

**BIOGRAPHICAL SKETCH**

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NAME: Teruel, Mary

eRA COMMONS USER NAME (credential, e.g., agency login): MTERUEL

POSITION TITLE: Associate Professor of Biochemistry

**EDUCATION/TRAINING**

INSTITUTION AND LOCATION	DEGREE	Completion Date MM/YYYY	FIELD OF STUDY
Duke University, Durham, NC	Postdoctoral	12/2000	Cell Biology
Stanford University, Stanford, CA	Ph.D.	01/1996	Aeronautical Engineering
Stanford University, Stanford, CA	M.S.	08/1989	Aeronautical Engineering
University of Pennsylvania, Philadelphia, PA	B.S.	05/1985	Mechanical Engineering

**A. Personal Statement**

I am trained as an aeronautical engineer and carried out my PhD research in Experimental and Computational Fluid Mechanics at Stanford University and at the NASA Ames Research Center in Mountain View, CA. During my thesis, I became fascinated by the emerging field of biomedical engineering and accepted a postdoctoral position in the Dept. of Cell Biology at Duke University to develop new biological instrumentation to manipulate cells and monitor signaling processes using fluorescent reporters and new cutting-edge microscopy techniques. I then accepted an Assistant Professor position at the Depts. of Chemical & Systems Biology and Bioengineering at Stanford University that allowed me to focus on one of the most pressing new clinical challenges, obesity, where I had the goal to understand at the cellular level how adipose tissue grows by both increasing the number and size of adipocytes that ultimately leads to obesity and diabetes. As an example of this work, a recent study from my lab [1] was cited in Nature and in NIH Research Matters and was awarded the inaugural Stanford Diabetes Knowledge Award for being the most impactful diabetes-related publication from Stanford in 2017-2018. I credit this transition to the many discussions and interactions with wonderful colleagues including Fredric Kraemer, M.D., the Chief of Stanford Endocrinology, with whom I have collaborated on several publications on hormonal control of adipogenesis in rodents.

Three years ago, I was offered a unique opportunity to establish a well-equipped microscopy and mouse laboratory and focus my efforts more narrowly on a personal interest of mine, childhood obesity and diabetes, by joining the Druker Institute for Children's Health at Weill-Cornell. In particular, my goal here in NY is to understand how dysregulated circadian rhythms cause obesity and how restoring normal circadian rhythms can treat obesity in children.

My lab has pioneered the development of in vitro long-term live-cell imaging approaches that enable us to identify and understand molecular mechanisms driving the decision of progenitor cells to irreversibly commit to become adipocytes or to choose alternative cell fates. This mechanistic understanding would be impossible by using in vivo models alone. Our unique advantage is that we develop in the same laboratory both new microscopy approaches to understand cell fate choices in vitro and in parallel validate our main in vitro findings by developing in vivo mouse models. Below are examples of publications from my lab:

1. Bahrami-Nejad Z\*, Zhao ML\*, Tholen S, Hunderdosse D, Tkach KE, van Schie S, Chung M, and **Teruel MN.** (2018). A transcriptional circuit filters oscillating circadian hormonal inputs to regulate fat cell differentiation. *Cell Metabolism* Apr 3, 27(4):854-868.e8. PMID: 29617644. \*equal contribution. Highlighted in *Nature*, *NIH Research Matters*, and by the *Faculty of 1000*.
2. Zhang Z, Sinha J, Bahrami-Nejad Z, and **Teruel MN.** (2022). The circadian clock mediates daily bursts of cell differentiation by periodically restricting cell differentiation commitment. *Proc Natl Acad Sci USA.* Aug 16;119(33):e2204470119. doi: 10.1073/pnas.2204470119. Epub 2022 Aug 8. PMID: 35939672; PMCID: PMC9388110.
3. Tholen S, Patel R\*, Agas A\*, Kovary KM, Rabiee A, Nicholls HT, Bielczyk-Maczyńska E, Yang W, Kraemer FB, and **Teruel MN.** (2022). Flattening of circadian glucocorticoid oscillations drives acute hyperinsulinemia and adipocyte hypertrophy. *Cell Reports* Jun 28. 39(13):111018. PMID: 35767959. \*equal contribution.
4. Ahrends R, Ota A, Kovary KM, Kudo T, Park BO, **Teruel MN.** (2014). Controlling low rates of cell differentiation through noise and ultra-high feedback. *Science* Jun 20; 344:1384-9. PMID: 24948735. Awarded an *Editors' Choice* rating by the signaling editors of *Science*.

Recently completed projects that I would like to highlight include:

NIH 1 R56 DK131432                      Teruel (PI)                      9/16/21-9/15/22

“Cell cycle control of adipogenesis”

NIH R01 DK106241                      Teruel (PI)                      6/1/15-5/31/21

“Controlling tissue size by noise and feedback”

NIH R01 DK101743                      Teruel (PI)                      2/1/15-1/31/21

“Controlling the rate of terminal cell differentiation: experiments and theory”

NIH P50 GM107615-01                      Ferrell (PI)                      7/1/13 – 6/30/18

Role: Co-Investigator and Director of the Technology Core

“Systems Biology of Collective Cell Decisions”

## **B. Positions, Scientific Appointments, and Honors**

### **Positions and Scientific Appointments**

2022 - present    Member of the Organizing Committee for the American Diabetes Association (ADA) 2023 Annual Meeting, Chair of Session on “New Breakthroughs in Adipose-Tissue Biology”, Speaker in Session on “Observing Metabolism Through New Lenses”, San Diego, June 22-26, 2023.

2022 – present    Member of the Organizing Committee for the FASEB Meeting on Dynamics and Encoding in Signal Transduction, Niagara Falls, NY, July 2024.

2022 – present    Member of the Einstein-Mount Sinai Diabetes Center, New York City, NY.

2021 – present    Member of the Organizing Committee for the Insights in Signaling Dynamics and Encoding (InSide) International Virtual Seminar Series.

2020 - 2022        Member of Scientific Committee for the 21<sup>st</sup> International Conference on Systems Biology: ICSB 2022, Berlin, Germany.

2020 – present    Member of the Weill Center for Metabolic Health, Weill Cornell Medical College, Cornell University, New York City, NY.

2020 – present    Associate Professor, Dept. of Biochemistry & the Drukier Institute of Children’s Health, Weill Cornell Medical College, Cornell University, New York City, NY.

2019 - 2022 Member of the Editorial Board of *PLOS Biology*

2019 Member of Scientific Committee for the 20<sup>th</sup> International Conference on Systems Biology: ICSB 2019, Okinawa, Japan.

2017 - present Member of the NIH P50 Stanford Diabetes Research Center, Stanford, CA.

2016 - 2020 Assistant Professor (by Courtesy), Dept. of Bioengineering, Stanford University, Stanford, CA.

2015 - 2020 Faculty Fellow, Stanford Institute for Chemistry, Engineering, and Medicine for Human Health (CHEM-H)

2014 - 2020 Member of the Stanford Cancer Institute

2013 - 2020 Co-Investigator and Director of the Technology Core, Stanford NIH Center for Systems Biology (P50)

2012 - 2020 Member of the Stanford Cardiovascular Institute

2012 - 2020 Assistant Professor, Dept. of Chemical & Systems Biology, Stanford University, Stanford, CA.

2007 - 2011 Senior Research Scientist, Dept. of Chemical & Systems Biology, Stanford University.

2007 - 2009 Visiting Scientist with Professor Ruedi Aebersold, Institute for Molecular Systems Biology, ETH Zürich, Zürich, Switzerland.

2001 - 2007 Senior Research Scientist, Dept. of Molecular Pharmacology, Stanford University.

2001 - 2005 Microscopy, Imaging, and Analysis Consultant for the Alliance for Cellular Signaling.

1998 - 2000 Postdoctoral Fellow, Dept. of Cell Biology, Duke University, Durham, NC.

1995 -1998 Microscopy Engineer, Dept. of Cell Biology, Duke University, Durham, NC.

1989 - 1995 Research Assistant with Prof. John Eaton, NASA Ames Research Center and the Dept of Mechanical Engineering, Thermosciences Division, Stanford University.

1988 - 1989 Research Assistant with Prof. Robert MacCormack, Dept. of Aeronautics & Astronautics, Stanford University. Computation of Hypersonic Duct Flow.

1988 Research Assistant with Prof. Peter Banks, Dept. of Electrical Engineering, Stanford University. Shuttle Electrodynamic Tether System Project

1986 - 1987 Test Engineer, Kronos Incorporated, Waltham, MA.

1985 - 1986 Helicopter Structural Test Engineer, Kaman Aerospace Corporation, Bloomfield, CT

### **Honors**

2018 Recipient of the Stanford McCormick/Gabilan Award given to a faculty member at Stanford for their work in supporting the mentoring, training and encouragement of women pursuing the study of medicine, in teaching medicine, and engaging in medical research.

2018 Recipient of the inaugural Diabetes Knowledge Award (DKA) awarded by the Stanford Diabetes Research Center for the most impactful, original diabetes-related publication from Stanford in 2017-2018.

2013 – present Stanford Gabilan Fellow

2007 Biochemical Journal Young Investigator Award

2000 - 2006 National Institutes of Health (NIH) Quantitative Mentored Career Development Award

1998 - 2001 National Institutes of Health Postdoctoral Fellowship

1989 – 1993 National Air and Space Administration (NASA) Graduate Student Fellowship

## C. Contributions to Science

### 1. Adipogenesis / Obesity / Diabetes

I have a deep interest that my basic science findings can someday be used to treat human disease, and this is a main motivation for my focus on adipogenesis and adipocyte function since defects in these lead to insulin resistance, diabetes, cardiovascular disease, and many types of cancer. My interest in adipocytes started with the development of a bioinformatics and fluorescence imaging approach to comprehensively identify proteins downstream of PI3K signaling which regulates insulin action and glucose uptake capability (Park,...Teruel, *Molecular Cell*, 2007). In a series of papers, my laboratory developed and experimentally validated the first quantitative molecular model of adipogenesis, based on stochastic differential equations, explaining how adipocyte progenitor cells undergo terminal differentiation, and how mammalian cells can adjust the fraction of cells that differentiate (Park,...,Teruel, *Cell Reports* 2012; Ahrends,...,Teruel, *Science*, 2014; Bahrami-Nejad,...,Teruel, *Cell Metabolism*, 2018). My lab has also developed novel targeted proteomics approaches that allow us to validate our in vitro findings, as well as to identify new regulatory mechanisms, in mouse models and in human patients (Ota,...,Teruel, *Journal of Lipid Research*, 2015). Of note, our recent paper (Bahrami-Nejad et al, *Cell Metabolism*, 2018) won the inaugural Diabetes Knowledge Award awarded by the Stanford Diabetes Center for the most impactful, original diabetes-related publication from Stanford in 2017-2018 and also was chosen by the NIH National Institute of Diabetes and Digestive and Kidney Disease (NIDDK) to be highlighted in *NIH Research Matters*. Our recent publication (Zhao,...,Teruel, *Cell Reports* 2020) provides a molecular explanation why mice deficient in the cyclin-dependent kinase inhibitors p21 and p27 have 6-fold increases in fat mass, as well as impaired glucose tolerance and insulin sensitivity.

- a) Ahrends R, Ota A, Kovary KM, Kudo T, Park BO, **Teruel MN**. (2014). Controlling low rates of cell differentiation through noise and ultra-high feedback. *Science* Jun 20; 344:1384-9. PMID: 24948735. *Awarded an Editors' Choice rating by signaling editors of Science.*
- b) Ota A, Kovary KM, Wu OH, Ahrends R, Costa MJ, Shen W, Feldman BJ, Kraemer FB, **Teruel MN**. (2015). Using SRM mass spectrometry to profile nuclear protein abundance differences between adipose tissue depots of insulin resistant mice. *Journal of Lipid Research* May; 56(5):1068-78. Epub Apr 3. PMID: 25840986.
- c) Bahrami-Nejad Z, Zhang Z, Tholen S, Sharma S, Rabiee A, Zhao ML, Kraemer FB, **Teruel MN**. (2022). Early enforcement of cell identity by a functional component of the terminally differentiated state. *PLOS Biology* Dec 5; DOI: 10.1371/journal.pbio.3001900; PMID: **36469503**.
- d) Kudo T, Zhao ML, Kovary KM, Covert M, **Teruel MN**. (2023). A dynamic HIF1 $\alpha$ -PPAR $\gamma$  circuit controls a paradoxical adipocyte regulatory landscape. *Cell Systems* (in press).

### 2. Cell Cycle Control of Terminal Cell Differentiation.

A main focus of our current work is on how tissues control the critical balance between proliferating progenitors and post-mitotic differentiated cells during the differentiation process. As part of the terminal cell differentiation process, progenitor cells must undergo permanent cell cycle exit. However, how cell cycle exit and differentiation are mechanistically coupled was not understood and had been a black box due to a lack of critical tools. To solve this long-standing question in terminal cell differentiation, we developed a method that allows us for the first time to simultaneously monitor in the same progenitor cell the moment when the cell irreversibly commits to terminally differentiate together with its progression through the cell cycle. Using this approach, we show that there is a precise time when cells commit to terminally differentiate and that this time is exclusively during the G1 phase of the cell cycle. Importantly, we identify the molecular mechanism for permanent cell cycle exit by showing that the moment cells commit to differentiate, they rapidly self-amplify PPARG and this switch mechanism triggers a parallel rapid increase in p21 that causes permanent cell cycle exit. We go on to show that a permanent increase in p21 is required to maintain a postmitotic and healthy differentiated state. Finally, the terminal differentiation control mechanism we discovered led to a new paradigm how tissues can balance their need to control both the levels of differentiated and progenitor cells during the differentiation process. Our in vitro studies can thus explain the conundrum why mice lacking the CDK inhibitor p21 have significantly increased adipogenesis and fat mass. Finally, our results have implications for neurogenesis, myogenesis, and terminal cell differentiation processes in general by providing a framework of how the size of terminally differentiated tissues and maintenance of the progenitor pool can be synergistically controlled by varying the relative strengths of mitogen and differentiation stimuli.

- a) Zhao ML, Rabiee AR, Kovary KM, Bahrami-Nejad Z, Taylor B, **Teruel MN.** (2020). Molecular competition in G1 controls when cells simultaneously commit to terminally differentiate and exit the cell-cycle. *Cell Reports* 2020 Jun 16; 31(11):107769.

### 3. Circadian Control of Cell Differentiation and Tissue Regeneration

Glucocorticoid and other differentiation-inducing hormones are secreted in mammals in circadian oscillations. Loss of this circadian oscillation pattern during stress and disease correlates with increased fat mass and obesity in humans, raising the intriguing question of how hormone secretion dynamics affect the process of adipocyte differentiation. In Bahrami-Nejad *et al* (*Cell Metabolism*, 2018), we used live, single-cell imaging of the key adipogenic transcription factors CEBPB and PPAR $\gamma$ , endogenously tagged with fluorescent proteins, and discovered that pulsatile circadian hormone stimuli are rejected by the adipocyte differentiation control system. In striking contrast, equally strong persistent signals trigger maximal differentiation. We identify the mechanism of how hormone oscillations are filtered as a combination of slow and fast positive feedback centered on PPAR $\gamma$ . Furthermore, we confirmed in mice that flattening of daily glucocorticoid oscillations significantly increases the mass of subcutaneous and visceral fat pads. Our results provide a molecular mechanism for why stress, Cushing's disease, and other conditions for which glucocorticoid secretion loses its pulsatility may lead to obesity. Given that oscillating hormones are ubiquitous in mammals, the temporal filtering mechanism we discovered likely represents a general principle for the control of cell differentiation.

- a) Bahrami-Nejad Z\*, Zhao ML\*, Hunderdosse D, Tkach KE, van Schie S, Chung M, **Teruel MN.** (2018). A transcriptional circuit filters oscillating circadian hormonal inputs to regulate fat cell differentiation. *Cell Metabolism* 27(4):854-868.e8. doi: 10.1016/j.cmet.2018.03.012. PubMed PMID: 29617644. \*equal contribution.
- *Highlighted in Nature, NIH Research Matters, ScienceNews, F1000-the Faculty of 1000, the Times (London), ABC News, CBS News, the Los Angeles Times, Reuters.*
  - *Awarded the inaugural Diabetes Knowledge Advancement (DKA) Award by the Stanford Diabetes Research Center, given to the most impactful, original diabetes-related research publication from Stanford (2017-2018).*
- b) Tholen S, Patel R\*, Agas A\*, Kovary KM, Rabiee A, Nicholls HT, Bielczyk-Maczyńska E, Yang W, Kraemer FB, and **Teruel MN.** (2022). Flattening of circadian glucocorticoid oscillations drives acute hyperinsulinemia and adipocyte hypertrophy. *Cell Reports* Jun 28. 39(13):111018. PMID: 35767959. \*equal contribution.
- c) Zhang Z, Sinha J, Bahrami-Nejad Z, and **Teruel MN.** (2022). The circadian clock mediates daily bursts of cell differentiation by periodically restricting cell differentiation commitment. *Proc Natl Acad Sci USA*. Aug 16;119(33):e2204470119. doi: 10.1073/pnas.2204470119. Epub 2022 Aug 8. PMID: 35939672; PMCID: PMC9388110.

### 4. Understanding how feedback and noise can control mammalian cell fate-decisions.

The advent of single cell approaches has made it clear that noise (cell-to-cell variability) is inherent in all cell populations, but how noise originates, propagates, and affects cell signaling outcome has been largely unexplored. Our goal is to identify and understand the different mechanisms that can be used to stabilize noisy signaling systems and how noise can be modulated to make robust cell-fate decisions. In Abell *et al*, (*PNAS*, 2011), we applied a novel combined mass spectrometry and modeling strategy to the calcium signaling system to understand how eukaryotic cells can prevent signaling failure despite the inherent noise in expression of individual signaling components. In Ahrends *et al* (*Science*, 2014), we used computational modeling and quantitative proteomics to show that noise, combined with multiple feedback loops in the regulatory circuits, enables the stable and infrequent differentiation required to homeostatically maintain tissue size. In Shi *et al* (*Molecular Cell*, 2017), we developed a quantitative mass spectrometry approach to understand variation in ribosomal composition in stem cells. In Kovary *et al* (*Molecular Systems Biology*, 2018), we developed single-cell mass spectrometry and imaging strategies to more accurately measure the variation of proteins between individual cells and to understand how systems can balance opposing needs of noise to make accurate single cell and population-level decisions

- a) Abell E, Ahrends R, Bandara S, Park BO, **Teruel MN.** (2011). Parallel adaptive feedback enhances reliability of the Ca<sup>2+</sup> signaling system. *Proc Natl Acad Sci U S A* Aug 30;108(35):14485-90. Epub 2011 Aug 15. *Awarded a "Must Read" and "Exceptional" rating by the Faculty of 1000.*

- b) Ahrends R, Ota A, Kovary KM, Kudo T, Park BO, **Teruel MN**. (2014). Controlling low rates of cell differentiation through noise and ultra-high feedback. *Science* Jun 20; 344:1384-9. PMID: 24948735. *Awarded an Editors' Choice rating by signaling editors of Science.*
- c) Shi Z, Fujii K, Kovary KM, Genuth NR, Röst HL, **Teruel MN**, Barna M. (2017). Heterogeneous Ribosomes Preferentially Translate Distinct Subpools of mRNAs Genome-wide. *Molecular Cell* Jul 6;67(1):71-83.e7. Epub 2017 Jun 15. PubMed PMID: 28625553.
- d) Kovary KM, Taylor B, Zhao ML, and **Teruel MN**. (2018). Expression variation impairs analog and enables binary signaling control. *Molecular Systems Biology* May 14;14(5):e7997. PMID: 29759982.

**For a complete list of publications, please see:**

[https://www.ncbi.nlm.nih.gov/myncbi/1N9\\_aqcG-dyoPP/bibliography/public/](https://www.ncbi.nlm.nih.gov/myncbi/1N9_aqcG-dyoPP/bibliography/public/)

## SELECTED INVITED LECTURES

July 2024	FASEB Meeting on Dynamics and Encoding in Signal Transduction, Niagara Falls, NY.
June 2023	American Diabetes Association (ADA) 2023 Annual Meeting, San Diego, CA. Session on "Observing Metabolism Through New Lenses".
May 2023	CSHL Meeting on "Mechanisms of Metabolic Signaling", Cold Spring Harbor, NY.
April 2023	Boston-Ithaca Islet Club Annual Meeting, Yale University, New Haven, CT.
April 2023`	13 <sup>th</sup> Annual Center for Circadian Biology Symposium, UC San Diego, La Jolla, CA.
March 2023	Department of Bioengineering, University of Virginia, Charlottesville, VA
January 2023	Keystone Symposium on "Bioenergetics in Health and Diseases", Keystone, Colorado.
November 2022	Department of Integrative Biology and Physiology (IBP), University of Minnesota, Minneapolis, MN.
January 2022	Institute of Molecular Medicine, UTHealth McGovern Medical School, Houston, Texas.
December 2020	Einstein-Mount Sinai Diabetes Research Center Seminar, NY, NY.
December 2020	Network of Minority Health Research Investigators (NMRI) West Regional Virtual Workshop, U. Washington, Seattle, Washington.
June 2020	Insights in Signaling Dynamics and Encoding (InSiDE 2020) Virtual Seminar Series.
May 2020	Society for Research on Biological Rhythms Biennial Meeting (Virtual), Amelia Island, Florida.
February 2020	Workshop on "The Dynamics of Collective Decisions", Wissenschaftskolleg, Berlin, Germany.
December 2019	American Society of Cell Biology (ASCB) Annual Meeting, Session on "Systems and Synthetic Biology of Decoding Complex Cellular Rhythms", Washington DC.
November 2019	ICSB 2019 - 20 <sup>th</sup> International Conference on Systems Biology, Chair and speaker of session on "Developmental Systems Biology", Okinawa, Japan.
October 2019	University of Cincinnati and Cincinnati Children's Hospital Research Foundation
March 2019	CHSL Meeting on Systems Biology: Networks, Cold Spring Harbor, NY.
February 2019	Winter Qbio Meeting 2019, Oahu, Hawaii
January 2019	Keystone Symposia on Signal Dynamics and Signal Integration in Development and Disease, Keystone, CO.
January 2019	Boston University, Dept. of Biomedical Engineering, Boston, MA

January 2019 Boston University, Dept. of Biochemistry, Boston, MA.

December 2018 Weill Cornell Medicine/Cornell University, Dept. of Biochemistry, New York City, NY.

December 2018 American Society of Cell Biology (ASCB) Annual Meeting, Session on “*Systems and Synthetic Biology of Decoding Complex Cellular Rhythms*”, San Diego, CA.

December 2018 University of Michigan, Dept. of Biomedical Engineering, Ann Arbor, MI.

December 2018 UC Santa Cruz; Dept. of Molecular, Cell, and Developmental Biology; Santa Cruz, CA.

October 2018 UC Berkeley, Dept. of Bioengineering, Berkeley, CA.

July 2018 Green Center for Systems Biology and Dept. of Cell Biology, UT Southwestern, Dallas, TX.

July 2018 CSHL Course on Single Cell Analysis, Cold Spring Harbor, NY.

July 2018 The Francis Crick Institute, London, England.

May 2018 Quantitative Biology Seminar Series, UC San Diego, San Diego, CA. "Students' Choice". Invited by the graduate students in the UCSD Quantitative Biology PhD program.

May 2018 Solvay Workshop on "*Dynamics of biological systems: Modelling genetic, signaling and microbial networks*", The International Solvay Institutes, Brussels, Belgium.

March 2018 Dept. of Cell Biology/Institute of Cell Dynamics, Johns Hopkins University, Baltimore, MD.

February 2018 SysBio 2018: 8th Advanced Lecture Course on Systems Biology, Innsbruck, Austria.

January 2018 Dept. of Systems Biology, Harvard University, Cambridge, MA.

January 2018 Institute of Genomics and Systems Biology, University of Chicago, Chicago, IL.

November 2017 Institute of Systems Biology and Dept. of Biomedical Engineering, Yale University, New Haven, CT.

May 2017 1<sup>st</sup> Latin-American Systems Biology Conference, Mexico City, Mexico.

April 2017 Stanford Diabetes Research Symposium, Stanford, CA.

February 2017 Fifth Annual Winter Quantitative Biology (q-bio) Conference, Kauai, Hawaii.

January 2017 Keystone Symposia on Obesity and Adipose Tissue Biology, Keystone, CO.

January 2017 UCSF/Gladstone Institutes Seminar, UC San Francisco, San Francisco, CA.

November 2016 NIH/NIDDK Workshop on the Adipose Tissue Niche, Bethesda, MD.

October 2016 University of Mississippi Medical Center, Jackson, MS. August 2015 EMBO workshop on Cell and Developmental Systems, Arolla, Switzerland.

October 2016 Biozentrum/University of Basel, Basel, Switzerland.

July 2016 q-bio 2016: Quantitative and Systems Biology in Nashville Conference, Nashville, TN.

September 2015 14<sup>th</sup> Human Proteome Organization World Congress – HUPO 2015, Session on Protein Networks and Systems Biology, Vancouver, Canada.

June 2016 Japanese Society of Cell Biology Annual Meeting, Kyoto, Japan.

February 2016 Biophysical Society Annual Meeting, Symposium on Synthetic Biology and Systems Biology, Los Angeles, CA.

December 2015 American Society of Cell Biology (ASCB) Annual Meeting, Minisymposium on Signaling and Differentiation, San Diego, CA.

November 2015 Dept. of Biomedical Engineering, Georgia Tech and Emory University, Atlanta, Georgia.

October 2015 Keystone Symposium on Diabetes: New Insights into Molecular Mechanisms and Therapeutic Strategies, Kyoto, Japan.

July 2015 International Conference on the Systems Biology of Disease, German Cancer Institute, Heidelberg, Germany.

May 2015 Program in Vascular Biology, UCLA, Los Angeles, CA.

April 2015 Friedrich Miescher Institute (FMI) for Biomedical Research, Basel, Switzerland.

April 2015 EMBO|EMBL Symposium: Cellular Heterogeneity: Role of Variability and Noise in Biological Decision Making, Heidelberg, Germany.

March 2015 Society for Developmental Biology, West Coast Meeting, Yosemite, CA.

February 2015 Third Annual Winter Quantitative Biology (q-bio) Conference, Maui, Hawaii.

December 2015 American Society of Cell Biology Annual Meeting, Philadelphia, PA.

October 2014 Cell Press Symposia: Systems Approach to Metabolic Diseases, Chicago, IL

July 2014 NIH National Centers for Systems Biology Annual Meeting, San Diego, CA.

June 2014 Sanofi/Aventis, Frankfurt, Germany.

February 2014 Second Annual Winter Quantitative Biology (q-bio) Conference, Kona, Hawaii.

October 2013 University of Chicago, Institute of Genomics and Systems Biology, Chicago, IL.

August 2013 Quantitative Biology (q-bio) 2013 Conference on Cellular Information Processing, St. Johns College, Santa Fe, NM.

June 2013 International Conference on the Systems Biology of Disease, German Cancer Institute, Heidelberg, Germany.

November 2012 Uppsala University, Department of Medical Cell Biology, Uppsala, Sweden.

November 2012 EMBL Symposium: From Functional Genomics to Systems Biology, Heidelberg, Germany.

July 2012 Kern Lipid Conference on Systems Biology and Cardiometabolic Diseases, Aspen, CO.

March 2012 U.S. Human Proteome Organization (HUPO) Annual Meeting, San Francisco, CA.