

## Jacob Dylan Bruney

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### EDUCATION

**PhD**, Applied Mathematics

Expected May 2022

*University of North Carolina at Chapel Hill, NC*

- Concentration: Fluid Dynamics and Computational Modeling
- Henry Owl Fellowship (previously the NC Excellence Award) Recipient

**BS**, Mathematics

May 2016

*University of North Carolina at Chapel Hill, NC*

- Graduated with Honors and Distinction
- Graduated from the Honors College
- Honors Thesis: “The Mathematics of Sinking Through Sharply Stratified Liquids”
- Minor: Asian Studies
- GPA: 3.72

*University of Melbourne, Australia*

Jan - Jun 2015

- Leonard and Rozelia S. Herring Study Abroad Scholarship Recipient

**Associate of Science**

May 2013

*Rowan-Cabarrus Early College High School & Community College, NC*

- Honor of Valedictorian
- GPA: 4.00

### RELEVANT COURSEWORK

*Undergraduate:* Discrete Mathematics \* Advanced Calculus \* ODEs \* PDEs \* Linear Algebra \* Combinatorics \* Real Analysis \* Mathematical Methods for the Physical Sciences I & II \* Euclidean and Non-Euclidean Geometry

*Graduate:* Scientific Computation I & II \* Mathematical Modeling I & II \* Numerical ODE/PDE I & II \* Independent Study on Mean Particulate Flow \* Fluid Dynamics \* Applied Mathematical Methods I & II \* Small Scale Physics of the Ocean \* Stochastic Modeling

### SUMMARY OF RESEARCH SKILLS

**Programming Languages :** Bash, C++, Fortran, Mathematica, MatLab, Python

**Software:** AmRex IAMR, ComSol, DataTank, IBAMR, NEK5000, VisIt

**Lab Equipment:** Viscometer, Fluid pumps, Densitometers, Conductivity meters, 3D Printers, Laser Cutting, Thermal Baths, PIV

### RESEARCH INTERESTS

Ocean Stratifications

Fluid Modeling

Analytic Methods for PDEs

Numerical Methods for PDEs

Experimentally Testing Models

Data Analysis

**CURRENT UNC-CH DISSERTATION RESEARCH EXPERIENCE****Primary Researcher**

Aug 2020

*Cavity collapsing in stratified Eulerian fluids | Dr. R. Camassa*

- Designed a novel experimental setup for studying a difficult initialization problem
- Analyzes the relationship of hyperbolic solutions against full DNS
- Collaborates with multiple numerical research teams to validate predictions

**Primary Researcher**

Aug 2020

*Dye transport via perturbed channel | Drs. R. Camassa & R. McLaughlin*

- Produces Monte Carlo and FEM simulations to model effective diffusivity
- Compares results to theory produced by center manifold and multiscale averaging
- Developed new technique for initializing dye distribution

**Primary Researcher**

Jan 2019

*Internal wave energy dissipation via beam waves | Dr. A. Scotti*

- Designed a novel experimental setup for producing beam waves via an organic topography
- Devised a new method of applying BOS (background-oriented Schlieren)
- Collaborates with current experts in the field in order to use new BOS processing algorithms

**Primary Researcher**

Aug 2015

*Particle residence and bounce at sharp stratifications | Dr. C. Falcon*

- Measures highly viscous fluids and analyzes data in DataTank, MatLab, and Python
- Incorporates lubrication theory into a numerical simulation to increase accuracy
- Executes experiments subject to strict constraints, needing to control and adapt for variability

**Research Assistant**

Aug 2015

*Multiple Projects | Drs. R. McLaughlin & R. Camassa*

- Mentors and educates undergraduate lab members on experimental setup, equipment, and execution
- Engineers different experimental setups for general fluid phenomenon

**ADDITIONAL RESEARCH EXPERIENCE****Summer Student Researcher**

Aug - Jun 2019

*Lagrangian mesh solvers | Dr. J. Albright | Los Alamos National Labs*

- Studied and tested different techniques for optimizing Lagrangian mesh solvers applied to various shock tube problems

**TEACHING EXPERIENCE****Course Instructor**

Aug 2018 - Present

*Department of Mathematics, University of North Carolina at Chapel Hill*

- Math 528L: Physical Mathematics Lab (Fall 2021)
- Math 528: Mathematical Methods for the Physical Sciences I (Summer 2021)
- Math 383: Differential Equations (Fall 2020)
- Math 290: Special Topics (Spring 2020)
- Math 118: Aspects of Modern Mathematics (Summer 2020, Spring 2019)
- Math 110: Algebra (Fall 2019)
- Math 130: Pre-Calculus (Fall 2018)

**Teaching Assistant**

Jun 2018 - Present

*Department of Mathematics, University of North Carolina at Chapel Hill*

- Math 233L: Calculus III Recitation (Fall 2021)
- Math 528: Mathematical Methods for the Physical Sciences I (Spring 2019, Fall 2021)
- Math 232H: Calculus II (Fall 2019)
- Math 130: Pre- Calculus (Summer 2018)

**Private Tutor**

Aug 2016 – Present

- Tutored eight different students for 150+ hours

**Tutor**

Aug 2016 – May 2017

*UNC Athletics, University of North Carolina at Chapel Hill*

- Tutored in a small group setting to provide individual attention to student athletes
- Developed and taught learning strategies for effective studying and test taking

**Tutor**

Aug 2013 – May 2014

*UNC Math Tutoring Center, University of North Carolina at Chapel Hill*

- Helped tutor across multiple classes

**CONFERENCE PRESENTATIONS**

Annual Meeting of the American Physical Society (APS) Division of Fluid Dynamics

Nov 2021

- “Dynamics of the Rapid Creation and Collapse of Dry Spot Regions In Fluid Layers”
- Poster: “Using Background Oriented Schlieren to Diagnose Changes in the Density Profile Produced by Self-Interacting Internal Wave Beams”

Triangle Area Graduate Mathematics Conference

Nov 2019

- “Data-Driven Mesh Optimization for Staggered-Grid Lagrangian Hydrodynamics”

**PROFESSIONAL AFFILIATIONS***Society for Industrial & Applied Mathematics*

Oct 2021

- Graduate Student Member

*SafeZone Certification Program*

Jan 2019

- LGBTQ Ally

*American Mathematical Society*

Aug 2017

- Graduate Student Member

*Chayon-Ryu Martial Arts*

Aug 2013

- Black Belt Instructor

*Boy Scouts of America*

Jun 2012

- Eagle Scout

REFERENCES

*Dr. Richard McLaughlin, Chair of the Department of Mathematics*  
Department of Mathematics  
University of North Carolina at Chapel Hill  
Campus Box #3250  
Chapel Hill, NC 27599-3250  
(919) 962-9816  
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*Dr. Roberto Camassa, Kenan Professor of Mathematics*  
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University of North Carolina at Chapel Hill  
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*Dr. Claudia Falcon, Postdoctoral Research Associate*  
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