Ferenc Krausz

Date of birth: 17 May 1962
Place of birth: Mór (Hungary)
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Max Planck Institute of Quantum Optics
Laboratory for Attosecond Physics
Hans-Kopfermann-Str. 1, 85748 Garching (Munich), Germany

Ludwig-Maximilians-Universität München
Chair of Experimental Physics – Laser Physics
Centre for Advanded 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

first electric field trace of visible light, measured in 2004

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

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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

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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 Kohlrausch Award, Austrian Physical Society, Austria, 1994

list of publications

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

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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 technology[1], to the attosecond-scale control of the oscillating laser fields, underlying attosecond technology[2]. The resultant controlled attosecond light force enabled them to access atomic-scale electron motions and make them perceivable to human observation. These advances[3–7] 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 femtosecond[3] and their use for capturing intra-atomic electron motion in real time[4]
// the control[5] and measurement[7] 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], molecules[8], solids[15], as well as in vacuum[19],
// the establishment of attosecond spectroscopy, allowing to (i) capture shake-up, cascaded Auger decay, tunneling[9], the photoelectric effect[12] and wavepacket motion[13] and field-induced shifts of energy levels[14] 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 organisms[20].

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).

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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

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LMU

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

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