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Meeting report for the 2023 UC Irvine Center for Neural Circuit Mapping Conference: structure, function and development of neural circuits

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The third annual conference hosted by the UC Irvine Center for Neural Circuit Mapping (CNCM) was held on August 21–23, 2023, at the Beckman Center of the National Academies of Science and Engineering in Irvine, California [1]. Additional events also took place on August 24 on the UC Irvine campus. Hurricane Hillary generated additional anticipation ahead of the conference as she was forecasted to hit Irvine the night before the meeting, and to be the biggest storm in Irvine in ~100 years! To everyone’s relief, Hillary mostly petered out and was downgraded to a tropical storm by Saturday night. Thus, despite the “virtual option” we made available, nearly everyone attended the conference in person.

This annual summer conference brought together a strong multidisciplinary group of neuroscientists, developmental biologists, and clinicians. Speakers and attendees included Thomas Südhof, winner of the Nobel Prize in Physiology or Medicine in 2013, John Ngai, Director of the National Institutes of Health’s (NIH) Brain Research Through Advancing Innovative Neurotechnologies Initiative, Hongkui Zeng, Executive Vice President and Director of the Allen Institute for Brain Science, and Julio Licinio, Editor in Chief of *Molecular Psychiatry*, as well as a special delegation from the Cajal Institute of Madrid, Spain, and the Spanish Society of Neuroscience. Our conference was held in the tradition of the Cajal Club, the joint host of the 2021–2023 summer conferences (please see <https://cncm.som.uci.edu/past-conferences/>). Santiago Ramon y Cajal was the Spanish neuroscientist who received the Nobel Prize in Physiology or Medicine in 1906 for establishing the “neuron” as the basic unit of nervous structure [2]. In Cajal’s book, *Advice for a Young Investigator* (translated by University of Southern California Professor Larry Swanson), Cajal advised:

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AUTHOR CONTRIBUTIONS

SFG, TCH and XX prepared the figure and wrote the report.

COMPETING INTERESTS

The authors declare no competing interests.

“Tackle small problems first, so that if success smiles and strength increases one may then undertake the great feats of investigation. This cautious approach may not always lead to fame, but at least it will earn for us the esteem of the learned and the respect and consideration of our colleagues” [3].

Following Cajal’s lead, speakers and attendees brought unique perspectives to the theme of integrating the different facets of neural circuits—structure, function, development, and disease. And keeping with the tradition established in 2021 and 2022, the Cajal Club Secretary Charles “Chuck” Ribak commenced the conference with the official Cajal Club gavel (Fig. 1).

The following topics were discussed by 32 invited world-class neuroscientists in the following six major Sessions (Fig. 2): (1) Cell Types and Circuits (Chaired by Hongkui Zeng, Allen Institute), (2) Circuit Development (Chaired by Liqun Luo, Stanford University), (3) Systems and Function (Chaired by Leah Krubitzer, University of California, Davis), (4) Developmental Disorders of Connectivity (Chaired by John Rubenstein, University of California, San Francisco), and (5) Special & Selected Presentations (Chaired by Edward Callaway, Salk Institute for Biological Studies). This year’s conference included a sixth Session with workshops on spatial transcriptomics (presented by Vizgen) and miniscope imaging (presented by the University of California, Los Angeles (UCLA) Miniscope). After the conclusion of the main conference sessions, additional “boot-camps” on spatial transcriptomic imaging using MERSCOPEs (presented by Vizgen), and Statistics for Neuroscience & Single Cell Omics Data (presented by UCI Professors Zhaoxia Yu and Wei Li) were held in the Interdisciplinary Science and Engineering Building on UC Irvine campus.

Monday, August 21st began with a morning session (Session 1), entitled “Cell Types and Circuits”, and included talks from keynote speaker Hongkui Zeng of the Allen Institute, Maria Antonietta Tosches of Columbia University, Yuki Oka of the California Institute of Technology (Caltech), Silvia Arber of the Biozentrum and Friedrich Miescher Institute, and Fan Wang of the Massachusetts Institute of Technology. Monday’s afternoon session (Session 2) entitled “Circuit Development” included talks from Denis Jabaudon of the University of Geneva, Hollis T. Cline of the Scripps Research Institute, Corey Harwell of the University of California, San Francisco, Nenad Sestan of Yale University, and Sergiu Pasca of Stanford University.

Tuesday, August 22nd began with a morning session (Session 3) entitled “Systems and Function”, including talks from the Cajal Club PJ Harman Lecturer Tirin Moore of Stanford, Cory Miller of the University of California, San Diego, Cris Niell of the University of Oregon, Karen Sears of the University of California, Los Angeles and Leah Krubitzer of University of California, Davis. Tuesday afternoon’s session (Session 4), entitled “Developmental Disorders of Connectivity”, heard talks from Thomas Südhof of Stanford, Anna Victoria Molofsky of UCSF, Linda Richards of Washington University in St. Louis, John Rubenstein of UCSF, and John Ngai of the NIH.

Wednesday, August 23rd had a number of Special & Selected Presentations (Session 5) that included Special Presentations from Ruth Benavides-Piccione, Carlos Vicario,

Sandra Jurado and Juan M. Encinas of the Cajal Institute and other Spanish Institutions, and Selected Presentations from Laszlo Zaborszky of Rutgers University, Shen-Ju Chou of Academia Sinica in Taiwan, Alec J. Davidson of Morehouse School of Medicine, and Michel Baudry of Western University of Health Sciences. Details on the topics covered by each speaker from all sessions (1–6) can be found by opening the link <https://cncm.som.uci.edu/2023-cncm-conference/>.

Hongkui Zheng was the main scientific organizer of the 2023 conference and is currently the Executive Vice President and Director of the Allen Institute for Brain Science. Dr Zheng has been working at the Allen Institute since 2006, and as a result of her work there, she was elected to the National Academy of Sciences this year. At our Conference, Dr Zheng delivered the Keynote Lecture. She proposed that by mapping the cell type-specific molecular features and neuroanatomy of the brain in detail, brain scientists will gain new insight into its function. One of the most successful approaches for mapping specific cell types of the brain in very recent years has been the use of high-throughput single-cell and spatial transcriptomics. The Allen Institute became well-known among brain scientists almost 20 years ago because of the mouse brain atlas it had developed using traditional fluorescent in situ hybridization. Dr Zheng is now following this early work and mapping the entire mouse brain using high-throughput transcriptomics approaches. The atlases generated from this work is among the most important resources in brain science [4], and will drive new theories and hypotheses about the function of brain regions based on the diversity and makeup of their resident neurons.

While our 2024 CNCM Summer Conference will be a member-focused meeting, we will continue to host a larger conference every other year. Please save your dates (August 18–20, 2025) for our 2025 Irvine Conference entitled “The Changing Brain” which is currently being planned. Its organization is led by Dr. Liqun Luo at Stanford University, and it will be jointly sponsored by UCI/Cajal Club/Allen Institute/Stanford.

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Fig. 1. Conference commencement.
Professor Charles "Chuck" Ribak upholds tradition by commencing the UCI Center for Neural Circuit Mapping 2023 Summer Conference with the official Cajal Club gavel.



Fig. 2. UCI Center for Neural Circuit Mapping 2023 Conference group photograph.

UCI Center for Neural Circuit Mapping 2023 Conference group photograph. Speaker, organizers, and guests from left to right, include (1) Sandra Jurado, (2) Todd C. Holmes, (3) Karen Sears, (4) Anna Victoria Molofsky, (5) George Emmanuel, (6) Xiaoxiao Lin, (7) Cris Niell, (8) Hollis T. Cline, (9) Julio Licinio, (10) Cory Miller, (11) Juan M. Encinas, (12) John Ngai, (13) Alec J. Davidson, (14) Carlos Vicario, (15) Hongkui Zheng, (16) Laszlo Zaborszky, (17) Thomas Südhof, (18) Charles “Chuck” Ribak, (19) Lulu Chen, (20) Xiangmin Xu, (21) Don B. Arnold, (22) Michel Baudry, (23) Leah Krubitzer, (24) Ruth Benavides-Piccione, (25) Nenad Sestan, (26) Linda Richards, (27) John Rubenstein, (28) Edward Callaway, (29) Liqun Luo, (30) Maria Tosches, (31) Corey Harwell, (32) Sergiu Pasca, (33) Ulrich Schridde, and (34) Peyman Golshani. Photographed by Samson Lautzenheiser.