



Nuclear Applications Master of Science

FACULTY 03
CHEMISTRY AND BIOTECHNOLOGY



**Kontrollbereich
Radioaktiv**

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You will find all relevant information with respect to the course of studies Nuclear Applications in the internet. For that purpose, just photograph the QR code and use the adequate reader of your mobile phone*.



* Please note: Costs may arise upon initiating the web page.

Introducing in the degree programme

The use of nuclear technologies is very widespread in many different industries and in research. Many applications of nuclear technologies are not immediately obvious, such as the use of nuclear scattering techniques for the characterization of surfaces in materials science and nanotechnology or the production of very high quality semiconductor materials.

Best known is the production of nuclear energy which provides many countries with up to one third of their energy needs in a reliable and safe way. Moreover, nuclear power plants do not produce greenhouse gases and therefore can contribute to the goals of the Kyoto protocol. New technologies for improved fuels and even safer power plants are being developed.

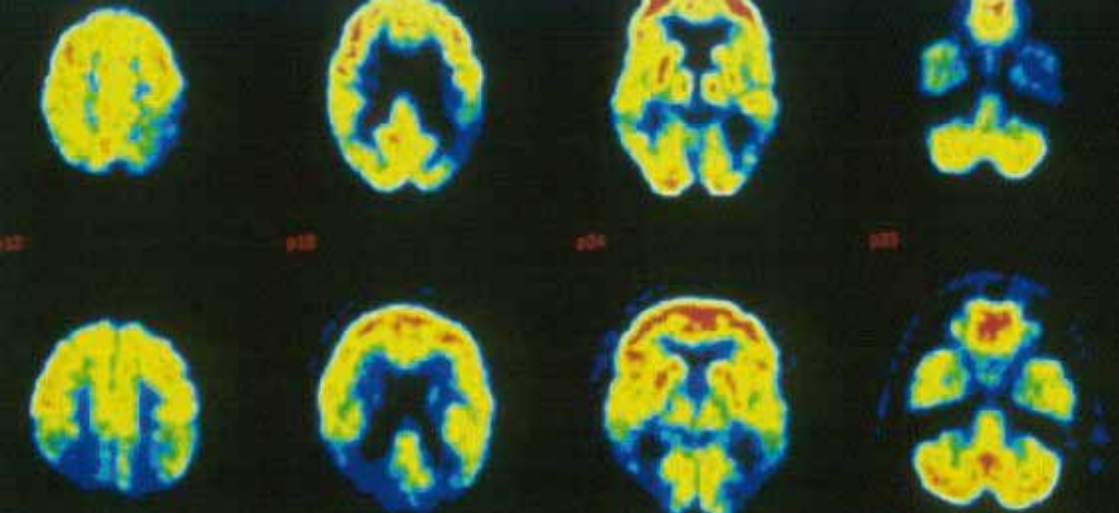
Nuclear energy production is closely connected to the safe handling and storage of nuclear waste. A growing industry is developing systems for the decommissioning and decontamination of

nuclear installations. Impressive technical solutions have been developed and are steadily being improved.

Our present knowledge in life sciences is based to a large extent on the use of radioactive tracers. These tracer methods still play a vital role in the development of new drugs and in the characterization of the toxicological profiles of chemical compounds. A particular application of the tracer technique is the use of radiopharmaceuticals in nuclear medicine to diagnose and treat numerous diseases. Radiation therapies using radioactive sources as well as accelerators are used very successfully for cancer therapies world-wide. Medical Physics Experts are required for planning, quality controls and radiation safety in medical applications of ionizing radiations.

In order to measure the environmental impact of nuclear technologies, radio-analytical techniques are applied.

These include the measurement of



natural and artificial radionuclides at high levels as well as at the ultra-low levels prevailing in most regions worldwide. Radio-analytical chemical separations are frequently required to meet such high demands.

For these and many other fields of technology, an increasing number of specialists with an interdisciplinary background are required. We accept applications from graduates holding a Bachelor's degree in the relevant fields of engineering and science, and aim to provide a challenging program to educate them further.

On a local level, we co-operate in our Competence Centre Forum Kerntechnik West with research and industries. We contribute to the German Competence Alliance in Nuclear Technology. On a European level, we are foundation member of the network CHERNE. Within this cooperation, each of the member universities organizes classes for interested students

who are part of the network in order to expand the topics of studies and gain access to facilities (e.g. research reactors, accelerators etc.).

We focus our energy on practical research projects. Our students perform their two research projects in industry, European research centres or at our own facilities.

We are proud that we have been awarded being one of the best five nuclear study programs (duration over six months) by Nuclear Engineering International in 2013 and 2014.





Nuclear Applications

Career openings

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 and 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
- > Hospitals (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 interdisciplinary skills based on scientific expertise.

Almost half of our graduates have continued their studies in PhD programmes of German and European Universities.

Skills and expertise

The European Master of Science in Nuclear Applications (EMiNA) programme 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 program, 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 responsibility 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.

Areas of specialisation

Nuclear Power Technology | In choosing this specialist area, you will open up opportunities for a career in the field of nuclear energy technology. You will gain insight into the working principles of nuclear power plants, their design and operation. The discussion of safety aspects plays an important role. Included in this area are all the aspects of the nuclear fuel cycle. The issue of decommissioning plays a significant role along with the safe treatment of nuclear waste as well as the design and operation of nuclear repositories.

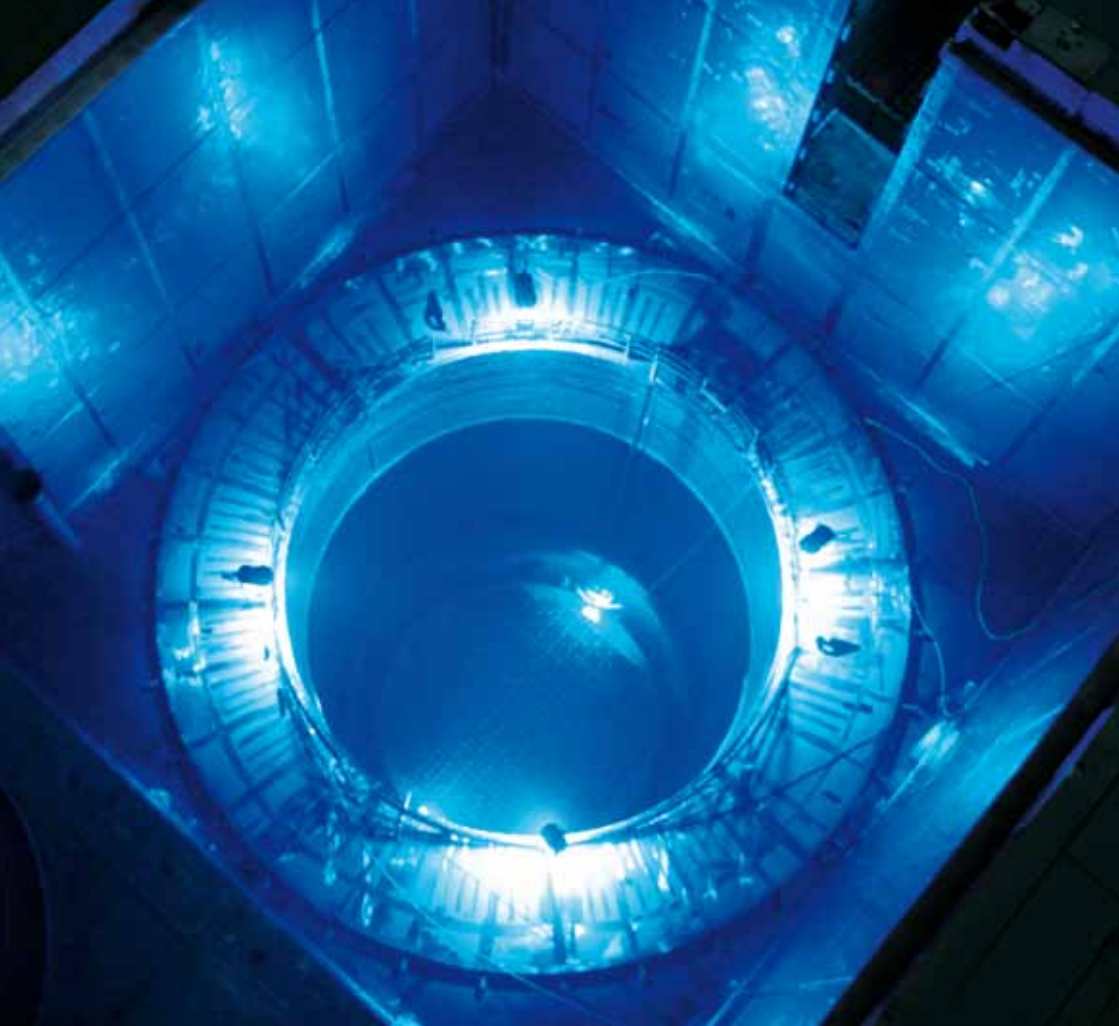
Medical Physics | Radiation Safety aspects and dosimetry play a dominant role in medical diagnostics and therapies utilizing ionizing radiation. A variety of medical imaging methods are based on nuclear effects e.g. SPECT, PET and MRI. A growing number of patients receive e.g. cancer treatment with different types of radiation therapy. Legal requirements demand Medical Physics Experts to do irradiation planning and dosimetric control of these diagnostic and therapeutic procedures. Our program covers most of the requirements of the “Guidelines on Radiation Safety in Medicine”.

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 and fuel integrity and control the 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 radiolabelled compounds. A specialized field is the development and production of radiopharmaceuticals for medical applications as diagnosis and therapy.



Before you start

Application requirements

We are happy to receive your application and consider you for admission. However, spaces in the Master's programs 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 equivalent.

English | All courses in the Master's 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 equivalent.
Our TOEFL code number is 9023
- > IELTS Band 5.5
- > German Abitur or Fachhochschulreife with a minimum mark of 3 (befriedigend) in English

The Program 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 third semester.



The practical
degree programme
Nuclear Applications

Partners in industry, research and 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 performed their projects in leading laboratories.

Close partnerships have been developed with leading nuclear industries and power companies including RWE, Siem-pelkamp 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.

As well as 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 specialized courses organized by the eighteen partner institutions.

In the well-equipped laboratories of our Campus we do research in the fields of Nuclear Safety, Radiation Detection, Radioecology, Imaging, Waste Management, Radiopharmacy and Nuclear Chemistry. These projects are organized within Jülich Institute for Applied Nuclear Technologies

Course description

The first semester concentrates on laying a sound foundation in the 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 following second semester the students are introduced to the areas of specialization: Nuclear Power Technology, Medical Physics, and Nuclear Chemistry. Students work first in a study project, which can be undertaken in our own laboratories or undertaken as an internship in the facilities of our partners.

The third semester is devoted to specialist study in the chosen field. In very intensive theoretical and practical classes, given by specialists from industry and research, the students study principles and learn to apply them to practical problem-solving.

The program is corroborated by additional classes which aim to develop additional skills, e.g. application and use of nuclear simulation techniques or business administration.

Curriculum

No.	Name of module	C/E	Cr	SWS					Σ	
				L	T	Lab	SU			
1st semester										
310040	Fundamental Skills 1	C	5							
	Basic Radiation Biology			2	0	0	0			2
	Introduction to Monte-Carlo Methods			2	0	1	0			3
310210	Nuclear Physics	C	5	2	1	1	0			4
310220	Radiation Detection	C	5	2	1	1	0			4
310050	Nuclear Chemistry 1	C	5	2	0	2	0			4
310060	Nuclear Chemistry 2	C	5	2	2	0	0			4
310070	Business Adminsitration	C	5	2	2	0	0			4
Total			30	14	6	5	0			25
2nd semester										
320050	Nuclear Applications 1	C	5							
	Nuclear Data for Science and Technology			0	0	2	0			2
	Reactor Physics			0	0	2	0			2
320060	Nuclear Applications 2	C	5							
	Biomedical Applications			0	2	0	0			2
	Radioecology			0	2	0	0			2
320070	Fundamental Skills 2	C	5							
	Research Planning & Scientific Writing			3	0	0	0			3
	Presentation and Discussion Techniques			0	0	0	2			2
320220	Elective 1 (Fundamentals of Chemistry, C Cell Biology, Anatomy)	C	5	4	0	0	0			4
320300	Project Nuclear Applications (2 Months)	C	10							
Total			30	15	0	0	2			17

Cr: Credits
L: Lecture

C: Compulsory
T: Tutorial

E: Elective
Lab: Laboratory

SWS: Contact hours per week
SU: Seminar

No.	Name of module	C/E	Cr	SWS					Σ
				L	T	Lab	SU		
3rd semester									
330050	Scientific Skills	C	5						
	The Ethics of Nuclear Risk Governance			0	0	0	2		2
	Research Seminar			0	0	0	2		2
330060	Modeling and Simulation	C	5	2	1	1	0		4
330070	Focus Fields	C	20						
	A: 330210 Nuclear Technology			-	-	-	-		-
	B: 330220 Medical Physics			-	-	-	-		-
	C: 330230 Nuclear Chemistry			-	-	-	-		-
Total			30	2	1	1	4		8
4th semester									
	Paper	C	25	-	-	-	-		-
	Defence of Thesis	C	5	-	-	-	-		-
Total			30	-	-	-	-		-

Cr: Credits
L: Lecture

C: Compulsory
T: Tutorial

E: Elective
Lab: Laboratory

SWS: Contact hours per week
SU: Seminar



General Information

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 program currently starts in both the winter (September) and summer semester (March). **The program 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 program starting in September.**

Fees and the cost of the programme

Every semester all students must pay a social contribution to the Studentenwerk (Student Services) and a student contribution, to the work of 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.studierendensekretariat.fh-aachen.de

Application | Please apply on our internet portal <https://movein-fh-aachen.moveonnet.eu/movein/portal/studyportal.php>

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 and degrees
- > proof of English language requirement
- > 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 | 15 June for the program starting the following September. 15 November for the program starting the following March. For EU applicants: 15 June and 15 January.

You find more information on our homepage <http://www.fh-aachen.de/en/programmes/nuclear-applications-msc/>

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