

Ferenc Krausz

Date of birth: 17 May 1962

Place of birth: Mór (Hungary)

Nationality: Hungarian, Austrian

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Max Planck Institute of Quantum Optics

Laboratory for Attosecond Physics

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Ludwig-Maximilians-Universität München

Chair of Experimental Physics – Laser Physics

Centre for Advanced Laser Applications

Am Coulombwall 1, 85748 Garching (Munich), Germany

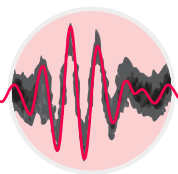


appointments

- Since 2019** Co-Founder (with M. Žigman), CEO // Center for Molecular Fingerprinting (CMF), Budapest, www.cmf.hu
- Since 2015** Founding Director // Centre for Advanced Laser Applications (CALA), LMU Munich, www.cala-laser.de
- 2010–2019** Director // Munich-Centre for Advanced Photonics (MAP)
- 2006** Co-Founder (with D. Habs) // Munich-Centre for Advanced Photonics (MAP)
- Since 2006** Founding Director // International Max Planck Research School of Advanced Photon Science (IMPRS-APS), www.mpq.mpg.de/APS
- Since 2004** Full Professor // Chair of Experimental Physics – Laser Physics, Ludwig-Maximilians-Universität München (LMU), www.physik.lmu.de/en
- Since 2004** Director // Max Planck Institute of Quantum Optics (MPQ), www.mpq.mpg.de/en
- 1999–2004** Full Professor // Technische Universität Wien (TUW), Department of Electrical Engineering
- 1996–1998** Assistant Professor // Technische Universität Wien (TUW), Department of Electrical Engineering

academic education

- 1993** Habilitation with distinction // Technische Universität Wien, Department of Electrical Engineering
- 1991–1993** Postdoctoral fellow // Technische Universität Wien, Department of Electrical Engineering
- 1991** Ph.D. with distinction in laser physics // Technische Universität Wien, Department of Electrical Engineering
- 1988–1991** Ph.D. studies // Technische Universität Wien, Department of Electrical Engineering
- 1985–1987** Ph.D. studies // Budapest University of Technology, Institute of Physics



- 1985** // Diploma with distinction in electrical engineering // Budapest University of Technology
- 1981–1985** // Undergraduate studies in electrical engineering // Budapest University of Technology
- Undergraduate studies in theoretical physics // Eötvös Loránd University, Budapest

scientific interest

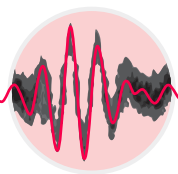
- Main fields** // Laser physics, time-resolved metrology, biomedical applications
- Research focus** // Attosecond physics and technology
- // Exploring the frontiers of electronics
- // Laser physics for health monitoring

major achievements

- // Co-invention of chirped multilayer mirrors and their use for the generation of few-cycle light
- // Generating and measuring controlled light waveforms and isolated attosecond pulses, developing time-resolved metrology and spectroscopy at the attosecond time scale
- // These advances heralded the emergence of a new field: **attosecond physics**

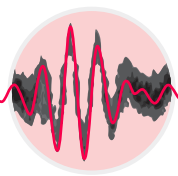
responsibilities

- Since 2009** // Initiating and coordinating the creation of the Laboratory of Extreme Photonics (LEX) at the LMU for the advancement of the technology of few-cycle light
- // Initiating and coordinating the creation of the Centre for Advanced Laser Applications (CALA) for the development of laser-driven brilliant X-ray and particle sources and their use for early cancer detection and therapy
- Since 2006** // Establishing and directing the International Max Planck Research School of Advanced Photon Science, offering a world-class graduate training and education program for some 50 Ph.D. students from all over the world
- // Establishing, coordinating, and (since 2010) directing the cross-disciplinary research activities of some 40 groups from 9 departments at the LMU and the Technical University of Munich, and the MPQ, in the areas of physics, chemistry, biology and medicine
- Since 2004** // Coordinating and directing the research of some hundred researchers and technical staff at the LMU-MPQ Laboratory for Attosecond Physics



honors

- 2024 Order of Saint Stephen of Hungary, The Head of the House of Habsburg-Lorraine
- 2024 Hungarian Corvin Chain, President of Hungary
- 2024 Grand Decoration of Honour in Gold with Sash for services to the Republic of Austria
- 2024 Honorary Doctorate Degree, Budapest University of Technology and Economics, Hungary
- 2024 Neumann Professorship, Budapest University of Technology and Economics, Hungary
- 2024 Bavarian Maximilian Order for Science and Art, Bavarian state government, Germany
- 2023 Nobel Prize in Physics, Royal Swedish Academy of Sciences, Sweden
- 2023 Frontiers of Knowledge Award, BBVA Foundation, Spain
- 2022 Wolf-Prize in Physics, Wolf Foundation, Israel
- 2022 Einstein-Lecture, Freie Universität Berlin, Max-Planck-Society
- 2019 Vladilen Letokhov Medal, the European Physical Society & the Russian Academy of Sciences
- 2018 János Arany Award for Outstanding Scientific Performance, the Hungarian Academy of Sciences
- 2016 Member of Leopoldina, the National Academy of Germany
- 2015 Thomson Reuters Citation Laureate in Physics
- 2014 Listed in The World's Most Influential Scientific Minds 2014, Thomson Reuters, USA
- 2013 Otto-Hahn-Preis of the DPG, GDCh and the City of Frankfurt/M, Germany
- 2013 King Faisal International Prize for Science, Saudi Arabia
- 2012 Knight's Cross of the Order of Merit of Hungary
- 2012 Member of the Academia Europaea, United Kingdom
- 2012 Member of the European Academy of Sciences (EURASC), Belgium
- 2011 Bundesverdienstkreuz am Bande (Order of Merit of the Federal Government), Germany
- 2011 Member of the Russian Academy of Sciences, Russia
- 2011 Falling-Walls Lecturer, falling-walls.com/lectures/ferenc-krausz, Germany
- 2010 Honorary Professorship at the Shanghai Institute of Optics and Fine Mechanics, China
- 2010 Visiting Professorship, King Saud University, Saudi Arabia
- 2010 Distinguished Visiting Professorship, POSTECH, Korea
- 2009 Fellow, Optical Society of America, USA
- 2009 Honorary Professorship, Xian Institute of Optics, Chinese Academy of Sciences, China
- 2009 Honorary Citizen, City of Mór, Hungary
- 2009 ERC Advanced Investigator Grant, European Union
- 2007 Member of the European Academy of Sciences and Arts, Austria
- 2007 Member of the Hungarian Academy of Sciences, Hungary
- 2006 Gottfried Wilhelm Leibniz-Prize, Deutsche Forschungsgemeinschaft, Germany



A T T O W O R L D

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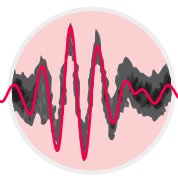


- 2006 Prize of the City of Vienna for Natural and Technical Sciences, Austria
- 2006 Progress Medal of the Royal Photographic Society, United Kingdom
- 2006 Manne Siegbahn Memorial Lecture, Royal Swedish Academy of Sciences, Sweden
- 2006 Max von Laue Memorial Lecture, Physikalische Gesellschaft zu Berlin, Germany
- 2006 James Frank Memorial Lecture, Israel Academy of Sciences, Israel
- 2006 Quantum Electronics Award, IEEE Laser and Electro-Optics Society, USA
- 2005 Honorary Doctorate Degree from the Budapest University of Technology, Hungary
- 2005 Honorary Professorship at the Vienna University of Technology, Austria
- 2003 Member of the Austrian Academy of Science, Austria
- 2003 Julius Springer Award in Applied Physics, Springer, Germany, USA
- 2002 Wittgenstein Award, Federal Ministry of Science and Education, Austria, 2002
- 1998 Carl Zeiss Award, Ernst Abbe Foundation, Germany, 1998
- 1996 START Award, Federal Ministry of Science & Education, Austria, 1996
- 1994 Fritz Kohlrusch Award, Austrian Physical Society, Austria, 1994

list of publications

www.attoworld.de/publications/ferenc-krausz.html

first electric field trace of visible light, measured in 2004



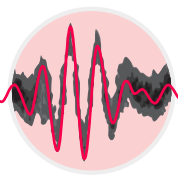
Ferenc Krausz, his coworkers & collaborators have advanced the femtosecond-scale control of the amplitude and frequency of laser light, serving as the basis for femtosecond technology¹, to the attosecond-scale control of the oscillating laser fields, underlying attosecond technology². The resultant controlled attosecond light force enabled them to access atomic-scale electron motions and make them perceivable to human observation. These advances³⁻⁷ marked the birth of a new discipline, attosecond physics, on the turn of the millenium.

Attosecond physics provides, for the first time, direct access to electronic and concomitant nuclear motions that occur in attosecond-femtosecond and picometer-nanometer dimensions of time and space. Electronic motions underlie chemical reactions just as they do information technologies based on electronic and optical signal processing. They constitute the primary steps of any change in the physical, chemical, and biological properties of materials and living organisms. The capability of observing and controlling them hence impacts the development of new materials, understanding biological function and malfunction, advancing information processing to its ultimate frontiers and exploring novel physical metrologies for medicine.

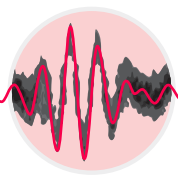
Ferenc Krausz and his coworkers have contributed to the establishment, validation and first applications of attosecond physics with milestones including:

- // the generation and measurement of the first light pulses shorter than one femtosecond³ and their use for capturing intra-atomic electron motion in real time⁴
- // the control⁵ and measurement⁷ of light fields, permitting the extension of the synthesis of electromagnetic waveforms from microwave to light frequencies^{14,18}
- // the use of the attosecond force that controlled light waveforms exert on electrons^{5,6,14,18} (a) for establishing attosecond technology based on isolated attosecond pulses^{6,11} synchronized to the controlled light force, allowing for the (b) control of electrons in atoms^{14,18}, molecules⁸, solids¹⁵, as well as in vacuum¹⁹,
- // the establishment of attosecond spectroscopy, allowing to (i) capture shake-up, cascaded Auger decay, tunneling⁹, the photoelectric effect¹² and wavepacket motion¹³ and field-induced shifts of energy levels¹⁴ in atoms, (ii) control Angstrom-scale electron transport^{10,16} in solids as well as their optical properties^{15,17,18}
- // electric-field-resolved molecular fingerprinting of biofluids for detecting and monitoring changes in the health state of living organisms²⁰.

With these advances, Ferenc Krausz has inspired and influenced the work of a research community that is now running several hundred ultrafast laser laboratories all over the world. Until the end of 2022, his work has been cited more than 49 (Web of Science) / 72 (Google Scholar) thousand times with an h-index of 101 (WoS) / 115 (GS).



- 1 Intense few-cycle laser fields: Frontiers of nonlinear optics**
T. Brabec & F. Krausz
Reviews of Modern Physics **72**, 545 (2000)
technologies underlying the generation of few-cycle laser light and their applications for exploring the frontiers of nonlinear optics
- 2 Attosecond physics**
F. Krausz & M. Ivanov
Reviews of Modern Physics **81**, 163 (2009)
basic concepts and techniques of attosecond measurements
- 3 Attosecond metrology**
M. Hentschel et al. *Nature* **414**, 509 (2001)
generation and measurement of a light pulse shorter than 1 femtosecond
- 4 Time-resolved atomic inner-shell spectroscopy**
M. Drescher et al. *Nature* **419**, 803 (2002)
real-time observation of electron dynamics in inner shells of atoms
- 5 Attosecond control of electronic processes by intense light fields**
A. Baltuška et al. *Nature* **421**, 611 (2003)
generation of laser light with controlled waveform and its use for controlling atomic-scale electron motion
- 6 Atomic transient recorder**
R. Kienberger et al. *Nature* **427**, 817 (2004)
demonstration of a light-field-driven “streak camera”, now the gold standard in attosecond metrology
- 7 Direct measurement of light waves**
E. Goulielmakis et al. *Science* **305**, 1267 (2004)
measurement of the oscillating electric field of a visible light pulse
- 8 Control of electron localization in molecular dissociation**
M. Kling et al. *Science* **312**, 246 (2006)
electron steering inside a molecule with the controlled electric field of light
- 9 Attosecond real-time observation of electron tunnelling in atoms**
M. Uiberacker et al. *Nature* **446**, 627 (2007)
tracking electron tunneling and intra-atomic electron interactions
- 10 Attosecond spectroscopy in condensed matter**
A. Cavalieri et al. *Nature* **449**, 1029 (2007)
real-time observation of electron transport through atomic layers of a crystal



- 11 Single-cycle nonlinear optics**
Goulielmakis et al. *Science* **320**, 1614 (2008)
breaking the 100-asec barrier in light pulse generation
- 12 Delay in photoemission**
M. Schultze et al. *Science* **328**, 1658 (2010)
discovery of a delay in the photo-effect, measured with a resolution better than the atomic unit of time
- 13 Real-time observation of valence electron motion**
E. Goulielmakis et al. *Nature* **466**, 739 (2010)
tracking the sub-femtosecond oscillatory motion of an electron inside an atom
- 14 Synthesized light transients**
A. Wirth et al. *Science* **334**, 195 (2011)
super-octave light waveform synthesis, observation of sub-femtosecond Stark shift and ionization
- 15 Optical-field-induced current in dielectrics**
A. Schiffrin et al. *Nature* **493**, 70–74 (2013)
Controlling dielectrics with the electric field of light
M. Schultze et al. *Nature* **493**, 75–78 (2013)
manipulation of the electric and optical properties of solids at light frequencies, paving the way towards petahertz signal metrology and processing
- 16 Direct observation of electron propagation and dielectric screening on the atomic length scale**
S. Neppl et al. *Nature* **517**, 342 (2015)
first attosecond real-time observation of electron transport through atomic layers in a solid
- 17 Optical attosecond pulses and tracking the nonlinear response of bound electrons**
M. Hassan et al. *Nature* **530**, 66 (2016)
attosecond pulses of visible-ultraviolet light and its applications for controlling and tracking intra-atomic electron motions
- 18 Attosecond nonlinear polarization and light-matter energy transfer in solids**
A. Sommer et al. *Nature* **534**, 86 (2016)
first direct observation of the oscillating optical polarization and energy exchange between light and matter
- 19 All-optical control and metrology of electron pulses**
C. Kealhofer et al. *Science* **352**, 429 (2016)
temporal control & characterization of freely propagating ultrashort electron wave-packets
- 20 Field-resolved infrared spectroscopy of biological systems**
I. Pupeza et al. *Nature* **577**, 52 (2020)
Electric-field molecular fingerprinting of biological systems for probing physiological changes of living organisms