

## Curriculum Vitae

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Date and place of birth: September 25<sup>th</sup> 1962, Bayreuth  
Citizenship: German

### • EDUCATION

2004            Habilitation at Ludwig-Maximilians-Universität Munich / Germany  
1997            PhD (summa cum laude)  
                  Ludwig-Maximilians-Universität Munich / Germany  
1993            Diploma  
                  Justus Liebig Universität Giessen / Germany  
1987-1993     Physics  
                  Justus Liebig Universität Giessen / Germany  
1990-1991     Physics  
                  University of Washington / Seattle, USA

### • CURRENT POSITIONS

2016 –            Professor at Ludwig-Maximilians-Universität Munich / Germany  
2004 –            Permanent research associate  
                  Laser spectroscopy division / Max Planck Institute of Quantum Optics / Garching,  
                  Germany

### • PREVIOUS POSITIONS

1998 – 2004     Research associate  
                  Laser spectroscopy division / Max Planck Institute of Quantum Optics / Garching,  
                  Germany  
2000            Postdoc  
                  NIST / Boulder, USA

### • SCIENTIFIC ACHIEVEMENTS

I graduated in 1997 with the first phase coherent optical frequency measurement on atomic hydrogen using. The key instruments at that time have been the optical interval dividers and modulator type optical comb generators. Already during my PhD I tested certain properties of combs generated by mode locked lasers, like recording beat notes with other lasers. Right after graduation I assembled the first self-referenced optical comb generator based on the  $7f$ - $8f$  technique. Soon after, I could replace this by a much more compact  $f$ - $2f$  technique. This was done for the first time and simultaneously by Scott Diddams and co-workers at JILA. The long lasting problem of optical frequency measurement was solved with this and I devoted myself to improving spectroscopy. The uncertainty of the  $1S$ - $2S$  transition frequency has been reduced right after the introduction of the frequency comb by a factor of 2 and subsequently by a factor 40 through improvements of the spectrometer. To generate more hydrogen data I designed and supervised a new experiment on the  $1S$ - $3S$  transition using two-photon direct comb spectroscopy. Another activity includes the usage of our  $1S$ - $2S$  apparatus as a source of cold  $2S$  atoms

for an improved measurement of the 2S-4P transitions. Both experiments are generating data now. In addition to the hydrogen activities I was leading an experimental astronomical frequency comb that is now being used to detect extrasolar planets at one of the largest telescopes operated by the European Southern Observatory (ESO). Finally I am also contributing to a 920 km long optical fibre link between MPQ and the Physikalisch-Technische Bundesanstalt (PTB) at Braunschweig, Germany. With this test set-up it was possible to demonstrate that optical frequencies can be transmitted with 19 digit accuracy over such a long distance.

- **COLLABORATIONS**

Over the years I have collaborated with a large number of groups worldwide. Currently we work closely with the group of Ferenc Krausz on HHG and fs enhancement cavities. On the theory side we are working with the group of Giovanna Morigi at the Universität des Saarlandes at Saarbrücken, Germany. We are also in close contact with the theory groups of Ulrich Jentschura at Missouri University of Science and Technology, Rolla, Missouri, USA and Krzysztof Pachucki at Warsaw University. On high power lasers we have a close collaboration with the Fraunhofer-Institut für Lasertechnik (ILT) at Aachen, Germany. To provide the time base for precision measurements we collaborate closely with the Physikalisch-Technische Bundesanstalt (PTB) at Braunschweig, Germany and with BNM-SYRTE, Paris. On the astrocomb project we work with the European Southern Observatory to have access to the large telescopes at the Atacama Desert, Chile.

- **FELLOWSHIPS AND AWARDS**

2013	EPS Prize for Research in Laser Science and Applications
2011	Elected fellow of the American Physical Society
2010	Elected fellow of the Optical Society of America
2006	Röntgen Award of the University of Giessen
2006	Habilitation Award of the Ludwig-Maximilians-Universität Munich
1998	Philip Morris Research Award
1994	WE-Hareaus Student Award

- **SUPERVISION OF GRADUATE STUDENTS AND POSTDOCTORAL FELLOWS**

2004 – Supervised 14 postdocs, 18 PhD students and 16 master/diploma students.  
Three of my former PhD students stayed in academia.  
One former postdoc became assistant professor at the Colorado State University.

- **TEACHING ACTIVITIES**

2001 – Teaching at the Ludwig-Maximilians-Universität Munich various classes on optics, quantum optics, spectroscopy, ion traps and non-linear optics. Among those classes is a 3<sup>rd</sup> semester course on Optics with more than 300 students that I have teaching 4 times since 2008, and a first semester class Mechanics with more than 500 students that I taught in 2015.

- **ORGANISATION OF SCIENTIFIC MEETINGS**

2016-	Journal of Physics B Editorial Board member
2014-	EGAS Board member
2014	Program committee of Laser Spectroscopy 2015
2014	International steering committee of Frequency Standards and Metrology 2015
2014	Sub-committee chair CLEO IQEC 2015
2004-	Served many times as sub-committee member for CLEO and CLEO Europe

- **MEMBERSHIPS OF SCIENTIFIC SOCIETIES**

Fellow Member of the American Physical Society  
Fellow Member of the Optical Society of America  
Member, German Physical Society

- **PUBLICATIONS THAT RECEIVED THE LARGEST NUMBER OF CITATIONS**

**Optical Frequency Metrology**

Nature 416, 233 (2002), 1117 citations\*.

**Attosecond Control of Electronic Processes by Intense Light Fields**

Nature 421, 611 (2003), 1031 citations\*.

**Direct Link between Microwave and Optical Frequencies with a 300 THz Femtosecond...**

Phys. Rev. Lett. 84, 5102 (2000), 687 citations\*.

**Optical Frequency Synthesizer for Precision Spectroscopy**

Phys. Rev. Lett. 85, 2264 (2000), 659 citations\*.

**Absolute Optical Frequency Measurement of the Cesium D1 Line with a Mode Locked Laser**

Phys. Rev. Lett., 82, 3568 (1999), 476 citations\*.

**Measurement of the Hydrogen 1S-2S Transition Frequency by Phase Coherent Comparison...**

Phys. Rev. Lett. 84, 5496 (2000), 408 citations\*.

**An Optical Clock Based on a Single Trapped  $^{199}\text{Hg}^+$  Ion**

Science 293, 825 (2001), 384 citations\*.

**Controlling the Phase Evolution of Few-Cycle Light Pulses**

Phys. Rev. Lett. 85, 740 (2000), 352 citations\*.

**A Frequency Comb in the Extreme Ultraviolet**

Nature 436, 234 (2005), 319 citations\*.

**Phase-Coherent Measurement of the Hydrogen 1S-2S Transition Frequency with and Optical...**

Phys. Rev. Lett., 79, 2646 (1997), 301 citations\*.

\* ISI Science Citation Index as of April 13<sup>th</sup> 2016: The same data base lists 192 publications that I am co-authoring. My h-index is at 45.

- **REPRESENTATIVE SENIOR AUTHOR PUBLICATIONS**

**Doppler Cooling Trapped Ions with a UV Frequency Comb**

Phys. Rev. Lett. 116, 043002 (2016).

**Absolute Frequency and Isotope Shift of the Magnesium  $(3s^2)^1S_0$ - $(3s3d)^1D_2$  two-photon ...**

Phys. Rev. A 92, 063403 (2015).

**Simplified Scheme for Generating narrow-band mid-ultraviolet Laser Radiation**

Rev. Sci. Instr. 86, 033110 (2015).

**Quantum Interference in Two-Photon Frequency-Comb Spectroscopy**

Phys. Rev. A 90, 012512 (2014).

**Frequency-Comb Spectroscopy of the Hydrogen 1S-3S and 1S-3D Transitions**

Ann. Phys. (Berlin) 525, L29 (2013).

**Nonlinear Amplification of Side-Modes in Frequency Combs**

Opt. Expr. 21, 11670 (2013).

**Sub-millikelvin spatial Thermometry of a single Doppler-cooled Ion in a Paul Trap**

Phys. Rev. A 85, 023427 (2012).

**Vacuum ultraviolet Frequency Combs generated by a fs enhancement Cavity in the Visible**

Opt. Lett. 37, 503 (2012).

**Single-Pass High-Harmonic Generation at 20.8 MHz Repetition Rate**

Opt. Lett. 36, 3428 (2011).

**Highly sensitive Dispersion Measurement of a high-power passive optical Resonator using ...**

Opt. Express 18, pp. 26184 (2010).

**Injection Locking of a Trapped-Ion Phonon Laser**

Phys. Rev. Lett. 105, 013004 (2010).

**High-Precision Calibration of Spectrographs**

Mon. Not. R. Astron. Soc. Lett. 405, L16 (2010).

**Two-Photon direct Frequency Comb Spectroscopy with chirped Pulses**

Phys. Rev. A 81, 033427 (2010).

**A Phonon Laser**

Nature Physics 5, 682 (2009).

**Precision Spectroscopy of the 3s-3p Fine-Structure Doublet in  $\text{Mg}^+$**

Phys. Rev. A 80, 022503 (2009).

- Fabry-Pérot Filter Cavities for Wide-Spaced Frequency Combs with Large Spectral Bandwidth**  
Appl. Phys B 69, 251 (2009).
- Feasibility of Coherent XUV Spectroscopy on the 1S–2S Transition in Singly Ionized Helium**  
Phys. Rev A. 79, 052505 (2009).
- A deep-UV Optical Frequency Comb at 205 nm**  
Opt. Express 17, 9183 (2009).
- Laser Frequency Combs for Astronomical Observations**  
Science 321, 1335 (2008).
- High Harmonic Frequency Combs for High Resolution Spectroscopy**  
Phys. Rev. Lett. 100, 253901 (2008).

- **MONOGRAPHS**

- Durchkämte Spektren**  
Physik Journal p. 45, Juli 2012.
- Frequency Comb Benefits**  
Nature Photonics 3, 82 (2009).
- Constant Insights from Recoils**  
Nature Physics 2, 153 (2006).
- Light-Insensitive Optical Clock**  
Nature 435, 291 (2005).
- Short and Sharp–Spectroscopy with Frequency Combs**  
Science 307, 364 (2005).

- **GRANTED PATENTS**

- Method and device for producing radio frequency waves**  
US patent US2004021056, Inventors: R. Holzwarth, Th. Udem and T.W. Hänsch
- Generation of stabilized, ultra-short light pulses and the use thereof for synthesizing optical ...**  
US patent US6785303, Inventors: R. Holzwarth, J. Reichert, Th. Udem and T.W. Hänsch
- Method and device for producing stabilized ultrashort laser light pulses**  
International patent WO0221644, Inventors: R. Holzwarth, Th. Udem and T.W.Hänsch
- Method and device for generating radiation with stabilized frequency**  
International patent WO0221649, Inventors: R. Holzwarth, Th. Udem and T.W. Hänsch
- Optical Resonator with direct geometric access the optical axis**  
US patent US8988766B2, Inventors: P. Russbuldt, J. Weitenberg, I. Pupeza and Th. Udem

- **INVITED PRESENTATIONS**

Since 2005 I gave a number of invited talks at international conferences and schools. Below I am listing the plenary talks and presentations at schools that I have given during this period:

International Conference on Laser Spectroscopy (ICOLS) **2005**. Frequency Control Symposium (FCS), **2005**. 36th Winter Colloquium on the Physics of Quantum Electronics **2006**. European Time and Frequency Forum (EFTF) **2006**. Enrico Fermi Summer School, **2006**. International school on Quantum Metrology and Fundamental Constants, Ecole de Physique **2007**. International Conference on Atomic Physics (ICAP) **2008**. 7th Symposium on Frequency Standards and Metrology **2008**. Joint Meeting of the European Frequency and Time Forum (EFTF) and the IEEE International Frequency Control Symposium (FCS) **2009**. Gordon Conference on Electronic Spectroscopy and Dynamics **2009**. DPG Symposium 50 Years of Lasers, **2010**. Frontiers of Quantum and Mesoscopic Thermodynamics **2011**. Short course on frequency combs at CLEO/Europe **2011**, **2013** and **2015**. Summer School of Metrology by the Braunschweig international graduate school of metrology, **2012**. European Conference on Trapped Ions, **2012**. Stanford Photonics Research Center Annual Symposium, **2012**. Time and Matter 2013. International Conference on Laser Spectroscopy (ICOLS), **2013**. Annual Congress of the Swiss Academy of Sciences, **2013**. Enrico Fermi International Summer School, **2014**. Europhoton conference, **2014**. Annual Meeting of the Swiss Physical Society, **2014**. Light and Atoms Celebration of the international Year of Light, **2015**. Collège de France, **2015**. APS Division of Atomic, Molecular and Optical Physics (DAMOP), **2016**.