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Dr. rer. nat. (PhD) in Chemistry / Diploma in Biophysics

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Radiation Protection Manager

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**Research areas**

Our research focuses on elucidating the molecular details of signal transduction processes in membrane proteins and in metalloenzymes. In particular we are interested on structural investigations of various G-protein-coupled receptor (GPCRs), photoreceptors (e.g. vertebrate cone and rhodopsins, microbial rhodopsins, phytochromes, photolyases, melanopsins), GPCR-related signaling proteins (e.g. G-proteins, arrestins, phosphodiesterases, dishevelled) and several metalloenzymes (e.g. [NiFe]-hydrogenases and lipoxygenases). In my lab we apply a wide array of different techniques to study different protein systems, such as membrane and soluble protein production (e.g. different heterologous cell expression systems), molecular biology, biochemical, biophysical (e.g. multi-angle light scattering, differential scanning calorimetry, microscale thermophoresis) and crystallization (using robot-platforms, conventional, lipid cubic phase (LCP), micelle/bicelle). Our core skills are protein-production and -engineering, protein X-ray crystallography and combined crystallographic-spectroscopic approaches with a broad network of international collaborators and access to several high-end synchrotrons. In the last years, we established also conventional and pump-probe methods for our protein samples at free electron laser facility LCLS-SLAC in Stanford, USA. In parallel, we started a collaboration with our in-house partners on cryo-electron microscopy to investigate several membrane protein and protein-complex targets.

**Research key words**

Protein X-ray crystallography, membrane proteins, signal transduction, X-ray structure analysis, molecular structure, dynamics and function of proteins, molecular modelling, methodological development of a combined crystallographic and spectroscopic approach, free-electron laser techniques, photoreceptors and related signal transduction proteins, G-protein-coupled receptor, GPCR, rhodopsin, arrestin, G-protein, channelrhodopsin,

microbial opsins, melanopsin, phytochrome, photolyase, cryptochrome, [NiFe]-hydrogenase, metallo-proteins, Two-component regulatory systems, CpxRAP system, phosphodiesterase, PRG's

### **Funding for approved projects / grants / applications**

**01/ 2017 – 12/ 2020 - 2. Period - SFB 1078-B6 Full Project:** "Proton-coupled conformational changes in photoreceptors" shared with Prof. Peter Hildebrandt (TU-Berlin) – Collaborative Research Center 1078 "Protonation Dynamics in Protein Function " supported by the German Research Foundation (DFG) - (Host: Freie Universität Berlin - <http://www.sfb1078.de/index.html>)

**01/ 2015 – 12/ 2018 SFB 740-B6 Full Project:** "Structural elucidation of the GPCR allosteric machine"– Collaborative Research Center 740 "From Molecules to Modules: Organisation and Dynamics of Functional Units in Cells" supported by the German Research Foundation (DFG) - (Host: Charité – University Medicine Berlin - <http://www.sfb740.de/en/>)

**01/ 2017 – 01/ 2020** – Industry-Cooperation with Bayer AG

**11/ 2012 – 12/ 2018 UniCat Full Project - Research area E3-1:** "Structural investigations of oxygen-tolerant [NiFe] hydrogenases" – Cluster of Excellence "Unifying Concepts in Catalysis" supported by the German Research Foundation (DFG) - (Host: Technische Universität Berlin - <http://www.unicat.tu-berlin.de/>)

**01/ 2013 – 12/ 2016 - 1. Period - SFB 1078-B6 Full Project:** "Proton-coupled conformational changes in photoreceptors" shared with Prof. Peter Hildebrandt (TU-Berlin) – Collaborative Research Center 1078 "Protonation Dynamics in Protein Function " supported by the German Research Foundation (DFG) - (Host: Freie Universität Berlin - <http://www.sfb1078.de/index.html>)

**01/ 2013 – 12/ 2020 European Synchrotron Radiation Facility (ESRF)** synchrotron beamtime application – shared with Dr. N. Krauss (KIT, Karlsruhe / Prof. A. Zouni (Humboldt Universität Berlin) / Dr. P. Scheerer (Charité – Universitätsmedizin Berlin) - Period: 01/2015-12/2018 (continuation from 2007) - Research topics: G-protein-coupled receptors, rhodopsin, phytochromes, photolyases, photosystems, [NiFe]-hydrogenase etc.

**01/ 2006 – 12/ 2022 Helmholtz-Zentrum Berlin (HZB)-BESSY II** (periods 2006 - 2017) - Synchrotron – beamtime application-grants: Topic: G-protein-coupled receptors, rhodopsin, phytochromes, photolyases, [NiFe]-hydrogenase and others.

**2015 – 2018 - SLAC-LCLS** – Free electron Laser - **Linac Coherent Light Source** beamtime application-grants: Topic: Rhodopsin, Phytochrome, [NiFe]-hydrogenase

### **Memberships**

Deutsche Gesellschaft für Biophysik (DGfB), Deutschen Gesellschaft für Kristallographie (DGK), Humboldt-Universitäts-Gesellschaft, Berlin Institute of Health (BIH) Young Science, Einstein Centre for Catalysis EC<sup>2</sup>

### **Refereeing Activities**

*e.g. Nature, Nature Chemical Biology, Nature Communications, Faseb J., J. Biol. Inorg. Chem, etc.*

### **Protein structure database related entries** (<http://www.rcsb.org/>)

(6GYH; 6G1Y; 6G1Z; 6G20; 6ELW; 5MDL; 5MDK; 5MDJ; 5T4X; 5U5Q; 5MND; 5TRX; 5KCM; 5LFA; 5LC8; 5IR4; 5IR5; 5I5L; 5HSQ; 5L49; 5L48; 5L4D; 5L4A; 5L4B; 5L4C; 5D51; 5FLX; 3JCJ; 3JCN; 5AJ0; 4U63; 4V6T; 4PXF; 4TTT; 4IUB; 4IUC; 4IUD; 4J2Q; 4DJA; 3RGW; 3ITF; 3PXO; 3PQR; 3DQB; 3CAP; 3J18; 3J19; 3RJS; 2OR9; 2ORB; 2I9E; 2OBI; 1ZEA)

## Summary of all publications

Source “[Google Scholar](#)” – h-index = 27 (*i10-index* 42; (since 2013): *h-index* = 24, *i10-index* = 38)

**69 publications (> 4770 citations) in scientific journals - period 08-2018 – 01-2004**

(and 5 submitted manuscripts)

(\* These first authors contributed equally to this work)

(<sup>§</sup> Corresponding author)

### 2018

- (69) Qureshi BM, Schmidt A, Behrmann E, Bürger J, Mielke T, Spahn CMT, Heck M, **Scheerer P<sup>§</sup>**. Mechanistic insights into the role of prenyl-binding protein PrBP/δ in membrane dissociation of phosphodiesterase 6. *Nature Communications* 2018, 9(1):90. PMID: 29311697
- (68) Clément K, Biebermann H, Farooqi IS, Van der Ploeg L, Wolters B, Poitou C, Puder L, Fiedorek F, Gottesdiener K, Kleinau G, Heyder N, **Scheerer P**, Blume-Peytavi U, Jahnke I, Sharma S, Mokrosinski J, Wiegand S, Müller A, Weiß K, Mai K, Spranger J, Grüters A, Blankenstein O, Krude H, Kühnen P. MC4R agonism promotes durable weight loss in patients with leptin receptor deficiency. *Nature Medicine*. 2018, 24(5):551-555. PMID: 29736023
- (67) Kalms J, Schmidt A, Frielingsdorf S, Utesch T, Gotthard G, von Stetten D, van der Linden P, Royant A, Mroginski MA, Carpentier P, Lenz O, **Scheerer P<sup>§</sup>**. Tracking the route of molecular oxygen in O<sub>2</sub>-tolerant membrane-bound [NiFe] hydrogenase. *Proc Natl Acad Sci U S A* 2018, 115(10):E2229-E2237. PMID: 29463722
- (66) Khajavi N, Finan B, Kluth O, Müller TD, Mergler S, Schulz A, Kleinau G, **Scheerer P**, Schürmann A, Gudermann T, Tschöp MH, Krude H, DiMarchi RD, Biebermann H. An incretin-based tri-agonist promotes superior insulin secretion from murine pancreatic islets via PLC activation. *Cellular Signalling*. 2018, 51:13-22. PMID: 30055232
- (65) Saleh N, Kleinau G, Heyder N, Clark T, Hildebrand PW<sup>§</sup>, **Scheerer P<sup>§</sup>**. Binding, Thermodynamics, and Selectivity of a Non-peptide Antagonist to the Melanocortin-4 Receptor. *Frontiers in Pharmacology*. 2018, 9:560. PMID: 29910730
- (64) Borchert A, Kalms J, Roth SR, Rademacher M, Schmidt A, Holzhutter HG, Kuhn H<sup>§</sup>, **Scheerer P<sup>§</sup>**. Crystal structure and functional characterization of selenocysteine-containing glutathione peroxidase 4 suggests an alternative mechanism of peroxide reduction. *Biochim Biophys Acta. (BBA) - Molecular and Cell Biology of Lipids* 2018, 1863(9):1095-1107. PMID: 29883798
- (63) Bräunig J, Dinter J, Höfig CS, Paisdzior S, Szczepek M, **Scheerer P**, Rosowski M, Mittag J, Kleinau G, Biebermann H. The Trace Amine-Associated Receptor 1 Agonist 3-Iodothyronamine Induces Biased Signaling at the Serotonin 1b Receptor. *Frontiers in Pharmacology*. 2018, 9:222. PMID: 29593543
- (62) Elgeti M, Kazmin R, Rose AS, Szczepek M, Hildebrand PW, Bartl FJ, **Scheerer P**, Hofmann KP. *J Biol Chem*. 2018, 293(12):4403-4410. PMID: 29363577

### 2017

- (61) **Scheerer P<sup>§</sup>**, Sommer ME<sup>§</sup>. Structural mechanism of arrestin activation. *Current Opinion in Structural Biology*. 2017, 45:160-169. PMID: 28600951
- (60) Oberthuer D, Knoška J, Wiedorn MO, Beyerlein KR, Bushnell DA, Kovaleva EG, Heymann M, Gumprecht L, Kirian RA, Barty A, Mariani V, Tolstikova A, Adriano L, Awel S, Barthelmess M, Dörner K, Xavier PL, Yefanov O, James DR, Nelson G, Wang D, Calvey G, Chen Y, Schmidt A, Szczepek M, Frielingsdorf S, Lenz O, Snell E, Robinson PJ, Šarler B, Belšak G, Maček M, Wilde F, Aquila A, Boutet S, Liang M, Hunter MS, **Scheerer P**, Lipscomb JD, Weierstall U, Kornberg RD, Spence JC, Pollack L,

Chapman HN, Bajt S. Double-flow focused liquid injector for efficient serial femtosecond crystallography. *Scientific Reports*. 2017, 7:44628. PMID: 28300169

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- (58) Lamparter T<sup>§</sup>, Krauß N<sup>§</sup>, **Scheerer P<sup>§</sup>**. Phytochromes from *Agrobacterium fabrum*. *Photochem Photobiol*. 2017, 93(3):642-655. PMID: 28500698
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- (53) Zhang F, Ma H, Bowatte K, Kwiatkowski D, Mittmann E, Qasem H, Krauß N, Zeng X, Ren Z, **Scheerer P<sup>§</sup>**, Yang X<sup>§</sup>, Lamparter T<sup>§</sup>. Crystal Structures of Bacterial (6-4) Photolyase Mutants with Impaired DNA Repair Activity. *Photochem Photobiol*. 2017, 93(1):304-314. PMID: 27992645

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- (52) Müller A, Berkmann JC, **Scheerer P**, Biebermann H, Kleinau G. Insights into Basal Signaling Regulation, Oligomerization, and Structural Organization of the Human G-Protein Coupled Receptor 83. *PLoS One*. 2016, 11(12):e0168260. PMID: 27936173
- (51) Banthiya S, Kalms J, Yoga E, Ivanov I, Tauber R, Carpena X, Hamberg M, Kuhn H<sup>§</sup>, **Scheerer P<sup>§</sup>**. Structural and functional basis of phospholipid oxygenase activity of bacterial lipoyxygenase from *Pseudomonas aeruginosa*. *Biochim Biophys Acta. (BBA) - Molecular and Cell Biology of Lipids* 2016, 1861(11):1681-1692. PMID: 27500637
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## Awards and press releases

- 2016** **Spotlight on Science** at European Synchrotron Radiation Facility (ESRF), Grenoble, France –  
“High-pressure cryocooling of protein crystals reveals gas transport channels in a hydrogen-converting enzyme”
- 2015** **ESRF HIGHLIGHT 2014 in structural biology** at European Synchrotron Radiation Facility ESRF, Grenoble,  
France – Article: “Crystal structure of a common GPCR binding interface for G protein and arrestin”
- 2014** **Hohe Platzierungen für Dr. Patrick Scheerer im Zitations-Ranking des Laborjournals zum Thema  
"Proteinforschung": Publikationsanalyse des Laborjournals (Stichtag 19.05.2014) zum Thema  
"Proteinforschung" im Zeitraum von 2008-2012 für den gesamten deutschsprachigen Raum  
Platz 7 und 9** unter den „meistzitierten Artikeln“  
und **Platz 28** mit insgesamt 1510 Zitationen bei 17 gezählten Publikationen unter den „meistzitierten Köpfen“
- 2014** **ESRF HIGHLIGHT 2013 in structural biology** at European Synchrotron Radiation Facility ESRF, Grenoble,  
France – “Crystal structure of pre-activated arrestin p44” – Article: “How arrestin is activated for GPCR binding”
- 2013** **Webpresentation am Helmholtz-Zentrum Berlin (HZB)** - Das Zentrum im Überblick - Gesundheitsforschung –  
„Wie Proteine das Sehen steuern“
- 2013** **Interview** in der Druckschrift des Helmholtz Zentrums Berlin, Lichtblick: "Wie Proteine das Sehen steuern"
- 2012** **Spotlight on Science** at European Synchrotron Radiation Facility (ESRF), Grenoble, France – “How an oxygen-  
tolerant hydrogenase protects itself from oxygen”
- 2012** **Interview – Special** – Laborpraxis – “Dem Sauerstoff trotzen – Hydrogenasen als Wasserstoffproduzenten”
- 2011** **Current research highlight in structural biology** at European Synchrotron Radiation Facility ESRF, Grenoble,  
France – “The crystal structure of an oxygen-tolerant hydrogenase uncovers a novel iron-sulphur centre”
- 2011** **Interview** – Biotechnologie.de – “Sehrezceptor in Aktion geblitzt“
- 2011** **Structure of the Month** at Bessy II -Helmholtz Zentrum Berlin – “Crystal structure of Metarhodopsin II”
- 2009** **First poster award** – Helmholtz Zentrum Berlin User Meeting at Bessy II, Germany
- 2008** **Interview** – Biotechnologie.de – “Strukturbiologischer Schnappschuss vom Sehen”
- 2008** **Poster award** – Jahrestagung der DGfB (Deutsche Gesellschaft für Biophysik) in Berlin, Germany
- 2008** **Interview** –Sichtbar (Ausgabe 03) – Magazin der Helmholtz-Zentrum Berlin für Materialien und Energie GmbH  
“Rhodopsin – Sehen wie man sieht - Aktive Proteinkristalle”
- 2005** **Shared second poster award** – GBM-Tagung (Gesellschaft für Biochemie und Molekularbiologie) in Berlin,  
Germany
- 2003** **First poster award** – 2.Studententag der Diplomanden und Doktoranden der Lebenswissenschaften in Berlin,  
Germany
- 2003** **First poster award** – 11.Jahrestagung der DGK (Deutsche Gesellschaft für Kristallographie) in Berlin, Germany