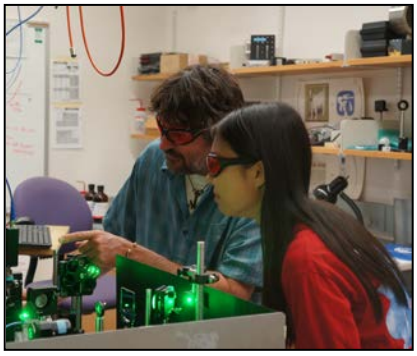
Physics Department Student Research



The Physics Department has research opportunities for undergraduates in the areas of computational, educational, experimental, applied and theoretical physics. These opportunities have led to numerous publications, with some students writing theses as part of the Honors in Physics graduation requirement.

Below are recent independent study and summer projects carried out in the department.

Professor Mario Belloni

Theoretical: Quantum Mechanics

Kevin Gutierrez (Physics '20) **Using a Recursive Algorithm to Find Eigenstates and Sum Rules for the Supersymmetric Infinite Well,** Summer 2018 (work supported by the Michael D. Jenks Summer Research Fund).

Henry Brooks (Physics '19) **Creating and Testing Waves Lessons Across the Physics Curriculum for Improving the Performance of Women and Underrepresented Student Groups,** Fall 2018 (work in collaboration with Psychology professor Jessica Good).

Jamie Barnhill (Physics '19) **Quantum-mechanical Scattering and Bound States Using the Spectral Method**, Spring/Summer/Fall 2018 (work supported by the Michael D. Jenks Summer Research Fund).

Esteban Leon (Physics '19) **The Supersymmetric Infinite Square Well: Wavefunctions, Sum Rules, Wigner Functions, and Applications to Econophysics,** Summer 2017/Fall 2018

Esteban Leon (Physics '19) **Utilizing Quantum Mechanics to Model and Study American Stock Market Returns** (work supported by a DRI Grant and in collaboration with Economics professor Mark Foley).

Nancy Pruett (Physics '18) **Mathematical Modeling of Fluorescent Minerals**, Summer 2017 (work supported by a DRI Grant). Poster presented at the DRI Summer Research Poster session, Davidson College, September 2017.

Vincent Hickl (Physics '17), **Using the Spectral Method to Analyze Wave Packet Revivals in the Asymmetric Infinite Square Well,** Spring/Summer 2015/Honors Spring 2017 (work in collaboration with Richard Robinett of Pennsylvania State University; Summer 2015 work supported by a DRI Grant). V. Hickl and M. Belloni, "An Analytic Analysis of an Asymmetric Infinite Square Well," Contributed Poster, Fall Meeting of the North Carolina Section of the American Association of Physics Teachers, Davidson, NC. April, 2015.

Nikos Dokmetzoglou (Physics '17), **Momentum 'Tails' of 1D, 2D, AND 3D Quantum Systems,** Summer 2015 and Spring 2016 (work in collaboration with Richard Robinett of Pennsylvania State University). N. Dokmetzoglou and M. Belloni, "Momentum 'Tails' of 1D, 2D, AND 3D Quantum Systems," Contributed

Poster, Fall Meeting of the North Carolina Section of the American Association of Physics Teachers, Davidson, NC. October 2015.

Alex Tyner (Physics '17), **Bouncing Wave Packets,** Spring 2016 (work in collaboration with Richard Robinett of Pennsylvania State University).

Guy Scott (Physics '16), **The Physics of Archery,** Fall 2015.

Colin Malone (Physics '15), **Bouncing Wave Packets,** Spring 2015 (work in collaboration with Richard Robinett of Pennsylvania State University).

Marcus Begley (Physics '15), **Analytical Solutions to Quantum Wells Using the Spectral Method,** Fall 2014.

Jacob Simmonds (Physics '16), **Using the Spectral Method in Mathematica and MATLAB**, Summer 2014 (work in collaboration with Richard Robinett of Pennsylvania State University).

Professor Dan Boye

Experimental: Volumetric X-ray Imaging, Optical properties of crystals, nanocrystals and glasses, Rare earth spectroscopy

Carl Sukow (Physics '21), **Comparing the benefits of Digitome volumetric radiography and traditional 2D radiography**, Summer 2018.

Henry Brooks (Physics '19) **Material and time dependence of fluorescence spectra of SST scintillating materials**, Spring 2018.

Ryan Stempert (Physics '18), **Volumetric Radiography of Watermarks**, Summer 2017.

Greg Alspaugh (Physics '18), **Haley Seligmann** (Mathematics '19), **Applications of 2D and 3D X-ray Imaging**, Summer 2017.

Collin Epstein (Physics '18), **Cody Herron** (Physics '17), **Ryan Stempert** (Physics '18), **Ryan Kozlowski** (Physics '16), **Improvements in 2D X-radiography and volumetric X-ray tomosynthesis**, Summer 2015 - Spring 2017.

Takuya Wakayama (Physics '18) **Tb3+ Cross-Relaxation Dynamics in Core-Shell Tb:NaGdF4 Nanoparticles**, Spring and Summer 2016

Ryan Kozlowski (Physics '16), **Volumetric Dual Energy Subtraction Imaging with Digitome**, Physics Department Honors Thesis, Spring 2016.

Rebecca Garner (Physics '16), **Ryan Kozlowski** (Physics '16), **Examining paintings on wood or canvas using 3D X-rya imaging with Digitome**, Spring 2016.

Nancy Pruett (Physics '18) **Summer 2016 S2- as a Quantum Mechanical Harmonic Oscillator, Solid state synthesis of fluorescent minerals: Introducing S2- centers into synthetic crystal structures**, (in collaboration with Professor Cain). Poster presented at the DRI Summer Research Poster session, Davidson College, September 2016. "Solid state synthesis of fluorescent minerals: Introducing S2- centers into synthetic crystal structures", Nancy Pruett*, Dan Boye and L.S. Cain, poster presented at 2016 Quadrennial Physics Conference, San Francisco, CA, November 3-5, 2016.

Alex Demopoulos (Classics/Astrophysics minor '17) **Applying Histogram Analysis to 3D X-Ray Imaging**, Summer 2015 (in collaboration with Professor Cain). Poster presented at the DRI Summer Research Poster session, Davidson College, September 2015.

Ryan Kozlowski (Physics ’16), **3D X-Ray Imaging of the Remains of Queen Anne’s Revenge**, Summer 2014.

Sarah Friedensen (Physics ‘15) Summer 2014 **Mimicking Minerals for Better Lighting: Synthesis of a Broadband Yellow Phosphor Based on Scapolite S2- Fluorescence**, (in collaboration with Professor Cain). Poster presented at the DRI Summer Research Poster Session, Davidson College, September 2014. Geomimicry of Naturally Occurring Fluorescent Minerals, Summer 2013.

Professor Larry Cain

Experimental Condensed Matter Physics

Nancy Pruett (Physics ’18) **Solid state synthesis of fluorescent minerals: Introducing S_2^- centers into synthetic crystal structures**, Summer 2016 (in collaboration with Professor Boye). Poster presented at the DRI Summer Research Poster session, Davidson College, September 2016. “Solid state synthesis of fluorescent minerals: Introducing S_2^- centers into synthetic crystal structures”, Nancy Pruett*, Dan Boye and L.S. Cain, poster presented at 2016 Quadrennial Physics Conference, San Francisco, CA, November 3-5, 2016.

Alex Demopoulos (Classics/Astrophysics minor ’17) **Applying Histogram Analysis to 3D X-Ray Imaging**, Summer 2015 (in collaboration with Professor Boye). Poster presented at the DRI Summer Research Poster session, Davidson College, September 2015.

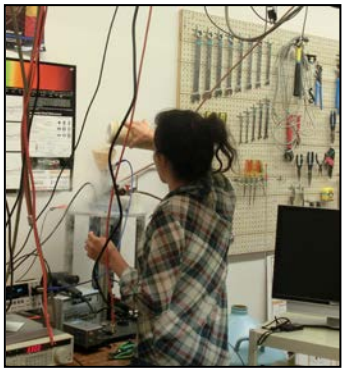
Sara Friedensen (Physics ’15) Mimicking **Minerals for Better Lighting: Synthesis of a Broadband Yellow Phosphor Based on Scapolite S_2^- Fluorescence**, Summer 2014 (in collaboration with Professor Boye). Poster presented at the DRI Summer Research Poster Session, Davidson College, September 2014.

Professor Tim Gfroerer

Experimental: Semiconductor Spectroscopy

Christina Chen (Physics '19) **Imaging Laser-Excited Blue LEDs,** Summer 2017**,** "Imaging laser-excited blue LEDs," 2017 Meeting of the Southeastern Section of the APS in Milledgeville, GA.

Collin Epstein (Physics '18) **Exploring Light Absorption and Emission in Blue Light Emitting Diodes,** Spring 2016**, and Charge Carrier Diffusion in Blue Light Emitting Diodes,** Spring 2017**,** Davidson College Research Symposia (2016 and 2017). "Combining photoluminescence and photocurrent measurements to distinguish photovoltaic losses," Proceedings of the 43rd Photovoltaic Specialists Conference (IEEE, 2016) pp. 1549-1552.



Ben Stroup (Physics '16) **Photoluminescence and photocurrent in a blue LED,** Summer 2015 and Spring 2016, "Photoluminescence and photocurrent in a blue LED," 2015 Meeting of the NC Section of the American Association of Physics Teachers. "Combining photoluminescence and photocurrent measurements to distinguish photovoltaic losses," Proceedings of the 43rd Photovoltaic Specialists Conference (IEEE, 2016) pp. 1549-1552.

Ryan Phillips (Physics '16), **Modeling radial thermal diffusion**, Spring 2015**,** 2015 Meeting of the NC Section of the American Association of Physics Teachers. "Thermal diffusivity imaging," FEATURE ARTICLE in the American Journal of Physics **83**, 923 (2015).

Peter Rossi (Physics '15) **Measuring radial thermal diffusion,** Summer 2014**,** "Thermal diffusivity imaging," FEATURE ARTICLE in the American Journal of Physics 83, 923 (2015).

Grace Watt (Physics '15) **Why do blue LEDs become less efficient at high power?** Summer 2014. "Understanding LED function and mechanisms of energy loss," 2015 APS Conference for Undergraduate Women in Physics at the Research Triangle.

Keyuan Zhou (Physics '15) **Recombination modeling for GaAs solar cells**, Summer and Fall 2014. "Recombination modeling for GaAs solar cells," 2014 Meeting of the Southeastern Section of the APS in Columbia, SC.

Professor Anthony Kuchera
Nuclear Physics

Tan Phan (Physics '18), Summer 2017. **Measurement of ^{9}He ground and excited states,** awarded Davidson Research Initiative Fellowship**,** presented poster at the 2017 Fall Meeting of the American Physical Society Division of Nuclear Physics in Pittsburgh, PA. Honors thesis titled **Experimental Nuclear Structure Studies of Light Nuclei**.

Robbie Seaton-Todd (Physics '20), Summer 2018. **First measurement of excited states in neon nuclei**, awarded Davidson Research Initiative Fellowship.

Professor Michelle Kuchera
Computational: Nuclear, High Energy

Alex Karbo (Physics '18) **Studying High-dimensional supersymmetry models with neural networks,** Summer and Fall 2017. Presented at the 2014 Meeting of the Southeastern Section of the APS in Milledgeville, GA.

Jack Taylor (Physics '18) **Evaluating Machine Learning Methods for Event Classification in the Active-Target Time Projection Chamber**, Fall and Spring 2017. Presented at the American Physical Society Division of Nuclear Physics meeting in Pittsburgh, PA.

Christina Chen (Physics '19) **Optimization Methods for Track Fitting in the Active-Target Time Projection Chamber,** Summer, Fall and Spring 2017. To be presented at the American Physical Society Division of Nuclear Physics meeting in Waikoloa, Hawaii.

Professor Kristen Thompson
Observational Astrophysics

Sam Frederick (Physics '19) **Modeling Stability of Magnetic Fields in Magnetars,** in collaboration with Dr. Michelle Kuchera, Fall 2018, Spring 2018. Honors thesis.

Sam Frederick (Physics '19) **Studying the Behavior of Intermittent Pulsars,** Fall 2017. Poster presented at the Davidson College Alenda Lux Symposium, Davidson College, May 2018; the North Carolina Astronomers' Meeting, Jamestown, NC, September 2018.

Ella Brewer-Jensen (Physics '18) **Constructing a Map of Magnetic Fields in the Milky Way,** Summer 2017. Poster presented at the Davidson College Summer Research Symposium, Davidson College, September 2017.

Caroline Evans (Physics '20) **Frequency-Switched Spectral Lines from the Green Bank Telescope,** Summer 2017. Poster presented at the Davidson College Summer Research Symposium, Davidson College, September 2017.

Hannah Thigpen (Physics '18) Calculating Distances to Molecular Clouds, Spring 2017. Poster presented at the Davidson College Alenda Lux Symposium, Davidson College, May 2017.

Vincent Hickl (Physics '17) Determination of Magnetic Field Strengths in the Galactic Center Using CASA, Summer 2016, Fall 2016. Poster presented at the Davidson College Summer Research Symposium, Davidson College, September 2014; the North Carolina Astronomers' Meeting, Jamestown, NC, September 2016; the 2016 Quadrennial Physics Congress, Silicon Valley, CA, November 2016.

Bjorn Ordoubadian (Physics '16) Determining Magnetic Field Strengths in Molecular Clouds via 21 cm HI Absorption, Fall 2015. Poster presented at the Summer Research Symposium, Davidson College, September 2014. Received award for best undergraduate poster at the fall meeting of the NCS-AAPT, Davidson College, October 2015.

Graham Wrenn (Physics '16) Surveying OH Spatial Variations in Giant Molecular Clouds, Spring 2015. Poster presented at the Davidson College Math and Science Research Symposium, Davidson College, May 2015.

Graham Wrenn (Physics '16) Cloudy Modelling of Giant Molecular Clouds in the Milky Way, Summer 2014. Poster presented at the Summer Research Symposium, Davidson College, September 2014.

Professor John Yukich

Experimental: Atomic, Molecular and Optical Physics

David Sisson (Physics '19) *Photodetachment Spectroscopy of Cooled Negative Ions,* Summer 2018.

Joseph Martin (Physics '18) *Magnetic field structure in photodetachment to the excited states of O*,

Spring 2017 and Fall 2017, presented at the Southeastern Section of the American Physical Society, Milledgeville, GA, November 2017.

Hannah Thigpen (Physics '18) *Magnetic field structure in photodetachment to the excited states of O*, Summer 2016 and Summer 2017, presented at the Southeastern Section of the American Physical Society, Milledgeville, GA, November 2017, the Southeastern Section of the American Physical Society, Charlottesville, VA, November 2016, and PhysCon 2016, Silicon Valley, CA, November 2016.

Raphael Douglas (Physics '17) *Automated wavelength control and stabilization for a single-mode ring laser*, Spring 2017.

Colin Tyznik (Physics '16), *Photodetachment spectroscopy of the S_2^- anion*, Summer 2014, and *Photodetachment spectroscopy to the excited states of O^-,* Summer 2015, presented at Southeastern Section of the American Physical Society, Mobile, AL, November 2015.

Shannon Eriksson (Chemistry '15) Photodetachment spectroscopy of the S_2^- anion, Summer 2013.