Christoph D. Rau, Ph.D.

11004B Mary Ellen Jones Building
116 Manning Drive, Chapel Hill, NC, 27599
Tel: 929-962-5641
Email: ChristophRau@unc.edu

EDUCATION AND TRAINING

University of California, Los Angeles, Los Angeles, California
Postdoctoral Training, Department of Anesthesiology, **2013-2020**
Mentor: Yibin Wang

University of California, San Francisco, San Francisco, California
Visiting Scholar, Department of Medicine, Fall **2017**
Mentor: Noah Zaitlen

University of California, Los Angeles, Los Angeles, California
PhD, Molecular Biology, Immunology and Molecular Genetics, **2007-2013**
Advisor: Aldons J. Lusis

Harvey Mudd College, Claremont, California
B.S. (with honors), Mathematical Biology, **2003-2007**

PROFESSIONAL EXPERIENCE

University of North Carolina at Chapel Hill, *Dept. of Genetics* Chapel Hill, NC
Assistant Professor, Computational Medicine Program. **2020-**

University of California, Los Angeles, *Dept. of Anesthesiology* Los Angeles, CA
Advisor: Yibin Wang **2013-2020**
Postdoctoral Research into the epigenetics underlying heart failure and numerous collaborations in and beyond UCLA.

University of California, San Francisco, *Dept. of Medicine* San Francisco, CA
Advisor: Noah Zaitlen **Fall 2017**
Visiting Scholar exploring the role of individual ancestry on SNP effect sizes in mice and humans.

University of California, Los Angeles, *Dept. of Microbiology, Immunology and Molecular Genetics*
Advisor: Aldons J. Lusis **2007-2013**
Ph.D Dissertation: A Systems Genetics Approach For The Identification of Causal Genes In Heart Failure Using A Large Mouse Panel.

Harvey Mudd College, *Dept. of Biology* Claremont, CA
Advisor: Robert Drewell **2006-2007**
Senior Thesis research on regulation of HOX gene expression by poorly conserved enhancer elements. Used bioinformatic tools to identify preserved 2' lncRNA structures in enhancers

University of California, Santa Cruz, *Dept. of Biomolecular Engineering* Santa Cruz, CA
Advisor: Todd Lowe **Summer 2006**

Designed tools for the UCSC Genome Browser to identify and characterize snoRNAs.

ACADEMIC AND PROFESSIONAL HONORS

Best of AHA Specialty Session Poster Award (2014, 2017)
Postdoctoral Leadership Program Award (2015)
Basic Cardiovascular Sciences Conference Travel Award, American Heart Association (2014)
Early Career Investigator Award of Excellence, Kern Lipid Conference (2012)
Vascular Biology Training Grant (Ruth L. Kirshstein Predoctoral NRSA) (2011-2013)
Cell and Molecular Biology Training Grant (Ruth L. Kirchstein Predoctoral NRSA) (2008-2011)
Harvey S. Mudd Scholarship (2003-2007)

BIBLIOGRAPHY

An up-to-date list of my publications may be found at https://tinyurl.com/RauPubs

Refereed Articles:

Olver TD, Edwards JC, Jurrissen TJ, Veteto AB, Jones JL, Gao C, **Rau C**, Warren CM, Klutho PJ, Alex L, Ferreira-Nichols SC, Ivey JR, Thorne PK, McDonald KS, Krenz M, Baines CP, Solaro J, Wang Y, Ford DA, Domeier TL, Padilla J, Rector RS, Emter CA. Western Diet-fed, Aortic-Banded Ossabaw Swine: A Pre-Clinical Model of Cardio-Metabolic Heart Failure. *JACC Basic Translational Science* 4(3):404-421 (2019)

Tzimas C, **Rau CD,** Buergisser PE, Jean-Louis G, Lee K, Chukwuneke J, Dun W, Wang Y, Tsai EJ. Wipi1 is a Conserved Mediator of Right Ventricular Failure. *JCI Insight.* 2019 Apr 25;5. *pii: 122929* (2019).

Lin L, Chun-Chang S, O'Hearn J, Hui ST, Seldin M, Gupta P, Bondar G, Deng M, Jauhiainen R, Kuusisto J, Laakso M, Sinsheimer JS, Deb A, **Rau C**, Ren S, Wang Y, Lusis AJ, Wang JJ, Huertas-Vazquez A. Systems Genetics Approach to Biomarker Discovery: GPNMB and Heart Failure. *G3* pii*: g3.200655.2018* (2018)

Park S, Ranjbarvaziri S, Lay FD, Zhao P, Miller MJ, Dhaliwal JS, Huertas-Vasquez A, Wu X, Qiao R, Soffer JM, **Rau C**, Wang Y, Mikkola HKA, Lusis AJ, Ardehali R. Genetic Regulation of Fibroblast Activation and Proliferation in Cardiac Fibrosis. *Circulation* 18:1224-1235 (2018)

Santolini M, Romay MC, Yukhtman CL, **Rau CD,** Ren S, Saucerman JJ, Wang JJ, Weiss JN, Wang Y, Lusis AJ, Karma A. A Personalized, Multiomics Approach Identifies Genes Involved in Cardiac Hypertrophy and Heart Failure. *NPJ Systems Biology and Applications* 4:12 (2018)

Chang SC, Ren S, **Rau CD,** Wang JJ. Isoproterenol-Induced Heart Failure Mouse Model Using Osmotic Pump Implantation. *Methods in Molecular Biology* 1816:207-220 (2018)

Rau CD, Vonriska TM. DNA Methylation and Human Heart Failure: Mechanisms or Prognostics. *Circulation* 136(16):1545-1547 (2017)

Patterson M, Barske L, Van Handel B, **Rau CD**, Gan P, Sharma A, Parikh S, Denholtz M, Huang Y, Yamaguchi Y, Shen H, Allayee H, Crump JG, Force TI, Lien CL, Makita T, Lusis AJ, Kumar SR, Sucov HM. Frequency of Mononuclear Diploid Cardiomyocytes Underlies Natural Variation in Heart Regeneration. *Nature Genetics* 49(9):1346-1353 (2017)

Wisniewski N, Bondar G, **Rau C**, Chittoor J, Chang E, Esmaeili A, Cadeiras M, Deng M. Integrative Model of Leukocyte Genomics and Organ Dysfunction in Heart Failure Patients Requiring Mechanical Circulatory Support: a Prospective Observational Study. BMC Med Genomics 10(1):52 (2017)

Rau CD, Romay MC, Tuteryan M, Wang JJ, Santolini M, Ren S, Karma A, Weiss JN, Wang Y, Lusis AJ. Systems Genetics Approach Identifies Gene Pathways and Adamts2 as Drivers of Isoproterenol-Induced Cardiac Hypertrophy and Cardiomyopathy in Mice. *Cell Systems* 4(1):121-128 (2017)

Gao C, Howard-Quijano K, **Rau CD**, Takamiya T, Song Y, Shivkumar K, Wang Y, Mahajan A. Inflammatory and Apoptotic Remodeling in Autonomic Nervous System Following Myocardial Infarction. *PloS one.* 12(5):e0177750 (2017)

Seldin MM, Kim ED, Romay MC, Li S, **Rau CD**, Wang JJ, Wang Y, Deb A, Lusis AJ. Systems genetics approach identifies Trp53inp2 as a link between cardiomyocyte glucose utilization and hypertrophic response. *Am J Physiol Heart Circ Physiol.* doi:10.1152/ajpheart.00068.2016 (2017)

Rau CD, Civelek M, Pan C, Lusis AJ. Algorithms for the visualization and integration of systems genetics data. *Methods in Molecular Biology*. **1488**,153-188 (2017)

Rau CD, Gao C, & Wang Y. Deconvolution of the Human Endothelial Transcriptome. *Cell Syst.* **3,** 218–220 (2016).

Chen H, Orozco LD, Wang J, **Rau CD**, Rubbi L, Ren S, Wang Y, Pellegrini M, Lusis AJ, & Vondriska TM. DNA Methylation Indicates Susceptibility to Isoproterenol-Induced Cardiac Pathology and Is Associated With Chromatin States. *Circ. Res.* **118,** 786–97 (2016).

Gao C, Ren S, Lee J-H, Qiu J, Chapski DJ, **Rau CD**, Zhou Y, Abdellatif M, Nakano A, Vondriska TM, Xiao X, Fu X-D, Chen J-N, & Wang Y. RBFox1-mediated RNA splicing regulates cardiac hypertrophy and heart failure. *J. Clin. Invest.* **126,** 195–206 (2016).

Lusis AJ, Seldin M, Allayee H, Bennett BJ, Civelek M, Davis RC, Eskin E, Farber C, Hui ST, Mehrabian M, Norheim F, Pan C, Parks B, **Rau C**, Smith DJ, Vallim T, Wang Y, & Wang J. The Hybrid Mouse Diversity Panel: A Resource for Systems Genetics Analyses of Metabolic and Cardiovascular Traits. *J. Lipid Res.* **58,** 7250–7 (2016).

Monte E, Rosa-Garrido M, Karbassi E, Chen H, Lopez R, **Rau CD**, Wang J, Nelson SF, Wu Y, Stefani E, Lusis AJ, Wang Y, Kurdistani SK, Franklin S, & Vondriska TM. Reciprocal Regulation of the Cardiac Epigenome by Chromatin Structural Proteins Hmgb and Ctcf: IMPLICATIONS FOR TRANSCRIPTIONAL REGULATION. *J. Biol. Chem.* **291,** 15428–46 (2016).

Wang JJC, **Rau C**, Avetisyan R, Ren S, Romay MC, Stolin G, Gong KW, Wang Y, & Lusis AJ. Genetic Dissection of Cardiac Remodeling in an Isoproterenol-Induced Heart Failure Mouse Model. *PLoS Genet.* **12,** 1–30 (2016).

Sun H, Olson KC, Gao C, Prosdocimo DA, Zhou M, Wang Z, Jeyaraj D, Youn J-Y, Ren S, Liu Y, **Rau CD**, Shah S, Ilkayeva O, Gui W-J, William NS, Wynn RM, Newgard CB, Cai H, Xiao X, Chuang DT, Schulze PC, Lynch C, Jain MK, & Wang Y. Catabolic Defect of Branched-Chain Amino

Acids Promotes Heart Failure. *Circulation* **133,** 2038–49 (2016).

Karbassi E, Monte E, Chapski DJ, Lopez R, Rosa Garrido M, Kim J, Wisniewski N, **Rau CD**, Wang JJ, Weiss JN, Wang Y, Lusis AJ, & Vondriska TM. Relationship of disease-associated gene expression to cardiac phenotype is buffered by genetic diversity and chromatin regulation. *Physiol. Genomics* **48,** 601–15 (2016).

Rau CD, Lusis AJ, & Wang Y. Genetics of common forms of heart failure: challenges and potential solutions. *Curr. Opin. Cardiol.* **30,** 222–7 (2015).

Rau CD, Wang J, Avetisyan R, Romay MC, Martin L, Ren S, Wang Y, & Lusis a. J. Mapping Genetic Contributions to Cardiac Pathology Induced by Beta-Adrenergic Stimulation in Mice. *Circ. Cardiovasc. Genet.* **8,** 40–49 (2015).

Neelankavil J, **Rau CD**, & Wang Y. The Genetic Basis of Coronary Artery Disease and Atrial Fibrillation: A Search for Disease Mechanisms and Therapeutic Targets. *J. Cardiothorac. Vasc. Anesth.* **29,** 1328–32 (2015).

Rau CD, Parks B, Wang Y, Eskin E, Simecek P, Churchill GA, & Lusis AJ. High-Density Genotypes of Inbred Mouse Strains: Improved Power and Precision of Association Mapping. *G3 (Bethesda).* **5,** 2021–6 (2015).

Parks BW, Sallam T, Mehrabian M, Psychogios N, Hui ST, Norheim F, Castellani LW, **Rau CD**, Pan C, Phun J, Zhou Z, Yang W-P, Neuhaus I, Gargalovic PS, Kirchgessner TG, Graham M, Lee R, Tontonoz P, Gerszten RE, Hevener AL, & Lusis AJ. Genetic Architecture of Insulin Resistance in the Mouse. *Cell Metab.* **21,** 334–346 (2015).

Parks BW, Nam E, Org E, Kostem E, Norheim F, Hui ST, Pan C, Civelek M, **Rau CD**, Bennett BJ, Mehrabian M, Ursell LK, He A, Castellani LW, Zinker B, Kirby M, Drake T a, Drevon C a, Knight R, Gargalovic P, Kirchgessner T, Eskin E, & Lusis AJ. Genetic control of obesity and gut microbiota composition in response to high-fat, high-sucrose diet in mice. *Cell Metab.* **17,** 141–152 (2013).

Lagarrigue S, Hormozdiari F, Martin LJ, Lecerf F, Hasin Y, **Rau C**, Hagopian R, Xiao Y, Yan J, Drake T a, Ghazalpour A, Eskin E, & Lusis AJ. Limited RNA Editing in Exons of Mouse Liver and Adipose Tissue. *Genetics* **193,** 1107–1115 (2013).

Lu G, Ota A, Ren S, Franklin S, **Rau CD**, Ping P, Lane TF, Zhou ZH, Reue K, Lusis AJ, Vondriska T, & Wang Y. PPM1l encodes an inositol requiring-protein 1 (IRE1) specific phosphatase that regulates the functional outcome of the ER stress response. *Mol. Metab.* **2,** 405–16 (2013).

Rau CD, Wisniewski N, Orozco LD, Bennett B, Weiss J, & Lusis AJ. Maximal information component analysis: a novel non-linear network analysis method. *Front. Genet.* **4,** 28 (2013).

Davis RC, Van Nas A, Bennett B, Orozco L, Pan C, **Rau CD**, Eskin E, & Lusis AJ. Genome-wide association mapping of blood cell traits in mice. *Mamm. Genome* **24,** 105–18 (2013).

Ghazalpour A, **Rau CD**, Farber CR, Bennett BJ, Orozco LD, van Nas A, Pan C, Allayee H, Beaven SW, Civelek M, Davis RC, Drake T a, Friedman R a, Furlotte N, Hui ST, Jentsch JD, Kostem E, Kang HM, Kang EY, Joo JW, Korshunov V a, Laughlin RE, Martin LJ, Ohmen JD, Parks BW, Pellegrini M, Reue K, Smith DJ, Tetradis S, Wang J, Wang Y, Weiss JN, Kirchgessner T, Gargalovic PS, Eskin E, Lusis AJ, & Leboeuf RC. Hybrid mouse diversity panel: a panel of inbred mouse strains suitable for analysis of complex genetic traits. *Mamm. Genome* **23,** 680–92 (2012).

Weiss JN, Karma A, MacLellan WR, Deng M, **Rau CD**, Rees CM, Wang J, Wisniewski N, Eskin E, Horvath S, Qu Z, Wang Y, & Lusis AJ. 'Good enough solutions' and the genetics of complex diseases. *Circ. Res.* **111,** 493–504 (2012).

Mungrue IN, Zhao P, Yao Y, Meng H, **Rau C**, Havel J, Gorgels T, Bergen A, MacLellan WR, Drake T a, Boström KI, & Lusis AJ. Abcc6 deficiency causes increased infarct size and apoptosis in a mouse cardiac ischemia-reperfusion model. *Arterioscler. Thromb. Vasc. Biol.* **31,** 2806–2812 (2011).

Ho MCW, Johnsen H, Goetz SE, Schiller BJ, Bae E, Tran D a, Shur AS, Allen JM, **Rau C**, Bender W, Fisher WW, Celniker SE, & Drewell R a. Functional evolution of cis-regulatory modules at a homeotic gene in Drosophila. *PLoS Genet.* **5,** e1000709 (2009).

Invited Talks:

A Systems Approach to Unraveling the Genetic Basis of Heart Failure. Presented at the NHLBI Systems Biology Meeting 10/16
A Network-based Approach to Identify Novel Regulators of Heart Failure. Presented at the International Society of Heart Researchers Conference 6/15

Application of Systems Genetics Tools for the Discovery of Genes Contributing to Complex Diseases. Presented at the Singapore Heart Failure Conference 11/14

The Genetic Basis of Isoproterenol-induced Cardiac Fibrosis. Presented at the American Heart Association Basic Cardiovascular Sciences Conference 7/17/14

A Primer on Systems Genetics. Presented at Cedars Sinai Hospital 10/29/12

In Press/Submitted Manuscripts:

Rau CD, Lusis AJ, Wang Y. Systems Genetics for Mechanistic Discovery in Heart Disease. *Cardiovascular Research*. in press (2020, 45 pages)

Wong E, Tan WLW, Tan HS, Li Y, Ng SH, Tejo E, Vondriska, TM, Wang Y, Foo R, **Rau CD**. Differential DNA Methylation Co-segregates with Severity of Heart Failure. *Cardiovascular Research*. In review. (2019, 18 pages)

Rau CD, Gonzales NM, Park D, Palmer AA, Lusis AJ, Zaitlen N. The Effects of Mutations are Modified by Genetic Background in Mice. *PLoS Genetics.* In review Available on bioRxiv. doi: 10.1101/555383 (2019, 27 pages)

TEACHING AND MENTORSHIP

Graduate Student Mentor, *University of California--Los Angeles*, 2013-2020
Mentored 2 doctoral and 2 masters student in mouse genetics and bioinformatic techniques

Undergraduate Mentor, *University of California--Los Angeles,* 2008-2020
Mentored 15 undergraduate students in lab. Taught basic lab techniques, developed and guided them in independent projects.

Postdoctoral Leadership Program, *University of California--Los Angeles,* Fall 2015
Guided first year graduate students through the process of writing NSF-style pre-doctoral training grants.

Teaching Assistant, *University of California--Los Angeles,* Fall 2008, Winter 2010,2011
Teaching assistant for an upper division/graduate level course on human genetics. Developed course materials, led 3 discussion sections (20-30 students each) teaching critical manuscript analysis and topics related to candidate gene identification and modes of inheritance. Approximately 30 hours of teaching and 40 hours of office hours per year.

GRANT SUPPORT

Active:

NIH 1K99 HL138301 Program Title: *Discovery of Novel Epigenetic Regulators of Heart Failure in a Panel of Mice*. 5/1/2018-4/30/2023
Role: PI Effort: 100% Funding: 970k/5 years
This grant is concerned with the identification and characterization of epigenetic factors and associated genes which regulate the progression of cardiac hypertrophy and failure by integration of novel DNA methylome data with other available 'omics from the same cohort of animals

Completed:
AHA 15POST25310006 Program Title: *A Systems Approach to Dissect the Epigenetic Regulation of Heart Failure*. 07/01/15-06/30/2017
Role: PI Effort: 100% Funding: 110k/2 years
The goal of this grant was to isolate DNA from the Hybrid Mouse Diversity Panel and perform Reduced Representation Bisulfite Sequencing to identify possible drivers of heart failure.

PROFESSIONAL SOCIETIES

Sigma Xi (2019-)
International Society for Heart Research. *Member* (2014-)
American Heart Association, Basic Cardiovascular Sciences Council. *Member* (2010-)

.