

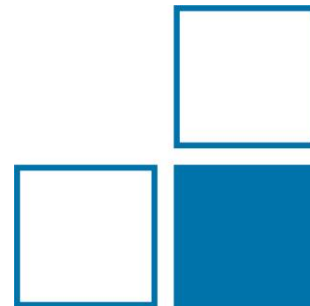


Physikalisch-Technische Bundesanstalt
Braunschweig and Berlin
National Metrology Institute

PTB and German Public Service

Andreas Schüller

Department 6.2 “Dosimetry for Radiation Therapy and Diagnostic Radiology”

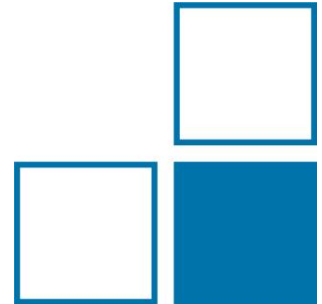


OMA Careers Workshop 2.-3.9.19, Seville

PTB and German Public Service

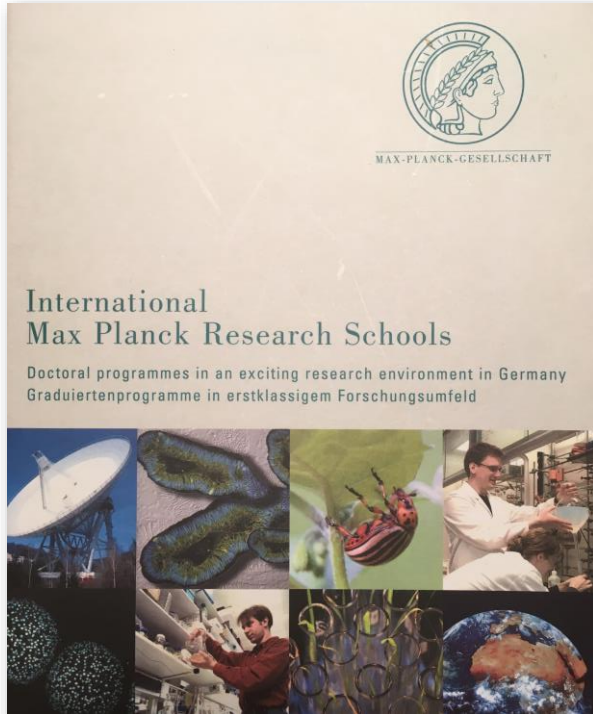
Contents:

1. Own career pathway to PTB
2. Introduction of PTB
3. Work areas related to medical accelerators
4. Other National Metrology Institutes worldwide
5. My job description
6. Typical career pathway within PTB



own career pathway

Early Stage Researcher / PhD in a research training group



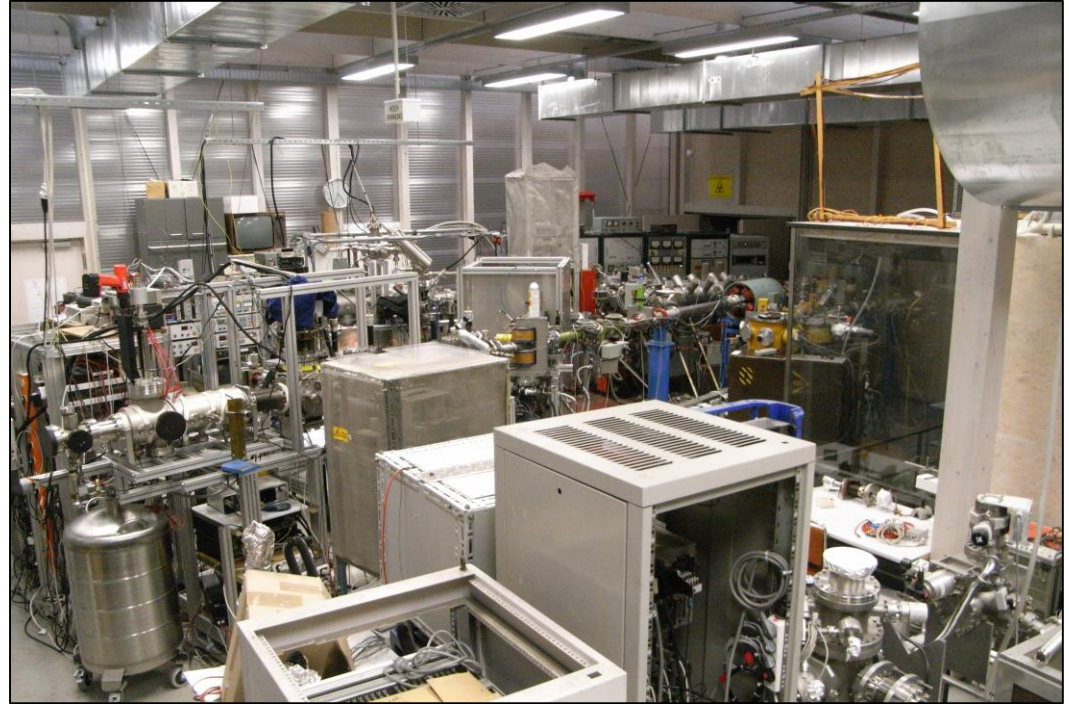
IMPRS-CS Workshop, 5 – 9.2.2007, Ringberg Castle

own career pathway

postdoc position

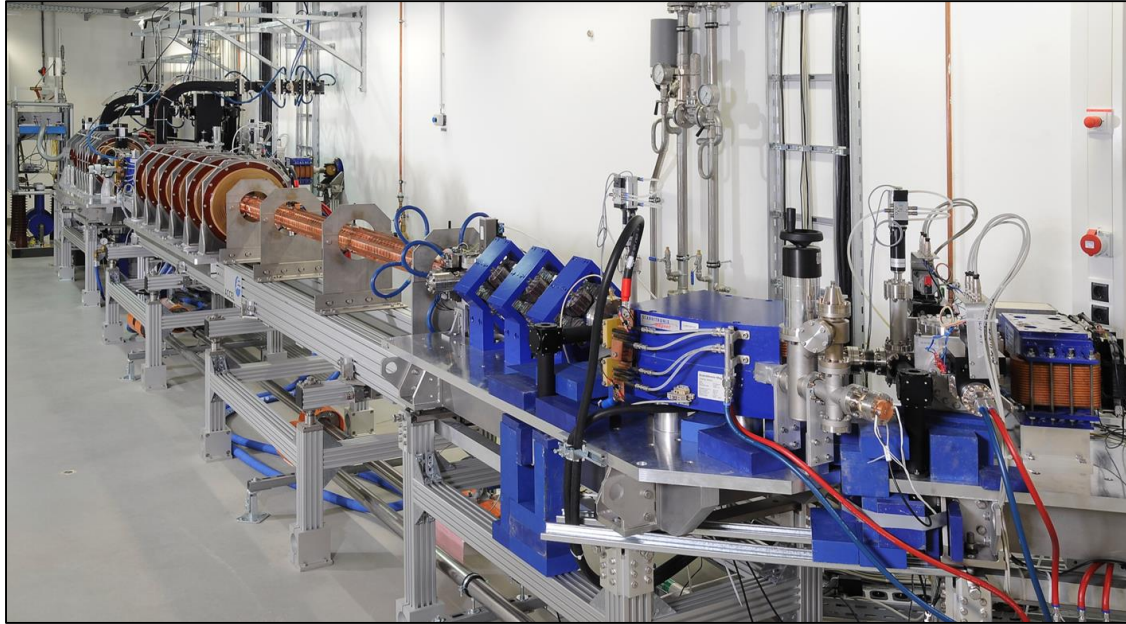


Ion accelerator
Humboldt-Universität zu Berlin
2010



own career pathway

postdoc position → permanent position



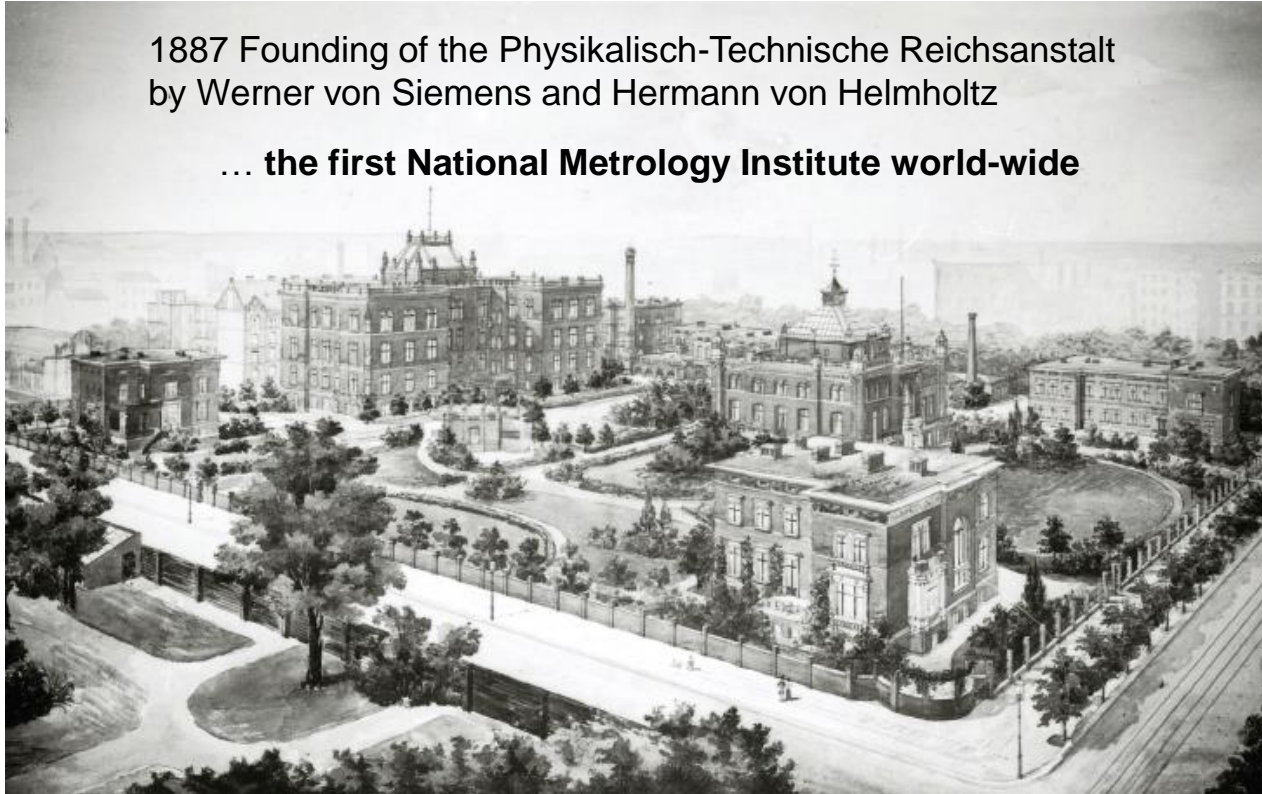
PTB research LINAC, 2011



medical LINAC

1887 Founding of the Physikalisch-Technische Reichsanstalt
by Werner von Siemens and Hermann von Helmholtz

... the first **National Metrology Institute** world-wide



... as state-financed,
university-external, major
research institution
which combines free
fundamental research
with services for industry

Selected scientific highlights

- Planck's Law → Nobel Prize for Willy Wien in 1911
- Counters for α and β particles by Hans Geiger
- First measurement of the Quantum Hall resistance together with Klaus von Klitzing



Employees: ~2000

Budget: ~200 Mio. €/a

R&D: ~60 %

Central mission:

Provision of an innovative, **reliable measurement** infrastructure

- associated services
 - research and development on highest level
 - internationally recognized and harmonized
- for the benefit of the *economy*
 - for the (protection-) benefit of *society*
 - to support *policy*
 - to support internationally leading *science*

Primary standard of the unit “Gray” for **absorbed dose to water**

$$D_w = d\varepsilon/dm$$

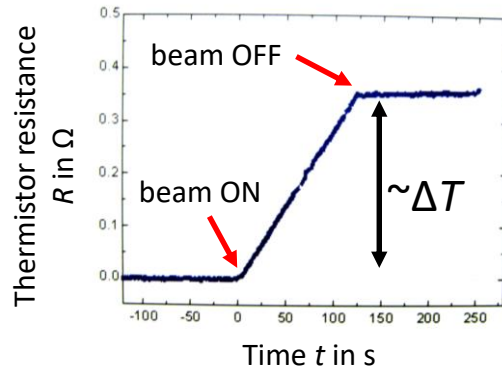
ε : energy deposit in medium, m : mass of medium

$$1 \text{ Gy} = 1 \text{ J/Kg}$$

$$D_w = c_p \cdot \Delta T \cdot \Pi k_i$$

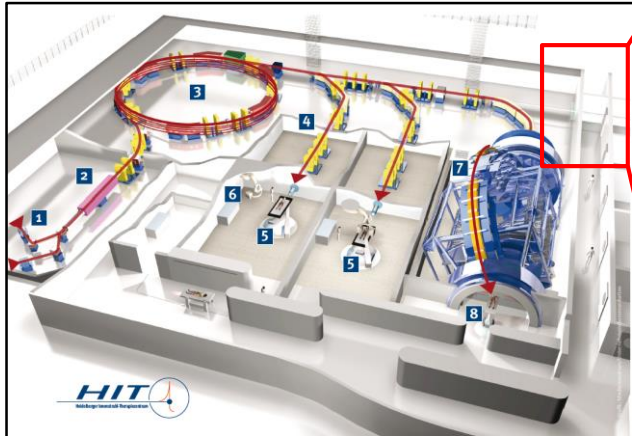
c_p : Heat capacity of water, ΔT : Radiation-induced temperature rise
 Πk_i : corrections for perturbations (heat transport, etc.)

$$\Delta T = 0.24 \text{ mK/Gy}$$



Water calorimeter in front of a medical accelerator

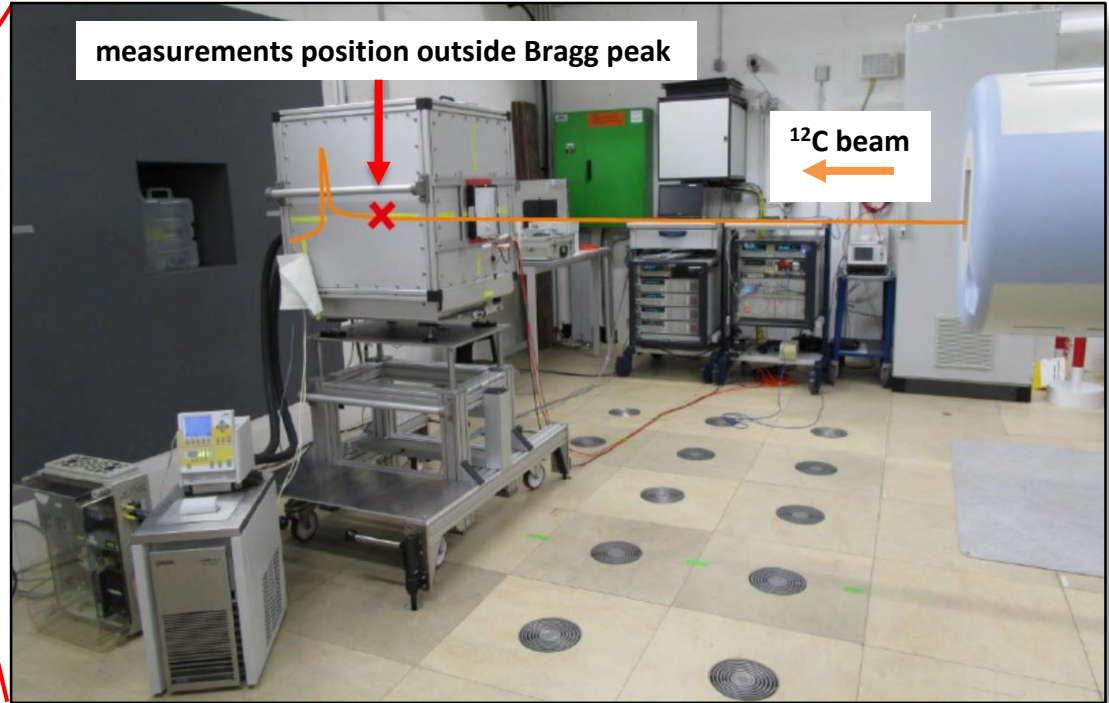
Dosimetry of hadron beams



Heidelberg Ion-Beam Therapy Center

Result: reduction of uncertainty
by factor 3

Phys.Med.Biol.62 (2017) 2033

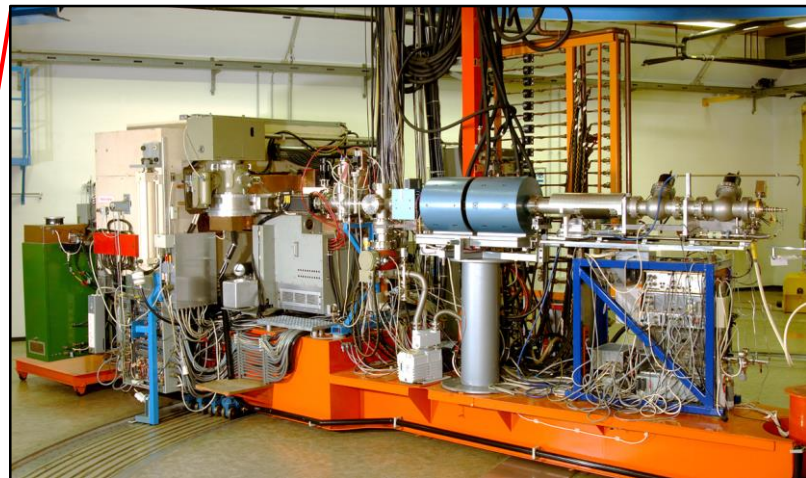
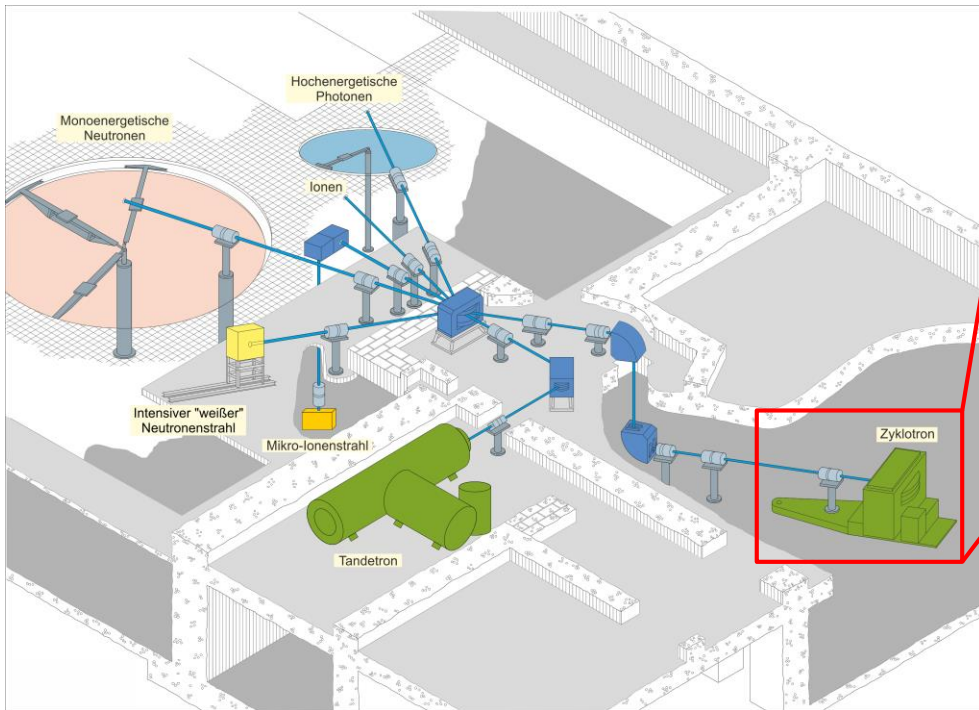


Water calorimetry in a 430 MeV/u ¹²C beam

Spectrometry of secondary neutron fields in particle therapy facilities

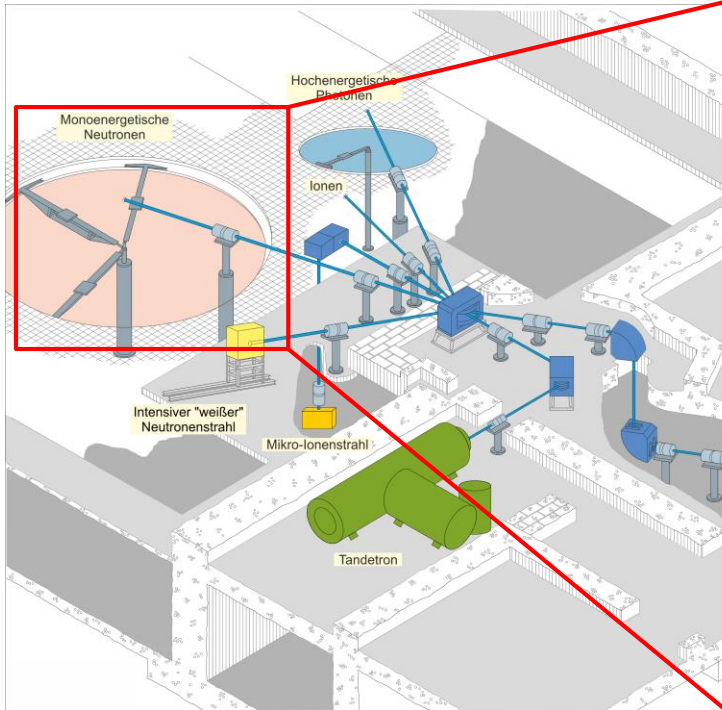


PTB's NEMUS at PTC OncoRay, Dresden



Cyclotron

| Ion | Cyclotron | Tandetron |
|---------------|------------------|-----------------|
| p | 4 MeV – 19 MeV | 0,2 MeV – 4 MeV |
| d | 4 MeV – 13,5 MeV | 0,2 MeV – 4 MeV |
| ^4He | 8 MeV – 26 MeV | 0,4 MeV – 6 MeV |



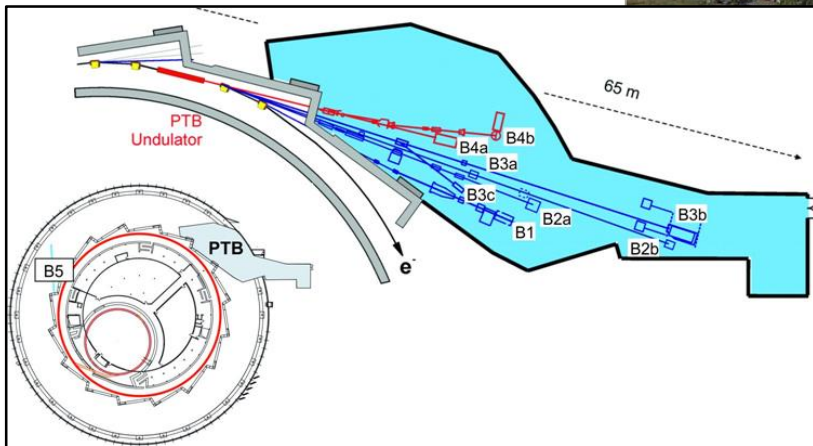
Experimental hall for proton beam and mono-energetic neutrons



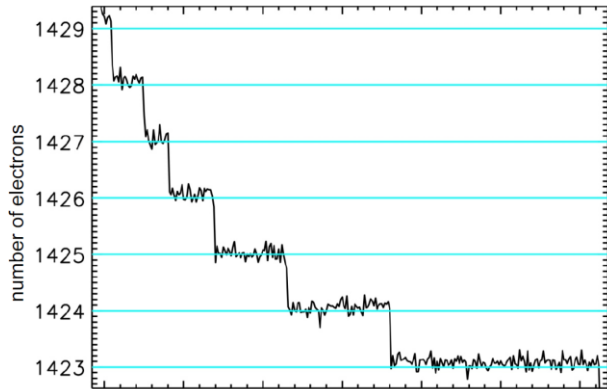
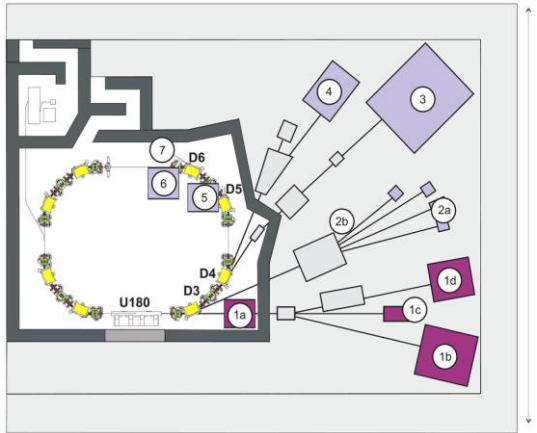
PTB laboratory for X-ray radiometry at BESSY II

Metrology Light Source of PTB for UV und VUV radiometry

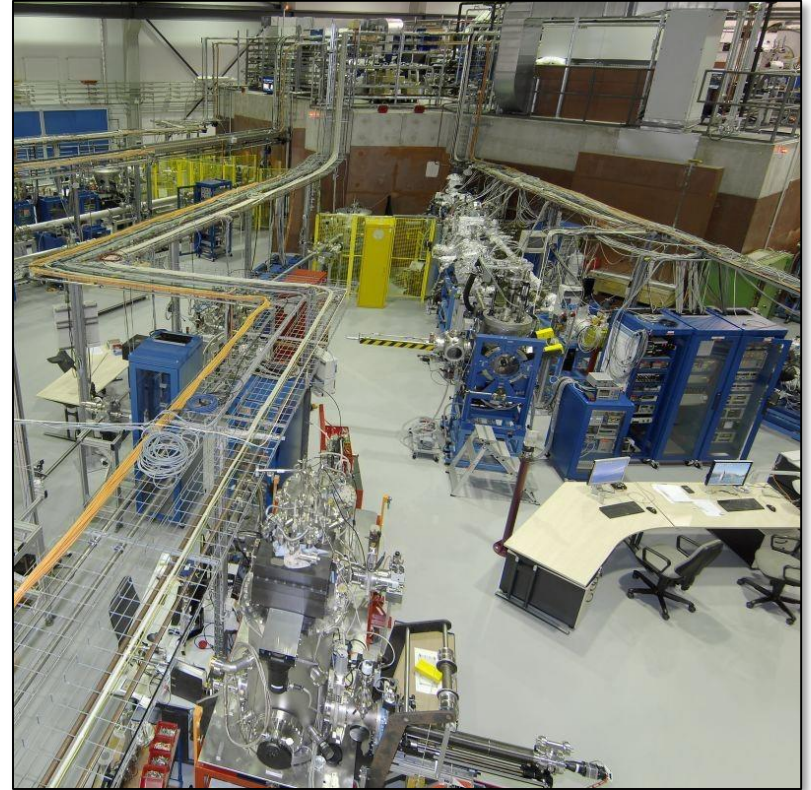
PTB staff in Berlin-Adlershof: 60



PTB's undulator beam lines



Roman Klein et al.



PTB's Metrology Light Source



PTB's CT for

- Verification of CT-dosimetry concepts
- Investigation of new detectors for dosimetry
- type approval of dosimeters for diagnosis



PTB's MRT for research in medical imaging
-> PTB division 8: "Medical Physics"

Metrology Institutes worldwide – potential employers



<https://www.bipm.org/en/worldwide-metrology/regional/>

Metrology Institutes worldwide – potential employers

NIST Search NIST Q NIST MENU

INTERNATIONAL AND ACADEMIC AFFAIRS OFFICE

Office of International Affairs +
Academic Affairs Office +
IAAO Staff Directory

National Metrology Laboratories

f in t

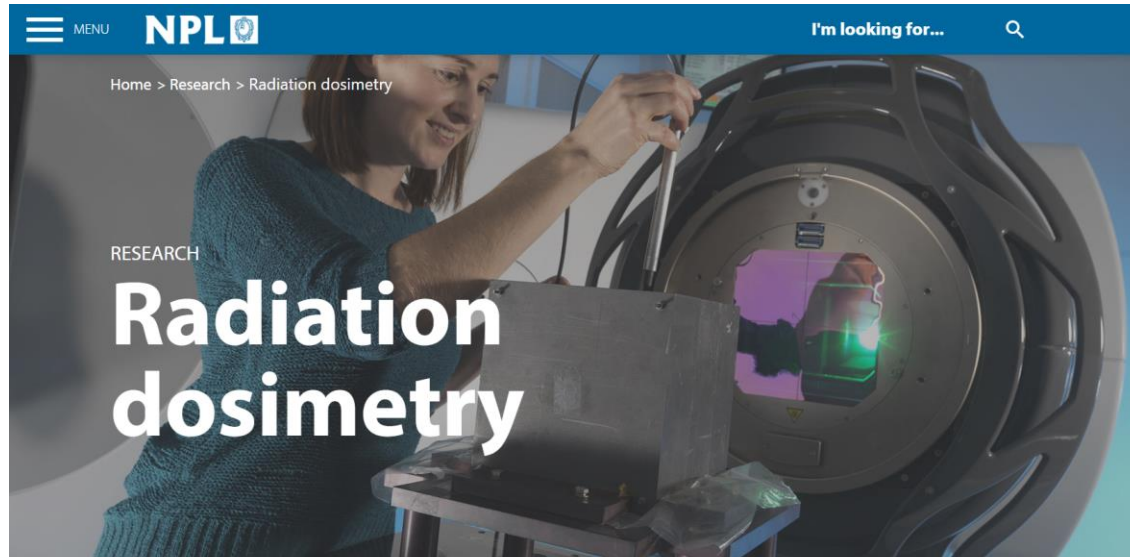
National Metrology Laboratories
[A - F] | [G - M] | [N - S] | [T - Z]

[International Metrology Laboratories](#)

| | |
|--|--|
| Albania National Directorate of Metrology and Calibration (NDMC) Street "Sami Frasheri", Nr. 33 AL - Tirana Phone: (355) 42 331 74 Fax: (355) 42 334 62 E-mail: dkmk@sanx.net dkmk@san.com.al | Chile Instituto Nacional de Normalización (INN) @ Matias Cousiño #64, piso 6 Santiago Phone: (56 2) 445 8800 Fax: (56 2) 441 0427 E-mail: inn@inn.cl |
| Antigua and Barbuda Antigua and Barbuda Bureau of Standards @ P.O. Box 1950 Redcliffe St. & Corn Alley St. Johns Phone: (268) 562 4011 Fax: (268) 462 1625 E-mail: abbs@antigua.gov.ag | China National Institute of Metrology @ No. 18 Bei San Huan Dong Lu Beijing 100013 Phone: (86 1) 6421 8565 Fax: (86 1) 6421 8703 E-mail: ws@nim.ac.cn |
| Argentina | Colombia Superintendencia de Industria y Comercio SIC @ |

<https://www.nist.gov/iaao/national-metrology-laboratories>

Metrology Institutes worldwide – potential employers





Measuring and assessing doses of radiation

Radiation dosimetry refers to the measurement, calculation and assessment of the ionising radiation dose absorbed by the human body. Accurate dosimetry in radiotherapy is essential to eradicate a cancer, whilst minimising the risk of severe side effects due to the unavoidable irradiation of healthy tissues and organs.

In industrial irradiators for sterilisation of medical equipment and pharmaceuticals, the need for accurate dosimetry is governed by two opposing requirements: achieving legal tolerance levels for microbiological

Metrology Institutes worldwide – potential employers

NIST Search NIST   **NIST MENU**

Physical Measurement Laboratory / Radiation Physics Division

DOSIMETRY GROUP

The Dosimetry Group advances the measurement of quantities important in the radiological sciences through programs in the dosimetry of x-rays, gamma-rays, electrons, and other charged particles.

Laboratory Homepage

Division Homepage

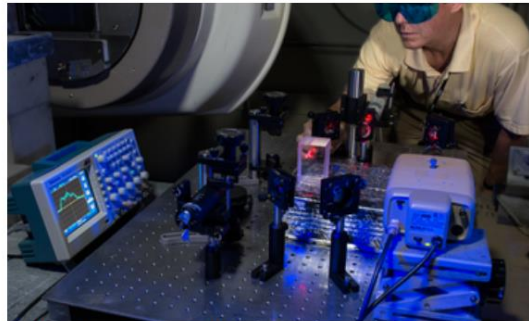
Calibrations

Council on Ionizing
Radiation
Measurements and
Standards

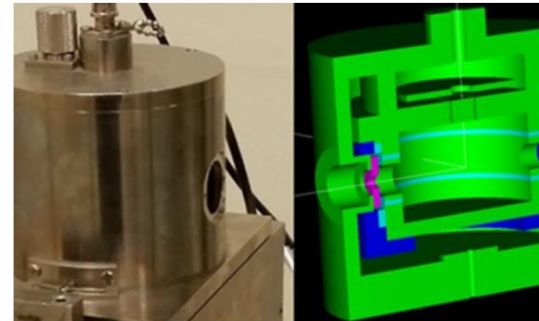
Groups

Dosimetry

Neutron Physics



Calibrating Cancer Radiotherapy Beams Using Light and Sound



Computing for Better Radiation Therapy

Metrology Institutes worldwide – potential employers

Ionizing radiation standards calibration services

From: [National Research Council Canada](#)

Facilities

NRC is equipped with low and medium energy X-ray generators, a therapy level irradiator for ^{60}Co gamma radiation, two industrial/radiation protection level irradiators providing a range of source strengths for ^{60}Co or ^{137}Cs gamma radiation, an Elekta microSelectron brachytherapy afterloader with a high dose rate (HDR) ^{192}Ir source, a Hopewell free air chamber for low dose rate (LDR) brachytherapy, a wide variety of low activity radioactive sources, calibrated neutron Am-Be sources, a neutron generator, two β -ray irradiators, two Elekta clinical linear accelerators, a 35 MeV electron linear accelerator, and a collection of calibrated standard capacitors connected to a calibrated voltage source for therapy class electrometer charge calibrations.

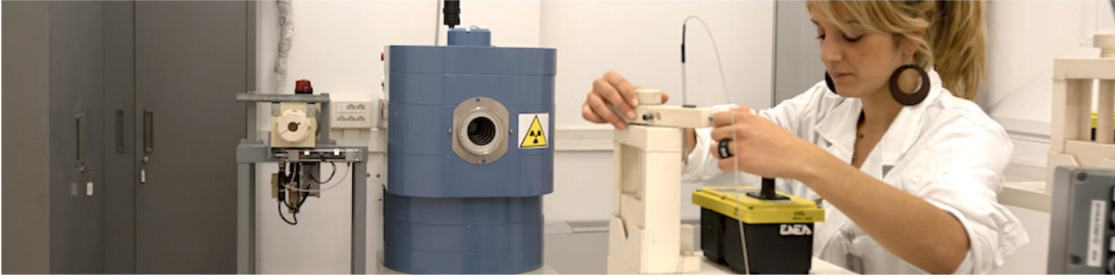


Metrology Institutes worldwide – potential employers

SITE MAP ACCESSIBILITY CONTACT

ENEA
Agenzia nazionale per le tecnologie, l'energia
e lo sviluppo economico sostenibile
Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti

Home | The Institute | Scientific Research | Calibration services | Metrology



You are here: [Home](#) / Calibration services

- Users
- Measurement Assemblies

Calibration services

Calibrations offered at ENEA-INMRI

Calibration services and evaluation of measurement systems are carried out for the Italian Public Administrations, and for other users, to ensure services, at the National level, that can be provided uniquely by INRIM or, within the limits of selected type of services, via Certified Calibration Laboratories.

Calibration of measurements instruments for quantities related to ionizing radiation is internationally certified, via a Mutual Recognition Agreement, and is offered by ENEA-INMRI on

Metrology Institutes worldwide – potential employers

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 Australian Government
Australian Radiation Protection
and Nuclear Safety Agency

 arpansa

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[Home](#) > [Our services](#) > [Testing and calibration](#) > Australian Clinical Dosimetry Service

In this section

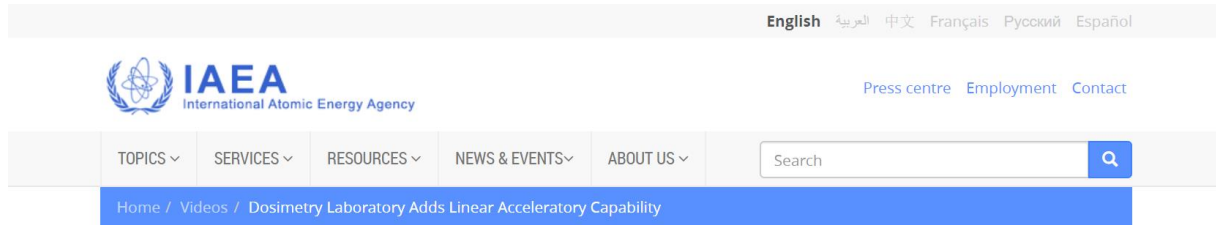
Australian Clinical Dosimetry Service

[Buyer's guide for sun protection](#)

dosimetry equipment.



Metrology Institutes worldwide – potential employers



Dosimetry Laboratory Adds Linear Acceleratory Capability



My job description

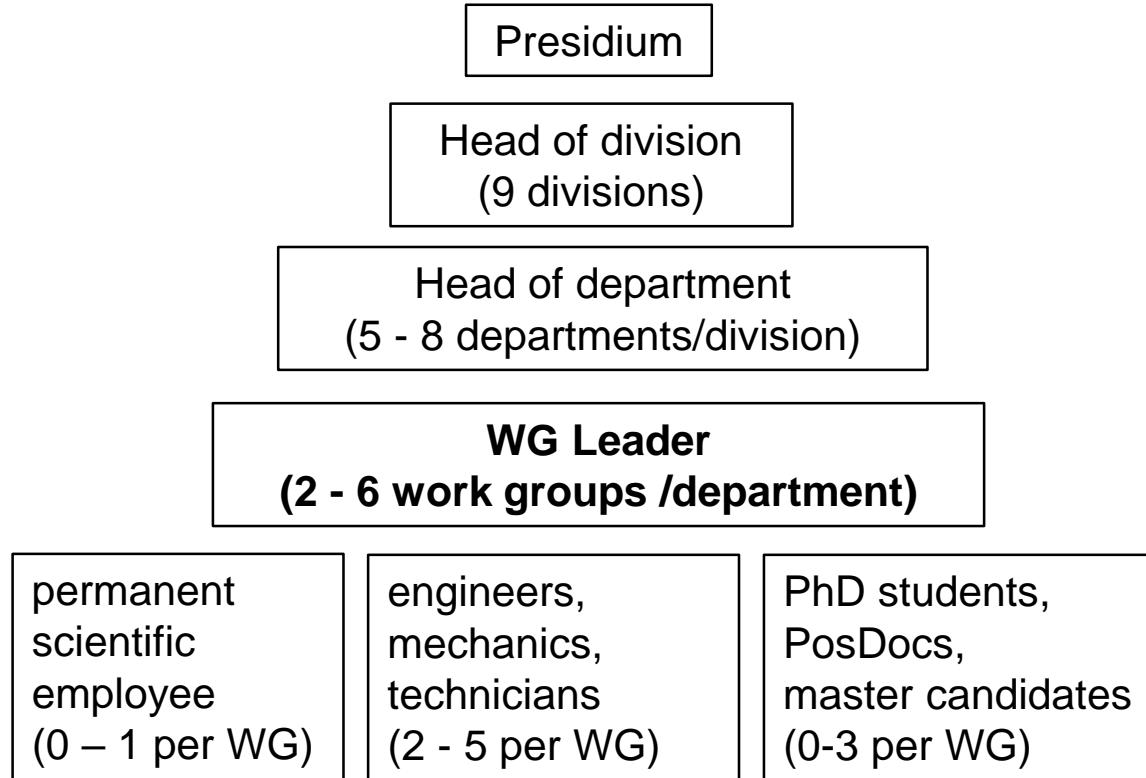
- Provision of metrological services in the field of dosimetry for the external radiotherapy and in accordance with the Medical Devices Act
- Testing, improvement and development of dosimeters and dosimetry measurement methods
- Optimization and further development of the electron accelerators at PTB for R&D of dosimetric questions
- R&D in the field of dosimetry for modern methods of radiation therapy, as e.g. FLASH radio therapy
- Processing of research projects and acquisition of third-party funding for projects in the dosimetry for modern radiation therapy
- Establishment of national and international cooperations
- Supervision of external scientists at the electron accelerators
- Presentation of the results at national and international conferences, and Project meetings as well as preparation of publications for peer-reviewed journals

My job description

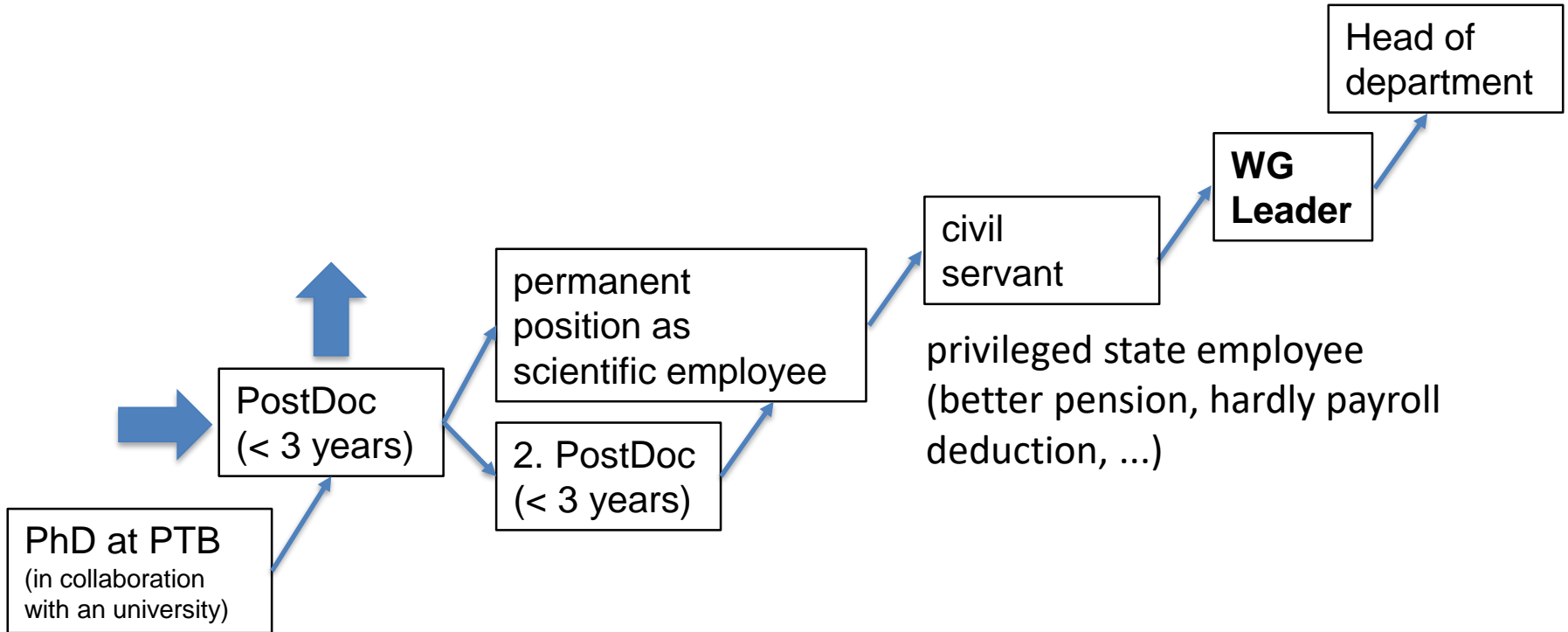
- Provision of metrological services in the field of dosimetry for the external radiotherapy and in accordance with the Medical Devices Act
- Testing, improvement and development of
- Optimization and further development of the dosimetric questions
- R&D in the field of dosimetry for modern radiotherapy
- Processing of research projects and acquisition of dosimetry for modern radiation therapy
- Establishment of national and international
- Supervision of external scientists at the ele
- Presentation of the results at national and international conferences as well as preparation of publications for peer-reviewed journals



Hierarchy structure at PTB



Typical career pathway in PTB as scientist



Salary

Tabelle TVöD Bund
gültig vom 1. März 2018 bis 31. März 2019
 (monatlich in Euro)

| Entgelt- gruppe | Grundentgelt | | Entwicklungsstufen | | | |
|--------------------|--------------|----------|--------------------|----------|----------|----------|
| | Stufe 1 | Stufe 2 | Stufe 3 | Stufe 4 | Stufe 5 | Stufe 6 |
| 15 | 4.584,49 | 5.000,77 | 5.260,14 | 5.840,78 | 6.339,54 | 6.667,67 |
| 14 | 4.151,65 | 4.528,23 | 4.841,03 | 5.245,42 | 5.788,30 | 6.119,17 |
| 13 | 3.827,03 | 4.196,02 | 4.479,41 | 4.893,73 | 5.433,88 | 5.683,28 |
| 12 | 3.430,90 | 3.796,05 | 4.276,90 | 4.741,63 | 5.315,77 | 5.578,27 |
| 11 | 3.312,60 | 3.656,01 | 3.941,33 | 4.311,77 | 4.836,69 | 5.099,20 |
| 10 | 3.194,27 | 3.497,22 | 3.775,33 | 4.064,56 | 4.501,99 | 4.620,12 |
| 9c | 2.831,63 | 3.205,55 | 3.416,48 | 3.784,40 | 4.115,44 | 4.309,52 |
| 9a | 2.831,63 | 3.095,75 | 3.297,39 | 3.655,23 | 3.976,99 | 4.239,47 |

Salary

Bundesbesoldungsordnung A

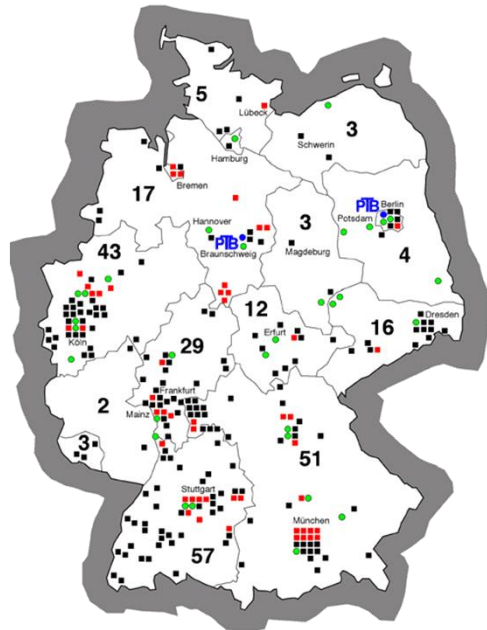
Grundgehalt (Monatsbeträge in Euro)

Gültig ab 1. April 2019

| BesGr. | Stufe 1 | Stufe 2 | Stufe 3 | Stufe 4 | Stufe 5 | Stufe 6 | Stufe 7 | Stufe 8 |
|--------|----------|----------|----------|----------|----------|----------|----------|----------|
| A 2 | 2.193,09 | 2.241,94 | 2.292,11 | 2.329,71 | 2.368,58 | 2.407,44 | 2.446,28 | 2.485,15 |
| A 3 | 2.277,07 | 2.328,45 | 2.379,84 | 2.421,22 | 2.462,58 | 2.503,94 | 2.545,32 | 2.586,68 |
| A 4 | 2.324,72 | 2.386,12 | 2.447,54 | 2.496,43 | 2.545,32 | 2.594,21 | 2.643,08 | 2.688,23 |
| A 5 | 2.342,24 | 2.418,70 | 2.480,11 | 2.540,31 | 2.600,49 | 2.661,92 | 2.722,07 | 2.780,99 |
| A 6 | 2.392,38 | 2.481,41 | 2.571,63 | 2.640,58 | 2.712,04 | 2.780,99 | 2.857,45 | 2.923,89 |
| A 7 | 2.511,48 | 2.590,46 | 2.694,53 | 2.801,04 | 2.905,09 | 3.010,39 | 3.089,37 | 3.168,34 |
| A 8 | 2.656,89 | 2.752,17 | 2.886,28 | 3.021,69 | 3.157,05 | 3.251,07 | 3.346,34 | 3.440,36 |
| A 9 | 2.867,47 | 2.961,50 | 3.109,43 | 3.259,85 | 3.407,74 | 3.508,29 | 3.612,89 | 3.714,89 |
| A 10 | 3.069,30 | 3.198,41 | 3.385,21 | 3.572,83 | 3.763,94 | 3.896,95 | 4.029,92 | 4.162,96 |
| A 11 | 3.508,29 | 3.705,84 | 3.902,11 | 4.099,66 | 4.235,24 | 4.370,82 | 4.506,40 | 4.642,01 |
| A 12 | 3.761,38 | 3.995,09 | 4.230,09 | 4.463,79 | 4.626,49 | 4.786,59 | 4.948,00 | 5.112,00 |
| A 13 | 4.410,86 | 4.630,37 | 4.848,57 | 5.068,09 | 5.219,17 | 5.371,54 | 5.522,59 | 5.671,08 |
| A 14 | 4.536,10 | 4.818,87 | 5.102,96 | 5.385,72 | 5.580,68 | 5.776,98 | 5.971,94 | 6.168,23 |
| A 15 | 5.544,54 | 5.800,22 | 5.995,18 | 6.190,17 | 6.385,16 | 6.578,83 | 6.772,52 | 6.964,89 |
| A 16 | 6.116,56 | 6.413,57 | 6.638,22 | 6.862,90 | 7.086,29 | 7.312,27 | 7.536,93 | 7.759,03 |

PTB as starting point for career in public service

Calibrations for industry:
Accredited Calibration Laboratories



Verification:
Federal Verification Authorities



https://www.eichamt.de/extranet/?rq_Layout=Eichamt.de#{1}



Home > About Us & Careers > Careers > Vacancies > Vacancy

Careers

- Vacancies
- Statement on Data Protection
- Charta der Vielfalt
- Berufsausbildung
- What PTB offers students
- What PTB offers doctoral candidates
- What PTB offers school children
- Family and work
- Betriebliches Gesundheitsmanagement
- About Us
- PTB Institutional Documents

Vacancy

Doctoral candidate or experimental physicist with a doctor's degree in physics or in a comparable field (19-115-6) Friday, 20. September 2019

The Physikalisch-Technische Bundesanstalt (PTB) is the National Metrology Institute of the Federal Republic of Germany with scientific and technical service tasks. It furthers progress and reliability in metrology for society, the economy and science.

Department 6.2 "Dosimetry for Radiation Therapy and Diagnostic Radiology" of Division 6 is looking for a

doctoral candidate or experimental physicist with a doctor's degree in physics or in a comparable field

This position is available on the basis of a 3-year fixed-term contract. You will be employed at our Braunschweig site.

The remuneration will be paid in accordance with remuneration group 13 TVöD Bund for postdocs (85 % for doctoral candidates).

One of the aspects of the scope of tasks of Department 6.2 is the development and improvement of dose measurement procedures for modern radiotherapy. Within the scope of the European research project "Metrology for advanced radiotherapy using particle beams with ultra-high pulse dose rates", a subgroup is to develop for the first time a traceable dose measurement procedure for a potential future radiation therapy with FLASH modality. Four European metrology institutes, eight European research institutions and universities as well as several industrial enterprises are involved in this project. A research accelerator for the generation of high-energy electron radiation in FLASH modality is available in the department for the measurements. In addition to experimental work, also Monte Carlo radiation transport calculations are to be performed for which support is available by the expertise in the department.

Depending on the focus, the tasks are well suited for both a doctoral thesis and a post-doctoral position.

Your tasks:

- Developing, improving and applying a dose measurement procedure for radiation therapy with FLASH modality, i.e. for pulsed high-energy electron radiation with very high doses per pulse

- Carrying out radiation transport calculations, evaluating and verifying the measurement and simulation results
- Collaborating actively in the project, regular exchange with project partners and, if applicable, organizing, planning and implementing measurements on site at European partners
- Presenting the results at project meetings and scientific congresses as well as writing scientific publications

Your profile:

- You have completed university studies in physics or in a comparable subject
- You have pronounced experimental skills and are flexible
- You have good programming skills for data analysis (e.g. in MATLAB or Python)
- A sound knowledge of, and experience in, the following fields are of advantage:
 - Interaction of ionizing radiation with matter
 - Dosimetry of ionizing radiation, dose measurement technology, dose measurements with ionization chambers
 - Simulation of radiation transport in matter using Monte Carlo methods
 - Fundamentals of metrology, data analysis, and measurement uncertainty
- You have an independent, accurate and well-structured working style as well as good organizational skills
- You have a very good command of both spoken and written German and English
- You have excellent communication skills and are a team player
- You are willing to travel within the scope of your assignment (within Germany and abroad)
- You are aware of the fact that you may be occupationally exposed to radiation

For further subject-related information, please contact

Dr. Andreas Schüller, phone: +49 531 592-6209, e-mail: andreas.schueler@ptb.de
 Dr. Ralf-Peter Kapsch, phone: +49 531 592-6210, e-mail: ralf-peter.kapsch@ptb.de or
 Dr. Ulrike Ankerhold, phone: +49 531 592-6200, e-Mail: ulrike.ankerhold@ptb.de.

[Click here to learn more about our department](#)

PTB promotes the professional equality of women and men and is thus especially interested in applications from women. Within the scope of the official feasibility, PTB offers flexible part-time work schemes in order to support in particular the compatibility of work and family life. Disabled persons will be given priority if they have the same occupational aptitude.

Are you interested? Then we are looking forward to hearing from you.

Please use our

[online application form](#)

or send your application to the following postal address:

Physikalisch-Technische Bundesanstalt
 Referat "Personal"
Reference number 19-115-6
 Bundesallee 100
 38116 Braunschweig
 Germany

Unfortunately, we cannot accept applications sent via e-mail.

The closing date for applications is **20 September 2019**.





**Physikalisch-Technische Bundesanstalt
Braunschweig and Berlin**

Bundesallee 100

38116 Braunschweig

Andreas Schüller

Telefon: 0531 592-6209

E-Mail: andreas.schueller@ptb.de

www.ptb.de



Stand: 08/2019

...give some insight into career opportunities at PTB
and **German research organizations** in general



HELMHOLTZ RESEARCH FOR
GRAND CHALLENGES



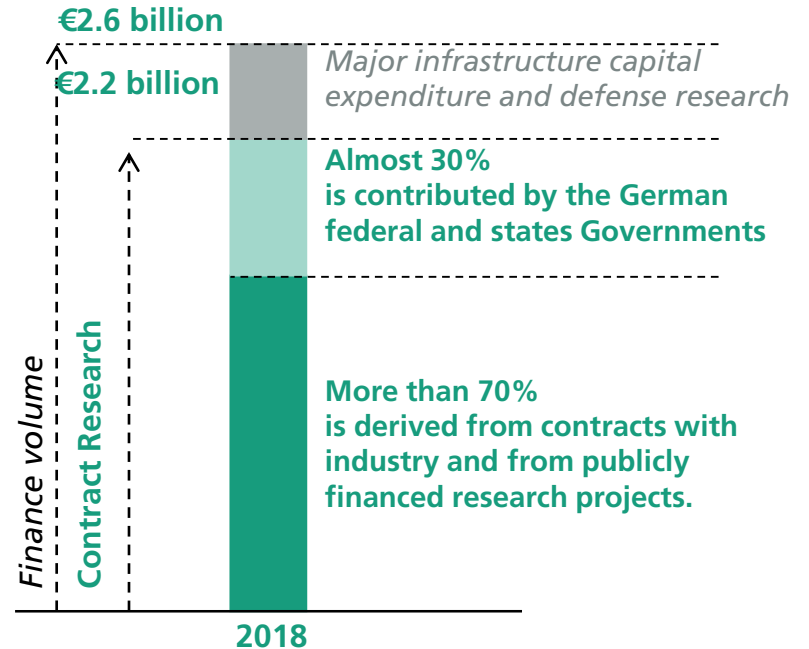
 **Fraunhofer**

The Fraunhofer-Gesellschaft at a Glance

The Fraunhofer-Gesellschaft undertakes applied research of direct utility to private and public enterprise and of wide benefit to society.


26,600 staff


72 institutes and research units



Career at Fraunhofer

Career paths

- *Qualification*
 - *Work on your bachelors/masters/Ph.D. thesis at Fraunhofer*
- *Fraunhofer-internal career paths*
 - *Management Career, e.g. group leader, head of department...*
 - *Specialist Career (e.g. Scientist, Engineer, Business developer)*
- *Springboard careers*
 - *Research → Universities, other research organizations*
 - **Business → Industry**
 - *Spin-offs → Entrepreneurship*

Career at Fraunhofer

Fraunhofer-internal career paths

Management Career

- *Take management responsibility for a group, department...*
- *Shape and enable the research performed there*
- *Turning towards the management side, less thematic work in the lab*

Specialist Career

| Scientific profile | Responsibility | Tasks |
|---------------------------|---|---|
| Scientist | <ul style="list-style-type: none">▪ <i>Scientific reputation</i>▪ <i>Develop and expand fields of research</i> | <ul style="list-style-type: none">▪ <i>Acquires and executes research projects</i>▪ <i>Supervises young researchers / doctoral students</i>▪ <i>Publishes, attends conferences, teaches</i> |
| Engineer | <ul style="list-style-type: none">▪ <i>Technology development</i>▪ <i>Application in industry Projects</i> | <ul style="list-style-type: none">▪ <i>Develops technology and business areas</i>▪ <i>Acquires and executes industry projects</i>▪ <i>Handles customer care, marketing</i> |
| Business developer | <ul style="list-style-type: none">▪ <i>Tap new markets and customers</i>▪ <i>Increase revenue</i> | <ul style="list-style-type: none">▪ <i>Undertakes market analysis, customer acquisitions</i>▪ <i>Develops utilization strategies and business models</i>▪ <i>Oversees patent management</i> |

Career at Fraunhofer

Springboard careers

| Focus | Main Destination | Skills you will learn that will get you there |
|-----------------|--|---|
| Research | <ul style="list-style-type: none"> ▪ <i>Universities</i> ▪ <i>Research Organizations</i> | <ul style="list-style-type: none"> ▪ <i>Work on a scientific degree at Fraunhofer (e.g. Ph.D., Dr. rer.nat.)</i> ▪ <i>Acquire in-depth scientific expertise in your field</i> ▪ <i>Publish and present your work at scientific conferences</i> ▪ <i>Work with universities in research projects</i> ▪ <i>Build a reputation in the scientific community</i> |
| Business | <ul style="list-style-type: none"> ▪ <i>Industry</i> | <ul style="list-style-type: none"> ▪ <i>Professional project management</i> ▪ <i>Projects with or for industry will help you get into contact on a thematic level</i> ▪ <i>Establish these contacts</i> ▪ <i>Acquire relevant technical know-how in the technical field</i> ▪ <i>Getting to know the customer needs of your industry contacts</i> ▪ <i>Promote your work and acquire new projects</i> |
| Spin-Off | <ul style="list-style-type: none"> ▪ <i>Entrepreneurship</i> | <ul style="list-style-type: none"> ▪ <i>Analyze the market or your customer's needs</i> ▪ <i>Create a technology or idea that can be developed into a product</i> ▪ <i>Learn to promote your product and capabilities</i> ▪ <i>Know how the market works and whether this product can sustain a small enterprise</i> ▪ <i>Gather management and financial know-how (there are courses offered specific for this purpose)</i> |

Some benefits and down-sides (purely subjective)

| What about... | Benefits | Downside |
|---------------------|---|--|
| Research | <ul style="list-style-type: none"> Applied research with a specific goal Targetted towards an immediate use and immediate feedback of its usefulness (in contrast to e.g. fundamental research) Working on more than one project gives a potentially large variety Doesn't get boring or repetitive, constant expansion of capabilities (30% of work load is devoted to this) | <ul style="list-style-type: none"> Juggling many projects can be hard For people that tend towards academia: it's applied research ☹ Results of most projects are covered by Nondisclosure agreements, cannot be published Specific research topics cannot be chosen arbitrarily. There has to be funding, either by industry or the public sector |
| Job position | <ul style="list-style-type: none"> Secure position during the length of the contract Knowing usually ½ year in advance whether the contract will be continued Getting help through training courses Many options besides full-time work (part-time options, home office....) | <ul style="list-style-type: none"> When entering Fraunhofer positions are always temporary Temporary positions are limited in time by law (6 years in total across the german public sector) Few permanent positions Fewer positions in the Management Career |
| Payment | <ul style="list-style-type: none"> Salaries are linked to public service pay („automatic“ payment increases) High transparency through public service tariff contract Gender-equal pay Has small elements of performance-linked wages | <ul style="list-style-type: none"> Salaries are linked to public service pay (depending on the economic situation industry might offer more) You cannot demand more money than your qualification allows |