University (Lushun Campus)
- Presenters:
 

Takashi Izumi	(Professor, Biochemistry, Dean of Graduate School of Medicine)
Tomoaki Shirao	(Professor, Neurobiology and Behavior)
Yasuki Ishizaki	(Professor, Molecular and Cellular Neurobiology)
Hirokazu Hirai	(Professor, Neurophysiology)
Satoru Yamada	(Special Duty Professor, Heavy Ion Medical Research Center)
Jun-ichi Saito	(Associate Professor, Radiation Oncology)
- Number of Student Participants: About 150  
(16 of them were interviewed individually.)



## Activity Report 2



### Heavy Ion Science Symposium = At Padjadjaran University, Indonesia =

We held the Heavy Ion Beam Science Symposium for the purpose of recruiting students and explaining the outline of our doctoral course for the Program for Leading Graduate Schools.



- Date: March 20, 2012
- Venue: Lecture Hall at Padjadjaran University
- Presenters:
 

Takashi Izumi	(Professor, Biochemistry, Dean of Graduate School of Medicine)
Tomoaki Shirao	(Professor, Neurobiology and Behavior)
Tatsuaki Kanai	(Professor, Heavy Ion Medical Research Center)
Tatsuya Ohno	(Professor, Heavy Ion Medical Center)
- Number of Student Participants: About 90



## Activity Report 3



### Public Symposium Held

Gunma University held the 2nd Symposium of the Gunma University Leading PhD Program at Tojo Hall on the Showa Campus on December 7, 2012.

In Part 1, Teiji Nishio from the National Cancer Center, Professor Yamakoshi from Gunma University Graduate School of Engineering, and Professor Kanai from Gunma University Heavy Ion Medical Center gave talks on “Development of Cutting-Edge Physical Engineering Technologies for Advanced Particle Therapy.” After lunch, as a special seminar, chief editor of Nature Climate Change, Rory Howlett, Ph.D, gave a lecture on how to write papers for Nature.

In Part 2, Yasushi Enokido, director of the Department of Pathology at the Institute for Developmental Research of Aichi Prefectural Colony, and others gave lectures on “Advances in Heavy-Ion Beam Biology and Radiation Biology of Brain Tissue.” In Part 3, Professor Hideyuki Sakurai, director of the Proton Medical Research Center at the University of Tsukuba, Shigeru Yamada, head of Treatment Team 2 in the Research Center for Charged Particle Therapy at the National Institute of Radiological Sciences, and Professor Ohno from Gunma University Heavy Ion Medical Center, gave lectures on “Current Status and Future Prospects of Proton and Heavy-Ion Beam Therapies.”

The final lecture was given by Koji Noda, director of the Department of Accelerator and Medical Physics at the National Institute of Radiological Sciences, and was a special lecture “Development of HIMAC and Next-Generation Irradiation Systems.” After 11 presenters’ lectures, this symposium was concluded with closing remarks from the program coordinator, Professor Nakano, director of Gunma University Heavy Ion Medical Center.

In this symposium, all lectures were conducted in English. Akiko Nakagawa, a first-year PhD student on the program was given the experience of acting as the overall facilitator for the proceedings. In addition, about 140 researchers and graduate school students from Gunma University and other institutions attended the lectures on the current status of heavy ion therapeutics and the latest advances in technology. The attendees entered a lively exchange of opinions during the question times that followed each lecture. After the lectures, many attendees gathered for a reception to mingle and expand their networks. The symposium ended on a high note and there are great expectations for the continuation of the program.



## Activity Report 4



### Nature Seminar Held

A special seminar on submitting to Nature was held in Tojo Hall on the Showa Campus of Gunma University on December 8th, 2012, the day after the 2nd Symposium of the Gunma University Leading PhD Program.

The seminar was held as part of a lecture in this program, “Cooperative Course on Heavy Ion Medical Engineering,” aiming to motivate not only graduate students but also young researchers competing in a global era.

The seminar began with an introduction and an opening address by the executive director of Nature Japan, Koichi Nakamura.

In the first half, Macmillan Science Communications publisher and editor-in-chief (Asia-Pacific) , Matthew Salter, Ph.D., delivered a talk on the activities of the Nature Publishing Group (NPG) and MacMillan Science Communications. He spoke about NPG’ s wide range of activities for contributing in many aspects of science, such as operating portal sites for separate topics, field-specific websites and blogs, and publishing about 50 magazines related to Nature.

In the second half, chief editor of Nature Climate Change, Rory Howlett, Ph.D., who has many years of experience in screening, gave a talk on the system used by the Nature editing department, including primary screening, peer review, acceptance, rejection, editing and publication, the thinking of the editorial staff, and what those working on the front line have to say.

Some participants took advantage of this valuable opportunity and actively posed questions directly to the Nature presenter about the rare lecture content and their queries about conditions for accepting submissions. In spite of an early morning start at 9.00 a.m. on a Saturday, about 80 students and young researchers attended the event. The attendees became better acquainted with Nature, and the session was so successful that it had to be extended.

Please Visit Nature URL <http://nature.asia/gunma-spotlight>



# Activity Report 5

## Public Seminars Held

### Academic Year 2012 Gunma University Activity

Content of Implementation	Date	Title	Lecturer	Participants
Joint Lecture Meeting Research Guidance	Oct 19	Carbon ion radiotherapy as a more intensive and less toxic cancer	Dr Hirohiko Tsujii (NIRS Fellow / Visiting Professor, Gunma University)	27
	Oct 20	Technical guideline of Carbon ion radiotherapy 2012		—
Heavy Ion Radiotherapy Seminar	Dec 4	Current status of ETOIRE project of carbon ion beam radiotherapy	Dr Jacques BALOSSO,MD,PhD (Directeur du Centre ETOILE)	—
Heavy Ion Physics Seminar 	Jan 17	An ion source and injector linac for a heavy ion radiotherapy	Dr Satoru Yamada (Special Duty Professor, Heavy Ion Medical Research Center, Gunma University)	45
		Design of an irradiation system using broad beam	Dr Yoshihisa Takada (Professor, Applied Physics, University of Tsukuba)	
		Treatment Planning for a broad beam irradiation system	Dr Nobuyuki Kanematsu (Head of Section of Treatment Planning System, Research Center for Charged Particle Therapy, NIRS)	
	Jan 18	Dosimetry for a heavy ion beam therapy	Dr Makoto Sakama (Assistant Professor, Department of Electrical and Electronic Engineering, College of Industrial Technology, Nihon University)	47
		Synchrotron acceleration for a heavy ion therapy	Dr Toshiyuki Shirai (Program leader, Research Center for Charged Particle Therapy, NIRS)	
		Treatment planning and optimization algorithm for a heavy ion scanning therapy	Dr Taku Inaniwa (Team leader, Research Center for Charged Particle Therapy, NIRS)	
	Jan 19	Definition of clinical dose and measurements of radiation quality	Dr Tatsuaki Kanai (Professor, Heavy Ion Medical Research Center, Gunma University)	38
		Biological model for a heavy ion radiotherapy	Dr Naruhiro Matsufuji (Team leader, Research Center for Charged Particle Therapy, NIRS)	
		Dosimetry at outer fields of an irradiation system in a heavy ion radiotherapy	Dr Shunsuke Yonai (Researcher, Research Center for Charged Particle Therapy, NIRS)	
Case Conference	Jan 31	Carbon ion radiotherapy for HCC: review of imaging and pathology.		—
Joint Lecture Meeting	Feb 7	Heavy ions in medicine and space exploration	Dr Marco Durante (GSI Helmholtz Centre for Heavy Ion Research / Visiting Professor, Gunma University)	21
Medical Engineering Seminar	Mar 1	Development of Next Generation Tumor Tracking Technology	Dr Masayori Ishikawa (Professor, Applied Molecular-Imaging Physics, Graduate School of Medicine, Hokkaido University)	18
Lecture Meeting Research Guidance	Mar 8	Carbon ion radiotherapy for pancreas cancer	Dr Makoto Shinoto (Assistant Professor, Center for Advanced Medical Innovation, Kyushu University)	16
		Research guidance for carbon ion radiotherapy		—
Lecture Meeting Research Guidance	Mar 29	Developments in Support Systems for Advanced Radiation Therapy	Hidetaka Arimura (Associate Professor, Department of Health Sciences, Medical Quantum Sciences, Kyushu University)	10
	Mar 28 · 29	Informatics and Image Processing		—

### Academic Year 2013 Gunma University Activity

Content of Implementation	Date	Title	Lecturer	Participants
1st Medical Engineering Seminar	Apr 26	Development of dose calculation system by Monte Carlo method on treatment planning system	Dr Yoshikazu Maeda (Medical Physicist, Fukui Prefectural Hospital Proton Therapy Center)	23
2nd Heavy Ion Medical Engineering Seminar	May 31	Optimal design of bolus for particle therapy	Dr Yoshihisa Takada (Professor, Division of Applied Physics, Faculty of Pure and Applied Sciences, University of Tsukuba)	19
3rd Heavy Ion Medical Engineering Seminar	Jun 24	Dosimetry for Hadron-therapy beams: the development of different type of calorimeters for primary dosimetry	Prof. Stefaan Vynckier,Ph.D. (Head Medical Physics,Cliniques univ.)	18
4th Heavy Ion Medical Engineering Seminar	Jul 26	Initial Experience of Carbon Ion Radiotherapy for Breast Cancer	Dr Kumiko Karasawa (Head of 3rd therapy Group Research Center Hospital for Charged Particle Therapy, NIRS)	30
5th Heavy Ion Medical Engineering Seminar	Aug 30	Medical applications of electron-tracking Compton camera and study of expansion technique of radiation field in vero4DRT	Dr Shigeto Kabuki (Special Duty Associate Professor, Radiation Oncology, Tokai University)	28
6th Heavy Ion Medical Engineering Seminar	Sep 13	Development if an accelerator-based nertron source for BNCT	Dr Makoto Sakai (Assistant Professor, Education and Research Support Center, Gunma University)	16
7th Heavy Ion Medical Engineering Seminar	Scheduled to Be Held on Month-End Friday			

# VOICE



A leader in the research and development by spreading the sight of heavy ion radiotherapy field

## Shinya Tajiri

Major - Heavy Ion Beam Medical Physics and Biology

This program can conduct study using the environment that can apply ideas that have been studied and developed using a heavy ion beam therapy system in the university to a real system.

In addition, it is possible to deepen and widen not only physical engineering of heavy ion beams but also medical sciences, by lectures, public symposium and special education lecture.

In the research and development, I would like to develop a tool to confirm whether detailed dose distribution of treatment planning for each patient is in the allowable range.

Furthermore, I would like to contribute to expanding the application of layer-stacking irradiation for respiratory moving organs.

In the future, I would like to contribute to the development of heavy ion beam therapy system and lead the world in this field.



# Realize the Future with Heavy-ion Therapy!

# VOICE



## Daisuke Irie

Major - Radiation Oncology

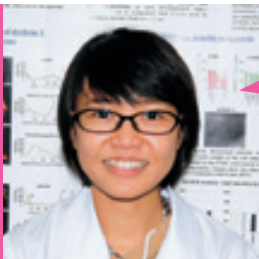


Japan leads the world in heavy-ion accelerators for medical treatment. Currently many facilities are being planned and constructed around the world. Heavy-ion therapy is a new field that needs not only doctors and researchers, but also scientists, physicists, engineers, technicians and more.

In my case, after working with heavy-ion therapy and seeing many successful cures, I decided to join the Program for Leading Graduate School so that I could contribute to the global promotion of heavy-ion therapy.

A few years ago I had an opportunity to assist at an IAEA heavy-ion therapy workshop. At that time, a professor from the Dept. of Radiation Oncology at Harvard Medical School listened to one of my presentations. He was impressed by my presentation and offered me a good advice for my future research. I was very happy to hear his comments.. Why don't you join us and bring the future to your world, to your country, to your life!

# VOICE



Learn the Latest Radiotherapy to be the World's leading expert

## Anggraeini Puspitasari

Major - Neurobiology and Behavior

The Global Leading Program welcomes students from all over the world. English and Japanese are used in this program during lectures and research activities. As a foreign student, I found this Program very interesting, challenging and promising. The academic atmosphere stimulates students to do interesting research, and the comprehensive discussion is possible with a variety of educational background of students.

### L-PhD Students in 2013

Year	Major	Name	Year	Major	Name
1	Radiation Oncology	Takanori Abe	2	Neurobiology and Behavior	Anggraeini Puspitasari
1	Radiation Oncology	Yosuke Takakusagi	2	Radiation Oncology	Daisuke Irie
1	Radiation Oncology	Napapat Amornwichee	2	Radiation Oncology	Akiko Nakagawa
1	Radiation Oncology	Navchaa Gombodroj	2	Radiation Oncology	Hongyu Ma
1	Heavy Ion Beam Medical Physics and Biology	Kyoko Sakama	2	Heavy Ion Beam Medical Physics and Biology	Shinji Tajiri
1	Heavy Ion Beam Medical Physics and Biology	Ayaka Shinohara	2	Heavy Ion Beam Medical Physics and Biology	Tetsuya Fujimoto

# Student Support etc.



**Since I am not yet working, I worry about financial difficulty.**



## Answer

Although there are conditions such as not receiving any regular income, there is a stipend for students to support their livelihood. Conditions and screening apply.

(100,000-200,000 yen/month) FY 2013: 150,000 yen/month



**How can I cover my research expenses?**



## Answer

If you do not receive funding from other institutes, the L-PhD research funding for original research activity for graduate students is available. Conditions and screening apply.

(Maximum 1,000,000 yen/year)  
FY 2013: 1,000,000-700,000 yen /year



**What does the course offer for my future career plans?**



## Answer

The course curriculum includes short-term training and internships in Japan and abroad.



**How do I enroll in the Program?**



## Answer

Enrollment is available for spring or fall semesters. For details, please check the following URL for admission procedures:

<http://www.med.gunma-u.ac.jp/admissions/grad/ikagaku/bosyu.htm>





## GUNMA UNIVERSITY

Program for Cultivating Global Leaders in Heavy Ion Therapeutics and Engineering



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