2019 Lecture Week 2: Timetable

	Groups	14 (Sun)	15 (Mon)	16 (Tue)	17 (Wed)	18 (Thu)	19 (Fri)
9:00-	All		Exp.6: PSD and friends **K. Danzmann**	Exp.8: Generation of squeezed light **S. Danilishin**	Exp.10: SN, PR, SR, RSE **B. Willke**	Geo.2: Hands-on session:Geodetic leveling **L. Timmen**	
				Rel.6:Linearized Gravitational Waves **M. Otto**			
10:30-	All		Coffee Break				
11:00- (Parallel session)	QF		Exp.7: Non-classical light **M. Heurs**	Exp.9: Squeezed light application and SQL **S. Danilishin**	Geo.1: Terrestrial measurements of gravity and heights for geodynamics **L. Timmen**	Exp.11: Gravity sensing with cold atoms - Concepts, visions, & very long baselines **W.Herr**	Exp.12: Overcoming uncertainties in Atom Gravimetry **W.Herr**
	IMPRS			Rel.7:Linearized theory, action on detect **M. Otto**	Rel.8:Einstein equations, initial-value formulation **J. Steinhoff**	Rel.9: Generation of GWs in linearized theory **J. Steinhoff.**	Rel.10: Spherical stars **J. Steinhoff**
12:30-	All		Lunch time				
14:00-	All		DA-St.1: Probability theory as extended logic **S. Kumar**	DA-St.2: Hypothesis testing **S. Kumar**	Ele.1: A Short Course in Fundamental Circuit Theory for RF Systems **C.Monka-Ewe**	Ele.2: Fundamentals of High Frequency Measurement Technology **C.Monka-Ewe** **S. Paul**	ST.1: From an Idea to a space project **J.Große**
15:30-	All		Coffee Break				
16:00-	All		Q&A, Students and Postdocs Presentation	Q&A, Students and Postdocs Presentation	Group Exercise	Q&A, Students and Postdocs Presentation	Departure
18:00-	All	Arrival	Break				
19:00-	All	Dinner Break and social hours					

Contents of Experimental lectures

Lecture 6 : PSD and friends (Karsten Danzmann AEI)

- Fourier transform
- Cross correlation and convolution
- Auto correlation
- Power spectrum and PSD
- One-sided linear spectral density
- Convergence Periodogram to PSD, averaging
- Spectrum Analyser, FFT Analyser

Lecture 7: Non-classical light (Michèle Heurs AEI)

- Quasi-probabilities
- Squeezing and displacement operators
- Minimum uncertainty states

Lecture 8: Generation of squeezed light (Stefan Danilishin AEI)

- Squeezing by non-linear processes
- Measurements with squeezed states
- Turning of squeezing ellipse

Lecture 9: Squeezed light application and SQL (Stefan Danilishin AEI)

- Standard Quantum Limit
- Kerr effect
- Radiation pressure and optical springs
- Radiation pressure dominated interferometers
- QND quantum variables
- Optical levers
- Macroscopic quantum states

Lecture 10 : SN, PR, SR, RSE (Benno Willke AEI)

- Shot noise, Schottky formula
- Johnson noise
- White noise, coloured noise
- Optical gain (ifo transfer function)
- Power recycling
- Signal Recycling
- Resonant Sideband Extraction

Lecture 11: Gravity sensing with cold atoms - Concepts, visions, & very long baselines (Waldemar Herr IQO)

- Fundamentals of atom interferometers
- Correction of vibrational noise
- Atom interferometers in & short recap of applications

Lecture 12: Overcoming uncertainties in Atom Gravimetry (Waldemar Herr IQO)

- Introduction to instability and uncertainty
- State-of-the-art atom gravimeter and their limitations
    - Uncertainty due to wave front aberrations
    - Uncertainty due to the Coriolis effect
- Overcoming current limitations
    - The Quantum Gravimeter – QG-1
- Novel upcoming effects to investigate
    - Uncertainty due to mean-field shifts
    - Uncertainty due to Black Body Radiation

Contents of Relativity

Lecture 6: Linearized Gravitational Waves (Markus Otto AEI)

- Einstein Equations
- Weak field approximation and transformation
- Linearization of the Einstein Equations
- Gauge transformation
- Trace reverse and gauge condition

Lecture 7: Linearized theory, action on detect (Markus Otto AEI)

- Wave equation
- Properties of Gravitational Waves
- The TT gauge
- The GW effect on free particles
- GW effect on light travel time in a Michelson interferometer
- (Transfer function of the Michelson interferometer)

Lecture 8: Einstein equations (Jan Steinhoff AEI)

- recapitulation of differential geometry
- Riemann tensor
- Einstein tensor and equations

Lecture 9: Generation of GWs in linearized theory

- Generation of GWs by isolated system with weak internal gravity: quadrupole formula
- GWs from binary systems: energy loss, time to merger, chirp mass
- Outlook: inspiral, merger, and ringdown

Lecture 10: Spherical stars

- Hydrostatic equilibrium
- The Tolman-Oppenheimer-Volkov equation
- Gravitational collapse
- Neutron stars

Contents of Data Analysis and Statistics lectures

Lecture 1: Probability theory as extended logic (Sumit Kumar AEI)

- Deduction vs Inference
- Logic, laws of probability
- Examples and Applications, PDFs

Lecture 2: Hypothesis testing (Sumit Kumar AEI)

- Bayes theorem, simple examples
- Decision theory
- Orthodox hypothesis testing
- Neyman-Pearson

Contents of Geodesy lecture

Lecture 1 : Terrestrial measurements of gravity and heights for geodynamics (Ludger Timmen IfE)

- Introduction: solid Earth and hydrosphere
- General characteristics
- Instruments and accuracies
- Reduction of non-tectonic gravity variations
- Germany from North to South: ongoing projects of/with LUH:
- Final general statements

Lecture 2 : Hands-on session:Geodetic leveling (Ludger Timmen IfE)

- Practice simple leveling with an older analog optical instrument and with an automatically working instrument around Steinhuder meer

Contents of Space Technology lecture

Lecture 1 : From an Idea to a space project (Jens Große DLR Bremen)

- How is a space project set up? (Project Phases, Reviews, what needs to be defined in which phase)
- Requirements definition and verification
- Systems Engineering approach
- Role of science team in design and implementation phase
- Examples from the BECCAL or MAIUS project

Contents of Microwave Engineering lectures

Lecture 1 : A Short Course in Fundamental Circuit Theory for RF Systems (Carsten Monka-Ewe IHF TUBS)

- Transmission Line Theory, Matching Networks and the Smith Chart, Scattering Parameters
- Resonators, Loss Mechanisms, Q factors, Coupling

Lecture 2 : Fundamentals of High Frequency Measurement Technology (Carsten Monka-Ewe IHF TUBS)

- Fundamentals of Vector Network Analysis, Scattering Parameters, Calibration
- Fundamentals of Spectrum Analysis, Device setup for various measurement applications

Extra:

- Lab session corner is installed for getting hands on experience with the actual instrument