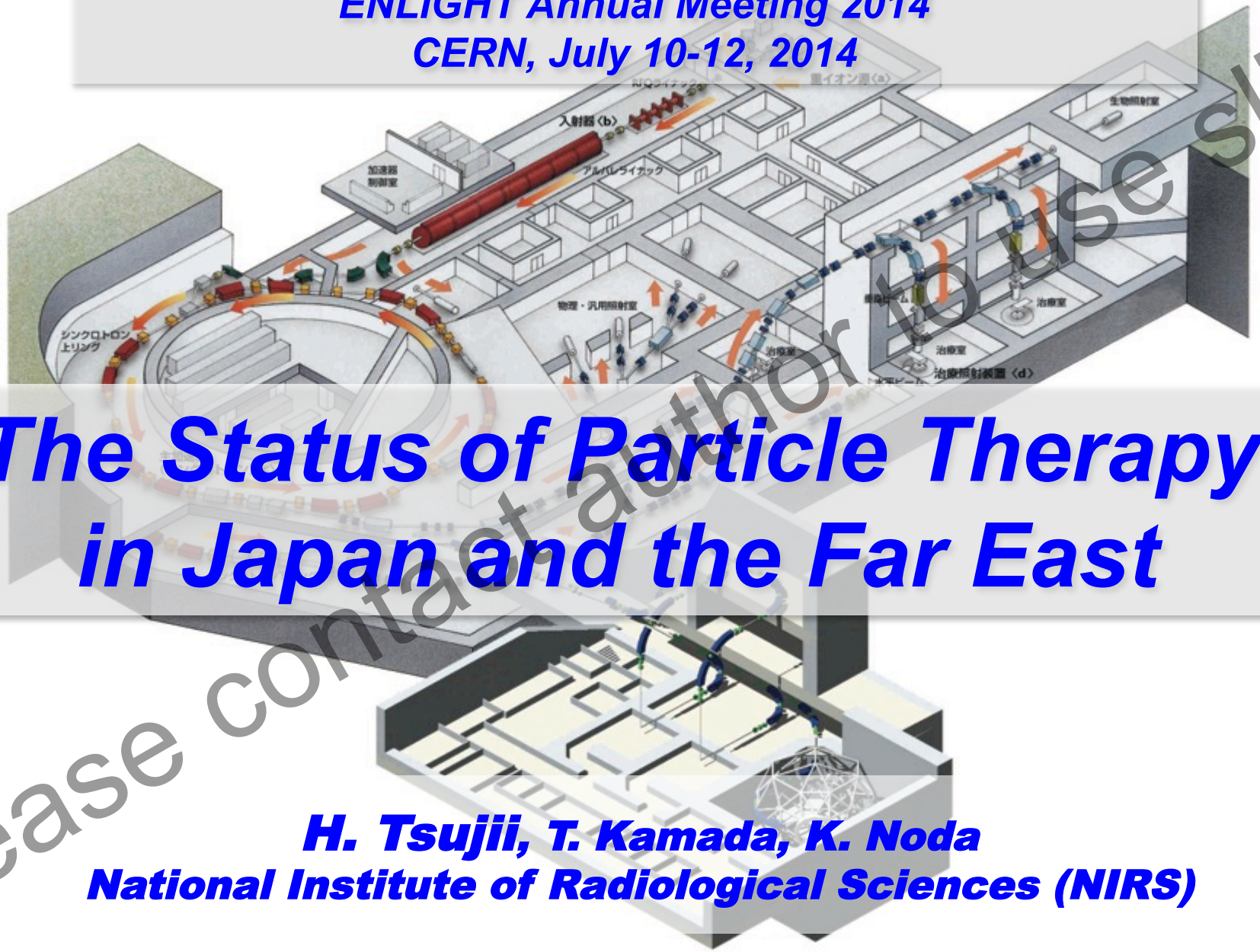
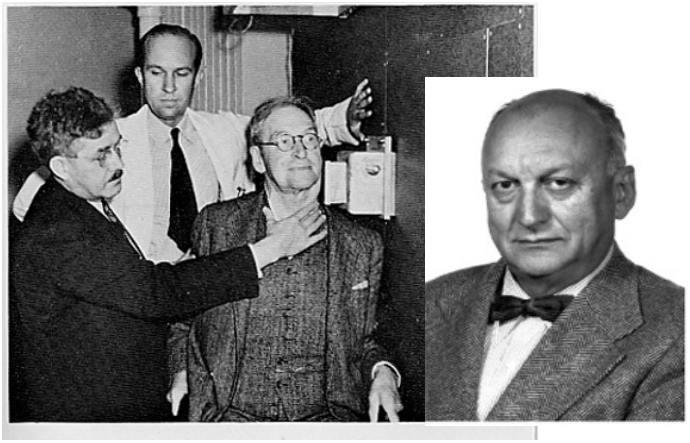
ENLIGHT Annual Meeting 2014
CERN, July 10-12, 2014



The Status of Particle Therapy in Japan and the Far East

H. Tsujii, T. Kamada, K. Noda
National Institute of Radiological Sciences (NIRS)

Pioneers of Charged Particle Radiotherapy



J. Lawrence and C. A. Tobias

J.R. Castro

1948: Biological experiments using protons.

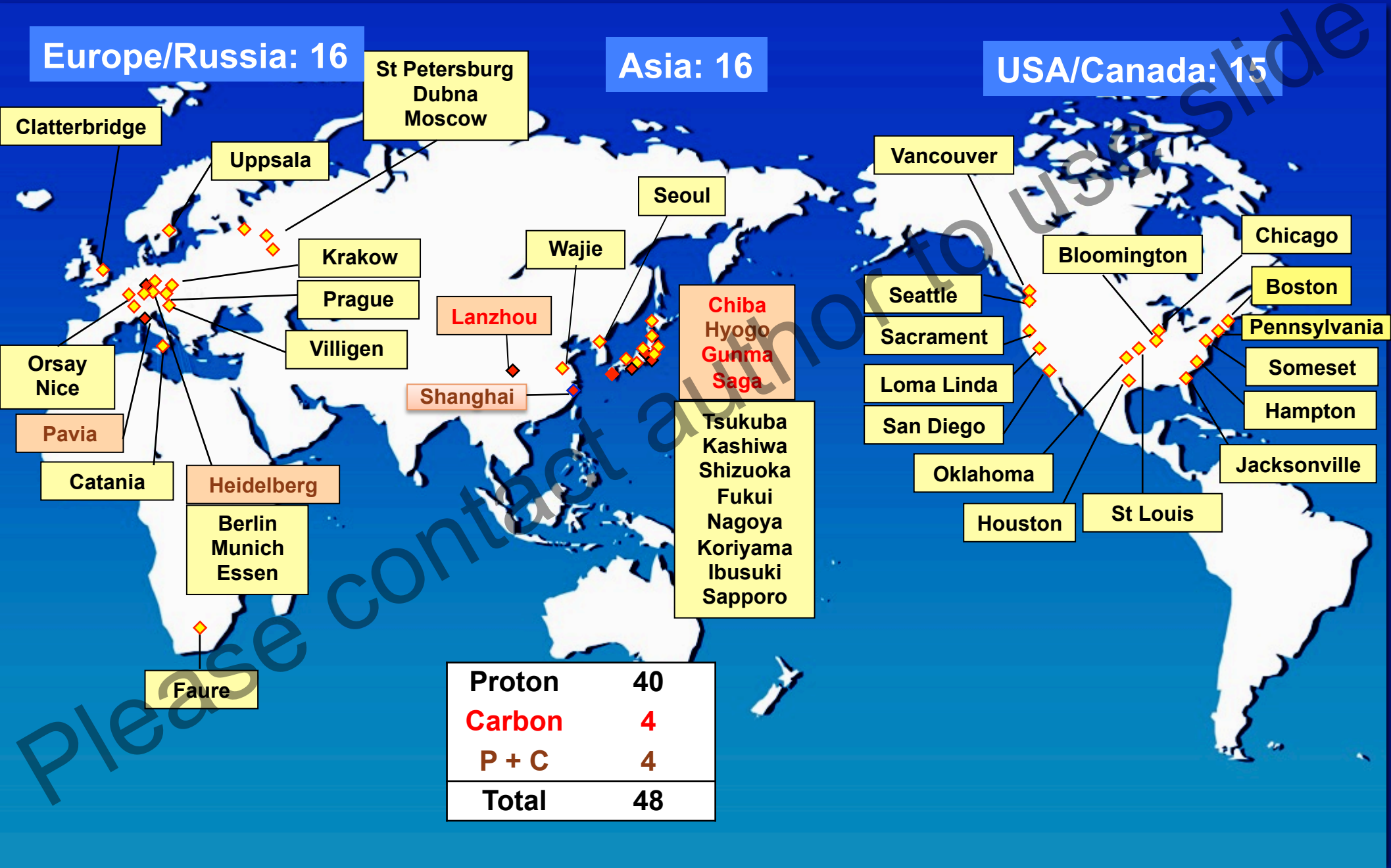
1952: Human exposure to accelerated p, d, He.

1954: 1st therapeutic PBT to humans at LBNL.

1975: Clinical trials started using heavy ions at LBNL.

Clinical Trials:>2,500 patients with He and Ne.

Particle therapy facilities in operation



Particle therapy facilities in a planning stage or under construction

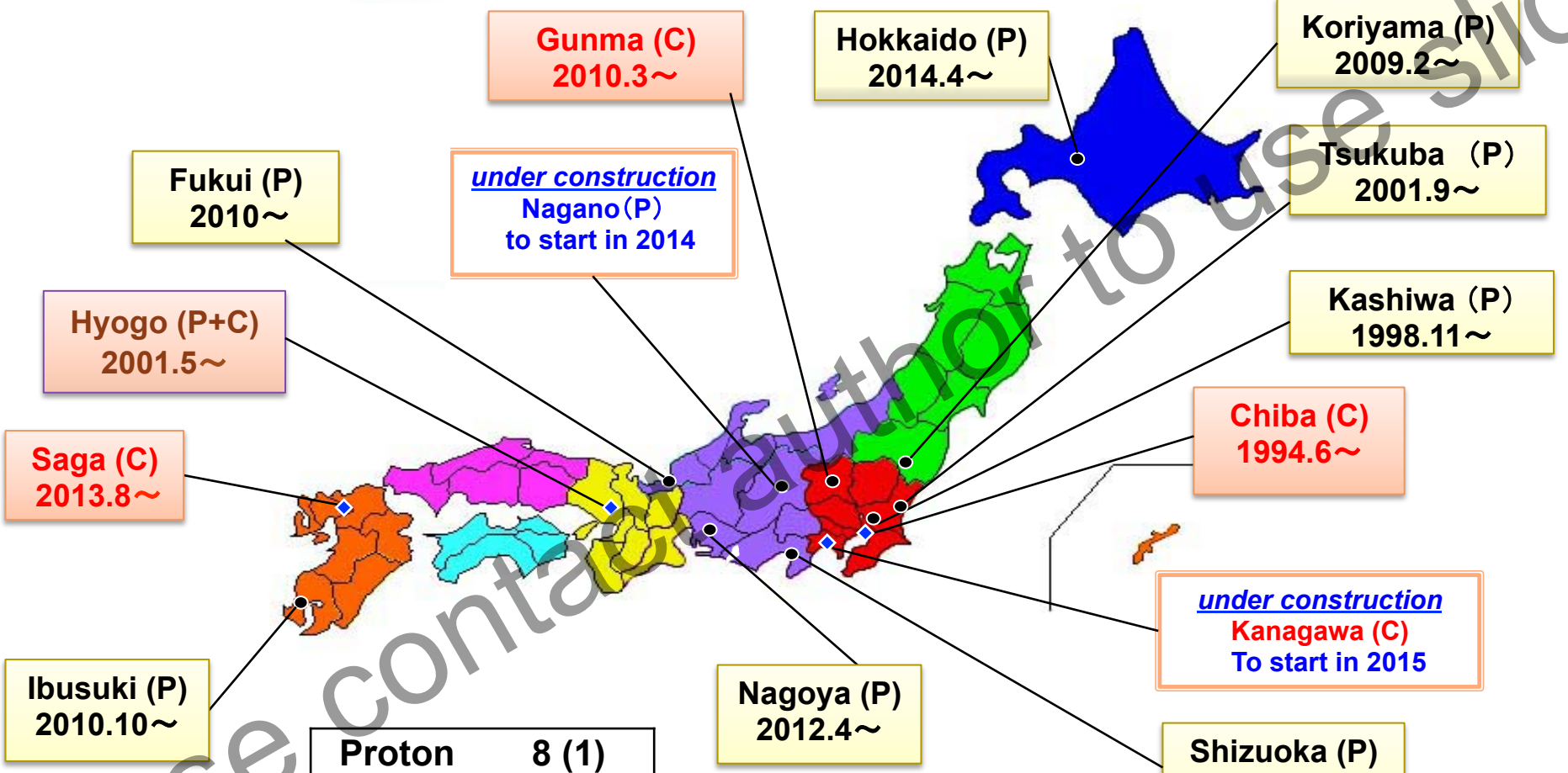
Europe/Russia: 12

Asia: 10

USA/Canada: 13

Proton	30
Carbon	4
P + C	2
Total	36

Charged Particle Therapy facilities in Japan



Proton	8 (1)
Carbon	3 (1)
P + C	1
Total	12 (2)

( ): under construction

Outline of Proton Facilities in Operation in Japan

Institute / Hospital	Location (Country)	Vendors	Period	Beam	Irradiation method	Max. Energy MeV/u
NCC	Kashiwa	Sumitomo	1998~	2 gantries	Broad	C 235
HIBMC	Hyogo	Mitsubishi	P 2001~ C 2002~	2 gantries h, v, 45°	Broad	S 230(p) S 320(C)
PMRC	Tsukuba	Hitachi	2001~	2 gantries 1 horiz	Broad	S 250
Shizuoka CC	Shizuoka	Mitsubishi	2003~	2 gantries 1 horiz	Broad	S 235
STPTC	Koriyama	Mitsubishi	2008~	2 gantries 1 horiz	Broad	S 235
MPTRC	Ibusuki	Mitsubishi	2011~	3 gantries	Broad	S 250
PTC	Fukui	Mitsubishi	2011~	2 gantries 1 horiz	Broad	S 235
Nagoya PTC	Nagoya	Hitachi	2013~	2 gantries 1 horiz	Broad Scanning	S 250
PBT center	Sapporo	Hitachi	2013~	1 gantry	Scanning	S 250
Aizawa PTC	Nagano	Sumitomo	2014~	1 gantry	Scanning	C 235

Carbon Facilities in Operation in the World

Institute / Hospital	Location (Country)	Vendors	Period	Rooms	Irradiation method	Max. Energy MeV/u
HIMAC	Chiba (Japan)	4 companies	1994 ~	3+2	Wobbler Layer stacking Raster Scanning	400(C)
HIBMC	Hyogo (Japan)	Mitsubishi	2001~	5	Wobbler	320(C) 230(p)
IMP	Lanzhou (China)	IMP	2006~	2	Wobbler Layer stacking	100 for V 400 for H
HIT	Heidelberg (Germany)	Siemens*	2009~	3	Raster Scanning	430(C) 250(P)
GHMC	Gunma (Japan)	Mitsubishi	2010~	3	Wobbler Layer stacking	400(C)
CNAO	Pavia (Italy)	CERN +CNAO	P: 2011~ (C: 2012)	3	Raster Scanning	400(C) 250(P)
SAGA-HIMAT	Saga	Mitsubishi	2003~	3	Wobbler (Scanning)	400(C)
SPHIC	Shanghai	Siemens*	2014~	4	Raster Scanning	430(C) 221(P)

* Withdrawals from the business

Carbon Facilities under Construction

Institute / Hospital	Location Country	Vendors	Start year	Ion	Room	Irradiation method
EBG MedAustron	Wiener Neustadt Austria	CERN+ MedAustron	2016	C P	3	Scanning
iROCK KCC	Kanagawa Japan	Toshiba	2015	C	4	Scanning
PTC UKGM	Marburg Germany	Siemens*	2014	C P	4	Scanning
IMP	Lanzhou China	IMP	2015	C	3	Scanning
IMP	Wuwei China	IMP	2015	C	3	Scanning

* Withdrawals from the business

Institute of Modern Physics (IMP)
Chinese Academy of Sciences, Lanzhou, China

Tumor Types treated at IMP

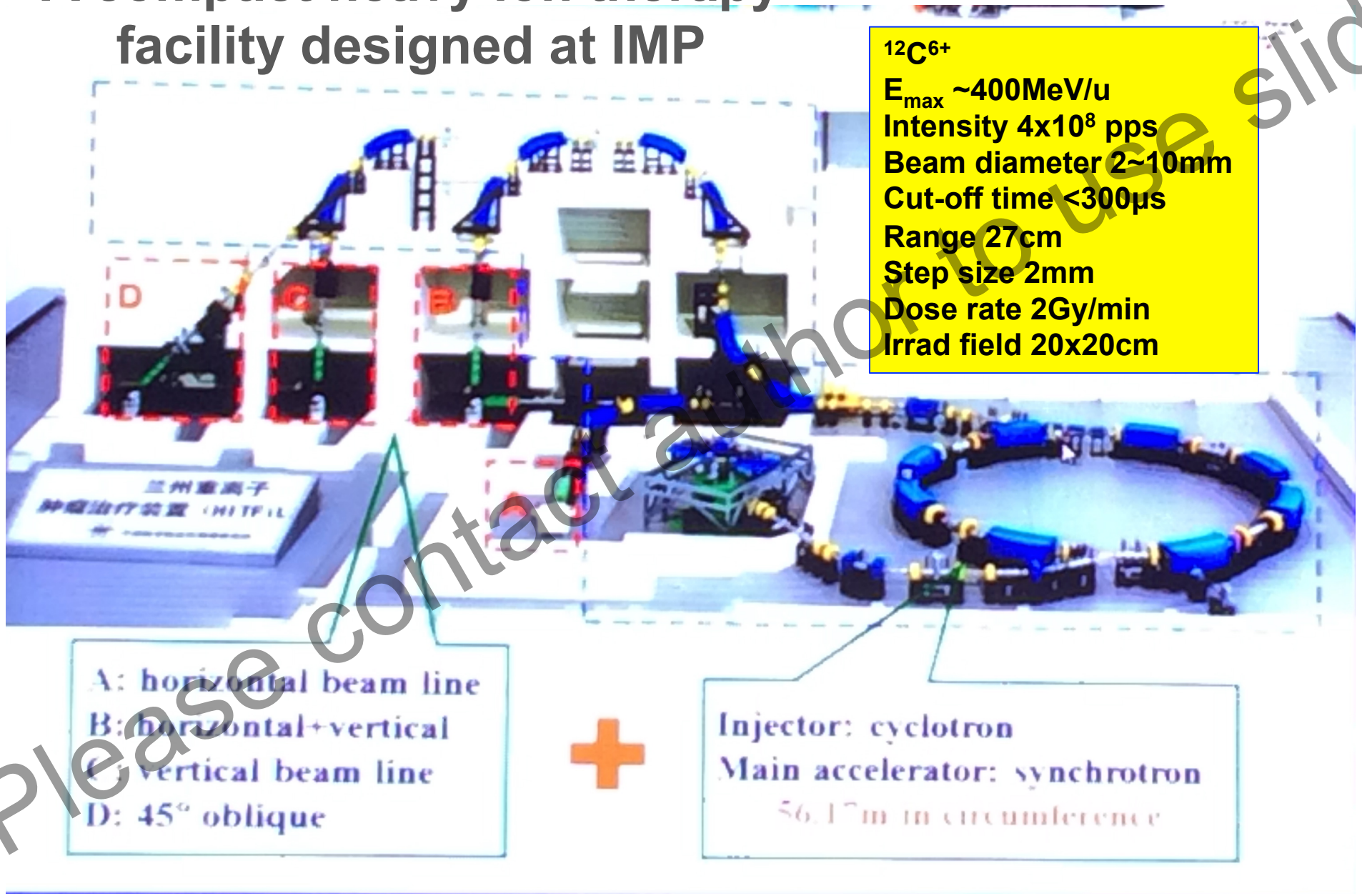
Superficial tumors (2006~2008)

Tumor type	No. pats
Cutaneous SCC	16
Basal cell ca	12
Skin malig. melanoma	7
Soft tissue sarcoma	11
Malignant lymphoma	6
Adenoca	4
Other skin lesions	38
Metastatic lymph nodes	9
Total	**103**

Deep-seated tumors (2009~2013)

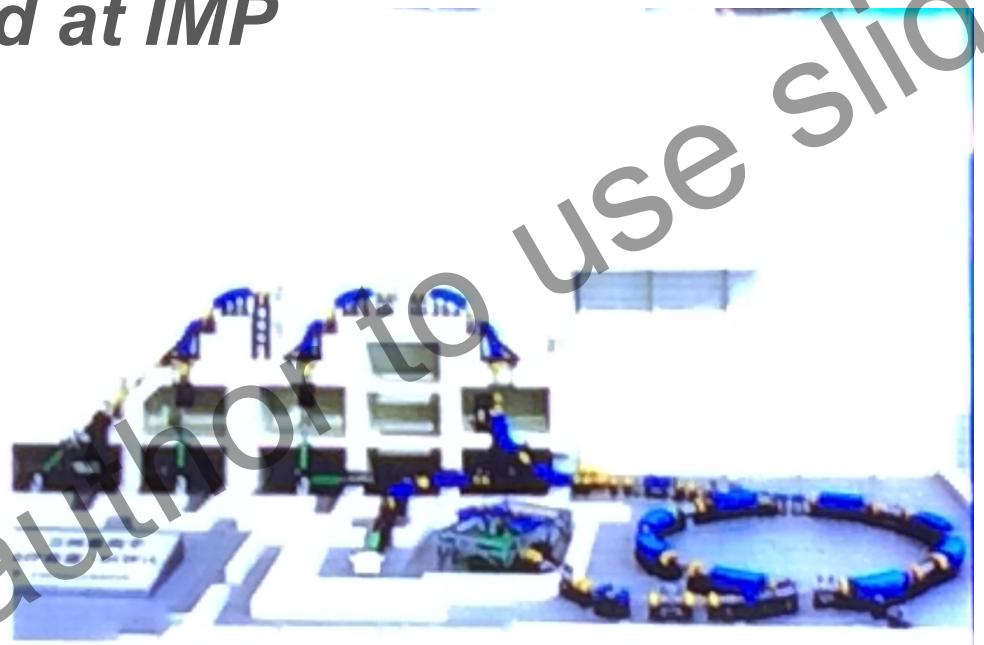
Tumor type	No. pats
Lung (primary+ meta)	22
Liver (primary+ meta)	16
Brain	25
Head and Neck	16
Bone & soft tissue sarcoma	13
Pancreas	3
Pelvis(rectal and prostate)	9
Others	6
Total	**110**

A compact heavy ion therapy facility designed at IMP



$^{12}C^{6+}$
E_{max} ~400MeV/u
Intensity $4x10^8$ pps
Beam diameter 2~10mm
Cut-off time <300μs
Range 27cm
Step size 2mm
Dose rate 2Gy/min
Irrad field 20x20cm

A compact heavy ion therapy facility designed at IMP

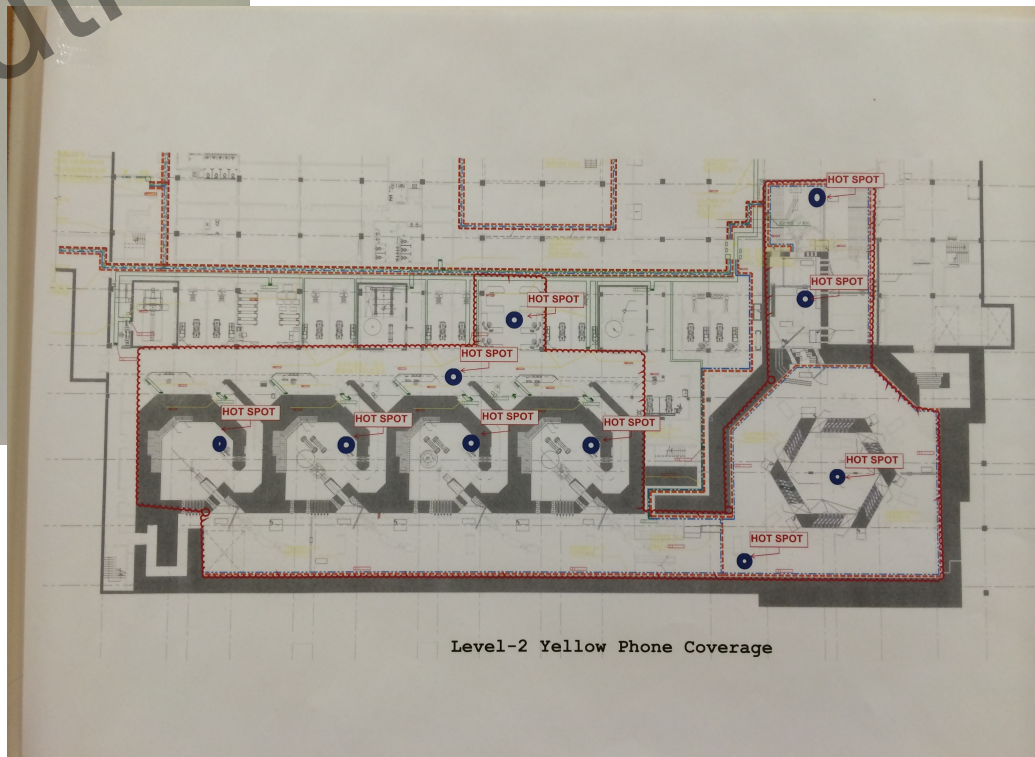


- **Two dedicated carbon therapy facilities are under construction in Gansu province in China, one in Lanzhou city and the other in Wuwei city.**
- **Commissioning is planned in the end of 2014 to 2015.**

Heavy ion therapy center under construction in Lanzhou

Installation of Facility will start in July, 2014

Shanghai Proton and Heavy Ion Center (SPHIC)



SPHIC
Shanghai

Outpatient

Inpatient

Specifications of Proton and Carbon Beam at SPHIC

Particles	Proton	Carbon
Scanning window at iso. Max.(Min)	20cmx20cm (>8mm in air)	20cmx20cm (>3.5mm in air)
Typical beam width	5 steps per energy about 8~33mm FWHM	5 steps per energy about 3.5~14mm FWHM
Beam energy & Bragg peak depth in water	290 steps from 48~221 MeV/u, 2~31cm	290 steps from 86~430 MeV/u, 2~31cm
Beam scanning method	3D modulated scanning	3D modulated scanning
Beam intensity (levels)	13~15	
Extraction time of full synchrotron filling	Max 8sec (typical ~5s)	
Acceleration time	<1 sec	
Beam position monitor accuracy	better than + 0.2mm for a beam width between 4 and 10mm better than + 0.6mm for a beam width between <4mm	
Beam position monitor frequency	50~500μs (typical 250μs)	

Clinical Trials for Approval of CFDA

- **32 pats to be treated within 3 months.**
- **Observe acute effects for 3 months without treating additional pats.**
- **Tumor sites:**
  - **minimum 3 pats for skull base and H&N**
  - **minimum 3 pats for chest**
  - **minimum 3 pats for abdominal or pelvic**
- **Ions**
  - **minimum 8 pats with protons**
  - **minimum 8 pats with carbon-ions**
- **Treat minimum 3 pats using respiratory gating**
- **If more than one grade 3 complications (5%), additional 30 pats should be treated in the trial.**
- **Submit the clinical data in January 2015 to obtain CFDA approval in March 2014.**

Tsujii and Dr Jiang

HIMAC(Heavy Ion Medical Accelerator in Chiba)

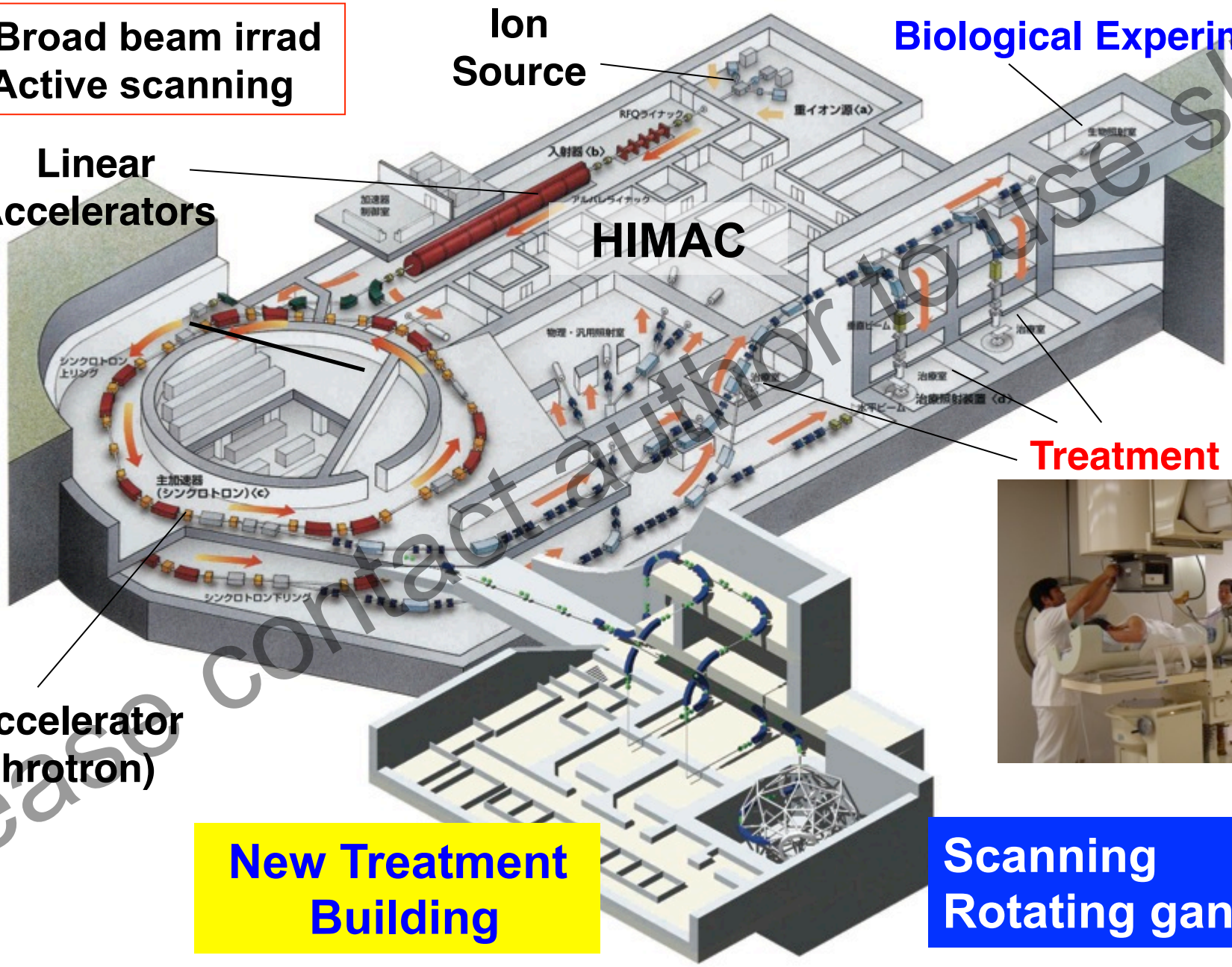
1994 Broad beam irrad
2011 Active scanning

Ion Source

Biological Experiment

Linear Accelerators

HIMAC



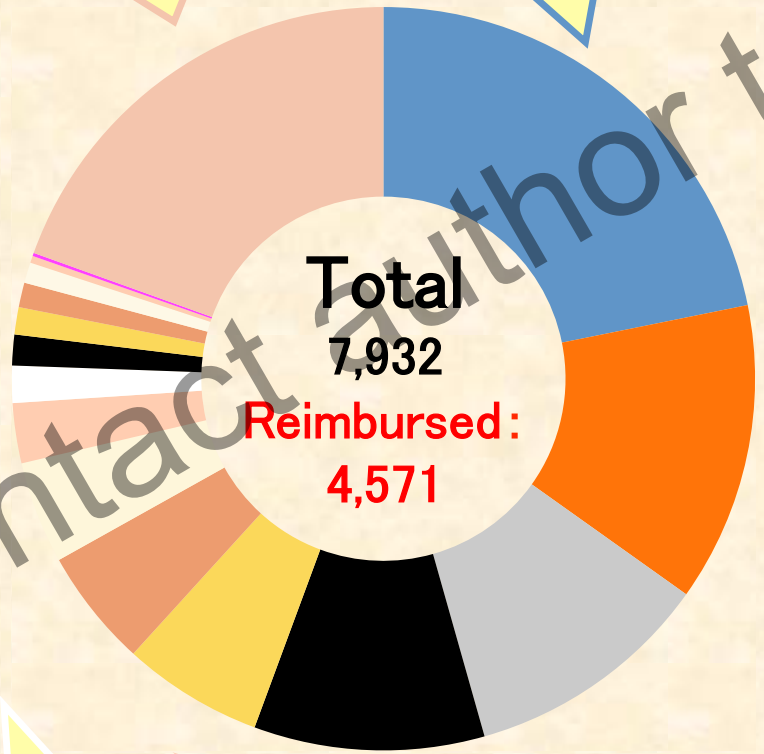
Treatment rooms

Main Accelerator (Synchrotron)

New Treatment Building

Scanning Rotating gantry

Tumor Sites in Carbon Ion Therapy at NIRS (Treatment : June 1994～March 2013)



Scanning
11(0.1%)

Miscelaneous
1547(19.5%)
Reimbursed:715

Prostate
1731(21.8%)
Reimbursed:1399

B&S
1033(13.0%)
Reimbursed:780

Lacr. Gl
24(0.3%)
Reimbursed:1

H&N
854(10.8%)
Reimbursed:529

Esophagus
71(0.9%)

Lung
795(10.0%)
Reimbursed:207

Skull base
85(1.1%)
Reimbursed:56

Liver
485(6.1%)
Reimbursed:250

Para-aor l.n
94(1.2%)
Reimbursed:87

Rectum
408(5.1%)
Reimbursed:338

Brain
106(1.3%)

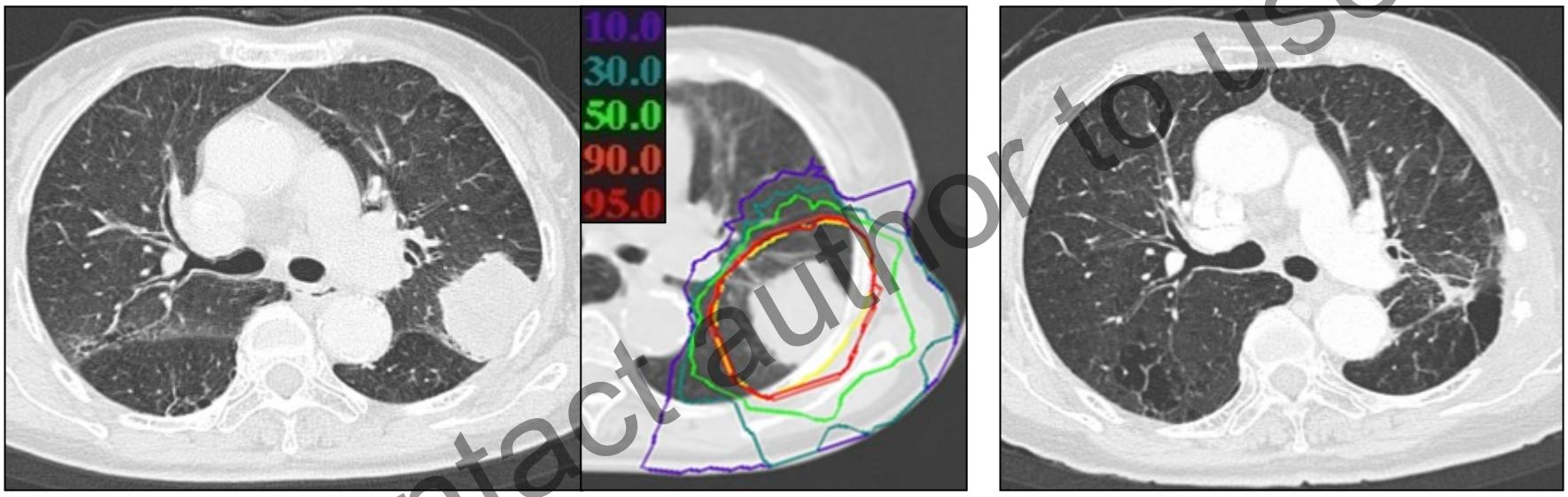
Eye
128(1.6%)
Reimbursed:86

GYN
207(2.6%)
Reimbursed : 10

Pancreas
353(4.5%)
Reimbursed:113

Single Fraction C-ion RT for Stage I NSCLC

71 yr female, cT2N0M0 Squamous cell ca.
40.0GyE/single fraction



18 mo after CIRT

Skin reaction
Grade 1

Stage I Lung Cancer

SBRT vs. Proton vs. Carbon

- **Local Control of T1 Lesions**

  SBRT ≈ Proton ≈ Carbon (Similar)

- **Local Control of T2 Lesions**

  SBRT < Proton < Carbon (Higher)

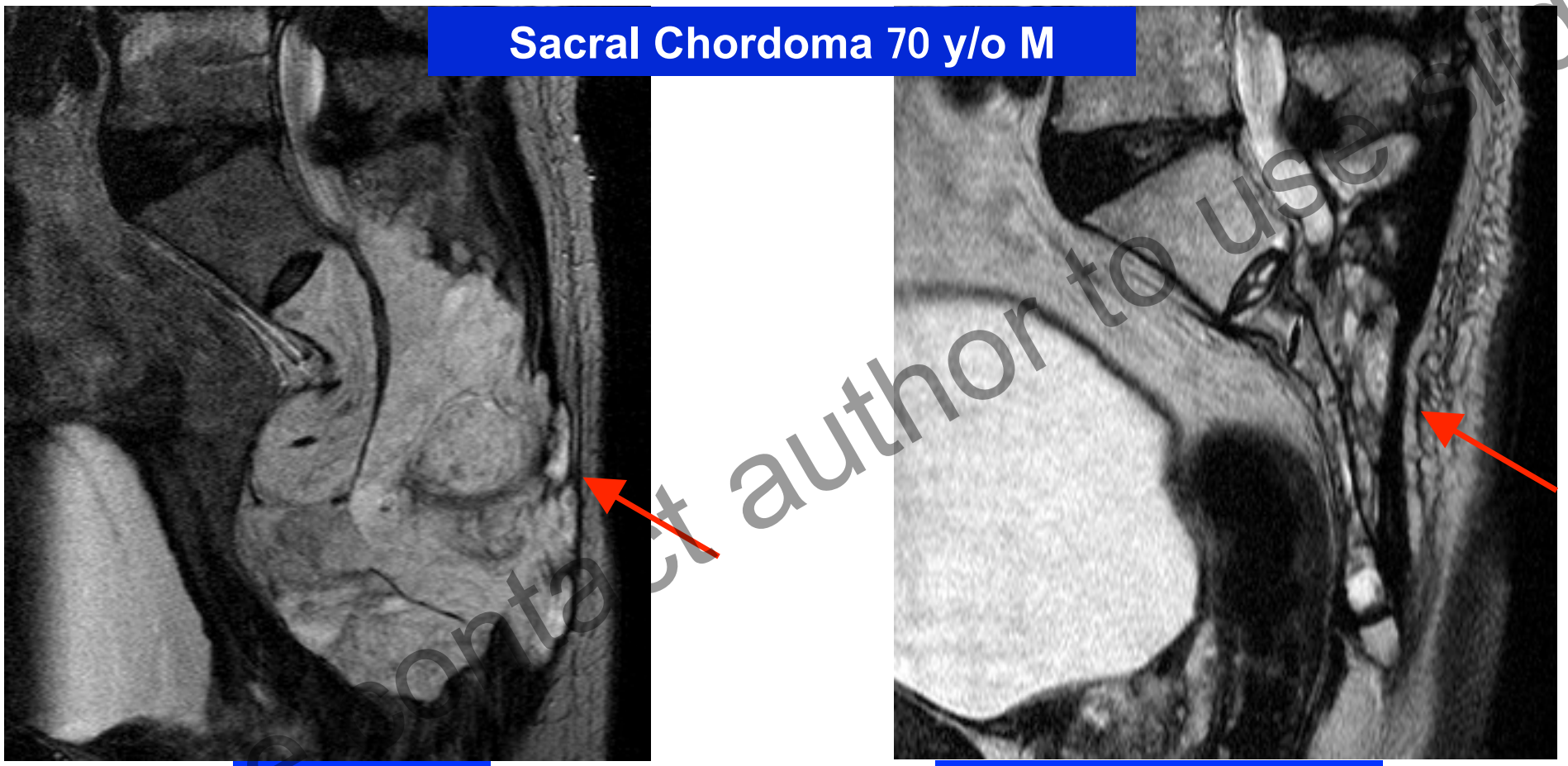
- **Toxicities:**

  SBRT > Proton ≥ Carbon (Lower)

- **Fractionation Schedule (Treatment Time):**

  Proton > SBRT ≥ Carbon (One day)

Radioresistant Tumor



- In sacral chordoma that is generally radiorestant, higher dose is needed than other pathological types.

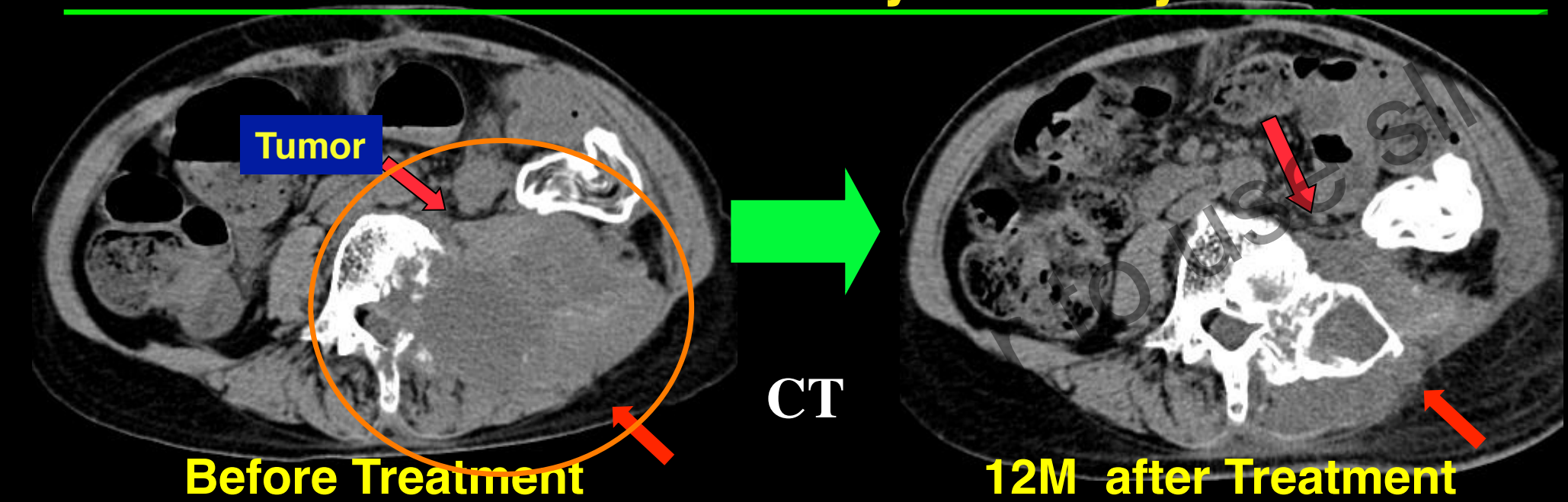
The result for carbon ion radiotherapy in sacral chordoma

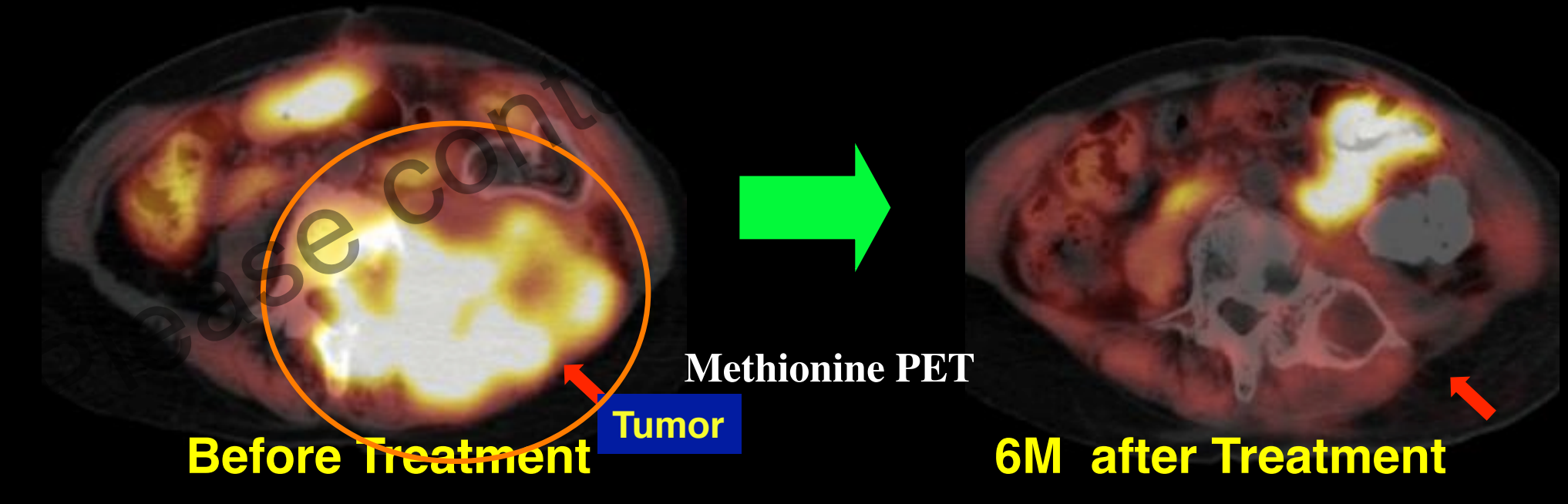
Institutes	No of pts	Treatment	5y-LC (%)	5y-OS (%)	10y-OS (%)
MGH [1)]	27	Surgery +proton	72	82	62
LBL [2)]	14	Surgery+He-ion	55	85	22
Mayo [3)]	52	Surgery	56	74	52
NIRS [4)]	183	C-ion alone	88	86	74

LC: local control, OS: overall survival

1)Park L, et al. Int J Radiat Oncol Biol Phys. 65(5):1514-21. 2006
2)Schoenthaler R, et al. Int J Radiat Oncol Biol Phys. 20;26(2):291-8. 1993
3)Fuchs B, et al. J Bone Joint Surg Am. 87(10):2211-6. 2005
4)Imai R, Kamada T, Sugahara S, et al. Br J Radiol. in press

Recurrent Rectal Cancer : 69y F 73.6GyE/16Fr





Post-operative pelvic recurrence of rectal cancer

Author	Year	No. Pats	Treatment	Overall Survival		Local Control
				2-yr	5-yr	
Wanebo HJ [1]	1999	53	Surgery	62%	31%	-
Saito N[2]	2003	43	Surgery	78%	39%	-
Moriya Y[3]	2004	48	Surgery	76%	36%	-
O' Connel MJ[4]	1982	17	Photon 50Gy	45%	0%	24%(2y)
Wong CS[5]	1991	22	Photon 40-50Gy	27%	16%	9%(5y)
Lybeert MLM[6]	1992	76	Photon 6-66Gy	61%(1y)	3%	28%(3y)
NIRS[7]	2013	161	Carbon 52.8GyE	90%	51%	93%(5y)

Surgery

Photon

Carbon

1. Wanebo HJ, et al. *Dis Colon Rectum* 1999; 42: 1438-48. **2.** Saito N, et al. *Dig Surg* 2002; 20: 192-200.
3. Moriya Y, et al. *Dis Colon Rectum* 2004; 47: 2047-54. **4.** O'Connel MJ, et al. *Int J Radiat Oncol Biol Phys* 1982; 8: 1115-9.
5. Wong CS, et al. I*nt J Radiat Oncol Biol Phys* 1991; 21: 1291-6.
6. Lybeert MLM, et al*. Int J Radiat Oncol Biol Phys* 1992; 24:241-6.
7. Yamada S, et al. *Proceedings of NIRS-ETOILE 2nd Joint Symposium on Carbon Ion Radiotherapy* 2011; NIRS-M-243: 54-9.

Combined treatment for improving survival

GEM+CIRT for locally advanced pancreas cancer

	Year	n	Treatment	Dose	Survival	
					1yr	2yr
ECOG	2008	34	GEM+RT	50.4Gy	50%	12%
		37	GEM	-	32%	4%
Ishii	2010	50	GEM	-	64%	14%
Sudo	2011	34	S-1+RT	50.4Gy	71%	25%
Small	2011	28	GEM+BZ* +RT	36Gy/15fr.	45%	17%
Schellenberg	2011	20	GEM+SBRT	25Gy/1fr.	50%	20%
NIRS		**47**	**GEM+CIRT**	**45.6-55.2 GyE**	**74%**	**54%**

*Bevacizumab

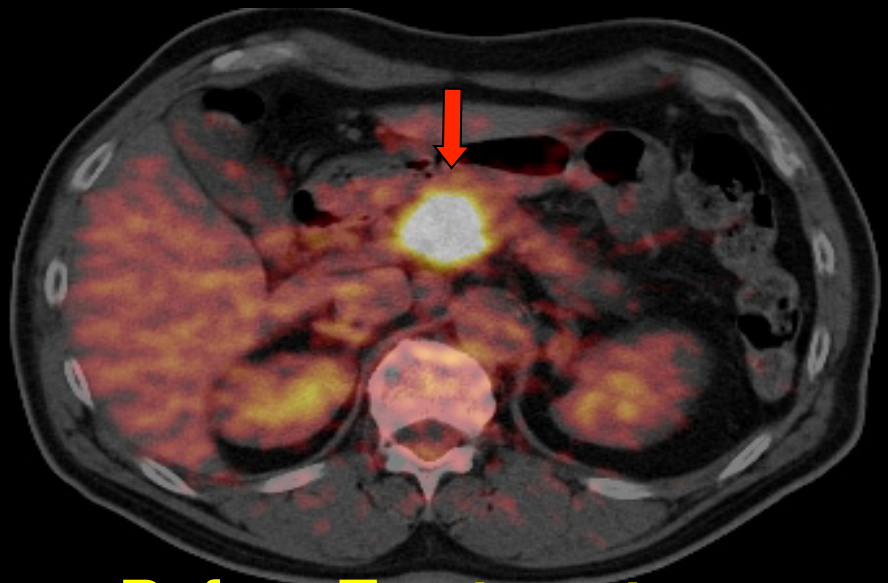
Case 1: 66y Male

50.4GyE / 12fr

Surviving for 64M after treatment

Before Treatment

40M after treatment

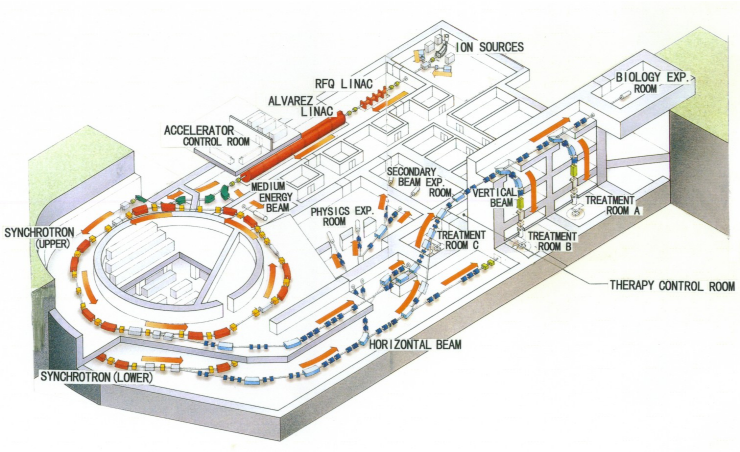


Before Treatment

6M after treatment

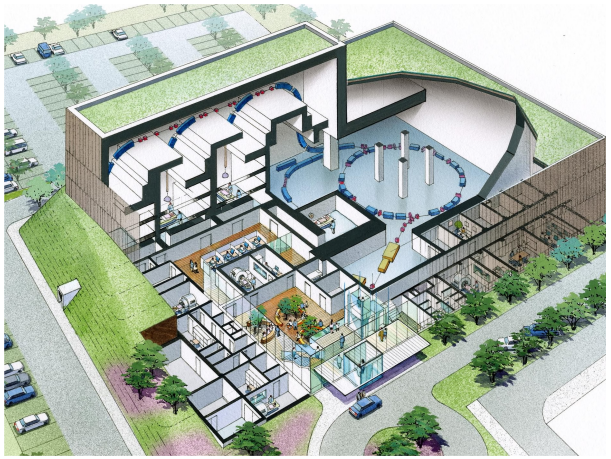
Development of Charged Particle Therapy Facility

HIMAC



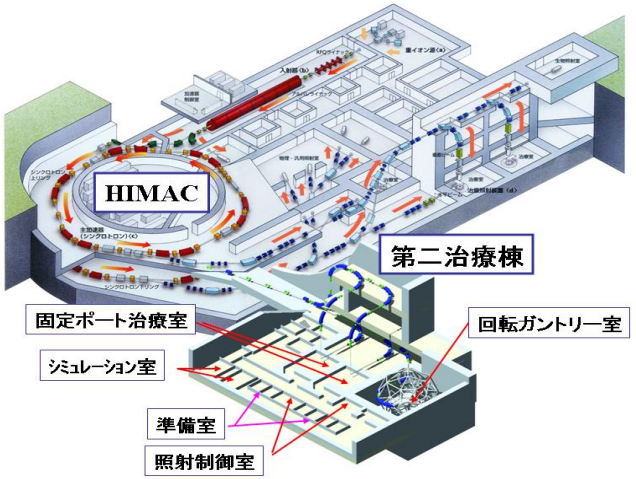
- He～Ar
- E_{max} 800MeV/n
- Wobbler method
- Respiratory gating
- Broad beam method

Compact Facility



- C
- E_{max} 400MeV/n
- Spiral wobbler
- Respiratory gating
- Stack layer irrad

New Treatment Research Facility



- C, O,(^{11}C, ^{15}O)
- E_{max} 430MeV/n
- Respiratory gating
- 3D Scanning
- Rotating gantry


Hyogo Ion Beam Medical Center
(HIBMC) Hyogo prefecture
Established as the first facility in the world for use of both proton and carbon ion therapy (2001)

Treatment rooms of carbon ions in Hyogo Ion Beam medical Center (HIBMC)

Horizontal & vertical beam lines

45° beam line

MITSUBISHI ELECTRIC
Changes for the Better
三菱電機

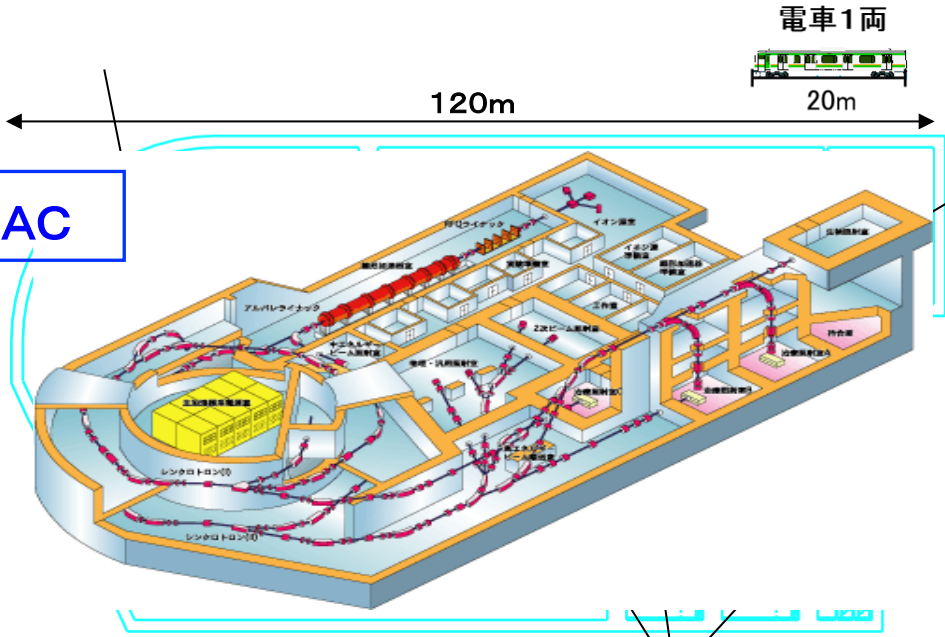
Hyogo Ion Beam Medical Center (HIBMC)

Hyogo prefecture

- As of the end of 2012, 5381 patients in total were treated.

	Total	Proton	Carbon ion
Prostate	**1780**	**1780**	**0**
Liver	**992**	**568**	**414**
Head and neck	**728**	**299**	**429**
Lung	**515**	**246**	**269**
Pancreas	**314**	**311**	**3**
Bone and soft tissue (sarcoma)	**199**	**74**	**125**
Others	**…**	**…**	**…**
Total	**5381**	**3728**	**1653**

Development of Compact Accelerator



HIMAC

Small-size and less expensive machine with high performance

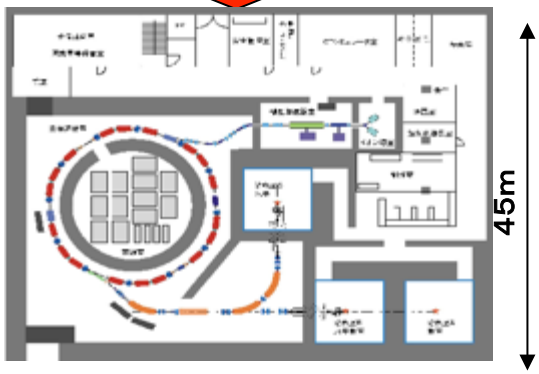
1/3

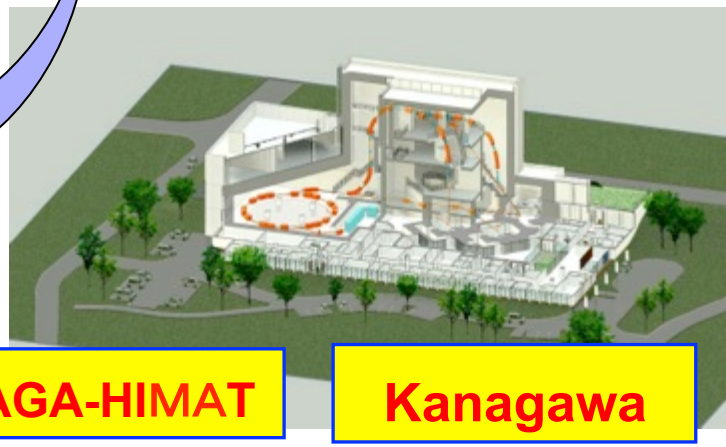
NIRS

R&D for small-sizing (2004～2005)

prototype

Gunma University





Catalog product for spread

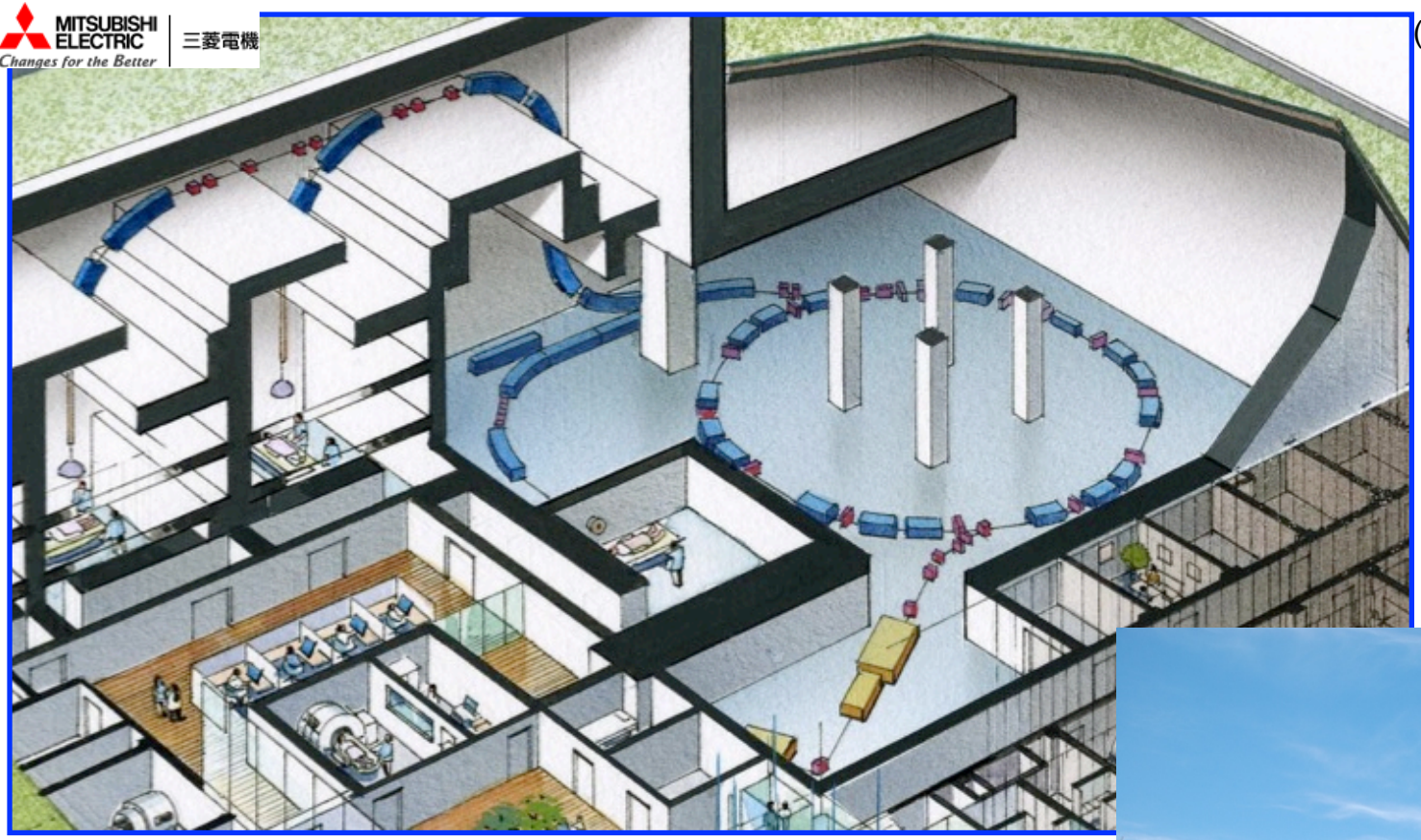
SAGA-HIMAT

Kanagawa

Gunma University Heavy Ion Medical Center (GHMC)

MITSUBISHI ELECTRIC 三菱電機
Changes for the Better

(http://heavy-ion.showa.gunma-u.ac.jp/)

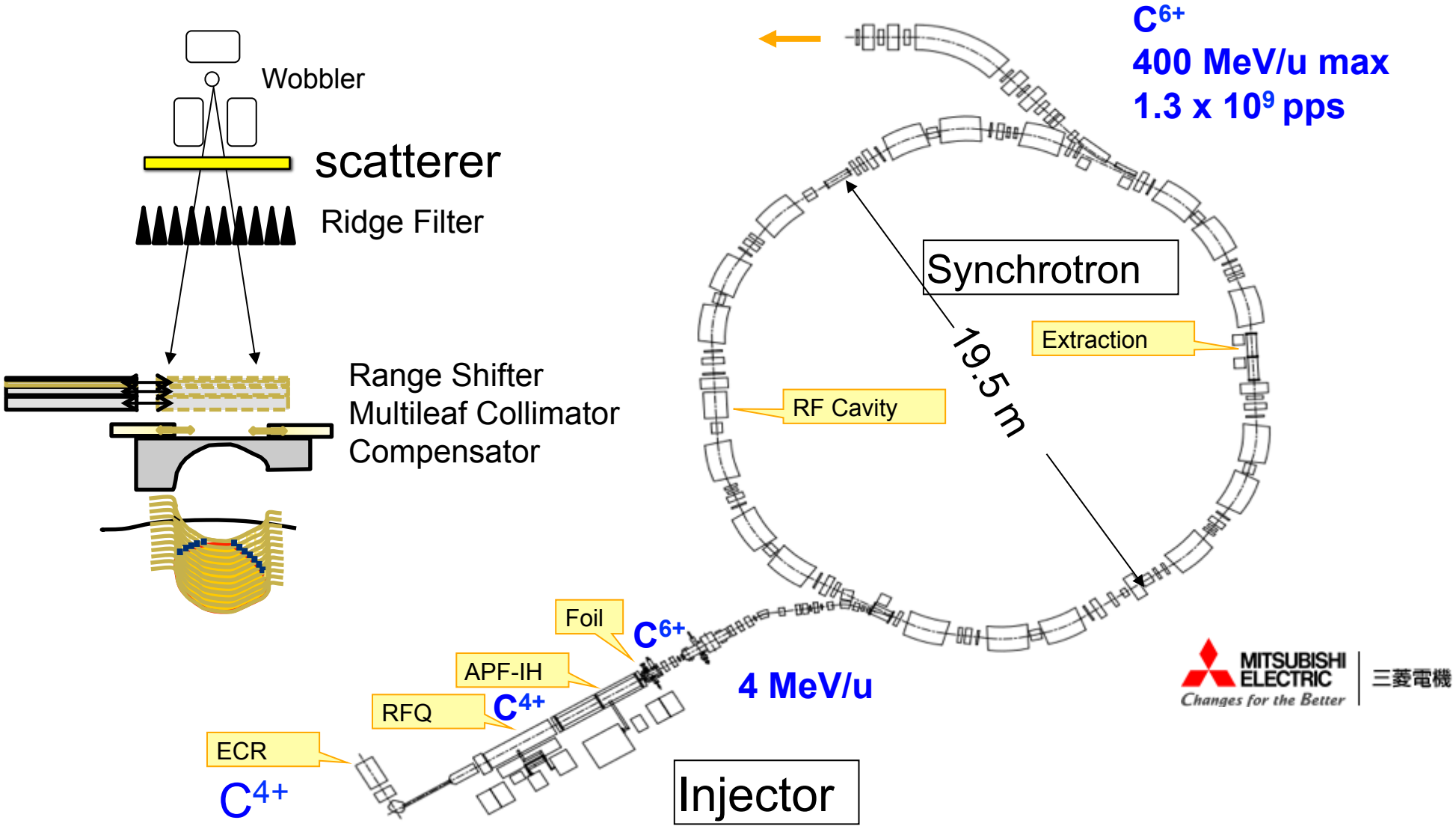


- Accelerator: Synchrotron
- Ion: Carbon
- Circum. : 63 m
- Beam energy
  - 400MeV/n
- Treatment rooms
  - Hori./Vert. x 1
  - Hori. x 1
  - Vert. x 1

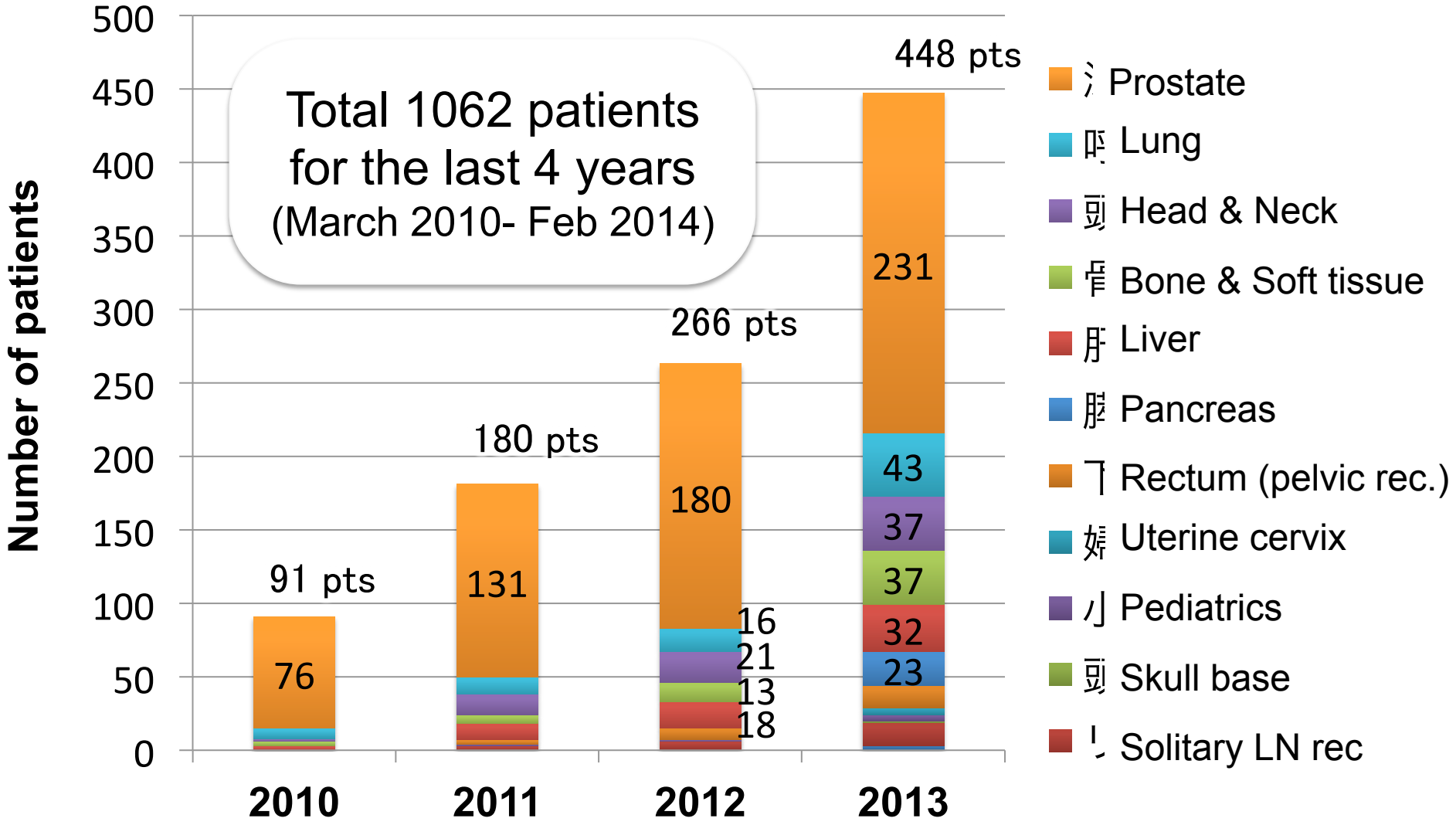
GHMC Main Features

Vendor	: Mitsubishi
Ion type	: Carbon
Energy	: 140 – 400 MeV/u (4,800MeV)
Maximum range	: 25 cm
SOBP	: 2 – 12 cm (with ridge filters)
Maximum aperture	: 15 cm x 15 cm
Lateral field shaping	: Single radius wobbling (Spiral wobbling)
Beam intensity	: 1.3 x 10^9 pps (3 sec cycle) @treatment nozzle
Dose rate	: 5 Gy RBE/min for ϕ15 cm、10 cm SOBP
Beam delivery modes	: Respiration gating Layer Stacking (SLCT)

Irradiation System at GHMC



Number and site at Gunma Univ.



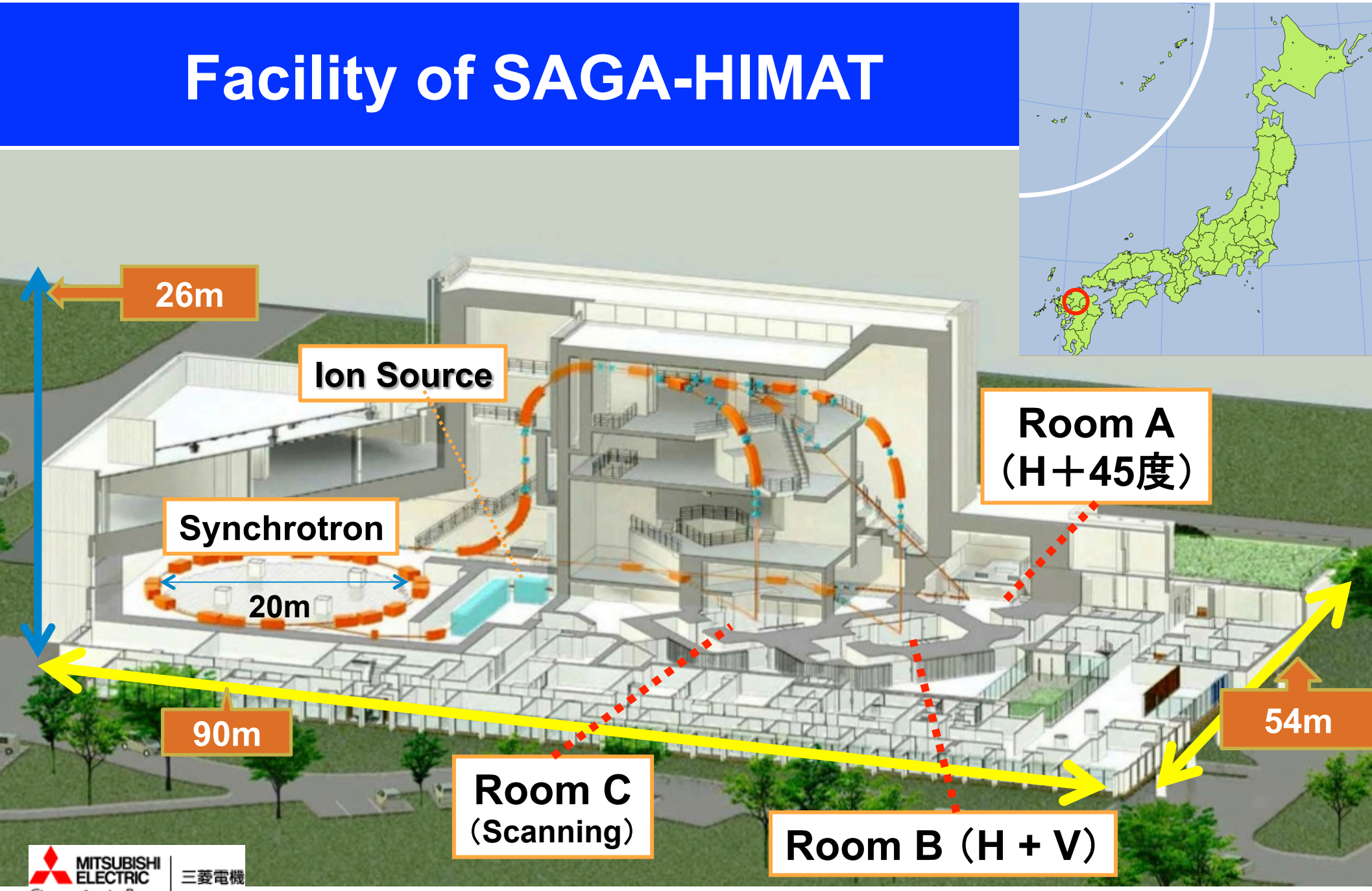
Late radiation toxicity in prostate cancer

Institutes	Treatment	Dose / Fractions	No. Pts	Late ≧G2 Injury	
				Rectal	Urinary
Christie H.[1]	IMRT	60Gy/20fr	60	9.5%	4.0%
Princess Margaret H.[2]	IMRT	60Gy/20fr	92	6.3%	10.0%
Cleveland CF.[3]	IMRT	70Gy/28fr	770	4.4%	5.2%
Stanford U.[4]	SRT	36.25Gy/5fr	41	15.0%	29.0%
RTOG 9406[5]	3DCRT	68.4-79.2Gy /38-41fr	275	7-16%	18-29%
	3DCRT	78.0Gy/39fr	118	25-26%	23-28%
Loma Linda U.[6]	Proton	75.0GyE/39fr	901	3.5%	5.4%
NIRS [7,8]	Carbon	57.6GyE/16fr	539	0.6%	1.9%
Gunma U.	Carbon	57.6GyE/16fr	459	0.8%	2.8%

Reproducible!

1) Coote JH IJROBP 2009, 2) Martin JM IJROBP 2007, 3) Kupelian PA IJROBP 2007, 4) [illegible]JROBP 2009, 5) Michalski JM, IJROBP 2010, 6) Schulte RW, Strahlenther Onkol 2000, 7) Tsuji H, IJRO[illegible], 8) Ishikawa H, IJROBP 2006.

Facility of SAGA-HIMAT



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三菱電機

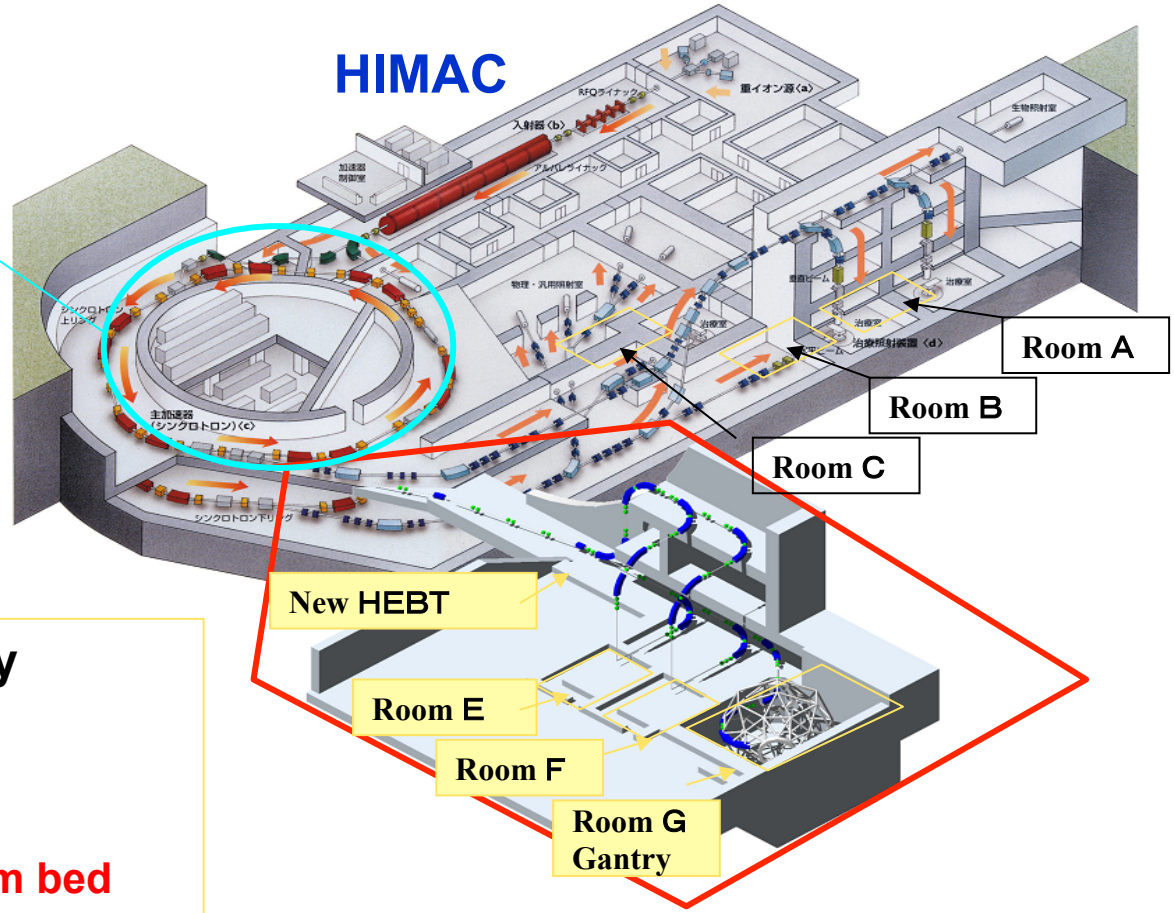
SAGA HIMAT
SAGA Heavy Ion Medical Accelerator in Tosu

Carbon

Overview of HIMAC Facility (NIRS)

Contribution to building the synchrotron

(under collaboration with other makers)



※ Radiological Sciences(2008.8)

New Treatment Facility (Toshiba)

Contribution to main parts of the facility

a. High energy beam transfer (HEBT)

b. Treatment rooms E & F

- Raster-scanning irradiation system
- Patient handling system with robot-arm bed
- Treatment management for particle therapy

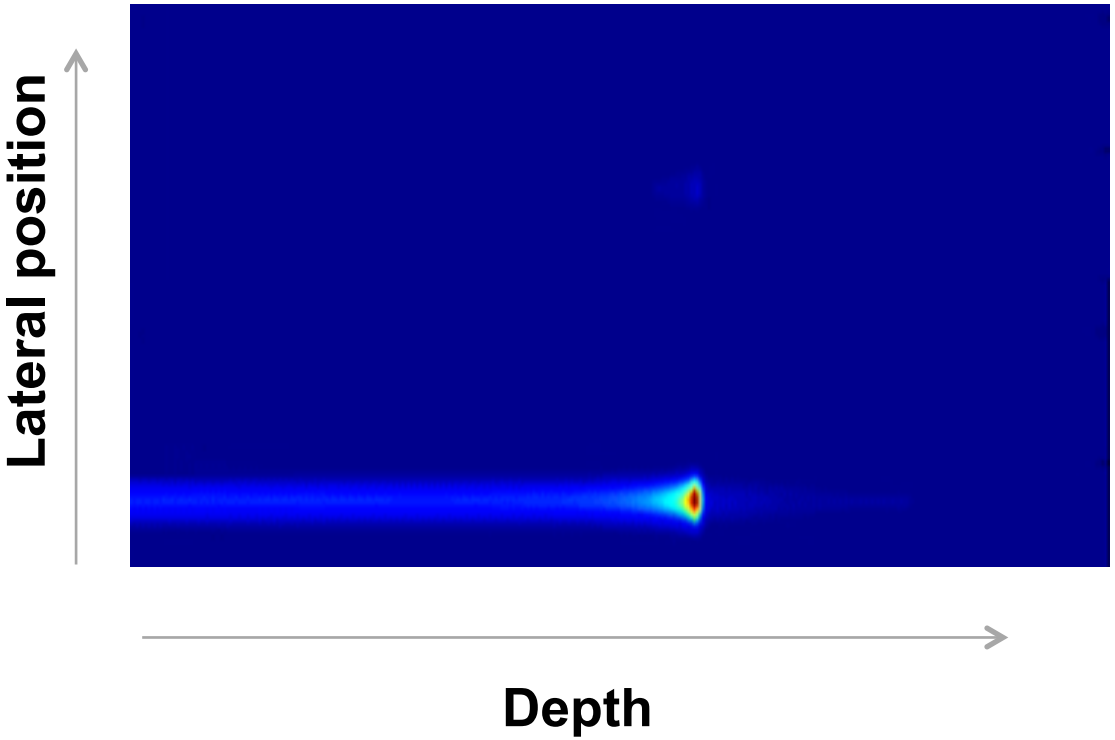
c. Treatment room G

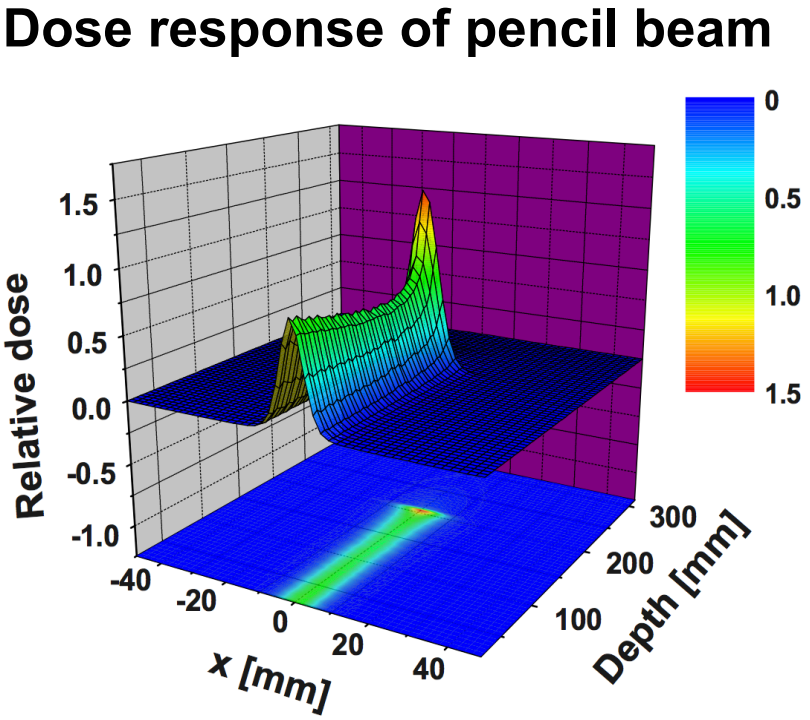
- Superconducting rotating gantry

Raster Scanning at NIRS

Scanning delivery in carbon therapy

Scanning = Superposition of pencil beams



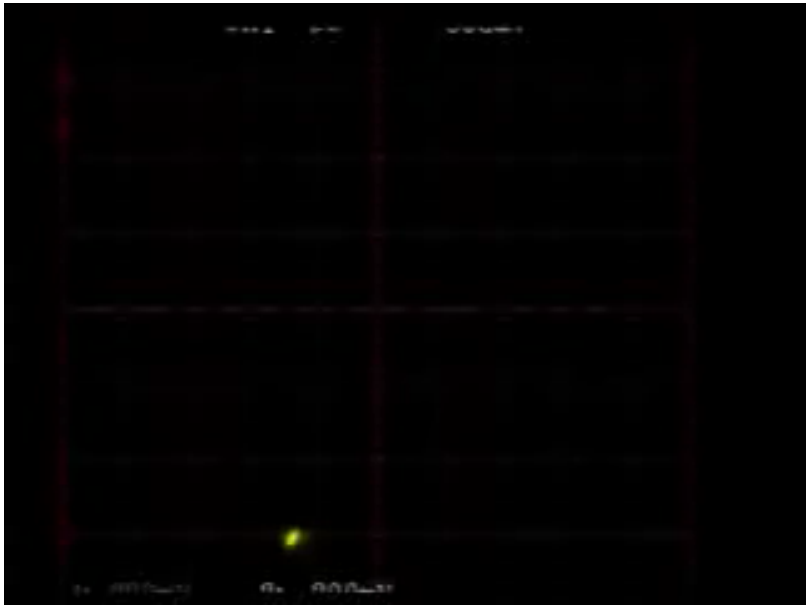


Beam is 3-dimensionally scanned to make desired field

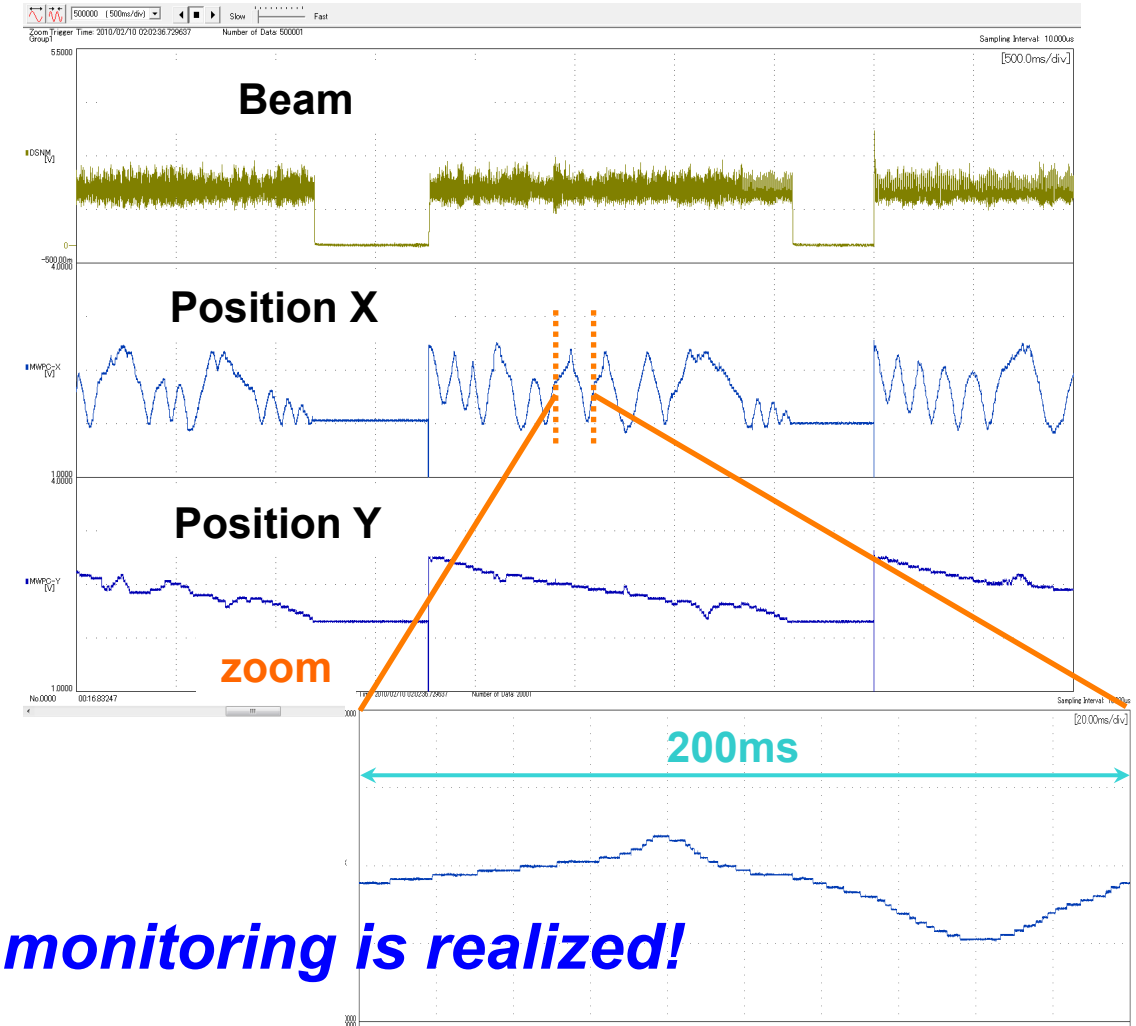
Beam position monitoring

1) Real-time monitoring & 2) position log

Output cycle : 5μs



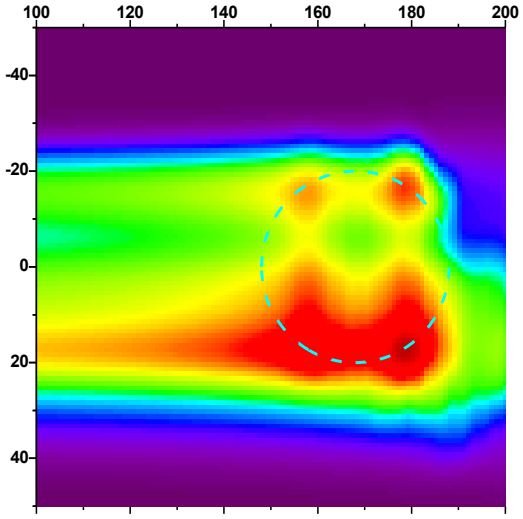
Real time position monitoring



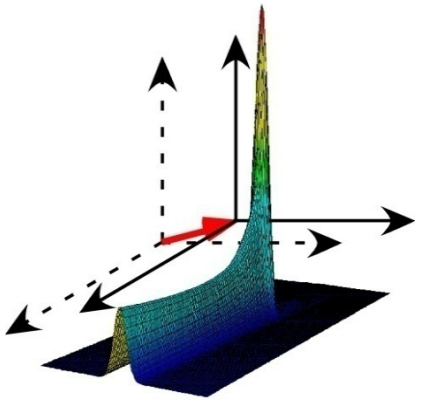
Fast & accurate monitoring is realized!

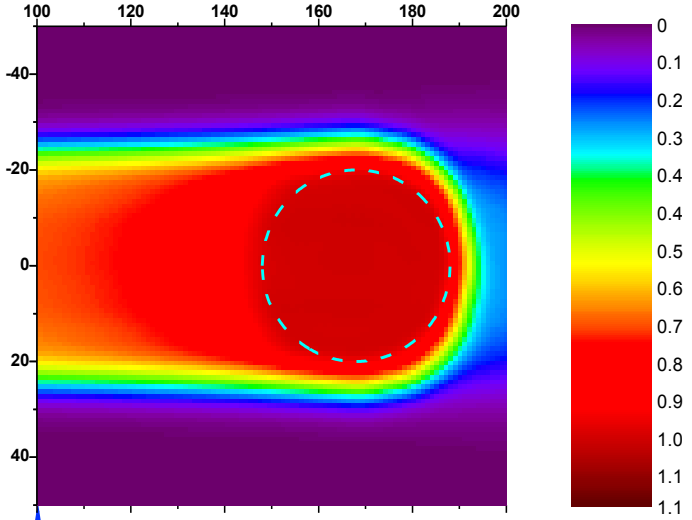
Fast Scanning for Moving Organs
NIRS approach

Simulation of moving tumor irradiation



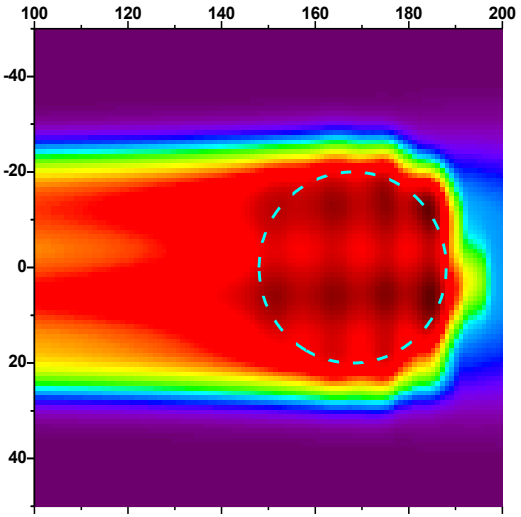
Non-gating





Gating with rescanning (8 times)

Gating

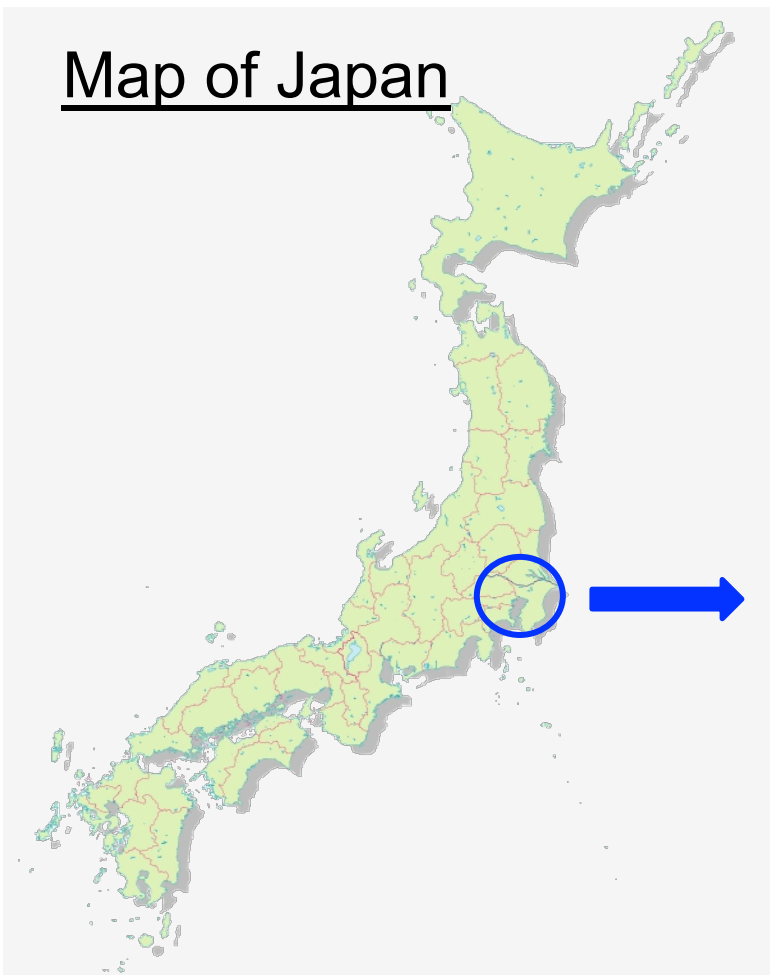


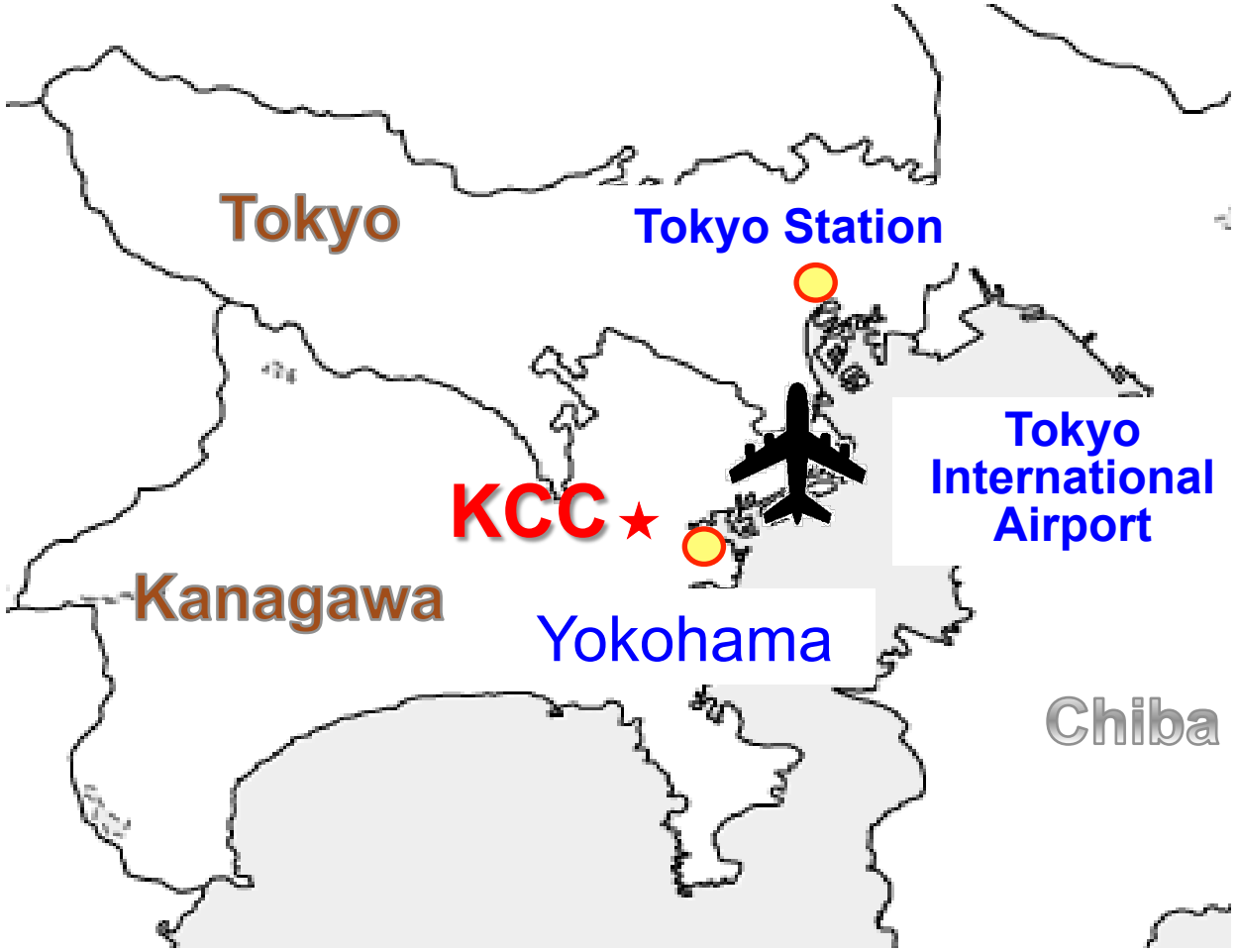
Example:
Φ40mm spherical target

Motion : 7mm in gate

We will start treatment of a moving target with scanning beam with rescanning.

Ion-beam Radiation Oncology Center in Kanagawa (iROCK)





Required time to KCC by train

Tokyo International Airport : 50 minutes

Tokyo Station : 60 minutes

Location of KCC from the Air

New KCC
Kanagawa Cancer Center

【 New Hospital 】
New hospital started operation in Nov. 2013.

【 i-ROCK】
Carbon-ion radiotherapy will start in Dec. 2015.

Specifications of i-ROCK

- Toshiba contracts the project.
- The project started in FY2011 and the therapy will start in FY2015.

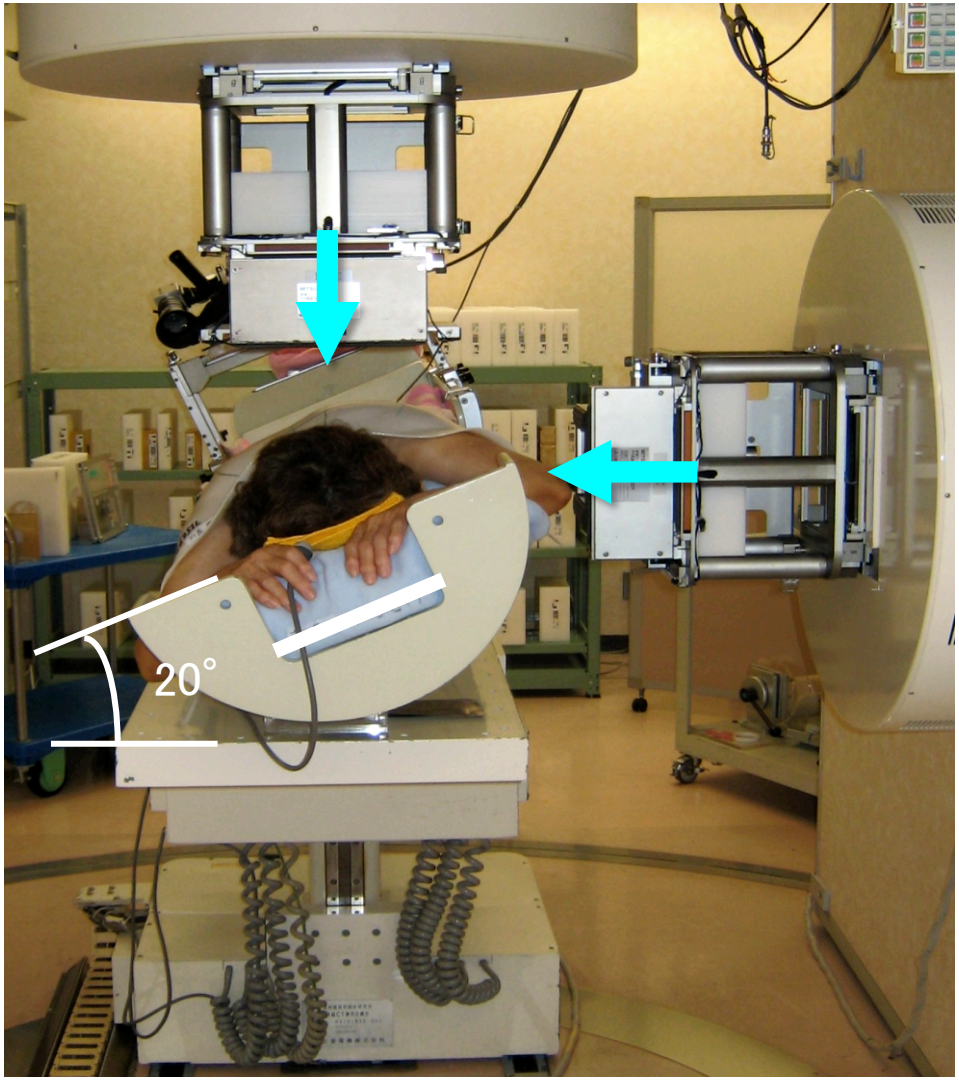
Overview of the facility

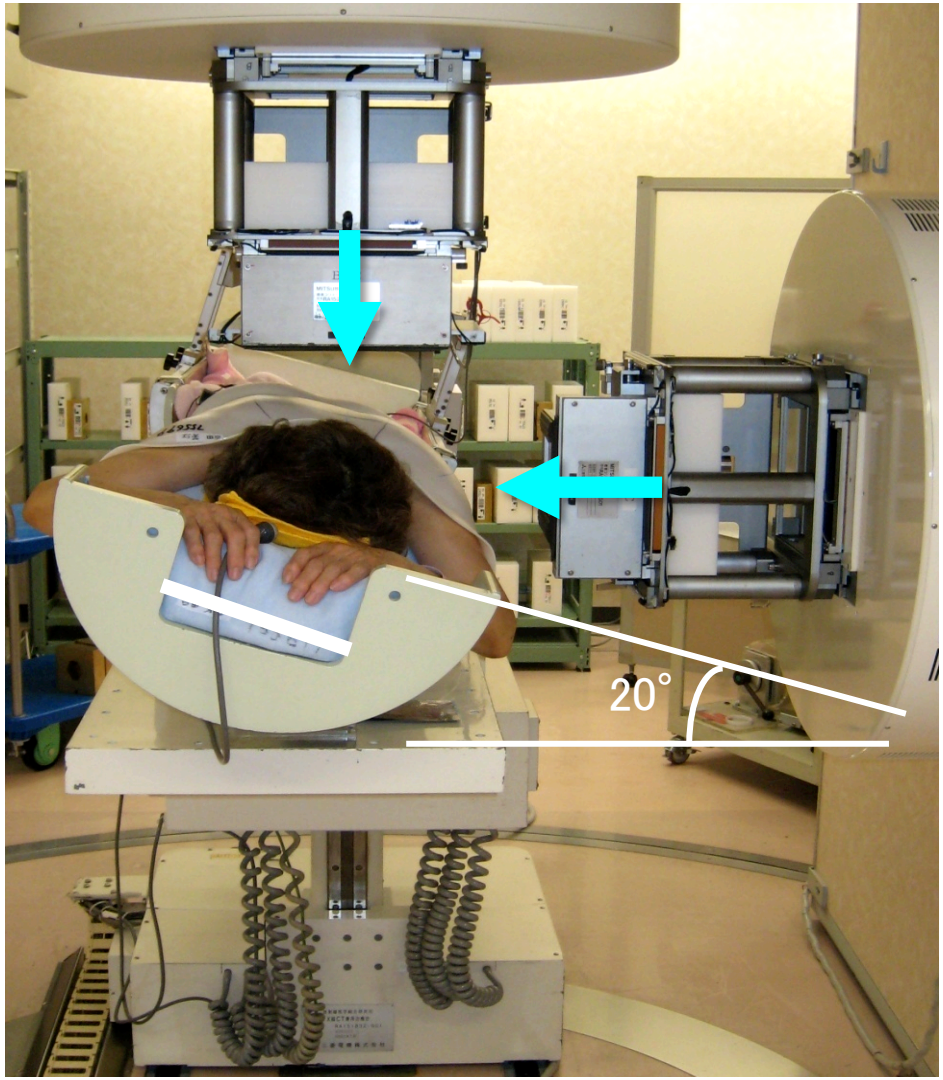
Vendor	Toshiba co.
Floor area	6,500 m^2
Beam type	Carbon ion (C^{6+})
Acceleration energy	430 MeV/n
Irradiated field	15 x 20 cm^2
Therapy rooms	4 rooms (2 rooms for H, other 2 for H and V)
Irradiation type	Spot-scanning and Wobbler

The facility "i-ROCK" is developed as a Japanese full-spec standard type based on NIRS technologies.

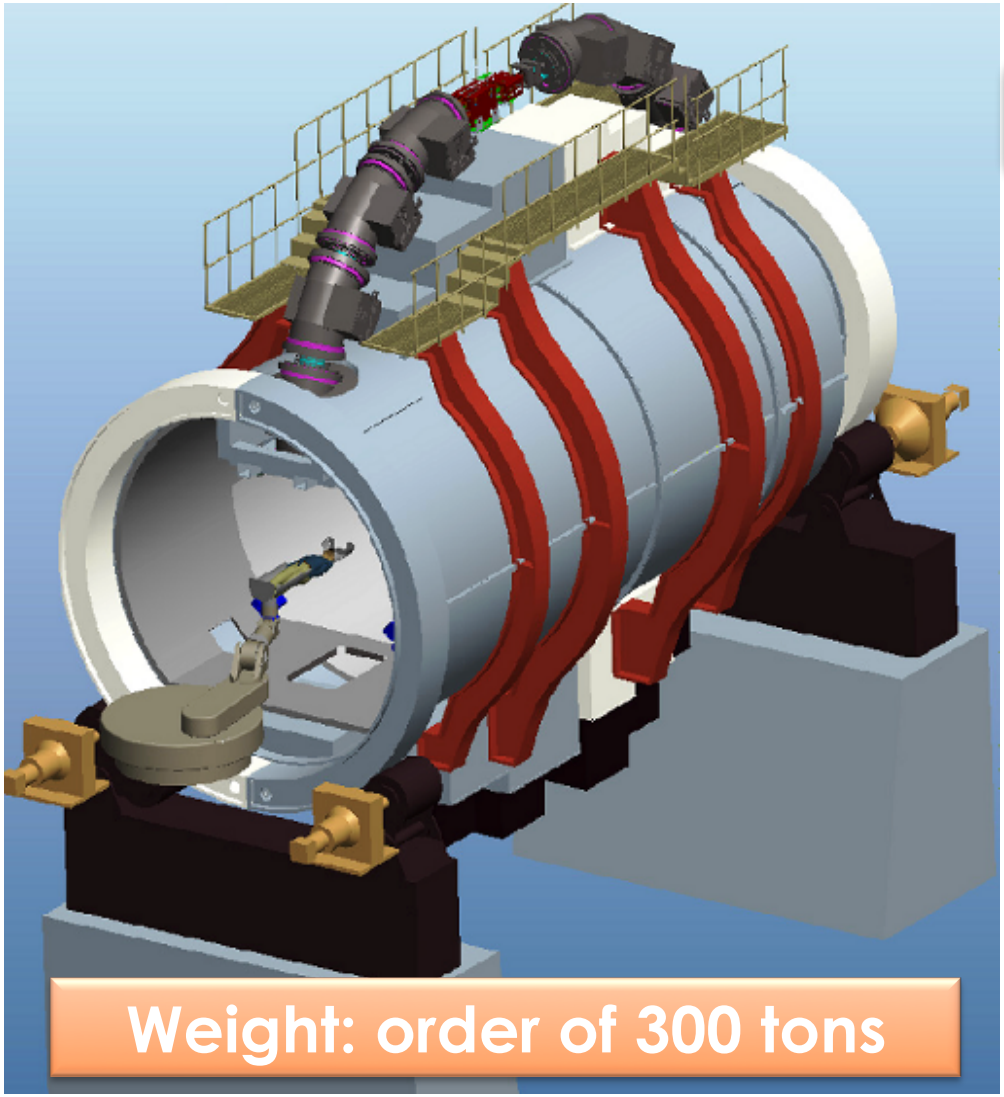
- ***i-ROCK will start its operation in 2015 as scheduled.***
- ***In 2017 PTCOG 56 will be held jointly by Kanagawa(iROCK) and Chiba(NIRS).***

4方向4門による照射





Development of SC gantry at NIRS



Use of superconducting (SC) magnets

Ion kind	: ^{12}C
Irradiation method	: 3D Scanning
Max. beam energy	: 430 MeV/n
Max. range	: 30 cm in water
Scan size	: 200mm×200 mm
Beam orbit radius	: 5.45 m
Length	: 13 m

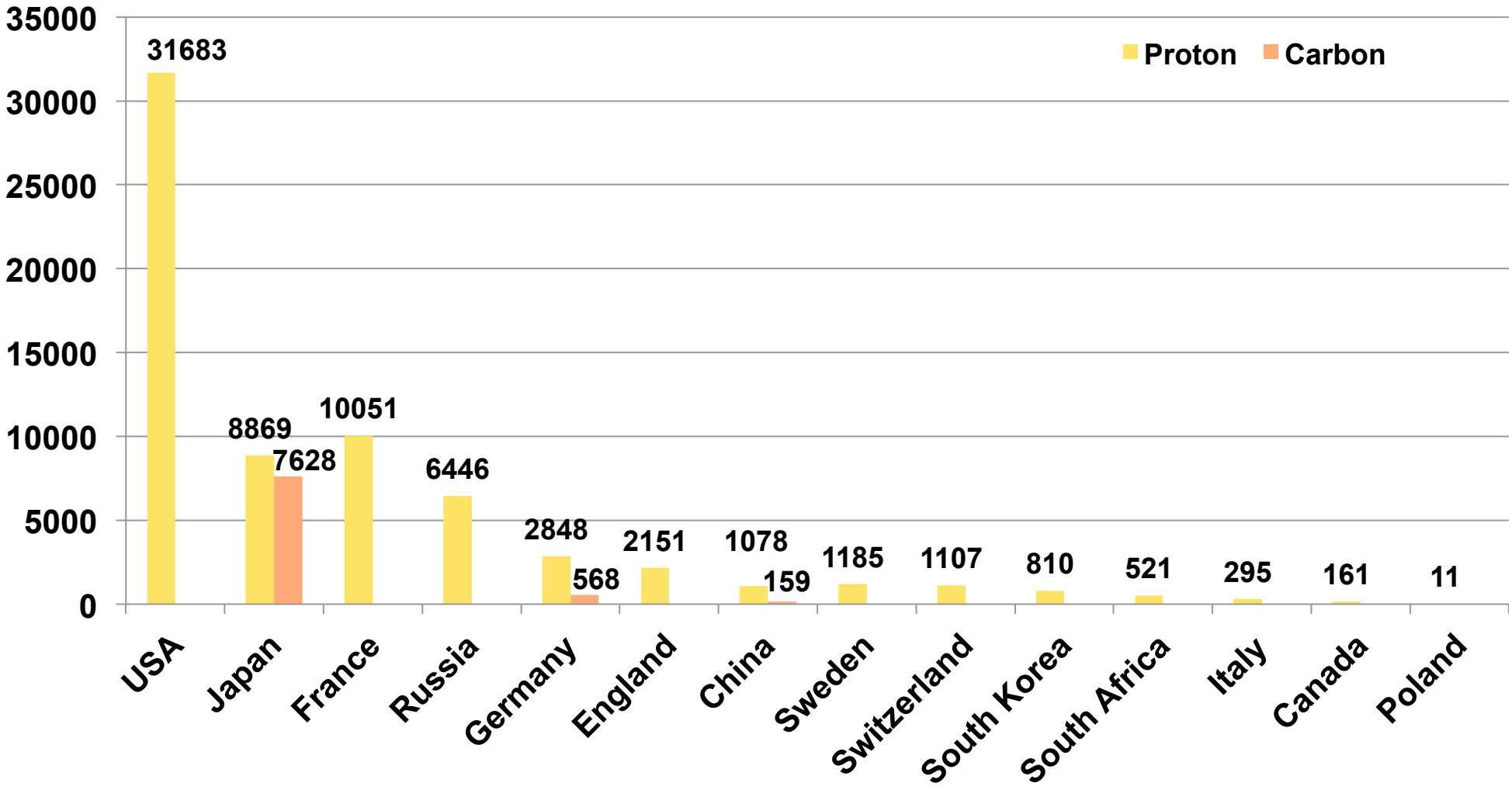
The size and weight are considerably reduced

Rotating-gantry for carbon therapy

- **Design of the SC rotating-gantry**
  - **Compact**
  - **Construction and tests of the SC magnets**

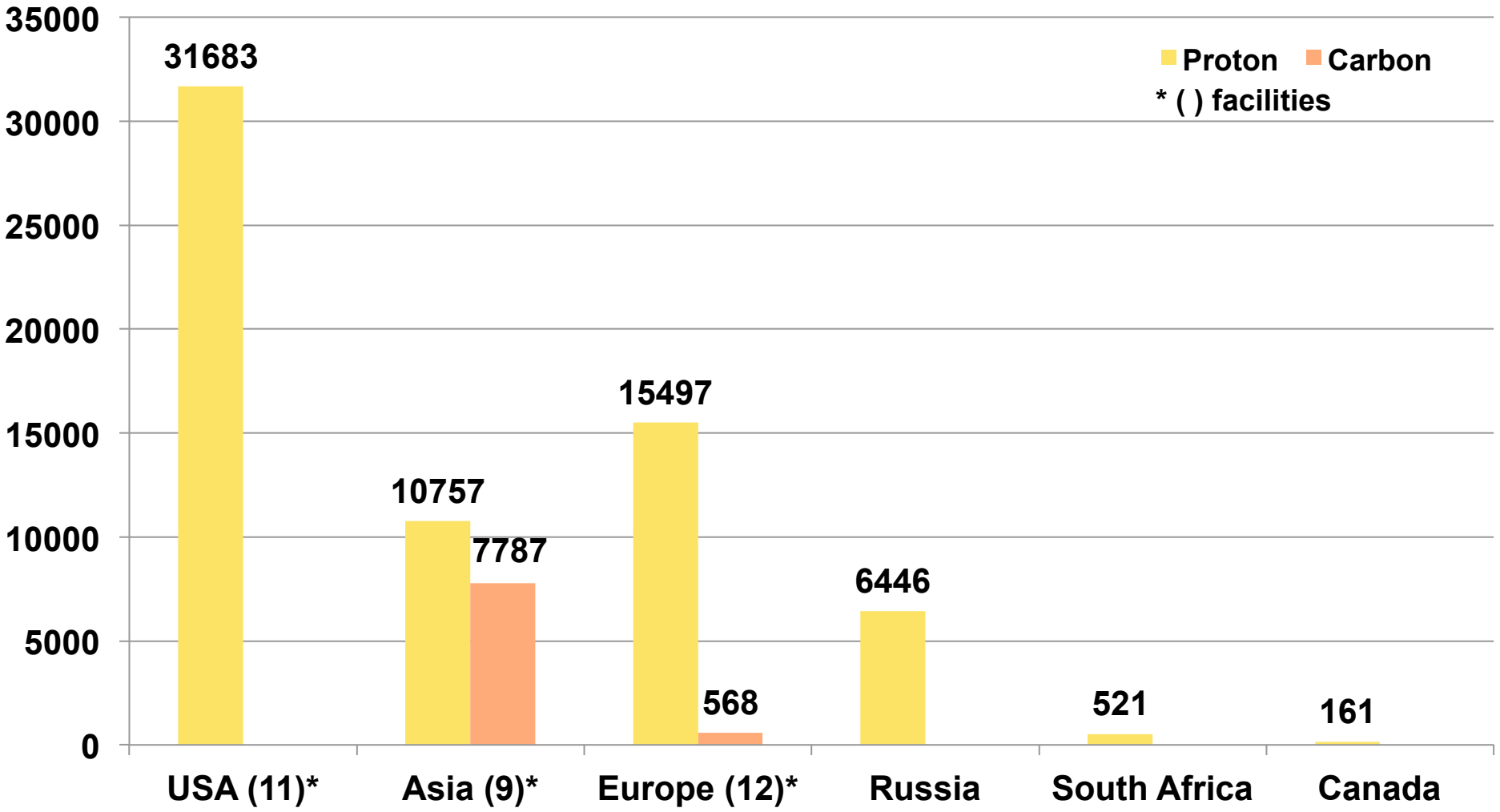
    → **Test results agreed with those designed**
- **Future plan**
  - **All the construction and installation will be made by the end of FY2014 (March 2015)**
  - **Commissioning will be made in FY2015**

Number of patients treated with Protons and C-ions in the world



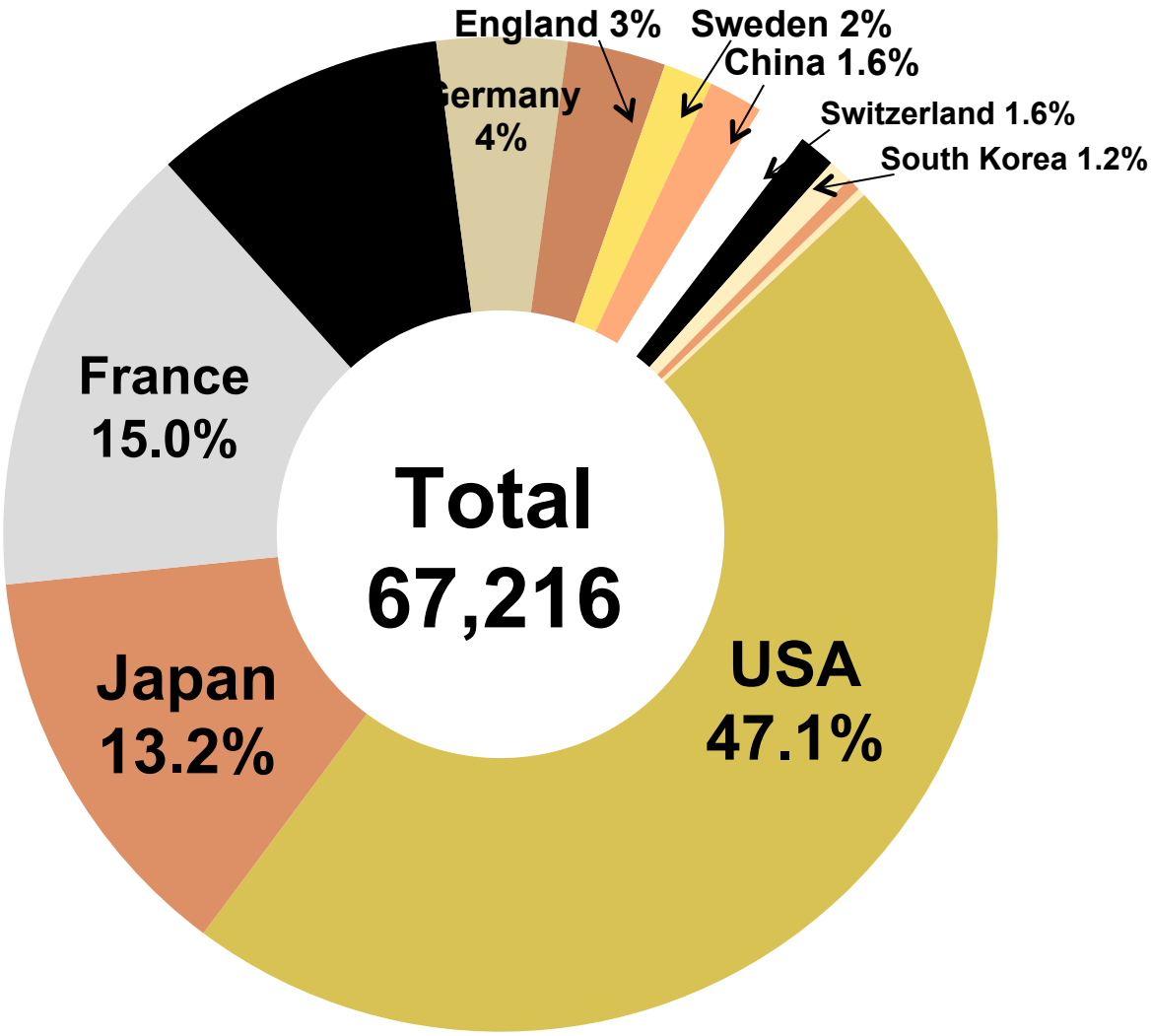
Referred to PTCOG (As of 26-June-2012)

Number of pats treated with Protons and C-ions in the world

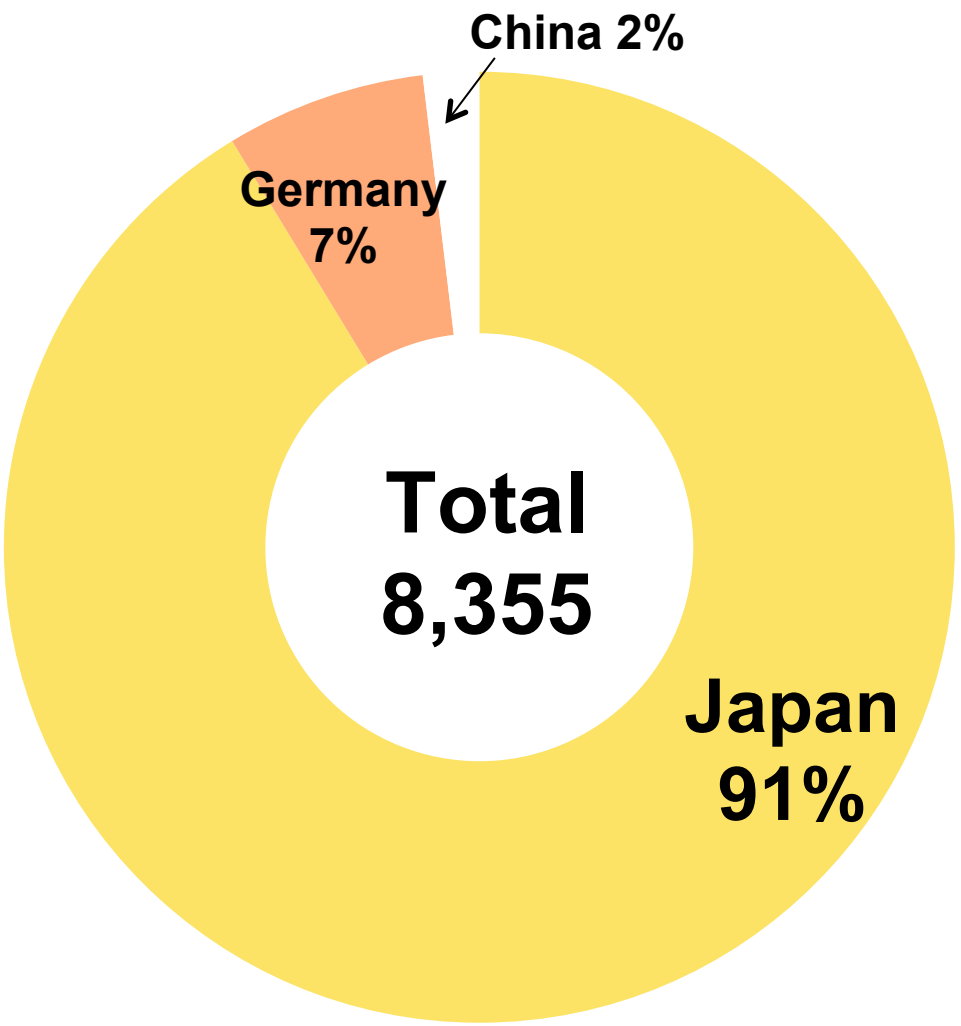


Referred to PTCOG (As of 26-June-2012)

Protons (%)


England 3%
Sweden 2%
China 1.6%
Germany 4%
Switzerland 1.6%
South Korea 1.2%
France 15.0%
Total 67,216
Japan 13.2%
USA 47.1%

Carbon-ions(%)

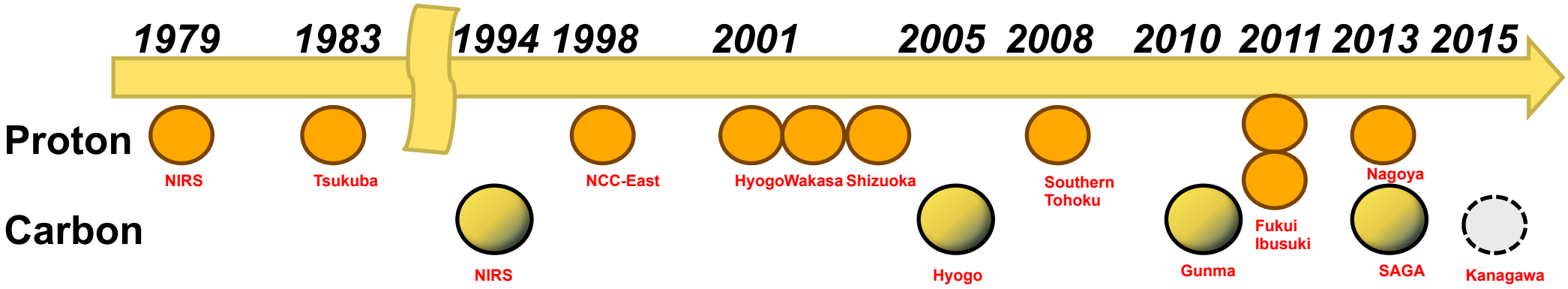


Institutes of Particle Therapy in JAPAN

1. Southern Tohoku Proton Therapy Center, Fukushima
2. Gunma University Heavy Ion Medical Center, Gunma
3. University of Tsukuba(Proton Medical Research Center), Ibaraki
4. National Cancer Center Hospital East, Chiba
5. National Institute of Radiological Sciences, Chiba
6. The Wakasa Wan Energy Research Center, Fukui(Closed)
7. Fukui Proton Therapy Center, Fukui
8. Shizuoka Cancer Center Hospital, Shizuoka
9. Nagoya Proton Therapy Center, Nagoya
10. Hyogo Ion Beam Medical Center, Hyogo
11. SAGA Heavy Ion Medical Accelerator in Tosu, Saga
12. Medipolis Proton Therapy and Research Center, Kagoshima

Method

- **Investigated period**
  - From 1979 to 2013 (33years)
- **Points of data-collection**
  - Primary Lesion
  - Gender
  - Age
  - Address of Patients
- **Surveyed institutes**

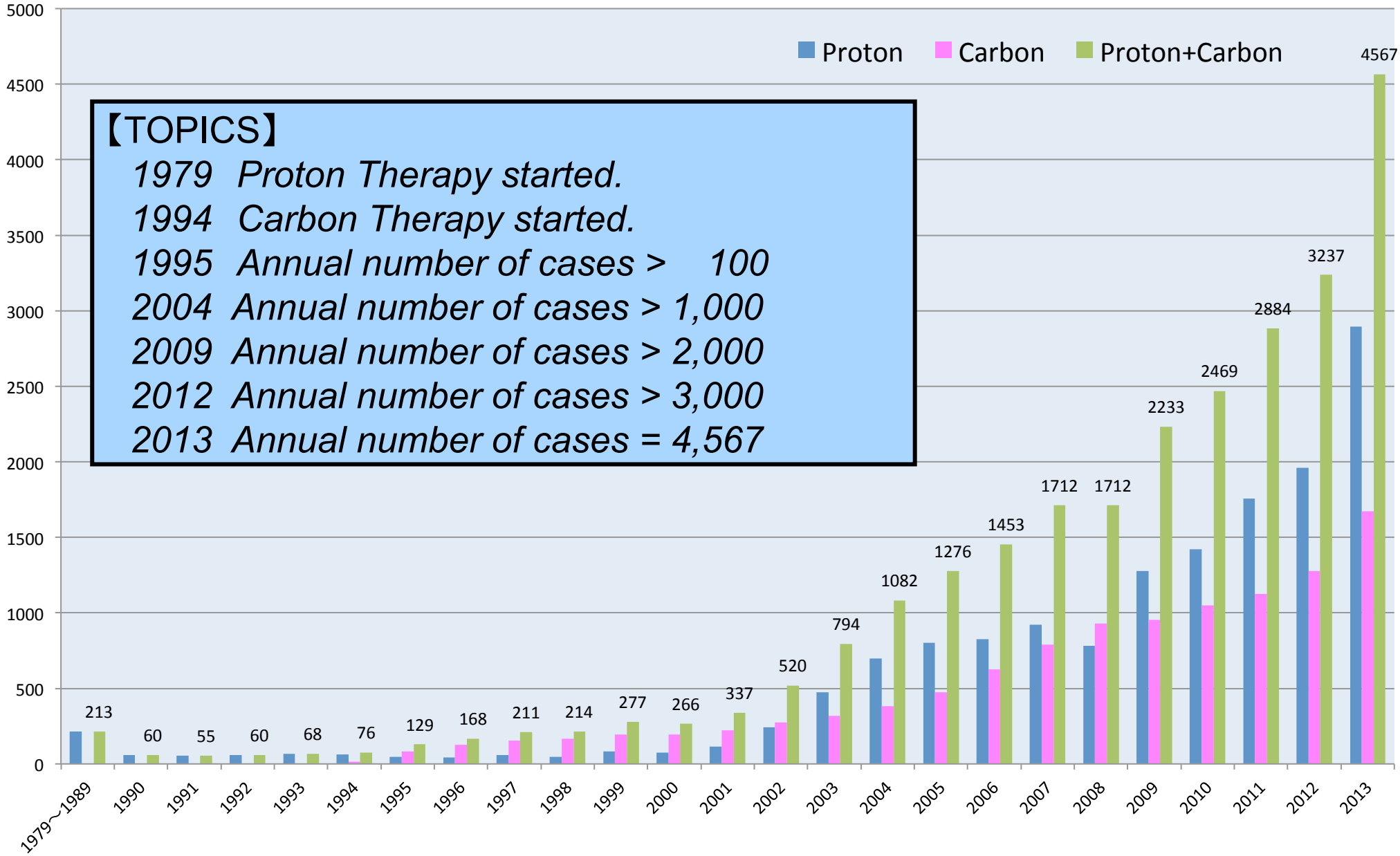


Number of Pats in Japan (1979 to 2013)

	1979 ～ 1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
proton	213	60	55	60	68	61	47	42	58	47	83	73	115
carbon						15	82	126	153	167	194	193	222
P+C	213	60	55	60	68	76	129	168	211	214	277	266	337

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	TOTAL
proton	244	474	699	803	827	923	781	1,278	1,421	1,757	1,961	2,895	15,045
carbon	276	320	383	473	626	789	931	955	1,048	1,127	1,276	1,672	11,028
P+C	520	794	1,082	1,276	1,453	1,712	1,712	2,233	2,469	2,884	3,237	4,567	26,073

The Number of treatment (1979 to2013)



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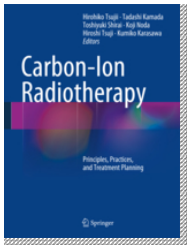
Medicine - Radiology | Carbon-Ion Radiotherapy - Principles, Practices, and Treatment Planning



Carbon-Ion Radiotherapy

Principles, Practices, and Treatment Planning
Tsujii, H.; Kamada, T.; Shirai, T.; Noda, K.; Tsuji, H.; Karasawa, K. (Eds.)

2014, XII, 312 p. 237 illus., 199 illus. in color.

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About this book

- Essen
- Clinica
- Discus

Published in Jan, 2014
Springer

This book
experience
National Institute of Radiological Sciences, step-by-step procedures and technological development of this modality are highlighted. The book is divided into two sections, the first covering the underlying principles of physics and biology, and the second section is a systematic review by tumor site, concentrating on the role of therapeutic techniques and the pitfalls in treatment planning.

Readers will learn of the superior outcomes obtained with carbon-ion therapy for various types of tumors in terms of local control and toxicities. It is essential to understand that the carbon-ion beam is like a two-edged sword: unless it is used properly, it can increase the risk of severe injury to critical organs. In early series of dose-escalation studies, some patients experienced serious adverse effects such as skin ulcers, pneumonitis, intestinal ulcers, and bone necrosis, for which salvage surgery or hospitalization was required. To preclude such detrimental results, the adequacy of therapeutic techniques and dose fractionations was carefully examined in each case. In this way, significant improvements in treatment results have been achieved and major toxicities are no longer observed. With that knowledge, experts in relevant fields expand upon techniques for treatment delivery at each anatomical site, covering indications and optimal treatment planning.

With its practical focus, this book will benefit radiation oncologists, medical physicists, medical dosimetrists, radiation therapists, and senior nurses whose work involves radiation therapy, as well as medical oncologists and others who are interested in radiation therapy.

Content Level » Professional/practitioner

Keywords » Cancer radiotherapy - HIMAC - Heavy ion - Ion beams - Protons - Relative biological effectiveness

Tsujii · Kamada · Shirai · Noda
Tsuji · Karasawa *Eds.*

Hirohiko Tsujii · Tadashi Kamada
Toshiyuki Shirai · Koji Noda
Hiroshi Tsuji · Kumiko Karasawa
Editors

Carbon-Ion Radiotherapy

Principles, Practices,
and Treatment Planning

Springer

Carbon-Ion Radiotherapy

International Training Course on Carbon-ion Radiotherapy

20-25 October 2014 Chiba & Gunma, Japan

Course Program

October 20(Mon)	History & Overview of Iron Beam Radiotherapy Phisics 1. Basic Knowledge	Biology 1. Biological Characteristics Phisics 2. Accelerators Clinical 1. Overview
21(Tue)	Biology 2. Biological Models Phisics 3. Beam Delivery & Dosimetry	Clinical 2. Head & Neck, Skull Base CNS, Lung Tumors, Esophagus Clinical 3. Pancreas, Ructum, Liver
22(Wed)	Phisics 5. Treatment Planning Phisics 6. Facility Design Clinical 4. Bone & Soft tissue Phisics 4. Radiation Shielding	Clinical 5. Genitourinary, Eye, Breast Cancer Gynecologic tumors Tour Patient Positioning Treatment Planning
23(Thu)	Move To Gunma	Clinical6. Diagnostic Imaging Case Study 1.
24(Fri)	Phisics 7 Phisics 8. Facility Set-up & Operation	Clinical 7. Clinical Trial Clinical 8. Cost Effectiveness Clinical 9. Multi Modality Approach Case Study 2
25(Sat)	Tour Free Discussion	Move To Chiba

Course Director

Hirohiko Tsujii, M.D., Ph.D.
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Tatsuya Ohno, M.D., Ph.D.
(Professor, Gunma University Heavy Ion Mefical Cnter)

Venue

NIRS Research Center for Charged Particle Therapy (Inage , Chaba)
Gunma University Heavy Ion Medical Center (Maebashi, Gunma)

Application

A prior registration is required.
Please search ITCCIR 2014

Registration Fee

80,000 JPY including 6 days accomodation with beakfast, lunch, and transportation from hotel to venue.

Organizer

Gunma University Heavy Ion Medical Center
Hyogo Ion Bem Medical Center
Ion Beam Therapy Center, SAGA HIMAT Foundation
Kanagawa Cancer Center (I-ROCK)
Proton Medical Research Center, University of Tsukuba
National institute of Radiological Sciences (NIRS)
Association for NUclear Technology in Medicine (ANTM)

Support

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Program for Cultivating Global Leaders in Heavy Ion Therapeutics and Engineering (Gunma Univer.)

For more information, please contact http://www.antm.or.jp/ITCCIR_2014/

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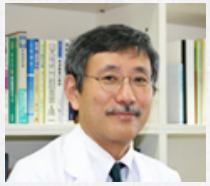

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Organizations

Welcome to PTCOG56 to be hosted by Kanagawa/NIRS in 2017