Stanford



Brian Kobilka

Hélène Irwin Fagan Chair of Cardiology

Molecular and Cellular Physiology

Bio

ACADEMIC APPOINTMENTS

- Professor, Molecular and Cellular Physiology
- Member, Bio-X
- Member, Cardiovascular Institute
- Member, Maternal & Child Health Research Institute (MCHRI)
- Member, Wu Tsai Neurosciences Institute

LINKS

- Personal Web site: http://med.stanford.edu/kobilkalab/

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

My laboratory is involved in studying several aspects of adrenergic receptor biology. Adrenergic receptors form the interface between the sympathetic nervous system and the cardiovascular system and play a critical role in the regulation of cardiovascular function. Specific projects include:

1- RECEPTOR STRUCTURE: We are interested in understanding the three dimensional structure of adrenergic receptors and learning about the conformational changes that mediate signal transduction. We are taking several experimental approaches including mutagenesis, biochemical, and biophysical studies.

2-INTRACELLULAR TRAFFICKING OF ADRENERGIC RECEPTORS: The function of receptors can be modulated by changes in receptor structure (phosphorylation) and by changes in subcellular localization. We are using immunocytochemical approaches to study the targeting of receptors to specific subcellular domains and agonist mediated redistribution of receptors. Our goal is to determine the functional significance of differences in targeting and trafficking that we have observed in several adrenergic receptors, and to identify cellular proteins that mediate receptor trafficking.

3-PHYSIOLOGIC RELEVANCE OF ADRENERGIC RECEPTOR SUBTYPE DIVERSITY: Multiple closely related subtypes of adrenergic receptors have been identified through cloning studies. We are using targeted gene modification in mice to study the physiologic role of these closely related subtypes. We have disrupted the genes for five adrenergic receptors (alpha 2a, alpha 2b, alpha 2c, beta 1, and beta2) and are investigating the consequence of these disruptions on neural and cardiovascular physiology.

Teaching

STANFORD ADVISEES

Med Scholar Project Advisor

Alexander Berg, Teja Peddada

Doctoral Dissertation Reader (AC)

Mia Greeson, Aswini Krishnan, Sonia Presti

Postdoctoral Faculty Sponsor

Jonathan Deutsch, Shi Feng, Chris Habrian, Chengyu Hao, Peng Huang, Michael Sacco, Jiemin Shen, Romy Thomas

Doctoral Dissertation Advisor (AC)

Teja Peddada

GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Biophysics (PhD Program)
- Molecular and Cellular Physiology (PhD Program)
- Neurosciences (PhD Program)

Publications

PUBLICATIONS

- **A biased allosteric modulator is a molecular glue for β2AR dimerization.** *Nature*
  Shen, J., Peddada, T. N., Komolov, K. E., De Pascali, F., Garces, A. M., Wang, H., Ehsan, M., Chae, P. S., Lerch, M. T., Benovic, J. L., Xu, J., Kobilka, B. K.
  2026

- **Factors modulating the assembly of human β2-adrenergic receptor-β-arrestin complexes.** *Nature structural & molecular biology*
  Wilhelm, F. M., Pluhackova, K., Janetzko, J., Masureel, M., Marsh, E., Hudspeth, J., Gaßner, W., Schertler, G. F., Kobilka, B. K., Müller, D. J.
  2026

- **Efficacy Modulation and Structural Insights of Mu Opioid-Sparing Agents**
  Paul, B., Huang, P., Ramos-gonzalez, N., Wang, J., Wells, E., Hammond, H., Sortman, B., Tanguturi, P., Polley, A., Appourchaux, K., Seekins, C., Warren, B., Streicher, et al
  ELSEVIER.2026

- **The dynamic basis of G-protein recognition and activation by a GPCR.** *Nature*
  Kobayashi, K., Kawakami, K., Matsui, T. E., Yokoi, S., Fukuda, M., Narita, T. J., Arai, H., Tambo, M., Sumikama, T., Tatsumi, M., Yamashita, K., Koyanagi, J., Kugawa, et al
  2026

- **Discovery and dynamic pharmacology of μ-opioid receptor positive allosteric modulators.** *bioRxiv : the preprint server for biology*
  O'Brien, E. S., Wang, J., Tanguturi, P., Li, M., White, E., Shiimura, Y., Paul, B., Appourchaux, K., Kumar, K. K., Huang, W., Majumdar, S., Traynor, J. R., Streicher, et al
  2026

- **The Role of Intrinsically Disordered Domains in Regulating G Protein-Coupled Receptor Signaling.** *Journal of the American Chemical Society*
  Xu, J., Qiu, R., Garces, A. M., Hübner, H., Xu, X., Hao, C., Weikert, D., Gmeiner, P., Lerch, M. T., Kobilka, B. K.
  2025

- **A biased allosteric modulator functions as a molecular glue to induce β2AR dimerization.** *Research square*
  Kobilka, B., Shen, J., Peddada, T., Komolov, K., De Pascali, F., Garces, A., Wang, H., Lerch, M., Benovic, J., Xu, J.
  2025

- **A biased allosteric modulator functions as a molecular glue to induce β2AR dimerization.** *bioRxiv : the preprint server for biology*
  Shen, J., Peddada, T. N., Komolov, K. E., De Pascali, F., Garces, A. M., Wang, H., Lerch, M. T., Benovic, J. L., Xu, J., Kobilka, B. K.
  2025
- **The role of intrinsically disordered domains in regulating G protein coupled receptor signaling.** *bioRxiv : the preprint server for biology*
  Xu, J., Qiu, R., Garces, A. M., Hübner, H., Xu, X., Weikert, D., Gmeiner, P., Lerch, M. T., Kobilka, B. K.
  2025
- **Ligand-dependent G protein dynamics underlying opioid signaling efficacy.** *bioRxiv : the preprint server for biology*
  Deutsch, J., Hilger, D., Janetzko, J., Schroeder, C. M., Chu, S., Kobilka, B. K., Shivnaraine, R. V.
  2025
- **Membrane phosphoinositides allosterically tune β-arrestin dynamics to facilitate GPCR core engagement.** *bioRxiv : the preprint server for biology*
  Janetzko, J., Deutsch, J., Shi, Y., Siepe, D. H., Masureel, M., Liu, W., Viner, R., Inoue, A., Kobilka, B. K., Shivnaraine, R. V.
  2025
- **The story of a structural sage.** *Nature reviews. Chemistry*
  Kobilka, B., Greed, S.
  2025
- **Structure and dynamics determine G protein coupling specificity at a class A GPCR.** *Science advances*
  Casiraghi, M., Wang, H., Brennan, P. C., Habrian, C., Hübner, H., Schmidt, M. F., Maul, L., Pani, B., Bahriz, S. M., Xu, B., Staffen, N., Assafa, T. E., Chen, et al
  2025; 11 (12): eadq3971
- **A cryptic pocket in CB1 drives peripheral and functional selectivity** *NATURE*
  Rangari, V., O'Brien, E. S., Powers, A. S., Slivicki, R. A., Bertels, Z., Appourchaux, K., Aydin, D., Ramos-Gonzalez, N., Mwirigi, J., Lin, L., Mangutov, E., Sobecks, B. L., Awad-Agbaria, et al
  2025
- **Calcineurin-fusion facilitates cryo-EM structure determination of a Family A GPCR.** *Proceedings of the National Academy of Sciences of the United States of America*
  Xu, J., Chen, G., Wang, H., Cao, S., Heng, J., Deupi, X., Du, Y., Kobilka, B. K.
  2024; 121 (48): e2414544121
- **A μ-opioid receptor modulator that works cooperatively with naloxone.** *Nature*
  O'Brien, E. S., Rangari, V. A., El Daibani, A., Eans, S. O., Hammond, H. R., White, E., Wang, H., Shiimura, Y., Krishna Kumar, K., Jiang, Q., Appourchaux, K., Huang, W., Zhang, et al
  2024
- **Mechanistic insights into G-protein coupling with an agonist-bound G-protein-coupled receptor.** *Nature structural & molecular biology*
  Batebi, H., Pérez-Hernández, G., Rahman, S. N., Lan, B., Kamprad, A., Shi, M., Speck, D., Tiemann, J. K., Guixà-González, R., Reinhardt, F., Stadler, P. F., Papasergi-Scott, M. M., Skiniotis, et al
  2024
- **Author Correction: Stepwise activation of a metabotropic glutamate receptor.** *Nature*
  Krishna Kumar, K., Wang, H., Habrian, C., Latorraca, N. R., Xu, J., O'Brien, E. S., Zhang, C., Montabana, E., Koehl, A., Marqusee, S., Isacoff, E. Y., Kobilka, B. K.
  2024
- **Stepwise activation of a metabotropic glutamate receptor.** *Nature*
  Krishna Kumar, K., Wang, H., Habrian, C., Latorraca, N. R., Xu, J., O'Brien, E. S., Zhang, C., Montabana, E., Koehl, A., Marqusee, S., Isacoff, E. Y., Kobilka, B. K.
  2024
- **Ligand efficacy modulates conformational dynamics of the -opioid receptor.** *Nature*
  Zhao, J., Elgeti, M., O'Brien, E. S., Sar, C. P., Ei Daibani, A., Heng, J., Sun, X., White, E., Che, T., Hubbell, W. L., Kobilka, B. K., Chen, C.
  2024
- **Time-resolved cryo-EM of G-protein activation by a GPCR.** *Nature*

Papasergi-Scott, M. M., Perez-Hernandez, G., Batebi, H., Gao, Y., Eskici, G., Seven, A. B., Panova, O., Hilger, D., Casiraghi, M., He, F., Maul, L., Gmeiner, P., Kobilka, et al

2024

- **Structural basis of α1A-adrenergic receptor activation and recognition by an extracellular nanobody.** *Nature communications*

  Toyoda, Y., Zhu, A., Kong, F., Shan, S., Zhao, J., Wang, N., Sun, X., Zhang, L., Yan, C., Kobilka, B. K., Liu, X.

  2023; 14 (1): 3655

- **Structure based approaches on fentanyl template to design novel mu opioid modulators**

  Ople, R., Wang, H., Li, Q., Polacco, B., Bernhard, S., Appourchaux, K., Sribhashyam, S., Eans, S., Huttenhain, R., McLaughlin, J., Kobilka, B., Majumdar, S.

  AMER SOC PHARMACOLOGY EXPERIMENTAL THERAPEUTICS.2023

- **Structural basis for activation of CB1 by an endocannabinoid analog.** *Nature communications*

  Krishna Kumar, K., Robertson, M. J., Thadhani, E., Wang, H., Suomivuori, C. M., Powers, A. S., Ji, L., Nikas, S. P., Dror, R. O., Inoue, A., Makriyannis, A., Skiniotis, G., Kobilka, et al

  2023; 14 (1): 2672

- **Constrained catecholamines gain β2AR selectivity through allosteric effects on pocket dynamics.** *Nature communications*

  Xu, X., Shonberg, J., Kaindl, J., Clark, M. J., Stößel, A., Maul, L., Mayer, D., Hübner, H., Hirata, K., Venkatakrishnan, A. J., Dror, R. O., Kobilka, B. K., Sunahara, et al

  2023; 14 (1): 2138

- **Function and dynamics of the intrinsically disordered carboxyl terminus of beta2 adrenergic receptor.** *Nature communications*

  Heng, J., Hu, Y., Perez-Hernandez, G., Inoue, A., Zhao, J., Ma, X., Sun, X., Kawakami, K., Ikuta, T., Ding, J., Yang, Y., Zhang, L., Peng, et al

  2023; 14 (1): 2005

- **Negative allosteric modulation of the glucagon receptor by RAMP2.** *Cell*

  Krishna Kumar, K., O'Brien, E. S., Habrian, C. H., Latorraca, N. R., Wang, H., Tuneew, I., Montabana, E., Marqusee, S., Hilger, D., Isacoff, E. Y., Mathiesen, J. M., Kobilka, B. K.

  2023; 186 (7): 1465-1477.e18

- **Negative allosteric modulation of the glucagon receptor by RAMP2**

  O'Brien, E. S., Kumar, K., Habrian, C., Latorraca, N. R., Wang, H., Tuneew, I., Montabana, E., Marqusee, S., Hilger, D., Isacoff, E. Y., Mathiesen, J. M., Kobilka, B. K.

  CELL PRESS.2023: 161A

- **Structural and dynamic insights into supra-physiological activation and allosteric modulation of a muscarinic acetylcholine receptor.** *Nature communications*

  Xu, J., Wang, Q., Hübner, H., Hu, Y., Niu, X., Wang, H., Maeda, S., Inoue, A., Tao, Y., Gmeiner, P., Du, Y., Jin, C., Kobilka, et al

  2023; 14 (1): 376

- **Structure-based design of bitopic ligands for the μ-opioid receptor.** *Nature*

  Faouzi, A., Wang, H., Zaidi, S. A., DiBerto, J. F., Che, T., Qu, Q., Robertson, M. J., Madasu, M. K., El Daibani, A., Varga, B. R., Zhang, T., Ruiz, C., Liu, et al

  2022

- **Insights into distinct signaling profiles of the OR activated by diverse agonists.** *Nature chemical biology*

  Qu, Q., Huang, W., Aydin, D., Paggi, J. M., Seven, A. B., Wang, H., Chakraborty, S., Che, T., DiBerto, J. F., Robertson, M. J., Inoue, A., Suomivuori, C., Roth, et al

  2022

- **Membrane phosphoinositides regulate GPCR-beta-arrestin complex assembly and dynamics.** *Cell*

  Janetzko, J., Kise, R., Barsi-Rhyne, B., Siepe, D. H., Heydenreich, F. M., Kawakami, K., Masureel, M., Maeda, S., Garcia, K. C., von Zastrow, M., Inoue, A., Kobilka, B. K.

  2022

- **A cholesterol analog stabilizes the human beta2-adrenergic receptor nonlinearly with temperature.** *Science signaling*

  Serdiuk, T., Manna, M., Zhang, C., Mari, S. A., Kulig, W., Pluhackova, K., Kobilka, B. K., Vattulainen, I., Muller, D. J.

  2022; 15 (737): eabi7031

- **Structure-based Evolution of G protein-biased mu-opioid Receptor Agonists.** *Angewandte Chemie (International ed. in English)*
  Gmeiner, P., Wang, H., Hetzer, F., Huang, W., Qu, Q., Meyerowitz, J., Kaindl, J., Hubner, H., Skiniotis, G., Kobilka, B. K.
  2022

- **Atypical structural snapshots of human cytomegalovirus GPCR interactions with host G proteins.** *Science advances*
  Tsutsumi, N., Maeda, S., Qu, Q., Vogele, M., Jude, K. M., Suomivuori, C., Panova, O., Waghray, D., Kato, H. E., Velasco, A., Dror, R. O., Skiniotis, G., Kobilka, et al
  1800; 8 (3): eabl5442

- **Translating science to medicine: The case for physician-scientists.** *Science translational medicine*
  Utz, P. J., Jain, M. K., Cheung, V. G., Kobilka, B. K., Lefkowitz, R., Yamada, T., Dzau, V. J.
  2022; 14 (632): eabg7852

- **Structures of active melanocortin-4 receptor-Gs-protein complexes with NDP-alpha-MSH and setmelanotide.** *Cell research*
  Heyder, N. A., Kleinau, G., Speck, D., Schmidt, A., Paisdzior, S., Szczepek, M., Bauer, B., Koch, A., Gallandi, M., Kwiatkowski, D., Burger, J., Mielke, T., Beck-Sickinger, et al
  2021

- **G-protein activation by a metabotropic glutamate receptor.** *Nature*
  Seven, A. B., Barros-Álvarez, X., de Lapeyrière, M., Papasergi-Scott, M. M., Robertson, M. J., Zhang, C., Nwokonko, R. M., Gao, Y., Meyerowitz, J. G., Rocher, J. P., Schelshorn, D., Kobilka, B. K., Mathiesen, et al
  2021

- **Crystal structure of dopamine D1 receptor in complex with G protein and a non-catechol agonist.** *Nature communications*
  Sun, B., Feng, D., Chu, M. L., Fish, I., Lovera, S., Sands, Z. A., Kelm, S., Valade, A., Wood, M., Ceska, T., Kobilka, T. S., Lebon, F., Kobilka, et al
  2021; 12 (1): 3305

- **Structural basis for the constitutive activity and immunomodulatory properties of the Epstein-Barr virus-encoded G protein-coupled receptor BILF1.** *Immunity*
  Tsutsumi, N., Qu, Q., Mavri, M., Baggesen, M. S., Maeda, S., Waghray, D., Berg, C., Kobilka, B. K., Rosenkilde, M. M., Skiniotis, G., Garcia, K. C.
  2021

- **How GPCR Phosphorylation Patterns Orchestrate Arrestin-Mediated Signaling.** *Cell*
  Latorraca, N. R., Masureel, M., Hollingsworth, S. A., Heydenreich, F. M., Suomivuori, C., Brinton, C., Townshend, R. J., Bouvier, M., Kobilka, B. K., Dror, R. O.
  2020

- **Viewing rare conformations of the beta2 adrenergic receptor with pressure-resolved DEER spectroscopy.** *Proceedings of the National Academy of Sciences of the United States of America*
  Lerch, M. T., Matt, R. A., Masureel, M., Elgeti, M., Kumar, K. K., Hilger, D., Foys, B., Kobilka, B. K., Hubbell, W. L.
  2020

- **Structural basis for GLP-1 receptor activation by LY3502970, an orally active nonpeptide agonist.** *Proceedings of the National Academy of Sciences of the United States of America*
  Kawai, T., Sun, B., Yoshino, H., Feng, D., Suzuki, Y., Fukazawa, M., Nagao, S., Wainscott, D. B., Showalter, A. D., Droz, B. A., Kobilka, T. S., Coghlan, M. P., Willard, et al
  2020

- **Analysis of beta2AR-Gs and beta2AR-Gi complex formation by NMR spectroscopy.** *Proceedings of the National Academy of Sciences of the United States of America*
  Ma, X., Hu, Y., Batebi, H., Heng, J., Xu, J., Liu, X., Niu, X., Li, H., Hildebrand, P. W., Jin, C., Kobilka, B. K.
  2020

- **Author Correction: Structural insights into mu-opioid receptor activation.** *Nature*
  Huang, W., Manglik, A., Venkatakrishnan, A. J., Laeremans, T., Feinberg, E. N., Sanborn, A. L., Kato, H. E., Livingston, K. E., Thorsen, T. S., Kling, R. C., Granier, S., Gmeiner, P., Husbands, et al
  2020

- **Structural insights into probe-dependent positive allosterism of the GLP-1 receptor.** *Nature chemical biology*
  Bueno, A. B., Sun, B., Willard, F. S., Feng, D., Ho, J. D., Wainscott, D. B., Showalter, A. D., Vieth, M., Chen, Q., Stutsman, C., Chau, B., Ficorilli, J., Agejas, et al

2020

- **An allosteric modulator binds to a conformational hub in the beta2 adrenergic receptor.** *Nature chemical biology*
  Liu, X., Kaindl, J., Korczynska, M., StoSSel, A., Dengler, D., Stanek, M., Hubner, H., Clark, M. J., Mahoney, J., Matt, R. A., Xu, X., Hirata, K., Shoichet, et al
  2020
- **Activation of the alpha2B adrenoceptor by the sedative sympatholytic dexmedetomidine.** *Nature chemical biology*
  Yuan, D., Liu, Z., Kaindl, J., Maeda, S., Zhao, J., Sun, X., Xu, J., Gmeiner, P., Wang, H., Kobilka, B. K.
  2020
- **Binding pathway determines norepinephrine selectivity for the human β1AR over β2AR.** *Cell research*
  Xu, X. n., Kaindl, J. n., Clark, M. J., Hübner, H. n., Hirata, K. n., Sunahara, R. K., Gmeiner, P. n., Kobilka, B. K., Liu, X. n.
  2020
- **Structure and selectivity engineering of the M1 muscarinic receptor toxin complex.** *Science (New York, N.Y.)*
  Maeda, S. n., Xu, J. n., N Kadji, F. M., Clark, M. J., Zhao, J. n., Tsutsumi, N. n., Aoki, J. n., Sunahara, R. K., Inoue, A. n., Garcia, K. C., Kobilka, B. K.
  2020; 369 (6500): 161–67
- **Structures of Gα Proteins in Complex with Their Chaperone Reveal Quality Control Mechanisms.** *Cell reports*
  Seven, A. B., Hilger, D. n., Papasergi-Scott, M. M., Zhang, L. n., Qu, Q. n., Kobilka, B. K., Tall, G. G., Skiniotis, G. n.
  2020
- **Structural insights into differences in G protein activation by family A and family B GPCRs.** *Science (New York, N.Y.)*
  Hilger, D. n., Kumar, K. K., Hu, H. n., Pedersen, M. F., O'Brien, E. S., Giehm, L. n., Jennings, C. n., Eskici, G. n., Inoue, A. n., Lerch, M. n., Mathiesen, J. M., Skiniotis, G. n., Kobilka, et al
  2020; 369 (6503)
- **Structure and selectivity engineering of the M1 muscarinic receptor toxin complex.** *Science (New York, N.Y.)*
  Maeda, S. n., Xu, J. n., N Kadji, F. M., Clark, M. J., Zhao, J. n., Tsutsumi, N. n., Aoki, J. n., Sunahara, R. K., Inoue, A. n., Garcia, K. C., Kobilka, B. K.
  2020; 369 (6500): 161–67
- **Conformational transitions of a neurotensin receptor1-Gi1complex.** *Nature*
  Kato, H. E., Zhang, Y., Hu, H., Suomivuori, C., Kadji, F. M., Aoki, J., Krishna Kumar, K., Fonseca, R., Hilger, D., Huang, W., Latorraca, N. R., Inoue, A., Dror, et al
  2019
- **Assembly of a GPCR-G Protein Complex** *CELL*
  Du, Y., Duc, N., Rasmussen, S. G. F., Hilger, D., Kubiak, X., Wang, L., Bohon, J., Kim, H., Wegrecki, M., Asuru, A., Jeong, K., Lee, J., Chance, et al
  2019; 177 (5): 1232-+
- **Structural Insights into the Process of GPCR-G Protein Complex Formation** *CELL*
  Liu, X., Xu, X., Hilger, D., Aschauer, P., Tiemann, J. K. S., Du, Y., Liu, H., Hirata, K., Sun, X., Guixa-Gonzalez, R., Mathiesen, J. M., Hildebrand, P. W., Kobilka, et al
  2019; 177 (5): 1243-+
- **Structures of the M1 and M2 muscarinic acetylcholine receptor/G-protein complexes** *SCIENCE*
  Maeda, S., Qu, Q., Robertson, M. J., Skiniotis, G., Kobilka, B. K.
  2019; 364 (6440): 552-+
- **Selective modulation of the cannabinoid type 1 (CB1) receptor as an emerging platform for the treatment of neuropathic pain** *MEDCHEMCOMM*
  Banister, S. D., Kumar, K., Kumar, V., Kobilka, B. K., Malhotra, S. V.
  2019; 10 (5): 647–59
- **Structural insights into the activation of metabotropic glutamate receptors (vol 566, pg 79, 2019)** *NATURE*
  Koehl, A., Hu, H., Feng, D., Sun, B., Zhang, Y., Robertson, M. J., Chu, M., Kobilka, T., Laeremans, T., Steyaert, J., Tarrasch, J., Dutta, S., Fonseca, et al
  2019; 567 (7747): E10
- **Diverse GPCRs exhibit conserved water networks for stabilization and activation** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*

Venkatakrishnan, A. J., Ma, A. K., Fonseca, R., Latorraca, N. R., Kelly, B., Betz, R. M., Asawa, C., Kobilka, B. K., Dror, R. O.
2019; 116 (8): 3288–93

- **Structural Insights into the Subtype-Selective Antagonist Binding to the M2 Muscarinic Receptor**
  Lee, S., Ryoji, S., Shoji, M., Kobayashi, T., Kobilka, B. K., Vaidehi, N.
  CELL PRESS.2019: 206A

- **Structure of a Signaling Cannabinoid Receptor 1-G Protein Complex** *CELL*
  Kumar, K., Shalev-Benami, M., Robertson, M. J., Hu, H., Banister, S. D., Hollingsworth, S. A., Latorraca, N. R., Kato, H. E., Hilger, D., Maeda, S., Weis, W. I., Farrens, D. L., Dror, et al
  2019; 176 (3): 448-+

- **An improved yeast surface display platform for the screening of nanobody immune libraries.** *Scientific reports*
  Uchanski, T., Zogg, T., Yin, J., Yuan, D., Wohlkonig, A., Fischer, B., Rosenbaum, D. M., Kobilka, B. K., Pardon, E., Steyaert, J.
  2019; 9 (1): 382

- **Angiotensin Analogs with Divergent Bias Stabilize Distinct Receptor Conformations.** *Cell*
  Wingler, L. M., Elgeti, M., Hilger, D., Latorraca, N. R., Lerch, M. T., Staus, D. P., Dror, R. O., Kobilka, B. K., Hubbell, W. L., Lefkowitz, R. J.
  2019

- **Mechanism of β2AR regulation by an intracellular positive allosteric modulator.** *Science (New York, N.Y.)*
  Liu, X. n., Masoudi, A. n., Kahsai, A. W., Huang, L. Y., Pani, B. n., Staus, D. P., Shim, P. J., Hirata, K. n., Simhal, R. K., Schwalb, A. M., Rambarat, P. K., Ahn, S. n., Lefkowitz, et al
  2019; 364 (6447): 1283–87

- **Conformational Plasticity of Human Protease-Activated Receptor 1 upon Antagonist- and Agonist-Binding.** *Structure (London, England : 1993)*
  Spoerri, P. M., Sapra, K. T., Zhang, C. n., Mari, S. A., Kato, H. E., Kobilka, B. K., Müller, D. J.
  2019

- **Conformational Complexity and Dynamics in a Muscarinic Receptor Revealed by NMR Spectroscopy.** *Molecular cell*
  Xu, J. n., Hu, Y. n., Kaindl, J. n., Risel, P. n., Hübner, H. n., Maeda, S. n., Niu, X. n., Li, H. n., Gmeiner, P. n., Jin, C. n., Kobilka, B. K.
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  Du, Y. n., Duc, N. M., Rasmussen, S. G., Hilger, D. n., Kubiak, X. n., Wang, L. n., Bohon, J. n., Kim, H. R., Wegrecki, M. n., Asuru, A. n., Jeong, K. M., Lee, J. n., Chance, et al
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  Jain, M. K., Cheung, V. G., Utz, P. J., Kobilka, B. K., Yamada, T. n., Lefkowitz, R. n.
  2019; 381 (5): 399–402

- **Structure of a Signaling Cannabinoid Receptor 1-G Protein Complex.** *Cell*
  Krishna Kumar, K., Shalev-Benami, M., Robertson, M. J., Hu, H., Banister, S. D., Hollingsworth, S. A., Latorraca, N. R., Kato, H. E., Hilger, D., Maeda, S., Weis, W. I., Farrens, D. L., Dror, et al
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