Dr. Guillermo Pérez-Hernández

Senior Research Associate
@Charité Universitätsmedizin Berlin

Computational biophysics of cell-signaling proteins, with emphasis on GPCRs, GPCR–G-protein complexes and kinases. Special interest in conformational dynamics and its modulation via ligands, pH, or mutations. Simulation-driven approaches (MD) combined with Markov modeling and dimensionality reduction. Developer of open-source tools for MD analysis (e.g., mdciao) and contributor to established packages (PyEMMA).

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Scientific Experience

Conformational Dynamics of Kinases [2023 – present]
@Charité Universitätsmedizin Berlin with Prof. A. Volkamer & Einstein BIH Visiting Fellow John Chodera

- Conformational dynamics of inhibitor-bound kinases under mutagenesis conditions
- Pipeline for large-scale conformational analysis of the structural kinome
- Integration of kinase-specific generic residue numbering into `mdciao`
- pH-dependent conformational switching

Molecular Simulation and Automated Analysis of GPCRs and GPCR-Gprotein complexes [2018 – present]
@Charité Universitätsmedizin Berlin with Prof. P.-W. Hildebrand, Dr. Patrick Scheerer & Einstein BIH Visiting Fellow Prof. Brian Kobilka

- Implementation of adaptive sampling protocols
- Group-wide support for simulation methodologies and infrastructure
- Automated MD analysis workflows and custom Python modules
- Development and release of open-source tool `mdciao`

Markov Modeling, Adaptive Sampling, Software Development [2012 – 2018]
@Freie Universität Berlin with Prof. F. Noé

- Molecular simulation of rhodopsin activation and conformational dynamics
- Development of dimensionality reduction techniques (e.g., TICA)
- Refactoring of `PyEMMA`'s API, especially the `coordinates` submodule
- Co-authorship and delivery of multiple `PyEMMA` tutorials to the community

Molecular Simulation of Water in Carbon Nanotubes [2010 – 2011]
@Freie Universität Berlin with PD Dr. B. Schmidt

- Confinement effects and transport phenomena of water inside carbon nanotubes

Quantum Chemistry, Spectroscopy, and Laser Control of Molecular Rotors [2005 – 2010, PhD]
@Freie Universität Berlin with Prof. J. Manz and PD Dr. L. González and @Friedrich-Schiller-Universität Jena with Prof. L. González

- Ground- and excited-state conformational dynamics and spectroscopy of light-triggered molecular rotors
- Quantum control approaches for laser-driven conformational transitions

Selected Publications

- Pérez-Hernández, G. & Hildebrand, P. W. **PLOS Computational Biology** [2025]
  mdciao: Accessible Analysis and Visualization of Molecular Dynamics Simulation Data
- Papasergi-Scott, M. M., Pérez-Hernández, G et al. **Nature** [2024]
  Time-resolved cryo-EM of G-protein activation by a GPCR
- Pérez-Hernández, G., Batebi, H. et al. **Nature Structural & Molecular Biology** [2024]
  Mechanistic insights into G-protein coupling with an agonist-bound G-protein-coupled receptor
- Scherer, M. K., Trendelkamp-Schroer, B. et al. **Journal of Chemical Theory and Computation** [2015]
  PyEMMA 2: A Software Package for Estimation, Validation, and Analysis of Markov Models
- Pérez-Hernández, G., Paul, F et al. **The Journal of Chemical Physics** [2013]
  Identification of slow molecular order parameters for Markov model construction

Education

Dr. rer. nat. *Summa Cum Laude* in Chemistry [2010]
@Friedrich-Schiller-Universität Jena. Doctoral Dissertation: *Light-triggered unidirectional molecular rotors*

Masters in Chemistry (*Licenciado en Ciencias Químicas*) [2005]
@Universidad de la Laguna, Tenerife, Canary Islands

Certificate Of Teaching's Competence (*Certificado de Aptitud Pedagógica*) [2006]
@Universidad Complutense, Madrid

Teaching and Mentoring

CADD Seminar: Data Driven Drug Design – Methods and Applications [2024-2025]
@Universität des Saarlandes, 8-week mentoring

- Develop talktorial for the TeachOpenCADD package

Molecular Modelling, companion practical course [2019 – 2022]
@Universität Leipzig, four semesters

- Enhanced sampling of MDs and MSMs
- Analysis of MD simulation
- Intro to software best practices

Advanced Molecular Simulation, lecture and exercises [2014 – 2016]
@Freie Universität Berlin, two semesters

- Theory and practice of MD, enhanced sampling, and MSMs
- Introduction to Python

Simulation and Analysis of Stochastic Processes, exercises [2012 – 2013]
@Freie Universität Berlin, two semesters

- Markov models and statistical mechanics

Physical and Quantum Chemistry Exercises [2007 – 2010]
@Friedrich-Schiller-Universität Jena

- Multiple semesters of hands-on student instruction
- Focus included wavefunctions, operators, and computational applications

Programming & Physical Chemistry, computer exercises [2006 – 2007]
@Freie Universität Berlin

- Taught basic programming (FORTRAN), logic and numerical methods for chemists

Workshops and Software Tutorials

Computer Tutorial in Markov Modeling (PyEMMA) [2018]
@Freie Universität Berlin

- Hands-on session on conformational dynamics and kinetics using PyEMMA

Free Energy Calculation and Molecular Kinetics Workshop [2016]
@King's College London

- Discussion of adaptive sampling and MSM-based analysis

Markov Models and Free Energies from MD [2016]
@Freie Universität Berlin

- Tutorial development and session coordination

Advanced Sampling and Long Timescale MD [2015]
@Forschungszentrum Jülich

- PyEMMA use in enhanced sampling applications

Free Energy and MSM Workshop [2015]
@King's College London

- MSM construction and hands-on sessions for participants

Peer-reviewed Publications

- Pérez-Hernández G., Hildebrand P. W. *mdciao: Accessible Analysis and Visualization of Molecular Dynamics Simulation Data*, **PLOS Comput. Biol. 21**, e1012837 (2025) DOI:10.1371/journal.pcbi.1012837
- Seufert F., Pérez-Hernández G., Pándy-Szekeres G., Guixà-González R., Langenhan T., Gloriam D. E., Hildebrand P. W. *Generic residue numbering of the GAIN domain of adhesion GPCRs*, **Nat. Commun. 16** (2025) DOI:10.1038/s41467-024-55466-6
- Pérez-Hernández G., Batebi H., Rahman S. N., Lan B., Kamprad A., Shi M., Speck D., Tiemann J. K. S., Guixà-González R., Reinhardt F., Stadler P. F., Papasergi-Scott M. M., Skiniotis G., Scheerer P., Kobilka B. K., Mathiesen J. M., Liu X., Hildebrand P. W. *Mechanistic insights into G-protein coupling with an agonist-bound G-protein-coupled receptor*, **Nat. Struct. Mol. Biol. 31**, 1692-1701 (2024) DOI:10.1038/s41594-024-01334-2
- Papasergi-Scott M. M., Pérez-Hernández G., Batebi H., Gao Y., Eskici G., Seven A. B., Panova O., Hilger D., Casiraghi M., He F., Maul L., Gmeiner P., Kobilka B. K., Hildebrand P. W., Skiniotis G. *Time-resolved cryo-EM of G-protein activation by a GPCR*, **Nature 629**, 1182-1191 (2024) DOI:10.1038/s41586-024-07153-1
- Heng J., Hu Y., Pérez-Hernández G., Inoue A., Zhao J., Ma X., Sun X., Kawakami K., Ikuta T., Ding J., Yang Y., Zhang L., Peng S., Niu X., Li H., Guixà-González R., Jin C., Hildebrand P. W., Chen C., Kobilka B. K. *Function and dynamics of the intrinsically disordered carboxyl terminus of β_2 adrenergic receptor*, **Nat. Commun. 14** (2023) DOI:10.1038/s41467-023-37233-1
- Kampfrath M., Staritzbichler R., Pérez-Hernández G., Rose A. S., Tiemann J. K. S., Scheuermann G., Wiegreffe D., Hildebrand P. W. *MDsrv: visual sharing and analysis of molecular dynamics simulations*, **Nucleic Acids Res. 50**, W483-W489 (2022) DOI:10.1093/nar/gkac398
- Beliu G., Altrichter S., Guixà-González R., Hemberger M., Brauer I., Dahse A., Scholz N., Wieduwild R., Kuhlemann A., Batebi H., Seufert F., Pérez-Hernández G., Hildebrand P. W., Sauer M., Langenhan T. *Tethered agonist exposure in intact adhesion/class B2 GPCRs through intrinsic structural flexibility of the GAIN domain*, **Mol. Cell 81**, 905-921.e5 (2021) DOI:10.1016/j.molcel.2020.12.042
- Galdadas I., Lovera S., Pérez-Hernández G., Barnes M. D., Healy J., Afsharikho H., Woodford N., Bonomo R. A., Gervasio F. L., Haider S. *Defining the architecture of KPC-2 Carbapenemase: identifying allosteric networks to fight antibiotics resistance*, **Sci. Rep. 8** (2018) DOI:10.1038/s41598-018-31176-0
- Islam B., Stadlbauer P., Gil-Ley A., Pérez-Hernández G., Haider S., Neidle S., Bussi G., Banas P., Otyepka M., Sponer J. *Exploring the Dynamics of Propeller Loops in Human Telomeric DNA Quadruplexes Using Atomistic Simulations.*, **J. Chem. Theory Comput. 13**, 2458-2480 (2017) DOI:10.1021/acs.jctc.7b00226
- Pérez-Hernández G., Noé F. *Hierarchical Time-Lagged Independent Component Analysis: Computing Slow Modes and Reaction Coordinates for Large Molecular Systems*, **J. Chem. Theory Comput. 12**, 6118-6129 (2016) DOI:10.1021/acs.jctc.6b00738
- Scherer M. K., Trendelkamp-Schroer B., Paul F., Pérez-Hernández G., Hoffmann M., Plattner N., Wehmeyer C., Prinz J., Noé F. *PyEMMA 2: A Software Package for Estimation, Validation, and Analysis of Markov Models*, **J. Chem. Theory Comput. 11**, 5525-5542 (2015) DOI:10.1021/acs.jctc.5b00743
- Nüske F., Keller B. G., Pérez-Hernández G., Mey A. S. J. S., Noé F. *Variational Approach to Molecular Kinetics*, **J. Chem. Theory Comput. 10**, 1739-1752 (2014) DOI:10.1021/ct4009156
- Pérez-Hernández G., Paul F., Giorgino T., Fabritiis G. D., Noé F. *Identification of slow molecular order parameters for Markov model construction*, **J. Chem. Phys. 139** (2013) DOI:10.1063/1.4811489
- Pérez-Hernández G., Schmidt B. *Anisotropy of the water–carbon interaction: molecular simulations of water in low-diameter carbon nanotubes*, **Phys. Chem. Chem. Phys. 15**, 4995 (2013) DOI:10.1039/c3cp44278k
- Pérez-Hernández G., González-Vázquez J., González L. *IR Spectrum of FHF–and FDF–Revisited Using a Spectral Method in Four Dimensions*, **J. Phys. Chem. A 116**, 11361-11369 (2012) DOI:10.1021/jp3058383
- Kupfer S., Pérez-Hernández G., González L. *Singlet oxygen generation versus O–O homolysis in phenyl-substituted anthracene endoperoxides investigated by RASPT2, CASPT2, CC2, and TD-DFT methods*, **Theor. Chem. Acc. 131** (2012) DOI:10.1007/s00214-012-1295-7
- Assmann M., Sanz C. S., Pérez-Hernández G., Worth G. A., González L. *Excited state dynamics of a model asymmetric molecular rotor: A five-dimensional study on 2-cyclopentylidene-tetrahydrofuran*, **Chem. Phys. 377**, 86-95 (2010) DOI:10.1016/j.chemphys.2010.08.019
- Assmann M., Pérez-Hernández G., González L. *On the Light-Driven Isomerization of a Model Asymmetric Molecular Rotor: Conformations and Conical Intersections of 2-Cyclopentylidene-tetrahydrofuran*, **J. Phys. Chem. A 114**, 9342-9348 (2010) DOI:10.1021/jp104898t
- Pérez-Hernández G., Pelzer A., González L., Seideman T. *Biologically inspired molecular machines driven by light.*

Optimal control of a unidirectional rotor, **New J. Phys. 12**, 075007 (2010) DOI:10.1088/1367-2630/12/7/075007

- Pérez-Hernández G., González L. *Mechanistic insight into light-driven molecular rotors: a conformational search in chiral overcrowded alkenes by a pseudo-random approach*, **Phys. Chem. Chem. Phys. 12**, 12279 (2010) DOI:10.1039/c0cp00324g
- Barth I., Manz J., Pérez-Hernández G., Sebald P. *Towards Toroidal Hydrogen Bonds*, **Z. Phys. Chem. 222**, 1311-1331 (2008) DOI:10.1524/zpch.2008.5390
- Pérez-Hernández G., González L., Serrano-Andrés L. *Rydberg or Valence? The Long-Standing Question in the UV Absorption Spectrum of 1,1 -Bicyclohexylidene*, **ChemPhysChem 9**, 2544-2549 (2008) DOI:10.1002/cphc.200800454
- Matute R. A., Contreras R., Pérez-Hernández G., González L. *The Chromophore Structure of the Cyanobacterial Phytochrome Cph1 As Predicted by Time-Dependent Density Functional Theory*, **J. Phys. Chem. B 112**, 16253-16256 (2008) DOI:10.1021/jp807471e
- González L., Rozgonyi T., Ambrosek D., Pérez-Hernández G., Maroulis G., Simos T. E. *Laser Control of Wavepacket Photodissociation and Photoisomerization Dynamics in Isolated Molecules*, **AIP Conf. Proc. 963**, 576-585 (2007) DOI:10.1063/1.2827044

Science Outreach & Science Diplomacy

Over the years, I have actively organized and engaged in science outreach and science diplomacy activities as much as my work and family obligations have allowed me to. These are some of them:

CERFA e.V., Society of Spanish Scientists in Germany (www.cerfa.de)

- President [2022-2024]
- Vice-President [2021]
- Regional Director Berlin-Brandenburg [2015-2020]
- Member since its inception [2013]

CERFA is an independent, non-profit organization that brings together Spanish research professionals in Germany, and supports them at any stage of their career ▪ Produces science outreach and networking events in national, international and multilateral manner ▪ Provides visibility to our members through seminars, courses, debates, workshops, and symposia ▪ Connects researchers and institutions —in Spain and in Germany— at personal, professional and institutional levels ▪ Circa 700 members in Germany ▪ Annual operating budget of circa 25.000€

RAICEX, Network Of Associations Of Spanish Researchers And Scientists Abroad (www.raicex.org)

- Secretary [2024]
- Treasurer [2022-2023]

RAICEX globally represents 22 associations, aggregating over 4500 Spanish researchers and scientists abroad ▪ Stakeholder and consulting role for Spanish science policy initiatives

Town Halls and Scientific Dialogues

The above activities have led to invitations by third parties to moderate public scientific dialogues or interviews with:

- Ignacio Cirac, director of the Max Planck Institute of Quantum Optics in Garching [2021]
- Pedro Duque, former (2020-2021) Minister for Science and Innovation in Spain [2021]
- Belén Garijo, CEO Merck AG [2022]
- Yolanda Díaz, Second Deputy Prime Minister of Spain and Minister of Labour and Social Economy [2023]
- Mateo Valero, director of the Barcelona Supercomputing Center, and Christof Schütte, chair of the German National Supercomputing Alliance [Nov 2025]