Christopher D McFarland

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Education

Ph.D. Biophysics — Harvard University — 2014
The role of deleterious passenger mutations in cancer, Advisor: Dr. Leonid A Mirny

B.S. Physics & B.S. Biochemistry — University of Rochester — 2008
Magna cum laude

Research Experience

STANFORD UNIVERSITY, DEPARTMENT OF BIOLOGY — 2014 – present
Developed a DNA barcode and CRISPR-based method to investigating the fitness landscape and growth heterogeneity of lung adenocarcinoma in vivo with Dr. Dmitri A. Petrov and Dr. Monte M. Winslow

HARVARD UNIVERSITY, DEPARTMENT OF BIOPHYSICS — 2008 – 2014
Identified passenger mutations as deleterious to cancer cells and a barrier to carcinogenesis using evolutionary theory, genomic analyses, and experimental validation, advised by Dr. Leonid A. Mirny

UC SAN DIEGO, CENTER FOR THEORETICAL BIOLOGICAL PHYSICS — 2007
Studied hydrogen-bonding in proteins using molecular dynamics with Dr. José Onuchic

UNIVERSITY OF ROCHESTER, BIOCHEMISTRY AND BIOPHYSICS — 2006 – 2008
Determined the cytosolic regions of STE2 in yeast with Dr. Mark E. Dumont

WADSWORTH CENTER, MOLECULAR GENETICS — 2002 – 2004
Identified the binding partners of STP3 in yeast with Dr. Randall Morse

Awarded Grants

R01, NCI — 2022
PI, Tumor-barcoding coupled with high-throughput sequencing for quantitative radiogenomics of the abscopal response in NSCLC, $1,000,000 (CA271540)

Case Comprehensive Cancer Center: Pilot Grant — 2021
PI, *Cancer evolution under androgen receptor inverse agonist,* $80,000

K99/R00, NCI: PATHWAY TO INDEPENDENCE — 2018
PI, *Quantifying the sources and dynamics of tumor growth variability using Tuba-seq,* $985,260 (CA226506)

VELOSANO, CLEVELAND CLINIC: RACING FOR THE CURE — 2018
Co-Investigator (PI: Omar Mian, MD, PhD), *Establishing the function of key differentially-expressed genes in small-cell carcinoma of the bladder*, $100,000

R01, NCI: TRANSLATIONAL CLINICAL IGR — 2016
Co-author (PI: Monte Winslow), *A quantitative multiplexed platform for the pharmacogenomic analysis of lung cancer*, $554,000 (CA207133)

U54, NCI PS-OC: YOUNG-INVESTIGATORS AWARD — 2013

PI, *Direct visualization of the role of horizontal gene transfer in the evolution of drug resistance in cancer*, $15,000 (CA143874)

U54, NCI PS-OC: TRANS-NETWORK GRANT 2011
Co-Author (PI: Leonid Mirny), *Genotypic determinants of metastatic fitness: a delicate balance of passenger and driver mutations*, $400,000 (CA143874)

Teaching Experience

STANFORD UNIVERSITY, DEPARTMENT OF BIOLOGY 2016
Mentored Mahi Elango on using machine learning to understand drug vulnerabilities of the Cell Line Encyclopedia, which was an Intel ISEF 2016 Regional Finalist

MASSACHUSSETTES INSTITUTE OF TECHNOLOGY, PRIMES PROGRAM 2011 – 2012
Mentored Dash Elhauge and Michael Zhang, high school students who investigated: *The role cell fusion in cancer development*

HARVARD UNIVERSITY, DEPARTMENT OF CHEMISTRY 2010
Teaching Assistant for both undergraduate- and graduate-level Statistical Thermodynamics, Instructor: Dr. Eugene Shakhnovich

JOHNS HOPKINS UNIVERSITY, CENTER FOR TALENTED YOUTH 2008
Teaching Assistant for Nuclear Science (Instructor: Dr. Yuliya Kuznetsova) and Fast-Paced High School Physics (Instructor: Dr. William M. Kallfelz)

UNIVERSITY OF ROCHESTER, DEPARTMENT OF BIOLOGY 2008
Teaching Assistant for Introduction to Biochemistry, Instructor: Dr. Terry Platt

Scholarships & Awards

Scholarship to Physicists working on Cancer, Weizmann Institute of Science 2018
CSBS Postdoctoral Fellowship, Stanford University 2015
CEHG Postdoctoral Fellowship, Stanford University 2014
Scholarship to Emergent Order in Biology, IAS, Cargèse, France 2012
Best Poster Award, NCI Physical Sciences in Oncology Investigator's Meeting 2011
Phi Beta Kappa, University of Rochester 2008
Martin Tiernan Scholarship, University of Rochester 2005

Invited Talks

Max Planck for Evolutionary Biology, Plön Germany 2020
Integrative Genetics and Genomics Graduate Group, UC Davis 2019
Center for Theoretical Evolutionary Genomics Seminar, UC Berkeley 2018
Molecular Biology & Genetics Seminar, Johns Hopkins University 2018
THOR Seminar, Clevland Clinic, Case Western Reserve 2017

Contributed Talks

Systems Approaches to Cancer Biology	2018
Stanford Biology Retreat	2018
Gordon Research Seminar, Molecular Mechanisms in Evolution	2017
Stanford Systems Biology of Cancer Annual Symposium	2017
Stanford Cancer Biology Retreat	2015 & 2016
Forecasting Evolution?	2015
CEHG Stanford Symposium	2015
9th European Conference on Mathematical and Theoretical Biology	2014
American Physical Society, March Meeting	2012
Workshop on Mathematical Oncology IV: Integrative Cancer Biology	2012
NCI Physical Sciences in Oncology, Network Investigator's Meeting	2012
Journal of Biomolecular Structure and Dynamics	2011

Patents

Winslow, MM; Petrov, DA; **McFarland CD**; Rogers ZN; Winters IP. 2017. *Compositions and Methods for Multiplexed Quantitative Analysis of Cell Lineages*. US Patent Application 62481067, filed April 2017. Patent Pending.

Other

Verified Referee for *Nature Ecology & Evolution, PLoS Computational Biology, PLoS One*, *Genome Biology*, *Genome Biology & Evolution, Cancer Research, Physical Biology*, *Journal of Theoretical Biology* & *Journal of Statistical Computation and Simulation*

Developed and maintain several software packages:

fast_prng – Fastest exponential & normal pseudorandom number generator in C

tuba-seq – Processing & interpretation of ultra-deep DNA barcode sequencing

Publications

C Li, WY Lin, H Rizvi, H Cai, **CD McFarland**, ZN Rogers, M Yousefi, IP Winters, CM Rudin, DA Petrov, MM Winslow. (2021) Quantitative in vivo analyses reveal a complex pharmacogenomic landscape in lung adenocarcinoma. *Cancer Res,* **8:**5472.

H Cai, SK Chew, C Li, MK Tsai, L Andrejka, CW Murray, NW Hughes, EG Shuldiner, EL Ashkin, R Tang, KL Hung, LC Chen, SC Lee, M Yousefi, WY Lin, CA Kunder, L Cong, **CD McFarland**, DA Petrov, C Swanton, MM Winslow. (2021) A Functional Taxonomy of Tumor Suppression in Oncogenic KRAS–Driven Lung Cancer. *Cancer Discov,* **20:**1325.

S Tilk, C Curtis, DA Petrov, **CD McFarland**. (2019) Most cancers carry a substantial deleterious load due to Hill-Robertson interference. *bioRxiv,* 764340.

ZN Rogers*, **CD McFarland***, IP Winters, JA Seoane, JJ Brady, S Yoon, C Curtis, DA Petrov, MM Winslow. (2018) Mapping the in vivo fitness landscape of lung adenocarcinoma tumor suppression in mice. *Nat Genetics*, **50**:483-6.

IP Winters, SH Chiou, NK Paulk, **CD McFarland**, PV Lalgudi, RK Ma, L Lisowski, AJ Connolly, DA Petrov, MA Kay, MM Winslow. (2017) Multiplexed in vivo homology-directed repair and tumor barcoding enables parallel quantification of Kras variant oncogenicity. *Nat Commun,* **8**:2053-69.

ZN Rogers*, **CD McFarland***, IP Winters*, S Naranjo, CH Chuang, DA Petrov, MM Winslow. (2017) A quantitative and multiplexed approach to uncover the fitness landscape of tumor suppression in vivo. *Nat Methods,* **14**:737-42.
"Research Highlight" at *Nat Rev Genetics*, **18**:456.

CD McFarland*, JA Yaglom*, JW Wojtkowiak*, JG Scott, DL Morse, MY Sherman, LA Mirny. (2017) The damaging effect of passenger mutations on cancer progression. *Cancer Res*, **77**:4763-72.

BM Grüner, CJ Schulze, D Yang, D Ogasawara, MM Dix, ZN Rogers, C Chuang, **CD McFarland**, S Chiou, JM Brown, BF Cravatt, M Bogyo, MM Winslow. (2016) An in vivo multiplexed small-molecule screening platform. *Nat Methods,* **13**:883–9.

CD McFarland. (2015) A modified ziggurat algorithm for generating exponentially and normally distributed pseudorandom numbers. *J Statist Comput Simulations,* **86**:1281-94.

CD McFarland, LA Mirny, KS Korolev. (2014) A tug-of-war between driver and passenger mutations in cancer and other adaptive processes. *PNAS,* **111**:15138-43.
"Editor's Choice" at *Science,* **306**:597.

JA Yaglom, **CD McFarland**, LA Mirny, MY Sherman. (2014) Oncogene-triggered suppression of DNA repair leads to DNA instability in cancer. *Oncotarget*, **5**:8367-78.

CD McFarland, KS Korolev, GV Kryukov, SR Sunyaev, LA Mirny (2013). Impact of deleterious passenger mutations on cancer progression. *PNAS*, **110**:2910-2915.
"Research Highlight" at *Nat Rev Cancer*, **13**:219.

*Contributed Equally