



Curriculum Vitae Professor Dr Peter Hegemann



Image: Bernd Prusowski | HU Berlin

Name: Peter Hegemann
Born: 11 December 1954

Research Priorities: Channelrhodopsins, optogenetics, neural networks, photobiology of green algae (*Chlamydomonas reinhardtii*), photo receptors

Peter Hegemann is a biophysicist. The focus of his work is algae research. He analyses sensory photo receptors of microalgae and is one of the discoverers of channelrhodopsins. These light-sensitive proteins are the basis for the scientific field of optogenetics, which Peter Hegemann co-founded. Optogenetics allows neural networks to be investigated in new ways.

Academic and Professional Career

- since 2015 Hertie Senior Research Chair for Neurosciences, Hertie Foundation, Frankfurt am Main, Germany
- since 2012 Guest Fellow, Howard Hughes Medical Institute, Ashburn, USA
- since 2005 Professor of Experimental Biophysics, Humboldt-Universität zu Berlin, Berlin, Germany
- 1993 - 2004 Professor of Biochemistry, University of Regensburg, Regensburg, Germany
- 1992 Habilitation, Ludwig-Maximilians-Universität Munich (LMU) München, Munich, Germany
- 1986 - 1992 Principal Investigator, Research Group, Max Planck Institute of Biochemistry, Martinsried, Germany
- 1985 - 1986 Research Stay, Physics Department, Syracuse University, Syracuse, USA
- 1984 Doctorate, Max Planck Institute of Biochemistry, Martinsried, Germany
- 1980 Diploma in Biochemistry

1975 - 1980 Degree in Chemistry, University of Münster, Münster, Germany as well as LMU Munich, Munich, Germany

Functions in Scientific Societies and Committees

2009 - 2012 Member, Senate Committee on Collaborative Research Centres, German Research Foundation (DFG), Germany

2008 - 2010 Member, Administrative Council, Cluster of Excellence (EXC) 314 "UniCat – Unifying Concepts in Catalysis", DFG, Germany

Project Coordination, Membership in Collaborative Research Projects

since 2019 Applicant, Project "Functional in vivo studies of algal sensory photoreceptors", DFG, Germany

since 2019 Applicant, Project "Probing functional connectivity in vivo via holographic and molecular targeting", DFG, Germany

since 2019 Applicant, Subproject "Engineering of Chrimson for subcellular optogenetic application", Priority Programme (PP) 1926, DFG, Germany

since 2019 Applicant, Subproject "Shrimp rhodopsins as new far-red absorbing optogenetic tools", PP 1926, DFG, Germany

since 2018 Principal Investigator, Subproject "Development of molecular tools for manipulating and studying memory engrams", Collaborative Research Centre (CRC) 1315, DFG, Germany

2016 - 2023 Applicant, Subproject "Development and application of RoCK, a novel Rhodopsin Cyclase/K+ channel-based optogenetic tool for silencing of excitable cells", PP 1926, DFG, Germany

2016 - 2022 Applicant, Subproject "Development and application of new optogenetic tools targeted to intracellular compartments", PP 1926, DFG, Germany

2016 - 2021 Advanced Grant "Mechanism of enzyme rhodopsin activation (MERA)", European Research Council (ERC)

2016 - 2020 Advanced Grant "Active dendrites and cortical associations (ActiveCortex)", ERC

since 2015 Principal Investigator, Project "FTIR spectrometer with laser excitation system", DFG, Germany

since 2013 Principal Investigator, Subproject "Fault networks and scaling properties of deformation accumulation", CRC 1078, DFG, Germany

- since 2013 Principal Investigator, Subproject "Protonation dynamics in protein function", CRC 1078, DFG, Germany
- since 2013 Principal Investigator, Subproject "Gating and ion transport dynamics in channelrhodopsins and light-driven pumps", CRC 1078, DFG, Germany
- 2013 - 2017 Applicant, Subproject "Characterization of biomodal light-switchable rhodopsins and tailoring for optogenetic application", FOR 1279, DFG, Germany
- 2011 - 2016 Applicant, Project "Investigation of BLUF photochemistry by isotopic labeling of flavin cofactor and amino acid side chains", DFG, Germany
- 2011 - 2016 Applicant, Project "Ultrafast dynamics of biomolecules studied by vibrational spectroscopy on selectively isotope labeled proteins", DFG, Germany
- since 2010 Spokesperson, Research Unit (FOR) 1279 "Protein-based photoswitches", DFG, Germany
- 2009 - 2014 Applicant, Central Project, FOR 1261, DFG, Germany
- 2010 - 2017 Applicant, Subproject "Channelrhodopsin colour tuning", FOR 1279, DFG, Germany
- 2009 - 2014 Applicant, Project "Photochromism of Channelrhodopsin-1 of *Volvox carteri* (VCHR)", DFG, Germany
- 2009 - 2017 Applicant, Subproject "Functional characterization of novel rhodopsins of *Chlamydomonas* and other algae", FOR 1261, DFG, Germany
- 2007 - 2018 Participating Scientist, Cluster of Excellence (EXC) 314 "Unifying Concepts in Catalysis", DFG, Germany
- 2005 - 2010 Applicant, Subproject "Molecular mechanisms of gene silencing and positional effects in Green Algae", FOR 504, DFG, Germany
- 2005 - 2009 Applicant, Subproject "Nuclear gene targeting in *Chlamydomonas reinhardtii*", FOR 504, DFG, Germany
- 2005 - 2009 Principal Investigator, Subproject "Expression and spectroscopic characterization of channelrhodopsins and enzymerrhodopsins from *Chlamydomonas reinhardtii*", CRC 498, DFG, Germany
- 2004 - 2011 Participating Scientist, Subproject "Biochemical and spectroscopic characterization of blue light receptors with LOV and BLUF-domain-type chromophores from microalgae and purple bacteria", FOR 526, DFG, Germany
- 2004 - 2010 Spokesperson, FOR 526 "Blue-light sensitive photoreceptors", DFG, Germany
- 2003 - 2013 Applicant, Project "The channelrhodopsin mechanism", DFG, Germany
- 2000 - 2003 Spokesperson, Interdisciplinary Graduate School GK 640 "Sensory photoreceptors in natural and artificial systems", DFG, Germany

- 1997 - 1998 Principal Investigator, Subproject “Rhodopsin-regulated ion signal processes in Chlamydomonas und Volvox”, CRC 521, DFG, Germany
- 1996 - 2004 Principal Investigator, Subproject “Sensory rhodopsin single-celled algae”, CRC 521, DFG, Germany

Honours and Awarded Memberships

- since 2022 Member, National Academy of Sciences, USA
- since 2022 Member, American Academy of Arts and Sciences, USA
- 2022 Louisa Gross Horwitz Prize, Columbia University, New York City, USA
- 2021 Lasker Basic Medical Research Award, Lasker Foundation, New York City, USA
- 2020 Shaw Prize, Shaw Prize Foundation, Hong Kong, China
- 2019 Warren Alpert Foundation Prize, Warren Alpert Foundation, Providence, USA
- 2018 Rumford Prize, American Academy of Arts and Sciences, USA
- 2018 Canada Gairdner International Award, The Gairdner Foundation, Toronto, Canada
- 2018 Otto Warburg Medal, (German) Society for Biochemistry and Molecular Biology (GBM), Frankfurt am Main, Germany
- 2017 Mendel Medal, German National Academy of Sciences Leopoldina, Germany
- 2017 Harvey Prize, Technion – Israel Institute of Technology, Haifa, Israel
- 2016 Massry Prize, Meira and Shaul G. Massry Foundation, Beverly Hills, USA
- 2016 Hector Science Award and Hector Fellow, Hector Foundation II, Karlsruhe, Germany
- 2015 Berliner Wissenschaftspreis, Governing Mayor of Berlin, Germany
- since 2014 Member, European Molecular Biology Organisation (EMBO)
- since 2014 Member of the Berlin-Brandenburg Academy of Sciences and Humanities, Berlin, Germany
- 2013 Brain Prize, Lundbeck Foundation, Copenhagen, Denmark
- 2013 Louis-Jeantet Prize for Medicine, Louis-Jeantet Foundation, Geneva, Switzerland
- 2013 Gottfried Wilhelm Leibniz Award, DFG, Germany
- since 2012 Member, German National Academy of Sciences Leopoldina, Germany
- 2012 Zülch Prize Award for Translational Neuroscience, Max Planck Society for the Advancement of Science, Munich, Germany
- 2010 Karl Heinz Beckurts Prize, Karl Heinz Beckurts Foundation, Berlin, Germany

2010	Wiley Prize in Biomedical Sciences, Wiley Foundation, Hoboken, USA
1986	Karl Winnacker Grant, Aventis Foundation, Frankfurt am Main, Germany
1984	Otto Hahn Medal, Max Planck Society for the Advancement of Science, Munich, Germany

Research Priorities

Peter Hegemann is a biophysicist. The focus of his work is algae research. He analyses sensory photo receptors of microalgae and is one of the discoverers of channelrhodopsins. These light-sensitive proteins are the basis for the scientific field of optogenetics, which Peter Hegemann co-founded. Optogenetics allows neural networks to be investigated in new ways.

Channelrhodopsins are proteins made of single-cell micro algae (*Chlamydomonas reinhardtii*) that form light-sensitive ion-channels in the cell membrane. Under blue light, these channels become temporarily transparent for protons and cations (Na^+ , K^+ und Ca^{2+}). Peter Hegemann and his working group have characterised the function of the channelrhodopsins and analysed various subtypes.

In cooperation with the biophysicist Georg Nagel, from Würzburg, Germany, he was able to prove the concept of light-activated ion channels. Building on these insights, he expanded the scientific field of optogenetics, a mix of optical technology and genetics. When channelrhodopsin-2 proteins are inserted into the cell membrane, the cell can be controlled via light. The infiltrated proteins react like light switches. Thus, for the first time, scientists are now able to switch nerve cells on and off. Hegemann was able to prove that this principle works in different cell types.

In other work, Peter Hegemann and his colleagues were able to excite complex neural networks with light. Hegemann caused behavioural changes in mice using light. He succeeded in switching off neurons that use dopamine in mouse brains. This reduces the symptoms of Parkinson's disease.

His research group also identified the selectivity filter of the channelrhodopsins and modified them in such a way that the negatively charged chloride ions are guided through the ion channels. In this way, scientists have developed a new optogenetic tool (neurooptical technologies) with which the connectivity of neural networks can be analysed. The technology is suitable for investigating illnesses such as epilepsy, Parkinson's disease and age-related macular degeneration. Following on from this, it was possible to create new, specific treatment concepts, for example optical pacemakers.

In addition, Peter Hegemann's working group also looks at flavin-based blue light receptors such as phototropins. This receptor controls the bending movements of sprouts and leaves. The team were also able to successfully complete targeted gene modification in the green algae *Chlamydomonas* and thus provide algae research with an important new tool. Furthermore, Peter Hegemann is committed to the dialogue between science and society.