Harris H. Wang

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CITIZENSHIP United States of America

ACADEMIC APPOINTMENT

7/2020 – present Associate Professor of Systems Biology (with tenure)
Department of Systems Biology
Department of Pathology & Cell Biology
Columbia University Irving Medical Center, New York, NY, USA

3/2013 – 6/2020 Assistant Professor of Systems Biology
Department of Systems Biology
Department of Pathology & Cell Biology
Columbia University Irving Medical Center, New York, NY, USA

9/2011 – 2/2013 Instructor of Systems Biology (PI status)
Department of Systems Biology
Harvard Medical School, Boston, MA, USA

EDUCATION

9/2005 – 6/2010 Harvard University, Cambridge, MA, USA
Ph.D. in Biophysics
Harvard-MIT Health Sciences and Technology (HST), Cambridge, MA, USA
Joint-Ph.D. in Medical Engineering Medical Physics (MEMP)
Thesis title: "Multiplex Automated Genome Engineering (MAGE) for the Optimization of Metabolic Pathways, Construction of New Genetic Codes, and Evolution of Synthetic Organisms."
Advisor: George Church, Dept of Genetics, Harvard Medical School

9/2001 – 6/2005 Massachusetts Institute of Technology, Cambridge, MA, USA
B.S. in Physics
B.S. in Applied Mathematics
Minor in Biomedical Engineering

TRAINING

9/2010 – 2/2013 Wyss Technology Development Fellow (PI status)
Wyss Institute for Biologically Inspired Engineering, Harvard University, MA

1/2008 – 7/2008 Medical Clerkship (HST-MEMP), Mount Auburn Hospital, Cambridge, MA

HONORS & AWARDS

2019 Hirschl Trust Research Scientist Award, Irma T. Hirschl Trust
2018 Schaefer Research Scholar, Columbia University
2017 Dr. Harold & Golden Lamport Research Award in Basic Sciences, Columbia University
2017 Investigator in Pathogenesis of Infectious Disease Award, Burroughs Wellcome Fund
2017 Presidential Early Career Award for Scientists and Engineers (PECASE), White House
2017 ONR Director of Research Early Career Award, Office of Naval Research, DoD
2015 ONR Young Investigator Award, Office of Naval Research, DoD
2015 Sloan Research Fellowship, Sloan Foundation

2014 NSF CAREER Award, National Science Foundation
2012 Forbes 30 under 30 in Science
2011 NIH Director's Early Independence Award, National Institutes of Health
2011 Wyss Technology Development Fellowship, Wyss Institute, Harvard University
2009 Collegiate Inventors Competition Grand Prize, National Inventors Hall of Fame
2009 Certificate of Distinction in Teaching, Derek Bok Center, Harvard University
2006 NSF Graduate Research Fellowship (GRF), National Science Foundation
2006 National Defense Science and Engineering Graduate (NDSEG) Fellowship, DoD
2002 Exceptional Summer Student at NINDS, National Institutes of Health
2001 National Merit Scholar

PROFESSIONAL MEMBERSHIP AND COMMUNITY SERVICES

- Member of Executive Scientific Committee, Genome Project-Write Center of Excellence for Engineering Biology.
- Member of organizing committee of the 2019 Synthetic Biology: Engineering, Evolution & Design (SEED) Conference, New York, NY, USA; Member of organizing committee of the 2019, 2020 & 2021 International Conference on Microbiome Engineering, Boston, MA, USA.
- Associate editor for *Microbiome*; Editorial Board of *ACS Synthetic Biology.*
- Journal reviewer for *Nature, Science, Nature Biotechnology*, *Nature Methods*, *Nature Chemical Biology*, *Nature Nanotechnology*, *Nature Microbiology*, *Nature Communications*, *Cell Systems*, *Proceedings of the National Academies of Sciences of USA*, *BMC Systems Biology, BMC Genomics*, *Nucleic Acids Research*, *ACS Synthetic Biology*, *Molecular Systems Biology, PLoS Computational Biology, Biotechnology Journal*.
- Grant reviewer for NIH, NSF, DoD, DOE, Gates Foundation.
- Visiting Fellow at the Isaac Newton Institute for Mathematical Science on Program on Understanding Microbial Communities (Cambridge, UK, 2014).
- Participant of Congressional Visit Day (CVD) to advocate increasing science funding in both House of Representatives and Senate chambers (Washington DC, USA, 2006).

EDUCATIONAL CONTRIBUTIONS

Teaching activities

- *2015 Summer – 2018 Summer* Program organizer & Lecturer, Columbia University Medical Center
  Course: Columbia iGEM Program (U level)
- *2014 Fall – 2018 Fall* Lecturer, Columbia University Medical Center
  Course: Molecular Genetics (G level) [Cell Biology G4150x]
- *2017 Spring* Lecturer, Columbia University SEAS
  Course: Intro to Synthetic Biology [BMEN E4520x]
- *2018 Summer* Lecturer, 5th SSBSS, Siena, IT.
  Course: International Synthetic and Systems Biology Summer School
- *2016 Summer* Course organizer and instructor, Cold Spring Harbor Laboratories
  Course: Synthetic Biology Summer Course
- *2016 Summer* Lecturer, Weill Cornell Medical School
  Course: ACLS International Summer School
- *2013, 2014, 2017 Summer* Lecturer, Cold Spring Harbor Laboratories
  Course: Synthetic Biology Summer Course
- *2014 Fall* Workshop lecturer, Isaac Newton Institute for Mathematical Sciences
  Course: Understanding Microbial Communities
- *2009 Fall* Teaching Fellow, Harvard University *(Distinction in Teaching Certificate)*
  Course: Biophysics 101 Genomics, Computing, & Economics (U/G)

Graduate student PhD thesis supervisor

- Victoria Stockman (Integrated/C2B2 Program), graduated with Masters 6/2017
- Nathan Johns (Integrated/C2B2 Program), graduated with PhD 12/2018
- Sway Chen (MD/PhD Program), graduated with PhD 12/2018
- Frank Cusimano (Nutritional and Metabolic Biology Program), graduated with PhD 6/2019
- Ravi Sheth (Integrated/C2B2 Program), graduated with PhD 10/2019
- Jimin Park (Integrated Program), graduated with PhD 5/2020
- Tom Blazejewski (Integrated/C2B2 Program), graduated with PhD 9/2020
- Ross McBee (Biological Sciences Program), current G5
- Florencia Velez-Cortes (Integrated/C2B2 Program), current G5
- Miles Richardson (Integrated/C2B2 Program), current G4
- Yiming Huang (Integrated/C2B2 Program), current G4
- Tyler Perdue (Biological Sciences Program), current G3
- Chrystal Mavros (Genetics and Developmental Biology Program), current G3
- Deirdre Ricaurte (MD/PhD Program), current G2
- Thomas Moody (MD/PhD Program), current G1
- Yiwei Sun (PhD Program), current G2

Graduate student PhD thesis committee member

- Tyler Halpin-Healy (Integrated), Advisor: S. Sternberg, thesis committee (chair).
- Kira Tomlinson (MD/PhD), Advisor: A. Prince, thesis committee
- Tiffany Chien (BME), Advisor: T. Danino, thesis proposal committee
- Tetsuhiro Harimoto (BME), Advisor: T. Danino, thesis committee
- Marla Giddins (Integrated), Advisor: A. Chavez, thesis proposal committee
- Leo Vo (Integrated), Advisor: S. Sternberg, qualifying exam, thesis committee
- Dinara Usmanova (Integrated), Advisor: D. Vitkup, thesis committee
- Sydney Blattman (Integrated), Advisor: S. Tavazoie, thesis committee
- Cathy Guo (Biology), Advisor: N. Sanjana, qualifying committee (NYU, outside reviewer)
- Michael Klausen (PhD), Advisor: M. Sommer, thesis defense (DTU, outside reviewer)
- Brian Ji (MD/PhD), Advisor: D. Vitkup, thesis defense
- Alex Ketcham (Integrated), Advisor: S. Tavazoie, thesis defense
- Jamie Yang (MD/PhD), Advisor: S. Tavazoie, qualifying exam & thesis defense
- Robert Heler (PhD), Advisor: L. Marraffini, thesis defense (Rockefeller U, outside reviewer)
- Sean Llewellyn (MD/PhD), Advisor: J. Faith, thesis defense (MSSM, outside reviewer)
- Jordan Kesner (Integrated), Advisor: A. Califano, qualifying exam
- Nicholas Hornstein (MD/PhD), Advisor: P. Sims, thesis defense
- Andy Yao Zong Ng (Chemistry), Advisor: V. Cornish, qualifying exam & thesis defense
- James Brisbois (Chemistry), Advisor: V. Cornish, qualifying exam & thesis defense
- Nathan Jaffe (Biology), Advisor: Ruben Gonzales, thesis committee
- Mariam Konate (Integrated), Advisor: D. Vitkup, thesis committee

Graduate student research rotation supervisor

- Charlotte Rochereau (Integrated Program), Spring 2021
- Haley Lei Huang (Pathobiology Program), Spring 2021
- Aditi Trehan (Integrated Program), Spring 2021
- Logan Schwanz (Pathobiology Program), Fall 2021
- Andrew Liu (Physics Program), Summer 2020 rotation
- Ruxiao Tian (Immunology & Microbiology Program), Fall 2019 rotation
- Charles Fox (Biological Sciences Program), Summer 2019 rotation
- Izaak Coleman (Integrated/C2B2 Program), Fall 2018 rotation
- Sydney Blattman (Integrated/C2B2 Program), Spring 2018 rotation

- Felix Wu (Integrated/C2B2 Program), Spring 2017 rotation
- Hannah Levitin (Integrated/C2B2 Program), Fall 2015 rotation
- Emily Groopman (MD/PhD rotation), Summer 2015 rotation
- Julian Berger (Integrated Program rotation), Spring 2015 rotation
- Zach Baker (Integrated Program rotation), Fall 2014 rotation
- Tal Lorberbaum (Integrated Program rotation), Fall 2013 rotation
- John Szymanski (Integrated Program rotation), Fall 2013 rotation

Undergraduate student mentorship

- Jasmine Wang (Barnard) Spring 2021-current [Biology major]
- Jaysen Zhang (Columbia) Summer 2017-current [CS major]
- Jennifer Fang (Columbia) Summer 2017-Spring 2020 [Biology major]
- Tarun Srinivasan (Columbia) Summer 2017-Spring 2020 [Biochemistry major]
- Suppawat Kongthong (Columbia) Spring 2015-Spring 2017 [Biology major]
- Jacky Cheung (Columbia) Summer 2014-Summer 2017 [CS major]
- Sam Magaziner (Columbia) Summer 2015-Spring 2016 [Biochemistry major]
- Kellie Lu, (Columbia) Summer 2015 [CS major]
- Anthony Yang, (Columbia) Summer/Winter 2013 [BME major]
- Daniel Huang, (Columbia) Summer 2013 [BME major]

Postdoctoral fellow mentorship

- Carlotta Ronda (DTU, Microbiology) 1/2016 – present
- Sung Sun Yim (KAIST, Synthetic Biology/Microbiology) 10/2016 – present
- Liyuan Liu (CAS, Synthetic Biology) 10/2017 – present
- Guillaume Urtecho (UCLA, Molecular Biology) – 5/2020 – present
- Diego Gelsinger (Johns Hopkins, Molecular Biology) – 9/2020 - present
- Hsing Ho (Baylor, Microbiology) 9/1/2015 – 12/2019
- Christian Munck (DTY, Microbiology) 1/2017 – 2/2020
- Vitor Cabral (Institut Pasteur, Microbiology) 9/2014 – 4/2016
- Antonio Gomes (BU, Bioinformatics) 1/2014 – 11/2016

PATENTS & INVENTIONS

- *Multiplex Automated Genome Engineering*. Church GM, Wang HH, Isaacs FJ. WO2008/052101A2
- *Improving microbial fitness in the mammalian gut.* Wang HH. PCT/US No.: 14/66173
- *A High-throughput Strategy for Combinatorial Targeting of CRISPR/Cas9 to Multiple Genetic Loci.* Wang HH, Shapira SS, Stockman, V. PCT/US No.: 15/747,677
- *Microbial Fingerprinting for Real-time Microbiome Surveillance.* Wang HH, Sheth RU. PCT/US No.: 62/475,608.
- *Spatial Metagenomics to Map Microbial Biogeography in the Gut.* Wang HH, Sheth RU. PCT/US No.:62/486,244
- *In situ Microbiome Engineering through Engineered Mobile Genetic Elements.* Wang HH. PCT/US No.: 62/465,522
- *CRISPR-based Methods for Recording Biological Signals.* Wang HH, Sheth RU. PCT/US No.: 62/770,483
- *Novel Nano-piercing Transformation Method for Gut Bacteria*. Wang HH. PCT/US No.: 62/193,704.
- *CRISPR-based Methods for Altering Prokaryotic Genes and Altering the Gut Microbiome.* Wang HH PCT/US No.: 62/395,015
- *An Engineered Cas-Transposon System for Programmable and Precise DNA Transpositions.* Wang HH, Chen SP. PCT/US No.: 62/852,629

- *Advanced microbiome therapeutics engineered to produce serotonin in vivo.* Wang HH. Cusimano F, Bongers M, Sommer MOA. PCT/No. 62/861,007

PUBLICATIONS

(* denotes co-first authorship, # denotes senior/co-senior authorship, [ ] #'s are key papers)

Peer-reviewed research publications at CUIMC

[57] Yim SS, McBee RM, Song AM, Huang Y, Sheth RU, **Wang HH**#. Robust direct digital-to-biological data storage in living cells. *Nature Chem Biol* 17:246-253 (2021).

[56] Vo PLH, Ronda C, Klompe SE, Chen EE, Acree C, **Wang HH**, Sternberg SH. CRISPR RNA-guided integrases for high-efficiency and multiplexed bacterial genome engineering. *Nature Biotechnol.* 39:480-489 (2021).

55. Yim SS, Johns NI, Noireaux V, **Wang HH**#. Protecting Linear DNA Templates in Cell-Free Expression Systems from Diverse Bacteria. *ACS Syn Biol* 9(10):2851-2855 (2020).

[54] Ho HI, Fang JR, Cheung J, **Wang HH**#. Programmable and portable CRISPR-Cas transcriptional activation in bacteria. *Mol Syst Biol* 16:e9427 (2020).

53. Munck C, Sheth RU, Cuaresma E, Weidler J, Stump SL, Zachariah P, Chong DH, Uhlemann AC, Abrams JA, **Wang HH**, Freedberg DE. The effect of short-course antibiotics on the resistance profile of colonizing gut bacteria in the ICU: a prospective cohort study. *Critical Care* 24(1):404 (2020).

52. Gomes ALC*, Johns NI*, Yang A, Velez-Cortes F, Smillie CS, Smith MB, Alm EJ, **Wang HH**#. Genome and sequence determinants governing the expression of horizontally acquired DNA in bacteria. *The ISME J* 14:2347-2357 (2020).

51. Munck C, Sheth RU, Cuaresma E, Weidler J, Stump SL, Zachariah P, Chong DH, Uhlemann AC, Abrams JA, **Wang HH**, Freedberg DE. The effect of short-course antibiotics on the resistance profile of colonizing gut bacteria in the ICU: a prospective cohort study. *Critical Care* 24(1):404 (2020).

50. Freedberg DE, Messina M, Lynch E, Tess M, Miracle E, Chong DH, Wahab R, Abrams JA, **Wang HH**, Munck C. Impact of Fiber-Based Enteral Nutrition on the Gut Microbiome of ICU Patients Receiving Broad-Spectrum Antibiotics: A Randomized Pilot Trial. *Critical Care Explorations* 2(6):e0135 (2020).

[49] Munck C*, Sheth RU*, Freedberg DE, **Wang HH**#. Recording mobile DNA in the gut microbiota using an Escherichia coli CRISPR-Cas spacer acquisition platform. *Nature Commun*, 11:95 (2020).

48. Huang Y*, Sheth RU*, Kaufman AM, **Wang HH**#. Scalable and cost-effective ribonuclease-based rRNA depletion for bacterial transcriptomics. *Nucleic Acids Res* 48(4):e20 (2020).

47. Chen SP, **Wang HH**#. An Engineered Cas-Transposon System for Programmable and Precise DNA Transpositions. *The CRISPR Journal* 2(6):376-394 (2019).

46. Konate M, Plata G, Park J, **Wang HH**, Vitkup D. Molecular function limits divergent protein evolution on planetary timescales. *Elife 8:e39705* (2019).

[45] Yim SS, Johns NI, Park J, Gomes ALC, McBee RM, Richardson M, Ronda C, Chen SP, Garenne D, Noireaux V, **Wang HH**#. Multiplex transcriptional characterizations across diverse and hybrid bacterial cell-free expression systems. *Mol Syst Biol* 15:e8875 (2019)

[44] Blazejewski T, Ho HI, **Wang HH**#. Synthetic sequence entanglement augments stability and containment of genetic information in cells. *Science* 365:595-598 (2019).

[43] Sheth RU, Li M, Jiang W, Sims PA, Leong KW, **Wang HH**#. Spatial metagenomic characterization of microbial biogeography in the gut. *Nature Biotechnol* 37:877-883 (2019).

[42] Ji BW*, Sheth RU*, Dixit PD, Huang Y, Kaufman A, **Wang HH**#, Vitkup D#. Quantifying spatiotemporal variability and noise in absolute microbiota abundances using replicate sampling. *Nature Methods* 16:731-736 (2019).

[41] Ronda C*, Chen SP*, Cabral V*, Yaung SJ, **Wang HH**#. Metagenomic engineering of the mammalian gut microbiome in situ. *Nature Methods* 16:167-170 (2019).

40. Brunk E, Chang RL, Xia J, Hefzi H, Yurkovich JT, Kim D, Buckmiller E, **Wang HH**, Cho BK, Yang C, Palsson BO, Church GM, Lewis NE. Characterizing posttranslational modifications in prokaryotic metabolism using a multiscale workflow. *Proc Natl Acad Sci USA* 115(43): 11096-11101 (2018).

39. Sheth RU, **Wang HH**#. DNA-based memory devices for recording cellular events. *Nature Reviews Genetics* 19:718-732 (2018).

[38] Johns NI*, Gomes ALC*, Yim SS, Yang A, Blazejewski T, Smillie CS, Smith MB, Alm EJ, Kosuri S, **Wang HH**#. Metagenomic mining of regulatory elements enables programmable species-selective gene expression. *Nature Methods* 15:323-329 (2018).

37. Park J, **Wang HH**#. Systematic and synthetic approaches to rewire regulatory networks. *Curr Opin Syst Biol* 8:90-96 (2018).

[36] Sheth RU, Yim SS, Wu FL, **Wang HH**#. Multiplex recording of cellular events over time into a CRISPR biological tape. *Science* 358:1457-1461 (2017).

35. Kelsic ED*, Chung H*, Cohen N, Park J, **Wang HH**#, Kishony R#. Optimal codon choice throughout a gene. *Cell Systems* 3(6):563-571 (2016).

34. Stockman VB, Ghamsari L, Cabrera GL, Honig B, Shapira SD#, **Wang HH**#. A high-throughput strategy for dissecting mammalian genetic interactions. *PLoS One* 11(12):e0167617 (2016).

33. Boeke JD*, Church GM*, Hessel A*, Kelly NJ*, Arkin A, Cai Y, Carlson R, Chakravarti A, Cornish VW, Holt L, Isaacs FJ, Kuiken T, Lajoie M, Lessor T, Lunshof J, Maurano MT, Mitchell LA, Rine J, Rosser S, Sanjana NE, Silver PA, Valle D, **Wang HH**, Way JC, Yang L. The Genome Project-Write. *Science* 353:126-127 (2016).

32. Gomes ALC, **Wang HH**#. The role of genome accessibility in transcription factor binding in bacteria. *PLoS Comput Biol* 12(4):e1004891 (2016).

31. Utrilla J, O'Brien EJ, Chen K, McCloskey D, Cheung J, **Wang HH**, Armenta-Medina D, Feist AM, Palsson BO**.** Global rebalancing of cellular resources by pleiotropic point mutations illustrates a multi-scale mechanism of adaptive evolution. *Cell Systems* 2:260-271 (2016).

30. Johns NI, Tomasz Blazejewski T, Gomes ALC, **Wang HH**#. Principles for designing synthetic microbial communities. *Curr Opin Microbiol* 31:146-153 (2016).

29. Widder S, Allen RJ, Pfeiffer T, Curtis TP, Wiuf C, Sloan WT, Cordero OX, Brown SP, Momeni B, Shou W, Kettle H, Flint HJ, Haas AF, Laroche B, Kreft JU, Rainey PB, Freilich S, Schuster S, Milferstedt K, van der Meer JR, Groβkopf T, Huisman J, Free A, Picioreanu C, Quince C, Klapper I, Labarthe S, Smets BF, **Wang HH**, Isaac Newton Institute Fellows & Soyer OS. Challenges in microbial ecology: building predictive understanding of community function and dynamics. *The ISME Journal* 10:2557-2568 (2016).

[28] Sheth RU, Cabral V, Chen SP, **Wang HH**#. Manipulating bacterial communities by in situ microbiome engineering. *Trends in Genetics* 32:189-200 (2016).

27. Tasoff J, Mee MT, **Wang HH**#. An economic framework of microbial trade. *PLoS One* 10(7):e0132907 (2015).

26. Freedberg DE, Toussaint NC, Chen SP, Ratner AJ, Susan Whittier S, Wang TC, **Wang HH**#, Abrams JA#. Proton pump inhibitors alter specific taxa in the human fecal microbiome: results of a crossover trial. *Gastroenterology* 149:883-5 (2015).

[25] Yaung SJ, Deng L, Li N, Braff JL, Liu Q, Church GM, Bry L, **Wang HH**#, Gerber GK#. Improving microbial fitness in the mammalian gut by in vivo temporal functional metagenomics. *Mol Syst Biol* 11(788): 1-16 (2015).

24. Bonde MT*, Kosuri S*, Genee HJ, Sarup-Lytzen K, Church GM#, Sommer MOA#, **Wang HH**#. Direct mutagenesis of thousands of genomic targets using microarray-derived oligonucleotides. *ACS Synth Biol* 4(1):17-22 (2015).

23. Munck C, Gumpert HK, Nilsson AI, **Wang HH**, Sommer MOA. Resistance development against drug combinations is predicted by the evolutionary responses to the component drugs. *Sci Transl Med* 262:262ra156 (2014).

22. Orena Y, Smith MB, Johns NI, Zeevia MK, Birand D, Rond EZ, Coranderf J, **Wang HH**, Alm EJ, Pupko T. Transfer of noncoding DNA drives regulatory rewiring in bacteria. *Proc Natl Acad Sci USA* 111(45):16112-17 (2014).

[21] Mee MT, Collins JJ, Church GM, **Wang HH**#. Syntrophic exchange in synthetic microbial communities. *Proc Natl Acad Sci USA* 111(20):E2149-56 (2014).

20. Bonde MT, Klausen MS, Anderson MV, Wallin AIN, **Wang HH**#, Sommer MOA#. MODEST: A web-based design tool for oligonucleotide-mediated genome engineering and recombineering. *Nucleic Acids Res* W408-15. doi:10.1021/sb5001565 (2014).

19. Yaung S, **Wang HH**#. "Recent progress in engineering human-associated microbiomes." in Engineering and Analyzing Multicellular Systems, *Methods Mol Biol* 1151:3-25 (2014).

18. Esvelt K, **Wang HH**#. Genome-scale engineering for systems and synthetic biology. *Mol Sys Biol* 9:641 (2013).

17. DiCarlo JE, Conley AJ, Penttilä M, Jäntti J, **Wang HH**#, Church GM#, Yeast Oligo-mediated Genome Engineering (YOGE), *ACS Synth Biol* 2(12):741-9 (2013).

16. Lajoie MJ, Rovner AJ, Goodman DB, Aerni H, Mercer JA, **Wang HH**, Carr PA, Schultz PG, Jacobson JM, Rinehart J, Church GM, Isaacs FJ. Genomically Recoded Organisms Impart New Biological Functions. *Science* 342(6156):357-60 (2013).

Peer-reviewed research publications prior to CUIMC

15. **Wang HH**, Mee MT, Church GM. "Applications of Engineered Synthetic Ecosystems" in Synthetic Biology: Tools and Applications. Editor: Huimin Zhao, Elsevier, 317-325 (2013).

14. Mosberg JA, Gregg CJ, Lajoie MJ, **Wang HH**, Church GM. Improving Lambda Red Genome Engineering via Rational Removal of Endogenous Nucleases. *PLoS One* 7(9): e44638 (2012).

13. Mee M, **Wang HH**#. Engineering ecosystems and synthetic ecologies. *Mol Biosys* 8(10):2470-83 (2012).

[12] **Wang HH***, Kim HB*, Cong L, Jeong JH, Bang D, Church GM. Genome-scale Promoter Engineering by Co-Selection MAGE. *Nature Methods* 9:591-3 (2012).

11. Carr PA*, **Wang HH***, Sterling B*, Isaacs FJ, Xu G, Kraal L, Bang D, Jacobson J, Church GM. Enhanced Multiplex Genome Engineering through Cooperative Oligonucleotide Co-selection. *Nucleic Acids Res* 40(17):e132. (2012).

10. **Wang HH***, Huang P*, Xu G, Marbelstone A, Li J, Forster T, Jewett MC, Church GM. Multiplexed in vivo tagging of enzyme ensembles with MAGE for in vitro single-pot multi-enzyme catalysis. *ACS Synth Biol 1*:43-52 (2012).

[9] Isaacs FJ*, Carr PA*, **Wang HH***, Lajoie MJ, Sterling B, Kraal L, Tolonen AC, Gianoulis TA, Goodman DB, Reppas NB, Emig CJ, Bang D, Hwang SJ, Jewett MC, Jacobson JM, Church GM. Precise manipulation of chromosomes in vivo enables genome-wide codon replacement. *Science* 333: 348-53 (2011).

8. **Wang HH**, Xu G, Vonner AJ, Church G. Modified bases enable high-efficiency oligonucleotide-mediated allelic replacement via mismatch repair evasion. *Nucleic Acids Res* 39(16): 7336-47 (2011).
7. **Wang HH**, Church GM. Multiplexed genome engineering and genotyping methods applications for synthetic biology and metabolic engineering. *Method Enzymol* 498:409-26 (2011).
6. **Wang HH**. Synthetic Genomes for Synthetic Biology. *J Mol Cell Biol* 2(4):178-179, (2010).

[5] **Wang HH***, Isaacs FJ*, Carr PA, Sun ZZ, Xu G, Forest CR, Church GM. Programming cells by multiplex genome engineering and accelerated evolution. *Nature* 460: 894-8 (2009).

4. **Wang HH**, Menezes NM, Zhu MW, Ay H, Koroshetz WJ, Aronen HJ, Karonen JO, Liu Y, Nuutinen J, Wald LL, Sorensen AG. Physiological noise in MR images: an indicator of the tissue response to ischemia? *J Magn Reson Imaging* 27(4):866-71 (2008).
3. **Wang HH**, Wang XF. "Analytical methods of atherosclerosis research." in *Current Development in Atherosclerosis Research*, 33-66, Nova Science Publishing, NY (2006).
2. **Wang HH**, Wang XF. "Modeling atherosclerosis." in *Trends in Atherosclerosis Research*, 279-311, Nova Science Publishing, NY, (2004).
1. **Wang HH**. *Analytical model of atherosclerosis.* *Atherosclerosis* 159:1-7 (2001).

INVITED TALKS

65. Invited seminar: Imperial College, Centre for Synthetic Biology (virtual, Apr 2021)
64. Invited talk: ACS Presidential Symposium (virtual, April 2021)
63. Invited seminar: Rice University Bioengineering Seminar Series (virtual, Apr 2021)
62. Invited talk: Tri-Service Microbiome Consortium Bioinformatics Meeting (virtual, Apr 2021)
61. Invited talk: NYAS Bioengineering Seminar (virtual, Dec 2020)
60. Invited seminar: US Army Soldier Center Seminar (virtual, Dec 2020)
59. Oral presentation: CSHL Microbiome Meeting (virtual, Oct 2020)
58. Invited seminar: DOE SSD SFA Microbiome workshop (virtual, Oct 2020)
57. Invited seminar: Institute for Genomic Innovations, UCSF (virtual, Apr 2020)
56. Invited seminar: NYU Genes, Systems & Computational Seminar Series, NY (Feb 2020)
55. Invited talk: NSF BioTICC Workshop, Virginia, USA (January 2020)
54. Invited seminar: Department of Biomedical Engineering Seminar Series, Cornell University, Ithaca, NY, USA (Dec 2019)
53. Invited talk: GP-write & Sc 2.0 Conference, New York, NY, USA (Nov 2019)
52. Invited talk: 3rd Tri-service Microbiome Consortium Symposium, Dayton, OH (Oct 2019)
51. Invited seminar: Department of Biomedical Engineering Seminar Series, University of Utah, Salt Lake City, UT, USA (Oct 2019)
50. Invited seminar: Demark Technical University, Novo Nordisk Center for Biosustainability Copenhagen, Denmark (Aug 2019)
49. Invited talk: Synthetic Biology: Synthesis, Engineering, Evolution, and Design (SEED), New York, NY (Jun 2019)
48. Invited talk: SynGen Series 2019, Boston, MA, USA (May 2019)
47. Invited seminar: Northwestern University, Biochemistry and Molecular Genetics Department Seminar Series, Evanston, IL, USA (Feb 2019)
46. Invited seminar: PNNL Seminar Series, Richland, WA, USA (Feb 2019)
45. Invited seminar: UC Irvine Department of Biomedical Engineering Distinguished Seminar Series, Irvine, CA, USA (Jan 2019)
44. Invited talk: 9th International Conference on Biomolecular Engineering, CA, USA (Jan 2019)
43. Invited talk: 2nd International Conference on CRISPR Technologies, CA, USA (Dec 2018)
42. Invited talk: International Conference on Microbiome Engineering, MA, USA (Nov 2018)
41. Invited seminar: SIAT Seminar Series, Shenzhen, China (Oct 2018)

40. Invited talk: 2018 World Life Sciences Conference, Beijing, China (Oct 2018)
39. Invited talk: Biotech Without Borders Seminar Series, Brooklyn, NY, USA (Sept 2018)
38. Invited seminar: NSRDEC Seminar Series, NSRDEC, Natick, MA, USA (August 2018)
37. Invited seminar: NRL CBMSE Colloquium Series, NRL, MD, USA (May 2018)
36. Invited talk: DoD Tri-Service Microbiome Workshop, MD, USA (May 2018)
35. Invited seminar: UPenn Microbiology Seminar Series, U. Penn, PA, USA (Apr 2018)
34. Invited seminar: Bioengineering Seminar Series, UCSD, CA, USA (April 2018)
33. Invited seminar: Microbial Pathogenesis & Host Defense Seminar Series, UCSF, CA, USA (Mar 2018)
32. Invited talk: NAS Workshop: The Promise of Genome Editing Tools to Advance Environmental Health Research, Wash DC, USA (Jan 2018)
31. Invited talk: 12th International Conference on Genomics (ICG12), Shenzhen, China (Oct 2017)
30. Invited talk: Sino-US Chinese Conference on Synthetic Biology (SUCC2017), Hangzhou, China (Oct 2017)
29. Invited talk: The Human Microbiome – Emerging Themes at the Horizon of the 21st Century, NIH Workshop, Bethesda, MD, USA (August 2017)
28. Invited talk: SEED, Vancouver, Canada (June 2017)
27. Invited talk: ASM Microbe, New Orleans, LA, USA (June 2017)
26. Invited talk: GP-write Meeting 2017, NY Genome Center, NY, USA (May 2017)
25. Invited talk: NIAID/DMID Workshop Single Cell Technologies for Infectious Diseases, Rockville, MD, USA (April 2017)
24. Invited talk: NYBIG 2016, Keynote, NYU, NY, USA (May 2016)
23. Invited talk: Human Genome Project-Write Workshop, Harvard Medical School, MA, USA (May 2016)
22. Invited talk: Columbia University CRISPR Workshop, CUIMC, NY, USA (Nov 2015)
21. Invited seminar: Penn Bioinformatics Forum Seminar Series, University of Pennsylvania, Philadelphia, USA. (November 2015)
20. Invited talk: BioTechnology Institute Seminar Series, University of Minnesota, MN, USA (Oct 2015)
19. Invited talk: 7th Copenhagen Bioscience Conferences on Cell factories and Biosustainability, Copenhagen, Denmark (June 2015)
18. Invited talk: Genspace Seminar Series, Brookline, NY, USA (May 2015)
17. Invited seminar: Horizons Seminar Series, Dupont USA, DE, USA (December 2014)
16. Invited talk: Understanding Microbial Communities Workshop, Isaac Newton Institute, Cambridge, UK (November 2014)
15. Invited talk: Synthetic Biology Engineering, Evolution, and Design Conference, California, USA (July 2014)
14. Invited talk: 1st ASM Conference on Experimental Microbial Evolution, Washington DC, USA (June 2014)
13. Invited talk: National Academies of Science. Industrialization of Biology, Washington DC, USA (May 2014)
12. Invited seminar: Weill Cornell Institute for Computational Biomedicine, NY (Feb 2014)
11. Invited talk: Towards Next Generation Synthetic Biology Workshop, Warwick Centre for Integrative Synthetic Biology (WISB), University of Warwick, Coventry, UK. (Nov 2013)
10. Invited talk: 2013 Frontiers in Mucosal Immunology Symposium, Boston, USA. (Oct 2013)
9. Invited talk: Cold Spring Harbor Asia, Suzhou, China (Nov 2011)
8. Invited talk: 33rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Boston, MA, USA (Sept 2011)
7. Invited talk: 2011 International Union of Microbiological Societies, Japan (Sept 2011)
6. Invited talk: Workshop on Genome Engineering, Defense Threat Reduction Agency (DTRA), Springfield, VA, USA (2010 Oct)

5. Invited talk: Bio International Convention, Chicago, IL, USA (May 2010)
4. Invited talk: 17th Annual Microbial Genomics Conference, MD, USA (2009 Oct)
3. Invited seminar: Joint Bioenergy Institute, UC-Berkeley, Berkeley, CA, USA (Sept 2009)
2. Invited talk: Keynote, IEEE Congress on Evolutionary Computation, Trondheim, Norway (May 2009)
1. Invited talk: BBN Technologies, Boston, MA, USA (Apr 2009)

FUNDING

Active Research Support

- 1U54CA209997 *Centers for cancer systems therapeutics (CAST)*
  National Institutes of Health, NCI 8/8/2016 – 8/7/2021
  Award direct cost amount: $374,306 (Wang portion)
  Role: Co-Investigator (PI: Andrea Califano, Columbia University)
- N00014-17-1-2353 *Next-gen massively parallel cellular biosurveillance and recording devices*
  Office of Naval Research, Department of Defense 4/1/2017 – 3/31/2022
  Award direct cost amount: $637,284
  Role: Principal Investigator
- 1R01AI132403 *Micron-scale spatial metagenomic mapping of microbial biogeography in the gastrointestinal tract*
  National Institutes of Health, NIAID 6/1/2017 – 5/31/2022
  Award direct cost amount: $2,069,926
  Role: Principal Investigator
- HR0011-17-C-0068 *Sustainable biologically active modular building materials*
  Defense Advanced Research Projects Agency 7/1/2017 – 9/31/2021
  Award direct cost amount: $1,137,912 (Wang portion)
  Role: Co-Investigator (PI: Damen Schaak, Ecovative Designs)
- PATH1016691 *Mapping host-microbe & inter-microbial networks at ultra-high spatial resolution*
  Burroughs Wellcome Fund 9/1/2017 – 8/31/2022
  Award direct cost amount: $500,000
  Role: Principal Investigator
- 1R01DK118044 *Ecological dynamics and metabolic interactions in gut microbiome across space and time*
  National Institutes of Health, NIDDK 8/1/2018 – 4/30/2023
  Award direct cost amount: $2,407,729
  Role: Co-Principal Investigator (Co-PI: Dennis Vitkup, Columbia University)
- HR001118S0037 *A multimodal oral non-viral CRISPR-Cas medical countermeasure to enhance ionizing radiation resilience and survival*
  Defense Advanced Research Projects Agency 4/1/2019 – 3/31/2023
  Award direct cost amount: $9,553,235
  Role: Principal Investigator
- 1R21AI146817 *Identification of immunomodulatory microbes with MAGIC*
  National Institutes of Health, NIAID 9/1/2019 – 8/31/2021
  Award direct cost amount: $63,260 (Wang portion)
  Role: Co-Investigator (PI: Ivaylo Ivanov, Columbia University)
- Irma Hirschl Research Scientist Award, *Next-generation gut microbiome modulators of host behavior and cognition*
  Irma T. Hirschl Trust 7/1/2020 – 6/30/2025
  Award direct cost: $175,000

Role: Principal Investigator

- MCB-2032259 *Towards Life with a Reduced Protein Alphabet*
  National Science Foundation 10/1/2020 – 6/30/2023
  Award direct cost amount: $2,190,207
  Role: Principal Investigator
- MCB-2025515 *MTM 2: The rules of microbiota colonization of the mammalian gut*
  National Science Foundation 10/1/2020 – 9/30/2025
  Award direct cost amount: $2,249,007
  Role: Co-Principal Investigator (Co-PI: Georg Gerber, HMS/BWH)
- DOE 47879/SCW1710 *From Sequence to Cell to Population: Secure and Robust Biosystems Design for Environmental Microorganisms*
  Department of Energy SFA 10/15/2020 – 10/14/2023
  Award direct cost: $ 394,772 (Wang portion)
  Role: Co-Investigator (PI: Yongqin Jiao, LLNL)
- TalCoINY Alliance *Systematic discovery of bile acid metabolizing gut microbiota for IBD treatment*
  Takeda Pharmaceuticals, Millenium Pharmaceuticals 12/1/2020 – 12/31/2021
  Award direct cost amount: $100,000
  Role: Principal Investigator
- 1R01CA255298 *Role of the Microbiome and Notch Signaling in Esophageal Adenocarcinoma*
  National Institutes of Health, NCI 1/1/2021 – 12/31/2025
  Award direct cost amount: $50,000
  Role: Co-Investigator (PI: Julian Abrams, Columbia University)

Completed Research Support

- MCB-1453219 (CAREER) *Systems approach to study horizontal acquisition of regulatory DNA*
  National Science Foundation 1/1/2015 – 12/31/2020
  Award direct cost amount: $444,332
  Role: Principal Investigator
- INV-000609 *Azithromycin's impact on microbiome reassembly and re-configuration in mice*
  Gates Foundation 12/1/2018 –4/30/2020
  Award direct cost amount: $227,000
  Role: Principal Investigator
- 1U01GM110714 *A minimally invasive synthetic biology-driven approach for natural products discovery*
  National Institutes of Health, NIGMS 4/1/2015 – 3/31/2020
  Award direct cost amount: $1,262,907 (Wang portion)
  Role: Co-Investigator (PI: Sean Brady, Rockefeller University)
- N00014-18-1-2237 *Modular automated microbial banking and analysis (MAMBA) system to enhance DoD-relevant microbiome research*
  Office of Naval Research, Department of Defense (DoD) 6/1/2018 – 5/31/2019
  Award direct cost amount: $249,255
  Role: Principal Investigator
- Schaefer Research Award *Dissection of xenobiotic metabolism by the gut microbiome*
  Columbia University, Vagelos College of Physicians & Surgeons 6/1/2018 – 5/30/2019
  Award direct cost amount: $250,000
  Role: Principal Investigator
- HR0011-17-2-0041 *Engineering prototrophy in mammalian cells*
  Defense Advanced Research Projects Agency 5/1/2017 – 10/31/2018

Award direct cost amount: $472,136
Role: Principal Investigator

- N00014-15-1-2704 *A foundational synthetic biology toolbox for engineering human gut microbiota towards enhancing warfighter capabilities*
  Office of Naval Research, Department of Defense 6/1/2015 – 5/31/2018
  Award direct cost amount: $342,657
  Role: Principal Investigator
- 1DP5OD009172 *Functional metagenomic reprogramming of the human microbiome through mobilome engineering*
  National Institutes of Health, NIDCR 9/20/2011 – 5/31/2017
  Award direct cost amount: $1,250,000
  Role: Principal Investigator
- W911NF-15-2-0065 *In situ genome engineering of unculturable microbes and genomic recoding to limit genetic code*
  Defense Advanced Research Projects Agency 7/1/2015 – 8/30/2017
  Award direct cost amount: $1,052,786
  Role: Principal Investigator
- FR-2015-65795 *Evolutionary Drivers of Horizontal Gene Flow*
  Sloan Foundation 9/15/2015 – 9/14/2017
  Direct cost amount: $50,000
  Role: Principal Investigator