

Isaac Vock's CV

Education

Centre College, Danville, KY

Bachelor of Science in Physics with a Minor in Mathematics, Graduated in May 2019 *Summa Cum Laude* (4.0 GPA)

Fifth Year PhD Student in the Molecular Biophysics and Biochemistry Department at Yale University

Research Experience

Undergraduate Research Assistant in Dr. Rodenborn's Lab at Centre College

May 2016 – August 2016 and January 2017

- Constructed two systems of stepper motors and aluminum structures to macroscopically model bacteria that locomote with a rotating helical flagellum.
- Used Matlab scripts to control several stepper motors as well as the DC motor of the robotic bacterial analog.
- Characterized flagellar propulsion with torque sensors and Fast Fourier Transform analysis.

NSF REU in Protein Research at the University of Michigan

Summer 2017

- Designed and synthesized peptides with the goal of achieving differential binding affinities for two structurally similar proteins, p300 and CREB Binding Protein (CBP).
- Expressed and purified a domain of p300 (KIX domain) used for binding affinity analysis.
- Determined peptide binding affinity with a fluorescent polarization (FP) assay.

Research Internship in Biophysics Lab (Dr. Link's Lab) at Xavier University

Summer 2019

- Developed an understanding of the theory behind and use of circular dichroism (CD) spectropolarimetry, optical tweezers, and atomic force microscopy (AFM).
- Performed several basic pedagogical experiments and analyzed large CD datasets.
- Aided in Dr. Link's NSF funded research of cryptochromes in plants.

Graduate Student Researcher in Dr. Matthew Simons' Lab

March 2020 – Present

- Developed a hierarchical Bayesian mixture model to analyze TimeLapse-seq data
- Designed an R package (bakR) to implement the statistical model of TimeLapse-seq data that I developed and facilitate interpretation of the model fit
- Working to develop a suite of computational resources for researchers analyzing nucleotide recoding RNA sequencing (NR-seq) methods for assaying RNA metabolic kinetics

Research Presentations

“Modeling Bacterial Swimming” Kentucky Academy of Science (KAS) Undergraduate Research Presentation, University of Louisville. November 2016

“Differential Binding of c-Myb Mutants to CBP and p300-KIX” University of Michigan Undergraduate Research Academy Symposium, University of Michigan. August 2017.

“Differential Binding of c-Myb Mutants to CBP and p300-KIX” Undergraduate Research Symposium in

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the Chemical and Biological Sciences, University of Maryland Baltimore County. October 2017

Rotation Presentations: November 2019, January 2020, and March 2020

“Improved Statistical Modeling for Differential RNA Kinetics Analysis” IBDD RIP talk, Yale University. December 2021; C-Wing Hall Seminar, Yale University. December 2021

“Uncovering Differential RNA Metabolic Kinetics with Improved Statistical Modeling” MB&B departmental retreat graduate student poster session. March 2022

“Enhanced exploration of chemical probing RNA-seq data with HDProbe” C-Wing Hall Seminar, Yale University. September 2022

“bakR: uncovering differential RNA synthesis and degradation kinetics transcriptome-wide”. Cold Spring Harbor Laboratory Biological Data Science Conference, CSHL. November 2022; RNA Society Annual Meeting, Suntec Center, Singapore. June 2023

“Dissecting gene expression regulation mechanisms with bakR”. RNA Club, Yale University. July 2023; Steitz lab joint lab meeting, Yale University. October 2023

“Extending and improving the study of transcript isoform dynamics.” C-Wing Hall Seminar, Yale University. October 2023

“The joy of bioinformatics.” YBDIC computational biology lecture series, Yale University. November 2023

“Uncovering transcript isoform regulatory dynamics with metabolic labeling and EZbakR”. CSHL Systems Biology: Global Regulation of Gene Expression. March 2024

Other Work Experience

Physics Tutor **September 2016 – May 2019**

- Provide homework help or explain difficult concepts to those in introductory physics classes
- Help students develop useful problem-solving techniques and skills.

Physics Program Student Representative **August 2017 – May 2019**

- Attend meetings to discuss the Centre College physics program and offer student perspective about curriculum, budget, social events, etc.
- Answer questions from prospective physics majors about the program.

New Haven Science Fair (NHSF) Mentor **March 2020 – May 2021**

- Develop online science content for a second-grade class at Conte West Hills Magnet School, a local public elementary school.
- Work with a 5th/6th grade enrichment class at FAME, a local multilingual elementary school, to develop and conduct a science fair project to be presented in May at the NHSF

Teaching Assistant for Advanced Eukaryotic Molecular Biology **February 2021 – May 2022**

- Run discussion sections and grade assignments for MBB 443b/743b, a course on eukaryotic gene expression regulation for junior/senior undergraduates and 1st year graduate students.

PEB Discussion Group Coordinator and Moderator **September 2021 – May 2022**

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- Invite speakers (mainly graduate students and postdoctoral associates; all at Yale) to present at monthly RIP talks associated with Yale's Integrated Graduate Program in Physical and Engineering Biology
- In charge of organizing and moderating the talks

Other Relevant Experience

R

November 2019 – Present

- 4.5 years of experience
- Have written programs to simulate RNA sequencing and nucleotide recoding data, simulate gene expression, perform statistical analyses, etc.
- Experience with developing R packages, shiny apps, and statistical modeling of high-throughput data

Stan Probabilistic Programming Language

November 2019 – Present

- 4.5 years of experience; Hamiltonian Monte Carlo implementation software
- Have developed Bayesian hierarchical models to analyze nucleoside recoding data, time course RNA-seq experiments, TT-TimeLapse-seq experiments, etc.

Snakemake Workflow Manager

April 2022 – Present

- 2 years of experience.
- Developed a number of publicly available and extensively documented pipelines:
 - bam2bakR: Processing NR-seq data for analysis with bakR
 - PROseq_etal: PRO-seq + ChIP-seq pipeline with additional experimental compatibility in the works
 - THE_Aligner: Aligning almost any kind of RNA-seq data
 - AnnotationCleaner: Assembling and filtering transcriptome annotations

Additional Programming Experience:

- **Git/Github:** 4.5 years of experience
- **Python:** 2 years of experience
- **Pytorch:** 1 year of experience
- **C:** 1 year of experience

Honors and Awards

1 st prize Physics and Astronomy Oral Presentation KAS	2016
Max P. Canves Award for Highest GPA Freshman Year	2017
Induction into Sigma Pi Sigma Physics Honor Society	2017
Induction into Phi Beta Kappa General Honor Society	2018
Marshall Wilt Physics Prize for an Outstanding Physics Major	2018
T. Hunton Rogers Memorial Scholarship Prize for a Junior Excelling in the Physical Sciences	2018
Centre College Class of 2019 Valedictorian Prize	2019
NIH Chemical Biology Training Grant	2020-2022
MB&B's Excellence in Teaching Award	2022

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Yale RNA Center Travel Award	2023
Yale Associates in Teaching	2024

Publications

- Vock, I. W.**, Mabin J., Zhang A., Machyna M., Hogg R.J., Simon M.D. Expanding and improving analyses of all nucleotide recoding RNA-seq experiments with the EZbakR-suite.
- Scharfen, L., **Vock I. W.**, Simon M. D., Neguebauer K. M. Regulation of immediate RNA base pairing upon exit from eukaryotic RNA polymerases. *Submitted to Nat Struct Mol Bio.*
- Moon, M. H., **Vock I. W.**, Streit A. D., Connor L. J., Senkina J., Ellman J. A., Simon M. D. *ACS Chem Bio.* **2024.**
- Lu-Culligan, W. J., Connor L. J., Xie Y., Ekundayo B. E., Rose, B. T., Machyna, M., Zimmer, J. T., **Vock, I. W.**, Bhanu, N. V., King, M. C., Garcia, B. A., Bleichert, F., Simon, M. D. Acetyl-methyllysine marks histone H4 in regulated chromatin. *Nature.* **2023.**
- Zimmer, J. T., **Vock, I. W.**, Schofield, J. A., Kiefer, L., Moon, M. H., Simon, M. D. Improving the study of RNA dynamics through advances in RNA-seq with metabolic labeling and nucleotide-recoding chemistry. *bioRxiv.* **2023.**
- Vock, I. W.**, Simon, M. D. bakR: Uncovering differential RNA synthesis and degradation kinetics transcriptome-wide with Bayesian hierarchical modeling. *RNA.* **2023.**
- Sullivan, M. C., Niederer, R. O., **Vock, I. W.**, Kiefer, L., Gilbert, W. V., Simon, M. D. An internally normalized approach to comparing RNA levels between samples using nucleoside recoding chemistry. *NAR,* **2022.**
- Joy, S. T., Henley, M. J., De Salle, S. N., Beyersdorf, M. S., **Vock, I. W.**, Huldin, A. J. L., Mapp, A. K. A Dual-Site Inhibitor of CBP/p300 KIX is a Selective and Effective Modulator of Myb. *JACS.* **2021.**