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POSTGRADUATE STUDIES

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Medical Faculty Heidelberg

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Heidelberg Ion-Beam Therapy Centre

MASTER ONLINE

ADVANCED PHYSICAL METHODS IN RADIOTHERAPY

DISTANCE LEARNING PROGRAMS IN MEDICAL PHYSICS

IMPRINT

Publisher
Universität Heidelberg
Postgraduate Studies
Bergheimer Straße 58A
69115 Heidelberg
Germany

Editing
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Realisation
Universität Heidelberg
Communication and Marketing
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Last revised
March 2014

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Old University

Program Leaders

WELCOME

Dear Colleagues,

as the program leaders we are pleased to note your interest in the Master's (MSc) program or the Postgraduate (PG) study tracks in "Advanced Physical Methods in Radiotherapy" (APMR). The focus of these programs is on medical physics in radiation therapy – a vibrant field in which innovations and ongoing developments over the last few years have contributed significantly to the improvement of cancer therapies. In particular, three areas stand out with respect to these advancements:

Intensity Modulated Radiotherapy (IMRT), Image Guided Radiotherapy (IGRT), and Heavy Ion Therapy.

We are often reminded by our colleagues in institutions working in radiation therapy that it is difficult to keep up with all areas of modern radiation therapy, medical physics and medical technology, and to incorporate these into daily practice.

Currently there is no place in the world that offers an exhaustive academic training that fully integrates the modern methods of both medical physics and radiation therapy fully aligned to emerging scientific research issues and technological developments. The Master program in "Advanced Physical Methods in Radiotherapy" has been established to address this deficit in order to best prepare medical physicists for their increasing new responsibilities. The MSc and the Postgraduate (PG) study tracks in "Advanced Physical Methods in Radiotherapy" are accredited postgraduate study programs on the cusp of relevant therapeutic developments. Designed to provide work based training on location in Heidelberg it contributes directly to the improvement of patient care.

Your training will take place in Heidelberg, one of the world's most famous and scientifically acclaimed centers in the field of medical physics and radiation therapy. The internationally renowned German Cancer Research Center (DKFZ) is home to the largest research department for medical physics in Germany. Here major progress was made in the 1980s in the development of IMRT, and in 1997 the DKFZ also was one of the first centers to implement IMRT in clinical practice.

In that same year under the auspices of the Radiologic University Hospital, one of the largest radio oncology university hospitals in Europe, a scanned ion beam consisting of carbon ions was employed for the very first time in a clinical setting. This was performed in close collaboration with the DKFZ and the Gesellschaft für Schwerionenforschung (GSI) in Darmstadt. The pilot project ultimately culminated in the world's most modern and unique ion-beam therapy facility "HIT" at the University Hospital of Heidelberg opened for clinical operation in 2009.

Many of the scientists at the DKZF, the hospital and the GSI who have pioneered this field have been enlisted to teach on our postgraduate programs. This in turn presents the unique opportunity for you to academically engage with many of the world's most experienced, leading experts and thus to deepen your understanding of current research in this area.

In addition to the facilities in Heidelberg already mentioned above, the National Centre for Tumour Diseases (NCT) is seen to strengthen Heidelberg campus' extraordinarily strong oncological research network even further.

As a program participant you will be instructed online in the theoretical underpinnings of modern radiation therapy from the convenience of your home. During the attendance phases you will supplement your knowledge through work-based activities and hands-on training in imaging and image analysis, therapy planning, radiation, dosimetry, quality assurance and verification. The practical exercises will be supported by equipment and accelerators at the participating institutes. The spectrum of facilities in Heidelberg ranges from modern linear accelerators with IMRT and IGRT capabilities to tomotherapy and ion therapy.

Surely this is an unparalleled opportunity not to be missed!

In case you are having doubts about studying on a program delivered predominantly online, then consider the following. The student support provision on the APMR ensures that students new to online learning have the time and assistance necessary to feel comfortable using online technologies for studying. In using these new technologies you are certain to experience the benefits of an "anytime, anywhere" program. You will find an effective balance between individual self-study elements and collaborative activities online that foster lively discourse and critical discussion between your peers and esteemed subject experts from around the world – without ever leaving the comfort of your own home!

The flexible format of the APMR programs meet the needs of the working adult and we would be pleased to see you continue your education with us.

Prof. J. Debus, MD, PhD Prof. W. Schlegel, PhD

Prof. O. Jäkel, PhD

DESCRIPTION OF APMR PROGRAMS

INTRODUCTION

Thank you for your interest in the Master Online (MSc) and the Postgraduate (PG) study tracks in “Advanced Physical Methods in Radiotherapy” (APMR) delivered in English by the prestigious Heidelberg University in Germany. We are especially pleased to present the University’s first postgraduate online distance learning opportunities on the next few pages and aspire to answer at least some of your questions about continuing your education with us.

The APMR programs welcome students of all cultural and ethnic backgrounds and are designed to accommodate the diverse needs of adult learners with professional experience from different areas of expertise in the interdisciplinary field of medical physics. Whether you are an undergraduate physics student, a practicing medical physicist or just completing your Bachelor’s degree in biomedical technology, it’s never too early to think long term about your future career goals. This APMR programs information booklet is for you – regardless of the current stage of your academic or professional career. If you plan on refining knowledge and skills while learning advanced cancer treatment techniques on a flexible, English-speaking curriculum in the company of likeminded colleagues, then read on. Let us demonstrate how the APMR programs could be your springboard to exciting emergent career opportunities in the vibrant field of medical radiation therapy.

OVERVIEW

The APMR programs comprise a Master (MSc) study track with a duration of two years as set forth in the German quality assurance guidelines for Bachelor and Master programs of study and two Postgraduate (PG) study tracks of a duration of one to one and a half years respectively.

The MSc program entails 5 online modules (M1 – M5), one internship module (MI) and the Master’s Thesis (MT). The PG short study track includes three online modules of the MSc program, the PG full study track all six taught modules of the MSc without the Master’s Thesis.

APMR are part-time, postgraduate programs in medical physics delivered predominantly online (80%) with periodic attendance phases (20%) at flagship medical facilities in Heidelberg. Accredited in 2011 by the accreditation institute ACQUIN (Accreditation, Certification and Quality Assurance Institute), students are assured nothing less than expert instruction, high-quality learning materials and study support arrangements throughout the whole education period.

These unique distance learning programs are borne out of a fruitful, long-standing partnership between the successful German Cancer Research Center (DKFZ), the distinguished Heidelberg University Hospital and, more recently, the new state-of-the-art Heidelberg Ion-Beam Therapy Center (HIT).

The advanced technology available at these cutting-edge medical facilities plays an increasing role in the optimum care and treatment of cancer patients worldwide. Thanks to the ongoing collaborative activities between key stakeholders, and unlike any other programs in advanced physical methods, APMR programs offer students advanced workshops at these facilities on location in Heidelberg. These workshops are purposefully aligned to the continuous theoretical instruction from 70+ internationally based teaching staff and prominent experts, online, in the disciplines of radiology, radio oncology, radiation safety and medical physics.

OUTLOOK

Innovative research and developments in the field of medical physics continue to improve the quality of radiation treatment of cancer. Graduates of APMR programs will possess the specialized technical skills underpinned by a solid theoretical understanding of advanced cancer treatment techniques such as e.g. intensity modulated and image guided radiotherapy (IMRT, IGRT). A shortage of specialists is already imminent worldwide and this is where APMR programs can contribute to filling a widening gap. With a MSc or a PG Certificate in APMR successful candidates hold a valuable and worthwhile terminal degree that can open doors to challenging new careers in teaching, research or care services in medical centers, national laboratories, academic institutions, governmental regulatory agencies, and in medical and nuclear industrial facilities.

MODE OF STUDY

GENERAL

APMR programs are distance learning programs tailored to fit the adult learner's busy schedule! Strictly speaking the programs take a so-called blended learning approach. There is a growing consensus that the blended learning approach is the most effective at supporting student learning which on APMR programs entail dominant online phases (80%) supplemented by periodic attendance phases at medical facilities in Heidelberg (20%). By making effective use of online technology and educational multimedia students have access to a flexible and supportive virtual learning environment (VLE) hosted by the institutional Moodle platform. The VLE holds all relevant learning materials, assignments and activities. Web discussion boards and online seminars foster collegiate communication and collaboration with teaching experts and peers at times that suit students' individual needs.

This blended learning approach with online-on-site sequences enables students to concentrate on acquiring a solid theoretical grounding and on refining knowledge in advanced cancer treatment "anytime and anywhere" supplemented by hands on, practical training sessions at fixed times that still allow for a reasonable work-life-study balance.

During the on-site phases APMR students will find themselves working side by side with pioneering experts with longstanding experience in IMRT, ion beam scanning and treatment planning as well as radiobiological modeling.

These attendance phases including the internship sessions where students will be present in Heidelberg for a block of 14-18 days take place at the Department of Medical Physics in Radiotherapy at the German Cancer Research Center (DKFZ), the Department of Radiation Oncology and Radiation Therapy at the University Hospital of Heidelberg and at the Heidelberg Ion-Beam Therapy Center, HIT. Besides providing authentic beam time experiences at the required radiotherapy units, these prestigious institutions also offer interns international networking opportunities that are sure to prove valuable not only in future job searches.

German Cancer Research Center
(DKFZ)

Heidelberg Ion-Beam Therapy
Center HIT

Clinical environment,
Im Neuenheimer Feld, Heidelberg

MODE OF STUDY

MSC STUDY TRACK

MSc-APMR students are tasked with theoretical and practical coursework over a period of two years in five fully online modules (M1 – M5) including three to four scheduled short plus one longer attendance phase comprising the internship phase (MI). The attendance phases are scheduled in between two subsequent online modules according to the table shown. The first attendance phase the optional “Welcome Day” is the shortest one followed by two joint attendance phases for modules M1, M2 and M3, M4 at 4 days respectively. The longest attendance phase (14 – 18 days) comprises the joint attendance phase for module M5 and module MI (internships) which offers time for at least 4 internships during the 3rd semester before the Master’s Thesis (MT).

PG STUDY TRACKS

PG short study track
Students having selected the PG short study track, will find themselves enrolled for 3 online modules, two mandatory core modules, M2 and M4 and one custom picked module over a time period of approximately one year. The online sequences will be supplemented by three attendance phases of two days each.

PG full study track
The PG full study track will take about one and a half years. Students follow all 6 taught modules of the MSc track (M1 – M5 and MI) apart from the Master’s Thesis (MT) and participate as the MSc students in three to four short attendance phases lasting from 1 to 4 days plus the longer joint attendance phase for module M5 & the internship phase (MI) of 14 to 18 days.

SEMESTER 1							SEMESTER 2						SEMESTER 3						SEMESTER 4					
Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Module 1				**Module 2**			**Module 3**			**Module 4**			**Module 5**						**Master´s Thesis**					
Start M 1.0	Attendance phase „Welcome Day“ optional (1. day)					Attendance phase 2 (4 days)							Attendance phase 3 (4 days)					Attendance phase 4 (14-18 days)					Defense	
I1 online				I2 online		W1	I3 online			I4 online			S3	I5 online				W5						
						E1 (M1)							E3 (M3)					E5 (M5)						
						W2							W4					MI						
						E2 (M2)							E4 (M4)					4-5 Internships						

I: Introduction E: Exam M I: Internships S: Seminar W: Workshop

Advanced Physical Methods in Radiotherapy

Online expert guest lecture with Prof. Bortfeld, Boston, USA

MODE OF STUDY

STUDYING ONLINE

What is it like studying online? Studying online on the APMR programs entails a range of carefully developed learning objects and activities that accommodate the different ways of learning as a working adult. They are distance learning programs that have been designed to balance the flexibility of stand-alone web-based materials, self-paced activities and study units with collaborative tasks and synchronous (live) online sessions. New topics are introduced within study units by the subject experts in prerecorded video lectures complemented by easily accessible text-based content. Self-tests feature after each sub-module to encourage self-monitoring of progress at regular intervals during the semester designed to signal to the student and tutor possible areas of improvement.

Sharing views, raising relevant issues and presenting selected homework assignments takes place in the themed asynchronous (time-delayed) discussions and synchronous (same time) online study sessions. These feature in selected sub modules in order to foster peer to peer support and tutor contact time. It's also an ideal way to beat the online blues!

State-of-the-art online conferencing, discussion and web 2.0 technologies ensure reliable communication between all parties at a distance – from work, home or as in one instance on the program – even from a campsite in Italy! Online guest lectures delivered by experts from across the globe feature regularly and allow for international outreach not ever feasible in the traditional classroom.

Last but not least, APMR students are never alone as opportunities for communication and support are built into the curriculum in a number of ways. The program staff can be reached via email, phone or telephony (Skype) at any time for personal 1:1 advice and support. A dedicated problems forum is available for raising any concerns or questions to the program team and synchronous online study sessions with the subject experts help foster a scholarly peer-tutor relationship. The APMR program developers are experts in technology-enhanced teaching and learning and have designed programs with all the potential online pitfalls in mind.

Studying online

BENEFITS OF ONLINE STUDY

Still not sure if online study is right for you? Then consider the following benefits:

- Within limits students can study at a time and pace (and place) that suits them best.
- Online study is needs-based as material can be reviewed as many times as necessary to understand a topic.
- Geographic boundaries break down in synchronous online guest lecture sessions.
- Internet communication tools (ICT) in the VLE facilitate more communication than might be possible in the traditional classroom.
- It exposes students to emergent online communication technologies that are pivotal to collaborative research and technological developments in the global academic and professional communities.
- The global outreach of an online program allows for culturally and academically richer learning.
- The VLE is a one-stop-shop that holds all program resources to allow for more effective learning than if dispersed over time and place.

PROGRAM OBJECTIVES

In light of the rapid developments in the field of advanced cancer treatment the APMR programs aim to best prepare its graduates for the versatile challenges that lay ahead.

During their studies APMR participants will:

- consolidate and refine their fundamental medical knowledge in e.g. the fields of anatomy, physiology and medical imaging.
- acquire a robust, basic, theoretical and practical understanding of e.g. IMRT/IGRT and particle therapy.
- demonstrate knowledge of recent developments in e.g. IMRT/IGRT and particle therapy and apply this knowledge in the treatment of patients.
- acquire an in-depth understanding of e.g. dosimetry and quality assurance tailored to include the most recent radiation therapy techniques.
- demonstrate the practical ability to carry out research and clinical tasks independently on modern radiotherapy units for e.g. IMRT, IGRT and particle therapy.
- develop and improve independent learning, organizational and team-working skills.
- become confident in the use of information communication technology (ICT) and recognize the role technology-enhanced teaching and learning plays in continuing personal professional development.

MODE OF STUDY

MSC PROGRAM STRUCTURE

SEMESTER 1 (Start September Year 1)		ECTS Credits
Welcome Day (1 day – optional)		15
Module M1 Anatomy and Imaging for Radiotherapy	**Module M2** Intensity Modulated Radiotherapy (IMRT)	
	Attendance Phase M1, M2 (4 days)	
SEMESTER 2 (Start March / April Year 2)		
Module M3 Ion Therapy	**Module M4** Image Guided Radiotherapy (IGRT) and Adaptive Radiotherapy (ART)	15
	Attendance Phase M3, M4 (4 days)	
SEMESTER 3 (Start October / November Year 2)		
Module M5 Advanced Dosimetry and Quality Assurance (QA)	**Module MI** 4 Internships	15
Attendance Phase M5 + MI (14-18 days)		
SEMESTER 4 (Start March / April Year 4)		
Module MT Master's Thesis		30
	∑	75
MSc Prerequisites	– Relevant degree of higher or further education institute (Bachelor, Diploma, Master) – Proof of at least one year of professional experience following the first degree and at least two years of professional work experience in medical radiation physics upon application for admission to the Master's Examination – Competency in medical physics subject to scrutiny by submission panel – English language proficiency	45
PG Certs Prerequisites	– Relevant degree of higher or further education institute (Bachelor, Diploma, Master) – English language proficiency	
	∑	**120**

PROGRAM STRUCTURE PG STUDY TRACKS

Postgraduate short study track (30 ECTS)
Two core modules and one custom-picked module make up the Postgraduate short study track. The core modules are mandatory. They are:
– Module M2 Intensity Modulated Radiotherapy
– Module M4 Image Guided Radiotherapy and Adaptive Radiotherapy
The third module is then chosen on an individual basis from the following three modules:
– Module M1 Anatomy and Imaging for Radiotherapy
– Module M3 Ion Therapy
– Module M5 Advanced Dosimetry and Quality Assurance

Regardless of the module combination the Postgraduate short study track can be completed in one year including the attendance phases. The three modules may be taken in any order.

Postgraduate full study track (60 ECTS)
The Postgraduate full study track entails all six taught modules that comprise the MO APMR program prior to the Master's Dissertation.

The Postgraduate full study track can be completed in 1.5 years. The modules M1 – M5 may be taken in any order. Their successful completion is the prerequisite for attending Module MI (internships). Please be advised that taking the modules in a non-consecutive order may result in longer study times.

Note
The workload of the program is defined by the European Credit Transfer and Accumulation System, where 1 ECTS-Credit corresponds to 30 hours of work. This results in a weekly workload of about 15 hours during online phases depending on the individual educational background.

Note
The MO APMR program carries ACQUIN accreditation as do each of the individual modules taken in fulfillment of either of the PG study tracks. Completers of the PG short or full study track are awarded certification over accredited MO APMR modules accordingly. Each module is worth 7.5 ECTS points.

Whether a student opts to study for the PG short, PG full study track or full MSc the two core modules 2 and 4 must be taken. PG full study track completers have the option of continuing their studies to then exit the program with the MSc award.

MODE OF STUDY

ENTRY REQUIREMENTS

MSc study track
APMR is aimed at applicants from higher or further education institutions who have completed a Bachelor's degree in a subject related to physics or physical technology or have a diploma in physics, biomedical technology or equivalent engineering studies.

Furthermore, prospective students will have at least one year of qualified professional experience in the field of medical radiation physics following the first degree and at least two years of professional work experience in medical radiation physics upon application for admission to the Master's Examination. Additionally, prior knowledge in the field of medical physics as stated below in detail is required:

- fundamental knowledge of anatomy and physiology
- knowledge of biometry and statistics
- basic knowledge of the organizational and legal infrastructure of their national health care system
- fundamental knowledge of the methods of medical physics and engineering science (medical technology) and the application of this knowledge in medical procedures used in the treatment and care of patients
- knowledge of physics and engineering for radiotherapy and nuclear medicine
- knowledge of image generation and image processing (X-ray, CT, US, MRI)
- basic knowledge of dosimetry and radiation safety (basic course in radiation safety according to the German guideline on radiation safety in medicine, "Strahlenschutz in der Medizin" which can be found online at ■ www.bmu.de/strahlenschutz/doc/5613.php in the semester for which admission is being sought.

PG short and PG full study tracks
The entry requirements for the PG study tracks are slightly modified compared to the MSc track. In order to qualify the potential candidate must demonstrate the following:

- relevant degree (related to physics or physical technology or biomedical technology or an equivalent course of engineering studies) of higher or further education institute (Master, Bachelor, Diploma)
- proof of English language proficiency at a level comparable to C1 of the Common European Framework of Reference (as demonstrated by school reports, the Cambridge Certificate in Advanced English (CAE) or comparable experience), or school leaving certificate or prior higher education studies in English

"The beauty of the city
and its environs can fairly be
said to verge on the ideal."

Johann Wolfgang von Goethe

STUDENT SUPPORT

APMR program team support at a glance

- Program Information Booklet & website
- institutional virtual learning environment (Moodle) and technological support
- modern internet communication technology (ICT)
- email, phone and telephony contacts
- highly visible tutors online and on-site
- written and/or oral feedback to coursework
- alternative multi-media delivery formats
- administrative, pedagogical, and personal support from the program coordinating team

Heidelberg University offers you

- a 625 year reputation of excellence in teaching and research
- state-of-the-art medical facilities and global interdisciplinary partnerships
- library support and study resources including e-resources in the form of e-books and e-journals
- student registry, admissions and advisory service

Last but not least – you will be residing in the superb city of Heidelberg during the attendance phases.

Advanced Physical Methods in Radiotherapy

Prof. Wolfgang Schlegel, PhD

MR – images of prostate cancer patients

Typical IMRT dose distribution

MODULES OF STUDY

INTRODUCTION

The modules M1 – M5 are divided into a set of 4 – 6 themed sub-modules each with specific learning outcomes. Each sub-module is delivered slightly differently with variable emphasis on independent, self-paced activities and readings and collaborative assignments and scheduled online study sessions (as described earlier). Each sub-module terminates with a compulsory self-test designed to highlight learning deficits in a timely manner in order for student and tutor to address problems as early on in the program as possible. The self-tests are formative and do not contribute to the overall final mark awarded upon successful completion of the program.

APMR modules are inherently interdisciplinary and include topics from medicine and physics. The individuals responsible for the module content and the tutors appointed in each case will be experts in the respective subject areas. This ensures highest quality instruction and study material optimally aligned to the work-based practical training sessions carried out in the module attendance phases and later on in the internships.

ASSESSMENT

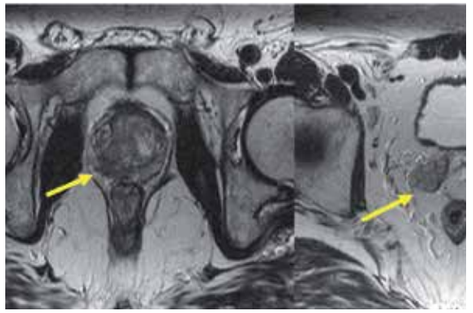
Five cumulative, paper-based written module exams are administered for modules M1 – M5 during their respective attendance phases. For module M3 one written report and for MI four written reports must be completed which together with the five final module exams contribute 60% to the final MSc award and 100% to the PG Certificate for the PG full study track. The Master's Thesis for MSc students is marked for its written content and oral defense and counts 40% toward the final grade.

For PG short study track students, three paper-based written module exams for modules M2, M4 and the third custom-picked module are administered during their attendance phases. The three written module exams contribute 100% to their PG Certificate.

SHORT OVERVIEW

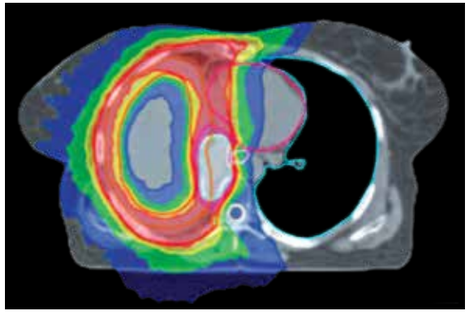
Module M1 Anatomy And Imaging for Radiotherapy
Topics: Introduction, Anatomy for Physicists, Imaging for Radiotherapy, Virtual Anatomy, Diagnostic Radiology, M1 Attendance Phase

We will refresh your anatomical knowledge and you will be exposed to the latest improvements in radiological imaging, including modern X-ray CT, dual energy CT, morphological and functional MRI and MR spectroscopy, as well as in modern techniques in molecular imaging. The knowledge gained will form the basis for the understanding and application of the new treatment techniques.



Module M2 Intensity Modulated Radiotherapy (IMRT)
Topics: Introduction IMRT, IMRT in Clinical Routine, Advanced Application Techniques, M2 Attendance Phase

After an overview of the basic features of IMRT, you will be introduced to the different technical implementations of modern IMRT and to applications in clinical practice. Building upon problem- and work-based scenarios you will have the unique opportunity to gain hands-on experience at our facilities and to discuss your activities on-site with the IMRT innovators.



MODULES OF STUDY

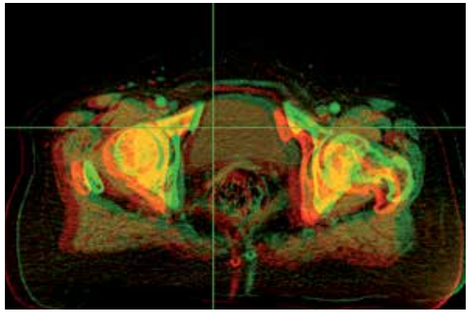
Module M3 Ion Therapy
Topics: Introduction, Physical Principles, Beam Generation and Application, Radiation Biologyl Treatment Planning, Clinical Application of Ion Therapy, M3 Attendance Phase

You will reinforce your knowledge about the basic physical interaction of protons and ions and discover how these can be harnessed to the benefit of the patient. An understanding of these interactions also forms the basis for the biological effects of high LET radiation, which you will study in detail. You will be introduced to vital technical features of accelerators, beam delivery systems and also to treatment planning and the implications for clinical practice

Ion gantry at the HIT facility

Module M4 Image Guided Radiotherapy and Adaptive Radiotherapy
Topics: Introduction, IGRT Techniques (physics), Clinical Application IGRT (medicine), Moving Target Volumes and Adaptive Radiotherapy, M4 Attendance Phase

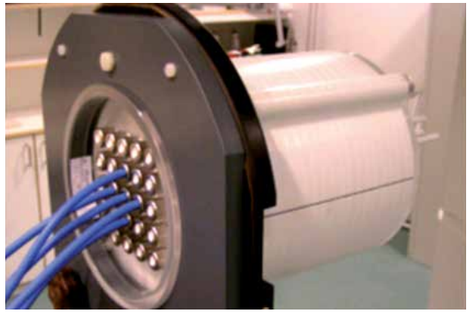
More recently IGRT has become an important new paradigm. You will discover that applications of IGRT are not merely restricted to accurate patient positioning, but include further the resolution of inter- and intrafractional motion in order to arrive at a true 4D dose conformation. The basics of modern biological imaging techniques and their implication for radiotherapy will also be explored.



CT/MRI image registration

Module M5 Advanced Dosimetry And Quality Assurance
Topics: Introduction, Dosimetric Principles, Dosimetry for Advanced Radiotherapy Techniques, Quality Assurance, M5 Attendance Phase

The highly advanced techniques of IMRT, IGRT and ion beam therapy require complex solutions for dosimetry and quality assurance. You will scrutinize relevant guidelines for the design of dedicated QA procedures adapted to the unique requirements of these modern techniques. Dosimetric principles will be studied in-depth and then applied to special dosimetry techniques for small fields, ion dosimetry and dynamic fields. Finally, you will find yourself working side by side with world renowned experts during the practical training sessions at our flagship facilities.



QA phantom

Module MI Internships
Topics: Treatment Planning, IMRT, ART, Ion Therapy, Dosimetry and QA

You will have the exclusive opportunity to visit the DKFZ, recognized as one of the birthplaces of IMRT in the 90'ies. Furthermore, you are given the rare opportunity to train at the world's first scanning beam ion facility, HIT. Here you will engage in discourse with the expert developers whilst experiencing state-of-the-art radiotherapy and its implementation in one of the largest radiotherapy centers in Europe.

Module MT Master's Thesis
During their dissertation students will be supervised by a subject expert member of the program teaching team. Topic to be selected from modules M1 – M5.

MODULES OF STUDY

MODULE 1: ANATOMY AND IMAGING FOR RADIOTHERAPY	
Module leader: Prof. Wolfgang Schlegel, PhD	
M1.1 Online	**Introduction Module 1** ECTS points: 0.5
M1.2 Online	**Anatomy for Physicists and Engineers** ECTS points: 1.5
Course objective: Competence in selected anatomical fields important to radiotherapy.	
M1.3 Online	**Imaging for Radiotherapy** ECTS points: 1
Course objective: Knowledge of the fundamentals of physics and engineering underlying advanced imaging techniques.	
M1.4 Online	**Radiological and Virtual Anatomy** ECTS points: 2
Course objective: Competence in the radiological anatomy of healthy subjects and in normal morphology in imaging (CT, MRI, ultrasound and PET).	
M1.5 Online	**Diagnostic Radiology** ECTS points: 1
Course objective: Knowledge of imaging for the diagnosis and radiotherapy of the most common tumors, specifically for identifying tumor volume, clinical target volume and target volume in planning as well as risk organs. Potential applications of current imaging technology for more accurately determining target volumes and for individualized assessment of organ and tumor motion.	
M1.6 On-site	**Module 1 Attendance Phase** ECTS points: 0.5
Course objective: Mastery of the contents of Module 1, practical experience in the application of imaging techniques in radiotherapy.	
E1 On-site	**Exam Module 1** ECTS points: 1

MODULE 2: INTENSITY MODULATED RADIOTHERAPY	
Module leader: Mark Bangert, PhD	
M2.1 Online	**Introduction Module 2** ECTS points: 0.5
M2.2 Online	**Introduction to IMRT** ECTS points: 1.5
Course objective: Acquiring the fundamentals of physics and methodology for performing IMRT.	
M2.3 Online	**IMRT in Daily Clinical Work** ECTS points: 2
Course objective: Awareness and overview of current research and of the application of IMRT.	
M2.4 Online	**Advanced Application Techniques for IMRT** ECTS points: 2
Course objective: Enhanced knowledge and competence in advanced IMRT applications.	
M2.5 On-site	**Module 2 Attendance Phase** ECTS points: 0,5
Course objective: Verification and expansion of the skills acquired through online learning, strengthening competence in applying IMRT.	
E2 On-site	**Exam Module 2** ECTS points: 1

MODULES OF STUDY

MODULE 3: ION THERAPY	
Module leader: Prof. Christian Karger, PhD	
M3.1 Online	**Introduction Module 3** ECTS points: 0.5
M3.2 Online	**Fundamentals of Physics** ECTS points: 1
Course objective: Understanding of the fundamental interaction mechanisms of the various types of ions and the differences among them for therapy; basic principles of modeling and of describing such interactions for application in therapy planning and dosimetry; appreciation of issues in the area of radiation protection.	
M3.3 Online	**Beam Generation and Application** ECTS points: 1
Course objective: Understanding of the most important parameters in beam generation and application and their influence on the quality of treatment; knowledge of the fundamental concepts of beam application as well as the potential and limitations when used on patients, including modeling these factors in therapy planning.	
M3.4 Online	**Radiobiology** ECTS points: 1
Course objective: More detailed knowledge of the biological effects of ion radiation, specifically of the complex effects of physical and biological parameters on RBE.	
M3.5 Online	**Ion Treatment Planning** ECTS points: 1
Course objective: Robust knowledge of treatment planning, specifically of calculating physical and biologically effective dose distribution and of clinical treatment planning including the uncertainties it entails.	
M3.6 Online	**Clinical Application** ECTS points: 1
Course objective: Fundamental and more detailed knowledge of the clinical use of particle therapy for treating various kinds of tumors. In addition, specialized medical knowledge of several tumors that are frequently treated using particle therapy as well as the specific treatment procedure for these disorders.	
M3.7 On-site	**Module 3 Attendance Phase** ECTS points: 1
Course objective: More detailed knowledge of a specific topic within the module.	
E3 On-site	**Exam Module 3** ECTS points: 1

MODULE 4: IMAGE GUIDED RADIOTHERAPY AND ADAPTIVE RADIOTHERAPY	
Module leader: PD Florian Sterzing, MD	
M4.1 Online	**Introduction Module 4** ECTS points: 0.5
M4.2 Online	**IGRT Techniques (Physics)** ECTS points: 2
Course objective: Knowledge of the fundamentals of physics and techniques for performing IGRT.	
M4.3 Online	**Clinical Applications of IGRT (Medicine)** ECTS points: 1.5
Course objective: Knowledge of the clinical applications, areas of indication and of IGRT protocols.	
M4.4 Online	**Moving Targets and Adaptive Radiotherapy (Medicine/Physics)** ECTS points: 2
Course objective: Knowledge of the methods in physics and medicine for performing 4D therapy.	
M4.5 On-site	**Module 4 Attendance Phase** ECTS points: 0,5
Course objective: Verification and expansion of the skills and competence in IGRT and ART acquired through online learning.	
E2 On-site	**Exam Module 4** ECTS points: 1

MODULES OF STUDY

MODULE 5: ADVANCED DOSIMETRY AND QUALITY ASSURANCE	
Module leader: Steffen Greilich, PhD	
M5.1 Online	**Introduction Module 5** ECTS points: 0.5
M5.2 Online	**Fundamentals of Dosimetry** ECTS points: 2
Course objective: More detailed knowledge of the relevant fundamentals of physics and of the measurement methods, under reference conditions, for determining the water energy dose with high-energy electron and photon radiation as well as with ion radiation. Superior competence in applying national and international dosimetry protocols. Mastery of calculation methods in dosimetry.	
M5.3 Online	**Dosimetry for Current Radiotherapy Techniques** ECTS points: 2
Course objective: More detailed knowledge of measurement methods under non-reference conditions, superior competence in applying measurement methods in dosimetric verification. Mastery of special methods of quality assurance related to accelerators.	
M5.4 Online	**Quality Assurance** ECTS points: 1.5
Course objective: More detailed knowledge of quality management as related to the medical and physical aspects of radiotherapy in general and to current techniques in particular.	
M5.5 On-site	**Module 5 Attendance Phase** ECTS points: 0.5
Course objective: Verification and expansion of the skills and competence in dosimetry and quality assurance acquired through online learning.	
E5 On-site	**Exam Module 5** ECTS points: 1

MODULE I: INTERNSHIPS	
Module leader: Prof. Oliver Jäkel, PhD	
The internships I 1.1, I 1.3 and I 1.5 are compulsory. At least one of the elective internships I 1.2 and I 1.4 must be completed. If students complete more than one elective module, the higher individual grade can be applied in calculating the overall grade for the module.	
1.1 On-site	**Internship in Treatment Planning** ECTS points: 2
Course objective: Guided preparation and practical application of high-quality treatment plans.	
1.2 On-site	**Internship in IMRT** ECTS points: 1.5
Course objective: Guided preparation and practical application of high-quality IMRT plans.	
1.3 On-site	**Internship in Ion Therapy** ECTS points: 2
Course objective: Verification and expansion of the skills acquired through online learning, strengthening competence in applying IMRT.	
1.4 On-site	**Internship in ART** ECTS points: 1.5
Course objective: More detailed and wider knowledge of ART, practical application under guidance.	
1.5 On-site	**Internship in Dosimetry and QA** ECTS points: 2
Course objective: Superior competence in applying dosimetry protocols and in commissioning a treatment planning system.	

MODULE T: MASTER'S THESIS	
MT	**Master's Thesis** ECTS points: 30
Content: Independent guided scientific research on a topic in the area of medical physics.	
Course objective: Extended competence and skill in a selected area of medical physics; independent scientific enquiry under guidance.	

PROGRAM TEAM

Program Leaders

Prof. Jürgen Debus, MD, PhD

Professor for Radiation Oncology at the Medical Faculty Heidelberg, Heidelberg University

Medical Director of the Department of Radiation Oncology and Radiation Therapy, Heidelberg University Hospital and CEO of HIT GmbH, Heidelberg

Prof. Oliver Jäkel, PhD

Professor for Medical Physics at the Medical Faculty Heidelberg, Heidelberg University

Head of the Department Medical Physics in Radiation Oncology, DKFZ, Heidelberg,
Medical Physics Director of HIT GmbH, Heidelberg

Prof. Wolfgang Schlegel, PhD

Professor for Medical Physics at the Medical Faculty Heidelberg, Heidelberg University

Department of Medical Physics in Radiation Oncology, DKFZ, Heidelberg

Module Leaders

Mark Bangert, PhD

German Cancer Research Center (DKFZ), Division Physical Models, Heidelberg, Germany

Prof. Marc Bischof, MD

SLK Clinics of Heilbronn, Radiation Therapy, Heilbronn, Germany

Prof. Stephanie Combs, MD

Heidelberg University Hospital, Radiation Oncology and Radiation Therapy, Heidelberg, Germany

Frederik Giesel, MD, Privatdozent

Heidelberg University Hospital, Nuclear Medicine, Heidelberg, Germany

Steffen Greilich, PhD

German Cancer Research Center (DKFZ), Heavy Ion Therapy Project, Heidelberg, Germany

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German Cancer Research Center (DKFZ), Quantitative Imaging Disease Characterization, Heidelberg, Germany

Florian Sterzing, MD

Heidelberg University Hospital, Radiation Oncology and Radiation Therapy, Heidelberg, Germany

Thomas Welzel, MD

Heidelberg University Hospital, Radiation Oncology and Radiation Therapy, Heidelberg, Germany

Prof. Angelika Zabel-du Bois, MD

Heidelberg University Hospital, Radiation Oncology and Radiation Therapy, Heidelberg, Germany

FEES AND FUNDING

FEES

MSc study track
Fee for regular 4-semester course:
Tuition fee per semester: €2,375
(will be officially released in May/June 2014)
Administration fees and student union fee per semester
(please refer to Heidelberg University website
■ www.uni-heidelberg.de/courses/prospective/fees/index.html as they are subject to changes)

A longer period of study will occur higher costs.

Postgraduate (PG) study tracks
The Postgraduate (PG) study certificates in "Advanced Physical Methods in Radiotherapy" are available in form of either a short PG study track (3 Modules – 30 ECTS "European Credit Transfer and Accumulation System") or a PG full study track (6 Modules – 60 ECTS).

The individual module fee runs at €1,400 which is paid by bank transfer and normally due on a module by module basis always 5 working days prior to the commencement date of each module, respectively, for which the student has enrolled.

PG short
The PG short study track incurs a tot al fee of
(€1,400 x 3) = €4,200

PG full
The PG full study track incurs a total fee of
(€1,400 x 6) = €8,400

Single Modules (M1-M5)
Only on demand, per module: €1,400

FUNDING

Costs for postgraduate studies can be offset against tax as special, professional or recurrent expenses. Please get in contact with your local Inland Revenue office or tax advisor for more information.

German residents can in some cases be supported by the German state through training and qualification cheques (Bildungs- und Qualifizierungschecks). Further details are available here: ■ www.bildungspraemie.info/

Additionally, most of the employers are willing to support 50% to 100% of their employees training fees. However, as we try to find alternative solutions please feel free to contact the APMR program coordinating team or refer to the APMR website.