Nuclear Applications
Master of Science

FH AACHEN
UNIVERSITY OF APPLIED SCIENCES

Contents

Nuclear Applications

All information about the degree programme can also be found on the internet. To this end, use a suitable reader to take a photo of the QR code.
fhac.de/nuclear-applications

Introduction

Nuclear technologies are widely used in many different industries and in research. Some of these applications are well known, for instance:

- nuclear power, where nuclear fission is used to produce energy
- nuclear medicine, where radioactive tracers (radiopharmaceuticals) are used for diagnostics in e.g. oncology, neurology, or cardiology, or where radioactive sources or radiation beams are used for cancer therapy.

Many other applications are not immediately obvious, such as the use of nuclear scattering techniques for the characterisation of surfaces in material science and nanotechnology, or the production of very high quality semiconductor materials. For these and many other fields of technology, an increasing number of specialists with an interdisciplinary background is required.

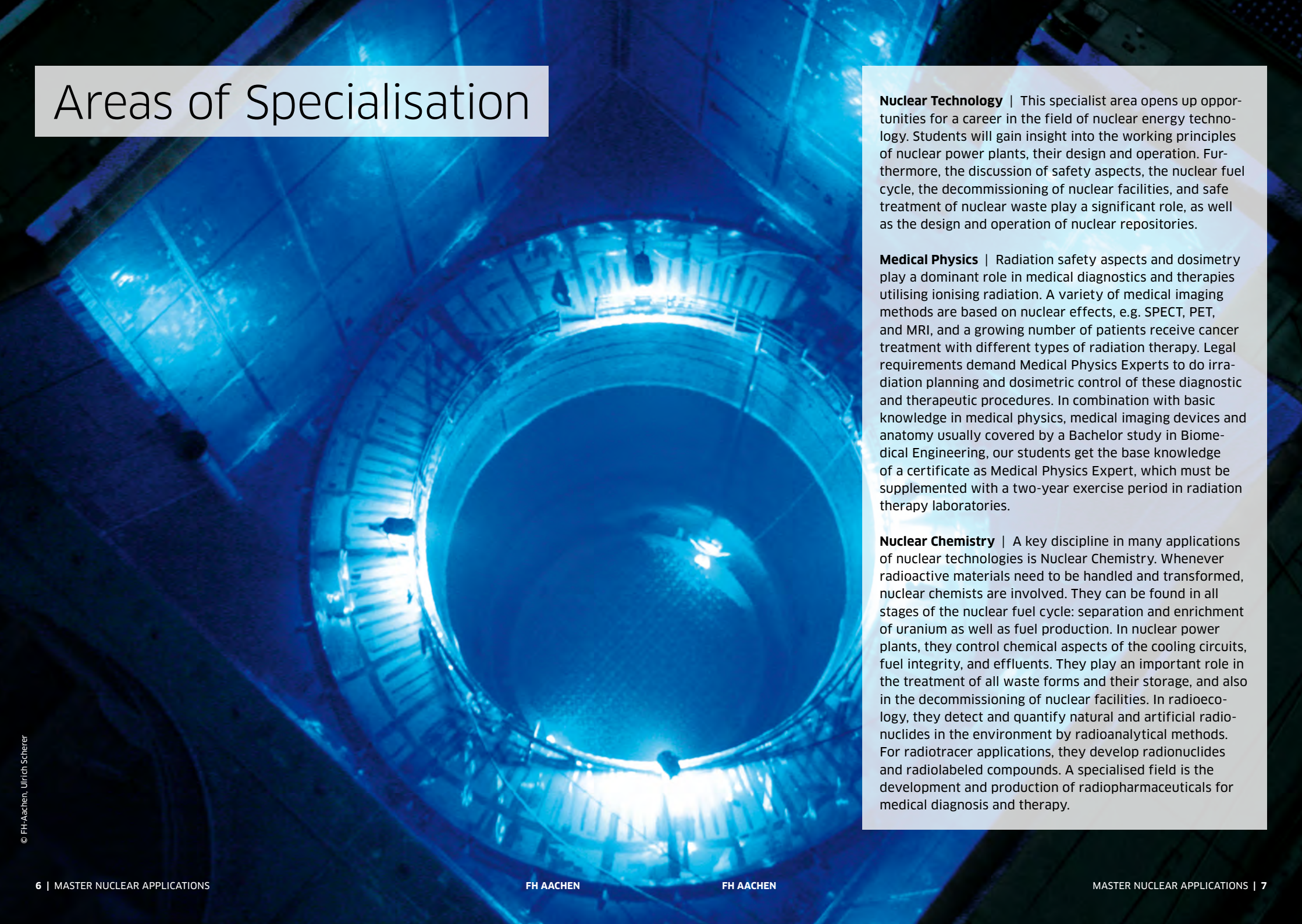
The Master of Nuclear Applications (MNA) aims to provide students from different fields of engineering and science with fundamental and practical knowledge in nuclear science, e.g. radiation safety, radiation detection methods, or radiation biology. In addition to the fundamental knowledge, students can specialise in three different fields:

- Nuclear technologies
- Nuclear chemistry
- Medical physics.

Lectures and practicals are given by experts in the field: professors from three different faculties of the FH Aachen and lecturers from the Research Center Jülich, the university hospital Aachen, the universities in Cologne and Essen, and from industry.

Our students also profit from our networks. On a national level, this is, for example, the Competence Centre Forum Kerntechnik West and the German Competence Alliance in Nuclear Technology. On a European level, we are a founding member of the university network CHERNE, which provides students access to courses and facilities (e.g. research reactors and accelerators) at partner universities.

Areas of Specialisation



Nuclear Technology | This specialist area opens up opportunities for a career in the field of nuclear energy technology. Students will gain insight into the working principles of nuclear power plants, their design and operation. Furthermore, the discussion of safety aspects, the nuclear fuel cycle, the decommissioning of nuclear facilities, and safe treatment of nuclear waste play a significant role, as well as the design and operation of nuclear repositories.

Medical Physics | Radiation safety aspects and dosimetry play a dominant role in medical diagnostics and therapies utilising ionising radiation. A variety of medical imaging methods are based on nuclear effects, e.g. SPECT, PET, and MRI, and a growing number of patients receive cancer treatment with different types of radiation therapy. Legal requirements demand Medical Physics Experts to do irradiation planning and dosimetric control of these diagnostic and therapeutic procedures. In combination with basic knowledge in medical physics, medical imaging devices and anatomy usually covered by a Bachelor study in Biomedical Engineering, our students get the base knowledge of a certificate as Medical Physics Expert, which must be supplemented with a two-year exercise period in radiation therapy laboratories.

Nuclear Chemistry | A key discipline in many applications of nuclear technologies is Nuclear Chemistry. Whenever radioactive materials need to be handled and transformed, nuclear chemists are involved. They can be found in all stages of the nuclear fuel cycle: separation and enrichment of uranium as well as fuel production. In nuclear power plants, they control chemical aspects of the cooling circuits, fuel integrity, and effluents. They play an important role in the treatment of all waste forms and their storage, and also in the decommissioning of nuclear facilities. In radioecology, they detect and quantify natural and artificial radionuclides in the environment by radioanalytical methods. For radiotracer applications, they develop radionuclides and radiolabeled compounds. A specialised field is the development and production of radiopharmaceuticals for medical diagnosis and therapy.

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Partners in Industry, Research and at Universities

Throughout the history of our university, a long-term collaboration with the Research Center Jülich has provided us with access to all facilities on the research site. Many of our students have carried out their projects in leading laboratories. Close partnerships have been developed with leading nuclear industries and power companies including RWE, Siempelkamp Nukleartechnik, GNS, Westinghouse Electric Germany, AREVA, Enrichment Technologies and others.

We are contributors to the German Nuclear Competence Alliance in Nuclear Technology and the local competence platform Forum Kerntechnik West.

In addition to enjoying several bilateral partnerships with universities, we are a foundation member of the Cooperation in Higher Education on Radiological and Nuclear Engineering CHERNE, where our students can participate in a large variety of specialised courses organised by the eighteen partner institutions.

In the well-equipped laboratories on our campus, we do research in the fields of Nuclear Safety, Radiation Detection, Radioecology, Imaging, Waste Management, Radiopharmacy, and Nuclear Chemistry.

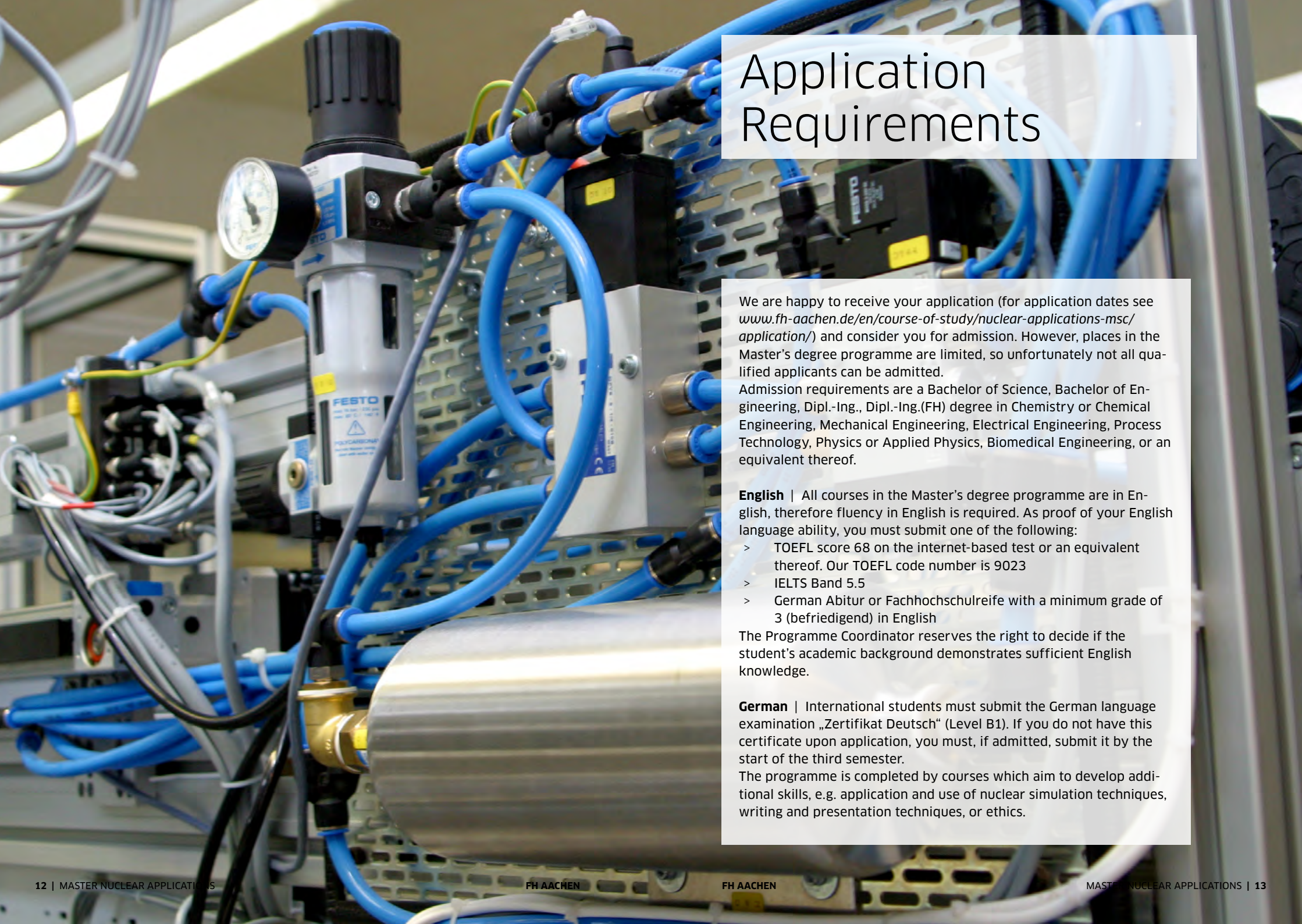
Career Options

The broad scientific and technical training given to our students enables graduates to choose from a wide range of possible career paths, the importance of which will continue to grow in the future. Depending on the specialist area chosen, personal interest, and preferences, they find employment in many different branches of industry and public service.

- Nuclear Power Producers
- Power Plant Development, Design and Construction
- Decommissioning
- Nuclear Waste Management
- National and International Legal Authorities
- Radiation Safety
- Radiopharmacy
- Medical Physics Experts
- Environmental Agencies
- Radioisotope Production
- Detector Industries
- Conventional Industries
- Research Institutions

Above all, career opportunities present themselves wherever technical problems must be solved systematically, using inter-disciplinary skills based on scientific expertise.

About one-third of our graduates have continued their studies in PhD programmes of German and European universities.



Application Requirements

We are happy to receive your application (for application dates see *www.fh-aachen.de/en/course-of-study/nuclear-applications-msc/application/*) and consider you for admission. However, places in the Master's degree programme are limited, so unfortunately not all qualified applicants can be admitted.
Admission requirements are a Bachelor of Science, Bachelor of Engineering, Dipl.-Ing., Dipl.-Ing.(FH) degree in Chemistry or Chemical Engineering, Mechanical Engineering, Electrical Engineering, Process Technology, Physics or Applied Physics, Biomedical Engineering, or an equivalent thereof.

English | All courses in the Master's degree programme are in English, therefore fluency in English is required. As proof of your English language ability, you must submit one of the following:

- TOEFL score 68 on the internet-based test or an equivalent thereof. Our TOEFL code number is 9023
- IELTS Band 5.5
- German Abitur or Fachhochschulreife with a minimum grade of 3 (befriedigend) in English

The Programme Coordinator reserves the right to decide if the student's academic background demonstrates sufficient English knowledge.

German | International students must submit the German language examination „Zertifikat Deutsch" (Level B1). If you do not have this certificate upon application, you must, if admitted, submit it by the start of the third semester.
The programme is completed by courses which aim to develop additional skills, e.g. application and use of nuclear simulation techniques, writing and presentation techniques, or ethics.

Course Description

The first semester concentrates on laying a sound foundation in basic nuclear sciences and the principles of radiation detection. As we accept students from a large variety of disciplines and countries, we offer additional courses to enable students to close gaps in their knowledge in relevant subjects.

During the second and third semester, the fundamental knowledge is deepened, e.g. in in-depth courses of nuclear physics and chemistry or medical applications. In addition to this general knowledge, the students can choose their area of specialisation: Nuclear Power Technology, Medical Physics, and Nuclear Chemistry. In very intensive theoretical and practical classes, given by specialists from industry and research, students study principles and learn to apply them to practical problem-solving.

Finally, students have two extensive study projects, which can be undertaken in our own laboratories or undertaken as an internship in the facilities of our partners in research and industry.

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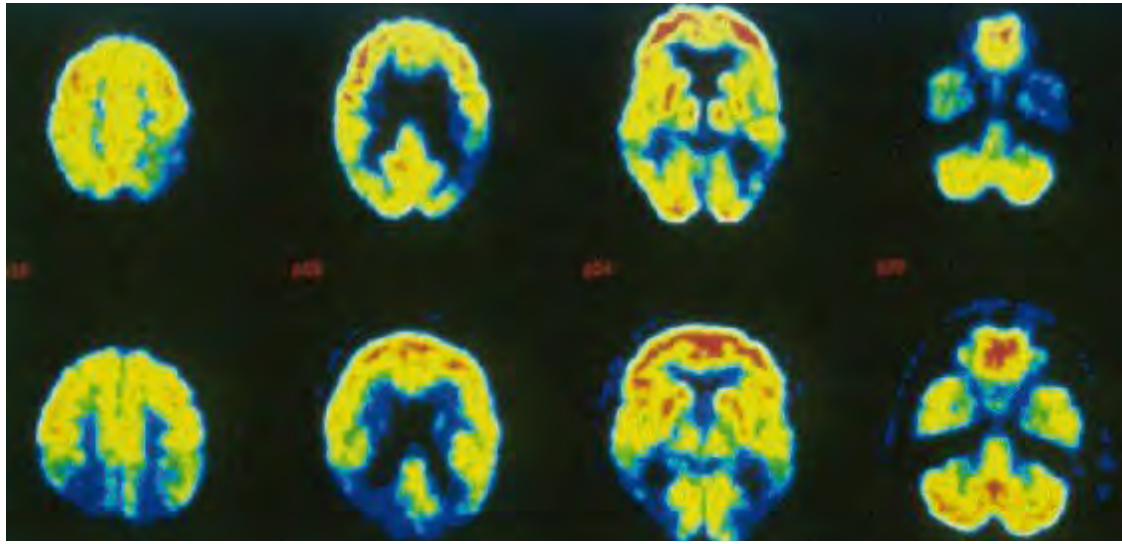
Curriculum

Name of Module	C/E	CR	SWS L	T	Lab	SU	∑
1st Semester (Winter Semester)							
Fundamentals of Nuclear Science	C	5	2	2	0	0	**4**
Detection of Nuclear Radiation	C	5	2	1	1	0	**4**
Fundamental Skills 1	C	5					
Basic Radiation Biology			2	0	0	0	**2**
Radiation Safety			1	0	1	0	**2**
Fundamental Skills 2	C	5					
Research Planning & Scientific Writing			3	0	0	0	**3**
Presentation and Discussion Techniques			0	0	0	2	**2**
Applied Data Analysis	C	5					
Introduction to Data Analysis with Matlab			2	1	0	0	**3**
Introduction to Monte Carlo Methods			1	1	0	0	**2**
Elective (Fundamentals of Chemistry, Cell Biology, Anatomy)	E	5	4	0	0	0	**4**
	Total	30	**17**	**6**	**2**	**0**	**27**
2nd Semester (Summer Semester)							
Nuclear Chemistry	C	5	2	0	2	0	**4**
Nuclear Physics	C	5	2	1	1	0	**4**
Nuclear Applications 1	C	5					
Nuclear Data for Science and Technology			2	0	0	0	**2**
Reactor Physics			2	0	0	0	**2**
Nuclear Applications 2	C	5					
Biomedical Applications			2	0	0	0	**2**
Radioecology			2	0	0	0	**2**
Focus Fields	E	10					
A: Nuclear Technology			depending on lectures and seminars chosen				
B: Medical Physics							
C: Nuclear Chemistry							
	Total	30					

The descriptions of contents of the study modules are available online.

Cr: Credits
L: Lecture
C: Compulsory
T: Tutorial
E: Elective
Lab: Laboratory
SWS: Contact hours per week
SU: Seminar

Name of Module	C/E	CR	SWS L	T	Lab	SU	∑
3rd Semester (Winter Semester)							
Scientific Skills	C	5					
The Ethics of Nuclear Risk Governance	C		0	0	0	2	**2**
Research Seminar	C		0	0	0	2	**2**
Modelling and Simulation	C	5	2	1	1	0	**4**
Project Nuclear Applications (2 Months) In cooperation with Research Partners and Industry	C	10					
Focus Fields		10					
A: Nuclear Technology			depending on lectures and seminars chosen				
B: Medical Physics							
C: Nuclear Chemistry							
	Total	30					
4th Semester (Summer Semester)							
Master's Thesis	C	25					
Colloquium	C	5					
	Total	30					



Skills and Expertise

The Master of Nuclear Applications provides students with a solid scientific basis to their studies, especially in specialist areas, enabling them to employ scientific and engineering methods to analyse technical procedures and develop practical solutions while taking into consideration related areas outside their specific field of study.

During the programme, the students acquire wide-ranging, integrated knowledge and understanding of the scientific and technical fundamentals of nuclear science and technology. They have at their disposal a critical understanding of the basic theories, principles and methods dealt with during their studies, and are in a position to broaden this knowledge independently.

Moreover, students gain the ability to collect and interpret data and to infer scientifically-based judgements from it, as well as to implement appropriate solutions which take into account social, scientific and ethical issues and to construct continuous learning processes independently. They learn how to formulate and defend opinions and solutions with reference to their specific field, to exchange information, ideas, problems and solutions with experts and lay people, and work responsible in a team.

These wide-ranging skills ensure flexibility with regard to career openings and form the ideal basis for the indisputable necessity of lifelong learning skills in modern professional life.

Organisational Matters

Programme Duration, Commencement of Study and Course Structure | Programmes at the FH Aachen are offered in modules and ECTS-credit points are awarded. Including the Master's thesis, the standard length of the programme is two years (four semesters) or 120 ECTS-points. Lectures are held in English.
The Master's degree programme currently starts in both the winter (September) and summer semester (March). The programme starting in March is only open to applicants with previous knowledge in the nuclear field. Applicants from other fields of study should apply for the programme starting in September.

Fees and Cost of the Programme | Every semester, all students must pay a social contribution to the Studierendenwerk (Student Services) and a student contribution to the ASTA (General Student's Committee). These include the semester ticket of the ASEAG (Aachen Public Transport Association). The amount is determined each semester. Current fees are listed at *www.fh-aachen.de/hochschule/studierendensekretariat*

Application | Please apply at our internet portal *https://hi.fh-aachen.de*

Application Documents | All documents must be in English or German or must be accompanied by certified translations into English or German. The following documents must be attached to the application:

- curriculum vitae/resume
- all university transcripts, degrees, and thesis topic
- proof of English language proficiency
- a letter of motivation

Important | Applications will be considered only if all prerequisites are fulfilled and all required documents are submitted.

Application Fee | There is no application fee at this time.

Confirmation of Receipt of Application and Admission | We will send you an email with an application number when we receive your application. You must use your application number in all correspondence with us.

Application Deadline | Check the following website to find out when the application procedure via our online portal starts: *www.fh-aachen.de/en/course-of-study/nuclear-applications-msc/application/.*

Please find more information on our homepage *fhac.de/nuclear-applications.*

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