



## Curriculum Vitae

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**Prof. Dr. Immanuel Bloch**

Max Planck Institute of Quantum Optics  
& Ludwig-Maximilians-Universität München

## Personal & Professional Information

**Date of Birth** 16. November, 1972 (Age 52)

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## Professional Experience

2024, 2020-2021	Managing Director, Max Planck Institute of Quantum Optics
2012-present	Vice-Dean of the "Fakultät für Physik", LMU Munich
2012-2014	Managing Director, Max Planck Institute of Quantum Optics
2009-present	Full Professor (W3), Chair at LMU Munich
2008-present	Scientific Director, Max Planck Institute of Quantum Optics
2003-2009	Full Professor (C4), Chair at the Johannes-Gutenberg University
2002-2003	Senior Scientist, LMU Munich
2000-2002	Senior Scientist, Max Planck Institute of Quantum Optics

## Education

1998-2000	PhD thesis in physics, Ludwig-Maximilians University, Munich (Prof. T.W. Hänsch)
1997-1998	Research visit, Stanford University (Prof. M.A. Kasevich)
1995-1996	Diploma thesis, Institute for Applied Physics, University of Bonn
1991-1995	Studies in physics, University of Bonn

## Publications

Over **205** publications (**47** in *Nature/Science*, **110** in *Phys. Rev. Lett./Nature Physics/Phys. Rev. X*)  
Google Scholar: *h*-index 116, # of citations >81550 ([Google Scholar Link](#))

**Clarivate Citation Laureate 2022** (for Quantum Simulation)  
**Clarivate Highly Cited Researcher 2014-2024**

## Invited Talks and Lectures

Over **335** talks at international conferences and workshops (including several schools) including many plenary and keynote talks. In addition, over **155** invited talks at national meetings.

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## Research Fields

Quantum Simulation • Quantum Computing • Quantum Optics • Strongly Correlated Quantum  
Many-Body Systems • Topological Phases • Non-Equilibrium Quantum Dynamics

## International Awards - Named Lectures - Academy Memberships

2025	<a href="#">Elected International Member of the National Academy of Sciences</a>
2025	<a href="#">Hightech Prize of the Bavarian Prime Minister</a>
2024	<a href="#">APS Outstanding Referee</a>
2024	<a href="#">Stern-Gerlach Medal of the German Physical Society (DPG)</a>
2023	Racah Lecture 2023 - Hebrew University of Jerusalem
2023	<a href="#">Zeiss Research Award 2023</a>
2022	<a href="#">Clarivate Citation Laureate 2022</a> <b>for pioneering work on Quantum Simulation</b>
2022	Hanna Visiting Professor, Stanford University
2021	Bavarian Maximilian Order for Science and Art
2020	<a href="#">Lise Meitner Distinguished Lecturer</a> , AlbaNova Stockholm (held in 2022)
2019	Ernest Kempton Adams Lecturer, Columbia University
2019	Hanan Rosenthal Lecturer, Yale University
2018	Lehrpreis Bayern – Prize for excellence in teaching in Bavaria
2018	Scott Lecturer, Cambridge University
2018	Elected Member of the Berlin Brandenburg Academy of Sciences (BBAW)
2018	Elected Member of the Bavarian Academy of Sciences (BAdW)
2018	Paco Yndurain Lecture, Universidad Autonoma de Madrid
2017	Cherwell Simons Lecture, Oxford University
2017	Goldener Sommerfeld – Prize for excellence in teaching by LMU physics students
2016	<a href="#">Harvey Prize of the Technion</a>
2015	Fellow of the American Physical Society
2014	Einstein Colloquium – Weizmann Institute of Science
2013	International BEC Award 2013
2013	<a href="#">Körber European Science Prize</a>
2013	ERC Synergy Grant “UQUAM” (Corresponding PI, with E. Altman, J. Dalibard & P. Zoller)
2013	<a href="#">Hector Science Prize</a> – Appointment as Hector Fellow
2013	Dr. Alexander M. Cruickshank Lecturer of the Gordon Research Conference program
2012	Distinguished Lecturer – MPI for the Science of Light
2011	Elected member of the German National Academy of Sciences (Leopoldina)
2011	EPS Senior Prize for Fundamental Aspects of Quantum Electronics and Optics
2010	Kavli Colloquium Lecturer – TU Delft
2008	Member of the Canadian Institute for Advanced Research (CIFAR)
2008	Distinguished Lecturer (Technion)
2007	Philip-Morris Research Prize
2005	International Commission for Optics Prize
2005	National Merit Medal of Germany (Bundesverdienstorden)
2004	Arkady Aronov Memorial Lecturer (Weizmann Institute of Science)
2004	Gottfried Wilhelm Leibniz Prize of the German Science Foundation (DFG)
2004	Marie-Curie Excellence Grant of the European Union
2003	Rudolf-Kaiser-Prize
2002	Otto-Hahn Medal of the Max-Planck Society
2001	PhD Prize of the Ludwig Maximilians University, Munich
2000	Research Prize of the Physics Faculty of the Ludwig Maximilians University, Munich
2000	Philip-Morris Research Prize (together with T.W. Hänsch & T. Esslinger)

## Organization of Conferences (Steering & Program Committee)

2024	Cal-Bay Quantum School (between Californian Universities and MCQST)
2024	Binational Italian-German WE-Heraeus-Seminar on Quantum Simulation
2024	Co-Director Enrico Fermi School on Quantum Computing and Simulation using Ultracold Atoms (with L. Fallani & A. Browaeys)
2024	Intl. Conference on Atomic Physics (ICAP2024) - Intl. Advisory Committee
2023	Ultracold Atomic Gases: Thirty Years of Activities and Looking Forward 2023 (Hong Kong)
2020	Intl. Conference on Atomic Physics (ICAP2020) - Intl. Advisory Committee
2019	MCQST-Technion Symposium on Quantum Science and Technology
2019	Intl. BEC Conference (San Feliu, Spain) – Chair
2019	Solvay Workshop on Quantum Simulation (Brussels, Belgium)
2018	Intl. Conference on Atomic Physics (ICAP 2018) - Intl. Advisory Committee
2018	Quantum Simulation & Computation (Bilbao, Spain)
2017	Intl. BEC Conference (San Feliu, Spain) – Vice Chair
2015	Frontiers in Quantum Simulations with Cold Atoms (INT, Seattle, USA)
2015	International Conference on Quantum Simulations (Benasque, Spain)
2014	ICTP Workshop on LZ Interferometry & Quantum Control in CM Physics (Izmir, Turkey)
2014	Intl. Conference on Quantum Communication, Measurement and Computing (Hefei, China)
2014	Intl. Conference on Atomic Physics (ICAP 2014)
2013	Intl. BEC Conference (San Feliu, Spain)
2013	Intl. Conference on Quantum Simulations (Benasque, Spain)
2013	Quantum Information Processing and Computing QIPC2013 (Florence, Italy)
2012	Quantum Simulations with Ultracold Atoms (ICTP Trieste, Italy)
2012	Photonics Europe 2012 Quantum and Atom Optics (Brussels, Belgium)
2011	2nd Exploratory Round Table Conference on Quantum Information Science (Shanghai, China)
2011	Advanced Workshop on Non-Standard Superfluids and Insulators (ICTP Trieste, Italy)
2011	IQEC/CLEO Pacific Rim, Cold Atoms and Molecules Committee Chair (Sydney, Australia)
2011	Quantum Gases in Dilute Atom Vapours (Bad Honnef, Germany)
2011	International Conference on Quantum Technologies (Moscow, Russia)
2011	Frontiers in Quantum Gases: Bose-Einstein Condensation (Sant Feliu, Spain)
2011	26th International Conference on Low Temperature Physics (Beijing, China)
2010	Beyond Standard Optical Lattices (KITP, Santa Barbara, USA)
2010	Frontiers of Ultracold Atoms and Molecules (KITP Santa Barbara, USA)
2008	Frontiers of Degenerate Quantum Gases CASTU (Beijing, China)
2008	XXXII International Workshop on Condensed Matter Theories (Loughborough, UK)
2007	SCALA 3rd Annual Meeting (Mainz, Germany)

## Other Activities (Editorial Work & Research Management)

Over the past **20 years**, Immanuel Bloch has managed and coordinated more than **20 research grants** awarded by different national and international funding agencies. Funding agencies include DFG, MPG, EU, BMBF, DARPA, USAF, Landesstiftung Rheinland-Pfalz, Körber Stiftung, Free State of Bavaria.

- APS Outstanding Referee (2024)
- Member of the SAB of the **Center for Quantum Technologies (CQT)** Singapore (since 2024)
- Member of the **John Stewart Bell Prize 2024** committee
- Member of the **Munich Quantum Valley Initiative - MQV** (since 2021)
- Scientific Spokesperson **Programmausschuss Quantensysteme** (2018-2022)
- Spokesperson of the DFG Excellence Cluster **Munich Center for Quantum Science and Technology (MCQST)** (since 2018)
- Spokesperson of the **DFG Research Unit 2414** (2016-2021)  
*"Artificial Gauge Fields and Interacting Topological Phases in Ultracold Atoms"*
- Board member of **Physik Journal** (2015-2019)
- Board member of the **Hector Fellow Academy** (since 2014)
- International Scientific Advisory Board – **KITP Santa Barbara** (2014-2016)
- **International Editorial Board: Physical Review B**, American Physical Society (2013-2017)
- **International Editorial Board: Annalen der Physik** (since 2013)
- Advisory Committee Member: **NIM Excellence Cluster** at LMU Munich
- Speaker of the **DFG Research Unit 801** (2007-2014)  
*"Strong Correlations in Multiflavor Quantum Gases"*
- Member of the Steering Committee of the DFG funded **SFB/TRR49** (until 2008)
- Member of the **Heinz-Maier Leibnitz Prize Committee** of the DFG (2006-2012)
- Member of the **Perspective Committee of the Max-Planck Society** (2009-2015)
- Referee for Nature, Science, Nature Physics, Physical Review X, Physical Review Letters, and others

## Support of Young Researchers

The support of young researchers is a vital part of the work of Immanuel Bloch. Over **20 young academics** working in the group have received a professorship, **20 postdoctoral researchers** have obtained permanent positions in academia, and **over 59 PhD students** have finished their thesis and moved on to prestigious positions in **academia and industry**.

Among some of the former group members now holding distinguished positions in academia are: M. Aidelsburger (MPQ/LMU), J. Barreiro (UC San Diego), K. Blaum (MPIKP), T. Chalopin (Institut d'Optique), Y.-A. Chen (USTC), M. Cheneau (Institut d'Optique), J.-Y. Choi (KAIST), N. Darkwah-Oppong (Caltech), M. Endres (Caltech), T. Fukuhara (RIKEN), M. Greiner (Harvard), C. Gross (Tübingen), L. Hackermüller (Nottingham), T. Hilker (Strathclyde), S. Hodgman (ANU), S. Kuhr (Strathclyde), S. Nascimbène (Paris), H. Ott (Kaiserslautern), A. Rauschenbeutel (HU Berlin), J. Rui (USTC), P. Schauss (Virginia), F. Scazza (Trieste), M. Schleier-Smith (Stanford), U. Schneider (Cambridge UK), J. Sherson (Aarhus), J. Vijayan (Manchester), C. Weitenberg (Dortmund), A. Widera (Kaiserslautern), S. Will (Columbia), T. Yefsah (ENS), M. Zwierlein (MIT)

## Brief Research Summary

Immanuel Bloch's work focuses on ultracold quantum matter at temperatures near absolute zero. With the help of laser beams, he generates artificial crystals of light, in which ultracold atoms or molecules can be captured in a matrix of microscopic light traps. In this way, artificial model systems can be generated, such as for real solids and beyond that can be controlled and probed in fundamentally new ways. For example, this makes it possible to precisely adjust the crystal structure or the interactions between the atoms and observe ground states, topological states or non-equilibrium dynamics with single site resolution and single atom and spin sensitivity. This also opens up entirely new parameter ranges to study the behavior of matter under most extreme conditions. In addition, the trapped atomic and molecular gases can be used to realize novel quantum optical light-matter interfaces without external optical elements. Exploring novel pathways for cooling, rapid preparation, potential engineering, and interaction control of such quantum gases forms a central focus of his team's research.

With his research, Immanuel Bloch has opened a new and interdisciplinary research field at the interface of **quantum physics, quantum information science, atomic- molecular- and condensed matter physics**. His work marks the first realization of **quantum simulators**, as initially proposed by **Richard Feynman** for exploring complex quantum matter, a field that is now intensely pursued in a wide variety of quantum systems ranging from trapped ions, and superconducting arrays to atomic tweezer arrays, to name just a few. Quantum simulations can be seen as one of the earliest scientific applications of quantum technologies, significantly enhancing our understanding of quantum many-body systems through innovative experimental observations and control techniques.

Immanuel Bloch has explored a wide array of research fields within quantum simulation. His work encompasses research on strongly correlated bosonic and fermionic quantum systems, as well as topological systems, disordered quantum gases, phenomena related to high-energy physics, non-equilibrium quantum dynamics, and innovative quantum optical light-matter interfaces. This diverse range of research not only highlights the extensive applications of quantum simulations but has also inspired numerous experiments across various experimental platforms.

## Main Scientific Achievements (Short List)

- First experimental realization of strongly correlated quantum phases with ultracold atoms in the **quantum phase transition from a superfluid to a Mott insulator** (*one of the most cited papers overall in Atomic, Molecular and Optical Physics with >8000 GS citations*). This work marks the **experimental starting point of the field of quantum simulations** ([Nature 415, 39 2002](#))
- Direct observation of the dynamical **collapse and revival of a macroscopic quantum field** induced by interactions ([Nature 419, 51 2002](#))
- First experimental realization of **collisional quantum gates** with neutral atoms ([Nature 425, 937 2003](#))
- First experimental realization of a 'fermionized' **Tonks-Girardeau gas** of neutral atoms ([Nature 429, 277 2004](#))
- Experimental realization of **noise correlation measurements** with ultracold quantum gases and first observation of **fermionic Hanbury-Brown & Twiss** type antibunching with neutral atoms ([Nature 434, 481 2005](#) & [Nature 444, 733 2006](#))
- First observation of **superexchange spin interactions** with ultracold atoms ([Science 319, 295 2008](#))
- Realization of **fermionic Mott Insulators** ([Science 322, 1520 2008](#))
- Together with the group of M. Greiner (Harvard), first **single-atom resolved observation of a Mott insulator** ([Nature 467, 68 2010](#))
- First **single-site and single-atom resolved spin control** in large 2D arrays of neutral atoms ([Nature 471, 319 2011](#))
- Direct observation of quantum fluctuations and **hidden order** in strongly interacting quantum systems ([Science 334, 200 2011](#))
- Generation of tuneable **artificial magnetic fields** for ultracold atoms in an optical lattice ([Phys. Rev. Lett. 107, 255301 2011](#))
- Observation of '**Higgs**' mode in two-dimensional quantum gases at the SF-MI QPT ([Nature 487, 454 2012](#))
- Realization of **negative absolute temperatures** in motional states of atoms ([Science 339, 52 2013](#))
- First observation of **light-cone-like spreading** of correlations in a many-body system (*marked the first observation of Lieb-Robinson light cones and information spreading in experiments*) ([Nature 481, 484 2012](#))
- Direct measurement of the **Zak-Phase** (Berry Phase) in topological Bloch bands ([Nat. Physics 9, 795 2013](#))
- Microscopic observation of **two-magnon bound states** ([Nature 502, 76 2013](#))
- Realization and direct observation of **mesoscopic Rydberg quantum crystals** ([Nature 491, 87 2012](#))
- First realization of **topological two-dimensional Bloch bands** with ultracold atoms via the **Hofstadter model** ([Phys. Rev. Lett. 111, 185301 2013](#))
- First measurement of **Chern number** and **Hall transport** in non-electronic systems ([Nat. Physics 11, 162 2015](#))
- First realization of an **Aharonov-Bohm type interferometer** for the measurement of Bloch band topology ([Science 347, 288 2015](#))
- First realization of a **Thouless quantum pump** (simultaneous with the group of Y. Takahashi) ([Nat. Physics 12, 350 2016](#))
- Observation of **Many-Body Localization** using interacting fermions in quasi-random lattices ([Science 349, 842 2015](#))



- Exploring **Many-Body Localization** using interacting bosons in 2D ([Science 352, 1547 2016](#))
- Observation of single-site **spin- and charge resolved AFM correlations** Fermi Hubbard model ([Science 353, 1257 2016](#))
- First realization of a **Topological spin pump** in 2D realizing the 4D Integer Quantum Hall Effect ([Nature 553, 55 2018](#))
- First observation of **hidden non-local antiferromagnetic ordering** ([Science 357, 484 2017](#))
- First direct **microscopic imaging** of a magnetic polaron in the 2d doped Fermi Hubbard model ([Nature 572, 358 2019](#))
- Direct observation of **dynamical spin charge deconfinement (fractionalization)** in 1D Fermi Hubbard chains ([Science 367, 186 2020](#))
- First realization of **subwavelength cooperative atom-light interfaces** in the optical regime ([Nature 583, 369 2020](#))
- Observation of **Floquet prethermal phases of matter** ([Phys. Rev. X 10, 021044 2020](#))
- Realization of the **symmetry-protected Haldane phase** in Fermi-Hubbard ladders ([Nature 606, 484 2022](#))
- Observation of **Kardar-Parisi-Zhang universality** in the quantum dynamics of 1d Heisenberg spin chains ([Science 376, 716 2022](#))
- Demonstration of **novel evaporation scheme for polar molecules** using microwave shielding. Cooling in 3d to deep quantum degeneracy ([Nature 607, 677 2022](#))
- Observation of **magnetically mediated hole pairing** in mixed dimensional Fermi-Hubbard Systems ([Nature 613, 462 2023](#))
- First demonstration of **field linked scattering resonances** for polar molecules ([Nature 614, 59 2023](#))
- First realization of **quantum metasurfaces** (subwavelength optical array switched by a single atom) ([Nature Physics 19, 714 2023](#))
- First realization of **ultracold field-linked tetratomic molecules** ([Nature 626, 283 2024](#))
- Observation of **Hilbert space fragmentation** in 2D and first detection of **fractonic excitations** ([Nature \(online\), 2024](#))

## Member of International Academic Societies

Deutsche Physikalische Gesellschaft  
 European Physical Society  
 Fellow of the American Physical Society  
 German National Academy of Sciences (Leopoldina)  
 Bavarian Academy of Sciences (BAdW)  
 Berlin Brandenburg Academy of Sciences (BBAW)  
 National Academy of Sciences (NAS)  
 Scientific Member of the Max-Planck Society