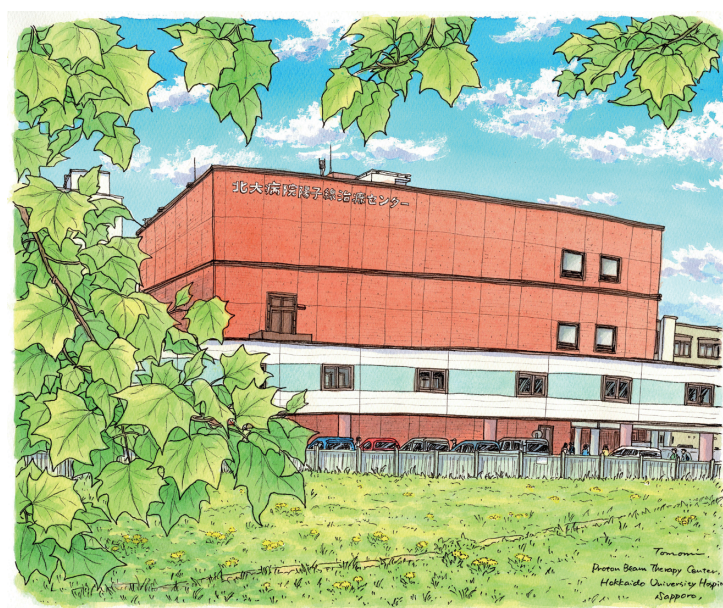


Global Station for Quantum Medical Science and Engineering
Global Institution for Collaborative Research and Education(GI-CoRE)
Hokkaido University

Final Evaluation Report



北海道大学 国際連携研究教育局
量子医理工学グローバルステーション

外部評価報告書

July 2020
2020年7月

**Final Evaluation Report
(brief version in Japanese)**

外部評価報告書（日本語・概要版）

もくじ（日本語版）

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はじめに

国際連携研究教育局（GI-CoRE）は、北海道大学の強みや特色を活かした国際連携研究教育の推進と、部局が独自に進める国際連携研究教育の支援を目的とし、世界トップレベルの教員を国内外及び学内から結集した総長直轄の教員組織です。

GI-CoRE 内には研究領域ごとの活動拠点である「グローバルステーション（GS）」を置き、各 GS において、原則 5 年間の設置期間内に重点的に研究教育活動を進めています。これまでに、延べ 7 つの GS（下記※を参照）を設置し、研究活動を推進するとともに、最先端の研究成果を大学院教育などに還元してきました。

GI-CoRE では、GS の設置期間満了を迎える年度に、各 GS でのこれまでの活動を振り返るとともに、今後、より強固かつ持続可能な研究教育体制を確立していくため、国内外の有識者により構成される外部評価委員会において、評価を実施することとしています。

この外部評価報告書は、2018 年 8 月に実施した量子医理工学 GS の自己点検成果報告書及び外部評価結果を一冊に収録した、いわば GS の研究教育活動の集大成です。

なお、設置期間を満了した量子医理工学 GS は、関連部局等に定着化し、2020 年 4 月以降も「GI-CoRE 協力拠点」として、GI-CoRE と連携しながら研究教育活動を継続しています。

本学では、外部評価結果を踏まえ、より充実した研究教育活動を実践していくことにより、世界の課題解決に貢献していきたいと考えております。

北海道大学 国際連携研究教育局
局長代行（総長代行）
笠 原 正 典

※これまでに設置したグローバルステーション（GS）

GS 名	設置期間 (年度)	主な学内連携部局等
量子医理工学	2014～2019	医学研究院、大学病院ほか
人獣共通感染症	2014～2019	人獣共通感染症リサーチセンター、 獣医学研究院
食水土資源	2015～2019	農学研究院ほか
ソフトマター	2016～2020	先端生命科学研究院ほか
ビッグデータ・サイバーセキュリティ	2016～2020	情報科学研究院ほか
北極域研究	2016～2020	北極域研究センターほか
バイオサーフィス創薬	2019～2023	薬学研究院ほか

国際連携研究教育局(GI-CoRE)
量子医理工学グローバルステーション
外部評価委員

*大阪大学 小川 和彦 教授

ペンシルベニア大学 コンスタンティノス・コーメニス 教授

北京大学第一医院 シンスウ・グァオ 教授

*委員長

国際連携研究教育局(GI-CoRE) 量子医理工学グローバルステーション 外部評価委員会実地調査要領

1. 調査日程

平成 30（2018）年 8 月 8 日（水）

2. 詳細スケジュール

時刻	次第
15:00～	名和 GI-CoRE 局長挨拶・趣旨説明
15:10～	関係教員ヒアリング①（全体像説明） 白土博樹 GS 長からの概要説明 Quynh-Thu Le 招へい教員からの補足説明
15:35～	関係教員ヒアリング②（臨床科学部門） 清水伸一教授・Khin Khin Tha 特任講師からの概要説明 Daniel Chang 招へい教員からの補足説明
15:55～	関係教員ヒアリング③（医学物理部門） 梅垣菊男教授・松浦妙子准教授・宮本直樹准教授からの概要説明 Lei Xing 招へい教員からの補足説明
16:15～	関係教員ヒアリング④（放射線生物部門） Jin-Min Nam 講師からの概要説明 Amato Giaccia 招へい教員からの補足説明
16:35～	全体に係る質疑応答
17:00～	評価委員の打合せ
17:30～	講評（～17:50 閉会）

国際連携研究教育局(GI-CoRE) 量子医理工学グローバルステーション 外部評価調書の概要（参考和訳）

総合評価：S

（評価コメント）

量子医理工学グローバルステーション（GSQ）は、世界のさまざまな課題解決、教育・研究機関の管理体制や構造の改革と再編、及び大学の資源を再配分することに貢献し得る人材育成をするための、魅力的なグローバル研究拠点の創設を目標としている。

研究面において北海道大学では、総長直轄の GI-CoRE という研究教員組織を設置し、北大の研究チームと共同研究を行う世界トップレベルの研究チームを誘致し、革新的な国際連携研究・教育を行っている。また、GSQ の所属教員は継続的に数多くの共同論文を発表しており、それは極めて素晴らしい功績となっている。GSQ は放射線治療の最先端分野において、中心的な役割を担い、技術革新の創造の可能性を広げている。さらに、AI、radiomics（放射線医学 Radiology と -omics 多量の情報を統計的に扱う科学とが合成された言葉）、ゲノミクス（genomics）においても新たな研究を始めており、この研究結果は、いずれ放射線治療を通じて社会的問題の解決につながることを期待される。

教育面においては、GSQ の研究結果に基づき、しっかりと整った枠組みが出来上がっている。2017 年 4 月には医理工学院を開設し、海外から参加者を誘致の上、医学物理学に関する夏季セミナー（医学物理サマースクール）を開催しており、2018 年からはセミナーの内容が放射線生物学にまで及んでいる。この大学院では理学院、保健科学研究所、工学研究所、医学研究所、歯学研究所等の教員たちが、量子科学と工学、分子科学と工学の医学の分野に有用な知識を持ったスペシャリストたちの専門教育の場に参加している。

GSQ の設置は、国際的なコラボレーションの模範的なプログラムであると言える。北大とスタンフォード大学の非常に優れた臨床教授や科学者たちが中心となり、アメリカ合衆国の UCSF（カリフォルニア州立大学サンフランシスコ校）や、京都大学、大阪大学からの研究者たちも加わっている。それぞれの機関における強みを際立たせるような研究と教育成果に重きを置きつつ、指揮しており、それにより綿密で極めて効果的な共同研究が行われている。

要約をすると、GSQ は国際連携研究・教育を行う体系と枠組みの創設を成し遂げ、プロジェクト開始後、称賛に価する著しい進歩を遂げている。我々は北大が今後も研究、教育、そして現行の運営体制を維持し、GSQ プロジェクトをさらに推し進めて行くことを推奨する。

Final Evaluation Report (original version in English)

外部評価報告書（英語・オリジナル版）

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Foreword

Hokkaido University established the Global Institution for Collaborative Research and Education (GI-CoRE) as a faculty organization under the direct control of the President that brings together world-class researchers from around the world and within the University. It aims to promote international collaborative research and education that leverages the University's strengths and distinctive features as well as to provide support for international collaborative research and education promoted by faculties and centers, respectively.

Under the GI-CoRE system, a research and education hub known as a Global Station (GS) is implemented for each research field. GSs have a finite implementation period of five (5) years in principle to conduct intensive research and education activities. Thus far, seven (7) GSs in total (see * below) have been implemented to further develop research activities and contribute the resulting cutting-edge research outcomes to graduate school education.

In the final year of the GI-CoRE project period, a Final Evaluation is conducted by the External Evaluation Committee composed of global experts outside Hokkaido University for each GS to not only review GS activities from past years but also build a stronger and more sustainable research and education system in the future.

This Final Evaluation Report contains the Research Progress Report of GS for Quantum Medical Science and Engineering (GSQ) conducted in August 2018 and the evaluation results. This report is a compilation of the research and education activities of GSQ.

After the implementation period, GS projects are transitioned into affiliated faculties and centers, then certified as "GI-CoRE Cooperating Hubs" to continue research and education activities in cooperation with GI-CoRE after April 2020.

Hokkaido University remains committed to continuing its efforts to contribute to resolving global issues by conducting advanced research and education activities based on evaluation results.

Professor Masanori Kasahara, M.D., Ph. D.
Interim Director
Global Institution for Collaborative Research and Education (GI-CoRE)
Hokkaido University
(Interim President, Hokkaido University)

*The Global Stations (GSs) implemented thus far.

Name of the GS	Implementation Period (FY)	Main Internal Affiliation
Quantum Medical Science and Engineering	2014–2019	Faculty of Medicine, University Hospital, and others
Zoonosis Control	2014–2019	Research Center for Zoonosis Control and Faculty of Veterinary Medicine
Food, Land and Water Resources	2015–2019	Research Faculty of Agriculture and others
Soft Matter	2016–2020	Faculty of Advanced Life Science and others
Big Data and Cybersecurity	2016–2020	Faculty of Information Science and Technology and others
Arctic Research	2016–2020	Arctic Research Center and others
Biosurfaces and Drug Discovery	2019–2023	Faculty of Pharmaceutical Sciences and others

Global Station for Quantum Medical Science and Engineering
Global Institution for Collaborative Research and Education (GI-CoRE)
External Evaluation Committee

*Professor Kazuhiko Ogawa,
Osaka University (Japan)

Professor Constantinos Koumenis,
University of Pennsylvania (United States)


Professor Xian-shu Gao,
Peking University First Hospital (China)

*Chair

委員長就任承諾書

平成30年3月19日

国立大学法人北海道大学国際連携研究教育局長 名 和 豊 春 殿

氏名 小川 和彦 

私は、北海道大学国際連携研究教育局（GI・CoRE）量子医理工学グローバルステーションに係る外部評価委員会に委員長として就任することを承諾します。

以上

Letter of Acceptance

03/19/2018

To Director Toyoharu Nawa of Global Institution for Collaborative Research and Education (GI-CoRE) at National Corporation Hokkaido University,

I hereby accept my appointment to serve as a member of the External Evaluation Committee for Global Station for Quantum Medical Science and Engineering at Global Institution for Collaborative Research and Education (GI-CoRE), Hokkaido University.

Signature



Constantinos Koumenis, PhD

Richard H. Chamberlain Professor

University of Pennsylvania

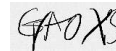
Letter of Acceptance

19/03/2018

To Director Toyoharu Nawa of Global Institution for Collaborative Research and Education (GI-CoRE) at National Corporation Hokkaido University,

I hereby accept my appointment to serve as a member of the External Evaluation Committee for Global Station for Quantum Medical Science and Engineering at Global Institution for Collaborative Research and Education (GI-CoRE), Hokkaido University.

Signature

A handwritten signature in black ink, appearing to read 'GAOX', is placed over a horizontal line that serves as a signature line.

Global Station for Quantum Medical Science and Engineering Global Institution for Collaborative Research and Education(GI-CoRE) Schedule of the External Evaluation Committee

1. Date of Implementation

Wednesday, August 8, 2019

2. On-site Investigation Schedule

Time	Contents
3:00pm	Opening Remarks and Briefing by GI-CoRE Director Toyoharu Nawa
3:10pm	Interview Session #1 (Overview) Professor Hiroki Shirato Professor Quynh-Thu Le
3:35pm	Interview Session #2 (Clinical Science Section) Professor Shin-ichi Shimizu, Lecturer. Khin Khin Tha Professor Daniel Chang
3:55pm	Interview Session #3 (Medical Physics Section) Professor Kikuo Umegaki, Associate Professor Taeko Matsuura, Associate Professor Naoki Miyamoto Professor Lei Xing
4:15pm	Interview Session #4 (Radiation Biology Section) Senior Assistant Professor Jin-Min Nam Professor Amato Giaccia
4:35pm	Q&A Session
5:00pm	Discussion among committee members
5:30pm	Review from the committee to the faculty members (- 5:50pm End of schedule)

Results of the Evaluation Committee

Evaluation Committee

Global Station for Quantum Medical Science and Engineering

Global Institution for Collaborative Research and Education (GI-CoRE)

Hokkaido University

October 2018

Summary Report

Professor Kazuhiko Ogawa, Osaka University (Japan)

Professor Constantinos Koumenis, University of Pennsylvania (United States)

Professor Xian-shu Gao, Peking University First Hospital (China)

Comprehensive Evaluation ☒ A / B / C / D (circle one)

The objectives of this program are to establish an attractive global research hub that is designed to nurture human resources who can contribute to address various issues in the world, and to reform and reorganize the governance and framework of the educational research organization, and also to assist in the reallocation of the resources of the university.

Regarding researches, HU has established the GI-CoRE as an educational research institution under the direct authority of the university president, where innovative international research is conducted through the collaboration effort between world leading educational research teams invited from overseas research institutions working together with research groups of HU. Also, GI-CoRE members have continuously published an impressive number of manuscripts together, in the areas of proton therapy, physics of target verification and organ motion compensation, that are extremely excellent point for GI-CoRE. GI-CoRE has played the active roles in the reforms and enables the creations of innovative technologies regarding radiotherapy. Moreover, GI-CoRE has started new studies regarding AI, radiomics and genomics. Some of research results from GI-CoRE results are expected to effectively solve social issues regarding radiotherapy treatments.

Regarding education, the educational framework has been fully prepared based on the research results from GI-CoRE project. Furthermore, HU has started a “Graduate School of Biomedical Science and Engineering” from April, 2017. GI-CoRE has also hold summer seminars regarding medical physics for participants from several countries, and the contents of these seminars have been extended to radiation biology from 2018. In this graduate school, teaching staff of the Faculty of Science, the Faculty of Health Sciences, the Faculty of Engineering, the Graduate School of Medicine, and the Graduate School of Dental Medicine participate in the education of specialists who will be able to contribute their knowledge of quantum science and engineering as well as molecular science and engineering to medicine.

Regarding establishment of framework, GI-CoRE has been established as an exemplary program for international collaboration. It is headed by exceptional clinician-scientists from both HU and SU and collaborations have been initiated with additional institutions, such as UCSF in the US, and Kyoto and Osaka University in Japan. The leadership has wisely chosen to focus research and educational efforts which represent strengths at each institution, thereby creating rigorous and highly effective research collaborations.

In summary, GI-CoRE project has successfully established the system and framework necessary to conduct international cooperative research and education, and the impressive and significant progress has

been made since the start of the project. We recommend that HU should proceed with the GI-CoRE project with continuous researches, educations and the current managements.

Global Station for Quantum Medical Science and Engineering Global Institution for Collaborative Research and Education (GI-CoRE) Final Evaluation

External Evaluation Committee Member Name: Kazuhiko Ogawa

Choose one of the five Evaluation Ratings options below as explained by the Evaluation Explanation for each Evaluation Item on the form.

Evaluation Ratings	Evaluation Explanation
S	Achieved outcomes surpassed the original plan (Outstanding)
A	Good progress has been maintained and expected outcomes have been achieved (Excellent)
B	Most expected outcomes have been achieved with some slight delays (Good)
C	Although certain outcomes were achieved, overall results were insufficient (Satisfactory)
D	No expected outcomes were achieved (Unsatisfactory)

I. Research

1. Has construction of an international research and education center capable of attracting outstanding researchers from around the world (including from HU) been achieved?

Evaluation Results and Reasons

(Your Evaluation Results)

☒ S / A / B / C / D (circle one)

(Reasons)

An international research and education center that gathers outstanding researchers from the inside and outside of Hokkaido University (HU) has been well constructed till now. World-leading researchers of Stanford University (SU) have been invited to HU to build a Stanford unit in the GSQ as a counterpart of the HU unit and started collaborative studies in the field of radiation biology, radiation oncology and medical physics. Also, international symposia and summer schools on a regular basis have been held to promote further collaboration and the sharing of important scientific insights. Regarding symposia, several areas of world-wide active researchers have been invited, and they have contributed to give “knowledge of showers” to the attending researchers and students. They also have contributed to take the chances of further collaboration studies of different areas to the attending researchers. Regarding inside persons, a total of 14 persons by HU including 1 person of head of the unit, 7 persons of clinical science section, 5 persons of medical physics section and 5 person of radiation biology section has been organized. Regarding outside persons, a total of 18 persons by SU including 1 person of head of the unit, 4

persons of clinical science section, 8 persons of medical physics section and 5 persons of radiation biology section has been organized. The number of these researchers have increased as compared to that of 2 years before. Also, faculty members of other facilities, such as University of California, Groningen University, National Institute of Radiological Science, Kyoto University, Osaka University and Tohoku University have contributed as lectures in the Summer school for Medical Physics and Radiation Biology, and also the in the GI-CoRE symposium in Sapporo. Regarding education, HU has opened a “Graduate School of Biomedical Science and Engineering” in April 2017 based on the research outcomes at the GSQ. This new graduate school will contribute to the participation in the education of specialists who will be able to contribute their knowledge of quantum science and engineering as well as molecular science and engineering to medicine. The new graduate school will help the students to attain a basic knowledge of medical fields, and enable the graduate specialists to be equipped with the highest ethical and humanitarian qualities.

Specific points

(Outstanding points)

GI-CoRE has already established the collaboration system between HU and SU, a world-leading international academic facility. Furthermore, new graduate school has opened in April 2017, that will help the students to attain a basic knowledge of medical fields, and enable the graduate specialists to be equipped with the highest ethical and humanitarian qualities.

(Suggestions for improvement)

None.

2. Is world-leading cutting-edge international cooperative research underway?

Evaluation Results and Reasons

(Your Evaluation Results)

☒ S / A / B / C / D (circle one)

(Reasons)

GI-CoRE has conducted the cutting-edge international cooperative researches from 2014. HU has heled to use their resources to start international collaborative clinical trials in radiation oncology. International clinical trials have been conducted to test the role of stereotactic ablative radiotherapy in improving the survival rates of the patients with lung or live cancer, while measuring cDNA in the blood test that can serve as a potential surrogate marker for treatment success of failure. Regarding medical physics, researches have been conducted to visualize 2D gold concentration distributions in objects by observing the amount of fluorescence X-rays when proton beams collided with gold at HU. Also, the medical physics team has conducted the studies developing technologies to determine proton ranges in real-time by observing ultrasonic waveforms emitted from the irradiated target during treatment. Also, data-driven models using normal tissue complication probability (NTCP) have been studied. In parallel with the rapid progress of machine learning and artificial intelligence (AI), the radiomics group will be

separated from the Clinical Science Section and be set up as a new unit for AI. Regarding radiation biology, the molecular mechanisms of radiation effects to improve the efficacy of radiation treatment on cancer cells have been studied by SU. Also, molecular mechanisms of cancer cell invasion and metastasis have been investigated by HU. In addition, molecular imaging regarding hypoxia has been studied along with the clinical studies.

Specific points

(Outstanding points)

Many studies conducted by GI-CoRE have been innovative and cutting-edge. Also, many research results have been already published, and many presentations have been conducted till now. There are already 77 publications, 51 verbal presentations and 4 awards received from the beginning of GI-CoRE at 2016. At 2018, There are 215 publications, 204 verbal presentations and 11 awards received. There are increasing numbers of research results. That is an extremely excellent point for GI-CoRE. These study groups have commenced to study new themes including AI and genomics.

(Suggestions for improvement)

None

3. Are research outcomes from GI-CoRE being actively utilized to solve social issues?

Evaluation Results and Reasons

(Your Evaluation Results)

☒ S / A / B / C / D (circle one)

(Reasons)

Radiotherapy is one of the most cost-effective curative treatments for cancer, and has the potential to maintain excellent function and form in patients during and after the treatment. Therefore, there are increasing demands for precise radiotherapy technology, cutting-edge knowledge of radiation biology, imaging technology, and well-organized clinical trials to improve the outcome of cancer treatment using radiotherapy. GI-CoRE has already played the active roles in the reforms and enables the creations of innovative technologies regarding radiotherapy. Some of research results from GI-CoRE results are expected to solve social issues regarding radiotherapy treatments.

Specific points

(Outstanding points)

The studies conducted by the GI-CoRE have important aspects regarding cancer, and these studies will contribute the success of radiotherapy treatment effectively, thereby satisfying the demands of social issues.

(Suggestions for improvement)

None.

II. Education
Is the educational system and curriculum designed to help develop researchers who possess specialized knowledge and are capable of working internationally?
<p>Evaluation Results and Reasons</p> <p>(Your Evaluation Results)</p> <p><input checked="" type="radio"/> S / A / B / C / D (circle one)</p> <p>(Reasons)</p> <p>The educational framework has been fully prepared based on the research results from GI-CoRE project. Furthermore, HU has opened a “Graduate School of Biomedical Science and Engineering” in April, 2017. In this graduate school, teaching staff of the Faculty of Science, the Faculty of Health Sciences, the Faculty of Engineering, the Graduate School of Medicine, and the Graduate School of Dental Medicine will participate in the education of specialists who will be able to contribute their knowledge of quantum science and engineering as well as molecular science and engineering to medicine. GI-CoRE also have held a summer seminar for participants from several countries, such as USA, UK, Nigeria, Columbia and Japan for each year. The contents of the seminar included medical physics till 2017, and have extended to radiation biology in addition to medical physics from 2018. Moreover, practical trainings regarding the part of the lectures has been added if possible. These seminars have received positive feedback in general regarding the contents and the quality of lectures.</p> <p>Specific points</p> <p>(Outstanding points)</p> <p>GI-CoRE aims to conduct studies to develop medical equipment to meet the needs of business and industry while promoting research related to medical physics and radiation biology for academia in our mission to meet the variety of needs of society.</p> <p>(Suggestions for improvement)</p> <p>None.</p>

III. Establishment of Framework
Are the necessary systems and frameworks being established in order to conduct international cooperative research and education?
<p>Evaluation Results and Reasons</p> <p>(Your Evaluation Results)</p> <p><input checked="" type="radio"/> S / A / B / C / D (circle one)</p>

(Reasons)

GI-CoRE has already established an attractive global research hub that is designed to nurture human resources who can contribute to address various issues in the world. For example, HU has prepared a highly equipped wet laboratory of 200m² for radiation biology. Also, HU has prepared a dry office of 150 m² for the medical physics section and an administration office in the proton beam therapy center. These establishments of frameworks have been sufficiently supported by the budgets for GSQ and GI-CoRE.

Specific points

(Outstanding points)

Hokkaido University has set up a GI-CoRE-specialized administrative section in the Office of International Affairs, distributed staff members with study/work abroad experiences to the section, and established bilingual (English) administrative support system. Also, bilingual staffs have been stationed in each global station office to support daily research activities conducted there.

(Suggestions for improvement)

None.

IV. Overall Evaluation

The objectives of this program are to establish an attractive global research hub that is designed to nurture human resources who can contribute to address various issues in the world, and to reform and reorganize the governance and framework of the educational research organization, and also to assist in the reallocation of the resources of the university. At present, HU has established the GI-CoRE as an educational research institution under the direct authority of the university president, where innovative international research is conducted through the collaboration effort between world leading educational research teams invited from overseas research institutions working together with research groups of HU. Regarding Global Stations for Quantum Medical Science and Engineering, the management of this section is going well at present. I think that GI-CoRE project has established the system and framework necessary to conduct international cooperative research and education. Moreover, these conditions have more progresses as compared to those 2 years before. Recently, new issues regarding AI, radiomics and genomics have emerged to effectively solve the social problems, but yet to be done. Therefore, I recommend that HU should proceed with the GI-CoRE project with continuous researches, educations and the current managements.

Global Station for Quantum Medical Science and Engineering Global Institution for Collaborative Research and Education (GI-CoRE) Final Evaluation

External Evaluation Committee Member Name: Constantinos Koumenis

Choose one of the five Evaluation Ratings options below as explained by the Evaluation Explanation for each Evaluation Item on the form.

Evaluation Ratings	Evaluation Explanation
S	Achieved outcomes surpassed the original plan (Outstanding)
A	Good progress has been maintained and expected outcomes have been achieved (Excellent)
B	Most expected outcomes have been achieved with some slight delays (Good)
C	Although certain outcomes were achieved, overall results were insufficient (Satisfactory)
D	No expected outcomes were achieved (Unsatisfactory)

I. Research

1. Has construction of an international research and education center capable of attracting outstanding researchers from around the world (including from HU) been achieved?

Evaluation Results and Reasons

(Your Evaluation Results)

(S) / A / B / C / D (circle one)

(Reasons)

Since the last review period (2016), the GI-CORE has been firmly established as a premier international research and education center. The level of international cooperation in performing transformational translational science is clearly evident by the prominent scientists collaborating in clinical, physics and biology projects.

Specific points

(Outstanding points)

- The center has initiated two state-of-the-art clinical trials in Stereotactic Ablative Radiotherapy (SABR) in which (a) SABR is directly compared to the standard of care in hepatocellular carcinoma, and (b) circulating tumor DNA (ctDNA) is used as a surrogate marker of response to SABR in lung carcinoma. This represents a significant development in the mission of the center, as it leverages expertise at both institutions and has trained clinical research coordinators in Japan to perform the trial in coordination with the Stanford PIs.
- Implementation of outstanding expertise in medical physics and imaging and SU and machine learning/bioinformatics at HU to develop a highly competitive radiomics program
- Incorporation of world-class science in circulating tumor DNA (ct DNA) in developing predictive models of response to radiotherapy
- Establishment of a new, state-of-the-art Radiation Biology Laboratory at the GI-CORE in Hokkaido, and recruitment of talented faculty into the program
- Since the recent establishment of the Graduate School of Biomedical Science and Engineering students have begun to matriculate in the GI-CORE program
- Highly successful Summer Program in Radiation Oncology, attracting young talented students from all over the world.

(Suggestions for improvement)

None noted

2. Is world-leading cutting-edge international cooperative research underway?

Evaluation Results and Reasons

(Your Evaluation Results)

(S) / A / B / C / D (circle one)

(Reasons)

Indeed, as mentioned above, highly innovative, translational science is being performed in all three areas of Radiation Oncology (Clinical, Physics and Biology).

Specific points

(Outstanding points)

There have been notable improvements in the performance of innovative and in some case, transformative science. For example:

- The initiation of two international clinical trials mentioned above, with potential for recruiting additional centers from Japan (e.g., for particle therapy treatment) and other countries.

- The radiomics program is well underway with impressive publications in the areas of multiparametric imaging (MPI) and machine learning. For example, a manuscript published in Radiology (IF 7.5) described superior performance of MPI compared to existing prognostic indicators in predicting overall survival of glioblastoma patients. Additional projects in the area of using MPI to distinguish different subtypes of GBM as well as breast cancer have also been published in impactful journals. MPI and machine learning are areas of intense focus and development world-wide and have the potential to revolutionize patient treatment.
- Moreover, the Physics projects employing organ motion movement, photoacoustic and X-Ray imaging approaches for Protons and X-Rays as well as use of nanoparticles to enhance radiotherapy effectiveness matured and either published or presented at prestigious international meetings (e.g., AAPM). The collaboration between Physicists at HU and SU is a major strength of the GI-CORE, and is supported by multiple visits and cross-appointments of Physicists from SU to HU, and, since the last review of the program, from HU to SU. In my estimation, the combined efforts between the Radiation Physicists from HU and SU represent one of the top 2-3 teams internationally which are working on improving clinical care of radiation patients.
- Despite essentially starting the Biology program “from scratch”, new faculty (Dr. Onodera) has been recruited which is already publishing exciting work in the area of mitochondrial biology and oxidative stress (Nat. Communications). Moreover, there has been progress in the areas of nanotechnology with RGD-peptides as radio-enhancers and in the investigation of the effects of radiation in the invasive activity of breast tumor cells.

(Suggestions for improvement)

- An area for potential improvement is the incorporation of immunocompetent mouse models to initiate studies on the impact of radiotherapy in the immune response to tumors (especially as it applies to Proton radiotherapy).

3. Are research outcomes from GI-CoRE being actively utilized to solve social issues?
<p>Evaluation Results and Reasons</p> <p>(Your Evaluation Results)</p> <p>(S) / A / B / C / D (circle one)</p> <p>(Reasons)</p> <p>Yes, the new clinical trials which have been initiated by the GI-CORE have the distinct potential to improve patient care at an international level. Moreover, the established interactions between the GI-CORE and the Graduate School of Biomedical Science and Engineering offer excellent opportunities for high-level graduate education to several students interested in radiation sciences and reciprocally, offer opportunities to GI-CORE faculty to disseminate knowledge and expertise to the broader academic community.</p> <p>Specific points</p> <p>(Outstanding points)</p> <ul style="list-style-type: none"> • Collaborative, state-of-the-art research has been reported in both Japanese journals (5), and in international (overseas) Journals (29). <p>(Suggestions for improvement)</p> <p>None noted</p>

II. Education
<p>Is the educational system and curriculum designed to help develop researchers who possess specialized knowledge and are capable of working internationally?</p>
<p>Evaluation Results and Reasons</p> <p>(Your Evaluation Results)</p> <p>(S) / A / B / C / D (circle one)</p> <p>(Reasons)</p> <p>Exceptional progress in the field of education. Two Summer Schools (Physics and Biology) have been established, several major symposia have been held at the GSQ and the newly established Graduate School of Biomedical Science and Engineering will have a major positive impact on the operations and scope of the GI-CORE.</p>

Specific points

(Outstanding points)

- The newly established Graduate School of Biomedical Science and Engineering represents a major development, positively impacting the efforts of the GSQ. This will (a) attract talented graduate students into research efforts of the GI-CORE and (b) allow the GI-CORE scientists (both from HU and the visiting professors from SU) to gain valuable teaching experience and also disseminate knowledge accumulated during the GI-CORE functions.
- An impressive number of educational activities have taken place under the auspices of the GI-CORE, including summer symposia with internationally-renowned scientists, a Summer School for Medical Physics (currently in its 5th year), and a newly established Summer School in Radiation Biology.

(Suggestions for improvement)

None noted

III. Establishment of Framework

Are the necessary systems and frameworks being established in order to conduct international cooperative research and education?

Evaluation Results and Reasons

(Your Evaluation Results)

(S) / A / B / C / D (circle one)

(Reasons)

Since its inception in April 2014, the GI-CORE has firmly established a robust and sustainable framework for performing high-caliber research, training new scientists and disseminating the resulting scientific findings to the broader international scientific community.

Specific points

(Outstanding points)

- Effective steering committee of the GI-CORE consisting of top, experienced officials appears to provide strong stewardship for activities and meets regularly and provides guidance and oversight.
- Outstanding leadership from both the HU and SU teams, particularly Drs. Shirato and Le, who are leading the GI-CORE efforts.
- Efficient mode of operations with cross-appointment of faculty and opportunities for training of both faculty

and staff.

(Suggestions for improvement)

None noted

IV. Overall Evaluation

Since its establishment in 2014, the GI-CORE has developed into one of the premier centers for Radiation Oncology Research. The initiation of two pivotal clinical trials with patients from both the US and Japan and tight cooperation between the clinical research groups at HU and SU, represents a model for similar future international collaborations. New research directions into the application of radiomics, machine learning and photoacoustic imaging are timely and cutting-edge. The Biology unit has now been adequately staffed and already making big strides with high-impact publications and excellent potential for future contributions. Finally, the international educational activities offered by the GI-CORE in Radiation Sciences are unparalleled. Going forward, implementation of the research findings into additional innovative clinical trials, translating Physics findings into new equipment or procedures and expanding radiomics efforts to include biochemical markers with ctDNA from the ongoing research efforts, has the potential to propel the GI-CORE to the forefront of Radiation Oncology academic entities.

Global Station for Quantum Medical Science and Engineering Global Institution for Collaborative Research and Education (GI-CoRE) Final Evaluation

External Evaluation Committee Member Name: Xianshu Gao (高献书)

Choose one of the five Evaluation Ratings options below as explained by the Evaluation Explanation for each Evaluation Item on the form.

Evaluation Ratings	Evaluation Explanation
S	Achieved outcomes surpassed the original plan (Outstanding)
A	Good progress has been maintained and expected outcomes have been achieved (Excellent)
B	Most expected outcomes have been achieved with some slight delays (Good)
C	Although certain outcomes were achieved, overall results were insufficient (Satisfactory)
D	No expected outcomes were achieved (Unsatisfactory)

I. Research	
1. Has construction of an international research and education center capable of attracting outstanding researchers from around the world (including from HU) been achieved?	
<p>Evaluation Results and Reasons</p> <p>(Your Evaluation Results)</p> <p><input checked="" type="radio"/> S / <input type="radio"/> A / <input type="radio"/> B / <input type="radio"/> C / <input type="radio"/> D (circle one)</p> <p>(Reasons)</p> <p>Specific points</p> <p>(Outstanding points)</p> <p>1. Extremely impressive and significant progress has been made since the start of the project, especially in research and development through collaboration among medical, science, and engineering faculty participants.</p> <p>2. The teachers invited from overseas have met the requirements for medical physics section and radiation biology section. They have spearheaded a number of important initiatives in research and education. The participation and collaboration have been very effective and greatly advanced the field of medical technology and healthcare.</p> <p>3. The role cooperative systems with the affiliated universities are very appropriate.</p>	

<p>4. The inter-departmental role cooperative systems within Hokkaido University are very appropriate and exemplify the power of multidisciplinary research.</p> <p>(Suggestions for improvement)</p> <p>None.</p>
<p>2. Is world-leading cutting-edge international cooperative research underway?</p>
<p>Evaluation Results and Reasons</p> <p>(Your Evaluation Results)</p> <p><input checked="" type="radio"/> A / B / C / D (circle one)</p> <p>(Reasons)</p> <p>Specific points</p> <p>(Outstanding points)</p> <p>1. Research is progressing smoothly and has exceeded the original plan in multiple aspects. Research program is exceedingly productive and fruitful.</p> <p>2. Significant clinical trials are carrying out smoothly. Although research results of these clinical trials will be available after several years, there is sufficient prospect of publishing high quality international collaborative papers.</p> <p>3. The radiation biology section has obtained research results which have significant scientific impact.</p> <p>(Suggestions for improvement)</p> <p>None.</p>
<p>3. Are research outcomes from GI-CoRE being actively utilized to solve social issues?</p>
<p>Evaluation Results and Reasons</p> <p>(Your Evaluation Results)</p> <p><input checked="" type="radio"/> A / B / C / D (circle one)</p> <p>(Reasons)</p> <p>Specific points</p> <p>(Outstanding points)</p> <p>1. Compared with the last appraisal, there are much more research results that lead to the resolution of social issues from GI-CoRE.</p> <p>2. The methods of communication from GI-CoRE to society are very appropriate.</p> <p>3. There are feasible plans to collaborate with research organizations or corporations as well as the affiliated universities with an aim of solving social issues.</p>

(Suggestions for improvement)

None.

II. Education

Is the educational system and curriculum designed to help develop researchers who possess specialized knowledge and are capable of working internationally?

Evaluation Results and Reasons

(Your Evaluation Results)

☒ S / A / B / C / D (circle one)

(Reasons)

Specific points

(Outstanding points)

- 1. The curriculum is highly useful and important to foster inter-disciplinary students.**
- 2. The goal of the Graduate Schools is clear, the organization of the personnel structure is reasonable, and the research area is also cutting-edge.**
- 3. The Graduate Schools expand its influence and popularity through different ways, such as Summer School.**

(Suggestions for improvement)

None.

III. Establishment of Framework

Are the necessary systems and frameworks being established in order to conduct international cooperative research and education?

Evaluation Results and Reasons

(Your Evaluation Results)

☒ S / A / B / C / D (circle one)

(Reasons)

Specific points

(Outstanding points)

A sufficient system and framework have been established to invite top researchers and conduct international cooperative research and education.

(Suggestions for improvement)

The educational framework is well designed, especially considering the broad spectrum of the attendees and students. It may be useful to individualize the educational program by offering courses at two more levels.

IV. Overall Evaluation

This program has constructed an international research and education center to carry out cutting-edge international collaborative research, which can be used to solve social issues. Based on these research results, this program has built Graduate Schools to develop personnel who have specialist knowledge and can act globally. The breadth and depth of this program can be further improved by extending this program based on this framework. For instance, researchers invited from overseas for clinical science section have not enough time to prepare and carry out more significant international multi-center clinical trials.

**Global Station for Quantum Medical Science and Engineering
Global Institution for Collaborative Research and Education
(GI-CoRE)
Hokkaido University**

**Research Progress Report
(Project Period: Academic Year 2014-2019)**

Contents

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I. Overview

- Name of Global Station: Global Station for Quantum Medical Science and Engineering (GSQ)

- Project Period: 2014-2019 academic years (5 years)

- Aims and Goals

The objectives of this program to establish an attractive global research hub that is designed to nurture human resources who can contribute to addressing various issues in the world, to reforming and reorganizing the governance and framework of the educational research organization, as well to assisting in the reallocation of the resources of the university. To achieve these objectives, Hokkaido University (HU) has established the Global Institution for Collaborative Research and Education (GI-CoRE) as an educational research institution under the direct authority of the university president, where innovative international research is conducted through the collaborative efforts between world leading educational research teams invited from overseas research institutions and research groups of HU. The GI-CoRE currently consists of six global stations: Global Stations for Quantum Medical Science and Engineering, for Zoonosis Control, for Food, Land and Water Resources, for Soft Matter, for Big Data and Cybersecurity, as well as that for Arctic Research. (Fig. 1).



Fig 1. Configuration of GI-CoRE (as of March 2018)

■ Necessity and Urgency

Cancer is one of the main causes of death in developed countries and the numbers of cancer patients are increasing in developing nations. An optimal cancer treatment would be one that can completely cure all patients while maintaining reasonable cost-effectiveness. In reality however, the success rates of treatments are less certain and the costs of anti-cancer pharmaceuticals are growing. Consequently, costs associated with cancer treatment are becoming a significant burden for national health services everywhere. Alternative solutions for treatment are thus urgently needed to help address this severe global issue.

Radiation therapy is one of the most cost-effective curative treatments for cancer and has great potential for allowing patients to maintain excellent function and form during and after treatment. There is increasing demand for precise radiotherapy technology, cutting-edge knowledge of radiation biology, imaging technology, and well-organized clinical trials to improve the outcome of cancer treatment using radiation. However, even with the most advanced radiotherapy, it is still not possible to cure all cancer patients with reasonable cost-effectiveness. Innovation is urgently needed to improve the outcome through studies in physics, biology, and clinical sciences with the collaboration among different countries as well as that between academia and industry. HU is willing to realize a “Hokkaido University that proposes solutions for problems experienced globally” in this field of cancer treatment using the framework of the GI-CoRE.

■ Originality, Novelty, etc.

The Global Station for Quantum Medical Science and Engineering (GSQ) has been established as part of the Global Institution for Collaborative Research and Education (GI-CoRE) in 2014 to solve problems in cancer treatment. The GSQ is one of the main efforts of HU to establish innovative research centers for international collaborative studies and developing human resources who will be able to assume responsibility for upcoming generations.



Fig.2 Proton beam therapy system with real-time tumor-tracking function.

HU has a long history conducting unique research on organ motion, developed new treatment systems, and also conducted related clinical studies on precise external beam radiotherapy. The Real-time tumor-tracking radiotherapy (RTRT) realized in 1999 and real-time-image gated proton beam therapy (RGPT) in 2013 are often cited in world-class journals and conferences.

The Department of Radiation Oncology, Stanford University (SU) School of Medicine is a well-established, world-leading research group. It developed the first linear accelerator in the Western Hemisphere and administered photon treatment using a linear

accelerator in 1956. In collaboration with Stanford Neurosurgery, it also developed Cyberknife in the 1990's, which is still presently used throughout the world for stereotactic ablative radiotherapy (SABR) for intracranial and extracranial tumors.

In 2013, the Department of Radiation Medicine and head-quarters of HU explained their idea of developing the GSQ to the Department of Radiation Oncology and related authorities in the Stanford School of Medicine. After months of discussion, SU understood the dedication of HU, potential of the GI-CoRE, scientific validity in collaborating with HU, and agreed to join the GSQ. World-leading researchers of SU have been invited to HU to build a Stanford University unit in the GSQ as a partner of the Hokkaido University unit and started collaborative studies in the field of radiation biology, radiation oncology and medical physics (Fig. 3).

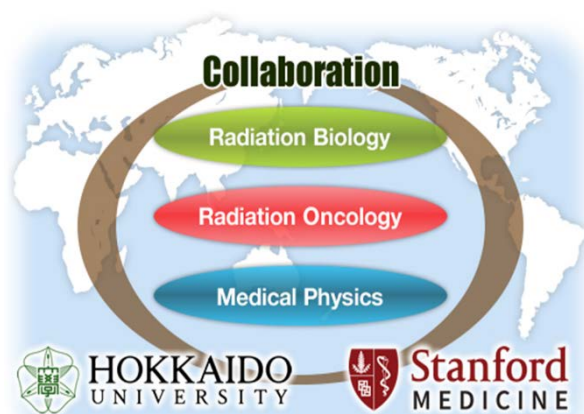


Fig.3 Global Station for Quantum Medical Science and Engineering.

As physical places for research and equipment, HU has prepared a highly equipped wet laboratory of 200 m² for radiation biology in the Graduate School of Medicine building. Hokkaido University Hospital has also prepared a dry office of 150 m² for the Medical Physics Section and an administration office in the Proton Beam Therapy Center. Hokkaido University Hospital also helped with use of their resources to start international collaborative clinical trials in radiation oncology.

Four professors including the chair of the department, associate/assistant professors, and other researchers of the Department of Radiation Oncology, Stanford University have visited their units in HU from periods of one-week to one-year. To facilitate the research, HU also introduces various new

arrangements for personnel affairs including an annual salary appointment scheme and cross appointment arrangements; it also assigns research funds selectively to promote and support the GI-CoRE. Furthermore, the facilitation also provides special considerations such as exemptions from management duties and from policies/regulations of each department to enable the researchers to conduct educational research activities without being constrained.

At the GSQ, innovative international research through the collaboration between HU and SU will contribute to the scientific community by producing high impact co-authored papers that are widely cited. Conducting international symposia and summer schools on a regular basis will also help to promote further collaboration and the sharing of important scientific insights.

HU created a new institute, the “Graduate School of Biomedical Science and Engineering” in April, 2017 by reallocation of enrollment places and faculty of existing graduate schools based on their world-leading research achievements. Integration of the research results and achievements of the GSQ is expected to grow into the development of the graduate schools for upcoming generations. The globalization of the student body will be accelerated through credit transfer arrangements with affiliated universities and increase the number of students who study outside Japan.

These activities make it possible to facilitate research conducted in the GSQ and enable the training of future international leaders through education at the new graduate school.

It is expected that the results of this project will make a very important contribution to the strategy of HU, “establishing innovative research centers for international collaborative studies and developing human resources who will be able to assume responsibility for coming generations”, that will be essential to realizing the goal of solving global problems.

II. Budget

Unit: 1,000 JPY

	Category	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018 (projected)	Total
Budget for GSQ	Personnel cost		10,583	36,462	21,220	45,251	113,516
	Operating cost		25,938	15,308	90,482	66,451	198,179
	Facility cost		32,055	0	0	0	32,055
GI-CoRE establishment of framework	Personnel cost (for researchers from overseas)	10,075	18,662	23,062	26,825	40,000	118,624
	Administrative cost*	20,609	26,122	27,232	28,057	24,725	126,745
	Operating and research cost	67,800	76,000	54,392	53,973	33,275	285,440
Total		98,484	189,360	156,456	220,557	209,702	874,559

*Including travel expenses for invited researchers from overseas

III. Detailed Results

1. Research

(1) Goals

Under the framework of the GSQ, investigators have engaged in research and development through collaboration among medical, science, and engineering faculty participants. The objectives of these three sections are: (a) The Clinical Science Section works to realize a cancer treatment that prevents recurrence and metastasis, (b) The Medical Physics Section works to establish the basics and technology involved in the research of 3D Real-time Imaging and dose determinations for radiation therapy, and (c) The Radiation Biology Section conducts creative medical research through study of the effects of radiation sensitizers and protective agents and that of molecular biology to control recurrence and metastasis.

(2) Current Progress/Future Developments

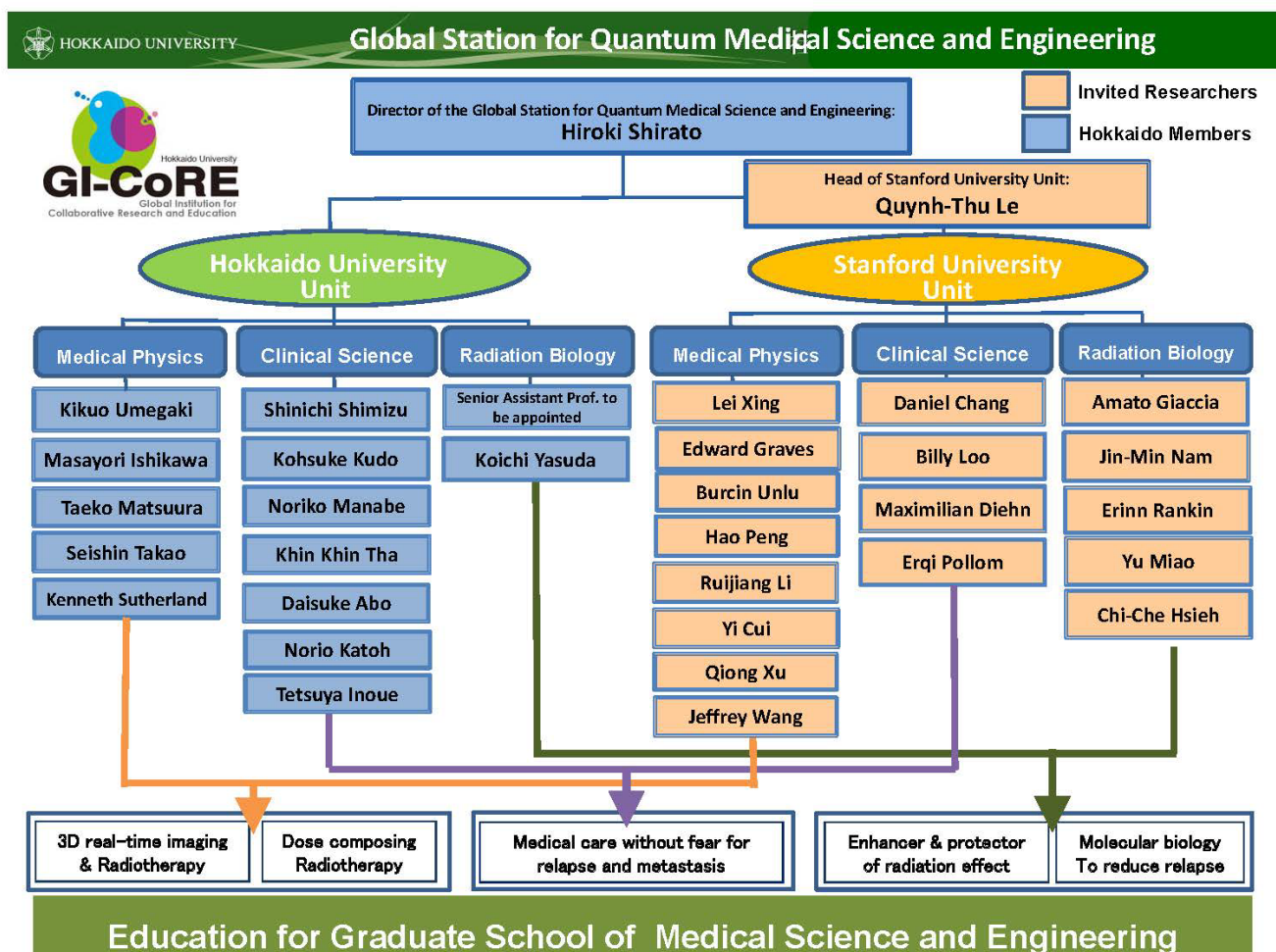
① Construction of base

As of March 2018

Affiliated institutions, departments, etc.	Researcher name	Description of research
Hokkaido University Faculty of Medicine Faculty of Engineering Faculty of Health Sciences Hokkaido University Hospital 【Head of the unit】 Professor, Hiroki Shirato	(Clinical Science Section) Professor, Shinichi Shimizu Associate Professor, Kohsuke Kudo Senior Assistant Professor, Noriko Manabe Senior Assistant Professor, Khin Khin Tha Senior Assistant Professor, Daisuke Abo Assistant Professor, Norio Katoh Assistant Professor, Tetsuya Inoue *Collaborative Researcher Yoriko Ida	<ul style="list-style-type: none"> • Study and enable medical treatments to avoid recurrence and metastasis • Development of minimally invasive innovative, advanced radiotherapy • Development of real-time tumor tracking technology • International clinical studies to measure cDNA (cancer cell genes in the blood) to improve survival rates of cancers • Development of minimally invasive markers for in vivo applications • Development of quantitative imaging technology with radiomics • Development of a system that automatically detects metastases
	(Medical Physics Section) Professor, Kikuo Umegaki Professor, Masayori Ishikawa Associate Professor, Taeko Matsuura Assistant Professor,	<ul style="list-style-type: none"> • Research and development of 3D real-time imaging • Development of dose determination technology for radiation therapy • Development of proton beam imaging technology • Development of real-time marker-

	Seishin Takao Assistant Professor, Kenneth Sutherland	less tracking technology • Research related to development of cone beam CT technology
	(Radiation Biology Section) Senior Assistant Professor to be appointed Assistant Professor, Koichi Yasuda *Collaborative Researcher Yasuhito Onodera	• Study of the effects of radiation sensitizers and protector • Research of reactive oxygen species related molecular mechanism in invasive breast cancer
Stanford University School of Medicine Department of Radiation Oncology 【Head of the unit】 Professor, Quynh-Thu Le	(Clinical Science Section) Professor, Daniel Chang Associate Professor, Billy Loo Assistant Professor, Maximilian Diehn Assistant Professor, Erqi Pollom	• Randomized Study of Transarterial Chemoembolization (TACE) versus Stereotactic Body Radiotherapy (SBRT) for Recurrent Hepatocellular Carcinoma after Initial TACE • iSABR – Phase II Trial of Individualized Lung Tumor Stereotactic Ablative Radiotherapy
	(Medical Physics Section) Professor, Lei Xing Associate Professor, Edward Graves Visiting Scholar, Burcin Unlu Visiting Scholar, Hao Peng Assistant Professor, Ruijiang Li Research Associate, Yi Cui Postdoctoral Researcher, Qiong Xu Postdoctoral Researcher, Jeffrey Wang	• Research of real-time image guided radiation therapy, proton therapy dosimetry, treatment planning • Radiomics and clinical data analysis • Molecular imaging and molecular image guided radiation therapy • Real time imaging of proton therapy • Radiomics and image analysis
	(Radiation Biology Section) Professor, Amato Giaccia Senior Assistant Professor, Jin-Min Nam	• Identify mechanisms by which tumor cells survive, recur, and metastasize following radiotherapy • Identify mechanisms to protect

	Assistant Professor, Erinn Rankin Research Fellow, Yu Miao Postdoctoral Researcher, Chi-Che Hsieh	normal tissues from acute and late toxicities associated with radiotherapy • Radiation related vesicle trafficking and exocytosis • Developing a possible clinical strategy for using gold nanoparticles to breast cancer following radiotherapy
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Organizational Structure of the GSQ (as of March 2018)

- Role sharing with affiliated universities

- (a) Clinical Science Section

The Clinical Science Section has started internationalization of the clinical studies in precision external radiotherapy conducted by Professor Quynh-Thu Le, Professor Daniel Chang, Associate Professor Billy Loo, and Assistant Professor Maximilian Diehn at SU. These Professors and clinical research coordinators visited the GI-CoRE and clinical research and development center at Hokkaido University Hospital before the start of these studies. The role of stereotactic ablative radiotherapy (SABR) in measuring cDNA in the blood, a potentially essential surrogate marker in improving cancer survival rates for lung cancer has been studied. A randomized clinical trial comparing SABR and the standard treatment, trans-arterial embolization for relapsed hepatocellular carcinomas has been conducted by SU. The GSQ has hired clinical research coordinators who are good at English to facilitate the international clinical trials. All English protocols and informed consents were translated into Japanese and accepted by the ethics committee of Hokkaido University Hospital. For these two clinical studies, the Clinical Science Section has made it possible to register patients treated at Hokkaido University Hospital into these studies with the great help from staff of clinical research at SU. SU has worked closely with HU on highly precise radiotherapy such as image guidance and usage of big data to predict outcomes of cancer treatments. The clinical benefit of proton beam and carbon beam therapies has been discussed extensively with data from HU and other Japanese institutions which utilize particle beam therapy. Linking these clinical studies effectively enables clinical research to realize new treatments aimed at avoiding recurrence and metastasis.

Professor Kohsuke Kudo, Senior Assist. Prof. Noriko Manabe, and Senior Assist. Prof. Khin Khin Tha from the Clinical Science Section of HU and Professor Lei Xing, Assist. Prof. Ruijiang Li, Research Associate Yi Cui, post-doctoral researcher Jeffrey Wang from the Medical Physics Section of SU are conducting collaborative research to identify noninvasive tumor biomarkers through analysis of magnetic resonance (MR) images using radiomics, an innovative quantitative image analysis. The first project was identification of imaging features to predict the overall survival of glioblastoma patients. Using MR imaging datasets of glioblastomas, Drs. Cui, Tha, Wang, Kudo, Xing, Shirato, and Li enabled the extraction of five imaging features, the combination of which predicted the overall survival of glioblastoma patients with superior performance over existing prognostic indicators (Fig. 4) (*Radiology* 2016; 278: 546-553). Drs. Cui, Tha, Shirato, and Li further extended the work to identify MR imaging features which could differentiate glioblastoma molecular subtypes (Fig. 5) — this differentiation is important as treatment responses and prognoses varied greatly among the subtypes. Through a few modifications of the radiomic analytics they developed, the researchers could distinguish the proneural subtype of glioblastoma from other molecular subtypes (*Eur Radiol* 2017; 27: 3583-3592). Using a similar approach, Drs. Wang, Manabe, Li, Cui, Tha, Kudo, and Shirato also identified MR imaging features that could differentiate triple-negative breast cancer (*PLoS One* 2015; 10: e0143308). Currently, these researchers are working on prediction of hypoxic regions within glioblastomas (Drs. Kudo, Tha, Cui, and Shirato), and on distinguishing pseudo-progression and pseudo-regression of diffuse gliomas from true tumor progression and responses (Drs. Tha, Xing, and Shirato), through radiomics and deep learning analytics of MR images. Hypoxic tumor areas are often resistant to standard doses of radiation therapy and require adaptation of treatment regimes. Distinguishing pseudo-progression and regression from true tumor progression and response is essential since treatment regimens differ for these conditions, but the performance of currently available imaging techniques is not satisfactory.

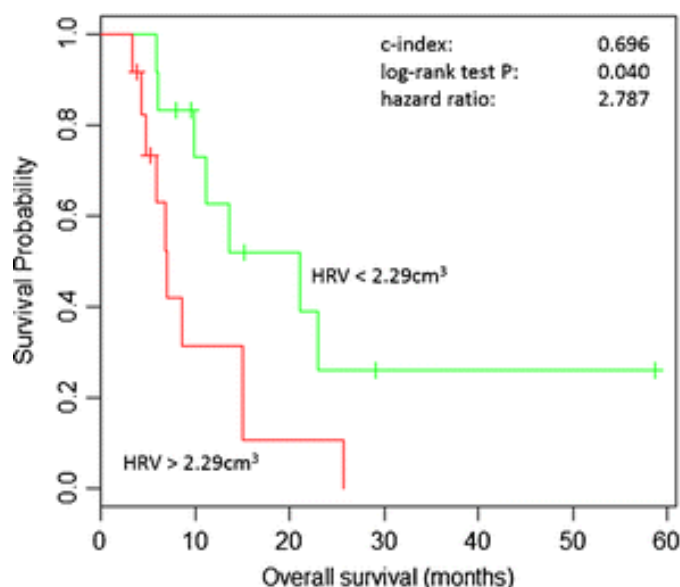


Fig.4 Kaplan-Meier curves showing the performance of MR imaging features extracted by radiomic analytics in distinguishing patients based on overall survival period (Radiology 2016; 278: 546-553)

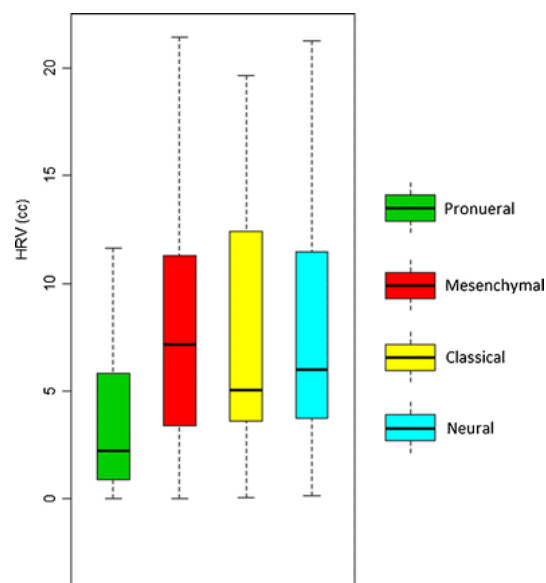


Fig.5 Boxplots showing smaller high-risk volume (HRV) MR images for the proneural glioblastoma molecular subtype (HRV was derived from the MR images) (Eur Radiol 2017; 27: 3583-3592)

(b) Medical Physics Section

The Medical Physics Section and researchers of SU have conducted research to visualize two dimensional (2D) gold concentration distributions in objects by observing the amount of fluorescence X-rays emitted when proton beams collided with gold, using the proton beam line at HU (M. Bazalova et al., *Med. Phys.* 2015). The team has also been engaging in the development of technology to determine proton ranges in real-time by observing ultrasonic waveforms emitted from the irradiated target during treatment (M. Ahmad et al., *Med. Phys.* 2015). Furthermore, working with Dr. Ruud Vinke, a doubly appointed Stanford researcher who stayed at HU for three months in 2015, the team developed technology to enable CBCT acquisition with multiplex X-ray energy levels which is better than the existing single energy cone beam CT technology. For research into proton beam irradiation technology, the team also developed a device to decrease duration of irradiation when the target moves due to respiration (T. Matsuura et al., *Phys. Med. Biol.* 2016). Another SU researcher, Cesare Jenkins, came to HU and performed the first experimental study of proton range verification using a phosphor coated phantom and the preliminary data was presented at the 2016 Annual Meeting of AAPM. Anastasia Makarova, a post-doctoral researcher at HU between 2016 and 2017, worked together with Associate Professor Taeko Matsuura and Assistant Professor Kenneth Lee Sutherland. They evaluated energy absorption by bystander gold nanoparticles. Through Monte Carlo simulation, efficiency of electron shielding by tumor-surrounding clusters of gold nanoparticles was examined. The study was presented at the 2017 Annual Meeting of AAPM. Dr. Hao Peng of SU works in pursuit of several projects together with Dr. Jeffrey Wang and other HU researchers. With Dr. Peng's vast experience in PET and MRI technologies, projects concerning development of detector designs are underway, investigating circuit multiplexing strategies, signal encoding, and optimization of systems using machine learning techniques. Dr. Peng also has been investigating characterization of a new imaging technique to improve accuracy of breast cancer diagnosis with Dr. Wang. The X-ray-induced acoustic (XA) imaging technique (pioneered by Prof. Lei Xing) has shown great promise as a technique able to produce tomographic images as well as act as a method of radiation therapy dose calculation. Dr. Peng was awarded a 3-year Grant-in-Aid

for Young Scientists from the Japan Society for the Promotion of Science (JSPS) which started in 2017, to develop a system to hybridize breast tomosynthesis and XA to improve diagnostic accuracy of mammography (Fig. 6). Specifically, the project aims to develop a comprehensive framework to characterize the performance of such a system, with respect to image quality and detection limit, as well as to build a prototype to demonstrate feasibility through phantom and in-vivo animal studies. Dr. Qiong Xu of SU visited between 2016 and 2018, during which time she advanced to become Assist. Prof. of HU. She has been investigating reconstruction of low-dose thoracic CT using dictionary learning of region-specific structures within organ compartments. The strategy successfully takes into account inherent regional differences inside reconstructed objects and lead to improved images. The results of this study have been submitted to the IEEE's Transactions on Medical Imaging (Fig. 7). Dr. Xu is currently working on a deep learning-based method of CT reconstruction with Dr. Wang. The technique exploits a deep convolutional decoder-encoder network learned prior to restore images corrupted by metal artifacts. The initial study has been submitted to at the 2018 Annual Meeting of AAPM. Dr. Mehmet Burcin Unlu is the latest scholar to visit from SU, an expert in the topics of photoacoustic imaging and inverse problems, also pursuing interests in radiation-induced acoustic imaging. At first, evaluation of an analytical model for acoustic signal induction is being performed against simulations and has been submitted to AAPM 2018. Several projects involving characterizing proton beam- and X-ray- induced acoustics experimentally are also underway.

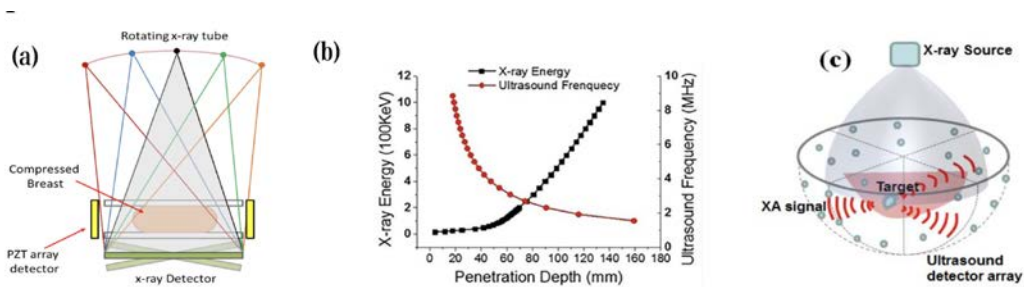


Fig.6 (a) Schematic drawing of a hybrid X-ray induced acoustic breast imaging system (not to scale). (b) The penetration depth of X-ray in different energies vs. the penetration depth of ultrasound wave in different frequencies, which are much larger compared to optical photons. (c) The acoustic signal emission from the target hit by a pulsed X-ray allows for 3D volumetric imaging (Xing et al., Scientific Reports 2016).

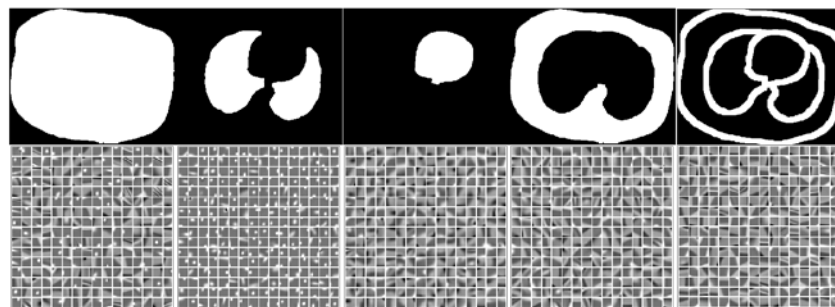


Fig. 7 Learned dictionaries for region-specific low-dose CT reconstruction (bottom) and their represented regions (top). The 1st column at left corresponds to the thorax region mask and represents the conventional single dictionary. The 2nd-5th columns are the lung, heart, surrounding tissue, and juncture region masks respectively, corresponding to the respective region-specific dictionaries (submitted by Xu et al., IEEE TMI 2018).

(c) Radiation Biology Section

Since 2014, the Radiation Biology Section has worked to develop a work environment, including wet laboratory space, an office, and research facilities on the 4th floor of the Graduate School of Medicine of HU that enables carrying out of collaborative radiation biology research between SU and HU. The research of the Radiation Biology Section led by Professor Amato J. Giaccia of SU, and the team including Senior Assist. Prof. Jin-Min Nam, Assist. Prof. Erinn B. Rankin, research fellow Yu Miao, and post-doctoral researchers Frances C. Recuenco and Chi-Che Hsieh have conducted several collaborative research projects at HU. The team has been focused on investigating the molecular mechanism of radiation effects to improve the efficacy of radiation treatment on cancer cells.

Dr. Giaccia has given three state-of-the-art special lectures on radiation biology and the tumor microenvironment at the annual GI-CoRE International Symposium. For education of students, Dr. Giaccia and Dr. Le will give a lecture series on radiation biology in the Hokkaido Summer Institute 2018/ GI-CoRE Summer School for Radiation Biology 2018. Dr. Nam has been giving lectures and research training to graduate students at HU of the Graduate School of Medicine and Graduate School of Biomedical Science and Engineering. Drs. Rankin and Miao gave talks at the annual GI-CoRE International Symposium. The SU members stayed and conducted discussions with lab members at HU.

In educational activities, under the supervision of Dr. Nam, Ping-Hsiu Wu (M.D.), a graduate student of the Graduate School of Medicine of HU, is engaged in research related to the application of sensitizers targeting certain cell surface receptors which regulate cancer cell invasion. Dr. Wu presented the research at several international conferences: The ASCB Annual Meeting (San Diego, 2015), The 3rd GI-CoRE Medical Science and Engineering Symposium (Sapporo, 2016), ASTRO (Boston, 2016), JCA (Yokohama, 2016), JASTRO (Osaka, 2017), and AACR 2018 (Chicago, 2018) sponsored by Drs. Giaccia and Le. Dr. Wu also visited the laboratories of Drs. Giaccia and Graves at SU to learn how to conduct *in vivo* experiments in mice. By the supervision of Dr. Nam and Dr. Giaccia, Dr. Wu published work about gold nanoparticles and radiation sensitization in the International Journal of Nanomedicine (Wu et al., *Int J Nanomedicine*, 2017, Fig.8). Dr. Recuenco has mastered the experimental system of *in vivo* imaging to analyze the effects of radiation using animal models. Dr. Recuenco provided training in animal work for students and technicians. The project of carrageenan, a natural seaweed polysaccharide, as an adjuvant in radiation therapy has been conducted by Drs. Recuenco, Hsieh, and Wu. They are writing up a manuscript with *in vitro* and *in vivo* results that λ -carrageenan improves the efficacy of radiation treatment of cancer cells. Dr. Hsieh has mainly been conducting the project on the CD44 variant in radioresistance.

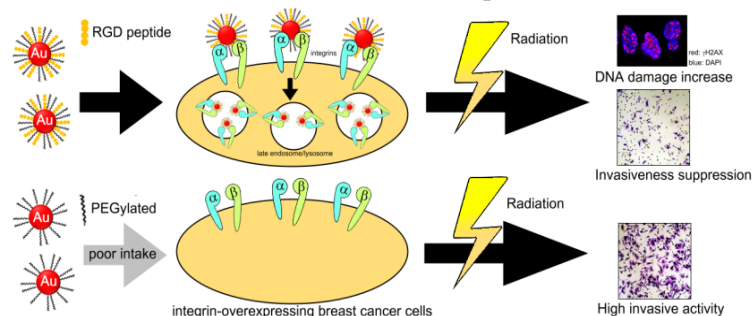


Fig.8 RGD-conjugated gold nanoparticles in radiotherapy

In addition to the original work, researchers of the GSQ Stanford University unit have been actively collaborating with other faculty groups in the Graduate School of Medicine to understand the molecular mechanisms of cancer cell invasion (Hashimoto et al., *J Cell Biol.*, 2016; *Cell Commun Signal.*, 2016), Nik-related kinase signaling on placental development (Morioka et al., *PLoS One*, 2017), and cell competition (Kon et al., *Nat Cell Biol.*, 2017). The GSQ Stanford University unit has also been working with an immunologist in collaborative research showing that the Toll-like receptor 3 signal augments radiation-induced tumor growth retardation in a murine model (Yoshida et al., *Cancer Sci.*, 2018). Drs. Le, Giaccia, Koong, and Shirato have put together a review on an emerging treatment paradigm in radiation oncology in the prestigious American Association for Cancer Research journal (Le QT et al.,

Clin Cancer Res 2015). Drs. Rankin, Nam, and Giaccia also published a review of Hypoxia and metastatic cascade (Rankin et al. *Trends Cancer*, 2016).

- Role sharing between faculty members at HU

- (a) Clinical Science Section

At the Clinical Science Section, Professor Hiroki Shirato has published summaries of the GI-CoRE 4th and 5th symposium with the co-editor Prof. Quynh-Thu Le of SU in a special edition of the Journal of Radiation Research, the official journal of the Japanese Society of Radiation Oncology (JASTRO). The aim of the symposium was to establish international consensus in the way to select external radiotherapy technology for individual patients and featured lecturers from the Netherlands, USA, and Japan. The special issue contains all peer-reviewed papers including those from distinguished researchers such as the Mayo Clinic, the MD Anderson Hospital, and the National Institute for Radiological Science in addition to HU and SU. Drs. Shirato, Le, and other professors at HU and SU have published a keynote review for this issue. A consensus statement from all of the speakers in the symposium has been published in the journal. Professor Shinichi Shimizu has led research to develop state-of-the-art, minimally invasive, advanced radiotherapy technology using proton beam therapy. Dr. Shimizu has published papers and made presentations at academic conferences related to the development of proton beam therapy with real-time tumor tracking technology and numerical simulations of clinical applications. Assistant Prof. Tetsuya Inoue has started two international clinical studies to measure cDNA (cancer cell genes in the blood) conducted by Assist. Prof. Maximilian Diehn at SU to improve survival rates of lung cancer. Assistant Prof. Norio Katoh and Senior Assist. Prof. Daisuke Abo, have become involved in the randomized trial conducted by Professor Daniel Chang at SU to compare the effect of stereotactic ablative body radiotherapy (SABR) with the standard treatment, intra-arterial embolization, for relapse of hepatocellular carcinomas. Dr. Abo studied at Stanford University Hospital for 3 months before the start of this study. These two international collaborative studies have been successful in recruiting patients from Japan to studies in the USA making the value of the studies international. Assist. Prof. Kentaro Nishioka has analyzed clinical results of real-time-image gated proton therapy (RGPT) and published the results. Senior Assist. Prof. Noriko Manabe has developed innovative quantitative image analysis technology for cardiac imaging with international colleagues.

Drs. Kudo and Tha have recently initiated a collaboration with Professor Miki Haseyama of the Graduate School of Information Science and Technology, who also belongs to the Global Station for Big Data and Cybersecurity (GSB), to develop a system that would allow automatic detection of small brain metastases. Development of such a system would be helpful in reducing the workload of radiologists involved in identifying these lesions from hundreds of images and also increase the diagnostic accuracy. Promising preliminary results have been obtained (Sugata et al., A note on the classification of brain metastases from MR images based on machine learning), and the researchers are currently planning to proceed with data analysis by incorporating larger volumes of image data. Members of the GSQ and Drs. Yasuda, Kudo, and Haseyama of GSB are planning to evaluate whether the system would also allow automatic detection of vertebral metastases. As a separate project, Drs. Tha and Manabe have initiated research to determine the usefulness of electric properties tomography — a new MR imaging technique, in evaluations of lung and liver tumors. Drs. Tha, Kudo, and Shirato have previously explored the role of this imaging technique in evaluations of brain tumors and observed that electrical conductivity measurable by this technique can differentiate glioblastomas from lower grade gliomas (*Eur Radiol* 2018; 28: 348-355). Dr. Wang of the Medical Physics Section is currently investigating multiparametric MRI, especially using new machine learning techniques, for diagnosis of breast cancer and prognosis of its treatment therapy with Dr. Manabe. Incorporation of the advanced Diffusion Kurtosis Imaging method, already shown to increase diagnostic specificity significantly, is expected to improve upon current models of predicting breast cancer outcomes with

the radiomics approach. Along with Dr. Tha, Dr. Wang is also studying diagnosis of early Parkinson's Disease and prognosis in brain tumor radiotherapy using deep generative neural network learning of biomarkers seen on Diffusion Tensor Imaging.

(b) Medical Physics Section

The Medical Physics Section has worked on developing new technology to improve the treatment accuracy of proton therapy, something that has attracted a great deal of public attention in recent years. Assoc. Prof. Taeko Matsuura of HU and Instructor Magdalena Bazalova (currently serving as an Assistant Professor at University of Victoria) developed technology to depict and outline the two dimensional gold concentration distributions in objects using the proton beam therapy system of HU (M. Bazalova et al., *Med. Phys.* 2015). Many specialists have pointed out the importance of developing technology to verify the proton beam range during treatment, and the team led by Dr. Matsuura and post-doctoral researcher Moiz Ahmad at SU has engaged in developing technology to determine the range of the proton beam in real-time using ultrasonic waveforms emitted by the irradiated target during treatment (M. Ahmad et al., *Med. Phys.* 2015). Since 2015, a team led by Assist. Prof. Seishin Takao, Professor Kikuo Umegaki, and post-doctoral researcher Ruud Vinke, who joined HU for three-months, has been engaging in the development of technology to make it easier to acquire CBCT with multiplex X-ray energy levels compared to the existing single energy approach. We can expect that this technology will improve resolution of obtained CT images and enable more accurate calculations of dose. The Matsuura team has also developed a device to decrease duration of irradiation needed when the target moves due to respiration (T. Matsuura et al., *Phys. Med. Biol.* 2016). In addition to these research activities, as previously mentioned in the Clinical Science Section, researchers in Medical Physics Section, Assist. Prof. Ruijiang Li who spent 6 months at HU and post-doctoral researcher Yi Cui (currently serving as a Research Associate at SU) who spent 12 months in the GSQ at HU, performed radiomics studies using the clinical imaging data of brain and pancreatic tumors treated at SU and HU. They published their results in the top journal in this field (*Radiology*, 2015). Professor Masayori Ishikawa and Assist. Prof. Kenneth Lee Sutherland at HU are engaging in the summer school sessions at HU as a part of the global educational outreach in collaboration with SU. With the growing presence of artificial intelligence, in efforts described above and all other industries, the GSQ, Global Station for Big Data and Cybersecurity (GSB), and the Institute for Genetic Medicine (IGM), held a joint symposium in July 2017. Topics of quantum science, informatics, biology, medicine, and the emerging "Internet of Things" were covered between interdisciplinary experts, spurring many discussions and further initiating collaborative efforts. Drs. Matsuura and Takao have investigated the impact of real-time image gating on spot scanning proton therapy for lung tumors, through simulation. For the purpose of studying the effectiveness of real-time image gated proton beam therapy for lung tumors, a novel respiratory model was developed employing 4DCT to express regular volumetric variations of respiration (Fig. 9, T. Kanehira et al., *Intl. Journal of Rad. Onc. Bio. Phys.* 2017). They have also developed an analytical dose-averaged-linear energy transfer (LETd)-calculation algorithm, which considers off-axis enhancement by secondary protons in proton therapy to evaluate the biological effects of proton beams as part of daily clinical routine. Large improvements of LETd accuracy were seen compared with the previous analytical approach based on the pencil-beam algorithm. This work has been submitted to *Medical Physics*. Dr. Kanehira, a graduate of HU, is currently visiting the Netherlands Institute for Cancer as a post-doctoral researcher investigating image-guided radiotherapy using MRI. Under the supervision of Drs. Matsuura, Makarova, Peng, Umegaki, and Shirato, Jihun Kwon, a student of HU's Graduate School of Medicine evaluated the energy absorption of gold nanoparticles (GNP). This work was presented at the 2017 annual meeting

of AAPM. Mr. Kwon is currently on a one-year visit to the Dana-Farber Institute of Brigham and Women's Hospital and Harvard Medical School. With local experts in the use of GNP, he conducts research investigating them as a vascular disrupting agent, focusing on a method to non-invasively quantify a "signature" of the disruption using ultrasound and MRI. In parallel, he also investigates prediction of treatment outcome using microvascular imaging. The first presentation of the work was presented at the North England chapter of AAPM 2018.

In addition to these original works, researchers of the GSQ Hokkaido University unit have been actively collaborating with other faculty groups in the Graduate School of Medicine to develop quantitative imaging techniques and the radiomics approach of data analysis. The details of these collaborative works and the publications to which they led have been listed above in the Clinical Sciences Sections.

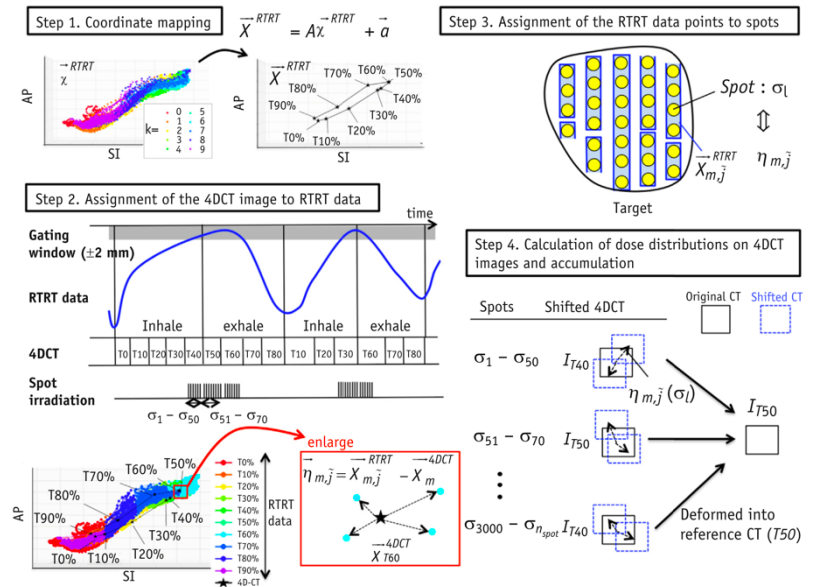


Fig. 9 Study workflow for the 4-dimensional dose calculation in studying impact of real-time image gating on spot scanning proton therapy for lung tumors (Kanehira et al. 2017)

(c) Radiation Biology Section

For the collaborative project in radiation biology, a number of studies with different themes have been conducted to find novel molecular targets to improve the efficacy of radiation therapy with the faculty of HU and the GSQ Stanford University unit. The collaborative team focused on vesicular trafficking of cell-surface receptors, cancer stemness, immune responses, and the extracellular microenvironment. The collaborative studies including experiments have mainly been conducted by postdoctoral fellows, graduate students, and technicians of HU in the lab of the Graduate School of Medicine under supervision of SU members, Faculty members of HU and the GSQ Stanford University unit. To conduct the collaborative research, Senior Assist. Prof. Yasuhito Onodera and Dr. Nam installed a 200 m² laboratory for radiation biology in 2014 (Fig.10). Faculty members of HU and SU have set up the *in vivo* imaging work equipment in the animal facility of the Faculty of Medicine (Fig. 11).



Fig.10 Set-up of the laboratory for biology

Dr. Onodera has been in discussions with members of the GSQ Stanford University unit and fellows about education and collaboration in research. Dr. Onodera has also been working with Drs. Shirato and Nam on a project of mitochondrial dynamics and cancer invasion (Onodera et al., *Nature communications*, 2018, Accepted).

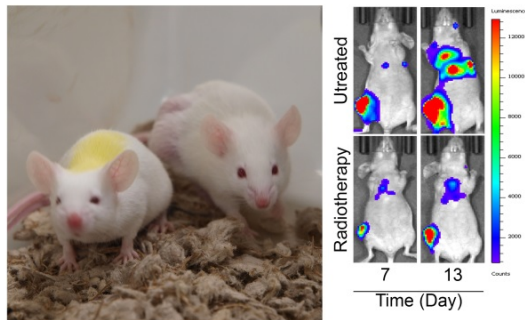


Fig. 11 *In vivo* Imaging

Assist. Prof. Koichi Yasuda visited the Rankin lab at SU for five months in 2015 to carry out collaborative research focusing on enhancing tumor radiosensitivity. For education of undergraduate and graduate students, faculty members of the GSQ have been organizing a monthly journal club with the topics of radiation biology in English. In addition, faculty members at HU have

been teaching graduate HU students of the Graduate School of Medicine and the Graduate School of Biomedical Science and Engineering. They will hold the Hokkaido Summer Institute/GI-CoRE Summer School for Radiation Biology in 2018.

● Future developments

The Clinical Science Section has consisted of radiation oncology and radiomics groups. In parallel with the rapid progress seen with machine learning and artificial intelligence (AI) across other fields as well as precision medicine, the radiomics group will be separated from the Clinical Science Section and be set up as a new unit for AI with a part of the Medical Physics Section. Here, data-driven model-based approaches to select appropriate external radiotherapy techniques will be studied using biomarkers *in silico*, such as in the case of normal tissue complication probability (NTCP) models. In the radiation oncology group, the benefit of particle beam therapy will be studied with both patients at HU as well as at other institutions using the national database for particle beam therapy. International clinical studies will be expanded from HU and SU to include institutions in other countries such as in Thailand and Singapore.

Going forward, along with the currently stationed Dr. Unlu, SU and HU researchers continue the efforts of GSQ medical physics developments to study topics aforementioned toward development of novel imaging techniques, developing and characterizing impact of new radiation and proton therapy techniques, as well as investigate novel methods of image reconstruction. In February 2018, an International Seminar on Radiation Oncology was held in Niseko, Japan. Drs. Xing of SU, Shirato and Shimizu of HU, as well as other attendees such as Dr. David Grosshans of the MD Anderson Cancer Center discussed the future of the Medical Physics Section. In parallel with its growth, the numerous efforts of the GSQ warrant some specialization of research interest groups. As mentioned above, a new AI and Big Data group for precision medicine is planned, as many projects now include the use of machine learning in analyzing increasingly complex data, a trend seen across all fields. Symposiums to showcase such efforts for education, as well promote discussion and collaboration, are also planned.

The Radiation Biology Section of the GSQ has invited the same section from SU and started advanced research with Faculty of HU on the topic, which is aimed at and will lead to the development of novel cancer therapies. It has been accelerating international collaborative research through its close interaction with SU and presented research results at international conferences and published papers using the research resources of both institutions until FY2017. Based on the achievements, the Radiation Biology Section will further develop research related to radiation sensitizers and understanding of molecular mechanisms of cancer cell invasion after radiation treatment. Through the collaborative research, the Radiation Biology Section will give advanced education and research training to graduate students in the Graduate School of Biomedical Science and Engineering, which was established in April 2017. In the school, students have the opportunity for training in the Cell

Processing Center at Hokkaido University Hospital to obtain qualifications as ‘Clinical Cultivist’ from The Japanese Society for Regenerative Medicine.

② International Collaborative Research

● Current progress in meeting initial research goals

(a) Clinical Science Section

We have conducted international collaborative research in the Clinical Science Section between HU and SU as follows.

a. International clinical trials

a-1. Phase II trial of individualized lung tumor stereotactic ablative radiotherapy (iSABR) P.I. Maximilian Diehn, and Billy Loo, M.D., Ph.D. (Fig. 12)

An official agreement was reached, as of September 1, 2015, by and between Hokkaido University and the BOARD OF TRUSTEES OF THE LELAND STANFORD JUNIOR UNIVERSITY, a body having corporate powers under the laws of the State of California for this International Multi-Site Clinical Trial.

From Hokkaido University, three patients have been successfully registered up to March 2018.

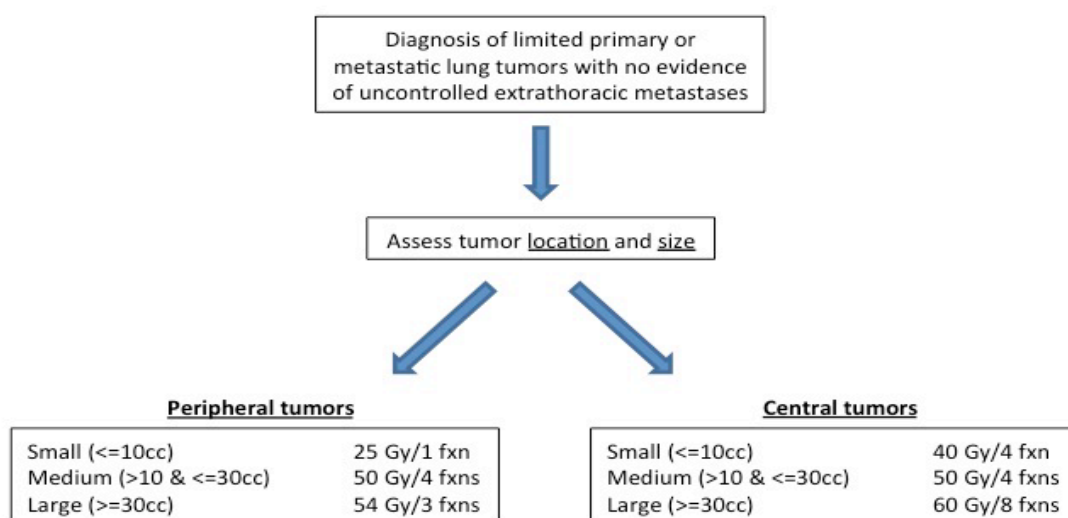


Fig.12 Schema of Phase II trial of individualized lung tumor stereotactic ablative radiotherapy (iSABR).

a-2. International Randomized Study of Transarterial Chemoembolization (TACE) versus Stereotactic Body Radiotherapy (SBRT) / Stereotactic Ablative Radiotherapy (SABR) for Residual or Recurrent Hepatocellular Carcinomas after Initial TACE. P.I. Daniel Chang, Protocol Number: IRB-35937 (Fig. 13)

From Hokkaido University, one patient has been successfully registered up to March 2018.

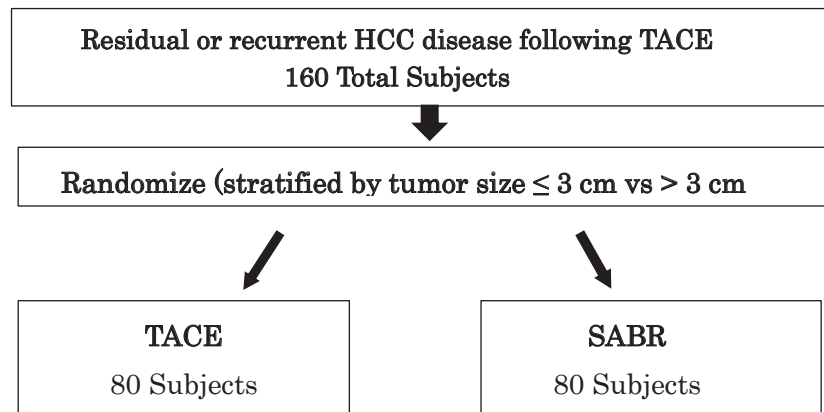


Fig.13 Schema of International Randomized Study of Transarterial Chemoembolization (TACE) versus Stereotactic Body Radiotherapy (SBRT) / Stereotactic Ablative Radiotherapy (SABR) for Residual or Recurrent Hepatocellular Carcinomas after Initial TACE.

b. Radiomics

A biomarker has been developed by Dr. Li of SU in collaboration with Dr. Tha based on radiomics. Dr. Cui, started working as a post-doctoral researcher of the GSQ and currently holds a double appointment between SU and HU, started clinical data analysis with Dr. Li of SU who has also once been hired at the GI-CoRE.

b-1. Glioblastomas

1. Cui Y, Tha KK, Terasaka S, Yamaguchi S, Wang J, Kudo K, Xing L, Shirato H, Li R. Prognostic Imaging Biomarkers in Glioblastoma: Development and Independent Validation on the Basis of Multiregion and Quantitative Analysis of MR Images. *Radiology*. 2016 Feb;278(2):546-53. doi: 10.1148/radiol.2015150358.
2. Cui Y, Ren S, Tha KK, Wu J, Shirato H, Li R. Volume of high-risk intratumoral subregions at multi-parametric MR imaging predicts overall survival and complements molecular analysis of glioblastoma. *Eur Radiol*. 2017 Sep;27(9):3583-3592. doi: 10.1007/s00330-017-4751-x

b-2. Breast cancer

1. Wang J, Kato F, Oyama-Manabe N, Li R, Cui Y, Tha KK, Yamashita H, Kudo K, Shirato H. Identifying Triple-Negative Breast Cancer Using Background Parenchymal Enhancement Heterogeneity on Dynamic Contrast-Enhanced MRI: A Pilot Radiomics Study. *PLoS One*. 2015 Nov 24;10(11):e0143308. doi: 10.1371/journal.pone.0143308.
2. Wang J, Kato F, Yamashita H, Baba M, Cui Y, Li R, Oyama-Manabe N, Shirato H. Automatic Estimation of Volumetric Breast Density Using Artificial Neural Network-Based Calibration of Full-Field Digital Mammography: Feasibility on Japanese Women With and Without Breast Cancer. *J Digit Imaging*. 2017. doi: 10.1007/s10278-016-9922-9
3. Wu J, Sun X, Wang J, Cui Y, Kato F, Shirato H, Ikeda DM, Li R. Identifying relations between imaging phenotypes and molecular subtypes of breast cancer: Model discovery and external validation. *J Magn Reson Imaging*. 2017 Oct;46(4):1017-1027. doi: 10.1002/jmri.25661.

c. Overview of radiotherapy

Based on the discussion at the GI-CoRE symposium, HU and SU have written a review article about the state-of-art of radiotherapy and the selection of external beam radiotherapies for precise and accurate cancer treatments.

1. Le QT, Shirato H, Giaccia AJ, Koong AC. Emerging Treatment Paradigms in Radiation Oncology. Clin Cancer Res. 2015 Aug 1;21(15):3393-401. doi: 10.1158/1078-0432.CCR-14-1191.
2. Shirato H, Le QT, Kobashi K, Prayongrat A, Takao S, Shimizu S, Giaccia A, Xing L, Umegaki K. Selection of external beam radiotherapy approaches for precise and accurate cancer treatment. J Radiat Res. 2018 Jan 24. doi: 10.1093/jrr/rrx092

(b) Medical Physics Section

We have conducted international collaborative research in the Medical Physics Section between HU and SU as follows.

a. Several novel imaging techniques are being investigated, including proton-induced X-ray fluorescence CT, X-ray-induced acoustic imaging, and Multi-energy Cone Beam CT.

1. Bazalova-Carter M, Ahmad M, Matsuura T, Takao S, Matsuo Y, Fahrig R, Shirato H, Umegaki K, Xing L: "Proton-induced x-ray fluorescence CT imaging.", Med Phys., 2015 Feb;42(2):900-7 (2015)
2. 3-year Kakenhi Grant-in-Aid for Young Scientists from the JSPS awarded to Dr. Hao Peng toward "Development of a hybrid tomosynthesis and acoustic imaging modality for early detection of breast cancer."
3. 2-year Kakenhi Grant-in-Aid for Young Scientists from the JSPS awarded to Dr. Jeffrey Wang toward "Development of an acoustic imaging modality for absolute and real-time radiotherapy dosimetry."

b. Developments concerning characterization of the impact of novel radiation and proton therapy techniques are also underway in parallel, including use of acoustics methods for range verification, devices to decrease duration of irradiation during movement, real-time image gating on spot scanning proton therapy, analytical models of dose-averaged-linear energy transfer, phosphor-coated phantoms, and gold nanoparticles.

1. Ahmad, M., Xiang, L., Yousefi, S., & Xing, L. (2015). Theoretical detection threshold of the proton-acoustic range verification technique. *Medical Physics*, 42(10), 5735–5744.
2. Matsuura T, Fujii Y, Takao S, Yamada T, Matsuzaki Y, Miyamoto N, Takayanagi T, Fujitaka S, Shimizu S, Shirato H: "Development and evaluation of a short-range applicator for treating superficial moving tumors with respiratory-gated spot-scanning proton therapy using real-time image guidance.", *Phys Med Biol.*, 61(4):1515-31 (2016)
3. Kanehira, Matsuura, Takao et al., "Impact of Real-Time-Image gating on Spot Scanning Proton Therapy for Lung Tumors: A Simulation Study," *International Journal of Radiation Oncology Biology Physics* 97.1 (2017): 173-181.
4. Hirayama, Matsuura, Ueda et al., "An Analytical Dose-Averaged LET-Calculation Algorithm Considering the Off-Axis LET Enhancement by Secondary Protons for Spot-Scanning Proton Therapy," *Med. Phys.* submitted (2018)

(c) Radiation Biology Section

International collaborative research in radiation biology has been conducted between HU and SU to find novel molecular targets and radiation sensitizers to improve the efficacy of radiation therapy.

1. RGD-conjugated gold nanoparticles (AuNPs) in radiotherapy decrease the invasive activity of breast cancer cells: The work has been conducted mainly at HU (Drs. Nam, Onodera, and Shirato) by collaboration with SU (Drs. Rankin and Giaccia) and companies (Aisin Seiki Co., Ltd., Aichi, Japan and IMURA America, Inc., Ann Arbor, MI). The study suggests that RGD/P-AuNPs can target integrin-overexpressing cancer cells to improve radiation therapy by suppressing invasive activity in addition to providing sensitization. The findings provide a possible clinical strategy for using AuNPs to treat invasive breast cancer following radiotherapy. Further studies are needed for a detailed understanding of the molecular mechanism. (Fig. 14)

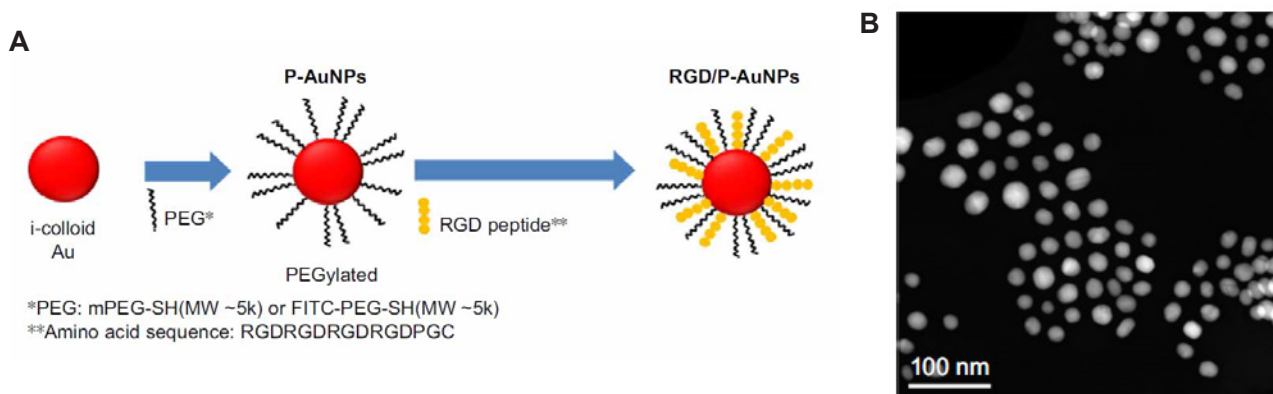


Fig. 14 (A)Schematic diagram of RGD/P-AuNPs. (B) Dark-field TEM image of synthesized AuNPs.

- Wu PH, Onodera Y, Ichikawa Y, Rankin EB, Giaccia AJ, Watanabe Y, Qian W, Hashimoto T, Shirato H, Nam JM. Targeting integrins with RGD-conjugated gold nanoparticles in radiotherapy decreases the invasive activity of breast cancer cells. *Int J Nanomedicine*. 2017 Jul 14;12:5069-5085. doi: 10.2147/IJN.S137833.

2. Radiation increases the invasive activity of breast cancer cells by altering the lysosome exocytosis: To find novel molecular targets and understand the mechanism of the activity, the exocytosis pathway in cells has been analyzed by Dr. Wu under supervision of staff at HU and SU, Drs. Shirato, Nam, Onodera, Giaccia, and Le. Dr. Wu, a graduate student at HU, found that radiation enhances lysosome exocytosis in breast cancer cells, an activity that can lead to increases in the invasive activity. The work will focus on providing details of a novel mechanism to understand cancer invasion after radiotherapy and suggest novel approaches to counteract this undesirable effect of radiotherapy.

- Wu PH, Onodera Y, Giaccia AJ, Le QT, Shirato H, Nam JM. Radiation increases invasive activity of breast cancer cells via altering lysosome exocytosis. *AACR Annual Meeting 2018*. Chicago, 2018. 4. 14-18.

3. Carrageenan as an adjuvant to improve radiotherapy: To identify radiation sensitizing compounds, HU and SU researchers paid attention to carrageenan, a family of linear sulfated polysaccharides. (Drs. Recuenco, Hsieh, Wu, Onodera, Giaccia, Le, Shimizu, Shirato, and Nam) The combined treatment of radiation and carrageenan significantly reduces lung metastasis in a 4T1 xenograft model of murine mammary cancer. The results of the work will potentially provide a therapeutic strategy with carrageenan as an adjuvant for radiotherapy.

- Hsieh CC*, Wu PH*, Recuenco FC, Onodera Y, Sasaki N, Giaccia AJ, Le QT, Shimizu S, Shirato H, Nam JM. Carrageenan as an adjuvant to improve radiotherapy via reducing the metastatic potential of breast cancer. *Equal contributions (Manuscript under preparation)

● Research results (FY 2014-2018)

As of April 2018

1. International collaborative papers (peer reviewed)	Featured in Japanese journals: 5, featured in overseas journals: 29
2. Other publications	Featured in Japanese journals: 48, featured in overseas journals: 132, books published: 1
3. Verbal presentations	Keynote speeches:7, invited lectures:86 (Japanese 70, International 16) other presentations: 111 (Japanese 85, International 26)
4. Patent applications	Registered patents: 14 (8 in Japan, 6 overseas) Pending patents: 1 (0 in Japan, 1 overseas)
5. Awards received	11
6. External grants	5

1) International collaborative papers (peer reviewed)

- Journals published by Japanese publishers, including those published in English, are listed as "Japanese journals".
- Papers where "GI-CoRE" is stated as an affiliated institution of a Japanese or overseas researcher, or those mentioning "Hokkaido University" in the acknowledgements, are marked with a "*" (asterisk)" and the applicable author name is underlined.
- Among the papers with "*" (asterisk)", papers where "GI-CoRE" is stated as an affiliated institution are marked with "i)", and papers which mention "Hokkaido University" in the acknowledgements are marked with "ii)".
- Papers where GI-CoRE researchers of Hokkaido University and Stanford University are stated are marked with "o".

- (1) Le QT, Shirato H. Preface. *J Radiat Res*. 2018 Mar 8. doi: 10.1093/jrr/rry015. [Epub ahead of print] PubMed PMID: 29528445 (2018) [Japanese journal] ○
- (2) Shirato H, Le Q-T, Kobashi K, Prayongrat A, Takao S, Shimizu S, Giaccia A, Xing L, Umegaki K: "Selection of external beam radiotherapy approaches for precise and accurate cancer treatment", *J Radiat Res*. Vol. 59, Issue suppl_1, 1 March 2018, i2-i10 (2018) [Japanese journal] *i) ○
- (3) Wu J, Tha KK, Xing L, and Li R: "Radiomics and radiogenomics for precision radiotherapy," *J Radiat Res*. DOI: 10.1093/jrr/rrx102 Published: 27 January (2018) [Japanese journal]*i) ○
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- (132) Tha KK: “The directional metrics of diffusion”, *J Radiol Radiat Ther*, 2(2): 1030. (2014)

Published books

- (1) Shirato H, Taguchi H: “Radiation Therapy”, Basics and Clinical, Gastroenterology, Nishimurasyoten, Inc., 1341-1344, 2015

3) Verbal presentations

- major presentations only.
- international conferences held in Japan are listed as “-[International conference]”.

Keynote speeches

- (1) Shirato H: “Painful years for particle beam therapists resulted in a little hope: Japanese experience”, The 5th Japan-Taiwan Radiation Oncology Symposium “No Pain, No Gain”. Kobe, May 20, 2017 [International conference]
- (2) Shirato H: “From Real-time Tumor-Tracking Technology to Motion Science in Life”, The 75th Annual Meeting of the Japanese Cancer Association, Yokohama, 2016.10.8 [Japanese conference]
- (3) Shirato H: “Present and future of proton beam therapy”, Sapporo, The 9th Specialist Seminar, Hokkaido Branch of the Japanese Society of Gastroenterology Japanese Gastroenterological Endoscopy Society, 2015.8.30 [Japanese conference]
- (4) Shirato H: “Features and perspectives of radiation therapy and particle therapy”, Sapporo, The 13th Japanese Society of Medical Oncology 2015 Annual Meeting, 2015.7.17 [Japanese conference]
- (5) Shirato H: “An image-guided spot-scanning proton beam therapy gated to real-time tumor-tracking system”, 3rd ESTRO Forum Joint Symposium: ESTRO-JASTRO, Barcelona, Spain, April 24-28, 2015 [International conference]
- (6) Shirato H: “Quality of Radiotherapy; Treatment (Quality control, guidelines, standard treatment)”, Yokohama, The 74th Annual Meeting of the Japan Radiological Society, 2015.4.19 [Japanese conference]
- (7) Umegaki K: “Development of gated spot scanning proton beam therapy system with real-time tumor tracking.”, Busan (South Korea) BEXCO, The 7th Korea-Japan Joint Meeting on Medical

Physics, Plenary Symposium, 2014.9.25 [International conference]

Invited lectures [Japanese conference]

- (1) Manabe N: “Findings in coronary artery pseudoaneurysms”, The 86th Study Meeting of Japan Society of Cardiovascular Radiology, Tokyo, January 13, 2018 [Japanese conference]
- (2) Manabe N: “We need to respond to every kind of cardiovascular disease! Beyond cardiac MRI”, The 4th Gunma Cardiac MRI Study Meeting, Maebashi, January 18, 2018 [Japanese conference]
- (3) Kudo K: “Improvements in QSM analysis and recently appearing topics”, Hi Advanced MRI Seminar in Kansai, Osaka, February 3, 2018 [Japanese conference]
- (4) Manabe N: “MRI of hypertrophic cardiomyopathy”, Cardiomyopathy Symposium, Tokyo, February 17, 2018 [Japanese conference]
- (5) Kudo K: “Acute phase diagnosis of cerebral ischemia”, The 43rd Japan Stroke Society Academic Conference, Fukuoka, March 15, 2018 [Japanese conference]
- (6) Manabe N: “Advantage of Comprehensive Myocardial Perfusion CT imaging”, The 82nd Annual Scientific Meeting of the Japanese Circulation Society, Osaka, March 24, 2018 [Japanese conference]
- (7) Kudo K: “TBD”, The 77th Annual Meeting of the Japan Radiological Society, JCR Hour 2018, Yokohama, April 15, 2018 (Scheduled) [Japanese conference]
- (8) Kudo K: “Images in the acute phase of cerebral infarction (tentative)”, FAST Conference, Tokyo, April 21, 2018.4.21 (Scheduled) [Japanese conference]
- (9) Kudo K: “TBD”, The 59th Annual Meeting of the Japanese Society of Neurology – Luncheon seminar, Sapporo, May 24, 2018 (Scheduled) [Japanese conference]
- (10) Kudo K: “Symptoms of Parkinson’s Disease: Focus on diagnostic imaging targeting the main complaint”, The 59th Annual Meeting of the Japanese Society of Neurology – Education course, Sapporo, May 26, 2018 (Scheduled) [Japanese conference]
- (11) Shirato H: “TBD”, The 77th Annual Meeting of the Japanese Cancer Association, Osaka, September 28, 2018 (Scheduled) [Japanese conference]
- (12) Kudo K: “Basics of analysis algorithms in Perfusion CT (Educational lecture)”, The 2nd Pancreas Perfusion · Functional Imaging Study Group, Tokyo, January 28, 2017 [Japanese conference]
- (13) Manabe N: “Cardiac MRI”, Japanese College of Cardiology Fundamental Course, Osaka, February 19, 2017 [Japanese conference]
- (14) Kudo K: “QSM: Newly available magnetic contrast features” (Symposium), The 40th Annual Meeting of the Japan Society for CNS Computed Imaging, Kagoshima, March 3-4, 2017 [Japanese conference]
- (15) Tha KK: “Noninvasive Assessment of Electrical Conductivity of Brain Tumors by MRI” (Symposium, The 40th Annual Meeting of the Japan Society for CNS Computed Imaging) Qualitative diagnosis of brain tumor - how far is it possible -, Kagoshima Sun Royal Hotel, March 3-4, 2017 [Japanese conference]
- (16) Manabe N: “Cardiac MRI”, The 34th Setouchi Cardiac CT / MR Study Meeting, Matsuyama, March 12, 2017 [Japanese conference]
- (17) Manabe N: “Diagnostic imaging of the myocardium with MRI”, The 9th Kyushu-Yamaguchi Cardiovascular Imaging Study Group, Fukuoka, March 25, 2017 [Japanese conference]
- (18) Tha KK: “Myself and Radiology Career” (Symposium), The 73rd Spring Congress of Japanese Society of Radiological Technology, Yokohama, April 16, 2017 [Japanese conference]
- (19) Abo D, Soyama T, Morita R, Kudo K: “Trancecatheter Arterial Embolization (TAE) for pulmonary arteriovenous malformation (PAVM) using a Detachable coil at Hokkaido University Hospital”, The 46th Annual Meeting of the Japanese Society of Interventional Radiology, Okayama, May 18, 2017 [Japanese conference]

- (20) Abo D: "Drainage based on anatomical features – the upper abdomen –", Technical education seminar, The 46th Annual Meeting of the Japanese Society of Interventional Radiology, Okayama, May 19, 2017 [Japanese conference]
- (21) Kudo K: "Basics of quantitative magnetic susceptibility mapping (QSM) and its clinical application", Radiology Forum, Chuo, May 26, 2017 [Japanese conference]
- (22) Manabe N: "Differential diagnosis of cardiomyopathy using cardiac MRI", The 52nd Educational Seminar, Japanese College of Cardiology Fundamental Course, Tokyo, May 28, 2017 [Japanese conference]
- (23) Manabe N: "Cardiac involvement in patients with sarcoidosis", The 11th Congress of Asian Society of cardiovascular imaging, Kyoto, June 1-3, 2017 [Japanese conference]
- (24) Kudo K: "Basics of MR examinations: central nerve / spinal area", The 18th Introductory Study of MR, Kyoto, June 10, 2017 [Japanese conference]
- (25) Manabe N: "Recent topics for diagnostic imaging of the cardiac area", The 31st The Hokkaido Society of Nuclear Medicine Technology Seminar, June 17, 2017 [Japanese conference]
- (26) Manabe N: "How very useful! Cardiac MRI", Toyoake Heart Imaging Seminar, Nagoya, June 22, 2017 [Japanese conference]
- (27) Tha KK: "Radiomics in Cancer Research and Therapy" (Special lecture), The 23rd Annual Meeting of Sensitization of Cancer Treatment Study Group, Karuizawa, July 15, 2017 * [Japanese conference]
- (28) Kudo K: "Progress of equipment / software", MR", SAMI 2017, Advanced Medical Imaging Study Group. Osaka, July 22, 2017 [Japanese conference]
- (29) Manabe N: "We have to fully understand this much in cardiac diagnostic imaging - The latest technology", The 33rd Japan Conference of Radiological Technologists / The 24th East Asia Conference of Radiological Technologists, September 23, 2017 [Japanese conference]
- (30) Kudo K: "MRI imaging with the stable oxygen isotope O-17", The 2nd Hokkaido Kamui Conference, Sapporo, September 2, 2017 [Japanese conference]
- (31) Kudo K: "Current Topics of Cerebral Perfusion and Oxygen Metabolism Imaging", Joint Symposium, The 45th Annual Meeting of the Japanese Society of Magnetic Resonance in Medicine – CSMRM – JSMRM, Utsunomiya, September 15, 2017 [Japanese conference]
- (32) Kudo K: "New developments in QSM imaging and analysis", Luncheon seminar, The 45th Annual Meeting of the Japanese Society of Magnetic Resonance in Medicine – CSMRM – JSMRM, Utsunomiya, September 15, 2017 [Japanese conference]
- (33) Kudo K: "MRI imaging with the stable oxygen isotope O-17", The 33rd Brain Function Imaging Conference, Kobe, September 23, 2017 [Japanese conference]
- (34) Kudo K: "Advanced Neuro MR Imaging", Hitachi Healthcare Global Partners Summit 2017, Tokyo, October 12, 2017 [Japanese conference]
- (35) Kudo K: "Full automated analysis of CT / MR perfusion images using PMA software", The 60th Annual Meeting of the Japanese Society of Cerebral Blood Flow and Metabolism, Osaka, November 3, 2017 [Japanese conference]
- (36) Kudo K: "Basic interpretation of brain MRI images - Focusing on cerebrovascular disorders and brain metastasis", The 2nd Medical Image Laboratory Lecture Meeting, Kushiro, November 7, 2017 [Japanese conference]
- (37) Kudo K: "Brain CT / MRI for physicians and technicians not specializing in the central nervous system – Focus on vascular disorders –", MIL Diagnostic Imaging Seminar, Asahikawa, November 16, 2017 [Japanese conference]
- (38) Kudo K: "Magnetic susceptibility analysis of the brain and abdomen by a newly developed QSM analysis method", The 53rd Miyazaki MRI Study Meeting, Miyazaki, December 5, 2017 [Japanese conference]
- (39) Abo D: "IVR meets post-surgical complications!", Resident Seminar, Yokohama, April 16, 2016

- [Japanese conference]
- (40) Shirato H: “Radiation therapy for cancers” (Special lecture) Radiation therapy for cancers, Tonan Hospital, June 20, 2016 [Japanese conference]
 - (41) Katoh N: “Proton beam therapy for liver cancer (short lecture)”, The 27th Annual Meeting of Liver Cancer Study Group of Hokkaido, Sapporo, June 25, 2016 [Japanese conference]
 - (42) Kudo K: “Evaluation of brain structure and oxygen metabolism by quantitative magnetic susceptibility mapping (QSM) (Symposium)”, The 57th Annual Meeting of the Japanese Society of Neurology, Kobe, May 18, 2016 [Japanese conference]
 - (43) Manabe N: “MRI findings based on cardiac sarcoidosis cases” AIMS Cardiac Imaging, Tokyo, May 21, 2016 [Japanese conference]
 - (44) Kudo K: “Oxygen metabolism imaging by MRI (Educational lecture)”, The 72nd Annual Meeting of the Cerebral Nerve Image Study Group, Akita, May 27, 2016 [Japanese conference]
 - (45) Kudo K: “Basics of MR examinations: central nerve / spinal area (Educational lecture)”, The 17th Introductory Study of MR, Tokyo, June 4, 2016 [Japanese conference]
 - (46) Manabe N: “Potential of a One stop shop for cardiac CT”, The 14th Hokkaido Cardiac CT Technical Seminar, Sapporo, June 15, 2016 [Japanese conference]
 - (47) Kudo K: “Structure and function of the brain depicted by QSM (Educational lecture)”, The 13th Okayama Advanced Imaging Seminar, Okayama, July 2, 2016 [Japanese conference]
 - (48) Manabe N: “Evaluation of myocardial ischemia and coronary blood flow reserve capacity using MRI”, The 26th Annual Meeting of the Japanese Society of Nuclear Cardiology, Tsu, July 16, 2016 [Japanese conference]
 - (49) Abo D: “Basic facts of radiation exposure”, The 2nd Imaging Seminar in Tokachi, Obihiro, August 19, 2016 [Japanese conference]
 - (50) Manabe N: “New potentials for Cardiac MRI”, The 44th Annual Meeting of the Japanese Society of Magnetic Resonance in Medicine, Omiya, September 9, 2016 [Japanese conference]
 - (51) Tha KK: “Current Aspects of Radiomics in Neuroimaging”, The 44th Annual Meeting of the Japanese Society of Magnetic Resonance in Medicine, Omiya, September 9, 2016 [Japanese conference]
 - (52) Manabe N: “Latest clinical applications of the 320-area detector CT in the circulatory field”, The 64th Annual Scientific Session of the Japanese College of Cardiology, Fireside Symposium, Tokyo, September 24, 2016 [Japanese conference]
 - (53) Manabe N: “Quantitative evaluation of myocardial blood flow and fibrosis using CT and MRI”, Hokkaido Cardiovascular Hospital, Sapporo, September 26, 2016 [Japanese conference]
 - (54) Shimizu S: Spot scanning proton beam therapy using real-time image guided technology (Hokkaido and Sakhalin Joint Cancer Symposium), Hokkaido University School of Medicine, Frate Hall, October 26-28, 2016 [Japanese conference]
 - (55) Kudo K: “Perfusion MRI: Challenges in clinical applications and future potentials including QIBA (Educational lecture)”, Bayer Radiology Day, Osaka, October 29, 2016 [Japanese conference]
 - (56) Manabe N: “How to scan? How to interpret? Cardiac MRI”, Bayer Image Diagnostic Web Conference, Osaka, November 16, 2016 [Japanese conference]
 - (57) Kudo K: “CT / MR perfusion imaging (Educational lecture)”, Brain Research Seminar, Sapporo, November 25, 2016 [Japanese conference]
 - (58) Manabe N: “Utility of CT and MRI in circulatory organs”, Sapporo Cardio Vascular Center, Cardiovascular Clinic, Sapporo, November 29, 2016 [Japanese conference]
 - (59) Manabe N: “Solutions to understanding diagnostic images with chest pain!”, Obihiro Kosei General Hospital Internship Seminar, Obihiro, December 16, 2016 [Japanese conference]

- (60) Shimizu S: Radiation therapy and particle therapy among the options for cancer treatment, The 30th Sapporo Winter Cancer Seminar, Sapporo Cancer Seminar Foundation, 2016.1.30 [Japanese conference]
- (61) Abo D: “The present state of non-vascular interventions in the hepatopancreatobiliary region in our department”, The 17th Annual meeting of the Japanese Society of Hepato-Pancreato-Biliary Study Group, Tomakomai, October 30, 2015 [Japanese conference]
- (62) Shirato H: “New directions in particle beam therapy – From therapeutic science to health care medicine”, Maehashi, The 28th Annual Meeting of the Japanese Society for Radiation Oncology, 2015.11.20 [Japanese conference]
- (63) Umegaki K: “Development of the innovative proton beam therapy system through industry-academia collaboration”, Tokyo Medical and Dental University, medU-net Regulatory Science Seminar, 2015.11.12 [Japanese conference]
- (64) Shimizu S: “Mission of the innovative proton beam therapy system”, Hakodate, The 52nd Annual Congress of Japan Municipal Hospital Association, 2015.10.9 [Japanese conference]
- (65) Shimizu S: “The latest proton beam therapy system”, Morioka, Iwate Prefectural Information Exchange Center, From photon beam therapy to particle beam therapy, The 51st Autumn Assembly of the Japan Radiological Society, 2015.10.3 [Japanese conference]
- (66) Umegaki K: “Proton beam therapy system using a real-time tumor monitoring system and spot-scanning beam therapy – From development to clinical application”, Hokkaido University, The 110th Annual Meeting of the Japan Society of Medical Physics, Sapporo, 110th Japan Society of Medical Physics, 2015.9.20 [Japanese conference]
- (67) Shimizu S: “Challenge of the Global Station for Quantum Medical Science and Engineering.”, Sapporo, 110th Japan Society of Medical Physics, 2015.9.19 [Japanese conference]
- (68) Shimizu S: “Proton beam therapy.”, Patient Advocate Program (PAP), Sapporo, The 13th Japanese Society of Medical Oncology 2015 Annual Meeting, 2015.7.17 [Japanese conference]
- (69) Umegaki K: “Development of the innovative proton beam therapy system – Implementation of proton beam therapy at Hokkaido University and future development”, Kaderu Sapporo 2.7, 2014 Annual Meeting on Radioisotope and Radiation Research, 2014.10.31 [Japanese conference]
- (70) Shimizu S: “The world first spot scanning proton beam therapy with IGRT”, Sapporo Convention Center, Educational Lecture at the 42nd Autumn Assembly of Japanese Society of Radiological Technology, 2014.10.11 [Japanese conference]

Invited lectures [International conference]

- (1) Manabe N: “Clinical application for cardiomyopathy”, Shiriraji CMR course, Bangkok, January 25-26, 2018 [International conference]
- (2) Manabe N: “Tissue characterization”, Shiriraji CMR course, Bangkok, January 25-26, 2018 [International conference]
- (3) Shimizu S: “Initial Clinical Experience for the Real-Time-Image Gated Proton (RGPT) System in Hokkaido University”, Radiation Oncology Grand Rounds, Johns Hopkins University (Baltimore), September 21, 2017 [International conference]
- (4) Matsuura T: “Physical Aspects for the RGPT System in Hokkaido University”, Radiation Oncology Grand Rounds, Johns Hopkins University (Baltimore), September 21, 2017 [International conference]
- (5) Kudo K: “Current Updates of QSM Sequence and Analysis”, 1st JKT (Japan-Korea-Taiwan) Neuroradiology Workshop, Osaka, October 7, 2017 [International conference]
- (6) Oyama-Manabe N: “CT coronaries combined with Perfusion: Does it add value to patient’s case and outcome”, German Roentgen Congress, Leipzig, May 25-27, 2017 [International conference]
- (7) Kudo K: “SWI and QSM in Stroke and Misery Perfusion KSMR”, Seoul, Korea, March 23-25, 2017

- (8) Kudo K: “Academic and Social Member Management” (Educational lecture), The 2nd AOSOR Chiang Mai, Thailand, November 17-19, 2016 [International conference]
- (9) Tha KK: “Tumors and cerebral white matter”, The 14th Annual Meeting of Myanmar Radiological Society, Chatrium Hotel Royal Lake, Yangon, Myanmar, November 4, 2016 [International conference]
- (10) Shimizu S: “Particle therapy – scanning method and gating for motion management.”, The 3rd GI-CoRE Medical Science and Engineering Symposium. Radiation Oncology, Biology&IVR, Sapporo, 2016.3.4 [International conference]
- (11) Nam JM: “Targeting integrin signaling to improve the efficacy of radiation treatment on breast cancer cells.”, The 3rd GI-CoRE Medical Science and Engineering Symposium. Radiation Oncology, Biology&IVR, Sapporo, 2016.3.3 [International conference]
- (12) Shimizu S: “Real time image-gated proton beam therapy.”, Seoul (South Korea), The 14th Seoul Radiation Oncology Symposium: Updates in Image-Guided Radiation Therapy, 2015.10.30 [International conference]
- (13) Kudo K: Contrast Enhanced MRI for Brain Tumors, 10th AOCNR Fukuoka, Japan 2015.11.5 [International conference]
- (14) Tha KK: Identification of Noninvasive Biomarkers for Glioblastoma: The Role of “Radiomics”. Taipei (Taiwan), NeuroImaging Summit., 2015.10.17 [International conference]
- (15) Umegaki K, Shirato H: “Development of Real-time Image Gated Spot Scanning Proton Beam Therapy (RGPT) system, National Taiwan University”, 2015 International Symposium on Radiation Medicine 2015.10.4 [International conference]
- (16) Shimizu S, Shirato H, Umegaki K, Hokin K: “Spot Scanning Proton beam therapy –State-of-the-art technology.”, Yuzhno-Sakhalinsk (Russia), Sakhalin Cancer Conference.”, 2014.10.1-3 [International conference]

Other presentations [Japanese conference]

- (1) Furuya S, Manabe N, Manabe O, Ohira H, Aikawa T, Koyanagawa K, Naya M: “Is accumulation in the liver an appropriate threshold measure for metabolic volume measurements of cardiac sarcoidosis lesions?”, The 28th Annual Meeting of Japanese Society of Cardiovascular Imaging & Dynamics, January 12-13, 2018 [Japanese conference]
- (2) Yasuda K, Tsuchiya K, Hatakeyama H, Homma A, Shimizu Y, Furukawa H, Onimaru R, Akita H, Fukuda S, Shirato H: “Treatment outcome after Radiation Therapy for Mucosal Malignant Melanoma of Head and Neck”, The 76th Annual Meeting of the Japan Radiological Society, Yokohama, April 13-16, 2017 [Japanese conference]
- (3) Oyama-Manabe N: “Evaluation of delayed contrast-enhanced CT with iterative model-based reconstruction in cardiac sarcoidosis: comparison with MRI”, The 76th Annual Meeting of the Japan Radiological Society, Yokohama, April 13-16, 2017 [Japanese conference]
- (4) Kinoshita R, Shimizu S, Nishikawa Y, Nishioka K, Hashimoto T, Suzuki R, Shirato H: “Incidental radiation dose to internal mammary lymph node in tangential breast irradiation: comparison of calculation algorithm” The 76th Annual Meeting of the Japan Radiological Society, Yokohama, April 13-16, 2017 [Japanese conference]
- (5) Morita R, Sakuhara Y, Katoh N, Abo D, Soyama T, Kudo K, Shirato H: “Percutaneous hepatic fiducial marker implantation for Real-time Tumor-tracking Radiotherapy (RTRT)”, The 76th Annual Meeting of the Japan Radiological Society, Yokohama, April 13-16, 2017 [Japanese conference]
- (6) Sasaki F, Nagasaki T, Masuyama K, Higashino K, Nakano S, Ishikawa M: “Comprehensive evaluation of the accuracy of the 3-dimensional water phantom scanning axis using a kV imaging device”, The 73rd Spring Congress of Japanese Society of Radiological Technology, Yokohama, April 13-16, 2017 [Japanese conference]

- (7) Ishikawa M, Nara K, Sutherland K, Takigami M, Asano T, Kojima H: "Improvements in dose distribution analysis using dose gradient information", The 113rd Annual Meeting of the Japan Society of Medical Physics, Yokohama, April 13-16, 2017 [Japanese conference]
- (8) Ogawara R, Ishikawa M: "Improvements in the tracking accuracy by volume of response analysis using a Parallel plane PET device", The 113rd Annual Meeting of the Japan Society of Medical Physics, Yokohama, April 13-16, 2017 [Japanese conference]
- (9) Nara K, Kojima H, Sutherland K, Ishikawa M: "A study of film resolution on the analysis of dose distributions with filmed data", The 113rd Annual Meeting of the Japan Society of Medical Physics, Yokohama, April 13-16, 2017 [Japanese conference]
- (10) Murayama Y, Baba K, Ogawara R, Ishikawa M: "Optical transport simulation for improvement of SOF detector using Geant", The 113rd Annual Meeting of the Japan Society of Medical Physics, Yokohama, April 13-16, 2017 [Japanese conference]
- (11) Kobayashi Y, Myojin M, Yuki T, Ishikawa M: "Study on a new method to create CT value density conversion tables for dose calculations using CBCT images", The 113rd Annual Meeting of the Japan Society of Medical Physics, Yokohama, April 13-16, 2017 [Japanese conference]
- (12) Fujii T, Matsuura T, Takao S, Miyamoto N, Hirayama S, Umegaki K, Shimizu S, Umekawa T, Baba R, Shirato H: "Analysis software to evaluate deviation of water-equivalent thickness along proton beam path between Plan CT and CBCT for proton therap", The 113rd Annual Meeting of the Japan Society of Medical Physics, Yokohama, April 13-16, 2017 [Japanese conference]
- (13) Hirayama S, Matsuura T, Koyano H, Takao S, Fujii T, Miyamoto N, Shimizu S, Fujii Y, Yamada T, Nihongi H, Umekawa T, Fujimoto R, Umegaki K, Shirato H: "The Retrospective Interplay Effect Evaluation for Real-time Image-gated Proton Therapy using the Fiducial Marker Motion and Treatment Machine Log", The 113rd Annual Meeting of the Japan Society of Medical Physics, Yokohama, April 13-16, 2017 [Japanese conference]
- (14) Soyama T, Abo D, Morita R, Sakuhara Y, Kudo K, Tsujino I, Nakatani M: "A case of embolization with AVP II for portopulmonary hypertension affected by congenital portosystemic shunt", The 46th Annual Meeting of the Japanese Society of Interventional Radiology, Okayama, May 18-20, 2017 [Japanese conference]
- (15) Yasuda K, Katoh N, Okamoto S, Kinoshita R, Shiga T, Mizumachi T, Hatakeyama H, Homma A, Taguchi J, Shimizu Y, Mori T, Tsuchiya K, Shirato H: "Treatment results with external irradiation including IMRT for the bone metastasis of differentiated thyroid tumors", The 41st Annual Meeting of Japan Society for Head and Neck Cancer, Kyoto, June 8-9, 2017 [Japanese conference]
- (16) Kato F, Aoike S, Hakoishi S, Umiya Y, Yamashita K, Baba M, Ishida N, Manabe N, Kudo K: "Clinical utility of the blood flow analysis software PMView for mammary gland dynamic MRI: for the Semi-automatic ROI function", The 25th Annual Meeting of the Japanese Breast Cancer Society, Fukuoka, July 13-15, 2017 [Japanese conference]
- (17) Kikuchi H, Yoshino H, Kato F, Kudo K, Shirato H: "Development of a database and teaching files for interpretation of autopsy images", The 15th Annual Meeting of the Japan Society of Autopsy Imaging, Tsu, August 26, 2017 [Japanese conference]
- (18) Kato F, Ihira K, Nozaki A, Naka T, Matsuno Y, Watari H, Manabe N, Kudo K: "Two cases of uterine cervical clear cell adenocarcinoma", The 18th Japanese Society for the Advancement of Women's Imaging Symposium, Awaji, September 1-2, 2017 [Japanese conference]
- (19) Kikuchi H, Yoshino H, Kudo K, Kato F, Nasuhara Y, Shinagawa N, Shimizu Y, Tanaka S, Hyodoh H, Matoba K, Mikami H, Tanaka S, Shirato H: "The roles of the autopsy imaging section and radiation diagnosticians at the Center for Cause of Death Investigations, Hokkaido University", The 53rd Autumn Assembly of the Japan Radiological Society, Matsuyama, September 8-10, 2017 [Japanese conference]
- (20) Soyama T, Abo D, Kato D, Yoshino H, Morita R, Kudo K: "Five cases of postoperative abscesses where drainage under ultrasonic guidance was possible for a transcuteaneous transluminal fistula",

The 53rd Autumn Assembly of the Japan Radiological Society, Matsuyama, September 8-10, 2017 [Japanese conference]

- (21) Morita R, Soyama T, Abo D, Kudo K: "Case presentations of collaboration with surgery and IVR to improve survival rates", The 9th Annual Meeting of the Japanese Society for acute Care Surgery Sapporo, September 9, 2017 [Japanese conference]
- (22) Miyamoto N, Suzuki R, Takao S, Matsuura T, Hirayama S, Fujii T, Tomioka S, Shimizu S, Umegaki K, Shirato H: "Evaluation of measurement accuracy of novel monoscopic X-ray imaging technique for three-dimensional target localization using multiple internal fiducial markers", The 114th Annual Meeting of the Japan Society of Medical Physics, September 15-17, 2017 [Japanese conference]
- (23) Arai Y, Ueda H, Nakagawa H, Miyamoto N, Umegaki K: "Target tumor localization algorithm using multiple fiducial markers for Real-time Tumor-tracking Radiation Therapy", The 114th Annual Meeting of the Japan Society of Medical Physics, September 15-17, 2017 [Japanese conference]
- (24) Nakagawa H, Miyamoto N, Hirayama S, Ueda H, Yokokawa K, Umegaki K: "Evaluation of dosimetric error with utilizing respiratory motion modeling aimed for beam angle optimization in proton beam therapy", The 114th Annual Meeting of the Japan Society of Medical Physics, September 15-17, 2017 [Japanese conference]
- (25) Hirayama S, Matsuura T, Ueda H, Takao S, Koyano H, Fujii T, Miyamoto N, Shimizu S, Fujii Y, Fujimoto R, Umegaki K, Shirato H: "Evaluation of the sensitivity to variable RBE considering LET dependence for the robust optimization and the PTV-based optimization", The 114th Annual Meeting of the Japan Society of Medical Physics, September 15-17, 2017 [Japanese conference]
- (26) Fujii T, Matsuura T, Takao S, Hirayama S, Miyamoto N, Umegaki K, Shimizu S, Umekawa T, Shirato H: "Evaluation of Water-Equivalent-Thickness (WET) deviation between Plan CT and Re-plan CT for prostate cancer in Spot-Scanning Proton-beam Therapy", The 114th Annual Meeting of the Japan Society of Medical Physics, September 15-17, 2017 [Japanese conference]
- (27) Murayama Y, Baba K, Kuga Y, Ishikawa M: "Study for the development of a single probe SOF detector using a C-MOS camera", The 14th Congress on Neutron Capture Therapy, Koriyama, September 29-30, 2017 [Japanese conference]
- (28) Baba K, Murayama Y, Ishikawa M: "Basic Study of the Bonner Sphere Spectrometer using a SOF Detector with particle transport calculation code Geant 4", The 14th Congress on Neutron Capture Therapy, Koriyama, September 29-30, 2017 [Japanese conference]
- (29) Hashimoto T, Terasaka S, Iguchi A, Yamaguchi S, Kobayashi H, Sugiyama M, Cho Y, Mori T, Takao S, Matsuura T, Onimaru R, Shimizu S, Shirato H: "Two cases of AYA germ cell tumors where intensity modulated proton beam irradiation (IMPT) of the entire skull and vertebra was useful in reducing myelosuppression", The 59th Annual Meeting of the Japanese Society of Pediatric Hematology / Oncology, Ehime, November 9-11, 2017 [Japanese conference]
- (30) Wu PH, Onodera Y, Ichikawa Y, Rankin EB, Giaccia AJ, Watanabe Y, Qian W, Hashimoto T, Shirato H, Nam JM: "Targeting integrins with RGD-conjugated gold nanoparticles in radiation therapy", The 30th Annual Meeting of the Japanese Society for Radiation Oncology, November 17-19, 2017 [Japanese conference] *i) ii)
- (31) Yasuda K, Katoh N, Okamoto S, Kinoshita R, Shiga T, Mizumachi T, Homma A, Taguchi J, Shimizu Y, Mori T, Shirato H: "Treatment results with external irradiation for thyroid differentiated cancer bone metastasis", The 30th Annual Meeting of the Japanese Society for Radiation Oncology, November 17-19, 2017 [Japanese conference]
- (32) Mori T, Hashimoto T, Katoh N, Kinoshita R, Nishioka K, Nishikawa Y, Uchinami Y, Shane PY, Onimaru R, Shimizu S, Shirato H: "Initial report on the acceptance of non-Japanese patients undergoing proton beam treatment at Hokkaido University", The 30th Annual Meeting of the Japanese Society for Radiation Oncology, November 17-19, 2017 [Japanese conference]

- (33) Hashimoto T, Mori T, Takao S, Matsuura T, Onimaru R, Shimizu S, Shirato H: “Three cases of AYA germ cell tumors where intensity modulated proton beam irradiation (IMPT) of the entire vertebra was useful in reducing myelosuppression”, The 30th Annual Meeting of the Japanese Society for Radiation Oncology, November 17-19, 2017 [Japanese conference]
- (34) Nishioka K, Goto K, Shimizu S, Matsuura T, Takao S, Hashimoto T, Kinoshita R, Nishikawa Y, Shirato H: “Correlation between fluctuations in urine volume and positional changes in the prostate during radiotherapy”, The 30th Annual Meeting of the Japanese Society for Radiation Oncology, November 17-19, 2017 [Japanese conference]
- (35) Katoh N: “Stereotactic body / ablative radiotherapy and proton beam therapy for liver cancer” (Symposium), The 75th Annual Meeting of the Japan Radiological Society, Yokohama, April 14-17, 2016 [Japanese conference]
- (36) Kudo K: “Brain Structures and Oxygen Metabolism Visualized by Quantitative Susceptibility Mapping” (QSM) (Luncheon, oral presentation), The 75th Annual Meeting of the Japan Radiological Society, Yokohama, April 14-17, 2016 [Japanese conference]
- (37) Kudo K: “Training in report creation from images-reading of report — Moving beyond the framework of the teaching file —” (Luncheon, oral presentation), The 75th Annual Meeting of the Japan Radiological Society, Yokohama, April 14-17, 2016 [Japanese conference]
- (38) Manabe N: “MRI-based myocardial quantitative evaluation”, The 75th Annual Meeting of the Japan Radiological Society, Yokohama, April 14-17, 2016 [Japanese conference]
- (39) Manabe N: “Clinical impact of 320-row area detector CT- myocardial perfusion imaging”, The 75th Annual Meeting of the Japan Radiological Society, Yokohama, April 14-17, 2016 [Japanese conference]
- (40) Abo D, Sakuhara Y, Soyama T, Morita R, Kimira T, Kudo K: “Local recurrence rate of ultraselective transcatheter arterial chemoembolization (TACE) for hepatocellular carcinoma (HCC)”, The 75th Annual Meeting of the Japan Radiological Society, Yokohama, April 14-17, 2016 [Japanese conference]
- (41) Tha KK, Yamaguchi S, Terasaka S, Fujima N, Kudo K, Shirato H: “Performance of Major Diffusion Metrics in Distinguishing Lymphomas and Glioblastomas”, The 75th Annual Meeting of the Japan Radiological Society, Yokohama, April 14-17, 2016 [Japanese conference]
- (42) Inoue T, Okamoto S, Watanabe S, Yasuda K, Katoh N, Harada K, Shiga T, Tamaki N, Kuge Y, Shirato H: “¹⁸F-fluoromisonidazole PET/CT for stage I non-small cell lung cancer treated by stereotactic body radiotherapy”, The 75th Annual Meeting of the Japan Radiological Society, Yokohama, April 14-17, 2016 [Japanese conference]
- (43) Katoh N, Shimizu S, Nishioka K, Hashimoto T, Inoue T, Matsuura T, Takao S, Onimaru R, Umegaki K, Shirato H: “Spot-scanning proton beam therapy (SSPT) with or without the use of a real-time tumor-tracking function: Clinical Experience”, The 75th Annual Meeting of the Japan Radiological Society, Yokohama, April 14-17, 2016 [Japanese conference]
- (44) Mori T, Onimaru R, Kobayashi K, Yasuda K, Toyonaga T, Manabe O, Hirata K, Shiga T, Tamaki N, Shirato H: “¹⁸F-labeled fluoromisonidazole (FMISO) positron emission tomography for pretreatment evaluation of hypoxia in metastatic brain tumor”, The 75th Annual Meeting of the Japan Radiological Society, Yokohama, April 14-17, 2016 [Japanese conference]
- (45) Morita R, Mori N, Kimura T, Soyama T, Ogawa K, Shimamura T, Abo D, Sakuhara Y, Kudo K: “Percutaneous embolization for hepatic encephalopathy due to portosystemic shunts”, The 75th Annual Meeting of the Japan Radiological Society, Yokohama, April 14-17, 2016 [Japanese conference]
- (46) Kinoshita R, Nishikawa Y, Nishioka K, Hashimoto T, Shimizu S, Suzuki R, Shirato H: “Dose volume analysis of the lung and heart in breast tangential irradiation”, The 75th Annual Meeting of the Japan Radiological Society, Yokohama, April 14-17, 2016 [Japanese conference]
- (47) Shimizu S, Katoh N, Takao S, Matsuura T, Miyamoto N, Hashimoto T, Ishioka K, Yoshimura T,

- Umegaki K, Shirato H: “Evaluation of dose rates and irradiation times of real-time image synchronized proton beam therapy for hepatic tumors with respiratory movement” The 75th Annual Meeting of the Japan Radiological Society, Yokohama, April 14-17, 2016 [Japanese conference]
- (48) Kato F, Mito S, Manabe N, Mori T, Umiya Y, Hasehawa K, Yamashita K, Kudo K: “Utility of the PMView technique in blood flow analysis at the 3T mammary gland using dynamic contrast-enhanced MRI” The 75th Annual Meeting of the Japan Radiological Society, Yokohama, April 14-17, 2016 [Japanese conference]
- (49) Nakagawa J, Kato F, Tanaka N, Mito S, Manabe N, Kudo K, Hosoda M, Yamashita K: “Study of early phase contrast-enhanced mammary gland MRI” The 75th Annual Meeting of the Japan Radiological Society, Yokohama, April 14-17, 2016 [Japanese conference]
- (50) Harada T, Kudo K, Ueno I, Yamashita N, Kameda H, Matsuda T, Sasaki M, Shirato H: “Improved Homogeneity of B1+ and Signal Intensity at 7T Using Parallel Transmission on Human Volunteers” The 75th Annual Meeting of the Japan Radiological Society, Yokohama, April 14-17, 2016 [Japanese conference]
- (51) Soyama T, Abo D, Kimura T, Morita R, Sakuhara Y, Kudo K: “Experience with initial use of steering microcatheters”, The 45th Annual Meeting of the Japanese Society of Interventional Radiology, Nagoya, May 26-28, 2016 [Japanese conference]
- (52) Morita R, Mori N, Kimura T, Soyama T, Abo D, Sakuhara Y, Kudo K: “A study on the outcomes of percutaneous embolization for hepatic encephalopathy”, The 45th Annual Meeting of the Japanese Society of Interventional Radiology, Nagoya, May 26-28, 2016 [Japanese conference]
- (53) Abo D, Sakuhara Y, Soyama T, Morita R, Kimura T, Kudo K: “Local recurrence rate of ultraselective transcatheter arterial chemoembolization (TACE)for hepatocellular carcinoma (HCC)”, The 45th Annual Meeting of the Japanese Society of Interventional Radiology, Nagoya, May 26-28, 2016 [Japanese conference]
- (54) Sakuhara Y, Nishio S, Soyama T, Abo D, Morita R, Kimura T, Kudo K: “An exploratory study of transcatheter arterial embolization with microspheres for symptomatic enlarged polycystic liver. (Featured abstracts)”, The 45th Annual Meeting of the Japanese Society of Interventional Radiology, Nagoya, May 26-28, 2016 [Japanese conference]
- (55) Kimura T, Morita R, Soyama T, Abo D, Sakuhara Y, Kudo K: “Percutaneous transhepatic stent placement for symptomatic portal venous stenosis after surgical treatment for pancreatic and biliary malignancies. (Featured abstracts)”, The 45th Annual Meeting of the Japanese Society of Interventional Radiology, Nagoya, May 26-28, 2016 [Japanese conference]
- (56) Soyama T, Sakuhara Y, Jeff Wang: “Innovative ultrasonic training system: Development of a digital/real hybrid phantom”, The 89th Annual Scientific Meeting of the Japan Society of Ultrasonics in Medicine, Kyoto, May 27-29, 2016 [Japanese conference]
- (57) Yasuda K, Okamoto S, Nishikawa Y, Ito Y, Shiga T, Inoue T, Mori T, Toyonaga T, Onimaru R, Watanabe S, Tsuchiya K, Takeuchi W, Katoh N, Kuge Y, Tamaki N, Shirato H: “Integration of Molecular Imaging into Treatment Planning of Radiotherapy”, The 11th Annual Scientific Meeting of the Japanese Society for Molecular Imaging, Kobe, May 28-29, 2016 [Japanese conference]
- (58) Yasuda K, Nishikawa Y, Okamoto S, Ito Y, Tsuchiya K, Shiga T, Onimaru R, Kuge Y, Tamaki N, Shirato H: “Analysis on FMISO-PET and radiotherapy for nasopharyngeal cancer”, The 40th Annual Meeting of Japan Society for Head and Neck Cancer [Japanese conference]
- (59) Kato F, Kudo K, Fujiwara T, Jeff W, Sugimori H, Yamashita K, Hosoda M, Manabe N, Mimura R, Shirato H: “Evaluation of invasive breast cancer using diffusion kurtosis imaging of 3T mammary gland MRI: Comparison of biomarkers in axillary lymph node metastasis”, The 24th Annual Meeting of the Japanese Breast Cancer Society, Tokyo, June 16-18, 2016 [Japanese conference]

- (60) Yabusaki T, Manabe N, Mitsuhashi T, Kuwatani M, Kawakami H, Sakamoto K, Mimura R, Kato F, Kudo K: "A Case of an Oncocytic-type IPMN-derived mucinous carcinoma of the pancreas", The 30th Annual Meeting of Japanese Society of Abdominal Radiology, June 24-25, 2016 [Japanese conference]
- (61) Tsuneta S, Yabusaki T, Kato F, Manabe N, Kudo K, Hatanaka K: "A case of a large Cholangiolocellular carcinoma with problematic preoperative diagnosis", The 30th Annual Meeting of Japanese Society of Abdominal Radiology, June 24-25, 2016 [Japanese conference]
- (62) Yamaguchi A, Yabusaki T, Kato F, Okada H, Orimo T, Harada T, Sakamoto K, Mimura R, Manabe N, Shirato H: "Four cases considered as spontaneous regressions of hepatocellular carcinomas", The 30th Annual Meeting of Japanese Society of Abdominal Radiology, June 24-25, 2016 [Japanese conference]
- (63) Kato F, Mimura R, Takeda M, Konno Y, Sasaki T, Watari H, Sakuragi N, Sakamoto K, Yabusaki T, Kikuchi H, Manabe N, Kudo K: "A case of a foreign object in the vagina of a child", The 17th Annual Symposium Japanese Society for the Advancement of Women's Imaging, Awaji, September 2-3, 2016 [Japanese conference]
- (64) Mimura R, Kudo K, Shimada C, Konno Y, Shirai S, Manabe N, Watari H, Sakuragi N, Sasaki H, Kudo K, Shirato H: "A case of a mature cystic teratoma complicated with anti-NMDA Receptor encephalitis, which was difficult to diagnose preoperatively", The 17th Annual Symposium Japanese Society for the Advancement of Women's Imaging, Awaji, September 2-3, 2016 [Japanese conference]
- (65) Miyamoto N, Suzuki R, Takao S, Matsuura T, Matsuzaki Y, Fujii T, Tomioka S, Shimizu S, Umegaki K, Shirato H: "Efficiency improvement in patient positioning / gated irradiation in real-time tumor tracking radiotherapy using respiratory phase evaluations by analysis of three-dimensional in vivo marker tracking" The 112th Japan Society of Medical Physics, Okinawa 2016.9.8-10 [Japanese conference]
- (66) Ishikawa M, Fuwa M, Nara K, Sutherland K, Suzuki R, Miyamoto N: "A study on the effect of image filters with filmed data in dose distribution analysis", The 112th Japan Society of Medical Physics, Okinawa 2016.9.8-10 [Japanese conference]
- (67) Fujima N, Okuaki T, Aoike T, Aoike S, Sugimori H, Kudo K: "Evaluation of water permeability for ischemic lesion in the brain using DW-ASL", The 44th Annual Meeting of the Japanese Society for Magnetic Resonance in Medicine, September 9, 2016 [Japanese conference]
- (68) Kikuchi H, Manabe N, Kato F, Mimura R, Sakamoto K, Habusaki T, Kudo K: "Coronary flow velocity reserve on left main trunk using 3T-MRI can predict coronary artery disease as 15O-labeled Water PET", The 44th Annual Meeting of the Japanese Society for Magnetic Resonance in Medicine, September 9, 2016 [Japanese conference]
- (69) Harada T, Kudo K, Shirai T, Bito Y, Shichinohe H, Tan C, Wan Z, Houkin K, Shirato H: "Quantitative measurement of susceptibility/R2* values of SPIO-labeled bone marrow stromal cells in gel phantom", The 44th Annual Meeting of the Japanese Society for Magnetic Resonance in Medicine, September 9, 2016 [Japanese conference]
- (70) Hashimoto T, Iguchi A, Terasaka S, Sugiyama M, Oshima J, Yamaguchi S, Kobayashi H, Cho Y, Shimizu S, Onimaru R, Shirato H: "Arrangements at Hokkaido University Hospital for childhood cancers using proton beam therapy", The 68th Annual Meeting of Northern Japan Pediatric Society, Hiroaki, September 9-10, 2016 [Japanese conference]
- (71) Soyama T, Abo D, Morita R, Sakuhara Y, Kudo K: "Two cases with effective steering of micro catheters", The 52nd Autumn Assembly of the Japan Radiological Society, Tokyo, September 1-19, 2016 [Japanese conference]
- (72) Wu PH, Onodera Y, Ichikawa Y, Watanabe Y, Hashimoto T, Shirato H, Nam JM: "Effect of the invasiveness of RGD Modified gold nano-particles on breast cancer cells after irradiation", The 75th Annual Meeting of the Japanese Cancer Association, Yokohama, October 8-8, 2016 [Japanese conference]

- conference] *i)
- (73) Takeda M, Yamazawa H, Izumi G, Sasaki O, Abe J, Sasaki D, Aikawa T, Kikuchi H, Manabe N: “Early diagnosis of cardiomyopathy - Duchenne / Becker muscular dystrophy using quantitative evaluations in cardiac MRI delayed contrast imaging”, The 25th Annual Meeting of the Japanese Society of Pediatric Myocardial Diseases, Tokyo, October, 8, 2016 [Japanese conference]
 - (74) Tamura H, Inoue T, Miyamoto N, Suzuki R, Fujita K, Hotta K: “Influence of intra-fractional organ motion on the IMRT of the esophagus”, The 44th Autumn Congress of Japanese Society of Radiological Technology, Omiya, October, 13-15, 2016 [Japanese conference]
 - (75) Miyamoto N, Takao S, Matsuura T, Matsuzaki Y, Suzuki R, Inoue T, Katoh N, Onimaru R, Shimizu S, Shirato H: “Evaluation of reproducibility of lung deformation due to respiration using trajectory data of multiple in vivo markers”, The 29th Annual Meeting of the Japanese Society for Radiation Oncology, November, 25-27, 2016 [Japanese conference]
 - (76) Hashimoto T, Tsuruga K, Kobayashi H, Iguchi A, Honda S, Sugiyama M, Yasuda K, Miyagi H, Yamaguchi S, Fujita N, Oshima J, Cho Y, Onimaru R, Shimizu S, Terasaka S, Morimoto Y, Shirato H: “Two cases of childhood cancer where proton beam therapy was performed under endotracheal general anesthesia”, The 58th Annual Meeting of the Japanese Society of Pediatric Hematology / Oncology, Tokyo, December 15-17, 2016 [Japanese conference]
 - (77) Nam JM, Onodera Y, Sabe H, Shirato H: “Analysis of molecular mechanism involved in maintenance of 3-dimensional structure on radiation treated mammary epithelial cells.”, Nagoya, The 74th Annual Meeting of the Japanese Cancer Association, 2015.10.8-10 [Japanese conference]
 - (78) Tha KK, Katscher U, Stehning C, Yamaguchi S, Terasaka S, Yamamoto T, Kudo K, Shirato H: “The Electrical Conductivity Characteristics of Glioma and Potential Usefulness of Noninvasive Electrical Conductivity Measurement in Evaluation of Glioma.”, Tokyo, JSMRM 43rd Annual Meeting, 2015.9.10-12 [Japanese conference]
 - (79) Kudo K: “Perfusion MRI for the Diagnosis of Brain Tumors.”, Tokyo, Advanced Neuroimaging Workshop, 2015.5.23 [Japanese conference]
 - (80) Matsuura T, Fujii Y, Takao S, Matsuzaki Y, Yamada T, Matsuo Y, Fujitaka S, Takayanagi T, Umegaki K, Shirato H: “Development of an range compensator for spot-scanning proton therapy using real-time gating system.”, Yokohama, 109th Japan Society of Medical Physics, 2015.4.16-19 [Japanese conference]
 - (81) Tha KK, Ulrich K, Stehning C, Yamaguchi S, Terasaka S, Sugimori H, Yamamoto T, Fujima N, Kudo K, Suzuki Y, van Cauteren M, Shirato H: “Electrical Conductivity Characteristics of Meningiomas: Noninvasive Assessment using Electric Properties Tomography.”, Nagoya, Japan Society of Neuroradiology 44th Annual Meeting, 2015.3.6-7 [Japanese conference]
 - (82) Tha KK, Katscher U, Yamaguchi S, Terasaka S, Stehning C, Fujima N, Kudo K, Shirato H: “Electrical conductivity characteristics of meningiomas: the results of a noninvasive assessment.”, Nagoya, Japan Society of Neuroradiology 44th Annual Meeting, 2015.3.6 [Japanese conference]
 - (83) Yasuda K, Tsuchiya K, Onimaru R, Harada Y, Harada K, Nishikawa Y, Kinoshita R, Tsuji S, Horita K, Suzuki R, Shirato H: “Effects of narrow CTV-PTV margin on variability of radiation dose prescription in cases that CTV was close to OAR.”, Yokohama, The 27th annual meeting of Japanese Society for Radiation Oncology (JASTRO), 2014.11.13 [Japanese conference]
 - (84) Nam JM, Onodera Y, Sabe H, Shirato H: “Analysis of molecular mechanism involved in invasiveness of radiation treated breast cancer cells.”, Yokohama, The 73th Annual Meeting of the Japanese Cancer Association, 2014.9.25-27 [Japanese conference]
 - (85) Inoue T, Katoh N, Shimizu S, Suzuki R, Sasaki T, Fukusima H, Komatsu Y, Shirato H. Chemoradiation therapy using intensity-modulated radiation therapy for locally advanced esophageal carcinoma.”, Yokohama, The 73rd Annual Meeting of the Japan Radiological Society. 2014.4.10-13 [Japanese conference]

Other presentations [International conference]

- (1) C Sanli, T Matsuura, L Xing, M Unlu: “Comparison of Acoustic Waves Generated in Proton and Carbon Ion Therapy” AAPM Annual Meeting 2018, Nashville, 2018.7.29-8.2 [International conference]
- (2) C Sanli, J Wang, M Unlu: “Absorption Dependence of the X-Ray Induced Acoustic Waves”, AAPM Annual Meeting 2018, Nashville, 2018.7.29-8.2 [International conference] *i)
- (3) Wu PH, Onodera Y, Giaccia AJ, Le QT, Shirato H, Nam JM: “Radiation increases invasive activity of breast cancer cells via altering lysosome exocytosis”. *AACR Annual Meeting 2018*. Chicago, 2018. 4. 14-18 [International conference] *i)
- (4) Tha KK: “Identification of Noninvasive Biomarkers for Glioblastoma: The Role of “Radiomics” GI-CoRE GSQ, GSB & IGM JOINT SYMPOSIUM: Quantum, Informatics, Biology & Medicine (5th GSQ Symposium & 1st GSB Symposium), Sapporo, July 10-11, 2017 [International conference]*i)
- (5) Nam JM, Hsieh CC: “Molecular targets for suppression of cancer invasion”, GI-CoRE GSQ, GSB & IGM JOINT SYMPOSIUM: Quantum, Informatics, Biology & Medicine (5th GSQ Symposium & 1st GSB Symposium), Sapporo, July 10-11, 2017 [International conference] *i)
- (6) Wu PH, Onodera Y, Ichikawa Y, Watanabe Y, Wei Q, Hashimoto T, Shirato H, Nam JM: “RGD-conjugated gold nanoparticles in radiotherapy decreases the invasion activity in breast cancer cells.”, Sapporo, The 3rd GI-CoRE Medical Science and Engineering Symposium. Radiation Oncology, Biology&IVR, 2016.3.3-4 [International conference]
- (7) Wu PH, Onodera Y, Ichikawa Y, Watanabe Y, Qian W, Hashimoto T, Shirato H, Nam JM: “Effects of RGD peptide conjugated gold nanoparticles in Breast Cancer Cells with ionization radiation.”, San Diego, ASCB Annual meeting, San Diego (U.S.A.), 2015.12.12-16 [International conference]
- (8) Shimizu S, Katoh N, Nishioka K, Hashimoto T, Inoue T, Matsuura T, Takao S, Matsuzaki Y, Fujii Y, Tamura M, Onimaru R, Umegaki K, Shirato H: “Initial clinical experience of spot-scanning proton beam therapy using real-time-image gated proton-beam therapy system.”, Dresden (Germany), 4D Treatment Planning Workshop 2015, 2015.11.26-27 [International conference]
- (9) Matsuura T, Takao S, Matsuzaki Y, Fujii Y, Fujii T, Miyamoto N, Katoh N, Shimizu S, Shirato H, Umegaki K: “Treatment of superficial liver tumors with spot-scanning proton therapy using real-time gating system-comparison between range compensation devices.”, OncoRay, Dresden (Germany), 7th International 4D Treatment Planning Workshop, 2015.11.26-27 [International conference]
- (10) Shimizu S, Katoh N, Takao S, Matsuura T, Miyamoto N, Hashimoto T, Nishioka K, Yoshimura T, Matsuzaki Y, Kinoshita R, Nishikawa Y, Onimaru R, Umegaki K, Shirato H: “Treatment of respiratory moving liver tumor using gated spot scanning proton beam therapy system with real-time tumor-tracking function.”, San Antonio (U.S.A.), ASTRO 57th Annual meeting, 2015.10.18-21 [International conference]
- (11) Umegaki K, Matsuura T, Takao S, Matsuzaki Y, Yamada T, Fujii Y, Miyamoto N, Shimizu S, Shirato H: “Startup experience of the new proton beam therapy with gated spot scanning and real-time tumor-tracking.”, Anaheim (U.S.A.), 57th AAPM Annual Meeting, 2015.7.16 [International conference]
- (12) Matsuura T, Fujii Y, Takao S, Yamada T, Matsuzaki Y, Miyamoto N, Takayanagi T, Fujitaka S, Shimizu S, Shirato H, Umegaki K: “Development of An Applicator for Treating Shallow and Moving Tumors with Respiratory-Gated Spot-Scanning Proton Therapy Using Real-Time Image Guidance”, Anaheim (U.S.A.), 57th AAPM Annual Meeting, 2015.7.12-16 [International conference]
- (13) Tha KK, Katscher U, Stehning C, Yamaguchi S, Terasaka S, Shirato H: “Electrical Conductivity Characteristics of Glioma and Potential Usefulness of Noninvasive Electrical Conductivity Measurement in Evaluation of Glioma.”, Chicago (U.S.A.), 101st Annual Meeting of RSNA, 2015.11.29 [International conference]

- (14) Wang J, Kato F, Yamashita H, Malkov S, Shepherd J, Kudo K, Shirato H: "Volumetric Breast Density of Japanese Women Using Adaptive Pattern Recognition-Based Calibrations.", San Francisco (U.S.A.), 7th International Workshop on Breast Densitometry and Cancer Risk Assessment, 2015.6.10-12 [International conference]
- (15) Kudo K, Uwano I, Hirai T, Nakamura H, Fujima N, Yamashita F, Goodwin J, Higuchi S, Sasaki M: "Diagnostic Performance of Dynamic Susceptibility Contrast Perfusion in Glioma Grading: Comparison of Cerebral Blood Volume among Different Analysis Software.", Tronto (Canada), 23rd ISMRM, 2015.6.1-5 [International conference]
- (16) Tha KK, Ulrich K, Stehning C, Yamaguchi S, Terasaka S, Sugimori H, Yamamoto T, Fujima N, Kudo K, Suzuki Y, van Cauteren M, Shirato H: "Electrical Conductivity Characteristics of Meningiomas: Noninvasive Assessment using Electric Properties Tomography.", Toronto (Canada), ISMRM 23rd Annual Meeting & Exhibition, 2015.5.30-6.5 [International conference]
- (17) Kudo K: "Perfusion MRI for the Diagnosis of Brain Tumors.", Seoul (South Korea), KSMRM, 2015.3.27-28 [International conference]
- (18) Wang J, Kato F, Kudo K, Yamashita H, Shirato H: "Heterogeneity of Background Parenchymal Enhancement on MRI Strongly Predictive of Breast Cancer Molecular Subtypes.", Chicago (U.S.A.), 100th Annual Meeting of RSNA, 2014.11.30-12.5 [International conference]
- (19) Kudo K: "Oxygen Extraction Fraction (OEF) Measurement using Quantitative Susceptibility Mapping (QSM).", Kobe, 15th AOCC, 2014.9.24 [International conference]
- (20) Shimizu S, Takao S, Matsuura T, Miyamoto N, Baba R, Umekawa T, Matsuda K, Sasaki T, Nagamine Y, Umegaki K, Shirato H: "Realization of the Cone Beam CT by FPDs That Mounted on the Spot-Scanning Dedicated Proton Beam Gantry.", San Francisco (U.S.A.), ASTRO 56th Annual meeting, 2014.9.14-17 [International conference]
- (21) Katoh N, Onishi H, Matsushita H, Nomiya T, Nakata K, Shirato H: "Japanese Multi-institutional Study of Stereotactic Body Radiation Therapy For Renal and Adrenal Tumors.", San Francisco (U.S.A.), ASTRO 56th Annual meeting, 2014.9.14-17 [International conference]
- (22) Sutherland K, Kanehira T, Matsuura T, Umegaki K and Shirato H, "Geant4 Simulations of Spot-Scanned Proton Beam Treatment Plans", Austin, AAPM 56th Annual Meeting & Exhibition, July 20-24 2014.7.20-14 [International conference]
- (23) Wang J, Kato F, Kudo K, Yamashita H, Shirato H: "Predicting Triple-Negative Breast Cancer and Axillary Lymph Node Metastasis using Diagnostic MRI.", Gifu, IWDM 2014, 2014.6.29-7.2 [International conference]
- (24) Tha KK, Stehning C, Suzuki Y, Katscher U, Keupp J, Kazumata K, Terasaka S, Cauteren MV, Kudo K, Shirato H: "Noninvasive Evaluation of Electrical Conductivity of the Normal Brain and Brain Tumors." Milan (Italy), 22nd ISMRM, 2014.5.12-16 [International conference]
- (25) Tha KK, Stehning C, Suzuki Y, Ulrich K, Jochen K, Kazumata K, Terasaka S, van Cauteren M, Kudo K, Shirato H: "Noninvasive evaluation of electrical conductivity of the normal brain and brain tumors." Milan (Italy), The joint annual meeting ISMRM-ESMRMB, 2014.5.10-16 [International conference]
- (26) Kudo K, Liu T, Goodwin J, Uwano I, Yamashita F, Higuchi S, Fujima N, Wang Y, Ogasawara K, Ogawa A, Sasaki M: "Oxygen Extraction Fraction Measurement using Quantitative Susceptibility Mapping in Patients with Chronic Cerebral Ischemia: Comparison with Positron Emission Tomography.", Milan (Italy), ISMRM, 2014.5.12-16 [International conference]

4) Patent applications

Number of patent applications (number of registered patents):

Japanese patents: 8 (8), overseas patents: 6 (5), total: 14 (13)

(1) 2015-008434, Radiation therapy system and treatment program, 2015 January, Hokkaido Univ.,

- Shimizu S, Matsuura T, Takao S, Umegaki K, Katoh T et al.
- (2) 2017-047982, Radiation therapy apparatus, 2017 March, Hokkaido Univ., Takao S, Matsuura T, Umegaki K et al.
 - (3) 2014-245562, Radiation therapy system to control X-ray imaging intervals, 2014 December, Hitachi Ltd. and Hokkaido Univ., Umegaki K et al.
 - (4) 2015-023202, Image processing unit and Particle beam therapy system equipped with image processing unit, 2015 February, Hitachi Ltd. and Hokkaido Univ., Umegaki K, Takao S et al.
 - (5) 2016-32729, Particle beam therapy system and ridge filter, and method of manufacture of the ridge filter, 2016 February, Hitachi Ltd. and Hokkaido Univ., Matsuura T, Umegaki K et al.
 - (6) 2016-69463, Particle Beam Dose Evaluation System, Planning Device, Particle Beam Irradiation System, And Dose Evaluation Method, 2016 March, Hitachi Ltd. and Hokkaido Univ., Matsuura T, Umegaki K, Shirato H et al.
 - (7) 2016-88163, Moving Body-Tracking Device And Radiation-Emitting System, 2016 April, Hitachi Ltd. and Hokkaido Univ., Umegaki K et al.
 - (8) 2016-103596, Radiation Application System And Moving Body Tracking Apparatus, 2016 May, Hitachi Ltd. and Hokkaido Univ., Umegaki K, Shimizu S et al.
 - (9) US 14/524,495 (Registered 2017), Charged particle beam system, 2014 October, Hitachi Ltd. and Hokkaido Univ., Shirato H, Shimizu S, Umegaki K et al.
 - (10) PCT/JP2015/054184, Charged Particle Irradiation System, 2015 February, Hitachi Ltd. and Hokkaido Univ., Shimizu S, Shirato H et al.
 - (11) PCT/JP2017/011866, Particle Beam Dose Evaluation System, Planning Device, Particle Beam Irradiation System, And Dose Evaluation Method, 2017 March, Hitachi Ltd. and Hokkaido Univ., Matsuura T, Umegaki K, Shirato H et al.
 - (12) PCT/JP2017/013173, Moving Body-Tracking Device And Radiation-Emitting System, 2017 March, Hitachi Ltd. and Hokkaido Univ., Umegaki K et al.
 - (13) PCT/JP2017/015682, Tracking Object Recognition Simulator Or Marker Recognition Simulator, Moving Body Tracking Device, And Irradiation System, 2017 April, Hitachi Ltd. and Hokkaido Univ., Umegaki K et al.
 - (14) PCT/JP2017/017950, Radiation Application System And Moving Body Tracking Apparatus, 2017 November, Hitachi Ltd. and Hokkaido Univ., Umegaki K, Shimizu S et al.

5) Awards, etc.

Number of awards: 11

- (1) Tha KK: “Guerbet Scientific Award, Third place” (Recent Advances and New Trends in Human Glioma Imaging) AOCNR 2018, Taipei, 2018.3.18-20. *
- (2) Manabe N: “Certificate of Merit Award”, the Radiological Society of North America, November 30, 2017
- (3) Manabe N: “Award as identified for Radiographics”, Radiological Society of North America, November 30, 2017
- (4) Fujii Y, Umekawa T, Umezawa M, Shirato H, Umegaki K, Miyamoto N, Matsuura T: “Imperial Invention Prize”, the 2017 National Invention *
- (5) Manabe N: “Best moderated Poster Award”, the 11th Congress of Asian society of cardiovascular imaging, June1-3, 2017
- (6) Koichi Yasuda: “Cypos Award, Bronze Medal”, the 76th Annual Meeting of the Japan Radiological Society, Yokohama, April 13-16, 2017
- (7) Tha KK: 2016 Excellent teacher Award of the Hokkaido University Graduate School of Medicine (outstanding performance award)
- (8) Umegaki K: “Development and practical application of a Proton Beam Therapy System with 4-D Real-time Tumor Tracking”, (The 13th Merit Award for Industry-Academia-government

Collaboration, the Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology), 2015.8.28

- (9) Shirato H: Hokkaido University President's Award for Research Excellence for AY2014 (Excellent Research Award), 2015.3.11
- (10) Shirato H: "Development and Clinical Research of a highly precise photon and particle beam therapy using stereotactic irradiation and real-time tumor tracking technologies" (The 2014 Hokkaido Science and Engineering Award), 2015.2.20
- (11) Yasuda K: "[18F] fluoromisonidazole and a new PET system with semiconductor detectors and a depth of interaction system for intensity modulated radiation therapy for nasopharyngeal cancer.", (The Umegaki award, 20th Japanese Society for Radiation Oncology (JASTRO)), 2014.12.12

6) External grants

Number of awards: 5. Amount of the grant indicates direct cost only.

- (1) Japan Agency for Medical Research and Development (AMED), "Research and development of medical devices and systems to realize future medical care - Research and development project for minimally invasive cancer diagnostic equipment", Development of next generation high precision particle beam therapy combining fine particle tumor markers with real-time 3-dimensional fluoroscopy, 2015-2019, JPY213,378,183, Shirato H, Umigaki K, Shimizu S, Matuura T, Abo D, Takao S, Sutherland KL, Nam JM, Katoh N, Inoue T et al.
- (2) Grants-in-Aid for Scientific Research, Japan Society for the Promotion of Science (Kakenhi), "Exploring target molecules to suppress changes in the extracellular microenvironment by radiation and invasive cancer recurrence", 2016-2018, JPY3,600,000, Nam JM
- (3) Grants-in-Aid for Scientific Research, Japan Society for the Promotion of Science (Kakenhi), Young Scientists (A) "Development of a hybrid tomosynthesis and acoustic imaging modality for early detection of breast cancer", 2017-2019, JPY11,300,000, Peng H
- (4) Grants-in-Aid for Scientific Research, Japan Society for the Promotion of Science (Kakenhi), Young Scientists "To investigate the role of cancer stem cells in regulating the invasion ability of radioresistant pancreatic cancer", 2018-2020, JPY3,200,000, Hsieh, CC
- (5) Grants-in-Aid for Scientific Research, Japan Society for the Promotion of Science (Kakenhi), Young Scientists "Development of an acoustic imaging modality for absolute and real-time radiotherapy dosimetry", 2018-2019, JPY1,300,000, Wang J

● Science outreach

- (1) Kudo K: "Visualizing cerebral diseases using magnetic forces and programming", Lecture at Otaru Chouryo High School, Otaru, February 8, 2018
- (2) Shirato H: "Present conditions and future prospects for medical physicist training", Symposium of Advanced Medical Professional Graduate School, Kyoto, February 2, 2018
- (3) Shirato H: "Accurate aiming at moving cancers", The 26th Specially opened Innovative Scientific University, Asahikawa, November 11, 2017
- (4) Shirato H: "Accurate aiming at moving cancers", Lecture at High School, Asahikawa, November 10, 2017
- (5) Kudo K: "Visualizing cerebral diseases using magnetic forces and programming", Lecture at Sapporo Minami High School, Sapporo, October 26, 2017
- (6) Shirato H: "Hokkaido University leading the world in X-ray treatment and proton beam therapy for cancer in moving organs", 2017 Hokkaido Home Coming Day, Sapporo, September 30, 2017
- (7) Manabe N: "What does the body look like inside? Exploring the microcosm called the human body", Minami High School, Rikka Seminar, Sapporo, September 30, 2016

- (8) Shimizu S: "Treatment of moving cancers" (the 3rd Chie lab lecture), Development of the proton beam treatment device to treat moving cancers-a worldwide first, Chieria Citizen's College, Sapporo, September 17, 2016
- (9) Inoue T: "Radiation therapy for lung cancer", "Advances in lung cancer treatment", Public lecture hosted by Hokkaido Newspaper, Sapporo Education and Culture Hall, June 18, 2016
- (10) Shirato H: "State-of-the-art cancer proton therapy", The 29th Public Lecture by Japanese Cancer Association, Sapporo, May 14, 2017
- (11) Shimizu S: "Patient centered cancer treatment", "Cancer treatment with minimal adverse effects: radiation therapy and proton beam therapy", Public lecture, Hokkaido University Conference Hall, Sapporo, 2016.5.26
- (12) Shirato H: "The latest in cancer radiation therapy", Advanced Medicine Promotion Organization, TFT Hall at Tokyo Big Site, 2016.3.12
- (13) Shimizu S: "Integration of Spot-scanning technology into a Real-time tumor tracking system", Special lecture at the 938th Workshop Sapporo City General Hospital and Cancer Treatment Center Network, Nov. 12, 2015.11.12
- (14) Shimizu S: "Introduction of the Hokkaido University Hospital Proton Beam Therapy Center, Patient centered radiation therapy for cancer", Public lecture by Hokkaido University Hospital Proton Beam Therapy Center, Sapporo, Nov. 7, 2015.11.7
- (15) Shimizu S: "Delivering innovative medical care to you - Aiming at total care without surgery and minimal pain", Lecture at The 9th Annual Hokkaido Meeting of the Nihon Sogo Igakukai (Japanese Society of General Medicine), Sapporo, 2015.9.27
- (16) Shirato H: "The present and future of proton beam therapy", The 9th Specialist Seminar, Hokkaido Branch of the Japanese Society of Gastroenterology Japanese Gastroenterological Endoscopy Society, Sapporo Convention Center, Aug. 30, 2015.8.30
- (17) Shimizu S: "Aiming to deliver patient centered treatment with few adverse effects", Open lecture by Kyoto Prefectural University of Medicine, Kyoto, Jul. 22, 2015.7.22
- (18) Shirato H: Educational lecture "Features and perspectives of radiation therapy and particle therapy", The Japanese Society of Medical Oncology 2015 Annual Meeting, Royton Sapporo, 2015.7.17
- (19) Shimizu S: "Proton Beam Therapy, Patient Advocate Program (PAP)", The Japanese Society of Medical Oncology 2015 Annual Meeting, Royton Sapporo, 2015.7.17
- (20) Shirato H: "Real-time Tumor Tracking Proton Beam Therapy System for Cancers", Hokkaido University Open Lecture (all-faculty project), 2015.7.2
- (21) Shimizu S: "Proton Beam Therapy, The 10th Tumor Center Seminar", co-hosted by the Department of Pharmacy and the Promotion Plan for the Platform of Human Resource Development for Cancer team, Sapporo, 2015.2.19
- (22) Shimizu S: "Radiation therapy and proton beam therapy, Promotion Plan for the Platform of Human Resource Development for Cancer", Public lecture "Radiation therapy and proton beam therapy – Aiming at cancer treatments with few adverse effects", Public lecture for "Learning about cancer treatment", Sapporo, 2015.1.24
- (23) Umegaki K: "Small highly efficient proton beam therapy system", Open lecture by Kyoto Prefectural University of Medicine

- Collaborations with institutions (universities, research institutes, local government, companies, etc.) other than affiliated universities

We have started international collaboration with other institutions to publicize GI-CoRE achievements.

Numerous researchers from internationally well-known institutions are collaborating in the GI-

CoRE Summer School for Medical Physics, the GI-CoRE Medical Science and Engineering Symposium, and the GI-CoRE seminars. Faculty members from the University of California San Francisco, the University of California Los Angeles, the National Institute of Radiation Science (NIRS) in Chiba, Tohoku University in Sendai, Osaka University in Osaka, the Nagoya Proton Therapy Center in Nagoya, the Johns Hopkins University School of Medicine in Baltimore, the University Medical Center Groningen in the Netherlands, the Mayo Clinic in Rochester, the University of Texas MD Anderson Cancer Center in Houston, the University of Technology Sydney in Sydney, the University of Groningen in the Netherlands, Peking University in Peking, and Pennsylvania University in Philadelphia have contributed as lecturers in the Summer School for Medical Physics, in the GI-CoRE Symposium, and in the GI-CoRE seminars in Sapporo.

The St. Jude Children's Research Hospital, the Mayo Clinics in Rochester and Arizona, the MD Anderson Cancer Center, the Johns Hopkins University, Kyoto Prefectural University, the National Cancer Centre Singapore, and the University of Navarra, which have all introduced the proton beam therapy system developed by HU and Hitachi, Ltd., visited HU and have promoted academic collaborations with HU. For the research related to the particle beam therapy system jointly developed by HU and Hitachi, Ltd. under the Funding Program for World-Leading Innovative R&D on Science and Technology (FIRST), the GSQ will conduct productive research with careful consideration of intellectual property rights. For the collaboration with Shimadzu Corporation, it is also planned to improve the SyncTraX function of the real-time tumor tracking device for X-ray therapy. AISIN/IMRA America and GI-CoRE GSQ collaborated to perform the research project on RGD-peptide-conjugated gold nanoparticles for radiation sensitization and presented the research at international and Japanese conferences, and have published in *the International Journal of Nanomedicine* (2017).

An Associate Executive Director of the American Board of Radiology attended the GSQ meeting as part of the preparations for our summer school - to make an educational course that meets the requirement for accreditation of medical physicists in the U.S.

Researchers from Asian and European universities and cancer institutions are also interested in the proton beam therapy center at HU. Prof. Shirato was nominated as a member of Proton Advisory Board of the National Cancer Centre Singapore. As of March 2018, there have been more than 2,400 visitors to see the proton beam therapy center and about twenty percent of the visitors are from overseas.

- Issues affecting the research and measures to overcome these/future developments

One of the elements of our potential improvement for the further enhancement of the GI-CoRE was to send young researchers into eminent institutions. In this regard, we have sent young scientists to distinguished science institutions: Drs. Abo and Yasuda visited SU for a collaborative research. Dr. Wu, a graduate student, also visited the SU lab. Mr. Kwon, a graduate student, and Dr. Kikuchi, a post-doctoral researcher, are on a one-year visit to Harvard University. Dr. Kanehira, a graduate of HU, is currently a post-doctoral researcher at the Netherlands Institute for Cancer. We hope the GI-CoRE will benefit from what those renowned institutions could offer to young researchers.

2. Education (Graduate Schools to Foster Global Human Resources)

(1) Goals

Based on the research outcomes at the GSQ, HU opened a “Graduate School of Biomedical Science and Engineering” in April, 2017.

The Graduate School of Biomedical Science and Engineering features a new disciplinary direction integrating the biomedical science and engineering fields, aiming to apply developments in science and engineering to medical science, under the four basic principles adhered to by Hokkaido University: Frontier Spirit, Global Perspectives, All-round Education, and Practical Learning.

In this graduate school, teaching staff of the Faculty of Science, the Faculty of Health Sciences, the Faculty of Engineering, the Faculty of Medicine, and the Faculty of Dental Medicine have been participating in the education of specialists who will be able to contribute their knowledge of quantum science and engineering as well as molecular science and engineering to medicine. The Graduate School of Biomedical Science and Engineering also aims to ensure that students attain a basic knowledge of medical fields and a thorough in-depth knowledge of science and engineering transcending the limits of conventional study areas, and which will enable the graduated specialists to be equipped with the highest ethical and humanitarian qualities.

Furthermore, it also aims to conduct studies to develop medical equipment to meet the needs of business and industry while promoting research related to medical physics for academia in our mission to meet the various needs of society. It is also expected that these efforts will make a significant contribution to the development of medical equipment, establishment of economic advantages in medical technology, improving competitiveness, and assisting in the creation of new important industries and other ventures.

(2) Current Progress/Future Developments

① Operating System of Education / Organizational Structure of Educational Programs

● Overview, background and social needs

The Graduate School of Biomedical Science and Engineering set up Biomedical Science and Engineering Courses (a Quantum Biomedical Science and Engineering Course and a Molecular Biomedical Science and Engineering Course), incorporated in a two-year Master’s Program and a three-year Doctoral Program. The graduate school confers Master’s (in biomedical science and engineering) and Doctoral degrees (Ph.D.) to graduating students. In the Master’s program, the graduate school trains experts who will contribute to society through medical physics and equipment development work related to radiology, with a thorough understanding of medical ethics. In the Doctoral program, the graduate school will train outstanding specialists who will be able to play leading roles in international research with knowledge and skills that will enable them to become leaders in these areas.

The Graduate School of Biomedical Science and Engineering is determined to respect the diverse backgrounds of students, and to offer a unique curriculum with lectures integrating medicine, science and engineering. English education will also be provided through the collaboration of the faculty of medical engineering and medicine exclusive to this new school where several instructors will provide each student with instruction related to the research.

The researchers who are joining the GSQ are expected to be teachers in the Graduate School of Biomedical Science and Engineering. The researchers who are hired in HU as well as the researchers visiting from SU have been providing lectures for graduate students and supervised research of doctoral students. Faculty of Radiation Oncology (three professors, one associate professor, and two assistant professors), Radiation Biology (one professor, one assistant professor, and one research fellow), and Medical Physics (one professor, one associate professor, and one assistant professor) of SU have stayed at HU for a total of several months every year to provide lectures, conduct research, and

make arrangements for international clinical joint research. Furthermore, one or two assistant professors and senior assistant professors of SU have spent time at HU every year to engage in research and instruction at the undergraduate and graduate schools here. Supported by an excellent environment for research and education, joint research and specialist training in the quantum medical science and engineering fields are promoted, based on the established GSQ. These meet the objectives of the GI-CoRE forming the foundations of a strong and flexible research framework and support arrangements.

In recent years, active involvement in health promotion and medical care is expected of educational and research institutions in Japan. This involvement should contribute to the realization of a healthy society, extended longevity, economic growth and global development. Society has a need for talented scientists who are able to apply innovative technology from science and engineering to assist in alleviating patient suffering brought about by diseases, through an understanding of the physiology of the human body and the pathology of diseases. The Graduate School of Biomedical Science and Engineering was established with the aim to train specialists who will be able to make such contributions.

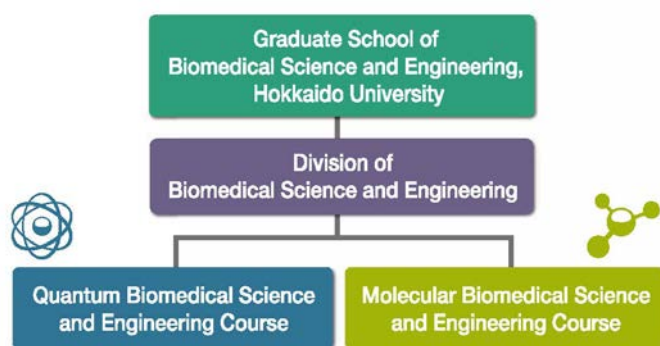


Fig. 15 Structure of Graduate School of Biomedical Science and Engineering, Hokkaido University

In the Quantum Biomedical Science Course, it is also planned to train specialists who will become engaged in the development of medical technology and equipment (medical applications) for use in radiation treatment, medical physics research and development of quality control techniques, and the optimization of radiation treatment plans as well as evaluation of treatment accuracy as medical physicists. The students will be comprehensively trained to become specialists in radiation treatment capable to conduct advanced radiation treatment safely and efficiently in concert with physicians and

medical professionals (clinical radiological technologists, radiotherapy quality control specialists, and dosimetrists).

In the Molecular Biomedical Science and Engineering Course students will be trained as specialists equipped with specialized knowledge and skills in quality control and verification of diagnostic images. After graduation, these specialists are expected to apply science and engineering technology in research and development related to new molecular imaging devices for use with *in vivo* molecules in diagnosis, as well as related molecular diagnostics, oncolytic virotherapy, and radiation sensitizers. In short, students will learn how to integrate molecular targeted therapies with imaging and radiation therapy, while maintaining a clear balance between effectiveness and safety of diagnoses as is expected from physicists in clinical settings. In both courses, all of the graduate school faculty systematically provide an innovative integrated education in basic knowledge and skills in the fields of science and engineering as well as a basic education in medicine and medical ethnics.

② International Collaborative Education

● Operating system of Education

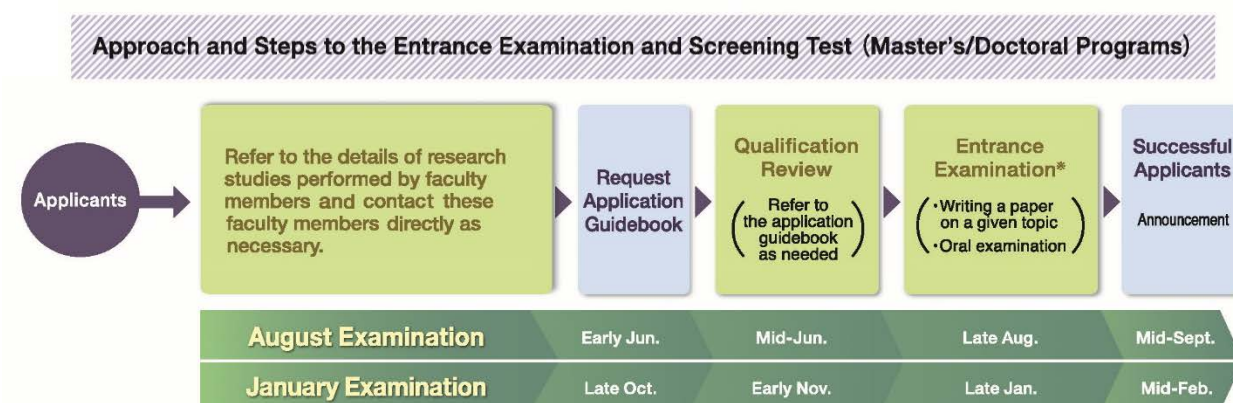


Fig. 16 Approach and Steps to the Entrance Examination and Screening Test (Master's/Doctoral Programs)

Admission numbers is twelve to the Master's Program and five to the Doctoral program, It is expected that the Master's Program will admit students from the faculties of medicine (health sciences), engineering, and science, while the Doctoral Program will admit students from graduate schools in bioscience and engineering areas as well as graduates of dental medicine. Last year, there were 16 masters students and 9 doctoral students enrolled.

● Good practices at the graduate school

The GSQ has held international symposia five times, and the number of participants is increasing annually. The latest GI-CoRE GSQ, GSB, & IGM Joint Symposium was successfully held over two days in July 2017, with four lecturers from SU, two lecturers from the University of Technology, Sydney, one lecturer from the National Institute for Quantum and Radiological Science and Technology, and one lecturer from Osaka University as well as lecturers from HU. (Fig. 17). In parallel with the symposium, a lecturer from SU also gave lectures on radiation biology for graduate students. (Fig. 18) The symposium was attended by 250 participants, which is a good indication that the efforts of the GSQ to expand the education and research area has progressed satisfactorily.



Fig.17 Speakers and participants at the GI-CoRE GSQ, GSB, & IGM Joint Symposium



Fig.18 Lecture for graduate students by Prof. Giaccia

The GSQ has also held the GI-CoRE Summer School for Medical Physics four times with faculty of SU. This is a one-week program and all the lectures and training in medical physics have been

conducted in English. To date, the Summer Schools have had a total of 83 participants from 26 countries. (Fig. 19)

The GSQ will hold the 5th GI-CoRE Summer School for Medical Physics and the 1st GI-CoRE Summer School for Radiation Biology in August of this year. Both Summer Schools are jointly conducted with the Hokkaido Summer Institute 2018-Medical Physics School- and the Hokkaido Summer Institute 2018-Radiation Biology School. The Hokkaido Summer Institute enables the participants to earn credits as graduate school study, which was suggested in the interim appraisal. The GSQ started accepting applications for the Hokkaido Summer Institute and the Summer Schools in February, 2018.

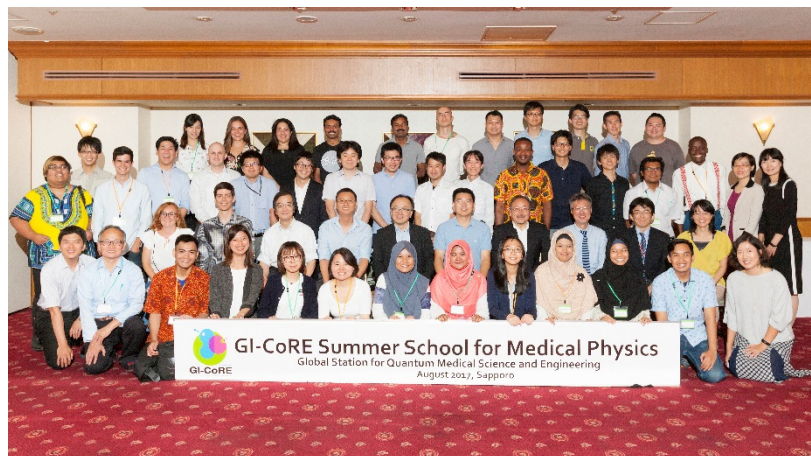


Fig.19 Participants and lecturers at the 4th GI-CoRE Summer School for Medical Physics

- Future developments

- (1) To strengthen English education by increasing the number of faculty and providing lectures exclusive to the Graduate School of Biomedical Science and Engineering, and to improve the quality of the GI-CoRE Summer School for Medical Physics and for Radiation Biology/the Hokkaido Summer Institute.
- (2) To have a curriculum that meets the requirements for accreditation of medical physicists in the U.S, and to increase the percentage of international admissions.
- (3) To increase the number of international joint studies by developing further relationships with faculty of institutions other than the Department of Radiation Oncology of Stanford University.

Overall, there will be numerous opportunities for graduate students and young researchers to experience innovative research at sophisticated leading laboratories, with education and instruction provided by internationally leading researchers, and through these, participants will gain a global perspective and know-how. This direct experience will stimulate the young researchers and students, leading to the development of dynamic youthful researchers, faculty, and other staff.

3. Establishment of Framework

(1) Management System

The Global Institution for Collaborative Research and Education (GI-CoRE) was established in April 2014 as a faculty organization under the direct control of the Hokkaido University President, with the aim of promoting international collaborative research and education that leverages Hokkaido University's strengths and distinctive character. The GI-CoRE is positioned as an independent educational and research organization managed by the President as its director. It brings together world-class teaching staff from around the world, within Japan and within Hokkaido University (HU), based on a new idea to invite the world's highest level research units. GI-CoRE's framework enables the conducting of international collaborative research and education systematically together with leading research units invited from the overseas, rather than relying on international exchange promoted by researchers individually. Implementing this unprecedented way to welcome overseas researchers, HU reformed the management system and established the framework of GI-CoRE effectively under the President's powerful leadership. GI-CoRE appointed the President as the director, and Vice President for International Affairs as the deputy director. Under the President/GI-CoRE director, the GI-CoRE steering committee is established to discuss matters important to GI-CoRE and comprises the President, Vice Presidents for International Affairs and for Planning and Management, and faculty deans/research center directors who are appointed to serve as members to the committee in turn. The steering committee was held in total 14 times by March 2018, and discussed 1) Matters regarding personnel transfers of faculties, 2) Matters regarding the establishment, reform or termination of global stations, 3) Matters regarding the evaluation of the research and educational activities of global stations, 4) Matters regarding budgets, and 5) Other important matters pertaining to the administration of GI-CoRE such as progress reports. To promote the collaborative research and education that capitalizes upon the distinctive characteristics of the university practically, HU places global stations (GS) in GI-CoRE. Each GS has a designated station director who shall be one of the core teaching staff in the research field. Invited world-leading overseas research units are assigned to the GS so as to foster them in promotion of international collaborative research and education together with the leading teaching staff within the university.

<Member List of the Steering Committee>

*As of 1 April 2018

	Name	Affiliation 1	Affiliation 2
1	Toyoharu NAWA	President	Director, Global Institution for Collaborative Research and Education
2	Masanori KASAHARA	Executive / Vice President	Deputy Director, Global Institution for Collaborative Research and Education
3	Jyunji NISHII	Executive / Vice President	
4	Fumihiko YAMAMOTO	Dean / Professor, Graduate School of Letters	
5	Koichiro ISHIMORI	Dean / Professor, Faculty of Science	
6	Takeshi SAITO	Dean / Professor, Faculty of Health Sciences	

7	Toshiyuki NAKAGAKI	Director / Professor, Research Institute for Electronic Science	
8	Hiroki SHIRATO	Professor, Faculty of Medicine	Director, Global Station for Quantum Medical Science and Engineering
9	Hirofumi SAWA	Professor, Research Center for Zoonosis Control	Director, Global Station for Zoonosis Control
10	Takashi INOUE	Professor, Research Faculty of Agriculture	Director, Global Station for Food, Land and Water Resources
11	Jian Ping GONG	Professor, Faculty of Advanced Life Science	Director, Global Station for Soft Matter
12	Yoshikazu MIYANAGA	Professor, Graduate School of Information Science and Technology	Director, Global Station for Big Data and Cybersecurity
13	Natsuhiko OTSUKA	Professor, Arctic Research Center	Director, Global Station for Arctic Research
14	Ko HASEGAWA	Executive / Vice President	
15	Ryuichiro SHIMA	Director, International Affairs Department	

(2) Establishment, Improvement of Acceptance System/Environment, Future Vision, Etc.

Under the governance of the President, GI-CoRE has established the necessary system to accept overseas researchers and improved the environment to operate GI-CoRE tasks as the following, in order to invite the world's top research units from external universities and institutions, as well as allow them to collaborate with the fine teaching staff in the related disciplines of the university.

1. GI-CoRE introduced the cross appointment system with overseas universities and institutions before the system implementation by the whole university. The cross-appointment system is to appoint top-class researchers from overseas and domestic institutions at Hokkaido University, while keeping their status at the host institutions and pay salaries to them based on the level of the effort at Hokkaido University.
2. The implementation of cross appointment system has produced more flexible personnel and salary system for the overseas faculty members such as choosing the annual salary system, relaxing the employment age restriction, and establishing a new title Distinguished Professor which shall be awarded in recognition of particularly important achievement in their fields of study.
3. For the overseas researchers who conduct education and research activities at Hokkaido University, GI-CoRE has set up a flexible system on travel expense and accommodation rental.
4. To utilize the exiting research resources in the university, GI-CoRE has also applied the cross appointment system to the participating researchers of Hokkaido University who conduct international collaborative research and education, and appointed them to the positions both in their original departments and in GI-CoRE.
5. Upon conducting advanced international collaborative research and education, GI-CoRE has reviewed the point-based personnel system and applied flexible personnel distribution even

in positions for researchers.

6. To secure the academic environment to concentrate on research, GI-CoRE faculty members are exempt from administrative tasks such as faculty meetings, etc.

The above-mentioned cross appointment system, annual-salary system for regular teaching staff, and other relevant systems have been started as a pilot system for other departments within the university. Other than these systems, GI-CoRE has also provided rich research environments and extensive educational experiences to young researchers, as well as led good effects as fusion of different research fields/interdisciplinary collaboration with diversified departments to cooperate in the project.

Given the proven cycle, effectiveness of the pilot systems at GI-CoRE has been gradually expanded to the whole university and has started to reinforce the university's administrative function.

Even now, GI-CoRE utilizes the established network and achieved outcomes of collaborative research with institutions/organizations in order to further strengthen research projects which give the entire university a certain advantage over other research universities and implements 'global postgraduate-level education by organic fusion of different fields' at graduate schools of related fields. For this promotion, besides the management expenses granted by the Japanese government, GI-CoRE aims to obtain various funds such as competitive funds as grants-in-aid for scientific research and donation, etc.

(3) Administrative System

In order to support research and educational activities in each global station, administrative staff are required to strengthen their capabilities to handle international affairs. Considering this, Hokkaido University has set up a GI-CoRE-specialized administrative section in the International Affairs Department, distributed staff members with study/work abroad experiences to the section, and established bilingual (English) administrative support systems. Also, bilingual staff have been stationed in each global station office to support daily research activities conducted there.

IV. Supplemental Revision

● Research results (FY 2018-2019)

As of March 2020

1. International collaborative papers (peer reviewed)	Featured in Japanese journals: 0, featured in overseas journals: 21
2. Other publications	Featured in Japanese journals: 4, featured in overseas journals: 61, books published: 1
3. Verbal presentations	Keynote speeches:16, invited lectures:47 (Japanese 34, International 13) other presentations: 123 (Japanese 54, International 69)
4. Patent applications	Registered patents: 0 (0 in Japan, 0 overseas) Pending patents: 16 (9 in Japan, 7 overseas)
5. Awards received	12
6. External grants	2

1) International collaborative papers (peer reviewed)

- Journals published by Japanese publishers, including those published in English, are listed as "Japanese journals".
 - Papers where "GI-CoRE" is stated as an affiliated institution of a Japanese or overseas researcher, or those mentioning "Hokkaido University" in the acknowledgements, are marked with a "*" (asterisk) and the applicable author name is underlined.
 - Among the papers with "*" (asterisk)", papers where "GI-CoRE" is stated as an affiliated institution are marked with "i)", and papers which mention "Hokkaido University" in the acknowledgements are marked with "ii)".
 - Papers where GI-CoRE researchers of Hokkaido University and Stanford University are stated are marked with "o".
- (1) Jihun Kwon, Rajalekha M. Rajamahendiran, Needa A. Virani, Sijumon Kunjachan, Erin Snay, Max Harlacher, Marios Myronakis, Shinichi Shimizu, Hiroki Shirato, Tomasz J. Czernuszewicz, Ryan Gessner, Ross Berbeco. Use of 3D contrast-enhanced ultrasound to evaluate tumor microvasculature after nanoparticle-mediated modulation. *Ultrasound in Medicine & Biology*, in press [Overseas journal] *, i)
 - (2) Yusuke Nomura, Qiong Xu, Hao Peng, Seishin Takao, Shinichi Shimizu, Lei Xing and Hiroki Shirato. Modified fast adaptive scatter kernel superposition (mfASKS) correction and its dosimetric impact on CBCT-based proton therapy dose calculation, in press *Med Phys*. [Overseas journal] *, i), ii) ○
 - (3) Yusuke Nomura, Jeff Wang, Hiroki Shirato, Shinichi Shimizu and Lei Xing. Fast spot-scanning proton dose calculation method using a three-dimensional convolutional neural network. In press, *Physics in Medicine and Biology*. [Overseas journal] *, i), ii) ○
 - (4) Kato F, Kudo K, Yamashita H, Baba M, Shimizu A, Oyama-Manabe N, Kinoshita R, Li R, Shirato H Predicting Metastasis in Clinically Negative Axillary Lymph Nodes with Minimum Apparent Diffusion Coefficient Value in Luminal A-like Breast Cancer. *Breast Cancer*. 2019 Sep;26(5):628-636. [Overseas journal] *, i), ii), ○
 - (5) Takayanagi, Taisuke & Uesaka, Tomoki & Kitaoka, Masanori & Unlu, Mehmet & Umegaki,

- Kikuo & Shirato, Hiroki & Xing, Lei & Matsuura, Taeko. A novel range-verification method using ionoacoustic wave generated from spherical gold markers for particle-beam therapy: a simulation study (2019) *Scientific Reports*. 2019 Mar 8;9(1):4011. doi: 10.1038/s41598-019-38889-w. [Overseas journal] *, i), ii), ○
- (6) Wu PH, Onodera Y, Recuenco FC, Giacchia AJ, Le QT, Shimizu S, Shirato H, Nam JM. Lambda-Carrageenan Enhances the Effects of Radiation Therapy in Cancer Treatment by Suppressing Cancer Cell Invasion and Metastasis through Racgap1 Inhibition. *Cancers* (Basel). 2019 Aug 16;11(8). pii: E1192. doi: 10.3390/cancers11081192. [Overseas journal] *, i), ii), ○
 - (7) Yusuke Nomura, Qiong Xu, Hiroki Shirato, Shinichi Shimizu, Lei Xing, Projection-domain scatter correction for cone beam computed tomography using a residual convolutional neural network. (Received 12 December 2018; revised 8 April 2019; accepted for publication 24 April 2019; *Medical Physics*, in press, 2019 *, i), ○
 - (8) C Liu, Z Li, W Hu, L Xing, H Peng Range and dose verification in proton therapy using proton-induced positron emitters and recurrent nenuralnetworks (RNNs) - *Physics in Medicine & Biology*, 2019 - iopscience.iop.org [Overseas journal] *, i)
 - (9) Z Li, Y Wang, Y Yu, K Fan, L Xing, H Peng Machine Learning Approaches for Range and Dose Verification in Proton Therapy Using Proton-induced Positron Emitters - *Medical physics*, 2019 - Wiley Online Library [Overseas journal] *, i)
 - (10) Y Yu, Z Li, D Zhang, L Xing, H Peng Simulation Studies of time reversal- based photoacoustic reconstruction for range and dose verification in proton therapy - *Medical physics*, 2019 - Wiley Online Library [Overseas journal] *, i)
 - (11) Demirkan, Irem, Mehmet Burcin Unlu, and Bukem Bilen. Determining sodium diffusion through acoustic impedance measurements using 80 MHz Scanning Acoustic Microscopy: Agarose phantom verification. *Ultrasonics* 94 (2019): 10-19. [Overseas journal] *
 - (12) Fujima N, Hirata K, Shiga T, Li R, Yasuda K, Onimaru R, Tsuchiya K, Kano S, Mizumachi T, Homma A, Kudo K, Shirato H. Integrating quantitative morphological and intratumoural textural characteristics in FDG-PET for the prediction of prognosis in pharynx squamous cell carcinoma patients. *Clinical Radiology* 2018 Sep 21; 73 (12): 1059.e1–1059.e8, [Epub ahead of print] [Overseas journal] *, i),○
 - (13) Prayongrat A, Kobashi K, Ito Y M, Katoh N, Tamura M, Dekura Y, Toramatsu C, Khorprasert C, Amornwichet N, Alisanant P, Shirato H, Shimizu S. The normal tissue complication probability model-based approach considering uncertainties for the selective use of radiation modality in primary liver cancer patients. *Radiotherapy and Oncology* 135 (2019) 100-106 [Overseas journal] i)
 - (14) Fujima N, Homma A, Harada T, Shimizu Y, Tha KK, Kano S, Mizumachi T, Li R, Kudo K, Shirato H. The utility of MRI histogram and texture analysis for the prediction of histological diagnosis in head and neck malignancies. *Cancer Imaging* 2019 Feb 4;19(1):5. doi: 10.1186/s40644-019-0193-9. [Overseas journal] *, i),○
 - (15) Kato F, Kudo K, Yamashita H, Baba M, Shimizu A, Oyama-Manabe N, Kinoshita R, Li R, Shirato H. Predicting metastasis in clinically negative axillary lymphnodes with minimum apparent diffusion coefficient value in luminal A-like breast cancer. *Breast Cancer*. 2019 doi: 10.1007/s12282-019-00969-0. [Overseas journal] *, i),ii), ○
 - (16) Kwon J, Sutherland K, Makarova A, Matsuura T, Hashimoto T, Peng H, Toshito T, Umegaki K, Shirato H, Shimizu S Investigation of energy absorption by clustered gold nanoparticles. *Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms*, 429, 34-41. 2018 [Overseas journal] ○
 - (17) Takayanagi T, Uesaka T, Kataoka M, Unlu MB, Umegaki K, Shirato H, Xing L, Matsuura T, “A novel range verification method using ion-acoustic wave generated from spherical gold markers for particle beam therapy: a simulation study”, in revision, *Scientific Reports* (2018). [Overseas

journal] ○

- (18) Nishikawa Y, Yasuda K, Okamoto S, Ito Y M, Onimaru R, Stiga T, Tsuchiya K, Watanabe S, Takeuchi W, Kuge Y, Peng H, Tamaki N, Shirato H. Local relapse of nasopharyngeal cancer and Voxel-based analysis of FMISO uptake using PET with semiconductor detectors. *Radiat Oncol*. 2017 Sep 6;12(1):148. doi: 10.1186/s13014-017-0886-9 [Overseas journal] *, i) ○
- (19) Bilen, Bukem, Belkis Gokbulut, Ulku Kafa, Emre Heves, Mehmet Naci Inci, and Mehmet Burcin Unlu. "Scanning Acoustic Microscopy and Time-Resolved Fluorescence Spectroscopy for Characterization of Atherosclerotic Plaques." *Scientific Reports* 8, no. 1 (2018): 14378. [Overseas journal] *, i)
- (20) Uluc, Nasire, Mehmet Burcin Unlu, Gultekin Gulsen, and Hakan Erkol. "Extended photoacoustic transport model for characterization of red blood cell morphology in microchannel flow." *Biomedical Optics Express* 9, no. 6 (2018): 2785-2809. [Overseas journal] *, i)
- (21) Demirkan, Irem, Mehmet Burcin Unlu, and Bukem Bilen. "Determining Sodium Diffusion through Acoustic Impedance Measurements using 80 MHz Scanning Acoustic Microscopy: Agarose Phantom Verification." *Ultrasonics* (2018). [Overseas journal] *, i)

2) Other original papers

- major papers only.

Japanese journals (including those in English)

- (1) Mizumachi T, Kano S, Homma A, Akazawa M, Hasegawa C, Shiroishi Y, Okamoto C, Kumagai S, Nishimura M, Takasaki H, Takeda H, Yasuda K, Minatogawa H, Dekura Y, Onimaru R, Shirato H, Fukuda S. [A Nutritional Supplement with a High Blend Ratio of ω -3 Fatty Acids(Prosure®) Reduces Severe Oral Mucositis and Body Weight Loss for Head and Neck Cancer Patients Treated with Chemoradiotherapy]. *Gan To Kagaku Ryoho*. 2019 Apr;46(4):685-689. Japanese. PubMed PMID: 31164507. [Japanese journal] *
- (2) Takayuki Hashimoto, Shinichi Shimizu, Seishin Takao, Shunsuke Terasaka, Akihiro Iguchi, Hiroyuki Kobayashi, Takashi Mori, Takaaki Yoshimura, Yuto Matsuo, Masaya Tamura, Taeko Matsuura, Yoichi M. Ito, Rikiya Onimaru and Hiroki Shirato , Clinical experience of craniospinal intensity modulated spot-scanning proton therapy using large fields for central nervous system medulloblastomas and germ cell tumors in children, adolescents, and young adults. *Journal of Radiation Research*, Vol. 60, No. 4, 2019, pp. 527–537 doi: 10.1093/jrr/rrz022 Advance Access Publication: 21 May 2019 [Japanese journal] *, i)
- (3) Onimaru R, Onishi H, Ogawa G, Hiraoka M, Ishikura S, Karasawa K, Matsuo Y, Kokubo M, Shioyama Y, Matsushita H, Ito Y, Shirato H. Final report of survival and late toxicities in the Phase I study of stereotactic body radiation therapy for peripheral T2N0M0 non-small cell lung cancer (JCOG0702). *Jpn J Clin Oncol*. 2018 Oct 1. doi: 10.1093/jjco/hyy141. [Japanese journal]
- (4) Morita R, Abo D, Soyama T, Sakuhara Y, Kajiyama M, Kudo K. Spontaneous recovery of multiple hepatic artery aneurysms with segmental arterial mediolysis. *Interventional Radiology* 2018 In press [Japanese journal]

Overseas journals

- (1) Miyamoto N, Maeda K, Abo D, Morita R, Takao S, Matsuura T, Katoh N, Umegaki K, Shimizu S, Shirato H. Quantitative evaluation of image recognition performance of fiducial markers in real-time tumor-tracking radiation therapy. *Phys Med*. 2019 Sep;65:33-39. doi: 10.1016/j.ejmp.2019.08.004. Epub 2019 Aug 12. PubMed PMID:31430584. [Overseas journal] *, i), ii)
- (2) Uchinami Y, Suzuki R, Katoh N, Taguchi H, Yasuda K, Miyamoto N, Ito YM, Shimizu S, Shirato H. Impact of organ motion on volumetric and dosimetric parameters in stomach lymphomas treated with intensity-modulated radiotherapy. *J Appl Clin Med Phys*. 2019 Aug;20(8):78-86. doi: 10.1002/acm2.12681. Epub 2019 Aug 10.

- PubMed PMID: 31400082; PubMed Central PMCID: PMC6698764. [Overseas journal] *, i), ii)
- (3) Ishikawa H, Tsuji H, Murayama S, Sugimoto M, Shinohara N, Maruyama S, Murakami M, Shirato H, Sakurai H. Particle therapy for prostate cancer: The past, present and future. *Int J Urol*. 2019 Oct;26(10):971-979. doi: 10.1111/iju.14041. Epub 2019 Jul 8. Review. PubMed PMID: 31284326. [Overseas journal] *, i)
 - (4) Endo K, Takahata M, Sugimori H, Yamada S, Tadano S, Wang J, Todoh M, Ito YM, Takahashi D, Kudo K, Iwasaki N. Magnetic resonance imaging T1 and T2 mapping provide complementary information on the bone mineral density regarding cancellous bone strength in the femoral head of postmenopausal women with osteoarthritis. *Clin Biomech* (Bristol, Avon). 2019 May;65:13-18. doi: 10.1016/j.clinbiomech.2019.03.010. Epub 2019 Mar 20. [Overseas journal] *
 - (5) Morita R1 Abo D, Sakuhara Y, Soyama T, Katoh N, Miyamoto N, Uchinami Y, Shimizu S, Shirato H, Kudo K Percutaneous insertion of hepatic fiducial true-spherical markers for real-time adaptive radiotherapy. *Minim Invasive Ther Allied Technol*. 2019 Sep 13:1-10. [Overseas journal] *, i), ii)
 - (6) Oyama-Manabe N, Manabe O, Naya M, Kudo K, Tamaki N. Comprehensive evaluation of myocardial ischemia with dynamic perfusion CT. *Annals of Nuclear Cardiology* 2019; 5(1) 79-83 [Overseas journal] *
 - (7) Abe N, Kato M, Fujieda Y, Narita H, Tha KK, Atsumi T. Tumor necrosis factor alpha blockade for non-inflammatory pain: beyond inflammation? *Scand J Rheumatol*. 48(6): 519-521, 2019 May 28:1-3. [Overseas journal] *
 - (8) Kazumata K, Tha KK, Tokairin K, Ito M, Uchino H, Kawabori M, Sugiyama T. Brain Structure, Connectivity, and Cognitive Changes Following Revascularization Surgery in Adult Moyamoya Disease. *Neurosurgery*. 2019 Jun 3. pii: nyz176. doi: 10.1093/neuros/nyz176. [Overseas journal] *
 - (9) Kato K, Yasojima N, Tamura K, Ichikawa S, Sutherland K, Kato M, Fukae J, Tanimura K, Tanaka Y, Okino T, Lu Y, Kamishima T. Detection of Fine Radiographic Progression in Finger Joint Space Narrowing Beyond Human Eyes: Phantom Experiment and Clinical Study with Rheumatoid Arthritis Patients. *Sci Rep*. 2019 Jun 12;9(1):8526. doi: 10.1038/s41598-019-44747-6. PMID: 31189913 [Overseas journal] *
 - (10) Fujimori M, Kamishima T, Narita A, Henmi M, Kato M, Sutherland K, Nishida M, Tanaka Y, Yutong L, Tanimura K, Atsumi T. Quantitative power Doppler signal assessment in the subchondral bone region of the metacarpophalangeal joint is an effective predictor of radiographic progression in the hand of rheumatoid arthritis: a pilot study. *Rheumatol Int*. 2019 Aug;39(8):1413-1421. doi: 10.1007/s00296-019-04320-w. Epub 2019 May 14. PMID: 31089859 [Overseas journal] *, i)
 - (11) Fujimori M, Murakami K, Sugimori H, Lu Y, Sutherland K, Oki N, Aoki T, Kamishima T. Intravoxel incoherent motion MRI for discrimination of synovial proliferation in the hand arthritis: A prospective proof-of-concept study. *J Magn Reson Imaging*. 2019 Oct;50(4):1199-1206. doi: 10.1002/jmri.26660. Epub 2019 Jan 31 PMID: 30706568 [Overseas journal] *, i)
 - (12) Kenneth Sutherland1. Toshiyuki Hamada2 . Masayori Ishikawa 1A. Naoki Miyamoto 1 ·5 . Masahiro Mizuta3 . Hiroyuki Date4 . Hiroki Shirato 1 ,5 3D Transformation Matrix Calculation and Pixel Intensity Normalization for the Dual Focus Tracking System. *Journal of Medical and Biological Engineering* August 2019 <https://doi.org/10.1007/s40846-019-00474-x> [Overseas journal] *, i), ii)
 - (13) Shimizu Y, Kudo K, Kameda H, Harada T, Fujima N, Toyonaga T, Tha KK, Shirato H. Prediction of Hypoxia in Brain Tumors Using a Multivariate Model Built from MR Imaging and (18)F-Fluorodeoxyglucose Accumulation Data. *Magn Reson Med Sci*. 2019 Oct 15. doi: 10.2463/mrms.mp.2019-0049. [Epub ahead of print] PubMed PMID: 31611541. [Overseas journal] *, i)
 - (14) Furuya S, Naya M, Manabe O, Hirata K, Ohira H, Aikawa T, Koyanagawa K, Magota K, Tsujino I, Anzai T, Kuge Y, Oyama-Manabe N, Kudo K, Shiga T, Tamaki N. ¹⁸F-FMISO PET/CT detects hypoxic lesions of cardiac and extra-cardiac involvement in patients with sarcoidosis. *J Nucl Cardiol* 2019 Dec 9. doi: 10.1007/s12350-019-01976-6. [Epub ahead of print] [Overseas journal] *, ii)
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Published books

- (1) Yasuda K: "Integration of Positron Emission Tomography into Radiation Therapy: With a focus on the Head and Neck Cancer" *Japanese Journal of Clinical Radiology* 2018 Sep; 63(9):961-967

3) Verbal presentations

- major presentations only.

- international conferences held in Japan are listed as "-[International conference]".

Keynote speeches

- (1) Shirato H: "Expectations for molecular imaging in next-generation cancer treatment - From the perspective of radiation therapy -", The 14th Annual Meeting of Japanese Society for Molecular Imaging, Sapporo, May 23, 2019
- (2) Shirato H: "Precise and Accurate Radiotherapy for Cancer Treatment". Taiwan Society for Therapeutic Radiology and Oncology (TASTRO) , Nov. 9, 2019, Taipei, Taiwan
- (3) Shirato H: Real-time-image gated proton beam therapy. Hokkaido University China Medical University Joint Symposium. June 21, 2018. Sapporo, Japan
- (4) Shirato H: Real-time-image gated proton beam therapy. Hokkaido University China Medical University Joint Symposium. June 21, 2018. Sapporo, Japan
- (5) Shirato H: Real-time Tumor-tracking Radiotherapy, 15th SGH Special Lecture, Dec. 1, 2018. Kyoto, Japan
- (6) Tha KK: Diagnostic Neuroanatomy: Know the Anatomy to Know the Pathology. International Visiting Professor Program, RSNA-AOSR. Feb 13, 2019. Yangon, Myanmar.
- (7) Tha KK: The role of CT and MRI in traumatic brain injury. Special CME Lecture, Wittoria Hospital. Feb 14, 2019. Yangon, Myanmar.
- (8) Tha KK: MRI findings of common congenital anomalies of the CNS. International Visiting Professor Program, RSNA-AOSR. Feb 15, 2019. Yangon, Myanmar.
- (9) Tha KK: The role of CT and MRI in traumatic brain injury. International Visiting Professor Program, RSNA-AOSR. Feb 15, 2019. Yangon, Myanmar.
- (10) Tha KK: Stroke imaging and beyond. International Visiting Professor Program, RSNA-AOSR. Feb 18, 2019. Yangon, Myanmar.
- (11) Tha KK: CT and MRI findings in infectious and inflammatory disease of the CNS. International Visiting Professor Program, RSNA-AOSR. Feb 19, 2019. Yangon, Myanmar.
- (12) Tha KK: Toxic and metabolic diseases of the CNS: how to arrive at correct and timely imaging diagnosis. International Visiting Professor Program, RSNA-AOSR. Feb 20, 2019. Yangon, Myanmar.
- (13) Tha KK: Recent updates in brain tumor imaging. International Visiting Professor Program, RSNA-AOSR. Feb 21, 2019. Yangon, Myanmar.
- (14) Tha KK: Imaging spectrum of demyelinating and neurodegenerative diseases. International Visiting Professor Program, RSNA-AOSR. Feb 22, 2019. Yangon, Myanmar.
- (15) Tha KK: Tips for Neuroimage interpretation. International Visiting Professor Program, RSNA-AOSR. Feb 25, 2019. Yangon, Myanmar.
- (16) Tha KK: A Glimpse to Researches in A Clinical Facility. June 15, 2018. Philips Research, Hamburg, Germany.

Invited lectures [Japanese conference]

- (1) Shimizu S: "Present and future of photon and particle beam therapies", The 48th Symposium of cancer control by radiation, Aomori, June 8, 2019
- (2) Shimizu S: "Radiotherapy options for high-risk prostate cancer - IMRT, heavy particle beam, proton beam, or brachy?", The 5th Annual meeting of the Japan Society of Urologic Oncology, Fukuoka, October 26, 2019
- (3) Shirato H: "Present proton beam therapy for cancer, Real-time tumor-tracking therapy and pinpointed proton beam irradiation", Soirée Louis Pasteur 2019, Tokyo, October 30, 2019
- (4) Tha KK: Electrical Conductivity of the Brain in Normal & Pathological States, The 78th Japan Radiology Congress, Yokohama, 2019
- (5) Shirato H: Cancer research and treatment using radiation. 77th Annual meeting of the Japan

- Cancer Association 2018. Sep. 27 - 29. Sapporo, Japan
- (6) Shimizu S: "Current status and potential of intensity-modulated radiotherapy / proton beam therapy for high-risk prostate cancers" The 56th Annual Meeting of Japan Society of Clinical Oncology, Yokohama, October 18, 2018 [Japanese Conference]
 - (7) Shimizu S: "Real-time image guided technology and radiotherapy" The 55th Seminar on Biological Response Science, Hirosaki, November 30 – December 1, 2018 [Japanese Conference]
 - (8) Kudo K: "Perspectives on CT / MR perfusion images in Japan", the 4th Frontier in Acute Stroke Treatment –FAST Conference-, Tokyo, April 21, 2018 [Japanese Conference]
 - (9) Kudo K: "MRI of Alzheimer's disease: QSM image reflecting amyloid pathology and iron deposition" 59th Annual Meeting of the Japanese Society of Neurology, Sapporo, May 24, 2018 [Japanese Conference]
 - (10) Kudo K: "Main complaints: Importance of bird's eye view before focusing in diagnostic imaging for "Parkinson's symptoms" 59th Annual Meeting of the Japanese Society of Neurology, Sapporo, May 26, 2018 [Japanese Conference]
 - (11) Kudo K: "Basics of MR examinations: central nervous system · spine" The 19th MR Introductory Lecture, Tokyo, June 9, 2018 [Japanese Conference]
 - (12) Kudo K: "Latest PMA developments" Brushup Seminar of NeuroEndovascular Therapy, Kobe, September 15, 2018 [Japanese Conference]
 - (13) Kudo K: "MR diagnosis of Alzheimer's disease using QSM", The 58th Annual Scientific Meeting of the Japanese Society of Nuclear Medicine, Ginowan, November 16, 2018 [Japanese Conference]
 - (14) Kudo K: "QSM (Quantitative Susceptibility Mapping)", Japanese Society for Magnetic Resonance in Medicine, the 22nd MR Practical Lecture, Tokyo, December 8, 2018 [Japanese Conference]
 - (15) Kudo K: "New diagnostic vistas opened by QSM analysis", Hi Advanced MR Seminar in Japan, Tokyo, January 12, 2019 [Japanese Conference]
 - (16) Kudo K: "TBD ", Innovative Synthetic Imaging Seminar, Nagoya, February 1, 2019 [Japanese Conference]
 - (17) Kudo K: "Central issues in diagnostic imaging of the central nervous system", The 48th Annual Meeting of The Japanese Society of Neuroradiology, Kurume, February 16, 2019 [Japanese Conference]
 - (18) Kudo K: "TBA", Sakurayama Imaging Seminar, Nagoya, February 22, 2019 [Japanese Conference]
 - (19) Oyama-Manabe N: "Diagnostic imaging for ACHD" The 120th Hokkaido Regional Meeting of the Japanese Circulation Society, Pediatric · Adult Congenital Heart Disease Study Group, Sapporo, 2018 [Japanese Conference]
 - (20) Oyama-Manabe N: "Impact of IQon Spectral CT on cardiovascular diagnostic imaging" The 13th Chubu Multi-Slice CT Symposium, Nagoya, 2018 [Japanese Conference]
 - (21) Oyama-Manabe N: "Unexpectedly frequent IgG4-related cardiovascular lesions", Japanese College of Radiology, Midsummer Seminar, Kobe, 2018 [Japanese Conference]
 - (22) Oyama-Manabe N: "Diagnosis of cardiovascular lesions using multiple contrast, directly addressing the treatment", Philips Summer Seminar – Future for Diagnostic Imaging Experts, Tokyo, 2018 [Japanese Conference]
 - (23) Oyama-Manabe N: "MRI-like CT? Development of cardiovascular diagnostic imaging realized by IQon Spectral CT", The 27th Annual Meeting of the Japanese Association of Cardiovascular Intervention and Therapeutics, Kobe, 2018 [Japanese Conference]
 - (24) Oyama-Manabe N: "All about Myocardial Dynamic Perfusion" The 8th 320 row area Detector CT Seminar, Fukushima, 2018 [Japanese Conference]
 - (25) Oyama-Manabe N: "New MRI approaches for cardiomyopathy", AIMS Cardiac Imaging 2018,

- Tokyo, 2018 [Japanese Conference]
- (26) Oyama-Manabe N: “New cardiovascular diagnostic imaging using IQon Spectral CT!”, The 77th Annual Meeting of the Japan Radiological Society, Yokohama, 2018 [Japanese Conference]
 - (27) Oyama-Manabe N: “Compressed SENSE imaging conditions and optimization of protocols, cardiovascular area”, Compressed SENSE Users Meeting, Yokohama, 2018 [Japanese Conference]
 - (28) Oyama-Manabe N: “Advantages of Comprehensive Myocardial Perfusion CT imaging”, The 82nd Annual Scientific Meeting of the Japanese Circulation Society, Osaka, 2018 [Japanese Conference]
 - (29) Oyama-Manabe N: “MRI for hypertrophic cardiomyopathy“, The 22nd Conference of Shinkinkai, Tokyo, 2018 [Japanese Conference]
 - (30) Oyama-Manabe N: “New diagnostic imaging tools for circulatory organs”, “Otaru Circulatory MRI Conference, Otaru, 2018 [Japanese Conference]
 - (31) Oyama-Manabe N: “Respond to any and every heart disease! Cardiovascular MRI Beyond”, The 4th Gunma Heart MRI Meeting, Maebashi, 2018 [Japanese Conference]
 - (32) Tha KK: The role of radiomics in evaluation of brain tumors. The 46th Annual meeting of the Japanese Society for Magnetic Resonance in Medicine. September 7, 2018. Kanazawa, Japan.
 - (33) Tha KK: Can EPT and APT imaging reflect the state of tissues? The 46th Annual meeting of the Japanese Society for Magnetic Resonance in Medicine. September 8, 2018. Kanazawa, Japan.
 - (34) Abo D: “Embolization for post-surgical hemorrhagic complications”, The 3rd JPEC, Osaka, 2018 [Japanese Conference]

Invited lectures [International conference]

- (1) Daniel Chang: Modern approaches to pancreatic cancer: updates and contouring session. Taiwan-American Radiation Oncology Society 7th Annual Meeting, Taipei, Taiwan, October 19, 2019. Invited Speaker.
- (2) Tha KK: A Clinician's View on DL-EPT. The 27th Annual Meeting of International Society for Magnetic Resonance in Medicine, Montreal, 2019
- (3) Tha KK: Radiomics and Machine Learning in Cancer Research and Therapy. The 9th Imaging Summit, Taipei, 2019
- (4) Tha KK: MR-Based Electrical Conductivity Imaging of the Brain in Normal & Pathological States, The 2nd International Workshop on MR-based Electrical Properties Mapping, Utrecht, 2019
- (5) Tha KK: Potential Clinical Applications of Phase-based Electrical Conductivity Imaging, The 5th International Workshop on MRI Phase Contrast & Quantitative Susceptibility Mapping, Seoul, 2019
- (6) Shimizu S: Overview about clinical indications of moving targets - state of the art photon and proton treatment, Visiting Professor Talk at Mayo Clinic, Rochester MN, USA, 2019.10.1
- (7) Shirato H: Recent Topics in Japan about radiotherapy for lung cancer. Beijing Multi-disciplinary Lung Cancer Diagnosis and Treatment Forum 2018. June 14 - 15, China
- (8) Shimizu S: Clinical application of gated X-ray and particle beam therapy using real-time images, The 6th Taiwan-Japan Radiation Oncology Symposium (TJROS), Taichung, Taiwan, May 19, 2018 [International Conference]
- (9) Shimizu S: Four-year treatment experience and efficiency with real time image gated proton therapy (RGPT) and IGRT system, MD Anderson – Stanford Conference, Houston, USA, October 25-26, 2018 [International Conference]
- (10) Oyama-Manabe N: ESCR meets ASCI symposium: Non-ischemic Cardiomyopathy “CMR in Cardiac Sarcoidosis”, European society of thoracic imaging/ European society of cardiovascular radiology, Geneva, 2018 [International conference]

- (11) Oyama-Manabe N: Cutting edge cardiac MR techniques: How to use in clinical settings, The congress of Asian society of cardiovascular imaging, Taipei, 2019 (March) [International conference]
- (12) Oyama-Manabe N: All about dual energy CT imaging for cardiovascular disease, The congress of Asian society of cardiovascular imaging, Taipei, 2019 (March) [International conference]
- (13) Li R: Radiomic tools to assess early response to cancer therapy, Symposium on Longitudinal Imaging for Radiotherapy, AAPM annual meeting, Nashville, TN. July 2018 [International Conference]

Other presentations [Japanese conference]

- (1) Katoh N, Uchinami Y, Abo D, Kawamoto Y, Nakamura T, Takao S, Taguchi H, Shito M, Shimizu S, Shirato H: “Initial clinical experience with Real-time tumor-tracking proton beam therapy combined with S- 1, targeting locally advanced pancreatic cancer”, The 14th Study Group of Preoperative therapy for Pancreatic cancer, Sapporo, October 12, 2019
- (2) Abo D, Soyama T, Morita R, Yoshino Y, Kimura T, Kudo K: Non-vascular IVR for salvage of post-operative complications, The 48th Annual Meeting of the Japanese Society of Interventional Radiology, Fukuoka, May 29 – June 1, 2019
- (3) Abo D, Soyama T, Morita R, Yoshino Y, Kimura T, Kudo K: The usefulness of guidance software for diagnosing tumor-feeding branches during transcatheter arterial chemoembolization for hepatocellular carcinomas, The 48th Annual Meeting of the Japanese Society of Interventional Radiology, Fukuoka, May 29 – June 1, 2019
- (4) Abo D, Soyama T, Morita R, Kamiishi T, Kanaya M, Takayanagi A, Yamazaki Y, Yoshino Y, Kimura T, Kudo K: “Fundamental study on the utility of microcatheters with movable, locking tips for coil embolization”, The 48th Annual Meeting of the Japanese Society of Interventional Radiology, Fukuoka, May 29 – June 1, 2019
- (5) Abo D: Is embolization only tool of treatment in IVR for post-operative hemorrhagic complication? ~Paradigm shift from embolization to preservation~, The 31st Meeting of Japanese Society of Hepato-Biliary-Pancreatic Surgery, Takamatsu, June 13-15, 2019
- (6) Abo D, Soyama T, Morita R, Yoshino Y, Kudo K: “The latest IVR for intraperitoneal abscesses - Secrets of puncture drainage – How specialists approach pancreatic fistula puncture!”, The 32nd Annual Meeting of the Japan Society for Surgical Infection, Gifu, November 29-30, 2019
- (7) Yasuda K, Minatogawa H, Dekura Y, Takao S, Tamura M, Tsushima Y, Suzuki T, Kano, S, Mizumachi T, Matsuo Y, Suzuka M, Yamano S, Onimaru R, Shimizu S, Homma A, Shirato H: Initial experience of Intensity Modulated Proton Therapy (IMPT) for Pharyngeal Cancer., The 32nd Annual Meeting of the Japanese Society for Radiation Oncology, Nagoya, November 21-23, 2019
- (8) Katoh N: “No development of proton beam therapy without developments in X-ray therapy”, The 28th Annual Meeting of the Japanese Society of Stereotactic Radiosurgery, Niigata, June 14, 2019
- (9) Abo D: When and how is Target® detachable coils useful in postoperative hemorrhagic complications after hepato-biliary-pancreatic surgery?, Fukuoka, May 29-June 1, 2019

- (10) Abo D: Update Interventional Radiology and Endoscopy for HBP, Technical tips and tricks of percutaneous drainage after hepato-biliary pancreatic surgery, The 31st Meeting of Japanese Society of Hepato-Biliary-Pancreatic Surgery, Takamatsu, June 13-15, 2019
- (11) Abo D: “Work and the current situation at our hospital for improving cTACE treatment outcomes”, The 55th Annual Meeting of Liver Cancer Study Group of Japan, Tokyo, July 4-5, 2019
- (12) Abo D: The usefulness of guidance software for diagnosing tumor-feeding branches during transcatheter arterial chemoembolization for hepatocellular carcinomas, 2nd HCC Preceptorship@APPLE2019, Sapporo, August 28, 2019
- (13) Abo D: Basics of superselective TACE for hepatocellular carcinoma, Seminar for interventional radiology in Asia-Pacific, Kanagawa, October 25-27, 2019
- (14) Abo D: “How to acquire outstanding skills and experience?”, 3rd Tokyo IR Club, Tokyo, November 15, 2019
- (15) Abo D: “IVR of pancreatic fistulas after pancreatectomy - Focusing on drainage –”, 3rd Pancreas cancer workshop, Nara, November 2, 2019
- (16) Abo D: “Current situation around percutaneous drainage in our department - From diagnosis to treatment –”, 5th IVR Seminar, Izumo, November 15, 2019
- (17) Abo D: “Current situation around postoperative image diagnosis and percutaneous drainage for hepato-biliary-pancreatic cases in our department”, Latest radiology workshop in Kochi, Kochi, November 27, 2019
- (18) Kudo K: “Changes in and latest information of dynamic contrast enhanced CT and MR perfusion images”, MRI workshop, Miyazaki, January 25, 2020
- (19) Kudo K: “History and present topics in dynamic contrast enhanced CT and MR perfusion images”, The 87th Magnetic Resonance Imaging Conference in Hokkaido, Sapporo, February 7, 2020
- (20) Kudo K: “Diagnosis of dementia by QSM and OEF analysis”, Brain Function Imaging Conference, Toyama, March 18, 2020
- (21) Kudo K: “Current situation and future perspectives on PMA, an automated software for analyzing perfusion images”, The Japan Stroke Society, Yokohama, March 26, 2020
- (22) Kudo K: “Ischemic penumbra imaging using CT / MR perfusion images”, Study meeting for Low Invasive Imaging Diagnosis and Treatment, Nagoya, December 20, 2019
- (23) Kudo K: “QSM analysis of the brain and trunk”, GE Healthcare Seminar, Hirosaki, December 10, 2019
- (24) Kudo K: “Three aspects of central nervous system and diagnostic imaging”, Japanese Seminar in RSNA 2019, Chicago, December 1, 2019
- (25) Kudo K: “Diagnosis of Alzheimer's disease by MRI-QSM”, The 38th Japan Society for Dementia Research, Tokyo, November 7, 2019
- (26) Kudo K: “Early diagnosis of dementia by iron deposition analysis on MRI-QSM images”, The 9th

Japan Society for Dementia Prevention, Nagoya, October 18, 2019

- (27) Kudo K: “Diagnosis of dementia by quantitative susceptibility mapping: Improvements in diagnostic accuracy by brain surface analysis”, The 47th Japanese Society for Magnetic Resonance in Medicine, Kumamoto, September 20, 2019
- (28) Kudo K: “Basics of MR examinations: central nerve and spine areas”, The 20th Introductory Lecture, Kyoto, June 8, 2019
- (29) Kudo K: “MRI of neurodegenerative diseases by QSM”, The 17th Radiology Seminar, Shimane, May 31, 2019
- (30) Kudo K: “Contrast-enhanced CT / MR perfusion imaging for acute cerebral infarction and brain tumors”, The 78th Japan Radiological Society, Yokohama, April 11, 2019
- (31) Kudo K: “Early diagnosis of Alzheimer's disease by QSM analysis and its application to cirrhosis”, The 78th Japan Radiological Society, Yokohama, April 11, 2019
- (32) Hashimoto T: “Proton beam therapy for cancer of pediatric”, The 45th Japanese Society of Pediatric Hematology / Oncology Seminar, Sapporo, February 22, 2020
- (33) Katoh F, Kudo K, Yamashita K, Baba M, Shimizu A, Oyama-Manabe N, Shirato H: “Evaluation of axillary lymph node metastasis using minimum ADC values of primary tumors in clinically metastatic negative luminal A-like breast cancer patients”, The 77th Annual Meeting of the Japan Radiological Society, Yokohama, April 12-15, 2018 [Japanese Conference]
- (34) Oyama-Manabe N: “Gold Medal prize”, The 77th Annual Meeting of the Japan Radiological Society, Study of cardiac late Gadolinium enhancement MRI in muscular dystrophy, The 77th Annual Meeting of the Japan Radiological Society, Yokohama, April 12-15, 2018 [Japanese Conference]
- (35) Oyama-Manabe N: Symposium: “Insights into Myocardial Ischemia with Dynamic CT perfusion”, The 77th Annual Meeting of the Japan Radiological Society, Yokohama, April 12-15, 2018 [Japanese Conference]
- (36) Izuka A, Suzuki R, Makinaga A, Miyamoto N: A study of quality evaluation in treatment plan of intensity modulated radiation therapy using the gradient measurement tool, The 115th Scientific Meeting of the Japan Society of Medical Physics, Yokohama, April 12-15, 2018 [Japanese Conference]
- (37) Matsuyama K, Miyamoto N, Makinaga A, Suzuki R: Marker recognition algorithm based on image similarity using pixel value histogram in real-time tumor-tracking radiotherapy, The 115th Scientific Meeting of the Japan Society of Medical Physics, Yokohama, April 12-15, 2018 [Japanese Conference]
- (38) Matsumoto N, Miyamoto N, Makinaga A, Suzuki R: Evaluation of correlation between internal fiducial marker motion and deformation field in lung, The 115th Scientific Meeting of the Japan Society of Medical Physics, Yokohama, April 12-15, 2018 [Japanese Conference]
- (39) Hirayama S, Matsuura T, Ueda H, Fujii Y, Fujii T, Takao S, Miyamoto N, Shimizu S, Fujimoto R, Umegaki K, Shirato H: Development of an analytical dose-averaged LET calculation method using a dual-LET-kernel model for spot-scanning proton therapy, The 115th Scientific Meeting of the Japan Society of Medical Physics, Yokohama, April 12-15, 2018 [Japanese Conference]
- (40) Sato S, Kudo A, Sato C, Naganuma R, Uwatoko H, Nishimura H, Shirai S, Takahashi I, Matsushima M, Yabe I, Harada T, Sasaki H: Assessment of central nervous system vasculitis by using intracranial vessel wall imaging, 59th Annual Meeting of the Japanese Society of Neurology, Sapporo, May 23-26, 2018 [Japanese Conference]

- (41) Soyama T, Yoshino Y, Kato D, Kato H, Morita R, Abo D, Yoshida D, Kudo K: Catheterization into Challenging Vessels with Steerable Microcatheters, The 47th Annual meeting of the Japanese Society of Interventional Radiology, Tokyo, May 31-June 2, 2018 [Japanese Conference]
- (42) Abo D, Soyama T, Morita R, Kato H, Yoshino Y, Kudo K, Watanabe M, Koshizuka Y, Kawamura N, Goto R, Shimamura T: Donor duodenal rupture after pancreas transplantation treated by direct injection using NBCA, The 47th Annual meeting of the Japanese Society of Interventional Radiology, Tokyo, May 31-June 2, 2018 [Japanese Conference]
- (43) Li X, Tha KK, Abiko K, Sheriff S, Maudsley A, Ahn S, Urushibata Y, Kudo K, Shirato H: Distribution of Major Metabolites of the Brain in Normal Adult Population: A Whole-Brain Magnetic Resonance Spectroscopic Imaging Study, The 46th Annual Meeting of the Japanese Society for Magnetic Resonance in Medicine, Kanazawa, September 7-9, 2018 [Japanese Conference]
- (44) Harada T, Kudo K, Kameda H, Sato R, Shirai T, Bito Y, Fujima N, Tsuneta S, Nogawa T, Maeda K, Hayashi H, Sasaki M: Phase I study of 17O-labeled water: safety and feasibility study of indirect proton MRI for the evaluation of cerebral blood flow, The 46th Annual Meeting of the Japanese Society for Magnetic Resonance in Medicine, Kanazawa, September 7-9, 2018 [Japanese Conference]
- (45) Shimura R, Shimizu Y, Harada T, Kameda H, Kudo K: Evaluation of injection rate of Gadobutrol in perfusion MRI., The 46th Annual Meeting of the Japanese Society for Magnetic Resonance in Medicine, Kanazawa, September 7-9, 2018 [Japanese Conference]
- (46) Yoshikawa M, Kudo K, Harada T, Sato R, Shirai T, Bito Y: Texture analysis of quantitative susceptibility mapping in the cirrhotic liver, The 46th Annual Meeting of the Japanese Society for Magnetic Resonance in Medicine, Kanazawa, September 7-9, 2018 [Japanese Conference]
- (47) Miyamoto N, Matsumoto N, Suzuki R, Takao S, Matsuura T, Fujii T, Hirayama S, Tomioka S, Shimizu S, Umegaki K, Shirato H: Real-time volumetric image generation with CT image deformation driven by displacement of internal fiducial markers, The 116th Scientific Meeting of the Japan Society of Medical Physics, Iwate, September 15-17, 2018 [Japanese Conference]
- (48) Fujii T, Takao S, Shimizu S, Matsuura T, Miyamoto N, Hirayama S, Umegaki K, Shirato H: 4D-CBCT technique with fiducial marker-position to reconstruct a volumetric image just before the treatment proton beam delivery in Real-time-image Gated Proton Therapy, The 116th Scientific Meeting of the Japan Society of Medical Physics, Iwate, September 15-17, 2018 [Japanese Conference]
- (49) Wu PH, Onodera Y, Shirato H, Nam JM: Radiation increases invasive activity of breast cancer cells by lysosome exocytosis, The 77th Annual Meeting of the Japanese Cancer Association, Osaka, Japan, September 27-29, 2018 [Japanese Conference]
- (50) Hashimoto T, Kobayashi H, Iguchi M, Mori T, Sugiyama M, Mogi H, Cho Y, Yamaguchi S, Onimaru R, Shimizu S, Shirato H: “Clinical benefits of intensity-modulated proton therapy for pediatric medulloblastoma / germ cell tumors requiring craniospinal irradiation, The 77th Annual Meeting of the Japan Neurosurgical Society, Sendai, October 10-13, 2018 [Japanese Conference]
- (51) Yasuda K: “Radiation Therapy for Maxillary Sinus Cancer: IMRT and Proton Beam Therapy“, The 9th Educational Seminar, Annual Meeting of Japan Society for Head and Neck Cancer, Tokyo, June 13, 2018 [Japanese Conference]
- (52) Oyama-Manabe N: “Tips for effective application of cardiac MRI”, Teine Keijinkai Seminar, Sapporo, 2018 [Japanese Conference]
- (53) Matsuura T: “Particle beam I, II “, Medical Physics Summer Seminar, Tsunan, September 1-2, 2018 [Japanese Conference]

- (54) Abo D: “Basics of superselective TACE for hepatocellular carcinoma”, Seminar for interventional radiology, Tokyo, 2018 [Japanese Conference]

Other presentations [International conference]

- (1) Katoh N, Uchinami Y, Abo D, Takao S, Inoue T, Taguchi H, Morita R, Soyama T, Hashimoto T, Onimaru R, Prayongrat A, Tamura M, Matsuura T, Shimizu S, Shirato H.: Initial Clinical Outcomes of Real-Time-Image Gated Spot-Scanning Proton Beam Therapy for Hepatocellular Carcinomas, American Society for Radiation Oncology (ASTRO) 61st 2019 meeting, Chicago, 2019.9.15-19.
- (2) Sawamura D, Tha KK, Hashimoto N, Nakagawa S, Narita H, Shirato H.: Differences in Brain Microstructural Alterations between Bipolar and Major Depression Revealed by Diffusion Kurtosis Imaging. (Scientific poster), The 27th Annual Meeting of International Society for Magnetic Resonance in Medicine, Montreal, 2019/5/11-16
- (3) Li X, Tha KK, Abiko K, Ahn S, Manabe O, Hattori N, Urushibata Y, Kudo K, Shirato H.: Distribution of Major Brain Metabolite Ratios in Adults: The Observations of Whole Brain Magnetic Resonance Spectroscopic Imaging Study.(Scientific poster), The 27th Annual Meeting of International Society for Magnetic Resonance in Medicine, Montreal, 2019/5/11-16
- (4) Sawamura D, Suzuki R, Sakai S, Tha KK: The benefits of combined working memory and attention training: observations in young healthy adults. (Scientific poster), The 7th GI-CoRE Medical Science and Engineering Symposium, Sapporo, 2019/8/18-19
- (5) Hamaguchi H, Patzke N, Urushibata Y, Katscher U, Tha KK: Performance of MRI sequences in evaluation of myelin: a preliminary report (Scientific poster), The 7th GI-CoRE Medical Science and Engineering Symposium, Sapporo, 2019/8/18-19
- (6) Koichi Yasuda: Clinical Usefulness of model-based approach (MBA) in Head and Neck Cancer (Symposiast), The 7th GI-CoRE Medical Science and Engineering Symposium, Sapporo, 2019/8/18-19
- (7) J Wang, H Shirato, KK Tha.: “Radiomic Analysis of Diffusion Tensor MRI for Discriminating Parkinson’s Disease”, European Congress of Radiology 2019 (C-1828)
- (8) J Wang, Y Nomura, H Shirato, L Xing, H Peng.: “Feasibility of X-Ray-Induced Acoustic Computed Tomography for Breast Imaging by Monte Carlo Simulation”, American Association of Medical Physics 46 (6), E426-E426
- (9) Y Nomura, J Wang, H Shirato, S Shimizu, L Xing.: “Fast Spot-Scanning Proton Dose Calculation Method with a 3-Dimensional Convolutional Neural Network”, American Association of Medical Physics 46 (6), E291-E291
- (10) C Sanli, J Wang, M Unlu.: “Absorption Dependence of the X-Ray Induced Acoustic Waves”, American Association of Medical Physics 45 (6), E593-E594
- (11) Q Xu, J Wang, H Shirato, L Xing.: “Metal Artifact Reduction with a Deep Image Prior”, American Association of Medical Physics 45 (6), E704-E704
- (12) Kudo K, Sato R, Yamaguchi A, Udo N, Matsushima M, Yabe I, Sasaki M, Harada M, Matsukawa N, Shirai T, Kawata Y, Ochi H, Bito Y: A Multicenter Study of the Correlation between the Quantitative Susceptibility Mapping (QSM) of Magnetic Resonance Imaging (MRI) and Amyloid Positron Emission Tomography (PET), AAIC (Alzheimer's Association International Conference), Los Angeles, 2019.7.12
- (13) Hashimoto T, Mori T, Takao S, Matsuo Y, Tamura M, Matsuura T, Onimaru R, Shimizu S, Shirato H.: “Dose-volume statistics comparison of intensity-modulated spot-scanning proton therapy sparing the inner ear and parotid and conventional X-ray therapy for the whole brain in pediatric and young adult patients with central nervous system tumors.”, 6th Annual

- PTCOG-NA meeting, Miami, 2019.10.14-16
- (14) Shimizu S: "Prospective data registration in proton beam therapy nation-wide evaluation trial (PROTON-NET) using unified treatment protocols with central and onsite monitoring", Particle Therapy Co-Operative Group58(PTCOG), UK, 2019.6.10-15
 - (15) Shirato H: "Present Status and Near Future of Quantum Biomedical Science and Engineering in Cancer Therapy", June 19, 2019, The Japan China Medical Association
 - (16) Kudo K: "Oxygen Extraction Fraction (OEF) using QSM in Patients", 5th International Workshop on MRI Phase Contrast & Quantitative Susceptibility Mapping, Seoul, Korea, 2019.9.26
 - (17) Kudo K : " QSM Analysis for the Early Diagnosis of Alzheimer's Disease", ASFNR, San Francisco, 2019.11.9
- The 7th GI-CoRE Medical Science and Engineering Symposium - FLASH, MBA, & 4DRT, Hokkaido, Japan, August 2019
- (18) Erinn Rankin "FLASH radiation therapy protects against radiation induced intestinal injury"
 - (19) Billy W. Loo "Clinical aspects of FLASH"
 - (20) Daniel Chang "Natural language processing for end-of-life predictive modeling"
 - (21) Amato Giaccia "Overview of Recent Advances in Quantum Biomedical Science and Engineering"
 - (22) Lei Xing "Real-world data and Deep Learning in Radiation Oncology"
 - (23) Yasuhito Onodera "*Radiotherapy, Distribution of ROS in Cells, and Mitochondria in Cells*"
 - (24) Koichi Yasuda "*Clinical Usefulness of model-based approach (MBA) in Head and Neck Cancer*"
 - (25) Khin Khin Tha "*Radiomics in Cancer*"
 - (26) Shinichi Shimizu "*Future of 4DRT*"
- The 6th GI-CoRE Summer School for Medical Physics 2019 and Hokkaido Summer Institute 2019 - Medical Physics School, Sapporo, 2019.8.19-23
- (27) Shirato H: Overview of Radiation Therapy
 - (28) Giaccia A: Important Concepts in Radiobiology that Impact Radiotherapy
 - (29) Xing L: Treatment Planning for Radiation Therapy
 - (30) Ishikawa M: SBRT and IGRT
 - (31) Shimizu S: Four-dimensional Radiation Oncology, Real-time-image Guided Radiation therapy
 - (32) Matsuura T: Dose Calculation Algorithms for Spot Scanning Proton Therapy
 - (33) Miyamoto N: Quality Assurance of Four-dimensional Radiation Therapy System
 - (34) Takao S: Patient Setup and Image Guidance Technique in Proton Therapy
 - (35) Umegaki K: Proton Treatment System in Hokkaido University
 - (36) Nam JM: Molecular and radiation biology of cancer invasion
 - (37) Onodera Y: Metabolic alterations and radio-response in cancer
 - (38) Kudo K : O-17 Imaging to Open the Next Door of Neuroscience, 4th ISMRM Japan Chapter, Chiba, 2019.12.13
 - (39) Harada T, Kudo K, Shimizu Y, Fujima N, Tha KK: Imaging medication-related changes in the central nervous system, SNR (XI Symposium Neuroradiologicum), Taipei, March 18-23,2018 [International conference]
 - (40) Wu PH, Onodera Y, Giaccia AJ, Le QT, Shirato H, Nam JM: Radiation increases invasive activity of breast cancer cells by lysosome exocytosis, American association for cancer research (AACR) annual meeting 2018, Chicago, April 14-18, 2018 [International conference]
 - (41) Dekura Y, Nishioka K, Hashimoto T, Miyamoto N, Suzuki R, Matsumoto R, Osawa T, Abe T, Maruyama S, Shinohara N, Shirato H, Shimizu S: Determination of the urethra position for accurate radiation therapy of prostate cancers, 16th Urological Association of Asia Congress

- 2018, Kyoto, Apr 18-21, 2018 [International conference]
- (42) Kanaya M, Morita R, Yoshino Y, Soyama T, Abo D, Kudo K, Kubo K: Combined iodized-oil and gelatin sponge embolization for refractory ruptured hepatocellular carcinoma with dilated sinusoid-like blood space: A case report, Asian Pacific Association for the Study of the Liver (APASL) Single Topic Conference 2018, Yokohama, May 11-13, 2018 [International conference]
 - (43) Hashimoto T, Mori T, Takao S, Yoshimura T, Matsuo Y, Tamura M, Matsuura T, Onimaru R, Shimizu S, Shirato H: Dosimetric and beam delivery time analysis of pediatric intensity-modulated spot-scanning craniospinal proton irradiation with or without anterior vertebral body sparing, 57th Annual Conference of the Particle Therapy Co-operative Group (PTCOG57) and 5th Annual PTCOG-NA meeting, Cincinnati, May 21-26, 2018 [International conference]
 - (44) Fujima N, Yonemaya M, Kim E, Aoike T, Aoike S and Kudo K: Diffusion weighted T2-mapping for the determination of tissue characteristics in patients with head and neck squamous cell carcinoma; ISMRM 26th Annual meeting, Paris, France, June 16, 2018-4.21; [International conference]
 - (45) Harada T, Kudo K, Sato R, Yoshikawa M, Yabusaki S, Shirai T, Bito Y: Comparison of reconstruction algorithms for quantitative susceptibility mapping in the upper abdomen, ISMRM (International Society of Magnetic Resonance in Medicine) 25th Annual Meeting, Paris, France, June 16-21, 2018 [International conference]
 - (46) Tha KK, Katscher U, Ishizaka K, Kudo K, Shirato H: Noninvasive Assessment of Electrical Conductivity Characteristics of Normal and Diseased Liver Using Electric Properties Tomography. ISMRM, Paris, 2018
 - (47) Xu Q, Wang J, Shirato H, Xing L: Metal Artifact Reduction with a Deep Image Prior, MEDICAL PHYSICS 45 (6), E704-E704., AAPM 2018 annual meeting, Nashville, July 29-August 2, 2018 [International conference]
 - (48) Sanli C, Wang J, Unlu M: Absorption Dependence of the X-Ray Induced Acoustic Waves, MEDICAL PHYSICS 45 (6), E593-E594., AAPM 2018 annual meeting, Nashville, July 29-August 2, 2018 [International conference]
 - (49) Sanli C, Wang J, Matsuura T, Xing L, Unlu B: A Comparison of the Acoustic Waves Generated in Proton and Carbon Ion Therapy., AAPM 2018 annual meeting, Nashville, July 29-August 2, 2018 [International conference]
 - (50) Fujii T, Takao S, Shimizu S, Matsuura T, Miyamoto N, Hirayama S, Umegaki K, Shirato H: 4D-CBCT technique based on fiducial marker-position estimated with dual-orthogonal fluoroscopic imaging system for Real-time-image Gated Proton Therapy, AAPM 2018 annual meeting, Nashville, July 29-August 2, 2018 [International conference]
 - (51) Miyamoto N, Matsumoto N, Suzuki R, Takao S, Matsuura T, Fujii T, Hirayama S, Tomioka S, Shimizu S, Umegaki K, Shirato H: Real-time volumetric image generation with CT image deformation driven by displacement of internal fiducial markers, AAPM 2018 annual meeting, Nashville, July 29-August 2, 2018 [International conference]
 - (52) K. Ueno, T. Matsuura, S. Takao, S. Hirayama, H. Ueda, Y. Matsuo, T. Yoshimura, S. Shimizu, K. Umegaki, H. Shirato: An Investigation of Biological Impact Caused by Edge-Scattered Protons in Pencil Beam Scanning Proton Therapy, AAPM 2018 annual meeting, Nashville, July 29-August 2, 2018 [International conference]
 - (53) T. Sodeta, T. Matsuura, S. Takao, S. Hirayama, T. Kanehira, N. Miyamoto, K. Nishioka, N. Kato, S. Shimizu, K. Umegaki, H. Shirato: A Study On the Influence of Changing the Motion Recognition Rate On the Dose Accuracy of Spot-Scanning Proton Therapy, AAPM 2018 annual meeting, Nashville, July 29-August 2, 2018 [International conference]
 - (54) Shimizu S, Yoshimura T, Katoh N, Inoue T, Hashimoto T, Nishioka K, Takao S, Matsuura T, Miyamoto N, Ito YM, Umegaki K, Shirato H: Analysis of Beam Delivery Times and Dose Rates

- for the Treatment of Mobile Tumors Using Real Time Image Gated Spot-Scanning Proton Beam Therapy., American Society for Radiation Oncology (ASTRO) 60th 2018 meeting, San Antonio, October 21-24, 2018 [International conference]
- (55) Onimaru R, Mori T, Yasuda K, Shirato H: Preliminary Study of Cell Survival Modelling Considering Stochastic Fluctuations in Cell Survival Rates During Radiation Therapy., American Society for Radiation Oncology (ASTRO) 60th 2018 meeting, San Antonio, October 21-24, 2018 [International conference]
 - (56) Yasuda K, Takao S, Matsuo Y, Yoshimura T, Tamura M, Minatogawa H, Dekura Y, Matsuura T, Onimaru R, Shiga T, Shimizu S, Umegaki K, Shirato H: Intensity-modulated Proton Therapy with Dose Painting based on Hypoxia Imaging for Nasopharyngeal Cancer., American Society for Radiation Oncology (ASTRO) 60th 2018 meeting, San Antonio, October 21-24, 2018 [International conference]
 - (57) Prayongrat A, Kobashi K, Ito Y, Katoh N, Dekura Y, Amornwichet N, Shimizu S, Shirato H. Uncertainties of Normal Tissue Complication Probability (NTCP) and NTCP difference between radiation treatment modality for radiation-induced liver toxicity in Child-Pugh A primary liver cancer patients, American Society for Radiation Oncology (ASTRO) 60th 2018 meeting, San Antonio, October 21-24, 2018 [International conference]
 - (58) T. Matsuura et. al.: Target Motion and Specificity of Hadron Therapy, The 50th Congress of the International Society of Paediatric Oncology, Kyoto, Japan, November 14 - 19, 2018 [International conference]
 - (59) Harada T, Kudo K, Fujima N, Kameda H, Tha KK, Korogi Y, Umino M: Imaging findings in medication-induced changes of the central nervous system: what radiologists should know (Traditional Poster), RSNA (The Radiological Society of North America), Chicago, America, November 24-30, 2018 [International conference]
 - (60) Tha KK, Katscher U, Kudo K, Shirato H. Electric Properties Tomography: A New Tool for Noninvasive Measurement of Tissue Electrical Conductivity. RSNA 104th Annual Meeting, Chicago, 2018
 - (61) Wu PH, Hsieh CC, Recuenco FC, Onodera Y, Sasaki N, Giaccia AJ, Le QT, Shimizu S, Shirato H, Nam JM: Carrageenan improves radiation therapy via integrin related molecular mechanism in cancer cell lines and in vivo, ASCB/EMBO 2018 meeting, San Diego, December 8-12, 2018 [International conference]
 - (62) Nishioka S, Wu PH, Onodera Y, Giaccia AJ, Le QT, Shimizu S, Shirato H, Nam JM: Involvement of Rab27 in radiosensitivity of glioblastoma cells. ASCB/EMBO 2018 meeting, San Diego, December 8-12, 2018 [International conference]
 - (63) Oyama-Manabe N: "What radiologists need to know about the utility of detector-based spectral CT imaging for cardiovascular disease", the 104th Radiological Society of North America, Chicago, 2018 [International conference]
 - (64) Wang J, Shirato H, Tha KK. "Radiomic Analysis of Diffusion Tensor MRI for Discriminating Parkinson's Disease", 2019 European Congress of Radiology, Vienna, February 27, 2019 [International conference]
 - (65) Tha KK: The electrical conductivity characteristics of the normal brain and brain tumors (tentative)., The 2nd International workshop on MR-based Electrical Properties mapping (IMEP), Utrecht, March 16, 2019 [International conference]
 - (66) Lin, Hongxiang, Takashi Azuma, Mehmet Burcin Unlu, and Shu Takagi. "Evaluation of Adjoint Methods in Photoacoustic Tomography with Under-Sampled Sensors." In *International Conference on Medical Image Computing and Computer-Assisted Intervention*, pp. 73-81. Springer, Cham, 2018.

- (67) Shimizu S: Four-dimensional Radiation Oncology, Real-time-image Guided Radiotherapy, The 2nd GI-CoRE GSQ, GSB, & IGM JOINT SYMPOSIUM, Sapporo, July 10, 2018 [International Conference]
- (68) Shimizu S: Overview about clinical indications of moving targets - state of the art photon and proton treatment, 4D Treatment Workshop for Particle Therapy, Sapporo, December 7-8, 2018 [International Conference]
- (69) Li R: Imaging and molecular biomarkers for precision oncology, Biomedical Informatics Graduate Program Seminar, Stanford University, November 2018 [International Conference]

4) Patent applications

Number of patent applications (number of registered patents):

Japanese patents: 9 (0), overseas patents: 7 (0), total: 16 (0)

- (1) Radiation Irradiation Planning Apparatus, Clinical Decision Support Apparatus and Program, Kobashi et al., PCT/JP2016/087808(June/4/2019), US16/467504 (June/7/2019)
- (2) Radiation Treatment Planning Apparatus, Method and Program, Du et al., JP2019-064207 (Mar/28/2018), PCT/JP2019/045904 (Nov/25/2019)
- (3) Particle Therapy System, Dose Distribution Evaluation System, And Method For Operating Particle Therapy System, Hirayama et al., JP2018-240752 (Dec/25/2018), PCT/JP2019/044837 (Nov/15/2019)
- (4) Creating Monochromatic CT Image, Tanaka, Sodai et al., JP2019- 92373 (May/15/2019)
- (5) Radiation Therapy System, Miyazaki et al., US 16/200682 (Nov/27/2018), EP3494887 (Nov/26/2018), CN109893775 (Dec/3/2018)
- (6) Particle beam irradiation system and irradiation planning device, Umegaki et al., JP2018-028532 (Feb/21/2018)
- (7) Radiation Therapy Apparatus, Bed Positioning Device, and Bed Positioning method, Fujii, Yusuke et al., JP2018-056379 (Mar/23/2018)
- (8) Radiation Treatment Planning Device, Radiation Treatment System, Radiation Treatment Planning Method and Radiation Treatment Planning Program, Hirayama, et al., JP2018- 61301 (Mar/28/2018)
- (9) Radiotherapy Device And Radiotherapy Method, Miyamoto et al., PCT/JP2019/020395 (May/23/2019)
- (10) Particle Beam Therapy System, Fujii et al., JP2018-086846 (Apr/27/2018), PCT/JP2019/015812 (Apr/11/2019)
- (11) Method and Device of Motion Tracking for Radiotherapy and Radiotherapy System providing the Device, Shimizu et al., JP2019-056069 (Mar/25/2019)
- (12) Particle beam therapy systems, methods to generate CT images to measure particle beams, and CT image generation programs, Shirato H, PCT/JP2019/045902 (Nov/25/2019)
- (13) 2018-535765, Lesion identification markers for radiotherapy using bone cement and lesion identification marker kits in radiotherapy, Abo D, Sakuhara Y, Morita R

- (14) 2018-106552, Magnetic resonance imaging equipment, Matsuda G, Kudo K, Sasaki M
- (15) 2018-160616, Image processing apparatus, image processing methods, image processing programming, and magnetic resonance imaging equipment, Sato R, Kudo K, Shirai T, Kawata Y
- (16) 2018-129750, Radiation treatment equipment and radiation treatment methods
Miyamoto N, Umegaki K, Shimizu S, Tomioka S, Takao S

5) Awards, etc.

Number of awards: 11 Others: 1

- (1) Shirato H: The 9th award of JCA-CHAAO, Japanese Cancer Association
- (2) Abo D: The 9th award of JCA-CHAAO, Japanese Cancer Association
- (3) Shimizu S: The 9th award of JCA-CHAAO, Japanese Cancer Association
- (4) Kudo K: "Excellent Paper of the year 2019", The 47th Japanese Society for Magnetic Resonance in Medicine
- (5) Sawamura D, Suzuki R, Sakai S, Tha KK: The benefits of combined working memory and attention training: observations in young healthy adults. (Bronze award, the 7th GI-CoRE Medical Science and Engineering Symposium)
- (6) Hamaguchi H, Patzke N, Urushibata Y, Katscher U, Tha KK: Performance of MRI sequences in evaluation of myelin: a preliminary report (Bronze award, the 7th GI-CoRE Medical Science and Engineering Symposium)
- (7) Oyama-Manabe N: "Gold Medal prize", The 77th Annual Meeting of the Japan Radiological Society, Study of cardiac late Gadolinium enhancement MRI in muscular dystrophy
- (8) Tha KK: Guerbet Scientific award (Cum Laude), the 12th Asian-Oceanian Congress of Neuroradiology
- (9) Tha KK: 2017 Excellent teacher Award of the Hokkaido University School of Medicine (outstanding performance award)
- (10) Tha KK: Global Networking Award 2018, WinGS (Women in Global Science) Project, Hokkaido University
- (11) Kudo K: "JJR Excellent Reviewer Award" The Japan Radiological Society
- (12) IEC/TR 62926 Edition 1.0, Medical electrical system - Guidelines for safe integration and operation of adaptive external-beam radiotherapy systems for real-time adaptive radiotherapy), May 20, 2019, Shirato H, Hirata Y

6) External grants

Number of awards: 2. Amount of the grant indicates direct cost only.

- (1) Japan Agency for Medical Research and Development (AMED), Development of Medical Devices and Systems for Advanced Medical Services, "Development of Intraoperative On-the-fly Therapeutic Decision Support System during Quantum Beam Surgery (QBS) and post-QBS Surgical Operation", 2017-2021, JPY 82,002,165 (projected), Shimizu S
- (2) Japan Agency for Medical Research and Development (AMED), The Translational Research program; Strategic PRomotion for practical application of INnovative medical Technology(TR-SPRINT), "Establishing non-clinical POC of real-world adaptive proton beam therapy system that develops motion tracking technology and acquires temporal change of three-dimensional shape and position of cancer according to the course of time", 2018-2020, JPY 135,318,701, Shimizu S

- Science outreach

- (1) Hashimoto T: “Proton beam therapy for cancer of pediatric and AYA age patients”, “New trends in cancer medicine”, Hokkaido Univ., November 30, 2019
- (2) Kudo K: “Challenges for an early diagnosis of Alzheimer’s disease with MRI”, Hokkaido Sapporo Minami High School, Sapporo, October 24, 2019
- (3) Taguchi H, “Radiotherapy for lung cancer, Public lectures to improve the awareness of lung cancer medicine and disease”, Sapporo, August 3, 2019
- (4) Shimizu S: “Precise consideration of tumor motion during radiotherapy– introduction of spot scanning proton beam treatment “, Academic Fantasia, Sapporo, February 5, 2020
- (5) Shimizu S: “Introduction of Hokkaido University Graduate School of Biomedical Science and Engineering & Development of real-time tumor-tracking proton beam therapy system”, Joint Symposium between Indonesia and Japan on Nuclear Application, Republik indonesia, 2020.3.9-13

- Collaborations with institutions (universities, research institutes, local government, companies, etc.) other than affiliated universities

The GSQ has established an international collaboration with the University of Maryland since 2018, aiming toward standardization of models for predicting adverse reactions to radiation therapy based on research carried out in collaboration with Hokkaido University and Stanford University. The GSQ has previously studied the use of the NTCP model for predicting effects of radiotherapy on indications for proton beam therapy and during the 4th and 5th (March 14-15, July 10-11, 2017 respectively) GI-CoRE GSQ symposia as well the special seminar held on November 15, 2017, have invited world leading researchers from the Netherlands and the United States well versed in this research to Hokkaido University. Consequently, results were published in a special issue of Journal of Radiation Research, co-authored by Professor Hiroki Shirato and Professor Quynh-Thu Le (JRR 2018;59. suppl_1, Radiat Oncol 2019). Thereafter at the 7th GI-CoRE GSQ Symposium, the GSQ invited Dr. Søren Bentsen (Professor, University of Maryland), Committee Chair on the NTCP Model at the International Commission on Radiation Units and Measurements (ICRU), an official partner of the WHO, to hold discussions. The proposed GI-CoRE model was evaluated with high confidence limits as a new and excellent model.

During a meeting with Dr. Bentsen and researchers from New York and Denmark at the 2019 ASTRO Annual Meeting in Chicago (September 15-17, 2019), the GI-CoRE's GSQ, University of Maryland, ICRU, and QUANTEC (the US NTCP model organization) were suggested to hold a joint workshop aiming at international standardization between Japan, the US, and Europe. At this joint workshop, Professor Shirato was asked to introduce the GI-CoRE model as a highly regarded idea towards solving the important topic of selecting appropriate proton therapy currently held around the world. On February 24-25, 2020, the joint workshop was held in Baltimore, Maryland as the GSQ’s first attempt to hold the international meeting overseas.

References

Global Institution for Collaborative Research and Education (GI-CoRE) Final Evaluation for the Global Station for Quantum Medical Science and Engineering/Global Station for Zoonosis Control projects

1. Aims

The Global Institution for Collaborative Research and Education (GI-CoRE) shall implement an external evaluation of the research, education and organizational framework of the Global Station for Quantum Medical Science and Engineering/Global Station for Zoonosis Control projects which started on April 1, 2014. As the projects have welcomed the final (fifth) year of the implementation period upon the Fiscal Year 2018, the feedback of this evaluation shall be used to decide whether or not to renew the Global Station project for a further period and improve operations upon the renewed period.

2. Evaluation Structure

A "Hokkaido University Global Institution for Collaborative Research and Education External Evaluation Committee" shall be established in each of the Quantum Medical Science and Zoonosis Control Global Stations in accordance with the External Evaluation Implementation Guidelines for the Hokkaido University Global Institution for Collaborative Research and Education Global Station (Document 2). All evaluations and reports shall be undertaken in English.

☐ Global Station for Quantum Medical Science and Engineering External Evaluation Committee

Candidates from Quantum Medical Science GS: 2 foreign members, 1 Japanese member

☐ Global Station for Zoonosis Control External Evaluation Committee

Candidates from Zoonosis Control GS: 2 foreign members, 1 Japanese member

*When the evaluation is complete, the GI-CoRE Steering Committee shall receive a report from the Committee chair.

3. Evaluation Method

☐ The External Evaluation Committee shall check the contents of the Research Progress Report (Document 3) sent in advance from HU before implementing the on-site investigation, and shall evaluate the evaluation items prescribed in Document 4.

☐ A 5-level evaluation ratings (S to D) and comments shall be obtained for each "Evaluation Item".

Evaluation Ratings	Evaluation Explanation
S	Achieved outcomes surpassed the original plan (Outstanding)
A	Good progress has been maintained and expected outcomes have been achieved (Excellent)
B	Most expected outcomes have been achieved with some slight delays (Good)
C	Although certain outcomes were achieved, overall results were insufficient (Satisfactory)
D	No expected outcomes were achieved (Unsatisfactory)

4. Required Expenses

Travel expenses and honorarium shall be provided to the Evaluation Committee Members (in accordance with HU regulations). Other expenses required for the External Evaluation (as travel expenses, honorarium, evaluation report printing expenses, etc.) shall be funded by the budget (non-personnel cost) of each Global Station.

5. Publishing of Evaluation Results

Evaluation of this project shall be broadly announced, with the results both published on the relevant HU websites and published as booklets which are sent to external organizations such as the Japanese Ministry of Education, Culture, Sports, Science and Technology.

GI-CoRE Global Station External Evaluation Schedule

Year and Month	Agenda
Fiscal Year 2017 (2017)	
August to November	Proposal of Evaluation Items and Evaluation Structure (Draft Fixed)
December	GI-CoRE Steering Committee #13 >> Fixing overviews of evaluation items, evaluation structure, schedule, etc. >> Starting to create the GI-CoRE Research Progress Report (in English)
	Selection/Arrangement of the Evaluation Committee Members *Criteria: 2 foreign and 1 Japanese members (candidates who can conduct evaluation in English) *Confirmation of affiliation, main achievements, contact details, etc.
March	GI-CoRE Steering Committee #14 >> Fixing the Evaluation Committee Members and evaluation forms >> Official appointment request (by letters from the GI-CoRE Director)
Fiscal Year 2018 (2018)	
April	Commencement of the Appointment as the Evaluation Committee Members
May to June	Completion of the Research Progress Report (in English) >> Forwarding the report to the Evaluation Committee Members for their document screening
July to August	On-site Investigation (by the External Evaluation Committee) July 19 -20 (for GSZ) August 8 (for GSQ)
October	Submission of the Report of the Final Evaluation >> Evaluation Committee Members shall forward their reports of the final evaluation, based on the document screening and on-site investigation
	GI-CoRE Steering Committee #18 >> Report of the Final Evaluation by each Chair of the External Evaluation Committees of GSQ/GSZ on behalf of the three External Evaluation Committee Members >> Decision of the GSQ/GSZ projects period extension until FY 2019
Fiscal Year 2019 (2020)	
March	Expiration of the GSQ /GSZ projects under the GI-CoRE system
Fiscal Year 2020 (2020)	
April	Internalization of the GSQ /GSZ projects into the affiliated faculty and center
July	Publication of the Final Evaluation Reports (in English)

Hokkaido University

Global Institution for Collaborative Research and Education (GI-CoRE)

External Evaluation Implementation Guidelines for the Global Stations

December 15, 2015

Establishment of the Global Institution for Collaborative Research and Education Steering Committee

1. Purpose

These implementation guidelines shall provide the necessary matters for the implementation of evaluation of the Global Station by non-University affiliated persons (hereinafter the “GS External Evaluation”) of the Hokkaido University Global Institution for Collaborative Research and Education (GI-CoRE).

2. Committee

(1) The "Hokkaido University Global Institution for Collaborative Research and Education External Evaluation Committee (hereinafter the "Committee")" shall be established by GI-CoRE in order to perform the matters prescribed in each of the following items.

(i) Implementation of GS External Evaluation

(ii) Matters related to the creation and publishing of the report pertaining to the GS External Evaluation

(2) A Committee shall be established for each Global Station that is target for external evaluation.

3. Composition

(1) The Committee shall be composed of third parties other than constituent members of Hokkaido University, and designated by the Director of GI-CoRE from persons prescribed in each of the following items.

(i) Person designated by the Director of GI-CoRE who is an expert both within and outside Japan in the research field of the Global Station to be externally evaluated

(ii) Persons whom the Director of GI-CoRE deems necessary

(2) The Committee members prescribed in the preceding paragraph shall be commissioned by the Director of GI-CoRE after approval by the GI-CoRE Steering Committee.

4. Term of Office

(1) The term of office for Committee Members shall be 1 year. However, if a Committee Member vacancy occurs, the term of office of the successor shall be the remaining term of the predecessor.

(2) Committee Members may be reappointed.

5. Committee Chair

(1) A Committee Chair shall be appointed and selected through mutual election by the Committee members.

(2) The Committee Chair shall call a Committee meeting as required, and shall chair the said meeting.

6. Proceedings

- (1) A Committee meeting may not be held unless a majority of the members are present.
 - (2) Committee meeting proceedings shall be decided by a majority of the attending members.
- In case of a tie, the Committee Chair shall decide the issue.

7. Implementation of GS External Evaluation

- (1) The Committee shall implement the GS External Evaluation as prescribed in the following Article.
- (2) The Committee may hear the opinions of persons concerned and implement firsthand investigations related to the implementation of the GS External Evaluation.

8. Evaluation Items

The Committee shall evaluate the items prescribed by GI-CoRE in each of the following items.

- (1) Items related to research
- (2) Items related to education
- (3) Items related to the structure of the research and education center
- (4) Other items deemed necessary by the Committee

9. Creation and Publishing of the Report

The Committee shall collate the evaluation results prescribed in the preceding paragraph and publish the results in a report.

10. Response to Evaluation Results

The Director of GI-CoRE shall promptly work to implement improvements in view of the report prescribed in the previous paragraph for items in which improvements are deemed necessary.

11. General Affairs

General affairs for the Committee shall be processed by the Division of International Relations, International Affairs Department.

12. Miscellaneous Provisions

Necessary matters concerning GS External Evaluation other than those prescribed within these implementation guidelines shall be prescribed separately by the GI-CoRE Steering Committee.

Supplementary Provisions

These guidelines shall come in force on 12 December 2017.

REGULATIONS FOR THE HOKKAIDO UNIVERSITY
GLOBAL INSTITUTION FOR COLLABORATIVE RESEARCH AND EDUCATION

HU Doc. No.151
April 1, 2014

(Purpose)

Article 1 These *Regulations* shall prescribe the organization and administration of the Hokkaido University Global Institution for Collaborative Research and Education (hereinafter referred to as "the Institution for Research and Education"), based upon the *Rules Concerning the Organization of Hokkaido University* (HU Doc. No. 31 of 2004), Article 37(4).

(Objectives)

Article 2 The objectives of the Institution for Research and Education shall be to invite teaching staff from Japan and overseas with world-class education and research results, to promote international collaborative research and international collaborative education (hereinafter referred to as "international collaborative research and education") that capitalizes upon the distinctive characteristics of Hokkaido University (hereinafter referred to as the "University"), and to provide support for international collaborative research being furthered independently by faculties or schools.

(Employees)

Article 3 A Director and other necessary teaching staff shall be placed in the Institution for Research and Education.

(The Director)

Article 4 The President shall be appointed as the Director of the Institution for Research and Education.

2. The Director shall supervise the work of the Institution for Research and Education.

(The assistant director)

Article 5 An assistant director shall be placed in the Institution for Research and Education.

2. A vice president designated by the President shall be appointed as the assistant director.

3. The assistant director shall assist the Director in his or her duties and shall take over those duties in the event of the latter being incapacitated.

(Global stations)

Article 6 The following global stations shall be placed in the Institution for Research and Education to promote international collaborative research and education that capitalizes upon the distinctive characteristics of the University.

- (1) The Global Station for Quantum Medical Science and Engineering
- (2) The Global Station for Zoonosis Control
- (3) The Global Station for Food, Land and Water Resources
- (4) The Global Station for Soft Matter
- (5) The Global Station for Big Data and Cybersecurity
- (6) The Global Station for Arctic Research

2. Full-time teaching staff from the University (including specially appointed academic staff who come under each item of Article 3 of the *Hokkaido University Specially Appointed*

Academic Staff Regulations (HU Doc. No. 35 of 2006). The same applies to Article 7(2) below.) and teaching staff invited from Japan and overseas shall be placed in the Institution for Research and Education.

3. The period for which a global station is established shall be five years. However, this period can be extended within five years if the steering committee provided for in Article 8 deems it necessary.

(Global station leaders)

Article 7 A global station leader shall be placed in each of the global stations referred to in the items of Article 6(1).

2. The global station leader shall be one of the teaching staff of the said global station who has been designated by the Director.
3. The global station leader shall supervise the work of the said global station under the orders of the Director.
4. The term of office of the global station leaders shall be three years or less, and they can be reappointed.

(Steering Committee)

Article 8 A steering committee shall be placed in the Institution for Research and Education to deliberate important matters concerning the said institution.

2. The organization and administration of the steering committee shall be prescribed separately.

(Administration)

Article 9 The administrative work of the Institution for Research and Education shall be processed in the Division of International Planning, the International Affairs Department.

(Miscellaneous provisions)

Article 10 In addition to what is prescribed in these *Regulations*, necessary matters regarding the operation of the Institution for Research and Education shall be prescribed separately by the President after approval by the steering committee.

Supplementary Provisions

These *Regulations* come into force on April 1, 2014.

Supplementary Provisions

These *Regulations* come into force on April 1, 2015.

Supplementary Provisions

These *Regulations* come into force on April 1, 2016.

Supplementary Provisions

These *Regulations* come into force on July 1, 2018.

REGULATIONS FOR THE GLOBAL INSTITUTION FOR COLLABORATIVE RESEARCH AND EDUCATION STEERING COMMITTEE

HU Doc. No. 152
April 1, 2014

(Purpose)

Article 1 These *regulations* shall provide for the necessary matters concerning the organization and administration of the Global Institution for Collaborative Research and Education Steering Committee (hereinafter referred to as "the committee"), based upon Article 8(2) of the *Regulations for the Global Institution for Collaborative Research and Education* (HU Doc. No. 151 of 2014, "*Regulations for the Institution for Education and Research*" in Article 3).

(Topics for Deliberation)

Article 2 The committee shall deliberate on the issues set forth in item (6) through item (10) of Article 2 of the *National University Corporation Hokkaido University Agenda for Hearing with Faculty Council Rules* (HU Doc. No. 42 of 2015, referred to as "*Hearing Rules*" in the following paragraph) and deliver opinions to the President.

2. In addition to the matters specified in the preceding paragraph, the committee shall deliberate the following matters pertaining to the Hokkaido University Global Institution for Collaborative Research and Education (hereinafter referred to as "the Institution for Research and Education" in (5) below).
 - (1) Matters regarding personnel affairs of the faculty (excluding matters set forth in item (6) through item (10) of Article 2 of the *Hearing Rules*).
 - (2) Matters regarding the establishment, reform or termination of global stations.
 - (3) Matters regarding the evaluation of the educational and research activities of global stations.
 - (4) Matters regarding budgets.
 - (5) Other important matters pertaining to the administration of the Institution for Research and Education.

(Structure)

Article 3 The committee shall consist of the following members:

- (1) The director of the Global Institution for Collaborative Research and Education (referred to as "the director" in Article 5)
- (2) The assistant director of the Global Institution for Collaborative Research and Education (referred to as "the assistant director" in Article 5)
- (3) One vice president designated by the President (excluding the person mentioned in the previous item)
- (4) One dean or director from each of the following categories (a-d), each of whom shall be designated by the President
 - a) The Graduate School of Letters, the Graduate School of Law, the Faculty of Education, the Research Faculty of Media and Communication, the Faculty of Economics and Business, the Faculty of Public Policy

- b) The Graduate School of Information Science and Technology, the Faculty of Fisheries Sciences, the Faculty of Environmental Earth Science, the Faculty of Science, the Research Faculty of Agriculture, the Faculty of Advanced Life Science, the Faculty of Engineering, the Faculty of Veterinary Medicine
 - c) The Faculty of Pharmaceutical Sciences, the Faculty of Health Sciences, the Faculty of Medicine, the Faculty of Dental Medicine, Hokkaido University Hospital
 - d) Each affiliated research institute, each research center, the Field Science Center for Northern Biosphere
- (5) Each global station leader as prescribed in Article 7 of the *Regulations* for the Institution for Education and Research
- (6) Other persons whom the President deems appropriate
2. The President shall appoint the committee members mentioned in the preceding item (6)

(Term of Office)

Article 4 The terms of office of the committee members indicated in paragraph 1(4) and paragraph 1(6) of the previous article shall be two years. However, the term of office of substitute committee members shall be the remaining term of office of the previous committee member.

2. The committee members indicated in the preceding paragraph may be reappointed.

(Committee Chair)

Article 5 The director shall be appointed as the committee chair.

- 2. The committee chair shall call committee meetings and preside over the said meetings.
- 3. The assistant director shall take over the director's duties in the event of the latter being incapacitated.

(Proceedings)

Article 6 The committee cannot validly convene unless at least two-thirds of the committee members are present.

- 2 Committee proceedings, other than those prescribed separately, shall be decided by the majority vote of the attending committee members.

(Attendance of Persons Other Than Committee Members)

Article 7 In cases deemed necessary by the committee, persons other than committee members may be permitted to attend committee meetings, and explanations or opinions of the said persons may be heard.

(Committees on Special Issues)

Article 8 Committees on special issues may be established within the committee when necessary in order to deliberate specialized matters.

(General Affairs)

Article 9 The administrative affairs of the committee shall be processed in the Division of International Planning, the International Affairs Department.

(Miscellaneous Provisions)

Article 10 In addition to what is prescribed in these *regulations*, necessary matters regarding the operation of the committee shall be prescribed by the said committee.

Supplementary Provisions

These *regulations* come into force on April 1, 2014.

Supplementary Provisions (HU Doc. No. 196 of April 1, 2015)

These *regulations* come into force on April 1, 2015.

Supplementary Provisions (HU Doc. No. 191 of October 1, 2016)

These *regulations* come into force on October 1, 2016.

Supplementary Provisions (HU Doc. No. 163 of April 1, 2017)

1. These *regulations* come into force on April 1, 2017.
2. The dean of the Graduate School of Dental Medicine who was specified as a committee member in c) of paragraph 1(4) of Article 3 prior to the revision (hereinafter referred to as “the former committee member” in this paragraph) shall be deemed to have been appointed as a committee member under the revised *regulations* in c) of paragraph 1(4) of Article 3 on the enforcement date of these regulations. The term of office of the said member shall be the remaining term of office of the former committee member on the enforcement date, notwithstanding the revised provisions of Article 4(1).

Supplementary Provisions (HU Doc. No. 182 of June 20, 2017)

These *regulations* come into force on June 20, 2017 and apply retroactively from April 1, 2017.

Supplementary Provisions (HU Doc. No. 98 of July 1, 2018)

These *regulations* come into force on July 1, 2018.



Final Evaluation Report

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