Harris H. Wang

Columbia University
Lasker, Rm 203BB
3960 Broadway
NY, NY 10032

Office: 212-305-1697
Email: hw2429@columbia.edu
Web: wanglab.c2b2.columbia.edu

CITIZENSHIP United States of America

FIELD Systems and synthetic biology; Genome engineering; Microbial communities; Evolutionary biology; Functional genomics

EDUCATION

2010 ***Harvard University***
Ph.D. in Biophysics

2010 ***Harvard-MIT Health Sciences and Technology***
Joint-Ph.D. in Medical Engineering Medical Physics (MEMP)

2005 ***Massachusetts Institute of Technology***
B.S. in Physics, B.S. in Applied Mathematics, minor in Biomedical Engineering

PROFESSIONAL EXPERIENCE

3/2013 – present
Assistant Professor of Systems Biology
Department of Systems Biology
Department of Pathology & Cell Biology
Columbia University, College of Physicians and Surgeons, New York, USA

2010 – 2013
Wyss Technology Development Fellow (PI status)
Instructor, Department of Systems Biology, Harvard Medical School
Wyss Institute for Biologically Inspired Engineering, Harvard University.
Faculty mentors: Jim J. Collins (BU), George M. Church, Don E. Ingber (HMS)
Projects: Functional metagenomic reprogramming of the human microbiome; Engineered cooperativity in synthetic ecosystems.

2005 – 2010
NSF Graduate Research Fellowship
NDSEG Graduate Research Fellowship
Department of Genetics, Harvard Medical School, Boston, MA
Ph.D. thesis advisor: George M Church,
Thesis committee: Jack Szostak (HMS), Jon Beckwith (HMS), David Liu (Harvard). Ron Weiss (MIT), Jim Hogle (HMS)
Ph.D. thesis title: "Multiplex Automated Genome Engineering (MAGE) for the Optimization of Metabolic Pathways, Construction of New Genetic Codes, and Evolution of Synthetic Organisms."

2008
Medical Clerkship, Mount Auburn Hospital, Cambridge, MA
Advisor: Dr. Valerie Pronio-Stelluto
Description: 3 month internal medicine rotation through HST MEMP

PUBLICATIONS

** denote shared first authorship, ¥ denote co-corresponding authorship*

33. Boeke JD, Church GM, Hessel A, Kelly NJ, et al. *The Genome Project-Write.* Science. DOI: 10.1126/science.aaf6850 (2016).
32. Gomes ALC, **Wang HH.** *The Role of Genome Accessibility in Transcription Factor Binding in Bacteria.* PLoS Comput Biol. DOI:10.1371/journal.pcbi.1004891 (2016). PMID: 27104615

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). PMID: 27135538
30. Johns NI, Tomasz Blazejewski T, Gomes ALC, **Wang HH.** *Principles for designing synthetic microbial communities.* Curr Opin Microbiol. 31:146–153 (2016). PMID: 27084981
29. Widder S, Allen RJ, Pfeiffer T, Curtis TP, … **Wang HH**, et al., *Challenges in microbial ecology: building predictive understanding of community function and dynamics.* The ISME Journal. doi: 10.1038/ismej.2016.45 (2016). PMID: 27022995
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. DOI: 10.1371/journal.pone.0132907 (2015). PMID: 26222307.
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). PMID: 26164495.
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 Sys Biol 11:788 (2015). PMID: 26148351.
24. 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). PMID: 25391482.
23. 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). PMID: 25313052.
22. Mee MT, Collins JJ, Church GM, **Wang HH**. *Syntrophic Exchange in Synthetic Microbial Communities.* Proc Natl Acad Sci USA 111(20): E2149-56 (2014). PMID: 24778240.
21. 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 Synthetic Biology 4(1):17-22 (2014). PMID: 24856730.
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) PMID: 24838561.
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). PMID: 24838875.
18. Esvelt K, **Wang HH**. *Genome-scale engineering for systems and synthetic biology.* Mol Sys Biol 9:641, (2013) PMID: 23340847.
17. DiCarlo JE, Conley AJ, Penttilä M, Jäntti J, **Wang HH¥**, Church GM, *Yeast Oligo-mediated Genome Engineering (YOGE)*, ACS Synth Bio. 2(12):741-9. (2013) PMID: 24160921.
16. **Wang HH**, Mee MT, Church GM. "Applications of Engineered Synthetic Ecosystems" in Synthetic Biology: Tools and Applications. Editor: Huimin Zhao, Elsevier, p. 317-325. (2013).
15. 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). PMID: 24136966.
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. doi:10.1371/journal.pone.0044638, (2012). PMID: 22957093.

13. Mee M, **Wang HH**. *Engineering ecosystems and synthetic ecologies.* Mol Biosys 8(10):2470-83 (2012). PMID: 22722235.
12. **Wang HH**, Kim HB, Cong L, Jeong JH, Bang D, Church GM. *Genome-scale Promoter Engineering by Co-Selection MAGE.* Nat Methods **9**: 591-3 (2012). PMID: 22484848.
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. DOI: 10.1093/nar/gks455, (2012). PMID: 22638574.
10. **Wang HH**, Huang P, Xu G, Marbelstone A, Li J, Forster T, Jewett MC, Church GM. *Multipliexed in vivo tagging of enzyme ensembles with MAGE for in vitro single-pot multi-enzyme catalysis.* ACS Synth Biol**1**: 43−52 (2012). PMID: 22737598.
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). PMID: 21764749.
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). PMID: 21609953.
7. **Wang HH**, Church GM. *Multiplexed genome engineering and genotyping methods applications for synthetic biology and metabolic engineering.* Method Enzymol **498**: 409-26 (2011). PMID: 21601688.
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). PMID: 19633652.
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). PMID: 18383248.
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). PMID: 11689200

Manuscripts

1. Stockman VB, Ghamsari L, Cabrera GL, Honig B, Shapira SD, **Wang HH**. *A High-throughput Strategy for Dissecting Mammalian Genetic Interactions.* In revision PLoS One (2016).
2. Kelsic ED, Chung H, Cohen N, Park J, **Wang HH**[¥], Kishony R[¥]. *Optimal codon choice throughout a gene.* In revision Cell Systems (2016).

INVITED TALKS

- "*Synthetic and Systems Biology Approaches to Study and Manipulate Horizontal Gene Flow*" NYBIG 2016, Keynote, NYU, NY, USA (May 2016)
- "*Mammalian synthetic biology through engineering the human microbiome*" Human Genome Project-Write Workshop, Harvard Medical School, MA, USA (May 2016)

- "*Synthesizing a Prototrophic Human Genome*" Human Genome Project-Write Workshop, Harvard Medical School, MA, USA (May 2016)
- "*Combinatorial CRISPR Screens*" Columbia University CRISPR Workshop, Columbia University, NY, USA (Nov 2015)
- *"Genome-scale Engineering of Microbial Cells and Communities*" BioTechnology Institute Seminar Series, University of Minnesota, MN, USA (Oct 2015)
- "*Genome-scale Engineering of Microbial Cells and Communities*" 7th Copenhagen Bioscience Conferences on Cell factories and Biosustainability, Copenhagen, Denmark (June 2015)
- "*Engineering the Human Microbiome with Synthetic Biology*" Genspace Seminar Series, Brookline, NY, USA (May 2015)
- "*Microbial Genome Engineering of Cells and Communities*" Horizons Seminar Series, Dupont USA, Wilmington, DE, USA (December 2014)
- "*Engineering Metabolic Exchange in Synthetic Microbial Communities*" Understanding Microbial Communities Workshop, Isaac Newton Institute, Cambridge, UK (November 2014)
- "*Massively Parallel Mutagenesis and Genome Engineering using Oligonucleotide Libraries*" Synthetic Biology Engineering, Evolution, and Design Conference, California, USA (July 2014)
- "*Syntrophic Exchange in Synthetic Microbial Communities*" 1st ASM Conference on Experimental Microbial Evolution, Washington DC, USA (June 2014)
- "*Multiplex Genome-scale Engineering" National Academies of Science. Industrialization of Biology*, Washington DC, USA (May 2014)
- "Multiplex Genome Engineering to Reprogram the Human Microbiome" Weill Cornell Institute for Computational Biomedicine (ICB) Seminar. New York, USA (Feb 2014)
- "Programming Cells and Microbial Communities by Multiplexed Genome Engineering" Towards Next Generation Synthetic Biology Workshop, Warwick Centre for Integrative Synthetic Biology (WISB), University of Warwick, Coventry, UK. (Nov 2013)
- "Metagenomic Synthetic Biology Systems for Microbiome Engineering" 2013 Frontiers in Mucosal Immunology Symposium, Boston, USA. (Oct 2013)
- "*Multiplexed Genome Engineering: methods and applications*" Cold Spring Harbor Synthetic Biology Course, Cold Spring, NY, USA (Aug 2013)
- "*Engineered Cooperativity in Synthetic Ecosystems*" Cold Spring Harbor Asia, Suzhou, China (Nov 2011)
- "*Construction of Synthetic Organisms through Large-scale Genome Engineering*" 33rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Boston, MA, USA (Sept 2011)
- "*Recoding Genomes for Synthetic and Orthogonal Biology*" 2011 International Union of Microbiological Societies, Sapporo, Japan (Sept 2011)
- "*Implications of Engineered Biological Chassis on Safety and Security*" Workshop on Genome Engineering, Defense Threat Reduction Agency (DTRA), Springfield, VA, USA (2010 Oct)
- "*Whole Genome Construction by Multiplexed Engineering and Automation*" Bio International Convention, Chicago, IL, USA (2010 May)
- "*Fast-pace Genome Engineering of Synthetic Organisms*" 17th Annual Microbial Genomics Conference, Rocky Gap, MD, USA (2009 Oct)
- Wang, HH. "*Engineering, Evolving, and Editing Genomes for Bioenergy Applications*" Joint Bioenergy Institute, UC-Berkeley, Berkeley, CA, USA (2009 Sept)
- "*Synthetic biology, accelerated evolution, and exploring diversity in biological systems*." (Keynote) IEEE Congress on Evolutionary Computation, Trondheim, Norway (2009 May)
- "*Synthetic biology, accelerated evolution, and exploring diversity in biological systems*." BBN Technologies, Boston, MA, USA (2009 April)

PATENT APPLICATIONS

- *Multiplex Automated Genome Engineering*. Church GM, Wang HH, Isaacs FJ. WO2008/052101A2
- *Wang HH. High-Throughput functional Selection of Microbiome Metagenomes. US Application No.: 61/905,530 (Provisional): CU14197*
- *Wang HH, Shapira SS, Stockman, V. A High-throughput Strategy for Combinatorial Targeting of CRISPR/Cas9 to multiple genetic loci. US Application No.: 62/199,291(Provisional)*

SELECTED AWARDS

2015-2017	ONR Young Investigator Program ($510,000)
2015-2016	Sloan Research Fellowship ($50,000)
2015	Gen9 G-Prize ($120,000)
2014-2019	NSF CAREER Award ($700,000)
2012	Forbes 30 under 30 in Science
2011-2016	NIH Director's Early Independence Award ($2,112,500)
2011-2013	Wyss Technology Development Fellowship ($210,000)
2009	Collegiate Inventors Competition Grand Prize Winner, National Inventors Hall of Fame ($30,000)
2009	Certificate of Distinction in Teaching, Derek Bok Center, Harvard University
2008-2010	National Science Foundation Graduate Fellowship ($121,500)
2006-2008	National Defense Science and Engineering Graduate Fellowship ($152,642)
2002	Exceptional Summer Student at NINDS
2001	Paul E. Gray UROP Researcher
2001	National Merit Scholar ($2,500)

PROFESSIONAL MEMBERSHIP

2011-2016	American Society of Microbiology
2011-2016	American Chemical Society
2011-2016	American Association for the Advancement of Science

PROFESSIONAL & COMMUNITY SERVICE ACTIVITIES

- Journal reviewer for *Nature Biotechnology*, *Nature Methods*, *BMC Systems Biology*, *Nucleic Acids Research*, *ACS Synthetic Biology*, *Molecular Systems Biology, PLoS Computational Biology, Biotechnology Journal*.
- Grant reviewer for NIH, ARO, DOE (JGI), NSF, NUS (Singapore).
- Visiting Fellow at the Isaac Newton Institute for Mathematical Science on Program on Understanding Microbial Communities (Cambridge, UK, 2014).
- Development of a Synthetic Biology course for public education with Genspace, a pioneer Do-It-Yourself Biology organization in Brooklyn, NY (2014-2016).
- Organizer of International Genetically Engineered Machines (iGEM) teams at Harvard University and Columbia University (2007, 2015, 2016).
- Organizer of Student Leadership Council for the NSF Synthetic Biology Engineering Research Center (Boston, USA, 2006-2010).
- Participant of Congressional Visit Day (CVD) to advocate increasing science funding in both House of Representatives and Senate chambers (Washington DC, USA, 2006).

TEACHING EXPERIENCE

2016 Lecturer, Weill Cornell Medical School

Summer	Course: *ACLS International Summer School*
2016	*Course organizer and instructor, Cold Spring Harbor Laboratories*
Summer	Course: Synthetic Biology Summer Course
	Instructor: Harris Wang, Vincent Noireaux, Mary Dunlop, Mo Khalil, Chase Biesel
2015	*Lecturer, Columbia University Medical Center*
Fall	Course: Molecular Genetics (G level) [Cell Biology G4150x]
2014	*Lecturer, Columbia University Medical Center*
Fall	Course: Molecular Genetics (G level) [Cell Biology G4150x]
2013	*Lecturer, Cold Spring Harbor Laboratories*
-2014	Course: Synthetic Biology Summer Course
	Instructor: Jeff Tabor, Julius Lucks, David Savage, Karmella Haynes
2009	*Teaching Fellow, Harvard University (awarded Certificate of Distinction in Teaching)*
Fall	Course: Biophysics 101 Genomics, Computing, and Economics (U/G level)
	Instructor: George Church, Department of Genetics, Harvard Medical School

GRADUATE STUDENTS THESIS COMMITTEE

- Andy Yao Zong Ng (Chemistry), Advisor: V. Cornish, thesis & quals committee
- Jamie Yang (MD/PhD), Advisor: S. Tavazoie, qualifying committee
- James Brisbois (Chemistry), Advisor: V. Cornish, qualifying committee
- Nathan Jaffe (Biology), Advisor: Ruben Gonzales, thesis committee
- Mariam Konate (Graduated 2014, C2B2), Advisor: D. Vitkup, thesis committee

GRADUATE STUDENTS MENTORSHIP

- Nathan Johns (G4, Integrated/C2B2 Program) – current
- Sway Chen (G3, MD/PhD) – current
- Tom Blazejewski (G3, Integrated/C2B2 Program) – current
- Jimin Park (G3, Integrated Program) – current
- Ravi Sheth (G2, Integrated/C2B2 Program) – current
- Frank Cusimano (G2, Nutritional and Metabolic Biology Program) – current
- Ross McBee (G2, Biological Sciences Program) – current
- Victoria Stockman (Integrated/C2B2 Program) – graduated
- Emily Groopman (MD/PhD rotation), Summer 2015
- Julian Berger (Integrated Program rotation), Spring 2015
- Zach Baker (Integrated Program rotation), Fall 2014
- Tal Lorberbaum (Integrated Program rotation), Fall 2013
- John Szymanski (Integrated Program rotation), Fall 2013

UNDERGRADUATE STUDENTS MENTORSHIP

- Jacky Cheung (Columbia U2, Summer 2014-current) [CS major]
- Suppawat Kongthong (Columbia) Spring 2015-current) [Biology major]
- Sam Magaziner (Columbia), Summer 2015-Spring 2016) [Biochemistry major]
- Anthony Yang, (Columbia), Summer/Winter 2013 [BME major]
- Daniel Huang, (Columbia), Summer 2013 [BME major]

POST-DOCTORAL FELLOWS MENTORSHIP

- Antonio Gomes (BU, Bioinformatics) 1/15/2014 - present
- Hsing Ho (Baylor, Microbiology) 9/1/2015 - present
- Carlotta Ronda (DTU, Microbiology) 1/15/2016 – present

- Sung Sun Yim (KAIST, Synthetic Biology/Microbiology) 10/12/2016 - present
- Vitor Cabral (Institut Pasteur, Microbiology) 9/1/2014 – 4/30/2016

FUNDING AWARDED

1DP5OD009172-01 (PI: Harris Wang) 9/01/11 – 8/31/16
National Institutes of Health, Director's Early Independence Award $2,112,500
Title: Functional Metagenomic Reprogramming of Human Microbiome through Mobilome Eng.
Description: Development of methods to engineer human-microbiome *in vivo* using new synthetic biology and genome manipulation approaches.

MCB-1453219 (PI: Harris Wang) 1/01/15 – 12/31/19
National Science Foundation, CAREER Award, Division of MCB $700,000
Title: A Systems Approach to Study Horizontal Acquisition of Regulatory DNA
Description: Development of methods and systematic analysis of determinants of horizontal transmission of mobile DNA.

FR-2015-65795 (PI: Harris Wang) 9/15/15 – 9/14/17
Alfred P. Sloan Foundation Research Fellowship $50,000
Title: Evolutionary Drivers of Horizontal Gene Flow
Description: Development of computational and experimental techniques to dissect governing principles that drive horizontal gene flow in microbial communities.

W911NF-15-2-0065 (PI: Harris Wang) 7/1/15 – 6/30/17
Defense Advance Research Project Agency $1,616,064
Title: In situ Genome Engineering of Unculturable Microbes and Genomic Recoding to Limit the Robustness of the Genetic Code
Description: Development of methods to engineer unculturable microbes in the GI tract and recode genes to reduce genetic code robustness

1U01GM110714-01 (PI: Sean Brady, Co-I Harris Wang) 7/1/15 – 6/30/20
National Institutes of Health, NIGMS $1,993,000 (Wang)
Title: A minimally invasive synthetic bio-driven approach for natural products discovery
Description: Development of tools to engineer pathways for natural product synthesis.

N00014-15-1-2704 (PI: Harris Wang) 6/1/15 – 5/31/18
Office of Naval Research Young Investigator Program $524,398
Title: A Foundational Synthetic Biology Toolbox for Engineering Human Gut Microbiota towards Enhancing Warfighter Capabilities
Description: Development of genome manipulation, transformation, and plasmid acquisition methods for GI microbes for microbiome augmentation

1U54CA209997-01 (PI: Andrea Califano, Co-I: Harris Wang) 8/8/16 – 8/7/21
National Institutes of Health, NCI $589,680 (Wang)
Title: Centers for Cancer Systems Therapeutics (CAST)
Description: Application of computational and experimental systems biology approaches to dissect cancer drivers and generate therapeutic methodologies.