Stanford

Kang Shen

Vincent V.C. Woo Director, Wu Tsai Neurosciences Institute, Frank Lee and Carol Hall Professor and Professor of Biology and of Pathology

Bio

ACADEMIC APPOINTMENTS

- Professor, Biology
- Professor, Pathology
- Member, Bio-X
- Member, Wu Tsai Neurosciences Institute

ADMINISTRATIVE APPOINTMENTS

- Assistant Professor, Biology, Stanford University, (2003-2009)
- Associate Professor, Biology, Stanford University, (2009-2013)
- Professor, Biology & Pathology, Stanford University, (2013- present)
- Howard Hughes Investigator, Biology, Stanford University, (2008- present)

HONORS AND AWARDS

- Helen Hey Whitney Postdoctoral Fellowship, Helen Hey Whitney Foundation (2000-2003)
- Alfred Sloan Award, Alfred Sloan Foundation (2004-2006)
- Whitehall Foundation Award, Whitehall Foundation (2004-2007)
- Mcknight Neuroscience Scholar Award, Mcknight Foundation (2004-2007)
- Basil O''Connor Award, March of Dimes (2005-2006)
- Searle Scholar Award, Chicargo Community Trust (2005-2008)
- Keck Distinguished Young Investigator Award, William Keck Foundation (2005-2009)
- Young Investigator Award, HFSP, Human Frontier Science Program (2006-2009)

PROFESSIONAL EDUCATION

- Ph. D, Duke University , Molecular Cellular neuroscience (1999)
- MD, Tongji Medical University, China (1994)

LINKS

- Shen Lab site: http://shenlab.stanford.edu/

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

The connectivity of a neuron (its unique constellation of synaptic inputs and outputs) is essential for its function. Neuronal connections are made with exquisite accuracy between specific types of neurons. How each neuron finds its synaptic partners has been a central question in developmental neurobiology. We utilize the relatively simple nervous system of nematode C. elegans, to search for molecules that can specify synaptic connections and understand the molecular mechanisms of synaptic as

PROJECTS

- Mechanisms of Synaptic Specificity in C. elegans - National Institutes of Health
- Patterning dendritic branches with environmental and neuronal surface molecules - National Institutes of Health
- Intracellular Trafficking of Neuronal Proteins - Howard Hughes Medical Institute

Teaching

COURSES

2023-24

- Introduction to Laboratory Research in Neuronal Cell Biology: BIO 43 (Aut, Spr)

2022-23

- Introduction to Laboratory Research in Neuronal Cell Biology: BIO 43 (Spr)
- Principles of Neurobiology: BIO 154 (Win)
- Principles of Neurobiology: BIO 254, NBIO 254 (Win)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Jacqueline Bendrick, URee Chon, Shawn Dhillon, Leyi Huang, Ayaka Kasamatsu, Nicholas Manfred, Carly Stein, Lexy Strom, Emma Theisen, Nabor Vazquez Martinez, Kathryn Wu, Yanbo Zhang

Postdoctoral Faculty Sponsor

Wendy Herbst, Xue Yan Ho, Yue Sun

Doctoral Dissertation Advisor (AC)

Zoe Cook, Dane Kawano, Junhao Xu

Doctoral (Program)

Dane Kawano

GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Biology (School of Humanities and Sciences) (Phd Program)
- Neurosciences (Phd Program)

Publications

PUBLICATIONS

- **Neurite Development and Repair in Worms and Flies.** *Annual review of neuroscience*
  Richardson, C. E., Shen, K.

2019

- **Atlastin-1 regulates morphology and function of endoplasmic reticulum in dendrites.** *Nature communications*
  Liu, X., Guo, X., Niu, L., Li, X., Sun, F., Hu, J., Wang, X., Shen, K.
  2019; 10 (1): 568

- **The inositol 5-phosphatase INPP5K participates in the fine control of ER organization** *JOURNAL OF CELL BIOLOGY*
  Dong, R., Zhu, T., Benedetti, L., Gowrishankar, S., Deng, H., Cai, Y., Wang, X., Shen, K., De Camilli, P.
  2018; 217 (10): 3577–92

- **gamma-Neurexin and Frizzled Mediate Parallel Synapse Assembly Pathways Antagonized by Receptor Endocytosis.** *Neuron*
  Kurshan, P. T., Merrill, S. A., Dong, Y., Ding, C., Hammarlund, M., Bai, J., Jorgensen, E. M., Shen, K.
  2018

- **Rapid Assembly of Presynaptic Materials behind the Growth Cone in Dopaminergic Neurons Is Mediated by Precise Regulation of Axonal Transport.** *Cell reports*
  Lipton, D. M., Maeder, C. I., Shen, K.
  2018; 24 (10): 2709–22

- **The THO Complex Coordinates Transcripts for Synapse Development and Dopamine Neuron Survival.** *Cell*
  Maeder, C. I., Kim, J., Liang, X., Kaganovsky, K., Shen, A., Li, Q., Li, Z., Wang, S., Xu, X. Z., Li, J. B., Xiang, Y. K., Ding, J. B., Shen, et al
  2018

- **A Dendritic Guidance Receptor Complex Brings Together Distinct Actin Regulators to Drive Efficient F-Actin Assembly and Branching** *DEVELOPMENTAL CELL*
  Zou, W., Dong, X., Broederdorf, T. R., Shen, A., Kramer, D. A., Shi, R., Liang, X., Miller, D. M., Xiang, Y. K., Yasuda, R., Chen, B., Shen, K.
  2018; 45 (3): 362-+

- **Dynein and EFF-1 control dendrite morphology by regulating the localization pattern of SAX-7 in epidermal cells** *JOURNAL OF CELL SCIENCE*
  Zhu, T., Liang, X., Wang, X., Shen, K.
  2017; 130 (23): 4063–71

- **Clarinet (CLA-1), a novel active zone protein required for synaptic vesicle clustering and release** *ELIFE*
  Xuan, Z., Manning, L., Nelson, J., Richmond, J. E., Colon-Ramos, D. A., Shen, K., Kurshan, P. T.
  2017; 6

- **Establishing Neuronal Polarity with Environmental and Intrinsic Mechanisms** *NEURON*
  Yogev, S., Shen, K.
  2017; 96 (3): 638–50

- **Local inhibition of microtubule dynamics by dynein is required for neuronal cargo distribution** *NATURE COMMUNICATIONS*
  Yogev, S., Maeder, C. I., Cooper, R., Horowitz, M., Hendricks, A. G., Shen, K.
  2017; 8

- **Optical control of cell signaling by single-chain photoswitchable kinases.** *Science*
  Zhou, X. X., Fan, L. Z., Li, P., Shen, K., Lin, M. Z.
  2017; 355 (6327): 836-842

- **Genetic defects in beta-spectrin and tau sensitize C.elegans axons to movement-induced damage via torque-tension coupling** *ELIFE*
  Krieg, M., Stuehmer, J., Cueva, J. G., Fetter, R., Spilker, K., Cremers, D., Shen, K., Dunn, A. R., Goodman, M. B.
  2017; 6

- **Deep phenotyping unveils hidden traits and genetic relations in subtle mutants** *NATURE COMMUNICATIONS*
  San-Miguel, A., Kurshan, P. T., Crane, M. M., Zhao, Y., McGrath, P. T., Shen, K., Lu, H.
  2016; 7

- **Microtubule Organization Determines Axonal Transport Dynamics.** *Neuron*
  Yogev, S., Cooper, R., Fetter, R., Horowitz, M., Shen, K.
  2016; 92 (2): 449-460

- **A multi-protein receptor-ligand complex underlies combinatorial dendrite guidance choices in C. elegans** *ELIFE*
  Zou, W., Shen, A., Dong, X., Tugizova, M., Xiang, Y. K., Shen, K.
  2016; 5
- **Autoinhibition of a Neuronal Kinesin UNC-104/KIF1A Regulates the Size and Density of Synapses.** *Cell reports*
  Niwa, S., Lipton, D. M., Morikawa, M., Zhao, C., Hirokawa, N., Lu, H., Shen, K.
  2016; 16 (8): 2129-2141
- **Two Clathrin Adaptor Protein Complexes Instruct Axon-Dendrite Polarity** *NEURON*
  Li, P., Merrill, S. A., Jorgensen, E. M., Shen, K.
  2016; 90 (3): 564-580
- **Receptor tyrosine phosphatase CLR-1 acts in skin cells to promote sensory dendrite outgrowth** *DEVELOPMENTAL BIOLOGY*
  Liu, X., Wang, X., Shen, K.
  2016; 413 (1): 60-69
- **The Neuronal Kinesin UNC-104/KIF1A Is a Key Regulator of Synaptic Aging and Insulin Signaling-Regulated Memory.** *Current biology*
  Li, L., Lei, H., Arey, R. N., Li, P., Liu, J., Murphy, C. T., Xu, X. Z., Shen, K.
  2016; 26 (5): 605-615
- **Precise regulation of the guidance receptor DMA-1 by KPC-1/Furin instructs dendritic branching decisions.** *eLife*
  Dong, X., Chiu, H., Park, Y. J., Zou, W., Zou, Y., Özkan, E., Chang, C., Shen, K.
  2016; 5
- **RAB-10 Regulates Dendritic Branching by Balancing Dendritic Transport** *PLOS GENETICS*
  Taylor, C. A., Yan, J., Howell, A. S., Dong, X., Shen, K.
  2015; 11 (12)
- **Mice lacking the synaptic adhesion molecule Neph2/Kirrel3 display moderate hyperactivity and defective novel object preference** *FRONTIERS IN CELLULAR NEUROSCIENCE*
  Choi, S., Han, K., Cutforth, T., Chung, W., Park, H., Lee, D., Kim, R., Kim, M., Choi, Y., Shen, K., Kim, E.
  2015; 9
- **MADD-4/Punctin and Neurexin Organize C. elegans GABAergic Postsynapses through Neuroligin.** *Neuron*
  Maro, G. S., Gao, S., Olechwier, A. M., Hung, W. L., Liu, M., Özkan, E., Zhen, M., Shen, K.
  2015; 86 (6): 1420-1432
- **The unfolded protein response is required for dendrite morphogenesis** *ELIFE*
  Wei, X., Howell, A. S., Dong, X., Taylor, C. A., Cooper, R. C., Zhang, J., Zou, W., Sherwood, D. R., Shen, K.
  2015; 4
- **Sarcomeres Pattern Proprioceptive Sensory Dendritic Endings through UNC-52/Perlecan in C. elegans** *DEVELOPMENTAL CELL*
  Liang, X., Dong, X., Moerman, D. G., Shen, K., Wang, X.
  2015; 33 (4): 388-400
- **Parkinson's Disease Genes VPS35 and EIF4G1 Interact Genetically and Converge on a-Synuclein.** *Neuron*
  Dhungel, N., Eleuteri, S., Li, L., Kramer, N. J., Chartron, J. W., Spencer, B., Kosberg, K., Fields, J. A., Stafa, K., Adame, A., Lashuel, H., Frydman, J., Shen, et al
  2015; 85 (1): 76-87
- **Intrinsic and Extrinsic Mechanisms of Dendritic Morphogenesis** *ANNUAL REVIEW OF PHYSIOLOGY, VOL 77*
  Dong, X., Shen, K., Buelow, H. E.
  2015; 77: 271-300
- **The unfolded protein response is required for dendrite morphogenesis.** *eLife*
  Wei, X., Howell, A. S., Dong, X., Taylor, C. A., Cooper, R. C., Zhang, J., Zou, W., Sherwood, D. R., Shen, K.
  2015; 4
- **Axon and dendritic trafficking** *CURRENT OPINION IN NEUROBIOLOGY*
  Maeder, C. I., Shen, K., Hoogenraad, C. C.

2014; 27: 165-170

- **In vivo neuron-wide analysis of synaptic vesicle precursor trafficking.** *Traffic*
  Maeder, C. I., San-Miguel, A., Wu, E. Y., Lu, H., Shen, K.
  2014; 15 (3): 273-291
- **Extracellular Architecture of the SYG-1/SYG-2 Adhesion Complex Instructs Synaptogenesis.** *Cell*
  Ozkan, E., Chia, P. H., Wang, R. R., Goriatcheva, N., Borek, D., Otwinowski, Z., Walz, T., Shen, K., Garcia, K. C.
  2014; 156 (3): 482-494
- **Local F-actin Network Links Synapse Formation and Axon Branching** *CELL*
  Chia, P. H., Chen, B., Li, P., Rosen, M. K., Shen, K.
  2014; 156 (1-2): 208-220
- **PTRN-1, a microtubule minus end-binding CAMSAP homolog, promotes microtubule function in Caenorhabditis elegans neurons.** *eLife*
  Richardson, C. E., Spilker, K. A., Cueva, J. G., Perrino, J., Goodman, M. B., Shen, K.
  2014; 3
- **Cellular and molecular mechanisms of synaptic specificity.** *Annual review of cell and developmental biology*
  Yogev, S., Shen, K.
  2014; 30: 417-437
- **Two Wnts Instruct Topographic Synaptic Innervation in C. elegans.** *Cell reports*
  Mizumoto, K., Shen, K.
  2013; 5 (2): 389-396
- **An Extracellular Adhesion Molecule Complex Patterns Dendritic Branching and Morphogenesis** *CELL*
  Dong, X., Liu, O. W., Howell, A. S., Shen, K.
  2013; 155 (2): 296-307
- **Intramolecular regulation of presynaptic scaffold protein SYD-2/liprin-alpha** *MOLECULAR AND CELLULAR NEUROSCIENCE*
  Chia, P. H., Patel, M. R., Wagner, O. I., Klopfenstein, D. R., Shen, K.
  2013; 56: 76-84
- **Interaxonal Interaction Defines Tiled Presynaptic Innervation in C. elegans** *NEURON*
  Mizumoto, K., Shen, K.
  2013; 77 (4): 655-666
- **Kinesin-1 regulates dendrite microtubule polarity in Caenorhabditis elegans.** *eLife*
  Yan, J., Chao, D. L., Toba, S., Koyasako, K., Yasunaga, T., Hirotsune, S., Shen, K.
  2013; 2
- **LIN-12/Notch signaling instructs postsynaptic muscle arm development by regulating UNC-40/DCC and MADD-2 in Caenorhabditis elegans.** *eLife*
  Li, P., Collins, K. M., Koelle, M. R., Shen, K.
  2013; 2
- **WNTs in synapse formation and neuronal circuitry** *EMBO JOURNAL*
  Park, M., Shen, K.
  2012; 31 (12): 2697-2704
- **Controlling gene expression with the Q repressible binary expression system in Caenorhabditis elegans** *NATURE METHODS*
  Wei, X., Potter, C. J., Luo, L., Shen, K.
  2012; 9 (4): 391-U105
- **Caenorhabditis elegans Muscleblind homolog mbl-1 functions in neurons to regulate synapse formation** *NEURAL DEVELOPMENT*
  Spilker, K. A., Wang, G. J., Tugizova, M. S., Shen, K.
  2012; 7
- **NAB-1 instructs synapse assembly by linking adhesion molecules and F-actin to active zone proteins** *NATURE NEUROSCIENCE*
  Chia, P. H., Patel, M. R., Shen, K.

2012; 15 (2): 234-242

- **UNC-33 (CRMP) and ankyrin organize microtubules and localize kinesin to polarize axon-dendrite sorting** *NATURE NEUROSCIENCE*
  Maniar, T. A., Kaplan, M., Wang, G. J., Shen, K., Wei, L., Shaw, J. E., Koushika, S. P., Bargmann, C. I.
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- **The transmembrane LRR protein DMA-1 promotes dendrite branching and growth in C. elegans** *NATURE NEUROSCIENCE*
  Liu, O. W., Shen, K.
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- **Sensory Transduction Channel Subunits, tax-4 and tax-2, Modify Presynaptic Molecular Architecture in C-elegans** *PLOS ONE*
  Hellman, A. B., Shen, K.
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- **Semaphorin Breaks Symmetry** *NEURON*
  Howell, A. S., Shen, K.
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- **Neuronal Polarity in C. elegans** *DEVELOPMENTAL NEUROBIOLOGY*
  Ou, C., Shen, K.
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- **CYY-1/Cyclin Y and CDK-5 Differentially Regulate Synapse Elimination and Formation for Rewiring Neural Circuits** *NEURON*
  Park, M., Watanabe, S., Poon, V. V., Ou, C., Jorgensen, E. M., Shen, K.
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- **Genetic dissection of synaptic specificity** *CURRENT OPINION IN NEUROBIOLOGY*
  Maeder, C. I., Shen, K.
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- **UNC-6 and UNC-40 promote dendritic growth through PAR-4 in Caenorhabditis elegans neurons** *NATURE NEUROSCIENCE*
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- **Functional Organization of a Neural Network for Aversive Olfactory Learning in Caenorhabditis elegans** *NEURON*
  Ha, H., Hendricks, M., Shen, Y., Gabel, C. V., Fang-Yen, C., Qin, Y., Colon-Ramos, D., Shen, K., Samuel, A. D., Zhang, Y.
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- **GRLD-1 regulates cell-wide abundance of glutamate receptor through post-transcriptional regulation** *NATURE NEUROSCIENCE*
  Wang, G. J., Kang, L., Kim, J. E., Maro, G. S., Xu, X. Z., Shen, K.
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- **Setting up presynaptic structures at specific positions** *CURRENT OPINION IN NEUROBIOLOGY*
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- **An Arf-like Small G Protein, ARL-8, Promotes the Axonal Transport of Presynaptic Cargoes by Suppressing Vesicle Aggregation** *NEURON*
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- **Two Cyclin-Dependent Kinase Pathways Are Essential for Polarized Trafficking of Presynaptic Components** *CELL*
  Ou, C., Poon, V. Y., Maeder, C. I., Watanabe, S., Lehrman, E. K., Fu, A. K., Park, M., Fu, W., Jorgensen, E. M., Ip, N. Y., Shen, K.
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- **Guidance Molecules in Synapse Formation and Plasticity** *COLD SPRING HARBOR PERSPECTIVES IN BIOLOGY*
  Shen, K., Cowan, C. W.
  2010; 2 (4)
- **Molecular mechanisms of synaptic specificity** *MOLECULAR AND CELLULAR NEUROSCIENCE*
  Margeta, M. A., Shen, K.

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- **Genetics and Cell Biology of Building Specific Synaptic Connectivity** *ANNUAL REVIEW OF NEUROSCIENCE, VOL 33*
  Shen, K., Scheiffele, P.
  2010; 33: 473-507
- **Neuronal and glial cell biology Editorial overview** *CURRENT OPINION IN NEUROBIOLOGY*
  Brophy, P., Shen, K.
  2009; 19 (5): 459-460
- **Deal Breaker: Semaphorin and Specificity in the Spinal Stretch Reflex Circuit** *NEURON*
  Maro, G. S., Shen, K., Cheng, H.
  2009; 63 (1): 8-11
- **Neurite Extension: Starting at the Finish Line** *CELL*
  Patel, M. R., Shen, K.
  2009; 137 (2): 207-209
- **Transient cell-cell interactions in neural circuit formation** *NATURE REVIEWS NEUROSCIENCE*
  Chao, D. L., Ma, L., Shen, K.
  2009; 10 (4): 262-271
- **RSY-1 Is a Local Inhibitor of Presynaptic Assembly in C. elegans** *SCIENCE*
  Patel, M. R., Shen, K.
  2009; 323 (5920): 1500-1503
- **A beta-Catenin-Dependent Wnt Pathway Mediates Anteroposterior Axon Guidance in C. elegans Motor Neurons** *PLOS ONE*
  Maro, G. S., Klassen, M. P., Shen, K.
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- **The Curious Case of a Wandering Kinase: CaMKII Spreads the Wealth?** *NEURON*
  Klassen, M. P., Shen, K.
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- **Clathrin adaptor AP-1 complex excludes multiple postsynaptic receptors from axons in C. elegans** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
  Margeta, M. A., Wang, G. J., Shen, K.
  2009; 106 (5): 1632-1637
- **The role of the ubiquitin proteasome system in synapse remodeling and neurodegenerative diseases** *BIOESSAYS*
  Ding, M., Shen, K.
  2008; 30 (11-12): 1075-1083
- **UNC-6/netrin and its receptor UNC-5 locally exclude presynaptic components from dendrites** *NATURE*
  Poon, V. Y., Klassen, M. P., Shen, K.
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- **Functional dissection of SYG-1 and SYG-2, cell adhesion molecules required for selective synaptogenesis in C-elegans** *MOLECULAR AND CELLULAR NEUROSCIENCE*
  Chao, D. L., Shen, K.
  2008; 39 (2): 248-257
- **Single-synapse ablation and long-term imaging in live C. elegans** *JOURNAL OF NEUROSCIENCE METHODS*
  Allen, P. B., Sgro, A. E., Chao, D. L., Doepker, B. E., Edgar, J. S., Shen, K., Chiu, D. T.
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- **Cellular conductors: Glial cells as guideposts during neural circuit development** *PLOS BIOLOGY*
  Colon-Ramos, D. A., Shen, K.
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- **GFP reconstitution across synaptic partners (GRASP) defines cell contacts and Synapses in living nervous systems** *NEURON*

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2008; 57 (3): 353-363

- **Building a synapse: lessons on synaptic specificity and presynaptic assembly from the nematode C-elegans** *CURRENT OPINION IN NEUROBIOLOGY*
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- **Glia promote local synaptogenesis through UNC-6 (netrin) signaling in C-elegans** *SCIENCE*
  Colon-Ramos, D. A., Margeta, M. A., Shen, K.
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- **Wnt signaling positions neuromuscular connectivity by inhibiting synapse formation in C-elegans** *CELL*
  Klassen, M. P., Shen, K.
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- **Spatial regulation of an E3 ubiquitin ligase directs selective synapse elimination** *SCIENCE*
  Ding, M., Chao, D., Wang, G., Shen, K.
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- **Hierarchical assembly of presynaptic components in defined C. elegans synapses** *NATURE NEUROSCIENCE*
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  Meyer, T., Shen, K.
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  Raucher, D., Stauffer, T., Chen, W., Shen, K., Guo, S. L., York, J. D., Sheetz, M. P., Meyer, T.
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- **Dynamic control of CaMKII translocation and localization in hippocampal neurons by NMDA receptor stimulation** *SCIENCE*
  Shen, K., Meyer, T.
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- **CaMKII beta functions as an F-actin targeting module that localizes CaMKII alpha/beta heterooligomers to dendritic spines** *NEURON*
  Shen, K., Teruel, M. N., Subramanian, K., Meyer, T.
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