Technische Universität Braunschweig

PTB
Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

Summer School of Metrology 2014

13th – 15th October
Haus Sonnenberg, Harz



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braunschweig igsm

Timetable

	Monday 13th October	Tuesday 14th October	Wednesday 15th October
09:00		Norbert Zisky **Digitally Signed Measurement Data of Taximeters for Trusted Data Exchange**	Andreas Waag **Research Topics in the New Laboratory for Emerging Nanometrology and Analytics**
09:30			
10:00		René Schödel **Primary Realization of Length Measurements by Means of Optical Interferometry**	Meinhard Schilling **Topics of the Research Training Group NanoMet**
10:30			
11:00		Coffee Break	Coffee Break
11:30		Klaus-Dieter Sommer **A Modern Approach to the Evaluation of Measurements II**	Karl-Heinz Glaßmeier **Rosetta: Europe's Comet Chaser – Physical Phenomena and Metrological Solutions**
12:00	**Arrival**		
12:30	Lunch	Lunch	Lunch
13:00			
13:30	Meinhard Schilling **Welcome**	Joint Activity	
14:00	Stefan Kück **Laser Radiometry**		**Departure**
14:30			
15:00	Coffee Break	Christian Koch **Metrology with and for Humans: Objective and Subjective Standards in Acoustics**	
15:30	Rainer Tutsch **Data Fusion in Dimensional Metrology**		
16:00		Coffee Break	
16:30	Klaus-Dieter Sommer **A Modern Approach to the Evaluation of Measurements I**	Dina Grohmann **Nano + Bio: a Metrology Challenge**	
17:00			
17:30	Dinner	Dinner	
18:00			
18:30	**Get Together & Postersession**	Frank Ludwig **Measurement Uncertainty** Workshop	
19:00			
19:30			
20:00			

Participants

Last name	First Name	Title / Degree	Email	Institution
Al-Hadhuri	Tawfik	M. Sc.	t.al-hadhuri@tu-bs.de	TU Braunschweig
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Waag	Andreas	Prof. Dr.	a.waag@tu-bs.de	TU Braunschweig
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Zhao	Ailun	M. Sc.	z.ailun@tu-bs.de	TU Braunschweig
Zisky	Norbert	Dr.	norbert.zisky@ptb.de	PTB Berlin

Posters

Last Name	First Name	Title of Poster
Al-Hadhuri	Tawfik	**Time-resolved fluorescence anisotropy of CdSe/ZnS quantum dots**
Broistedt	Hagen	**Random-Phase-Shift-Interferometer for the measurement of spherical surfaces**
Gangula	Sheetal	**Quatitative analysis by mass spectrometry**
Hampel	Benedikt	**Terahertz microscope with superconducting Josephson cantilever**
Hein	Christopher	**MBE GaN quantum dots: Growth and Characterization**
Jusuk	Ija	**Superresolution fluorescence imaging of nanopatterned DNA - origamis with semisynthetic fluorescent protein DANN conjugats**
Kazda	Michael	**FPGA-Based Triggered-Phase Transient Analyzer**
Ketzer	Fedor Alexej	**Photoluminescence investigations of anisotropic strained quantum well structures**
Kruskopf	Mattias	**Conditioning of 6H-SiC(0001) surfaces by argon annealing for epitaxial graphene growth**
Liu	Pei	**Data fusion of cylindrical form data with the two-point diameter data taken into account**
Liu	Bo	**Characterization of AAO/Au and TiO2/ZnO nanostructures**
Lòpez	Thais	**SilVIo, Modelling Social Vulnerability under a Local Perspective**
Mohajerani	Matin Sadat	**Emission from excitons bound to individual Zn atoms in low doped GaN:zn/ AlGaN quantum well**
Nazari Asl	Sara	**Capacitive electrodes in cEEG measurement**
Nording	Felix	**Manufacturing and Characterization of AMR-Sensors**
Oswald	Christoffer	**Three-dimensional monitoring of nanoparticle uptake and distribution in plant tissue using quantum dots**
Plag	Fabian	**Measurement uncertainty components of solar cell calibration**
Raab	Mario	**Flourescence microscopy with 6nm resolution on DNA origami**
Reifert	David	**RF-SET for charge detection in single electron experiments**
Remmer	Hilke	**Dynamic magnetic investigations of the particle-matrix interaction of magnetic hybrid materials**
Schroer	Alexander	**Detection of spin entanglement via spin-charge separation**
Sharafeev	Azat	**Raman spectroscopy: Characterization of nanomaterials**
Vietz	Carolin	**Self-assembled DNA origami nanoantennas for diagnostics**
Weber	Martin	**Extension of primary hydrophone calibration**
Wünsch	Bettina	**Studying the interaction between metallic nanostructures and fluorescent dyes**
Zhao	Ailun	**Investigation of recombination process in QW of GaN-based LED**

Laser Radiometry

Prof. Dr. Stefan Kück

Present Position	Head of the Department “Photometry and Applied Radiometry”, Physikalisch-Technische Bundesanstalt (PTB)

Academic Record

since 2013	Head of the Department “Photometry and Applied Radiometry”, PTB
2008 – 2013	Head of the Department “Optical Tecnologies”, PTB
since 2002	Head of the Working Group “Laser Radiometry”
2002	Habilitation in Experimental Physics, University of Hamburg
1994	Dr. rer. nat. in Physics, University of Hamburg
1990	Diploma in Physics, University of Hamburg

Scientific Interests: Photometry | Radiometry

Abstract

Lasers are nowadays the work horse for a variety of applications, e.g. laser material machining, medicine, photolithography, printing, communication, scientific research etc. One of the most important parameters is the laser power, which is measured by thermal or semiconductor detectors. The field of laser radiometry deals with the precise measurement of the laser power. At the Physikalisch-Technische Bundesanstalt measurements of laser power in the spectral range from 193 nm to 10.6 µm and in the power range between nanowatts to kilowatts are performed. In this presentation I will report on the different types of detectors and setups required in order to assure measurements with lowest uncertainties.

Data Fusion in Dimensional Metrology

Prof. Dr. Rainer Tutsch

Present Position	Head of the Institut für Produktionsmesstechnik (IPROM), TU Braunschweig

Academic Record

since 2013	Chair of AHMT (Arbeitskreis der Hochschullehrer für Messtechnik e.V.)
2010 – 2013	Vice Chair of AHMT (Arbeitskreis der Hochschullehrer für Messtechnik e.V.)
since 2008	Vice Chair of Task Committee TC14 (Geometrical Quantities) of IMEKO, the International Confederation of Metrology
since 2007	Member of the Management Board of the "Braunschweig International Graduate School of Metrology"
2003 – 2007	Dean of Academic Affairs, Department of Mechanical Engineering
since 2000	Full Professor (C4), TU Braunschweig
1995 – 2000	Head of R&D and substitute of CEO, grapho metronic GmbH, München
1991 – 1995	Chief Engineer Metrology and Quality Management, Fraunhofer-Institute of Production Technology IPT, Aachen
1994	Dr.-Ing., Production Engineering, RWTH Aachen
1985 – 1990	Scientific Assistent / Head of Working Group Optical Metrology, Fraunhofer-Institute of Production Technology IPT, Aachen
1984 – 1985	Scientific Assistant, Physics Institute, Heinrich-Heine-Universität Düsseldorf
1977 – 1984	Studies in Physics, Heinrich-Heine-Universität Düsseldorf

Scientific Interests	Production Metrology | Precision measurements | Geometrical quantities | Optical metrology | Quality management

A Modern Approach to the Evaluation of Measurements I + II

Prof. Dr.-Ing. Klaus-Dieter Sommer

Present Position	Head of Division Chemical Physics & Explosion Protection, Physikalisch-Technische Bundesanstalt
	Honorary Professor (since 2008), Faculty of Engineering, Friedrich-Alexander-Universität Erlangen-Nürnberg
	Honorary Professor (since 2012), Dept. of Electrical Engineering, Information Technology, Physics, TU Braunschweig

Academic Record

1994 – 2007	Director of Thuringian State Bureau for Metrology and Verification
1990 – 1994	Head of the Density-Laboratory, Physikalisch-Technische Bundesanstalt
1984 – 1990	Senior Research Engineer, (East-)German State Authority for Standardization, Metrology and Certification (ASMW)
1984	PhD, TU Ilmenau ("Development of new humidity sensors")
1977 – 1983	Research Assistant, TU Ilmenau

Scientific Interests: System theory of measurement: Measurement theory | Modelling of measurements | Distributed measurement systems | Measured data and uncertainty evaluation | Energy measurement and standards | Environmental metrology

Abstract

The presentation provides a comprehensible introduction to a modern Bayesian approach to measurement data and uncertainty evaluation as described in the Guide to the Expression of Uncertainty in Measurement (GUM). The presentation comprises:

1. Introduction to the description and modelling of measurement systems
2. Bayesian representation of imperfect knowledge about quantities and variables
3. Computer-based uncertainty evaluation in accordance with the GUM
4. Uncertainty evaluation by propagation of distributions using the Monte Carlo technique
5. Selected advanced topics like correlation, regression analysis and comparison measurement-based uncertainty estimation

Digitally Signed Measurement Data of Taximeters for Trusted Data Exchange

Dr. Norbert Zisky

Present Position	Head of working group data communication and security, Physikalisch-Technische Bundesanstalt (PTB)

Academic Record

since 2004	Head of working group data communication and security, PTB
1994 – 2003	Head of Laboratory "Measurement data transfer", PTB
1996	PhD (Dr.-Ing.) in grid concepts for site electronics, TU Braunschweig
1990 – 1993	Research Scientist in embedded real time systems and data modeling, PTB
1981 – 1990	Research Scientist in optical measurement techniques

Scientific Interests	Measurement sensors in smart grids | Cryptography | Security concepts for measurement systems

Abstract

The presentation shows a concept protecting measurement data against altering after generation by use of strong cryptography. The measures and components needed for the operation of such a system and the advantages will be demonstrated. The presentation will start with a short overview of cryptographic procedures. After the introduction into the concept the main data structures and the validation of signed data sets will be shown. A real implementation with a bigger number of taximeters is already put into operation. The concept can be used for all measurement data, which must be protected.

Primary Realization of Length Measurements by Means of Optical Interferometry

Dr. René Schödel

Present Position	Head of Department "Interferometry on Material Measures", Physikalisch-Technische Bundesanstalt (PTB)

Academic Record

since 2010	Head of Department "Interferometry on Material Measures", PTB
since 2005	Head of Working Group „Interferometry on Prismatic Bodies", PTB
since 2000	Research Scientist in interferential length measurements, PTB
1999	PostDoc at TU Berlin
1999	Dr. rer. nat. in physics, Humboldt-Universität zu Berlin (HUB)
1994 – 1998	Research Scientist in Physics (nonlinear spectroscopy on light harvesting complex II of higher plants), HUB
1988 – 1993	Physics studies at HUB

Scientific Interests: Precision interferometry | Gas refractometry | Length measurement methods

Abstract

The provision of length standards and the ability to measure length to a required accuracy are of fundamental importance to any technologically developed society. Throughout history, there have been many standards for the length beginning with simple definitions (cubit, feet etc.). It needed many years until the meter, one of the seven base units of the SI, was defined as the length of the path travelled by light in vacuum during a time interval of 1/299,792,458 of a second. This lecture describes the realization of length measurements according to this definition with a focus onto interferometry as this is the most accurate method.

Metrology with and for Humans: Objective and Subjective Standards in Acoustics

Dr. Christian Koch

Present Position	Head of Department "Sound", Physikalisch-Technische Bundesanstalt (PTB)

Academic Record

Since 2004	Head of Department Sound at PTB
2000 – 2004	Head of Laboratory and Working group Ultrasound at PTB
1994 – 2000	Researcher at Laboratory Ultrasound at PTB
1994	PhD in Laser physics from University of Hannover
1991 – 1994	Researcher in Nonlinear Optics, PTB and University of Hannover
1989 – 1991	Researcher at Physikalisch-Technisches Institut of Akademie der Wissenschaften, Jena
1989	Diploma in Physics, Friedrich-Schiller-University Jena

Scientific Interests: Audiology | Perception and assessment of non-audible sound | Industrial ultrasound and cavitation | Optical methods for ultrasound | Medical ultrasonics

Abstract

Hearing is one of our most vital senses and impairment can lead to severe degradation of quality of life. Also in contemporary times most of our communication uses speech and sound. On the other side life and material production produce noise which is an important environmental factor with a wide range of human responses from pleasant via annoying to harmful. The quantitative determination of acoustic parameters is the basis of any assessment of noise, the quality of sound and the intelligibility of speech. Metrological underpinning is required to ensure traceable and reliable measurement procedures for a wide variety of applications. The talk will introduce into the basics of hearing and fundamental concepts of realisation and dissemination of units and calibration in acoustics.

The impact of sound on a human strongly depends on properties and conditions of the person in question. Many applications require a quantitative description also of these subjective effects. Using the examples of hearing threshold and speech transmission index (STI) strategies of managing subjective relations and interaction are discussed within the talk.

Nano + Bio:
A Metrology Challenge

Dr. Dina Grohmann

Present Position	Junior Research Group Leader / Akademische Rätin a.Z., Institute of Physical and Theoretical Chemistry – NanoBioSciences, Technische Universität Braunschweig

Academic Record

since 2011	Junior Research Group Leader and Junior Lecturer (Akademische Rätin a.Z.), Institut für Physikalische und Theoretische Chemie, Dpt. NanoBioSciences, TU Braunschweig
2007 – 2011	Postdoctoral Research Fellow, Department of Structural and Molecular Biology, University College London, UK
2009	Visiting Researcher, Department of Chemistry and Biological Chemistry, Rutgers University, USA
2006	Postdoctoral Fellow, Institut für Molekulare Medizin, Universität zu Lübeck
2002 – 2006	PhD student, Max-Planck-Institut Dortmund and Universität zu Lübeck
1996 – 2002	Studies of Biology , Heinrich-Heine-Universität Düsseldorf

Abstract

Biological processes typically play out in the nanometer range and standard microscopic techniques do not allow us to visualize the structural organization either of single proteins or protein complexes with high resolution. In contrast, x-ray crystallography and/or NMR techniques provide a detailed but static picture of biomolecules. Often, these techniques can just be applied to a subset of molecules as many protein complexes are either too dynamic to yield high-diffracting crystals or too big to be used in NMR experiments. Fluorescence resonance energy transfer (FRET) has closed this gap as it can report on changes of distances in the range of 2 – 8 nanometers with millisecond temporal resolution. FRET, the non-radiative transfer of energy between a donor and acceptor fluorophore, is highly distance-dependent, which makes it an excellent molecular ruler. Consequently, FRET is an extremely powerful approach to study the dynamic aspects of interactions and conformational changes even in higher-ordered macromolecular complexes in solution. This lecture will take you on a journey into the inner life of a cell focusing on one of the most crucial processes in all living organisms, the decoding of our genetic information (e.g. transcription). I will highlight how the development of accurate FRET measurements on the single-molecule level provided us with the opportunity to gain unprecedented insights into and to decode molecular details of the transcriptional machinery.

Measurement Uncertainty

Workshop

Dr. Frank Ludwig

Present Position	Senior Scientist at the Institute of Electrical Measurements and Fundamental Electrical Engineering (EMG) of TU Braunschweig

Academic Record

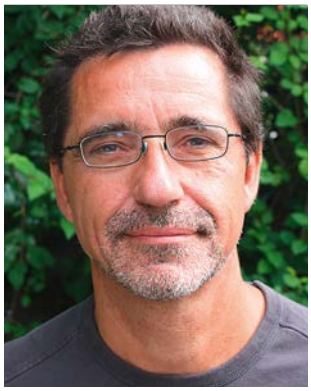
since 2001	Senior Scientist at EMG of TU Braunschweig
1995 – 2001	Research Scientist at Section Cryosensors at PTB
1992 – 1995	Research Associate at UC Berkeley
1987 – 1992	Research Scientist at Institute of Low Temperature Solid State Physics of Humboldt University Berlin
1987	Dr. rer. nat. in Physics at Humboldt University Berlin
1985 – 1987	Postgraduate student at Humboldt University Berlin
1980 – 1985	Study of physics at Humboldt University Berlin

Scientific Interests: Magnetic sensors | Magnetic nanoparticles in biomedicine | Thin-film technology

Abstract

The basics of measurement uncertainty are presented in detail in the lectures by Prof. Sommer from PTB. Goal of this workshop is to present and discuss some examples for the determination of measurement uncertainty according to the GUM. As part of this workshop, the application of the GUM Workbench software is presented.

Research Topics in the New Laboratory for Emerging Nanometrology and Analytics



Prof. Dr. Andreas Waag

Present Position	Head of the Institut für Halbleitertechnik, TU Braunschweig

Academic Record

since 2003	C4-Professor, TU Braunschweig, Head of the Institut für Halbleitertechnik
2000 – 2003	C3-Professor, Universität Ulm
1997	Habilitation in Experimental Physics, Julius-Maximilians-Universität Würzburg
1996 – 1997	Visiting Assistant Professor
1991	PhD (Dr. rer. nat.), Julius-Maximilians-Universität Würzburg
1981 – 1987	Studies in Physics, Diplom, Julius-Maximilians-Universität Würzburg

Scientific Interests	Wide Band Gap Semiconductors in Optoelectronics: Nitrides and Oxides | Processing and Nanotechnology | Novel Concepts for Device Applications | 3D Semiconductor Technology

Abstract

In the new Research center »Laboratory for Emerging Nanometrology« LENA Institutes from TU Braunschweig and from PTB will work together towards novel applications of nanodevices with the special focus on well controlled properties traceable to the SI units. For this purpose a new building with many new research instruments will be constructed. With this equipment the Metrology Initiative Braunschweig will pursue the aim of a joint research and education initiative in Metrology related topics with TU and PTB working together with many other research institutes in Braunschweig, in Germany and worldwide.

Topics of the Research Training Group »NanoMet«

Prof. Dr. Meinhard Schilling

Present Position	Head of the Institut für Elektrische Messtechnik und Grundlagen der Elektrotechnik, TU Braunschweig
	Chairman of the Braunschweig International Graduate School of Metrology

Academic Record

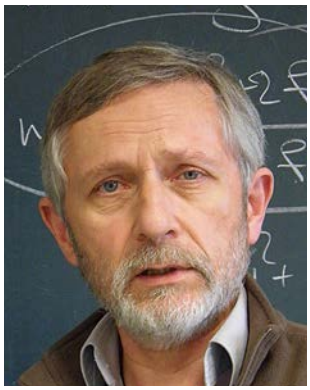
since 2001	Full Professor at the Fakultät für Elektrotechnik, Informationstechnik, Physik (C4), Institut für Elektrische Messtechnik und Grundlagen der Elektrotechnik, TU Braunschweig
1998 – 2001	Privatdozent at the Institut für Angewandte Physik, Universität Hamburg
1998	Habilitation in Experimental Physics (Universität Hamburg) with a thesis on "$YBa_2Cu_3O_7$ magnetometers – physics and applications"
1992 – 1998	Scientific Assistant (C1) at the Institut für Angewandte Physik, Universität Hamburg
1992	Doctoral degree Dr. rer. nat., Physics at the Universität Hamburg with thesis on "Superconducting quantum inferences devices from $YBa_2Cu_3O_7$"
1989 – 1992	PhD student at the Institut für Angewandte Physik, Universität Hamburg
1989	Diploma in Physics, Universität Hamburg

Scientific Interests	Nanotechnology and materials for sensor applications, optimization of magnetic field sensors for metrological applications | Biomedical sensors and sensor systems (ECG, EEG, MEG, MCG) | Measurement methods of ultrafast electronics from 1 GHz – 5 THz | Embedded systems for metrology

Abstract

The research training group »Metrology for Complex Nanosystems – NanoMet« is a new joint research project to TU Braunschweig and PTB. In this project the special metrological requirements and conditions in treating nano systems regarding traceability of their properties will be investigated. The complex nanosystems can contain a high number of smaller subsystems which only can be treated statistically. Other biological nanosystems are changing in time due to growth and thus are no ergodic systems. The third group are quantum mechanical nanosystems where the interesting properties are governed by uncertainty relations where observables have no independent measurement uncertainties. All these properties are described in the proposal as our starting point and possible research contributions by the involved partners in the next years will be presented.

Rosetta: Europe's Comet Chaser – Physical Phenomena and Metrological Solutions



Prof. Dr. Karl-Heinz Glaßmeier

Present Position	Chair Geophysics, Institute of Geophysics and extraterrestrial Physics, Technische Universität Braunschweig

Academic Record

2014	Basic Sciences Award of the International Academy of Astronautics
2013 – 2034	Lead investigator on the JUICE mission to Jovian moons Ganymed and Europa
2010 – 2015	Member of the Board of Scientific Editors of Science
2010	Julius-Bartels-Medal of the European Geoscience Union
2004 – 2008	Member DFG-Fachkollegium Geophysik und Geodäsie
2002 – present	Scientific Member of the Max-Planck-Society
2001 – 2005	Member of the Senat of the Technical University of Braunschweig
2001 – present	Elected member of the National Academy of Sciences Leopoldina
1997 – 2016	Principal Investigator (PI) of the magnetometer experiment on ROSETTA
1995 – 1997	Dean of the Faculty of Natural Sciences
1991 – present	Full Professor and Chair Geophysics at the TU Braunschweig
1985 – 1991	University of Cologne
1990	Jakow Borissowitsch Zeldovich Medal
1990	Werner-Heisenberg-scholar
1989	Habilitation in geophysics, University of Cologne
1985	Dr. rer. nat. , University of Münster
1979	Dipl.-Phys., University of Münster

Scientific Interests: Geophysics | Planetary Magnetism | Space Magnetometry | Space Plasma Physics | Cometary Physics | Data Analysis Tools

Abstract

About 99 % of the baryonic matter in our universe is in the plasma state. The structure and dynamics of this plasma is strongly controlled by magnetic fields. The measurement of magnetic fields in space is thus a most important experimental task. Within our solar system in-situ measurements of the magnetic field are possible. The state-of-art instrument is the flux-gate magnetometer. Though such magnetometers are well known and even available on the market, space born magneto-meters carry important features usually not realized by standard magnetometers. Issues of volume, mass, and power are important issues and need to be addressed when developing a space born magnetometer. However, the harsh space environmental conditions require further major achievements to successfully conduct magnetic field measurements in space. Furthermore, any other magnetic material or current drawing device on a spacecraft causes a major headache in that magnetic field contamination needs to be minimized. The development and building of a space born magnetometer is thus also a system integration problem. The magnetometer experiment on board the Rosetta spacecraft will be used to exemplify the issues mentioned.