

Andrew C. Kruse
Curriculum Vitae

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Research interests

My research centers on studying transmembrane signaling through biophysical methods and protein engineering approaches.

Education

Stanford University, Stanford, CA

Ph.D. in Structural Biology (09/2009 – 04/2014; thesis advisor Brian Kobilka, M.D.)

University of Minnesota Twin Cities, Minneapolis, MN

B.S. *summa cum laude* and with high distinction; major in Biochemistry, minor in Chemistry (2009)

B.S. Mathematics degree with high distinction (2009)

Certified proficiency in spoken and written Mandarin Chinese and French languages (2007)

Academic appointments

Professor (2020 – present)

Department of Biological Chemistry and Molecular Pharmacology
Harvard Medical School

Associate Professor (2017 – 2020)

Department of Biological Chemistry and Molecular Pharmacology
Harvard Medical School

Assistant Professor (2014 – 2017)

Department of Biological Chemistry and Molecular Pharmacology
Harvard Medical School

Selected awards

Richard A. Smith Excellence in Biomedical Research Prize (2024)

ASPET John J. Abel Award (2024)

Amgen Young Investigator Award (2019)

Sloan Research Fellowship (2017)

Vallee Scholars Award (2016)

Klingenstein-Simons Fellowship Award in Neuroscience (2016)

Forbes 30 under 30 list in healthcare (2016)

Smith Family Award for Excellence in Biomedical Research (2015)

NIH Director's Early Independence Award (2015)

National Science Foundation Graduate Research Fellowship (2010 – 2013)

Andrew C. Kruse

Phi Beta Kappa (2009)

Graduation *summa cum laude* and with high distinction, University of Minnesota (2009)

Teaching

Harvard Medical School

Course director and lecturer

BCMP250: Biophysical and biochemical mechanisms of protein function (course director 2017 – 2024; lecturer 2017 – present)

Guest lecturer

BCMP236: Principles of Drug Action in People (2016 – present)

Stanford University

Teaching assistant, Methods in Molecular Biophysics (2013)

University of Minnesota, Twin Cities

Teaching assistant, Department of Biochemistry, Molecular Biology, and Biophysics (2007)

Teaching assistant, Institute of Technology Center for Educational Programs (2005 – 2006)

Editorial activities

Ad hoc reviewer: Analytical Chemistry, Bioorganic and Medicinal Chemistry Letters, Biophysical Journal, Biotechnology Journal, Cell, Cell Reports, Cell Systems, eLife, EMBO Journal, Journal of the American Chemical Society, Journal of General Physiology, mAbs, Molecular Pharmacology, Nature, Nature Communications, Nature Chemical Biology, Nature Reviews Molecular Cell Biology, Nature Reviews Drug Discovery, Nature Structural and Molecular Biology, Neuron, Proceedings of the National Academy of Sciences of the USA, Protein and Cell, Science, Science Advances, Science Immunology, Scientific Reports, Structure

Board of Reviewing Editors member *eLife*, 2020-2022

Editorial Advisory Board member *Molecular Pharmacology*, 2023-present

Grant review activities

2015	Wellcome Trust, Sir Henry Wellcome Postdoctoral Fellowship review committee	<i>Ad hoc</i> reviewer
2016	Swiss National Science Foundation, Sinergia Grant program	<i>Ad hoc</i> reviewer
2017	Human Frontier Science Program Organization (HFSP)	<i>Ad hoc</i> reviewer
2017	Foundation for Polish Science	<i>Ad hoc</i> reviewer

2019	European Research Council Starting Grant program	<i>Ad hoc</i> reviewer
2020	Israel Science Foundation	<i>Ad hoc</i> reviewer
2020	NIH Special Emphasis Panel ZRG1 MDCN-V	<i>Ad hoc</i> reviewer
2020	Medical Research Council Laboratory of Molecular Biology	Program reviewer
2022	Austrian Science Fund	<i>Ad hoc</i> reviewer
2022	Czech Science Foundation	<i>Ad hoc</i> reviewer
2022	NIH Special Emphasis Panel ZRG1 F04A-V(20)L (F31/F32 Fellowship applications)	<i>Ad hoc</i> reviewer
2023	NIH Special Emphasis Panel ZRG1 F04A-K(20) (F31/F32 Fellowship applications)	<i>Ad hoc</i> reviewer
2023	Agency for Health Quality and Assessment of Catalonia	<i>Ad hoc</i> reviewer
2023	European Research Council Starting Grant program	<i>Ad hoc</i> reviewer
2024	Swiss National Science Foundation	<i>Ad hoc</i> reviewer

Other professional activities

2015 - 2019	Scientific Advisory Board	Ab Initio Biotherapeutics (now a part of Ligand Pharmaceuticals)
2016 - 2020	Co-founder, Scientific Advisor	Institute for Protein Innovation
2019 - 2024	Co-founder, Board of Directors member	Tectonic Therapeutic, Inc. (NASDAQ: TECX)
2021	Co-founder, Scientific Advisor	Seismic Therapeutic, Inc.

Publications

1. Hurley JD, Shlosman I, Lakshminarayan M, Zhao Z, Yue H, Nowak R, Fischer ES, Kruse AC. Decoding protein-peptide interactions using a large, target-agnostic yeast surface display library. (2025) *bioRxiv* doi: <https://doi.org/10.1101/2025.05.19.654863>
2. Tawfeeq C, Hilibrand AS, Smith JS, Portillo J, Kruse AC, Abrol R. G Protein Selectivity in Dopamine Receptors is Determined before GDP Release. (2025) *Biochemistry*. Online ahead of print.
3. Tan JMJ, Melamed S, Cofsky JC, Syangtan D, Hobbs SJ, Del Marmol J, Jost M, Kruse AC, Sorek R, Kranzusch PJ. A DNA-gated molecular guard controls bacterial Hailong anti-phage defence. (2025) *Nature*. Online ahead of print.
4. Skiba MA, Canavan C, Nemeth GR, Liu J, Kanso A, Kruse AC. Epitope-directed selection of GPCR nanobody ligands with evolvable function. (2025) *Proc. Natl. Acad. Sci. U. S. A.* 122:e2423931122.
5. Thaiprayoon A, Chantarasorn Y, Oonant W, Kasorn A, Longsompurana P, Tapaneeyakorn S, Riengrungraj P, Loison F, Kruse AC, DeLisa MP, Waraho-Zhmeyev D. Isolation of PCSK9-specific nanobodies from synthetic libraries using a combined protein selection strategy. (2025) *Sci. Rep.* 15:3594
6. Shlosman I, Vettiger A, Bernhardt TG, Kruse AC*, Loparo JJ*. The hit-and-run of cell wall synthesis: LpoB transiently binds and activates PBP1b through a conserved allosteric switch. (2024) *bioRxiv* doi: 10.1101/2024.12.13.628440. *Corresponding authors
7. Gilman MSA, Shlosman I, Guerra DDS, Domecillo M, Fivenson EM, Bourett C, Bernhardt TG, Polizzi NF, Loparo JJ*, Kruse AC*. MreC-MreD structure reveals a multifaceted interface that controls MreC conformation. (2024) *bioRxiv* doi: 10.1101/2024.10.08.617240. *Corresponding authors
8. Erlandson SC, Wang J, Jiang H, Rockman HA, Kruse AC. Engineering and characterization of a long half-life relaxin receptor RXFP1 agonist. (2024) *Mol. Pharmaceutics* 21, 4441-4449.
9. Susa KJ*, Bradshaw GA, Eisert RJ, Schilling CM, Kalocsay M*, Blacklow SC*, Kruse AC*. A spatiotemporal map of co-receptor signaling networks underlying B cell activation. (2024) *Cell Rep.* 43, 114332. *Corresponding Authors
10. Lyu J, Kapolka N, Gumpfer R, Alon A, Wang L, Jain MK, Barros-Álvarez X, Sakamoto K, Kim Y, DiBerto J, Kim K, Glenn IS, Tummino TA, Huang S, Irwin JJ, Tarkhanova OO, Moroz Y, Skiniotis G, Kruse AC*, Shoichet BK*, Roth BL*. AlphaFold2 structures guide prospective ligand discovery (2024) *Science* 384(6702):eadn6354. *Corresponding Authors
11. Skiba MA, Sterling SM, Rawson S, Zhang S, Xu H, Jiang H, Nemeth GR, Gilman MSA, Hurley JD, Shen P, Staus DP, Kim J, McMahon C, Lehtinen MK, Rockman HA, Barth P, Wingler LM, Kruse AC. Antibodies expand the scope of angiotensin receptor pharmacology. (2024) *Nat. Chem. Biol.* 20, 1577-1585.
12. Smith JS, Hilibrand AS, Skiba MA, Dates AN, Calvillo-Miranda VG, Kruse AC. The M₃ Muscarinic Acetylcholine Receptor Can Signal through Multiple G Protein Families. (2024) *Mol. Pharmacol.* 105, 386-394.

13. Dates AN, Jones DTD, Smith JS, Skiba MA, Rich MF, Burruss MM, Kruse AC, Blacklow SC. Heterogeneity of tethered agonist signaling in adhesion G protein-coupled receptors. (2024) *Cell Chem. Biol.* 31, 1542-1553.
14. Pahil KS, Gilman MSA, Baidin V, Clairfeuille T, Mattei P, Bieniossek C, Dey F, Muri D, Baettig R, Lobritz M, Bradley K, Kruse AC*, Kahne D*. A new antibiotic traps lipopolysaccharide in its intermembrane transporter. (2024) *Nature* 625, 572-577. *Corresponding authors
15. SpoVAF and FigP assemble into oligomeric ion channels that enhance spore germination. Gao Y, Amon JD, Brogan AP, Artzi L, Ramírez-Guadiana FH, Cofsky JC, Kruse AC, Rudner DZ. (2024) *Genes Dev.* 38, 31-45.
16. Susa KJ*, Kruse AC*, Blacklow SC*. Tetraspanins: structure, dynamics, and principles of partner-protein recognition. (2024) *Trends Cell Biol.* 34, 509-522. *Corresponding authors
17. Shlosman I, Fivenson EM, Gilman MSA, Sisley TA, Walker S, Bernhardt TG, Kruse AC*, Loparo JJ*. Allosteric activation of cell wall synthesis during bacterial growth. (2023) *Nat Commun.* 14, 3439.
18. Gao Y, Amon JD, Artzi L, Ramírez-Guadiana FH, Brock KP, Cofsky JC, Marks DS, Kruse AC, Rudner DZ. Bacterial spore germination receptors are nutrient-gated ion channels. (2023) *Science* 380, 387-391.
19. Erlandson AC, Rawson S, Osei-Owusu J, Brock KP, Liu X, Paulo JA, Mintseris J, Gygi SP, Marks DS, Cong X, Kruse AC. The relaxin receptor RXFP1 signals through a mechanism of autoinhibition (2023) *Nat. Chem. Biol.* 19, 1013-1021.
20. Harvey EP, Shin J, Skiba MA, Nemeth GR, Hurley JD, Wellner A, Shaw AY, Miranda VG, Min JK, Liu CC, Marks DS, Kruse AC. An *in silico* method to assess antibody fragment polyreactivity (2022) *Nat. Commun.* 13, 7554.
21. Page JE, Skiba MA, Do T, Kruse AC, Walker S. Metal cofactor stabilization by a partner protein is a widespread strategy employed for amidase activation (2022) *Proc. Natl. Acad. Sci. U. S. A.* 119, e2201141119.
22. Li Q, Humphries F, Girardin RC, Wallace A, Ejemel M, Amcheslavsky A, McMahon CT, Schiller ZA, Ma Z, Cruz J, Dupuis AP, Payne AF, Maryam A, Yilmaz NK, McDonough KA, Pierce BG, Schiffer CA, Kruse AC, Klempner MS, Cavacini LA, Fitzgerald KA, Wang Y. Mucosal nanobody IgA as inhalable and affordable prophylactic and therapeutic treatment against SARS-CoV-2 and emerging variants. (2022) *Front. Immunol.* 13:995412.
23. Gao Y, Barajas-Ornelas RDC, Amon JD, Ramírez-Guadiana FH, Alon A, Brock KP, Marks DS, Kruse AC, Rudner DZ. The SpoVA membrane complex is required for dipicolinic acid import during sporulation and export during germination (2022) *Genes Dev.* 36, 634-646.
24. Alon A, Lyu JK, Braz JM, Tummino TA, Craik V, O'Meara MJ, Webb CM, Radchenko DS, Moroz YS, Huang XP, Liu Y, Roth BL, Irwin JJ, Basbaum AI*, Shoichet BK*, Kruse AC*. Structures of the σ_2 receptor enable docking for bioactive ligand discovery (2021) *Nature* 600, 759-764. *Corresponding authors
25. Artzi L, Alon A, Brock KP, Green AG, Tam A, Ramírez-Guadiana FH, Marks D, Kruse A, Rudner DZ. Dormant spores sense amino acids through the B subunits of their germination receptors. (2021) *Nat. Commun.* 12, 6842.

26. Wellner A, McMahon C, Gilman MSA, Clements JR, Clark S, Nguyen KM, Ho MH, Hu VJ, Shin JE, Feldman J, Hauser BM, Caradonna TM, Wingler LM, Schmidt AG, Marks DS, Abraham J, Kruse AC*, Liu CC*. Rapid generation of potent antibodies by autonomous hypermutation in yeast. (2021) *Nat. Chem. Biol.* 17, 1057-1064. *Corresponding authors
27. Tummino TA, Rezelj VV, Fischer B, Fischer A, O'Meara MJ, Monel B, Vallet T, White KM, Zhang Z, Alon A, Schadt H, O'Donnell HR, Lyu J, Rosales R, McGovern BL, Rathnasinghe R, Jangra S, Schotsaert M, Galarneau JR, Krogan NJ, Urban L, Shokat KM, Kruse AC, García-Sastre A, Schwartz O, Moretti F, Vignuzzi M, Pognan F, Shoichet BK. Drug-induced phospholipidosis confounds drug repurposing for SARS-CoV-2. (2021) *Science* 373, 541-547.
28. Shin JE, Riesselman AJ, Kollasch AW, McMahon C, Simon E, Sander C, Manglik A, Kruse AC*, Marks DS*. Protein design and variant prediction using autoregressive generative models. (2021) *Nat. Commun.* 12, 2403. *Corresponding authors
29. Susa KJ, Rawson S, Kruse AC*, Blacklow SC*. Cryo-EM structure of the B cell co-receptor CD19 bound to the tetraspanin CD81. (2021) *Science* 371, 300-305. *Corresponding authors.
30. Amcheslavsky A, Wallace AL, Ejemel M, Li Q, McMahon CT, Stoppato M, Giuntini S, Schiller ZA, Pondish JR, Toomey JR, Schneider RM, Meisinger J, Heukers R, Kruse AC, Barry EM, Pierce BG, Klempner MS, Cavacini LA, Wang Y. Anti-CfaE nanobodies provide broad cross-protection against major pathogenic enterotoxigenic Escherichia coli strains, with implications for vaccine design. (2021) *Sci. Rep.* 11, 2751.
31. Skiba MA, Kruse AC. Autoantibodies as Endogenous Modulators of GPCR Signaling. (2021) *Trends. Pharmacol. Sci.* 42, 135-150.
32. Susa KJ, Seegar TC, Blacklow SC*, Kruse AC*. A Dynamic Interaction Between CD19 and the Tetraspanin CD81 Controls B Cell Co-Receptor Trafficking. (2020) *eLife*, 9:e52337. *Corresponding authors.
33. Greenfield DA, Schmidt HR, Sliz P*, Kruse AC*. Virtual screening identifies novel high-affinity sigma-1 receptor ligands. (2020) *A. C. S. Med. Chem. Lett.* 11, 1555-1561. Also preprinted bioRxiv 699793; doi: <https://doi.org/10.1101/699793>. *Corresponding authors
34. McMahon C, Staus DP, Wingler LM, Wang J, Skiba MA, Elgeti M, Hubbell WL, Rockman HA, Kruse AC*, Lefkowitz RJ*. Synthetic nanobodies as angiotensin receptor blockers. (2020) *Proc. Natl. Acad. Sci. U. S. A.* 117, 20284-20291. *Corresponding authors
35. Sjødt M, Rohs PDA, Gilman MSA, Erlandson SC, Zheng S, Green AG, Brock KP, Taguchi A, Kahne D, Walker S, Marks DS, Rudner DZ, Bernhardt TG, Kruse AC. Structural coordination of polymerization and crosslinking by a SEDS-bPBP peptidoglycan synthase complex. (2020) *Nat. Microbiol.* 5, 813-820.
36. Suomivuori CM, Latorraca NR, Wingler LM, Eismann S, King MC, Kleinhenz ALW, Skiba MA, Staus DP, Kruse AC, Lefkowitz RJ, Dror RO. Molecular mechanism of biased signaling in a prototypical G protein-coupled receptor. (2020) *Science* 367, 881-887.
37. Wingler LM, Skiba MA, McMahon C, Staus DP, Kleinhenz LW, Suomivuori CM, Latorraca NR, Dror RO, Lefkowitz RJ*, Kruse AC*. Angiotensin and biased analogs induce structurally distinct active conformations within a GPCR. (2020) *Science* 367, 881-887. *Corresponding authors.

38. Pascolutti R, Erlandson SC, Burri DJ, Zheng S, Kruse AC. Mapping and engineering the interaction between adiponectin and T-cadherin. (2020) *J. Biol. Chem.* 295, 2749-4759.
39. Schmidt HR, Kruse AC. The molecular function of sigma receptors: past, present, and future. (2019) *Trends Pharmacol. Sci.* 40, 636-654.
40. Chen H, Nwe P, Yang Y, Rosen CE, Bielecka AA, Kuchroo M, Cline GW, Kruse AC, Ring AM, Crawford JM, Palm NW. A forward chemical genetic screen reveals gut microbiota metabolites that modulate host physiology. (2019) *Cell* 177, 1217-1231.
41. Owens T, Taylor R, Pahil K, Bertani B, Ruiz N*, Kruse AC*, Kahne D*. Structural basis for unidirectional export of lipopolysaccharide to the cell surface. (2019) *Nature* 567, 550-553.
*Corresponding authors
42. Zheng S, Abreu N, Levitz J, Kruse AC. Structural basis for KCTD-mediated rapid desensitization of GABA_B signaling. (2019) *Nature* 567, 127-131.
43. Zheng S, Kruse AC. Solving a specificity mystery (2019) *eLife* e44298. (Invited commentary)
44. Winkler LM, McMahon C, Staus DP, Lefkowitz RJ*, Kruse AC*. Distinctive activation mechanism for angiotensin receptor revealed by a synthetic nanobody. (2019) *Cell* 176, 479-490. *Corresponding authors
45. Taguchi A, Welsh MA, Marmont LS, Lee W, Sjodt M, Kruse AC, Kahne D, Bernhardt TG, Walker S. FtsW is a peptidoglycan polymerase that is functional only in complex with its cognate penicillin-binding protein. (2019) *Nat. Microbiol.* 4, 587-594.
46. Ramírez-Guadiana FH, Rodrigues CDA, Marquis KA, Campo N, Barajas-Ornelas R, Brock K, Marks DS, Kruse AC, Rudner DZ. Evidence that regulation of intramembrane proteolysis is mediated by substrate gating during sporulation in *Bacillus subtilis*. (2018) *PLoS Genet.* 14(11):e1007753.
47. Rohs PDA, Buss J, Sim SI, Squyres GR, Srisuknimit V, Smith M, Cho H, Sjodt M, Kruse AC, Garner EC, Walker S, Kahne DE, Bernhardt TG. A central role for PBP2 in the activation of peptidoglycan polymerization by the bacterial cell elongation machinery. (2018) *PLoS Genet.* 14(10):e1007726.
48. Schmidt HR, Betz RM, Dror RO, Kruse AC. Structural basis for σ_1 receptor ligand recognition. (2018) *Nat. Struct. Mol. Biol.* 25, 981-987.
49. Wang X, Hughes AC, Brandão HB, Walker B, Lierz C, Cochran JC, Oakley MG, Kruse AC, Rudner DZ. In vivo evidence for ATPase-dependent DNA translocation by the *Bacillus subtilis* SMC Condensin Complex. (2018) *Mol. Cell* S1097-2765(18)30553-7.
50. Sham LT, Zheng S, Yakhnina AA, Kruse AC, Bernhardt TG. Loss of specificity variants of WzxC suggest that substrate recognition is coupled with transporter opening in MOP-family flippases. (2018) *Mol. Microbiol.* 109, 633-641.
51. Zheng S, Sham LT, Rubino FA, Brock KP, Robins WP, Mekalanos JJ, Marks DS, Bernhardt TG, Kruse AC. Structure and mutagenic analysis of the lipid II flippase MurJ from *Escherichia coli*. (2018) *Proc. Natl. Acad. Sci. U.S.A.* 115, 6709-6714.
52. Huang P, Zheng S, Wierbowski BM, Kim Y, Nedelcu D, Aravena L, Liu J, Kruse AC, Salic A. Structural Basis of Smoothed Activation in Hedgehog Signaling. (2018) *Cell* 174, 312-324.

53. Linkens K, Schmidt HR, Sahn JJ, Kruse AC, Martin SF. Investigating isoindoline, tetrahydroisoquinoline, and tetrahydrobenzazepine scaffolds for their sigma receptor binding properties. (2018) *Eur. J. Med. Chem.* 151, 557-567.
54. Sjødt M, Brock K, Dobihal G, Rohs PDA, Green AG, Hopf TA, Meeske AJ, Srisuknimit V, Kahne D, Walker S, Marks DS, Bernhardt TG, Rudner DZ, Kruse AC. Structure of the peptidoglycan polymerase RodA resolved by evolutionary coupling analysis. (2018) *Nature* 556, 118-121.
55. Staus DP, Wingler LM, Choi M, Pani B, Manglik A, Kruse AC, Lefkowitz RJ. Sortase ligation enables homogeneous GPCR phosphorylation to reveal diversity in β -arrestin coupling. (2018) *Proc. Natl. Acad. Sci. U.S.A.* 115, 3834-3839.
56. Erlandson SC, McMahon C, Kruse AC. Structural Basis for G Protein-Coupled Receptor Signaling. (2018) *Annu. Rev. Biophys.* Epub ahead of print.
57. Korczynska M, Clark MJ, Valant C, Xu J, Moo EV, Albold S, Weiss DR, Torosyan H, Huang W, Kruse AC, Lyda BR, May LT, Baltos JA, Sexton PM, Kobilka BK, Christopoulos A, Shoichet BK, Sunahara RK. Structure-based discovery of selective positive allosteric modulators of antagonists for the M2 muscarinic acetylcholine receptor. (2018) *Proc. Natl. Acad. Sci. U.S.A.* 6;115(10):E2419-E2428.
58. McMahon C, Baier AS, Pascolutti R, Wegrecki M, Zheng S, Ong JX, Erlandson SC, Hilger D, Rasmussen SGF, Ring AM, Manglik A*, Kruse AC*. Yeast surface display platform for rapid discovery of conformationally selective nanobodies. (2018) *Nat. Struct. Mol. Biol.* 25(3):289-296. *Corresponding authors
59. Seegar TCM, Killingsworth LB, Saha N, Meyer PA, Patra D, Zimmerman B, Janes PW, Rubinstein E, Nikolov DB, Skinotis G, Kruse AC, Blacklow SC. Structural basis for regulated proteolysis by the α -secretase ADAM10. (2017) *Cell* 171, 1638-1648.
60. Manglik A*, Kruse AC*. Structural basis for G protein-coupled receptor activation. (2017) *Biochemistry* 56, 5628-5634. *Corresponding authors.
61. Ramírez-Guadiana FH, Meeske AJ, Rodrigues CDA, Barajas-Ornelas RDC, Kruse AC, Rudner DZ. A two-step transport pathway allows the mother cell to nurture the developing spore in *Bacillus subtilis*. (2017) *PLoS Genet.* 13, e1007015.
62. Alon A, Schmidt HR, Wood MD, Sahn JJ, Martin SF, Kruse AC. Identification of the gene that codes for the sigma-2 receptor. (2017) *Proc. Natl. Acad. Sci. U.S.A.* 114, 7160-7165.
63. Squazzini E, Schmidt HR, Iyer KA, Kruse AC, Dukat M. Reevaluation of fenpropimorph as a sigma receptor ligand: Structure-affinity relationship studies at human sigma-1 receptors. (2017) *Bioorg. Med. Chem. Lett.* 27, 2912-2919.
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65. Alon A, Schmidt HR, Zheng S, Kruse AC. Structural Perspectives on sigma-1 receptor function. (2017) in Sylvia Smith *et al.* (Eds.), *Sigma Receptors: Their Role in Disease and as Therapeutic Targets. Adv. Exp. Med. Biol.*, Vol. 964.
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71. Schmidt HR, Zheng S, Gurpinar E, Koehl A, Manglik A, Kruse AC. Crystal structure of the human sigma-1 receptor (2016) *Nature* 532, 527-530.
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75. Maute RL, Gordon SR, Mayer AT, McCracken MN, Natarajan A, Ring NG, Kimura R, Tsai JM, Manglik A, Kruse AC, Gambhir SS, Weissman IL, Ring AM. Engineering high-affinity PD-1 variants for optimized immunotherapy and immune-PET imaging. (2015) *Proc. Natl. Acad. Sci. U.S.A.*, 112, E6506-E6514.
76. Kruse AC. Structural insights into activation and allosteric modulation of G protein-coupled receptors. (2015) in G. Scapin *et al.* (Eds.), *Multifaceted Roles of Crystallography in Modern Drug Discovery*, NATO Science for Peace and Security Series A: Chemistry and Biology.
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- Lemke HT, Lin G, Lyubimov AY, Manglik A, Mathews II, McPhillips SE, Nelson S, Peters JW, Sauter NK, Smith CA, Song J, Stevenson HP, Tsai Y, Uervirojnangkoorn M, Vinetsky V, Wakatsuki S, Weis WI, Zadvornyy OA, Zeldin OB, Zhu D, Hodgson KO. Goniometer-based femtosecond crystallography with X-ray free electron lasers. (2014) *Proc. Natl. Acad. Sci. U.S.A.*, 111, 17122-17127.
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