

Jackson Champer

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EDUCATION

Ph.D. in Biology, City of Hope Beckman Research Institute 6/2015
 M.S. in Physics, University of California, Los Angeles 12/2006
 B.S. in Physics and Mathematics, University of Oregon 6/2004

SIGNIFICANT RESEARCH EXPERIENCE

Postdoctoral Fellow, Cornell, PIs: Phillip Messer and Andy Clark 5/2016-Present

- Improved gene drive systems, designs and experiments.
- Collaboration with Harrington lab on mosquito gene drive.
- Computational modeling and genetic analysis of gene drives in realistic environments.

Postdoctoral Scholar, UC Riverside, PI: Omar Akbari 9/2015-3/2016

- Review article covering different gene drive systems.

Graduate Researcher, City of Hope, PI: Markus Kalkum 6/2011-2015

- Mass spectrometry and proteomics for antifungal vaccine development.
- Projects on detection assay for botulinum and anthrax.

Rotation Student, City of Hope, PI: S. Emily Wang 9/2010-12/2011

- Immunological and proteomic analysis of breast cancer extracellular matrix.

Research Assistant, University of Oregon, PI: Chuck Kimmel 10/2009-3/2010

- Fluorescent reporter systems in zebrafish.

Research Supervisor, UCLA, PI: Jenny Kim 6/2008-7/2009, 8/2013-9/2014

- Immunological and proteomic analysis of *Propionibacterium acnes* phylotypes.
- Analysis of antimicrobial treatments for acne and *Staphylococcus aureus* infection.

Graduate Researcher, UCLA: PI: David Cline 6/2004-9/2004

- Simulations, design, and construction of dark matter detector.

Undergraduate Researcher, University of Oregon, PI: Russell Donnelley 8/2003-6/2004

- Propagation of vortex rings in fluid and diffusion of marker dye.

Undergraduate Researcher, Stanford, PI: Lucy Shapiro 6/2003-7/2003

- Analysis of localization of genes in *Caulobacter crescentus*.

FORMAL TEACHING EXPERIENCE

Guest Lecturer, Cornell University 9/2017, 11/2018

- Lectures for the “Population Genetics” upper-division class.

Teaching Fellow, City of Hope Beckman Research Institute 3/2014-4/2014

- Lectures and student evaluation for the “Current Topics in Biology” graduate class.

Teaching Assistant, University of California, Los Angeles 9/2004-12/2006

- Laboratory and discussion sections of undergraduate physics classes.
- Revised UCLA’s physics laboratory manual for life science majors.

RESEARCH STUDENTS MENTORED

Cornell University: Anisha Luthra, Anna Langmuller, Chen Liu, Emily Yang, Isabel Kim, Jingxian Liu, Joan Chung, Joanna Zhao, Lin Xie, Matthew Metzloff, Phoebe Conley, Riona Reeves, Sam Champer, Sandra Lapinska, Suh Yeon Oh, Wei Cheng, Yineng Xu, Yoo Lim Lee, Zhaoxin Wen.

University of California, Riverside: Jennifer Shyong, Kenneth Truong.

University of California, Los Angeles: Elaheh Salehi, Julie Patel, Nathalie Fernando, Sam Ngo, Victoria Wong, Yang Yu.

City of Hope Beckman Research Institute: Jason Yu, Mayyen Wong, Miriam Champer, Molly Shannahoff.

OTHER SCIENCE EXPERIENCE

Referee: PLOS Genetics (2018), Evolutionary Applications (2017), Journal of Theoretical Biology (2017), European Journal of Dermatology (2015), Infection, Genetics and Evolution (2015)

Membership: Genetics Society of America (2016), American Association for the Advancement of Science (2015), American Society for Mass Spectrometry (2012)

HONORS AND AWARDS

City of Hope Beckman Research Institute: Chu Fellowship (2014), Scholarly Award (2011)

University of California, Los Angeles: Tutor of the Year Award (2009), Teaching Excellence Award (2004-2006)

University of Oregon: Honors in Physics (2004), Academic Scholarships (2002-2004)

Lane Community College: Geology Excellence Award (2002)

PUBLICATIONS

*Equal Contribution, ⁺Project Designer and Adviser to First Author

Gene Drive Preprints

Champer J, Zhao J, Champer S, Liu J, Messer PW Population dynamics of underdominance gene drive systems in continuous space. *bioRxiv*, 2018. (under revision at Evolutionary Applications) <https://www.biorxiv.org/content/early/2018/10/22/449355>
We computationally assessed underdominance systems in and found that they would have greater difficulty persisting or remaining confined than previously envisioned.

Research in Gene Drive

Champer J*, Wen Z*, Luthra A, Reeves R, Chung J, Liu C, Lee YL, Liu J, Yang E, Messer PW, Clark AG. CRISPR Gene drive efficiency and resistance rate is highly heritable with no common genetic loci of large effect. *Genetics*, 2019 (early online).
We examined the effect of genetic diversity on drive performance and identified genes associated with resistance allele formation. We successfully reduced resistance rates using RNAi.

Champer J, Chung J, Lee YL, Liu C, Yang E, Wen Z, Clark AG, Messer PW. Molecular safeguarding of CRISPR gene drive experiments. *Elife*, 8, e41439, 2019.
We developed synthetic target site and split gene drives to allow safe laboratory experiments for efficient gene drives without the danger of them spreading in the wild if accidentally released.

Liu J*, **Champer J****, Liu C, Chung J, Reeves R, Lee YL, Luthra L, Clark AG, Messer PW. Maximum likelihood estimation of fitness components in experimental evolution. *Genetics*, 211(3), 1005-1017, 2019.
We developed a highly accurate and flexible method to evaluate the fitness of a particular allele based on cage studies. This will be critical for measuring gene drive fitness.

Champer J*, Liu J*, Oh SY, Reeves R, Luthra L, Clark AG, Messer PW. Reducing resistance allele formation in CRISPR/Cas9 gene drive. *Proc Natl Acad Sci U S A*, 115(21), 5522-5527, 2018.
We found that multiple gRNAs reduced resistance, but by less than theoretical expectations. Modeling of drive scenarios indicated that additional improves would be needed.

Champer J, Reeves R, Oh SY, Liu C, Liu J, Clark AG, Messer PW. Novel CRISPR/Cas9 gene drive constructs reveal insights into mechanisms of resistance allele formation and drive efficiency in genetically diverse populations. *PLoS Genetics*, 13(7), e1006796, 2017.
We advanced knowledge of the mechanism of homing drives and resistance alleles in Drosophila. We showed that the resistance formation was variable in genetically diverse lines.

Champer J, Buchman, A, Akbari OS. Cheating evolution: Engineering gene drives to manipulate the fate of wild populations. *Nat Rev Genet*, 17, 146-159, 2016.

Research in Mycosis Vaccine Development

Champer J, Ito JI, Clemons KV, Stevens DA, Kalkum M. Proteomic analysis of pathogenic fungi reveals highly expressed conserved cell wall proteins. *J. Fungi*, 2(1), 6, 2016.

Lehrnbecher T, Kalkum M, **Champer J**, Tramsen L, Schmidt S, Klingebiel T. Immunotherapy in invasive fungal infection-focus on invasive aspergillosis. *Curr Pharm Des*, 19(20), 3689-3712, 2013.

Champer J, Diaz-Arevalo D, Champer M, Hong TB, Wong M, Shannahoff M, Ito JI, Clemons KV, Stevens DA, Kalkum M. Protein targets for broad-spectrum mycosis vaccines: quantitative proteomic analysis of *Aspergillus* and *Coccidioides* and comparisons with other fungal pathogens. *Ann N Y Acad Sci*, 1273, 44-51, 2012.

Research in Dermatology

Yu Y*, **Champer J***, Agak GW, Kao S, Modlin RL, Kim J. Different *Propionibacterium acnes* phylotypes induce distinct immune responses and express unique surface and secreted proteomes. *J Invest Dermatol*, 136(11), 2221-2228, 2016.

Yu Y, **Champer J**⁺, Kim J. Analysis of the surface, secreted, and intracellular proteome of *Propionibacterium acnes*. *EuPA Open Proteom*, 9, 1-7, 2015.

Yu Y, **Champer J**⁺, Beynet DP, Kim J, Friedman AJ. The role of the cutaneous microbiome in skin cancer: Lessons learned from the gut. *J Drugs Dermatol*, 14(5), 461-465, 2015.

Yu Y, **Champer J**⁺, Garbán H, Kim J. Typing of *Propionibacterium acnes*: A review of methods and comparative analysis. *Br J Dermatol*, 172(5), 1204-1209, 2015.

Schmidt NW, Agak GW, Deshayes S, Yu Y, Blacker A, **Champer J**, Xian W, Kasko AM, Kim J, Wong GC. PenTobra: An aminoglycoside with robust antimicrobial & membrane activity against *Propionibacterium acnes*. *J Invest Dermatol*, 135(6), 1581-1589, 2015.

Taylor EJM, Yu Y, **Champer J**⁺, Kim J. Resveratrol demonstrates antimicrobial effects against *Propionibacterium acnes*. *Dermatol Ther*, 4, 249-257, 2014.

Champer J, Patel J, Fernando N, Salehi E, Wong V, Kim J. Chitosan against cutaneous pathogens. *AMB Express*, 3(1), 37, 2013.

Friedman AJ, Phan J, Schairer DO, **Champer J**, Qin M, Pirouz A, Blecher-Paz K, Oren A, Liu PT, Modlin RL, Kim J. Antimicrobial and anti-inflammatory activity of chitosan-alginate nanoparticles: a targeted therapy for cutaneous pathogens. *J Invest Dermatol*, 133(5), 1231-1239, 2013.

Additional Research

Chow A, Zhou W, Liu L, Fong MY, **Champer J**, Van Haute D, Chin AR, Ren X, Gugiu BG, Meng Z, Huang W, Ngo V, Kortylewski M, Wang SE. Macrophage immunomodulation by breast cancer-derived exosomes requires Toll-like receptor 2-mediated activation of NF- κ B. *Sci Rep* 4, 5750, 2014.

Chandra M, Zang S, Li H, Zimmerman L, **Champer J**, Chow A, Zhou W, Tsuyada A, Yu Y, Gao H, Ren X, Lin RJ, Wang SE. Nuclear translocation of type I TGF- β receptor confers a novel function in RNA splicing. *Mol Cell Biol*, 32(12), 2183-95, 2012.

Bungau C, Camanzi B, **Champer J**, Chen Y, Cline DB, Luscher R, Lewin JD, Smith PF, Smith NJT, Wang H. Monte Carlo studies of combined shielding and veto techniques for neutron background reduction in underground dark matter experiments based on liquid noble gas targets. *Astroparticle Physics*, 23, 97-115, 2005.

Patents

Champer J, Messer PW, Clark AG. Toxin-antitoxin gene drives. Provisional Patent filed 3. October 2018.

Yu Y, **Champer J**⁺, Kim J. Compositions and Methods for Treating Skin and Mucus Membrane Diseases. US 20170065647. Published November 2015.

Taylor E, **Champer J**⁺, Kim J. Treatment of inflammatory and infectious skin disorders. US 20140018437 A1. Published January 2014.

PRESS

April 2019

[eLife Podcast](#)

March 2019

[Keeping gene drives in check](#)

January 2019

[Scientists demonstrate effective strategies for safeguarding CRISPR gene-drive experiments](#)

May 2018

[Researchers Hit Roadblocks with Gene Drives](#)

July 2017

[Gene Drives Will Need a Tune-Up to Power Past Resistance](#)

[Gene drives likely to be foiled by rapid rise of resistance](#)

[Resistance to CRISPR gene drives may arise easily](#)

[Genetically Engineering Nature Will Be Way More Complicated Than We Thought](#)

[The gene drive bubble: New realities](#)

["Ask Me Anything" on Reddit](#)

GENE DRIVE PRESENTATIONS

Champer J, Yang E, Kim I, Lee YL, Champer S, Clark AG, Messer PW. “Computational and experimental tests of new CRISPR gene drive strategies.” *Society for the Study of Evolution Annual Meeting*, 2019. (invited talk, scheduled for June 2019)

Champer J, Clark AG, Messer PW. “Can CRISPR gene drive succeed in natural populations?” *Entomological Society of America, Joint Annual Meeting*, 2018. (invited talk)

Champer J, Chung J, Liu C, Luthra L, Reeves R, Lee YL, Liu J, Wen, Z, Yang E, Clark AG, Messer PW. “A genome-wide association study to identify genetic factors affecting resistance allele formation in CRISPR gene drives.” *Genetics Society of America PEQG Conference*, 2018. (poster)

Liu J, **Champer J**⁺, Liu C, Chung J, Reeves R, Luthra L, Lee YL, Clark AG, Messer PW. “Maximum likelihood estimation of sex-dependent fitness costs of a yellow mutant allele in *Drosophila melanogaster*.” *Genetics Society of America, 59th Annual Drosophila Research Conference*, 2018. (talk)

Champer J, Chung J, Liu C, Luthra L, Reeves R, Lee YL, Liu J, Wen, Z, Yang E, Clark AG, Messer PW. “A genome-wide association study to identify genetic factors affecting resistance allele formation in CRISPR gene drives.” *Genetics Society of America, 59th Annual Drosophila Research Conference*, 2018. (talk)

Champer J, Reeves R, Oh SY, Liu C, Liu J, Clark AG, Messer PW. “CRISPR gene drives with reduced resistance allele formation.” *Cold Spring Harbor Laboratory Meetings, Genome Engineering: The CRISPR-Cas Revolution*, 2017. (talk)

Champer J, Reeves R, Oh SY, Liu C, Liu J, Clark AG, Messer PW. “Resistance allele formation and genetic diversity in *Drosophila* CRISPR/Cas9 gene drives.” *Genetics Society of America, 58th Annual Drosophila Research Conference*, 2017. (poster)

RESEARCH SUPPORT

Active Support

F32AI138476 Champer (PI) 4/2018 - Present
 NIH/NIAID
 Dynamics of gene drives in natural populations

R21AI130635 Messer, Clark (PIs), *Champer (key personnel) 9/2017 - Present
 NIH/NIAID
 Improved CRISPR gene drive systems with reduced resistance allele formation
 *drafted the grant and responsible for allocating most of the funding.

Pending Support

K22 (GRANT12728266) Champer (PI) Submitted Cycle III/October 2018
 NIH/NIAID
 Engineering and modeling improved CRISPR gene drive systems